LIGHT DUTY TRUCK FUEL, DRIVABILITY AND EMISSIONS

1987

SERVICE MANUAL

This manual covers fuel injected gas engines.
(Includes 1988 C/K Models)

FOREWORD

This service manual replaces Section 6C and 6E for 2.5 L, 2.8 L, 4.3 L, 5.0 L, 5.7 L, and 7.4 L gasoline engines with throttle body injection and supplements the following shop manuals:

- X-8732 10-30 Series R-V-G-P Light Duty Truck Service Manual
- X-8729 10 Series Light Duty Truck Service Manual
- X-8730 10 Series M-Van Light Duty Truck Service Manual
- X-8731 10-30 Series C-K Light Duty Truck Service Manual

This manual includes the general description of a system, diagnosis and on-vehicle service procedures for the fuel control and emissions used on light duty truck with a throttle body injection fuel control system.

Wiring diagrams for the above vehicles are also published in a separate "Truck Wiring Diagram" booklet.

This manual should be kept in a handy place for ready reference. If properly used, it will meet the needs of technicians and vehicle owners.

CAUTION:

These vehicles contain some parts dimensioned in the metric system as well as in the customary system. Some fasteners are metric and are very close in dimension to familiar customary fasteners in the inch system. It is important to note that, during any vehicle maintenance procedures, replacement fasteners must have the same measurements and strength as those removed, whether metric or customary. (Numbers on the heads of metric bolts and on surfaces of metric nuts indicate their strength. Customary bolts use radial lines for this purpose, while most customary nuts do not have strength markings.) Mismatched or incorrect fasteners can result in vehicle damage or malfunction, or possibly personal injury. Therefore, fasteners removed from the vehicle should be saved for re-use in the same location whenever possible. Where the fasteners are not satisfactory for re-use, care should be taken to select a replacement that matches the original. For information and assistance, see your authorized dealer.

GMC TRUCK OPERATION
TRUCK & BUS GROUP
General Motors Corporation
Pontiac, Michigan

CAUTION:

To reduce the chance of personal injury and/or property damage, the following instructions must be carefully observed.

Proper service and repair are important to the safety of the service technician and the safe, reliable operation of all motor vehicles. If part replacement is necessary, the part must be replaced with one of the same part number or with an equivalent part. Do not use a replacement part of lesser quality.

The service procedures recommended and described in this service manual are effective methods of performing service and repair. Some of these procedures require the use of tools specially designed for the prupose.

Accordingly, anyone who intends to use a replacement part, service procedure or tool, which is not recommended by the vehicle manufacturer, must first determine that neither his safety nor the safe operation of the vehicle will be jeopardized by the replacement part, service procedure or tool selected.

It is important to note that this manual contains various Cautions and Notices that must be carefully observed in order to reduce the risk of personal injury during service or repair, or the possibility that improper service or repair may damage the vehicle or render it unsafe. It is also important to understand that these "Cautions" and "Notices" are not exhaustive, because it is impossible to warn of all the possible hazardous consequences that might result from failure to follow these instructions.

ACTION SYMBOL USAGE

The general narrative writing style has been replaced in some procedures with action symbols. To improve readability and to provide emphases when needed, the following symbols are used in the text.


Remove or Disconnect


Install or Connect


Disassemble


Assemble


Clean


Inspect


Measure


Tighten


Important


Adjust

1987
LIGHT DUTY TRUCK
FUEL AND EMISSIONS
SERVICE MANUAL
FOR GASOLINE ENGINES
WITH
THROTTLE BODY INJECTION
C,K,P,R,V,S,T TRUCK
AND
M-VAN, G-VAN
MODELS
10/1500 - 20/2500 - 30/3500
SERIES

The Table of Contents on this page indicates the sections covered in this manual. At the beginning of each individual section is a Table of Contents which gives the page number on which each major subject begins.

When reference is made in this manual to a brand name, number, or specific tool, an equivalent product may be used in place of the recommended item.

All information, illustrations, and specifications contained in this Manual are based on the latest product information available at the time of publication approval. The right is reserved to make changes at any time without notice.

The 1988 C-K 10 through 30 series light duty truck TBI fuel and emission service is included in this service manual.

Printed in U.S.A.

TABLE OF CONTENTS	SECTION

He knows quality parts make a difference even on simple jobs.

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That's why Mr. Goodwrench wants to have a good stock of genuine GM Parts available. Everything from exclusive GM Goodwrench replacement engines and transmissions to GM Goodwrench Motor Oil that meets or exceeds all specifications for General Motors cars or light trucks. And Mr. Goodwrench has a complete line of GM chemicals for fine care of your GM vehicle. Plus accessories to add convenience—or just a little extra style.

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SECTION 1
GENERAL INFORMATION

CONTENTS

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

GENERAL

All engines in this manual have a Computer Command Control system with Electronic Control Module (ECM) to control the Throttle Body Injection (TBI) fuel system. The ECM varies the air/fuel ratio.

In addition, the ECM controls the ignition timing system as well as other emission control systems such as the exhaust gas recirculation system.

It is important to review the emission sections and ECM wiring diagrams for a specific engine to determine what is controlled by the ECM and what systems are non-ECM controlled.

- This Section has a brief description of systems used to control fuel and emissions.
- Abbreviations that are used in Driveability and Emissions are listed at the end of the manual.
- Wiring harness service information for harnesses used with the ECM is also provided in the Computer Command Control section.
- Special tools used to diagnose and repair a system are illustrated at the end of the manual.

DRIVEABILITY

The fuel and emissions 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 ECM diagnosis in Section 3 and then to Section 2 which references driveability symptoms.

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.

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.

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 Truck Service Manual or in the glove box for the maintenance service that should be performed to retain emission control performance.

VEHICLE EMISSION CONTROL INFORMATION LABEL

The Vehicle Emission Control Information label (Figure 1-1) 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).

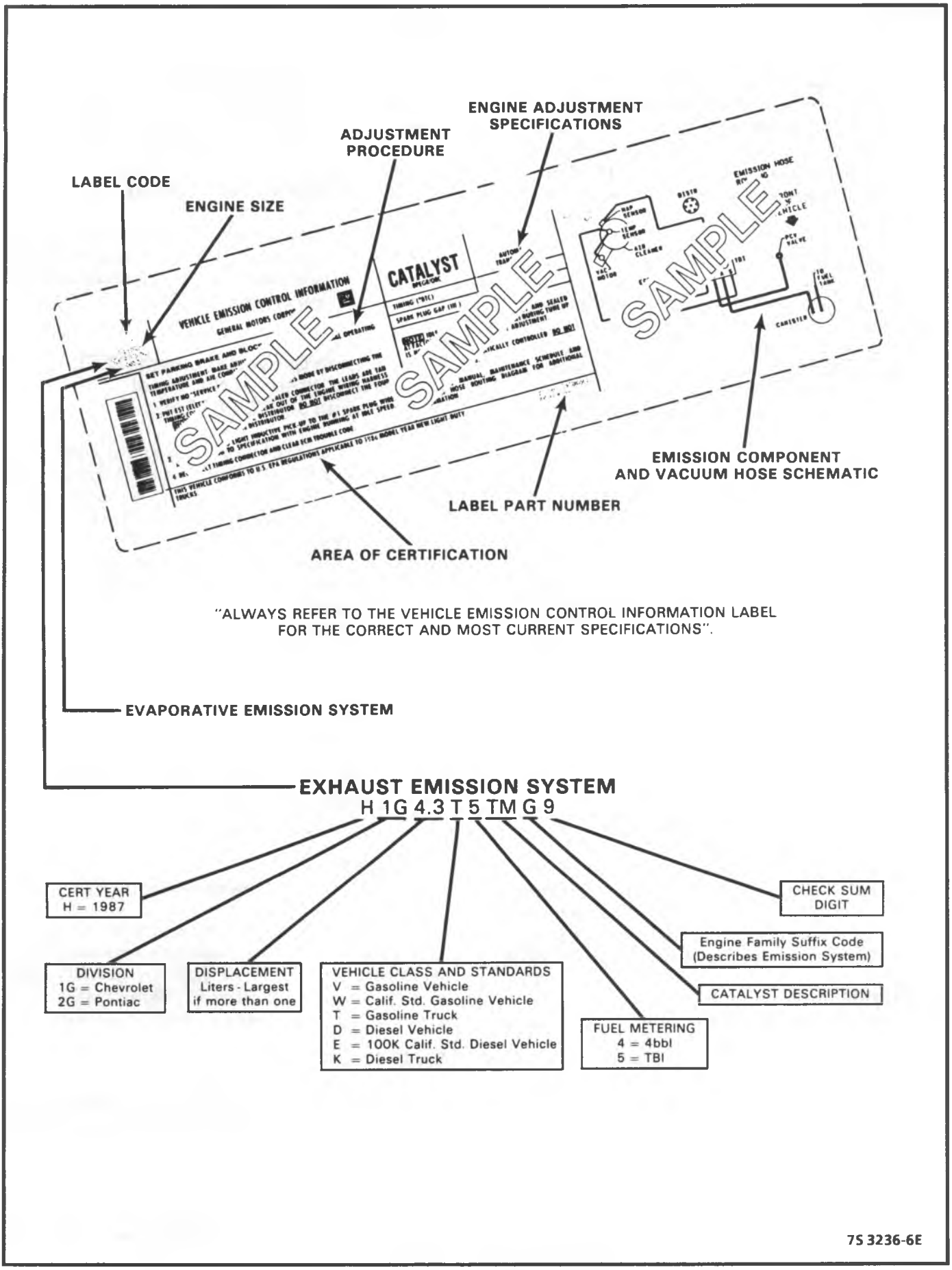


Figure 1-1 Vehicle Emission Control Information Label

COMPONENT SYSTEMS

There are many component systems used to control fuel and emissions. Each system is divided in a section which includes general description of the system, diagnosis and on-vehicle service. Component locations for all series vehicles and all engines are illustrated in Figures 1-2 through 1-13. Below is a brief description of each component system:

Section 3
Computer Command Control

This is an electronically controlled exhaust emission system that uses an electronic control module (ECM) to control fuel delivery, ignition timing, air management and exhaust gas recirculation. It also controls the engagement of the transmission converter clutch and the manual transmission shift light.

Section 4
Fuel Control System

The ECM controls the air/fuel delivery to the combustion chamber by controlling the fuel flow through the injector(s). The ECM also controls idle speed. The in-tank fuel pump is controlled by the ECM. When ignition is turned "ON", the pump will run for 2 seconds for most systems, then stop unless the engine is cranking or running. On some vehicles, the fuel pump will run for 20 seconds. The Fuel Control system is used on all engines. The ECM may control the A/C clutch of the compression and maintain idle speed to improve idle quality.

Section 5
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 is not controlled by the ECM.

Section 6
Ignition/Electronic Spark Timing

This system is controlled by the ECM which controls ignition timing and is used on all engines.

Section 7
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 and is used on all engines except the 2.5L & 7.4L.

Section 8
Air Management

This system provides additional oxygen to the exhaust gases to continue the combustion process. This system is on all engines except the 2.5L.

Section 9
Exhaust Gas Recirculation (EGR)

The EGR system uses a valve to feed a small amount of exhaust gas back into the intake manifold to control formation of NOx. This system is used on all engines and is controlled by the ECM.

Section 10
Transmission Converter Clutch (TCC), Downshift Control and Manual Transmission Shift Light Control

The TCC is ECM controlled and is used on all engines with a THM 700R4 automatic transmission. This system reduces slippage losses in the torque convertor by coupling the engine flywheel to the output shaft of the transmission.

The ECM controls the downshift solenoid in the THM 400 automatic transmission for wide-open throttle downshift.

The ECM controls the shift light on all engines with manual transmission to indicate the best shift point for maximum fuel economy.

Section 11
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.

Section 12
Thermostatic Air Cleaner (THERMAC)

The THERMAC system regulates heated air through the air cleaner to provide uniform inlet air temperature which gives good driveability under various climatic conditions. This system is not controlled by the ECM and is used on all engines.

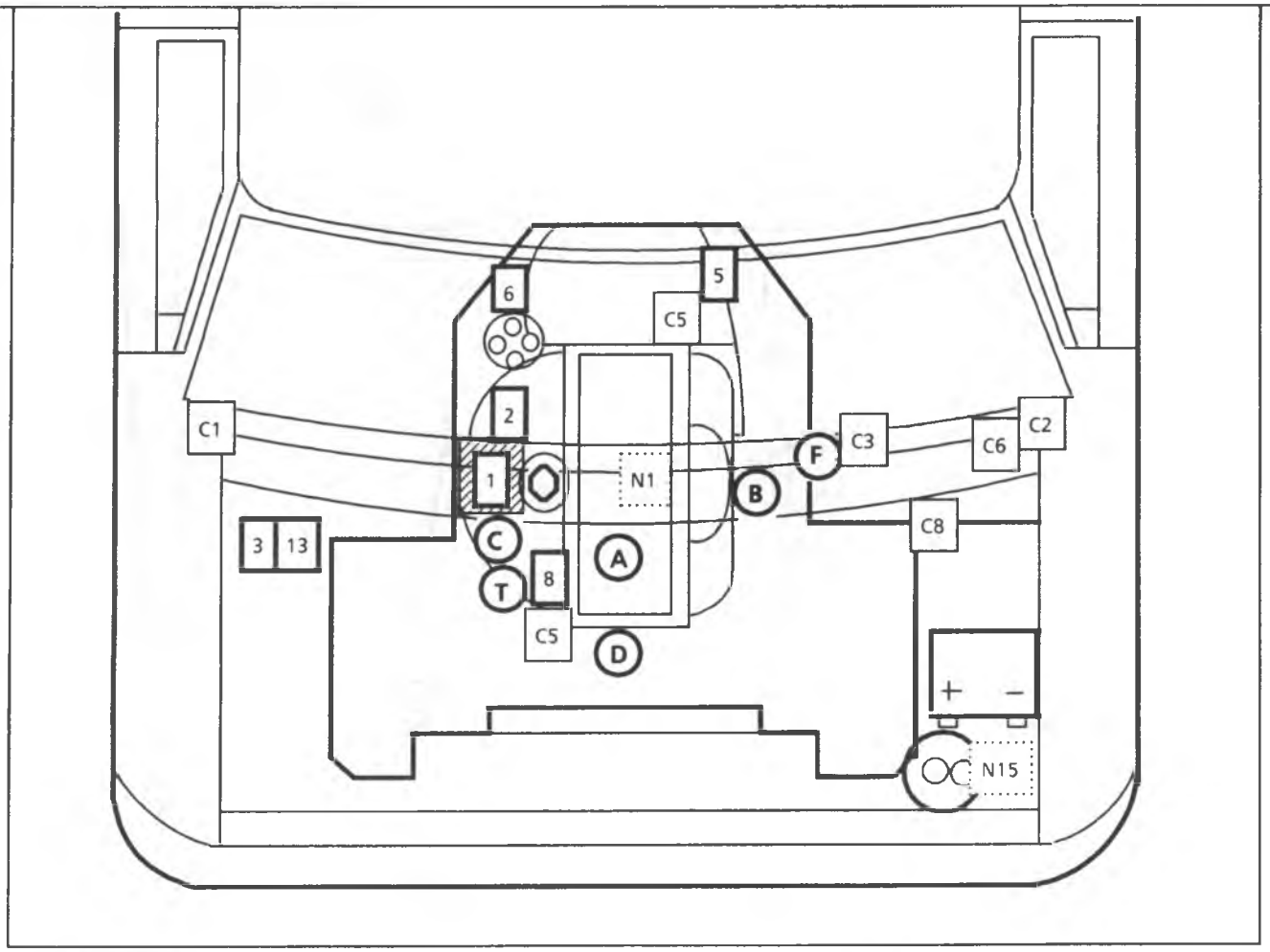
SPECIAL TOOLS

Refer to Section 13 for special tools and equipment needed to diagnose the fuel control and emissions systems.

ABBREVIATIONS

Refer to Section 14 for abbreviations used in this manual.

'M' SERIES RPO:LN8 ENGINE CODE:E 2.5L L4



COMPUTER COMMAND CONTROL

- C1 Electronic Control Module (E.C.M.)
- C2 ALDL diagnostic connector
- C3 "SERVICE ENGINE SOON" light
- C5 ECM harness ground
- C6 Fuse panel
- C8 Fuel pump test connector

ECM INFORMATION SENSORS

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

EMISSION COMPONENTS (NOT ECM CONTROLLED)

- N1 Crankcase vent (PCV) valve
- N15 Fuel vapor canister

ECM CONTROLLED COMPONENTS

- 1 Fuel injector
- 2 Idle air control
- 3 Fuel pump relay
- 5 Transmission Converter Clutch Connector
- 6 Electronic Spark Timing Distributor (E.S.T.)
- 8 Oil pressure switch
- 13 A/C relay

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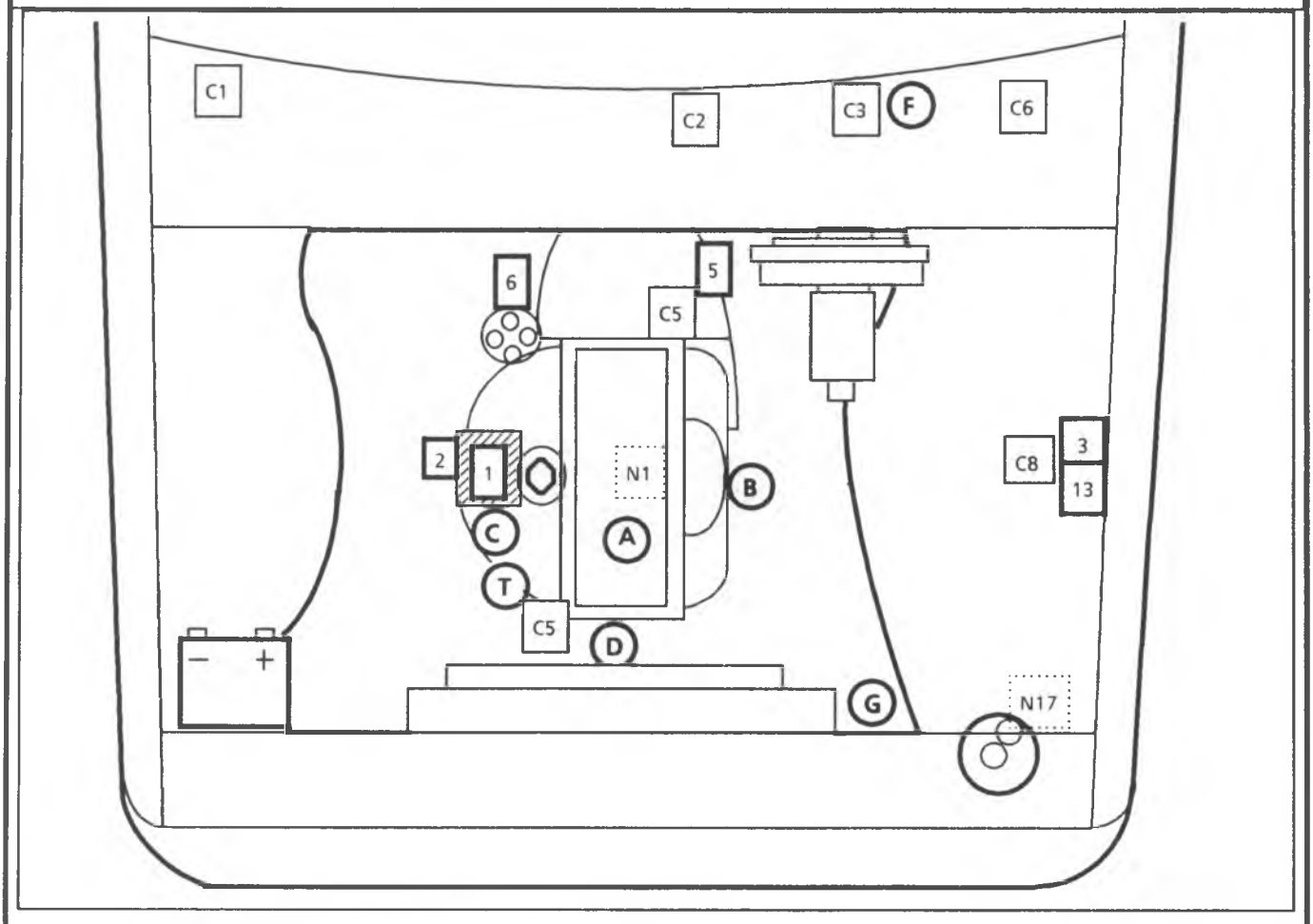
5-5-86

Figure 1-2 Component Locations - 2.5L (M Series)

'S/T' SERIES RPO: LN8 ENGINE CODE: E 2.5L L4



COMPUTER COMMAND CONTROL

- C1 Electronic Control Module (E.C.M.)
- C2 ALDL diagnostic connector
- C3 "SERVICE ENGINE SOON" light
- C5 ECM harness ground
- C6 Fuse panel
- C8 Fuel pump test connector

ECM CONTROLLED COMPONENTS

- 1 Fuel injector
- 2 Idle air control
- 3 Fuel Pump relay
- 5 Transmission Converter Clutch Connector
- 6 Electronic Spark Timing Distributor (E.S.T.)
- 13 A/C relay

ECM INFORMATION SENSORS

- A Manifold pressure (M.A.P.)
- B Exhaust oxygen
- C Throttle position (T.P.S.)
- D Coolant temperature
- F Vehicle speed (V.S.S.)
- G Power Steering Pressure
- T Manifold Air Temperature (M.A.T.)

EMISSION COMPONENTS (NOT ECM CONTROLLED)

- N1 Crankcase vent valve (PCV)
- N17 Fuel Vapor Canister

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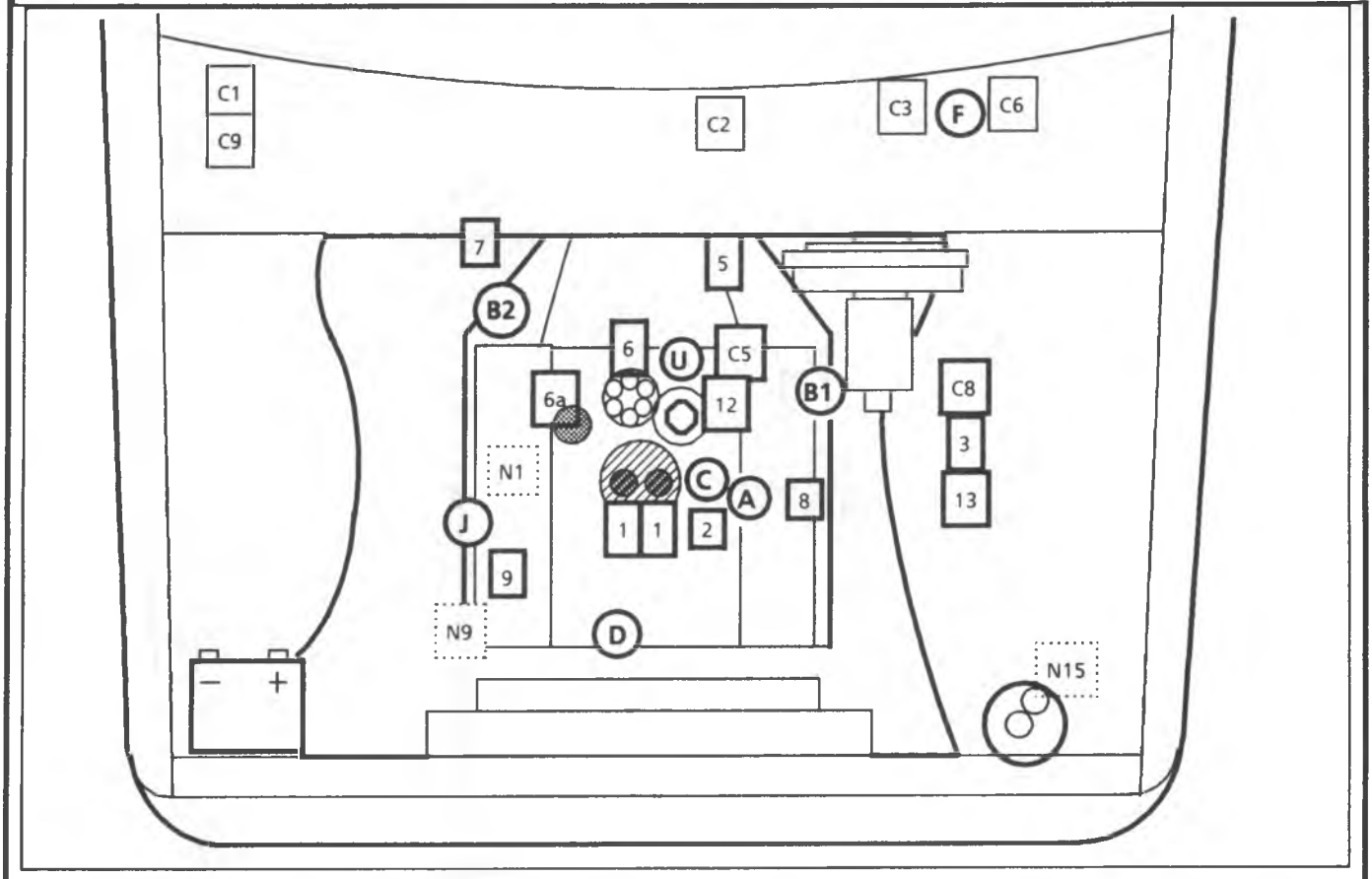
Figure 1-3 Component Locations - 2.5L (ST Series)

'S/T' SERIES RPO: LL2 ENGINE CODE: R 2.8L V6



COMPUTER COMMAND CONTROL

- C1 Electronic Control Module (E.C.M.)
- C2 ALDL diagnostic connector
- C3 "SERVICE ENGINE SOON" light
- C5 ECM harness ground
- C6 Fuse panel
- C8 Fuel pump test connector
- C9 Elapsed Timer Module

ECM CONTROLLED COMPONENTS

- 1 Fuel injector
- 2 Idle air control
- 3 Fuel pump relay
- 5 Transmission Converter Clutch Connector
- 6 Electronic Spark Timing Distributor (E.S.T.)
- 6a Remote ignition coil
- 7 Electronic Spark Control module (E.S.C.)
- 8 Oil pressure switch
- 9 Electric Air Control solenoid (E.A.C.)
- 12 Exhaust Gas Recirculation Vacuum Solenoid
- 13 A/C Relay

ECM INFORMATION SENSORS

- A Manifold Absolute Pressure (M.A.P.)
- B1 Exhaust oxygen (Federal)
- B2 Exhaust Oxygen (California)
- C Throttle position (T.P.S.)
- D Coolant temperature
- F Vehicle speed (V.S.S.)
- J Electronic Spark Control Knock (E.S.C.)
- U EGR vacuum diagnostic switch

EMISSION COMPONENTS (NOT ECM CONTROLLED)

- N1 Crankcase vent valve (PCV)
- N9 Air Pump
- N15 Fuel Vapor Canister

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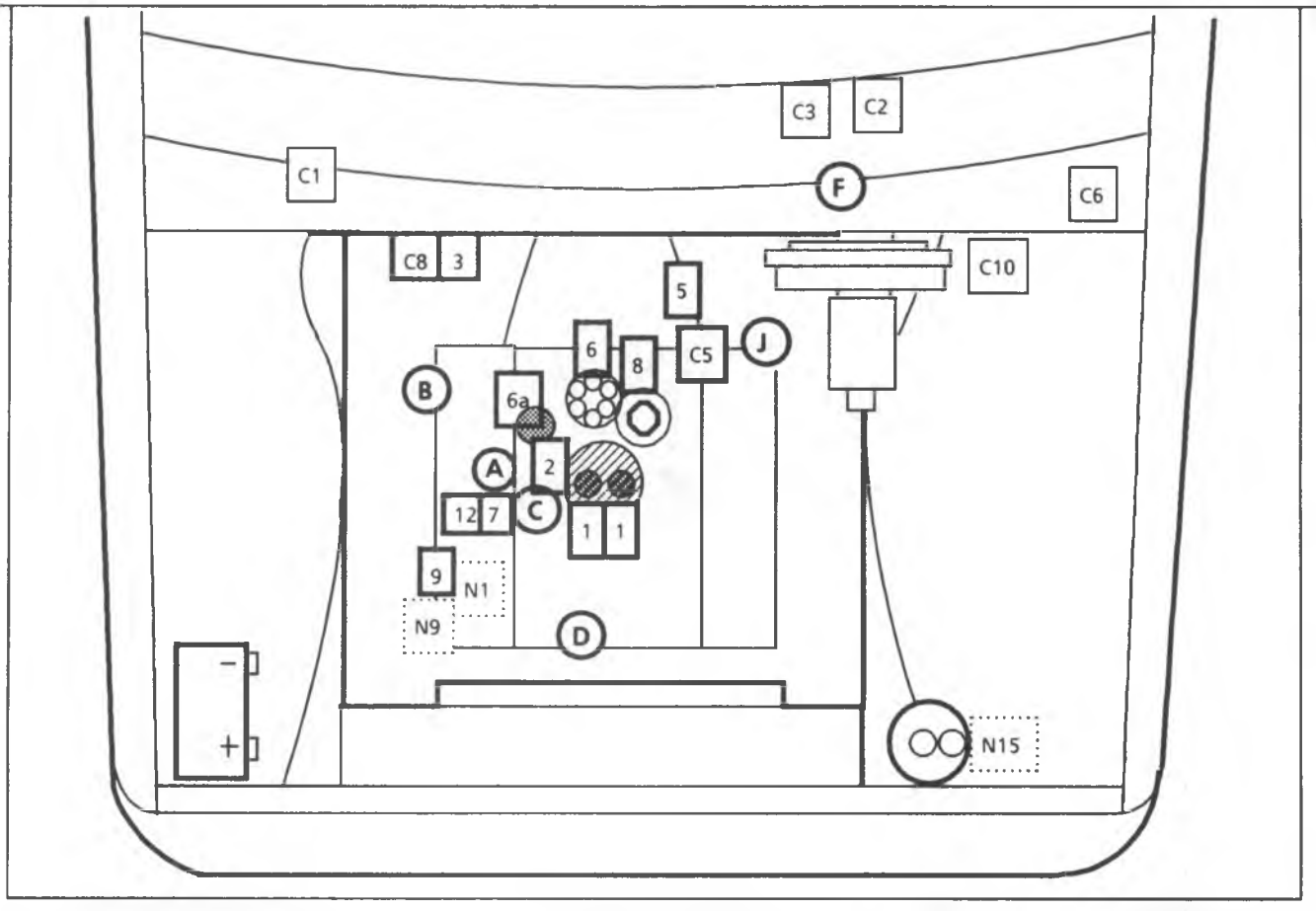
4-23-86

Figure 1-4 Component Locations - 2.8L (ST Series)

'C/K' SERIES RPO: LB4 ENGINE CODE: Z 4.3L V6



COMPUTER COMMAND CONTROL

- C1 Electronic Control Module (E.C.M.)
- C2 ALDL diagnostic connector
- C3 "SERVICE ENGINE SOON" light
- C5 ECM harness ground
- C6 Fuse panel
- C8 Fuel pump test connector

ECM INFORMATION SENSORS

- A Manifold Absolute Pressure (M.A.P.)
- B Exhaust oxygen
- C Throttle position (T.P.S.)
- D Coolant temperature
- F Vehicle speed (V.S.S.)
- J Electronic Spark Control Knock (E.S.C.)

EMISSION COMPONENTS (NOT ECM CONTROLLED)

- N1 Crankcase vent valve (PCV)
- N9 Air Pump
- N15 Fuel Vapor Canister

ECM CONTROLLED COMPONENTS

- 1 Fuel injector
- 2 Idle air control
- 3 Fuel pump relay
- 5 Transmission Converter Clutch Connector
- 6 Electronic Spark Timing Distributor (E.S.T.)
- 6a Remote ignition coil
- 7 Electronic Spark Control module (E.S.C.)
- 8 Oil pressure switch
- 9 Electric Air Control solenoid (E.A.C.)
- 12 Exhaust Gas Recirculation Vacuum Solenoid

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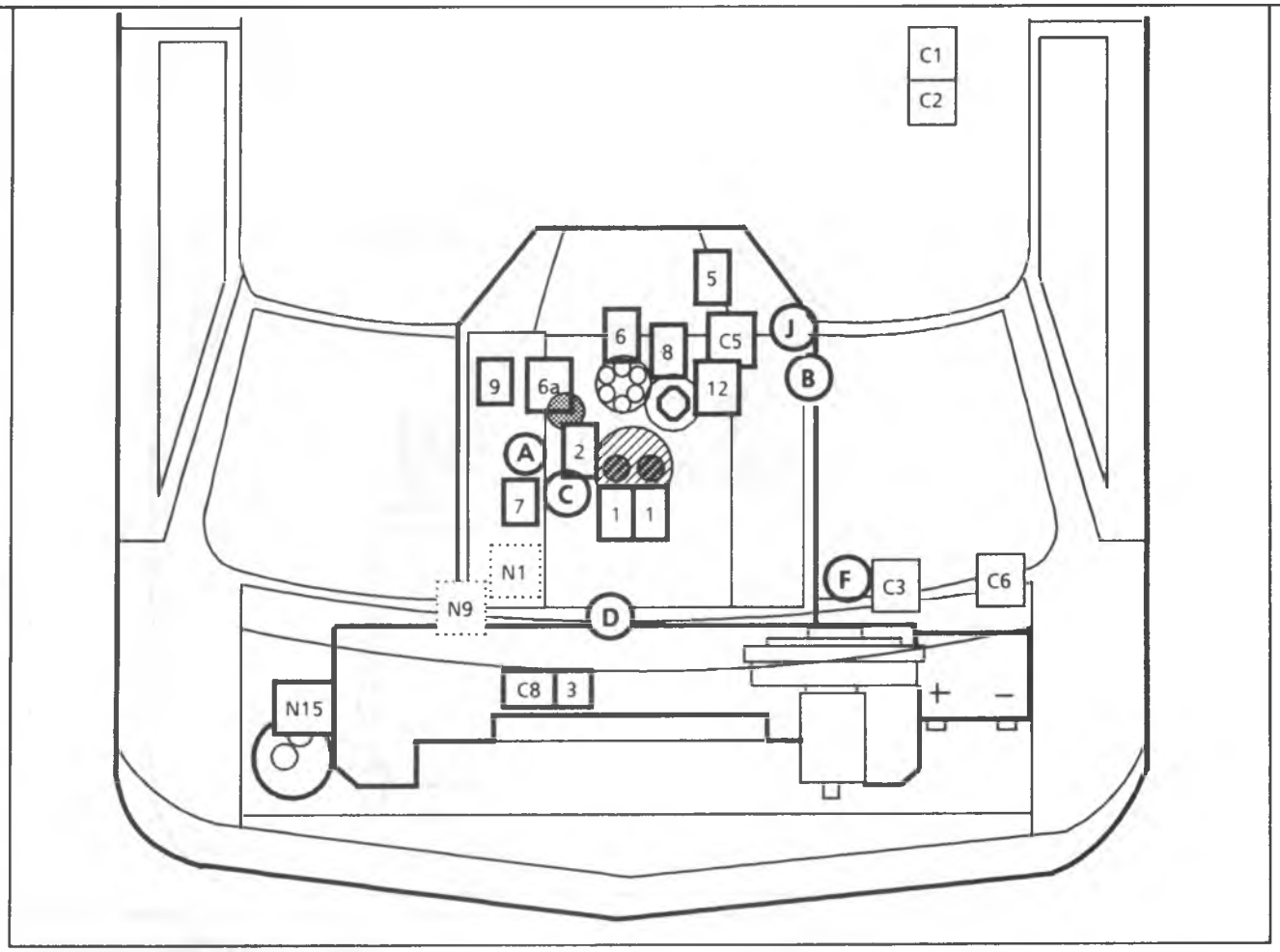
Figure 1-5 Component Locations - 4.3L (CK Series)

'G' SERIES RPO: LB4 ENGINE CODE: Z 4.3L V6



COMPUTER COMMAND CONTROL

- C1 Electronic Control Module (E.C.M.)
- C2 ALDL diagnostic connector
- C3 "SERVICE ENGINE SOON" light
- C5 ECM harness ground
- C6 Fuse panel
- C8 Fuel pump test connector

ECM INFORMATION SENSORS

- A Manifold Absolute Pressure (M.A.P.)
- B Exhaust oxygen
- C Throttle position (T.P.S.)
- D Coolant temperature
- F Vehicle speed (V.S.S.)
- J Electronic Spark Control Knock (E.S.C.)

EMISSION COMPONENTS (NOT ECM CONTROLLED)

- N1 Crankcase vent valve (PCV)
- N9 Air Pump
- N15 Fuel Vapor Canister

ECM CONTROLLED COMPONENTS

- 1 Fuel injector
- 2 Idle air control
- 3 Fuel pump relay
- 5 Transmission Converter Clutch Connector
- 6 Electronic Spark Timing Distributor (E.S.T.)
- 6a Remote ignition coil
- 7 Electronic Spark Control module (E.S.C.)
- 8 Oil pressure switch
- 9 Electric Air Control solenoid (E.A.C.)
- 12 Exhaust Gas Recirculation Vacuum Solenoid

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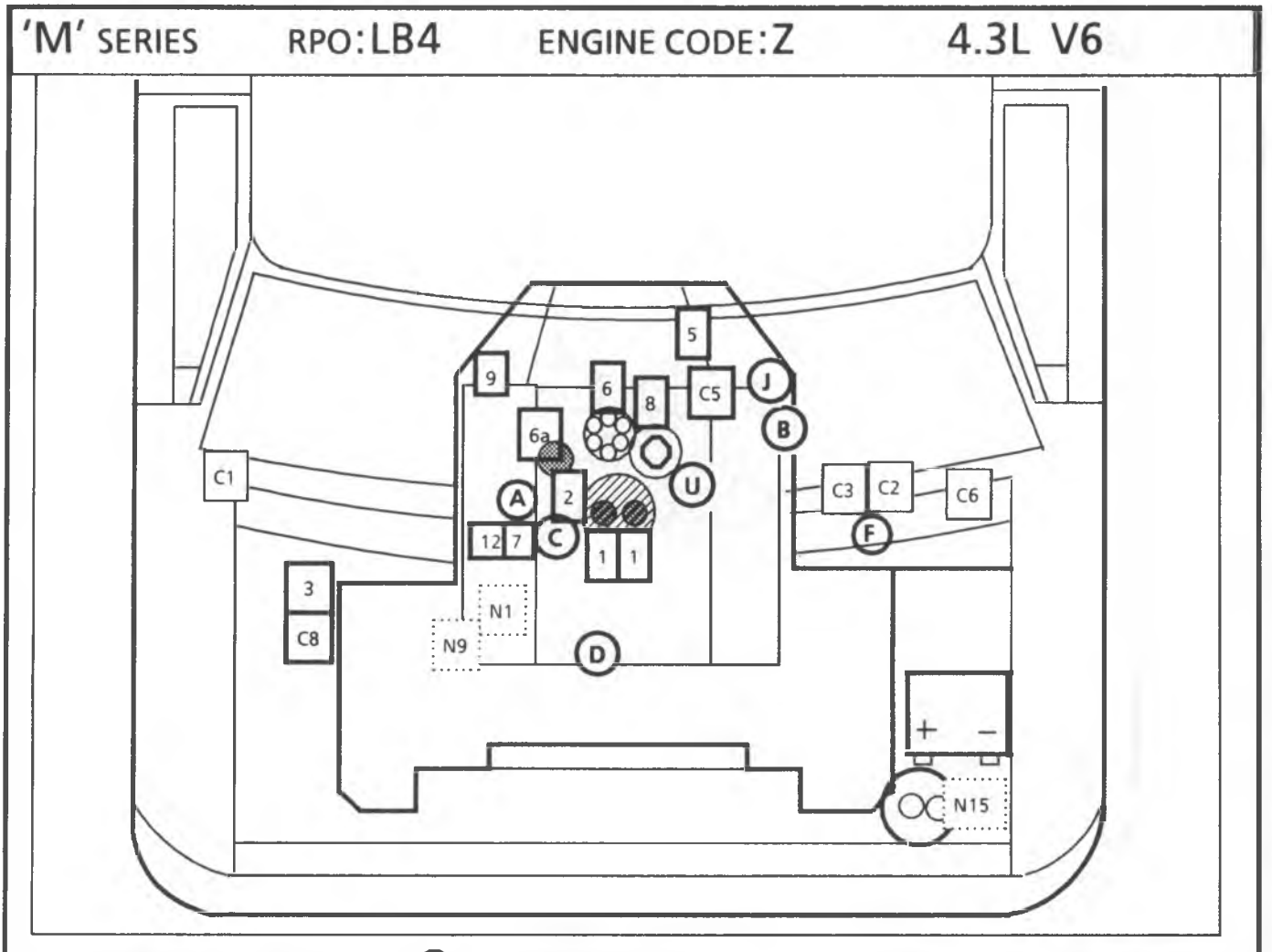
Figure 1-6 Component Locations - 4.3L (G Series)



COMPUTER COMMAND CONTROL

- C1 Electronic Control Module (E.C.M.)
- C2 ALDL diagnostic connector
- C3 "SERVICE ENGINE SOON" light
- C5 ECM harness ground
- C6 Fuse panel
- C8 Fuel pump test connector

ECM INFORMATION SENSORS

- A Manifold Absolute Pressure (M.A.P.)
- B Exhaust oxygen
- C Throttle position (T.P.S.)
- D Coolant temperature
- F Vehicle speed (V.S.S.)
- J Electronic Spark Control Knock (E.S.C.)

EMISSION COMPONENTS (NOT ECM CONTROLLED)

- N1 Crankcase vent valve (PCV)
- N9 Air Pump
- N15 Fuel Vapor Canister

ECM CONTROLLED COMPONENTS

- 1 Fuel injector
- 2 Idle air control
- 3 Fuel pump relay
- 5 Transmission Converter Clutch Connector
- 6 Electronic Spark Timing Distributor (E.S.T.)
- 6a Remote ignition coil
- 7 Electronic Spark Control module (E.S.C.)
- 8 Oil pressure switch
- 9 Electric Air Control solenoid (E.A.C.)
- 12 Exhaust Gas Recirculation Vacuum Solenoid

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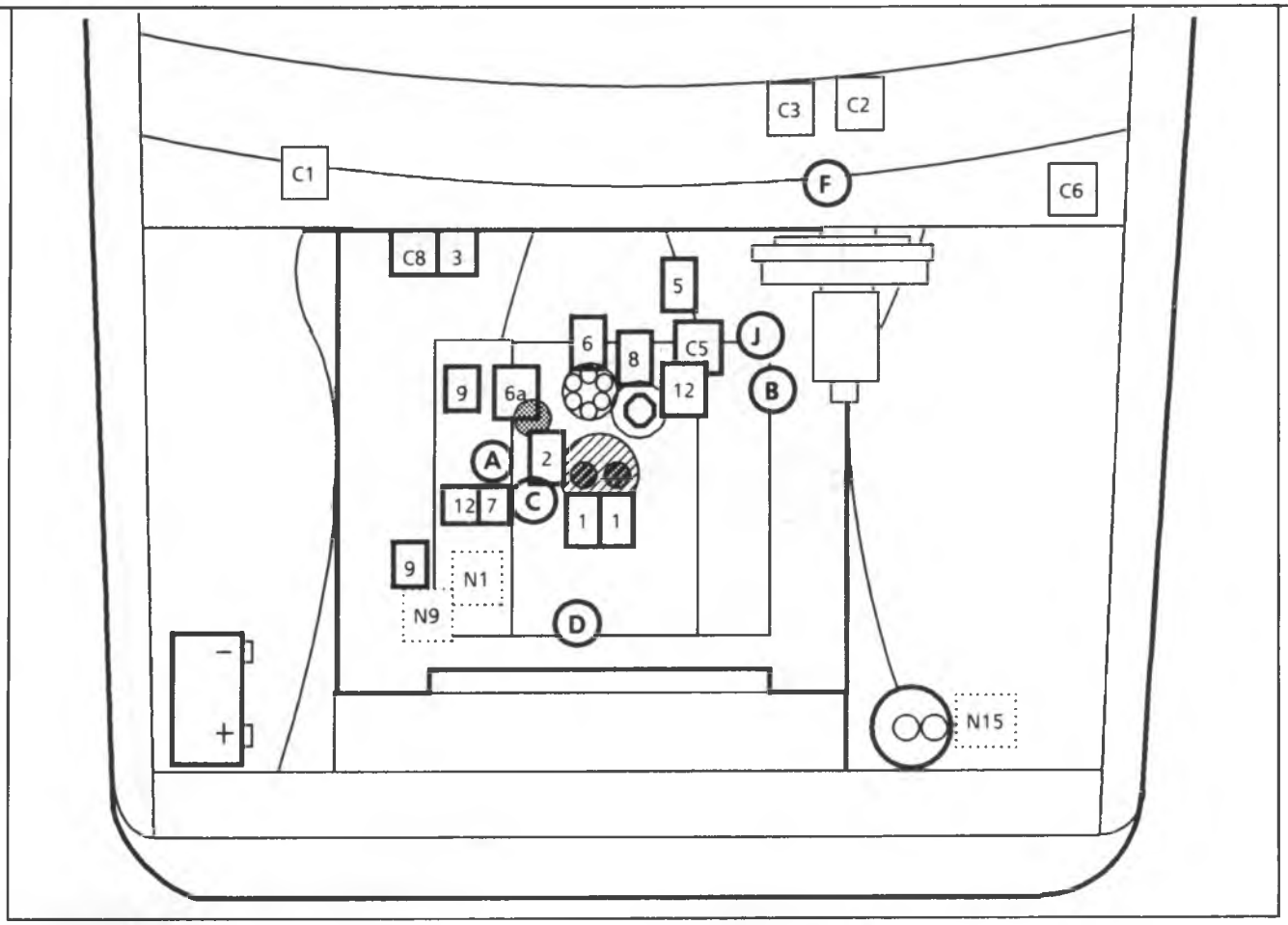
Figure 1-7 Component Locations - 4.3L (M Series)

'R/V' SERIES RPO:LB4 ENGINE CODE:Z 4.3L V6



COMPUTER COMMAND CONTROL

- C1 Electronic Control Module (E.C.M.)
- C2 ALDL diagnostic connector
- C3 "SERVICE ENGINE SOON" light
- C5 ECM harness ground
- C6 Fuse panel
- C8 Fuel pump test connector

ECM INFORMATION SENSORS

- A Manifold Absolute Pressure (M.A.P.)
- B Exhaust oxygen
- C Throttle position (T.P.S.)
- D Coolant temperature
- F Vehicle speed (V.S.S.)
- J Electronic Spark Control Knock (E.S.C.)

EMISSION COMPONENTS (NOT ECM CONTROLLED)

- N1 Crankcase vent valve (PCV)
- N9 Air Pump
- N15 Fuel Vapor Canister

ECM CONTROLLED COMPONENTS

- 1 Fuel injector
- 2 Idle air control
- 3 Fuel pump relay
- 5 Transmission Converter Clutch Connector
- 6 Electronic Spark Timing Distributor (E.S.T.)
- 6a Remote ignition coil
- 7 Electronic Spark Control module (E.S.C.)
- 8 Oil pressure switch
- 9 Electric Air Control solenoid (E.A.C.)
- 12 Exhaust Gas Recirculation Vacuum Solenoid

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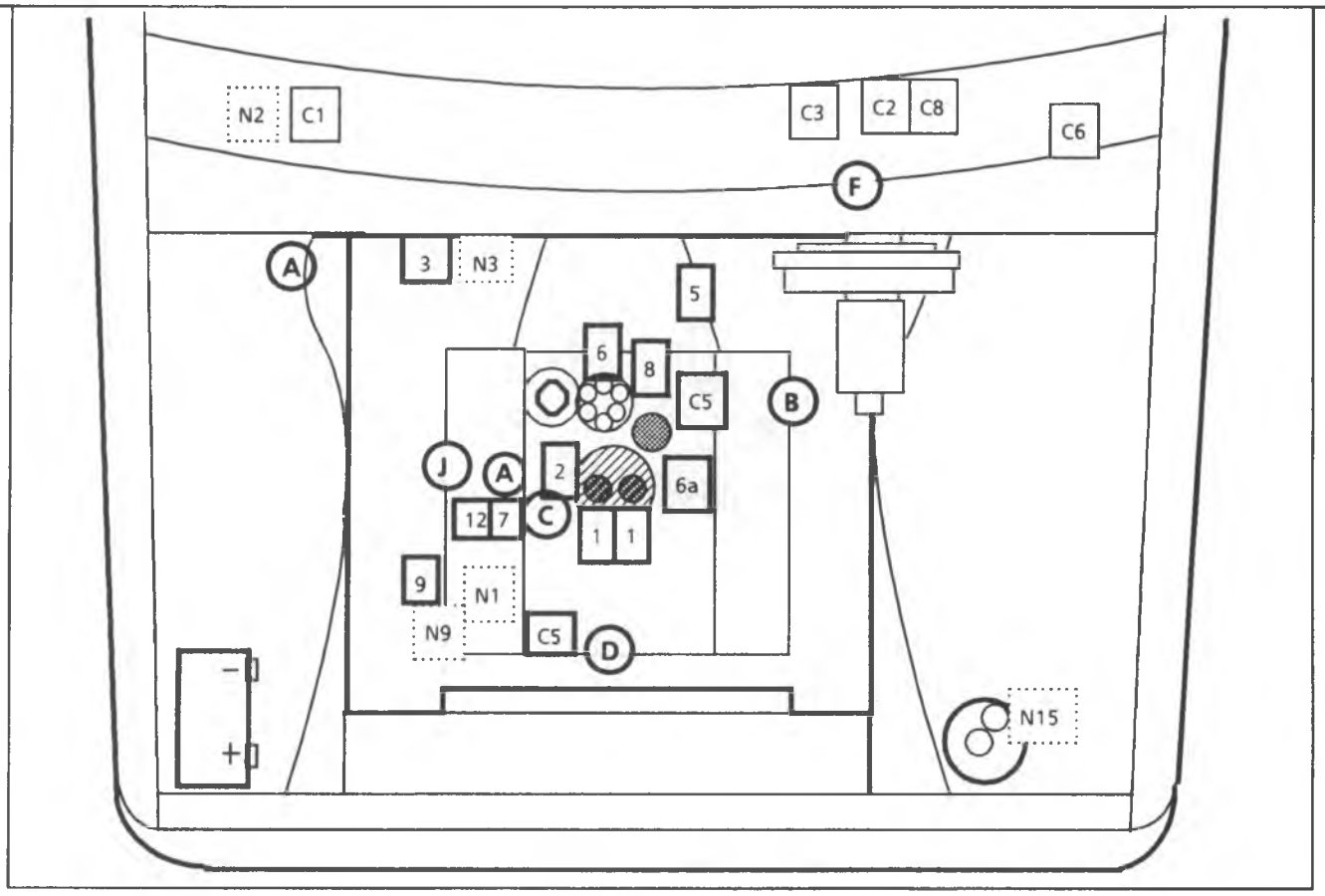
Figure 1-8 Component Locations - 4.3L (RV Series)

'C/K' SERIES RPO: L03/L05 ENGINE CODE: H/K 5.0/5.7L V8



COMPUTER COMMAND CONTROL

- C1 Electronic Control Module (E.C.M.)
- C2 ALDL diagnostic connector
- C3 "SERVICE ENGINE SOON" light
- C5 ECM harness ground
- C6 Fuse panel
- C8 Fuel pump test connector

ECM INFORMATION SENSORS

- A Manifold Absolute Pressure (M.A.P.)
- B Exhaust oxygen
- C Throttle position (T.P.S.)
- D Coolant temperature
- F Vehicle speed (V.S.S.)
- J Electronic Spark Control Knock (E.S.C.)

EMISSION COMPONENTS (NOT ECM CONTROLLED)

- N1 Crankcase vent valve (PCV)
- N2 Fuel Module (5.7L H.D. only)
- N3 Downshift Relay (THM 400 only)
- N9 Air Pump
- N15 Fuel Vapor Canister

ECM CONTROLLED COMPONENTS

- 1 Fuel injector
- 2 Idle air control
- 3 Fuel pump relay
- 5 Transmission Converter Clutch Connector
- 6 Electronic Spark Timing Distributor (E.S.T.)
- 6a Remote ignition coil
- 7 Electronic Spark Control module (E.S.C.)
- 8 Oil pressure switch
- 9 Electric Air Control solenoid (E.A.C.)
- 12 Exhaust Gas Recirculation Vacuum Solenoid

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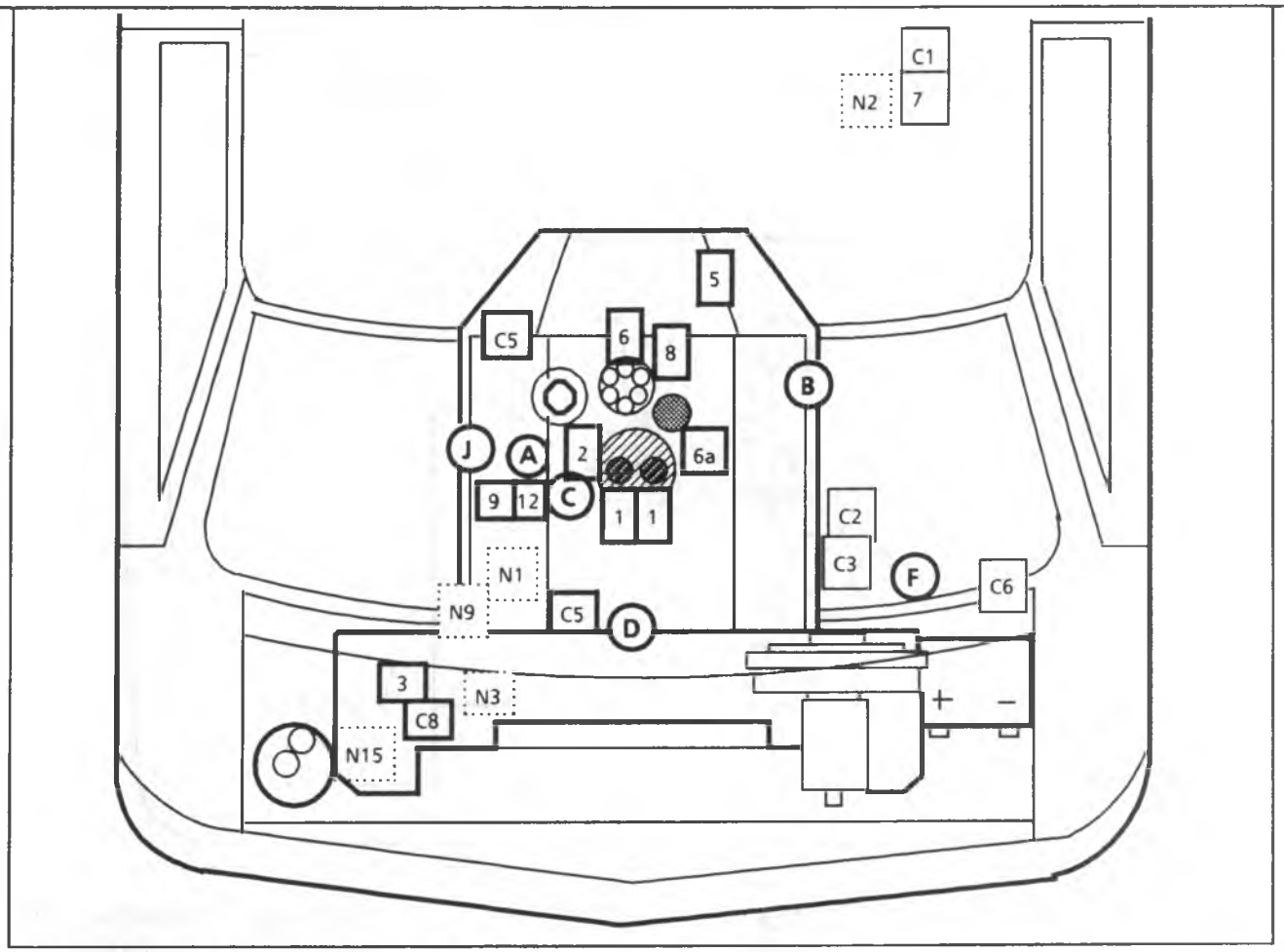
Figure 1-9 - Component Locations - 5.0L/5.7L (CK Series)

'G' SERIES RPO:L03/L05 ENGINE CODE:H/K 5.0/5.7L V8



COMPUTER COMMAND CONTROL

- C1 Electronic Control Module (E.C.M.)
- C2 ALDL diagnostic connector
- C3 "SERVICE ENGINE SOON" light
- C5 ECM harness ground
- C6 Fuse panel
- C8 Fuel pump test connector

ECM INFORMATION SENSORS

- A Manifold Absolute Pressure (M.A.P.)
- B Exhaust oxygen
- C Throttle position (T.P.S.)
- D Coolant temperature
- F Vehicle speed (V.S.S.)
- J Electronic Spark Control Knock (E.S.C.)

EMISSION COMPONENTS (NOT ECM CONTROLLED)

- N1 Crankcase vent valve (PCV)
- N2 Fuel Module
- N3 Downshift Relay (THM 400 only)
- N9 Air Pump
- N15 Fuel Vapor Canister

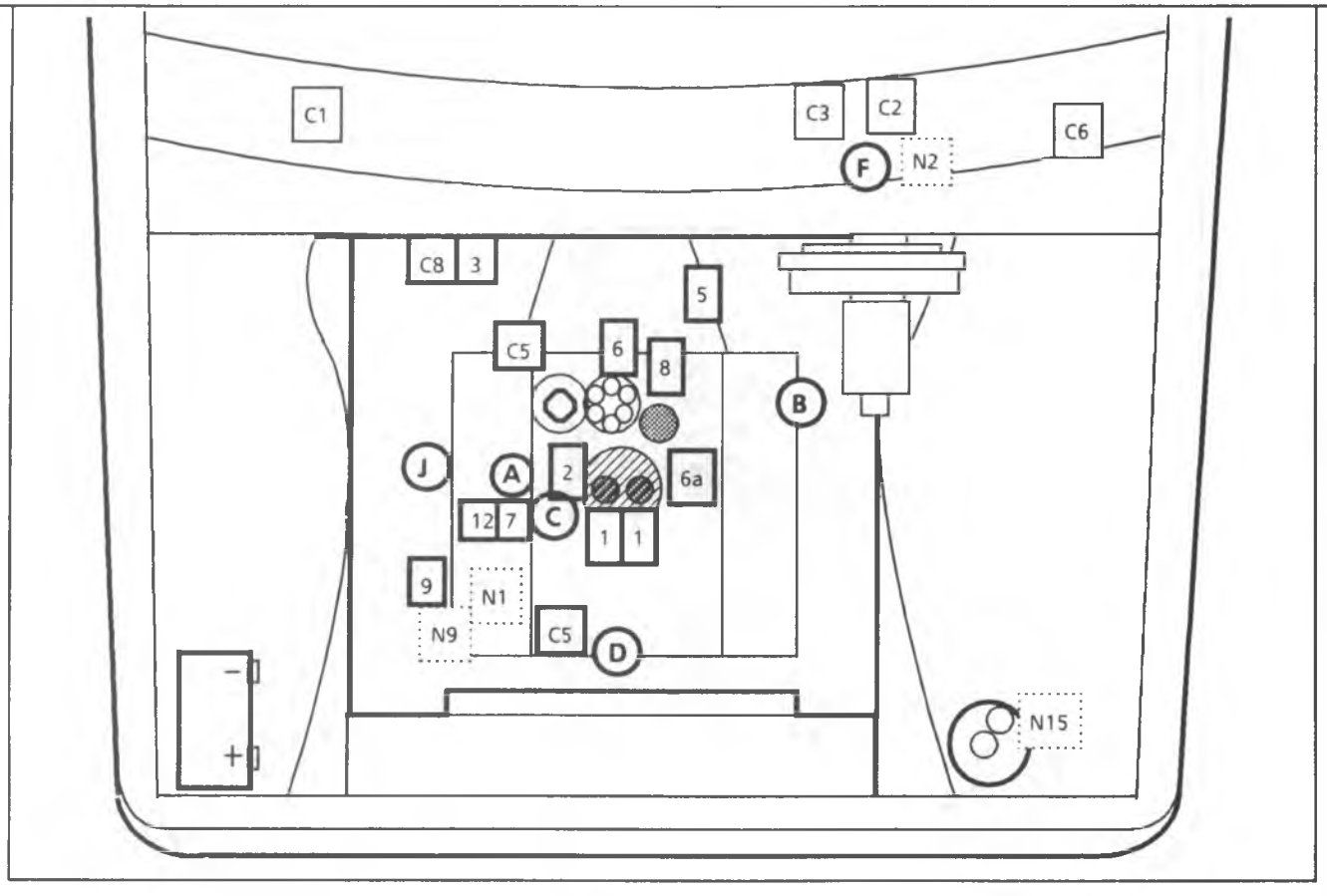
ECM CONTROLLED COMPONENTS

- 1 Fuel injector
- 2 Idle air control
- 3 Fuel pump relay
- 5 Transmission Converter Clutch Connector
- 6 Electronic Spark Timing Distributor (E.S.T.)
- 6a Remote ignition coil
- 7 Electronic Spark Control module (E.S.C.)
- 8 Oil pressure switch
- 9 Electric Air Control solenoid (E.A.C.)
- 12 Exhaust Gas Recirculation Vacuum Solenoid

7S 3304
7-24-86

Figure 1-10 - Component Locations - 5.0L/5.7L (G Series)

'R/V' SERIES RPO:L03/L05 ENGINE CODE:H/K 5.0/5.7L V8



COMPUTER COMMAND CONTROL

- C1 Electronic Control Module (E.C.M.)
- C2 ALDL diagnostic connector
- C3 "SERVICE ENGINE SOON" light
- C5 ECM harness ground
- C6 Fuse panel
- C8 Fuel pump test connector

ECM INFORMATION SENSORS

- A Manifold Absolute Pressure (M.A.P.)
- B Exhaust oxygen
- C Throttle position (T.P.S.)
- D Coolant temperature
- F Vehicle speed (V.S.S.)
- J Electronic Spark Control Knock (E.S.C.)

EMISSION COMPONENTS (NOT ECM CONTROLLED)

- N1 Crankcase vent valve (PCV)
- N2 Fuel Module (5.7L H.D. only)
- N9 Air Pump
- N15 Fuel Vapor Canister

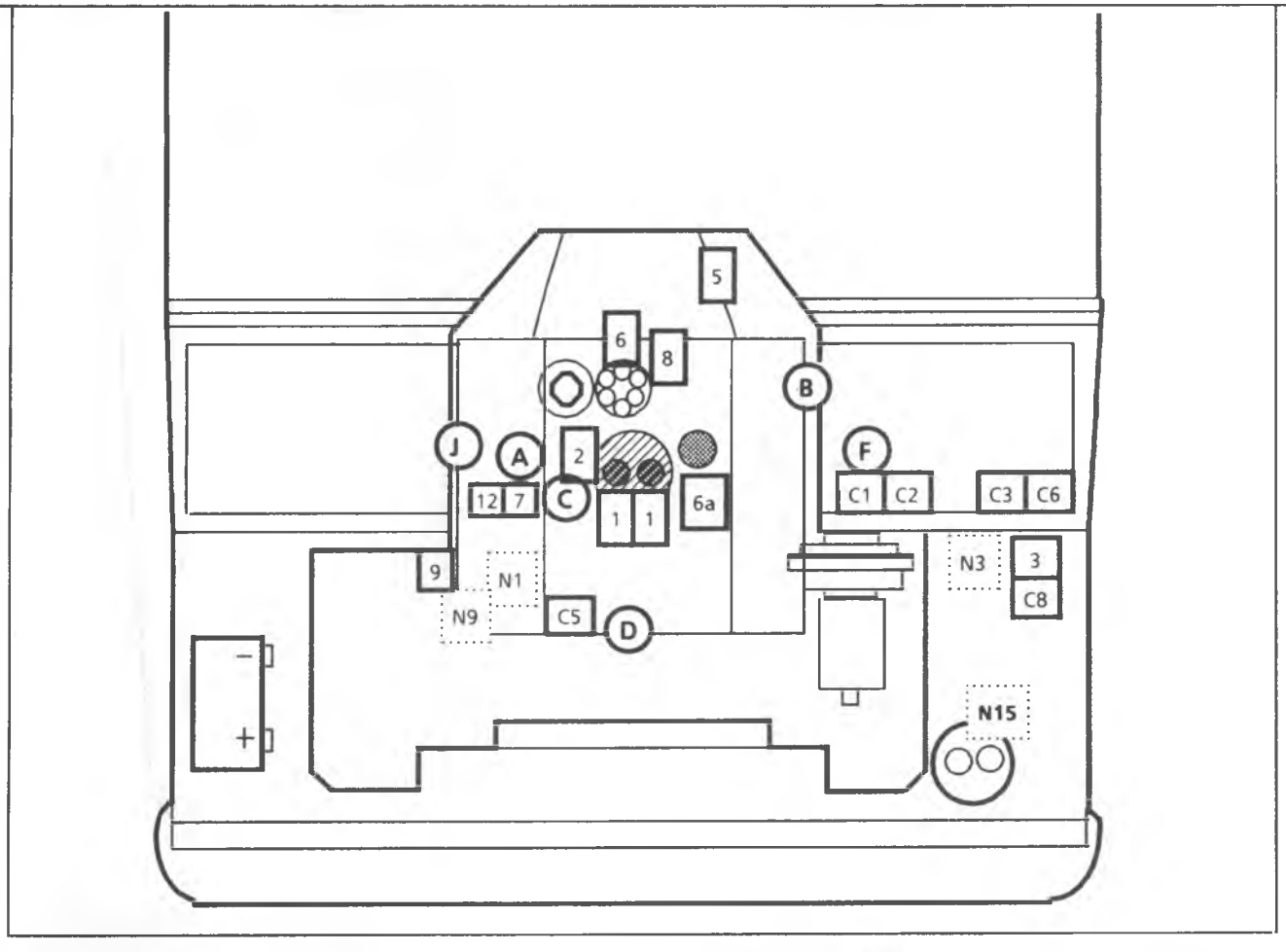
ECM CONTROLLED COMPONENTS

- 1 Fuel injector
- 2 Idle air control
- 3 Fuel pump relay
- 5 Transmission Converter Clutch Connector
- 6 Electronic Spark Timing Distributor (E.S.T.)
- 6a Remote ignition coil
- 7 Electronic Spark Control module (E.S.C.)
- 8 Oil pressure switch
- 9 Electric Air Control solenoid (E.A.C.)
- 12 Exhaust Gas Recirculation Vacuum Solenoid

* 7S 3305
7-25-86

Figure 1-11 - Component Locations - 5.0L/5.7L (RV Series)

'P' SERIES RPO: L05 ENGINE CODE: K 5.7L V8



COMPUTER COMMAND CONTROL

- C1 Electronic Control Module (E.C.M.)
- C2 ALDL diagnostic connector
- C3 "SERVICE ENGINE SOON" light
- C5 ECM harness ground
- C6 Fuse panel
- C8 Fuel pump test connector

ECM INFORMATION SENSORS

- A Manifold Absolute Pressure (M.A.P.)
- B Exhaust oxygen
- C Throttle position (T.P.S.)
- D Coolant temperature
- F Vehicle speed (V.S.S.)
- J Electronic Spark Control Knock (E.S.C.)

EMISSION COMPONENTS (NOT ECM CONTROLLED)

- N1 Crankcase vent valve (PCV)
- N3 Downshift Relay (THM 400 Only)
- N9 Air Pump
- N15 Fuel Vapor Canister

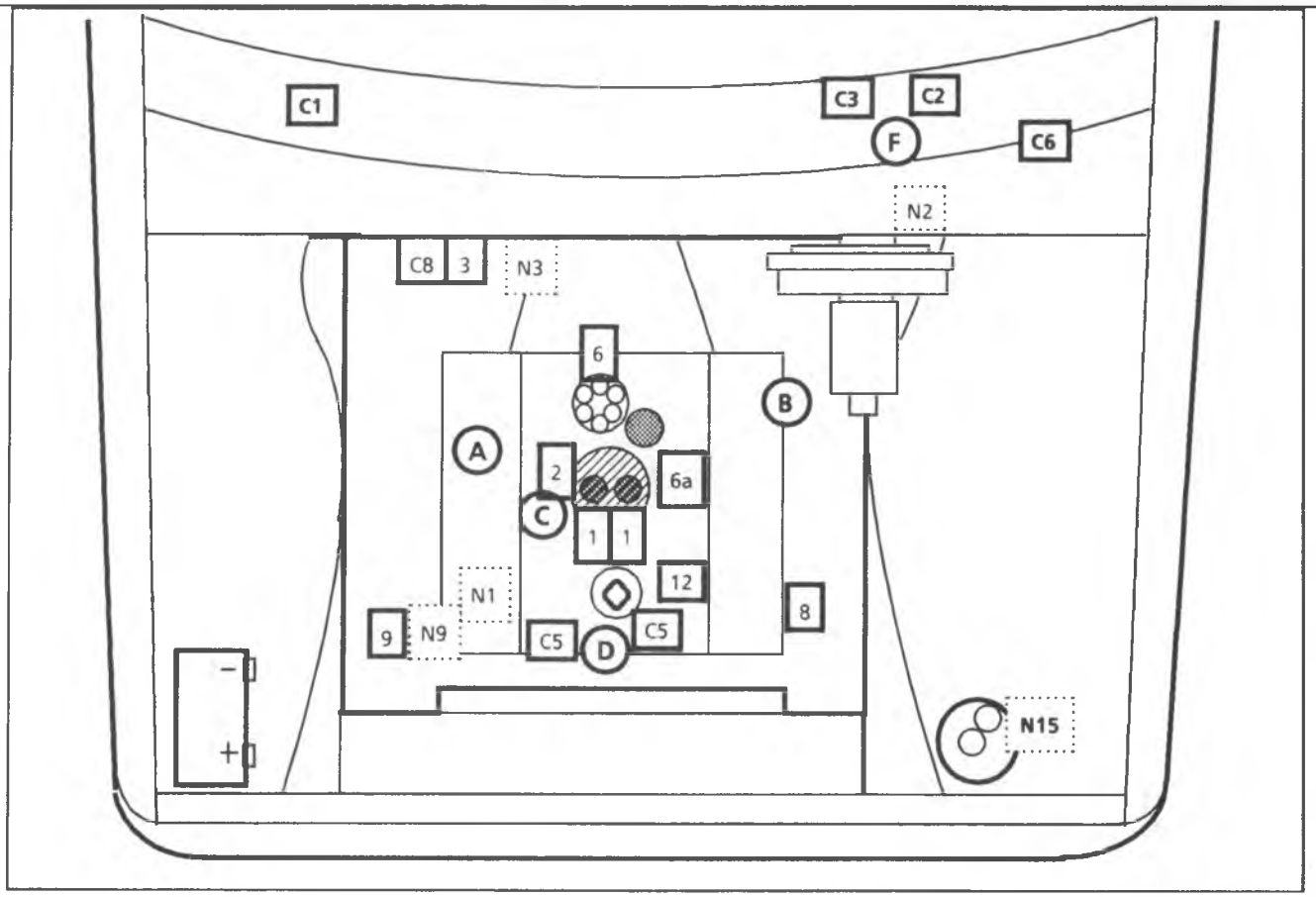
ECM CONTROLLED COMPONENTS

- 1 Fuel injector
- 2 Idle air control
- 3 Fuel pump relay
- 5 Transmission Converter Clutch Connector
- 6 Electronic Spark Timing Distributor (E.S.T.)
- 6a Remote ignition coil
- 7 Electronic Spark Control module (E.S.C.)
- 8 Oil pressure switch
- 9 Electric Air Control solenoid (E.A.C.)
- 12 Exhaust Gas Recirculation Vacuum Solenoid

7S 3307-6E
5-5-86

Figure 1-12 Component Locations - 5.7L (P Series)

'C/K & RV' SERIES RPO:L19 ENGINE CODE:N 7.4L V8



COMPUTER COMMAND CONTROL

- C1 Electronic Control Module (E.C.M.)
- C2 ALDL diagnostic connector
- C3 "SERVICE ENGINE SOON" light
- C5 ECM harness ground
- C6 Fuse panel
- C8 Fuel pump test connector

ECM INFORMATION SENSORS

- A Manifold Absolute Pressure (M.A.P.)
- B Exhaust oxygen
- C Throttle position (T.P.S.)
- D Coolant temperature
- F Vehicle speed (V.S.S.)

EMISSION COMPONENTS (NOT ECM CONTROLLED)

- N1 Crankcase vent valve (PCV)
- N2 Fuel Module
- N3 Downshift Relay (THM 400 only)
- N9 Air Pump
- N15 Fuel Vapor Canister

ECM CONTROLLED COMPONENTS

- 1 Fuel injector
- 2 Idle air control
- 3 Fuel pump relay
- 6 Electronic Spark Timing Distributor (E.S.T.)
- 6a Remote ignition coil
- 8 Oil pressure switch
- 9 Electric Air Control solenoid (E.A.C.)
- 12 Exhaust Gas Recirculation Vacuum Solenoid

7S 3306
7-24-86

Figure 1-13 - Component Locations - 7.4L (CK & RV Series)

SECTION 2
DRIVEABILITY SYMPTOMS

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BEFORE STARTING

Before using this section, you should have performed the DIAGNOSTIC CIRCUIT CHECK in Section 3 Diagnosis.

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, in Section 3.

Careful Visual Check

Several of the following symptom procedures call for a careful visual (physical) check. This check should include:

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

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

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

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 vehicle at one time, as previously shown by an actual road test.

- **CHECK:**
  - Engine thermostat for faulty part (always open) or for wrong heat range.
  - Fuel Pressure. See CHART A-5 in Section 3.
  - Ignition timing. See Vehicle Emission Control Information label for procedure.
  - TCC for proper operation. See Section 10.

ECM INTERMITTENT CODES OR PERFORMANCE

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

The ECM code charts, in Section 3, determine if there is a fault with a circuit, or, if there is an intermittent problem. An intermitent means that a code is stored in the ECM memory, but the circuit is OK.

- Most intermittent problems are caused by faulty electrical connections or wiring. Perform careful check of the suspected circuits 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 a problem circuit, should be carefully reformed to increase contact tension.
  - Poor terminal to wire connection. This requires removing the terminal from the connector body as outlined in Section 3.
- If a visual (physical) check does not find the cause of the problem, the vehicle can be driven with a voltmeter connected to a suspected circuit. An abnormal voltage reading, when the problem occurs, indicates the problem may be in that circuit .
- Loss of 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", for at least 10 seconds. If not, the ECM is faulty.
- **CHECK:**
  - 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.
  - 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 have a good contact to ground.
  - Ignition secondary shorted to ground.
  - CKT's 419 and 451 intermittently shorted to ground.
  - ECM power grounds.

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 injector(s) for leaking. Apply 12 volts to fuel pump test terminal to turn on fuel pump and pressurize fuel system. Visually check injector and TBI assembly for fuel leakage.

BACKFIRE

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

- **CHECK:**
  - EGR operation, for being open all the time. See EGR diagnosis.
  - Output voltage of ignition coil.
  - For crossfire between spark plugs (distributor cap, spark plug wires, and proper routing of plug wires).
  - For intermittent condition in primary ignition system.
  - Engine timing - See Vehicle Emission Control Information label.
  - For faulty spark plugs and/or plug wires or boots.
  - For proper valve timing.
- Perform a compression check - look for sticking or leaking valves.

ROUGH, UNSTABLE, OR INCORRECT IDLE, STALLING

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

- **CHECK:**
  - Ignition timing. See Vehicle Emission Control Information label.
  - P/N switch circuit. See ECM diagnosis.
  - For injector leaking. Check Fuel Pressure in CHART A-5, Section 3 Diagnosis.
  - Injectors - Too rich or lean.
- If ROUGH IDLE only occurs HOT, perform these additional checks:
  - Vacuum Leaks - Block idle air passage using J-33047 plug or equivalent. If closed throttle engine speed is above 650 rpm, locate and correct vacuum leak such as a disconnected thermac or cruise control hose.
  - Park/Neutral Switch (Automatic Transmission Only). See ECM diagnosis.
  - Sticking throttle shaft or binding linkage causes a high TPS Voltage (open throttle indication). The ECM will not control idle. Monitor TPS voltage. "Scan" and/or Voltmeter should read less than 1.2 volts, with throttle closed.
  - EGR "ON", while idling, will cause roughness, stoppage, and hard starting. See EGR diagnosis.
  - Battery cables and ground straps should be clean and secure. Erratic voltage will cause IAC to change its position, resulting in poor idle quality.
  - IAC valve will not move, if system voltage is below 9 or greater than 17.8 volts.
  - Power Steering - ECM should compensate for Power Steering loads. Loss of this signal would be most noticable when parking and steering loads are high. See ECM diagnosis.
  - MAP Sensor - Ignition "ON", engine stopped. Compare MAP voltage with known good vehicle. Voltage should be the same ± 400 mv (.4 volts).

    or

    Start and idle engine. Disconnect sensor electrical connector. If idle improves substitute a known good sensor and recheck.
  - A/C compressor or relay. If inoperative, refer to A/C diagnosis in Section 3.
  - A/C Refrigerant Pressure too high. Check for overcharge or faulty cycling switch.
  - Check PCV valve for proper operation by placing finger over inlet hole in valve end several times. Valve should snap back. If not, replace valve.
  - Run a cylinder compression check.
  - Inspect Oxygen sensor for silicon contamination from fuel, or use of improper RTV sealant. The sensor will have a white, powdery coating, and will result in a high, but false, signal voltage (rich exhaust indication). The ECM will, then, reduce the amount of fuel delivered to the engine, causing a severe driveability problem.
- Check A/C signal. See A/C diagnosis in Section 3.
- Check air management system for intermittent air to ports while in "Closed Loop."

ABOVE NORMAL EMISSIONS (ODORS)

- If test shows higher than normal CO and HC, (also has excessive odors), check items that will cause engine to run rich:
- **CHECK:**
  - For high fuel pressure. See CHART A-5, in Section 3.
  - For incorrect timing. See Vehicle Emission Control Information Label.
  - Canister for fuel loading.
  - For stuck PCV valve or blocked PCV hose. See PCV diagnosis.
  - Condition of spark plugs, plug wires, and distributor cap.
  - For lead contamination of catalytic converter (look for removal of fuel filler neck restrictor).

HARD START

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

- **CHECK:**
  - For water contaminated fuel.
  - Fuel pressure. See Section 3.
  - TPS for sticking or binding.
  - EGR operation. See Section 9.
  - Fuel pump relay (ST & M) - Connect test light between pump test terminal and ground. Light should be "ON", for 2 seconds, following ignition "ON".
    On 7.4L, and some 5.7L engines, a fuel module circuit will run the fuel pump for 20 seconds, following ignition "ON". If this circuit is not functioning, this may cause a hot, hard start condition.
  - For a faulty in-tank fuel pump, check valve, which would allow the fuel in the lines to drain back to the tank after the engine is stopped. To check for this condition:
    1. Ignition "OFF".
    2. Disconnect fuel line at the filter.
    3. Remove the tank filler cap .
    4. Connect a radiator test pump to the line and apply 103 kPa (15 psi) pressure. If the pressure will hold for 60 seconds, the check valve is OK.
- Check ignition system for:
  - Proper Output with J 26792 (ST-125).
  - Worn shaft.
  - Bare and shorted wires.
  - Pickup coil resistance and connections.
  - Loose ignition coil ground.
  - Moisture in distributor cap.
  - Spark plugs, wet plugs, cracks, wear, improper gap, burned electrodes, or heavy deposits.
- If engine starts, but then, immediately stalls, open distributor bypass line. If engine then starts, and runs OK, replace distributor pickup coil.
- Hard start, with engine at normal operating temperature. See Crank Signal Diagnosis, in Section 3.
- On vehicle, between 8,500 and 10,000 lb. GVW with a 5.7L or 7.4L engine, check fuel pump cycle system.

SURGES AND/OR CHUGGLE

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

- If a tool is available which plugs in to the ALDL connector, make sure reading of VSS matches vehicle speedometer.
- **CHECK:**
  - For intermittent EGR at idle. See Section 9.
  - Ignition timing. See Vehicle Emission Control Information label.
  - Inline fuel filter for dirt or restriction.
  - Fuel pressure. See Section 3.
  - Generator output voltage. Repair, if less than 9 volts or more than 16 volts
  - TCC Operation.
- 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.

- Compare customer's vehicle to similar unit. Make sure the customer's vehicle has an actual problem.
- Remove air cleaner and check air filter for dirt, or for being plugged. Replace as necessary.
- **CHECK:**
  - Ignition timing. See Vehicle Emission Control Information label.
  - For restricted fuel filter, contaminated fuel or improper fuel pressure. See CHART A-5 in Section 3.
  - ECM Grounds.
  - EGR operation for being open or partly open all the time. See Section 9.
  - Generator output voltage. Repair if less than 9 or more than 16 volts.
  - Engine valve timing and compression.
  - Engine for proper or worn camshaft.
- Check Exhaust system for restriction:
  1. With engine at normal operating temperature, connect a vacuum gage to any convenient vacuum port on intake manifold.
  2. Disconnect EGR solenoid electrical connector or connect EGR valve directly to vacuum source bypassing any switches or solenoids.
  3. Run engine at 1000 rpm and record vacuum reading.
  4. Increase rpm slowly to 2500 rpm. Note vacuum reading at steady 2500 rpm.
  5. If vacuum at 2500 rpm decreases more than 3", from reading at 1000 rpm, the exhaust system should be inspected for restrictions.
  6. Disconnect exhaust pipe from engine and repeat steps 3 & 4. If vacuum still drops, more than 3" with exhaust disconnected, check valve timing.

DETONATION / SPARK KNOCK

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

- Check for obvious overheating problems.
  - Low coolant.
  - Loose water pump belt.
  - Restricted air flow to radiator, or restricted water flow thru radiator.
- **CHECK:**
  - For poor fuel quality, proper octane rating.
  - For correct PROM. (See Service Bulletins).
  - THERMAC for staying closed.
  - Ignition timing. See Vehicle Emission Control Information label.
  - Fuel system for low pressure. See CHART A-5 in Section 3.
  - Check EGR system for not opening. See Section 9.
  - For proper transmission shift points and TCC operation.
  - For incorrect basic engine parts such as cam, heads, pistons, etc.
- Remove carbon with top engine cleaner. Follow instructions on can.
- On vehicles with 7.4L or 5.7L (over 8500 GVW) engine and a dual catalytic converter system, check for an exhaust restriction in the rear converter area.

HESITATION, SAG, STUMBLE

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

- Perform careful visual (physical) check as described at start of Section 2.
- **CHECK:**
  - Fuel pressure. See CHART A-5 in Section 3.
  - Water contaminated fuel.
  - Ignition timing. See Vehicle Emission Control Information label.
  - Fuel pump cycle system.
  - TPS for binding or sticking.
  - Generator output voltage. Repair if less than 9 or more than 16 volts.
  - For open HEI ground, CKT 453.
  - Canister purge system for proper operation. See Section 5.
  - EGR valve operation. See Section 9.

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.

- Check for missing cylinder by:
  1. Disconnecting IAC motor. Start engine. Remove one spark plug wire at a time using insulated pliers.
  2. If there is an rpm drop on all cylinders (equal to within 50 rpm), go to "ROUGH, UNSTABLE, OR INCORRECT IDLE, STALLING" symptom. Reconnect IAC motor.
  3. If there is no rpm drop on one or more cylinders, or excessive variation in drop, check for spark on the suspected cylinder(s) with J 26792 (ST-125) Spark Gap Tool or equivalent. If no spark, see Ignition Section 6. If there is spark, remove spark plug(s) in those cylinders and check for:
     - Cracks
     - Wear
     - Improper Gap
     - Burned Electrodes
     - Heavy Deposits
- **CHECK:**
  - Spark plug wires by connecting ohmmeter to ends of each wire in question. If meter reads over 30,000 ohms, replace wire(s).
  - Ignition coil and secondary voltage using spark tester J-26792 (ST-125), or equivalent.
  - For restricted fuel filter. Also check fuel tank for water.
  - For low fuel pressure. See CHART A-5 in Section 3.
  - Check for proper valve timing.
- Perform compression check on questionable cylinder(s) found above. If compression is low, repair as necessary.
- Visually check distributor cap and rotor for moisture, dust, cracks, burns, etc. Spray cap and plug wires with fine water mist to check for shorts.
- Remove rocker covers. Check for bent pushrods, worn rocker arms, broken valve springs, worn camshaft lobes.

SECTION 3
COMPUTER COMMAND CONTROL
TABLE OF CONTENTS

GENERAL DESCRIPTION

The Computer Command Control System has a computer (Electronic Control Module) to control the fuel delivery, ignition timing, some emission control systems and engagement of the transmission converter clutch, downshift control or the manual transmission shift light.

The system, through the electronic control module (ECM), monitors a number of engine and vehicle functions (Figure 3-1) and controls the following operations:

- Fuel Control
- Ignition/Electronic Spark Timing
- Electronic Spark Control
- Air Management
- Exhaust Gas Recirculation
- Transmission Converter Clutch, Downshift Control or Manual Transmission Shift Light

ALDL Connector

The Assembly Line Diagnostic Link (ALDL) is wired to the ECM and is located under the instrument panel.

This connector has terminals that are used to diagnose the system either with jumper wires or a "Scan" tool.

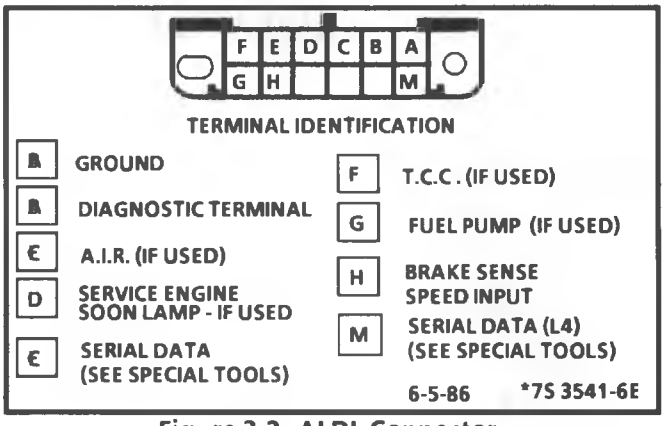

Figure 3-2 ALDL Connector

Wiring Harness and Connectors

A wiring harness electrically connects the ECM to various sensor, solenoid and relays within the system. Many connectors in the engine compartment are environmentally protected because of the systems low voltages and current levels.

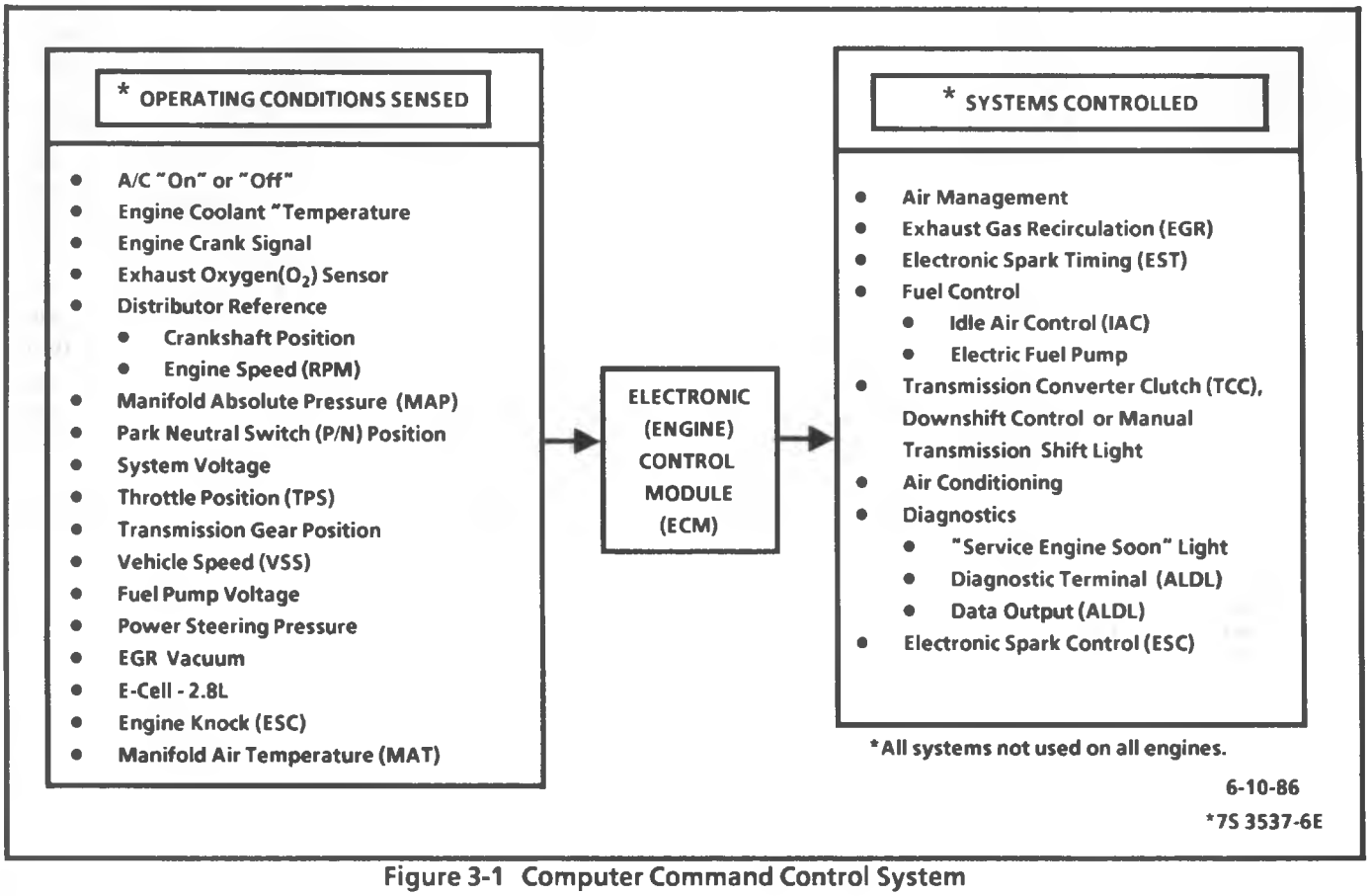

Figure 3-1 Computer Command Control System

Information Sensors

In addition to the ECM, the Computer Command Control System has the following information sensors:

- Oxygen sensor
- Coolant sensor
- Throttle position sensor
- Manifold absolute pressure sensor
- Vehicle speed sensor
- Manifold temperature sensor
- Knock sensor

and the following input signals:

- Park/neutral switch signal
- Crank signal
- Distributor reference signal
- Power steering pressure switch signal
- A/C control signal
- Transmission gear position signal
- EGR vacuum signal

ELECTRONIC CONTROL MODULE (Figure 3-3 or 3-4)

The Electronic Control Module (ECM) is located in the passenger compartment and is the control center of the Computer Command Control System.

The ECM constantly looks at the information from various sensors, and controls the systems that affect vehicle performance. The ECM performs the diagnostic function of the system. It can recognize operational problems, alert the driver through the "Service Engine Soon" light, and store a code or codes which identify the problem areas to aid the technician in making repairs. See Diagnosis section for more information.

The ECM is designed to process the various input information (Figure 3-1) and then sends the necessary electrical responses to control fuel delivery, spark timing and other emission control systems. The input information has an interrelation to more than one output, therefore, if the one input failed it could effect more than one system operations.

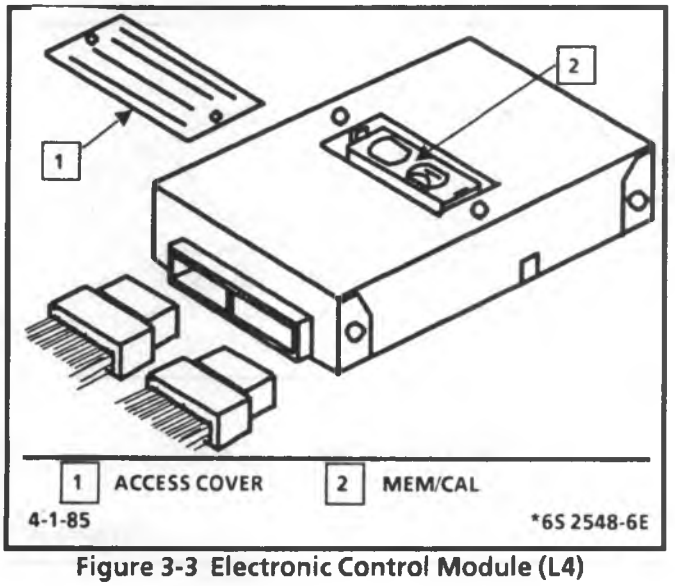

Figure 3-3 Electronic Control Module (L4)

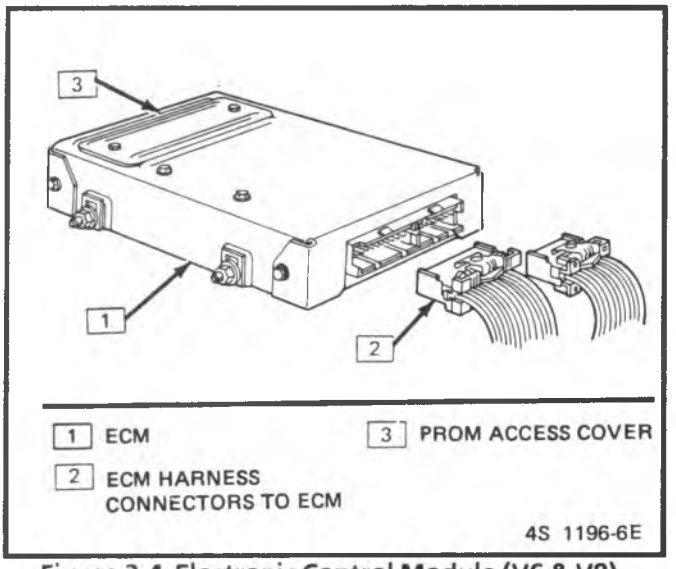

Figure 3-4 Electronic Control Module (V6 & V8)

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 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.

NOTICE: The ECM must be maintained at a temperature below 185°F (85°C) at all times. This most essential if the vehicle is put through a paint baking process. The ECM will become inoperative if its temperature exceeds 185°F (85°C). Therefore, it is recommended that temporary insulation be placed around the ECM during the time the vehicle is in a paint oven or other high temperature process.

There are two type of ECM's used in light duty trucks.

A vehicle equipped with a 4 cylinder engine has an ECM (referred to as GMP4) with two parts for service. A controller (an ECM without a MEM-CAL) and a MEM-CAL (Memory and Calibration unit).

All vehicles with a V6 or V8 cylinder engine have an ECM (referred to as GMCM) with three parts for service. A controller (an ECM without a PROM), a PROM with specific program information for an engine and vehicle and a CALPAK with specific calibration information.

MEM-CAL (L4) (Figure 3-3)

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

PROM (V6 & V8) (Figure 3-5)

Information for specific engine and vehicle is programmed using an integrated circuit called a PROM, (Programmable Read-Only Memory). In the parts book, it is listed as a calibrator. This allows one model of controller to be used for many different vehicles. The PROM is located inside the ECM and has information on the vehicle's weight, engine, transmission, axle ratio, and several others. While one ECM part number can be used by many vehicle lines, a PROM is very specific and must be used for the right vehicle. 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.

CALPAK (V6 & V8) (Figure 3-5)

A CALPAK is used to allow fuel delivery if other parts of the ECM are damaged. If the CALPAK is missing, it will result in a no start and run condition.

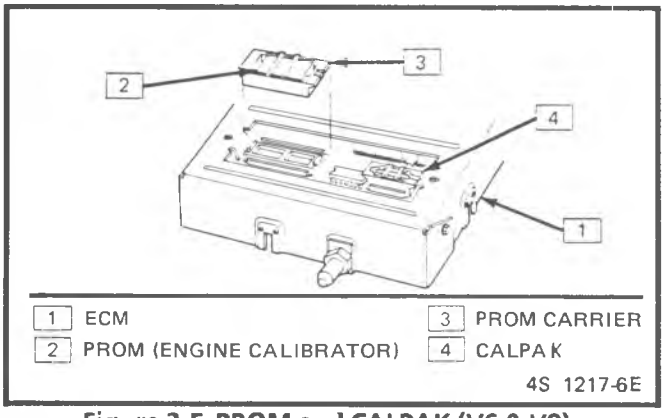

Figure 3-5 PROM and CALPAK (V6 & V8)

INPUT INFORMATION

Coolant Sensor (Figure 3-6)

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 (100,0000 ohms at -40°C/-40°F) while high temperature causes low resistance (70 ohms at 130°C/266°F).

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

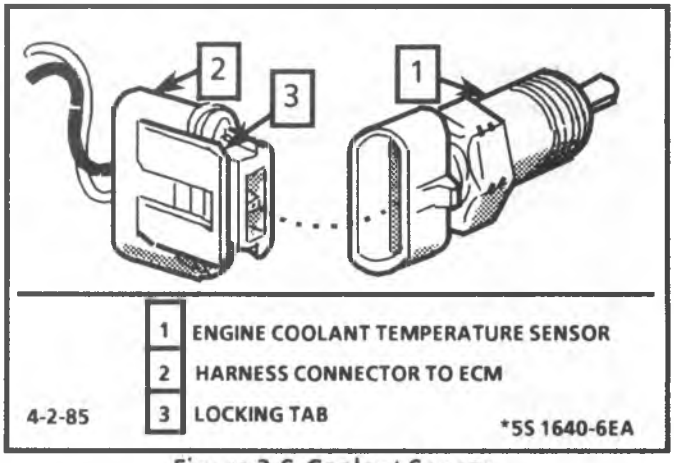

Figure 3-6 Coolant Sensor

MAP Sensor (Figure 3-7)

The Manifold Absolute Pressure (MAP) sensor 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 will produce a relatively low MAP output, while a wide-open throttle will produce a high output. This high output is produced because the pressure inside the manifold is the same as outside the manifold, so 100% of the outside air pressure is measured. The MAP sensor reading is the opposite of what you would measure on a vacuum gage. When manifold pressure is high, vacuum is low. The MAP sensor is also used to measure barometric pressure under certain conditions, which allows the ECM to automatically adjust for different altitudes.

The ECM sends a 5 volt reference signal to the MAP sensor. As the manifold pressure changes, the electrical resistance of the sensor also changes. By

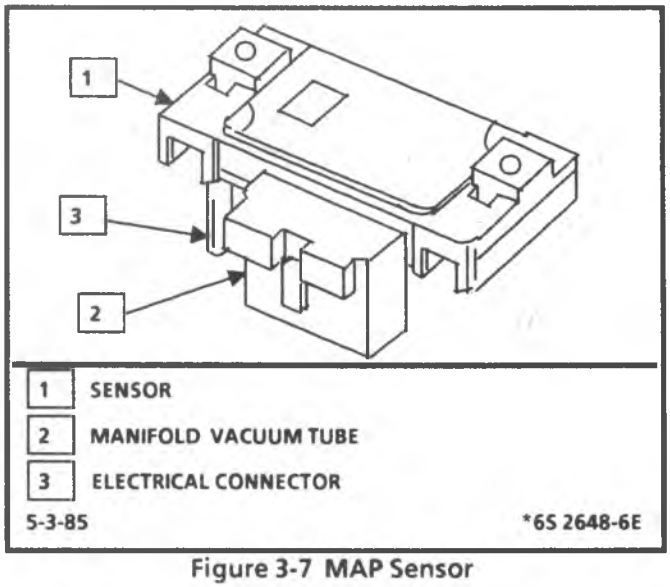

Figure 3-7 MAP Sensor

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.

The ECM uses the MAP sensor to control fuel delivery and ignition timing.

Oxygen (O_2) Sensor (Figure 3-8)

The exhaust oxygen (O_2) sensor is mounted in the exhaust system where it can monitor the oxygen content of the exhaust gas stream. The oxygen content in the exhaust reacts with the oxygen sensor to produce a voltage output. This voltage ranges from approximately .1 volts (high O_2 - lean mixture) to .9 volts (low O_2 - rich mixture).

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

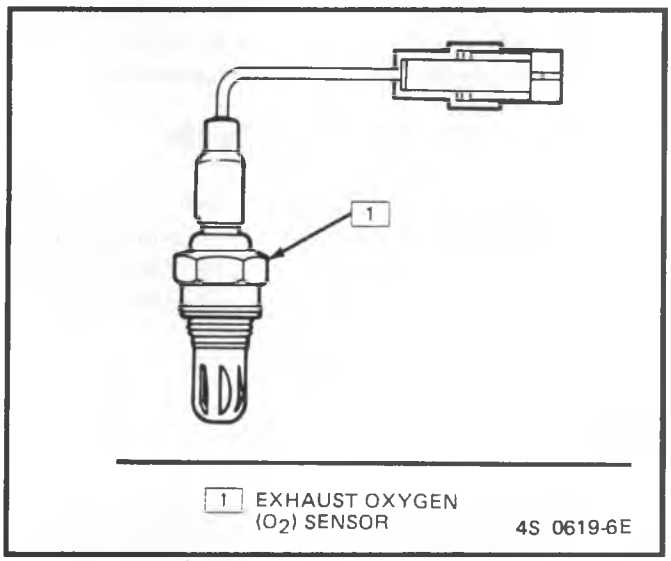

Figure 3-8 Oxygen Sensor

Throttle Position Sensor (Figure 3-9)

The Throttle Position Sensor (TPS) is connected to the throttle shaft on the TBI unit. It is a potentiometer with one end connected to 5 volts from the ECM and the other to ground. A third wire is connected to the ECM to measure the voltage from the TPS. As the throttle valve angle is changed (accelerator pedal moved), the output of the TPS also changes. At 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.

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

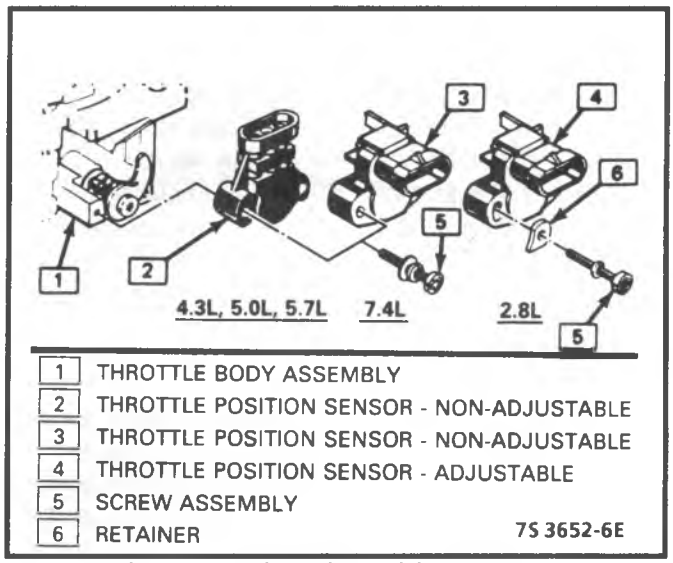

Figure 3-9 Throttle Position Sensor

Manifold Air Temperature (MAT) Sensor (Figure 3-10)

The Manifold Air Temperature (MAT) Sensor is a thermistor (a resistor which changes value based on temperature) mounted on a 2.5L engine in the manifold. Low temperature produces a high resistance (100,000 ohms at -40°C/-40°F) while high temperature causes low resistance (70 ohms at 130°C/266°F).

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

The MAT sensor signal is used by the ECM to delay EGR until the manifold air temperature reaches about 5°C (40°F).

The ECM uses the signal to slightly retard the timing during high ambient air temperatures.

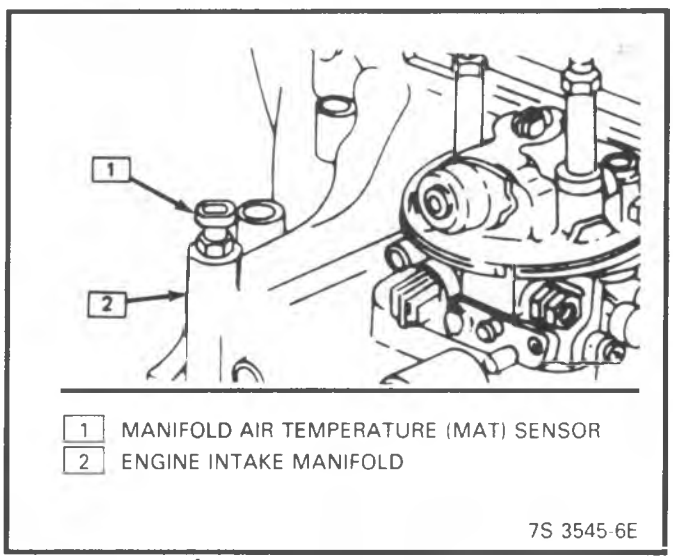

Figure 3-10 MAT Sensor

E-Cell - 2.8L (Federal Only)

The E-Cell located next to the ECM, is also known as an elapsed timer module or a cold start program modifier. The E-Cell is an emission device that is an enrichment signal to the ECM for about 4 seconds during cold start. After an elapsed time of operating hours, the signal is no longer required and becomes inoperative.

Vehicle Speed Sensor

The Vehicle Speed Sensor (VSS) located behind the speedometer 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, shift light, and cruise control.

Knock Sensor

Located in the engine block, it retards ignition timing during a spark knock condition to allow the ECM to maintain maximum timing advance under most conditions.

Park/Neutral Switch Signal

The Park/Neutral (P/N) switch, located on the steering column is used on an automatic transmission vehicle to indicate to the ECM when the transmission is in Park or Neutral. This information is used to control the operation of the transmission converter and idle air control.

Crank Signal

The ECM uses this signal to tell when the vehicle is in the STARTING mode.

Distributor Reference Signal

The distributor sends a signal to the ECM to indicate both engine RPM and crankshaft position. See Section 6 for further information.

Power Steering Pressure Switch Signal

Located near the power steering gear. When steering is to the extreme left or right, the switch is closed and this signal will increase the idle air rate and retard the spark for a stable idle.

A/C Control Signal

This signal indicates that the A/C control switch is turned "ON" and the pressure switch is closed. The ECM uses this signal to adjust the idle speed and on some systems engage the A/C compressor clutch.

Transmission Gear Position Signal

A switch, located inside the automatic transmission, opens when the transmission shifts to high gear. This signal is used for delayed disengagement of the transmission converter clutch.

DIAGNOSIS

The Computer Command Control System has a diagnostic system built into the ECM to indicate a failed circuit. An amber "Service Engine Soon" light on the instrument panel will illuminate if a problem has been detected when the engine and vehicle are running. This light is also used for a bulb and system check.

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. Refer to Section 13 for additional information about special tools.

Bulb Check

With the ignition "ON" and engine not running, the lamp should be illustrated which indicates that the ECM has completed the circuit to turn "ON" the light.

If the "Service Engine Soon" light is not "ON", refer to CHART A-1 for diagnosis.

When the engine is started, the light will turn "OFF". If the light remains "ON" refer to System Check.

SYSTEM CHECK (Figure 3-11)

The system check is performed through the twelve terminal Assembly Line Diagnostic Link (ALDL) connector (Figure 3-2) under the instrument panel in the passenger compartment. The following terminals are used:

A - This terminal provides a ground circuit to other terminals.

B - This terminal is the "diagnostic terminal" for the ECM. When grounded to "A" terminal, the "Service Engine Soon" light will flash codes (key "ON" and engine "OFF") entering the Diagnostic Mode or flashes a Field Service Mode (engine running) to determine if system is in a "Closed" or "Open" Loop operation.

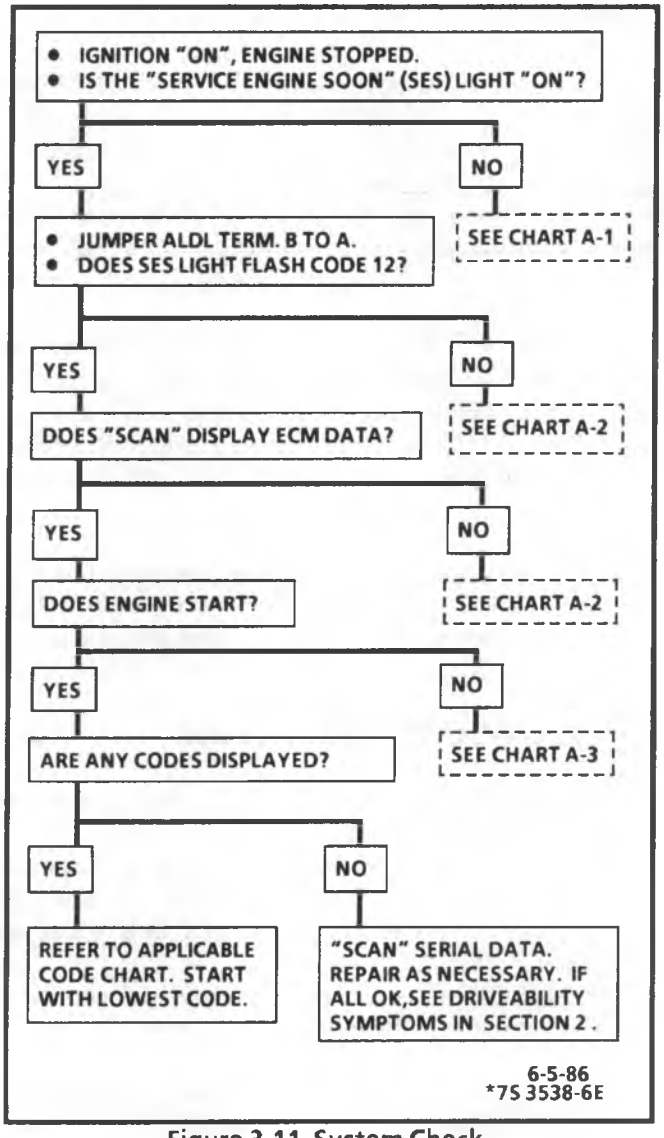

Figure 3-11 System Check

C - This terminal, on some air management systems is wired to the ground side of the electric air control valve. It can be used to diagnose the air management system. Refer to Section 8.

D - This terminal, on some systems, can be used to diagnose the "Service Engine Soon" light. Refer to CHART A-1.

E - This terminal is the serial data line on all engines except 2.5L and is used by a "Scan" tool to read various system data information.

F - This terminal is used to diagnose the TCC system and is wired to the ground side of the TCC Solenoid. Refer to Section 10.

G - This terminal is used to diagnose the fuel pump circuit on a 4.3L or V8 engine. On other engines the fuel pump test lead is in the engine compartment near the fuel pump relay. Refer to CHART A-5.

H - This terminal is used to diagnose the brake system on CK trucks. Refer to CK Light Duty Service Manual for additional information.

M - This terminal is the serial data line for the 2.5L engines and is used by the "Scan" tool to read various system data information.

With the key "ON" and the engine "OFF", jumper ALDL terminals "B" to "A". The "Service Engine Soon" light will flash Code 12 to indicate that the diagnostic system is working. Code 12 consists of "one flash" followed by a pause and then "two flashes". The code will repeat for a total of three times and will continue to repeat if there are no other codes stored.

If Code 12 does not display, refer to CHART A-2.

Engine Does Not Start

If the engine cranks but will not start, refer to CHART A-3 through A-5 to determine if it is a fuel or ignition problem.

"Scan" Tool

A "Scan" tool is designed to interface with the Computer Command Control System. It supplies a visual reading of most inputs to the ECM and some outputs. Review the tool instruction manual to understand its operation and limitations.

When the tool is connected to the ALDL and cigarette/cigar lighter connector or 12 volts, there should be a visual instruction displayed. If there is no display or tool reads "No DATA or No ALDL" with ignition "ON", refer to CHART A-2.

With the tool in the code position, the display window will indicate any code stored in the ECM memory (Figure 3-12). Referring to the applicable code chart, the tool will "Scan" an input to determine if a specific circuit is operating properly. If there are no codes, the System Check is completed. Additional information on "Scan" tools is in Section 13.

If there are additional driveability symptoms, refer to Section 2.

If there are additional codes, refer to applicable code chart.

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".

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.

Code System (Figure 3-12)

The ECM is equipped with a self-diagnosis system which detects system failure and aids the technician the circuit at fault via a code.

The 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 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 code in the memory. The 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.

An "intermittent" code is one which does not reset itself, and is not present while you are working on the vehicle. This is often caused by a loose connection. The facing page of a code chart 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 code number will lead you to the cause of the problem.

Clearing Codes

When the ECM sets a code, the "Service Engine Soon" light will come "ON" and a 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 code will stay in the ECM memory for 50 starts or until the battery voltage to the ECM is removed. Removing battery voltage for 30 seconds will clear all stored codes.

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 through 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.)

ELECTRONIC CONTROL MODULE

The diagnosis of the electronic control module (ECM) starts with the system check. The code system indicates a failure of a specific circuit and diagnosis may indicate replacement of the ECM. A Code 55 indicates that the ECM has failed and must be replaced.

If the ECM has been replaced and the condition was not corrected, the following information may be the cause:

- An incorrect ECM or PROM / MEM-CAL application may cause a malfunction and may or may not set a code.
- If the connector at the ECM is the possible problem, the terminal may have to be removed from the connectors in order to properly check them.
- Although the PROM / MEM-CAL rarely fails, it operates as part of the ECM, therefore, it could be the cause of the problem.
- Although a rare condition, the replacement ECM may be faulty.
- In the case of an intermittent problem, refer to Section 2 and make a careful physical inspection of the system involved.
- A shorted solenoid, relay coil or harness may cause an ECM to fail and a replacement ECM to fail when it is installed. Use a short tester J34636, BT 8405, or equivalent as a fast, accurate means of checking for a short circuit.

PROM

A PROM that has failed or was installed improperly will generally set a Code 51.

MEM-CAL

A MEM-CAL that has failed or was installed improperly will set a Code 51.

CALPAK

A no start and run condition will result if the CALPAK is not installed in the ECM. A CALPAK that is removed will set a Code 52.

FUEL PUMP CIRCUIT

Code 54 indicates a failure in the fuel pump circuit.

Two types of fuel pump relays are used on light duty trucks. The S,T and M series use one type and C, K, R, V, G and P series use the other type. Both relays have the same function, but terminals arrangement is different. Both relays have a terminal to test the fuel pump operation. this is either a separate terminal located near the relay or along the ECM harness or at terminal "G" in the ALDL connector. By applying voltage at this terminal, it can be determined if the fuel pump will operate. This terminal will also prime the fuel line to the TBI unit.

FUEL MODULE

A fuel module is used on all 7.4L and some 5.7L engines to correct a hot restart (vapor lock) during a high ambient condition. It is designed to override the ECM 2 second pump operation and will run the fuel pump for 20 seconds at initial ignition "ON".

An inoperative fuel module may be the cause of a hot stall/no start condition. Check for power and ground circuit to the fuel module and a complete circuit to the pump from terminal "A". If OK and the pump does not run for the specified 20 seconds at initial ignition "ON", replace the Fuel Module.

COOLANT SENSOR

Code 14 or Code 15 indicates a failures in the coolant sensor circuit.

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

MAP SENSOR

Code 33 or Code 34 indicates a failure in the MAP sensor circuit. Also refer to MAP output check diagnosis to check the MAP sensor if there is no code.

OXYGEN SENSOR

Code 13 indicates an open in the oxygen sensor circuit. Code 44 indicates a shorted oxygen sensor circuit. Code 45 indicates a high voltage in the oxygen sensor circuit. If a code is set, the engine will always run in the "Open Loop" mode. The oxygen sensor voltage output can be measured with a digital voltmeter having at least a 10 meg ohms input impedance. Use of a standard shop type voltmeter will result in an inaccurate reading.

Normal "Scan" voltage varies between 100 mv to 999 mv (.1 and 1.0 volt) while in "Closed Loop". Code 13 sets in one minute if voltage remains between .35 and .55 volts, but the system will go "Open Loop" in about 15 seconds.

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 Code 44 or Code 45 may have been set. If the condition for Code 44 exists, the block learn values will be around 150. If the condition for Code 45 exists, the block learn values will be around 115.

THROTTLE POSITION SENSOR

Code 21 indicates that there is a shorted TPS circuit. Code 22 indicates that there is an open in the TPS circuit. When a code is set, the ECM will use an artificial value for throttle position and some engine performance will return.

A broken TPS can cause intermittent bursts of fuel from the injector(s) and an unstable idle because the ECM thinks the throttle is moving.

A "Scan" tool reads throttle position in volts. Should read about .763 volts (2.5L), .45 volts (2.8L), .60 volts (4.3L & V8) ± .75 volts with throttle closed and ignition "ON" or at idle. voltage should increase at a steady rate as throttle is moved toward WOT.

"Scan" TPS while depressing accelerator pedal with engine stopped and ignition "ON". display should vary from below 2.5 volts (2500 mv) when throttle was closed, to over 4.5 volts (4500 mv) when throttle is held at wide open throttle position.

VEHICLE SPEED SENSOR

The vehicle speed sensor circuit diagnosis is in Code 24 chart.

"Scan" reading should closely match with speedometer reading, with drive wheels turning.

MAT SENSOR

Code 23 indicates that there is an open in the MAT circuit. Code 25 indicates that there is a short to ground in the MAT circuit.

A "Scan" tool reads temperature of the air entering the engine and should read close to ambient air temperature when engine is cold, and rises as underhood temperature increases.

EGR SYSTEM

Code 32 indicates that there is a failure in the EGR system circuit.

IDLE SPEED

Code 35 sets when there is an idle speed error on a 2.5L engine. Refer to diagnosis in Section 4 for idle air control valve check for other engines.

- 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 (.3 volts). Check for low regulated fuel pressure or water in fuel. a lean exhaust with an oxygen sensor output fixed above 800 mv (.8 volts) 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 (.8 volts).

ELECTRONIC SPARK TIMING

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

When the rpm for EST is reached (about 400 rpm), and by-pass voltage applied, the EST should no longer be grounded in the ignition module so the EST voltage should be varying.

If the by-pass line is open or grounded, the Ignition Module will not switch to EST mode so the EST voltage will be low and Code 42 will be set.

If the EST line is grounded, the Ignition Module will switch to EST, but because the line is grounded there will be no EST signal. A Code 42 will be set.

Code 42 sets if there is an open or a short to ground in the EST or by-pass circuit.

ELECTRONIC SPARK CONTROL

Code 43 sets if there is an open or short to ground in the ESC circuit.

If the conditions for a Code 43 are present, the "Scan" will always display "yes". There should not be a knock at idle unless an internal engine problem, or a system problem exists.

PARK/NEUTRAL SWITCH

Diagnosis of the park/neutral switch is on page 3-70 of this section.

CRANK SIGNAL

The crank signal diagnosis procedure is at the end of this section. If there is no crank signal to the ECM, the engine may be hard to start.

POWER STEERING PRESSURE SWITCH

The diagnosis of the power steering pressure switch is covered on page 3-72 of this section.

DISTRIBUTOR REFERENCE SIGNAL

The distributor reference signal is covered in Section 6 of the ignition system and electronic spark control.

A/C CLUTCH CONTROL

The diagnosis of the A/C clutch control on a 2.5L engine is covered on page 3-76 of this section.

A/C "ON" SIGNAL

The diagnosis of the A/C "ON" signal on all engines other than 2.5L is covered on page 3-80 of this section.

EXHAUST SYSTEM

Refer to Figure 3-13 for diagnosis of a restricted exhaust system.

CODE IDENTIFICATION

The "Service Engine Soon" light will only be "ON" if the malfunction exists under the conditions listed below. If the malfunction clears, the light will go out and the code will be stored in the ECM. Any codes stored will be erased if no problem reoccurs within 50 engine starts.

CODE AND CIRCUIT	PROBABLE CAUSE
Code 13 - O_2 Sensor Open Oxygen Sensor Circuit	Indicates that the oxygen sensor circuit or sensor was open for one minute while off idle.
Code 14 - Coolant Sensor High Temperature Indication	Sets if the sensor or signal line becomes grounded for 3 seconds.
Code 15 - Coolant Sensor Low Temperature Indication	Sets if the sensor, connections, or wires open for 3 seconds.
Code 21 - TPS Signal Voltage High	TPS voltage greater than 2.5 volts for 3 seconds with less than 1200 rpm.
Code 22 - TPS Signal Voltage Low	A shorted to ground or open signal circuit will set code in 3 seconds.
Code 23 - MAT Low Temperature Indication	Sets if the sensor, connections, or wires open for 3 seconds.
Code 24 - VSS No Vehicle Speed Indication	No vehicle speed present during a road load decel.
Code 25 - MAT High Temperature Indication	Sets if the sensor or signal line becomes grounded for 3 seconds.
Code 32 - EGR	Vacuum switch shorted to ground on start up OR Switch not closed after the ECM has commanded EGR for a specified period of time. OR EGR solenoid circuit open for a specified period of time.
Code 33 - MAP Sensor Low Vacuum	MAP sensor output to high for 5 seconds or an Open signal circuit.
Code 34 - MAP Sensor High Vacuum	Low or no output from sensor with engine running.
Code 35 - IAC	IAC error
Code 42 - EST	ECM has seen an open or grounded EST or Bypass circuit.
Code 43 - ESC	Signal to the ECM has remained low for too long or the system has failed a functional check.
Code 44 Lean Exhaust Indication	Sets if oxygen sensor voltage remains below .2 volts for about 20 seconds.
Code 45 Rich Exhaust Indication	Sets if oxygen sensor voltage remains above .7 volts for about 1 minute.
Code 51	Faulty MEM-CAL, Prom, or ECM.
Code 52	Fuel CALPAK missing or faulty.
Code 54 - Fuel Pump Low voltage	Sets when the fuel pump voltage is less than 2 volts when reference pulses are being received.
Code 55	Faulty ECM

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Figure 3 - 12 - ECM Code System

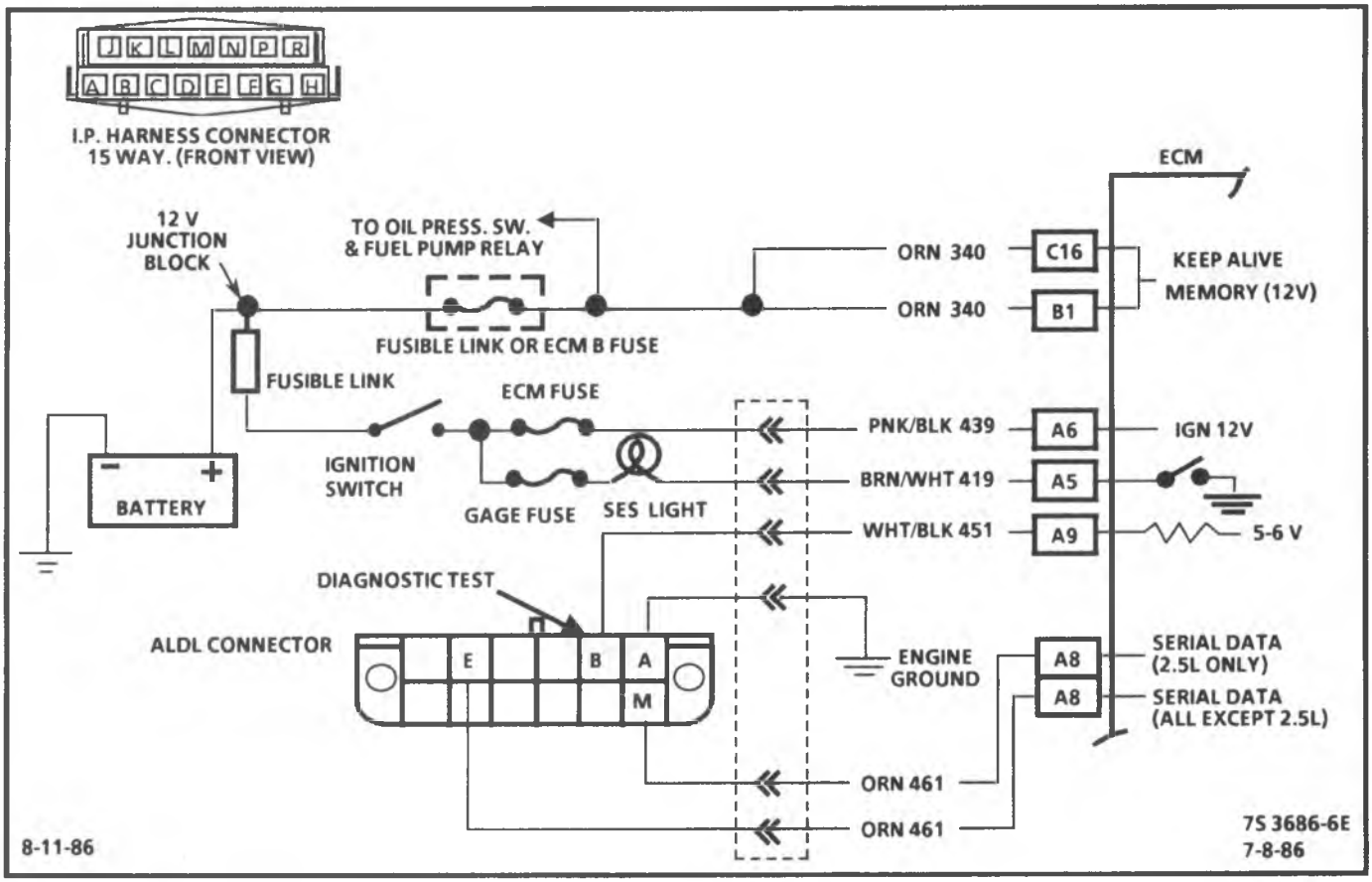


CHART A-1

NO "SERVICE ENGINE SOON" LIGHT ALL ENGINES

Circuit Description:

There should always be a steady "Service Engine Soon" light when the ignition is "ON" and engine stopped. Battery ignition voltage is supplied 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. If the fuse in holder is blown, refer to facing page of Code 54 for complete circuit.
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:

If the engine runs ok, check:

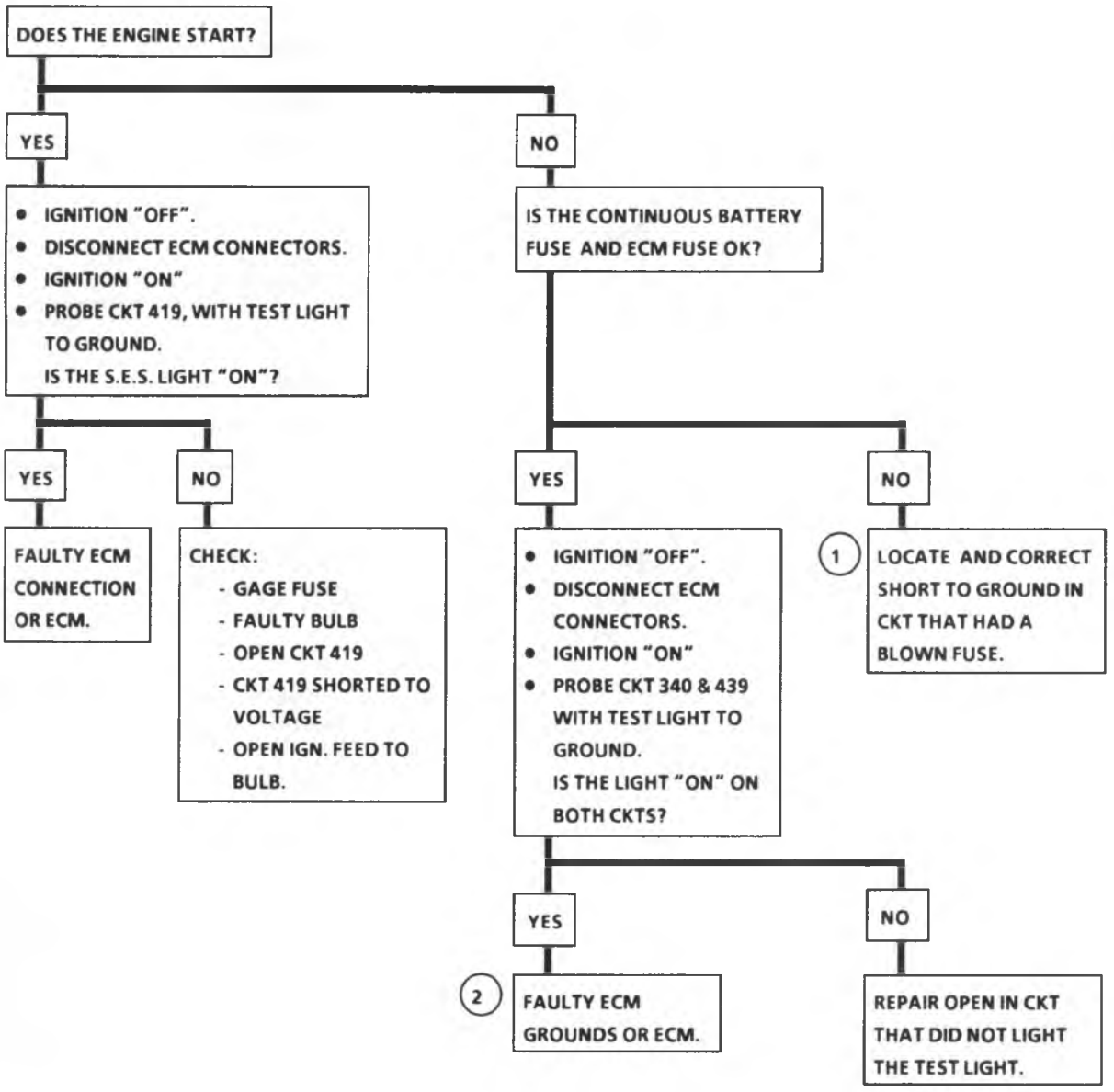
- Faulty light bulb.
- CKT 419 open.
- Gage fuse blown. This will result in no stop lights, oil or generator lights, seat belt reminder, etc.

If the engine cranks but will not run, check:

- Continuous battery-fuse or fusible link open.
- ECM ignition fuse open.
- Battery CKT 340 to ECM open.
- Ignition CKT 439 to ECM open.
- Poor connection to ECM.

CHART A-1

NO "SERVICE ENGINE SOON" LIGHT ALL ENGINES



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

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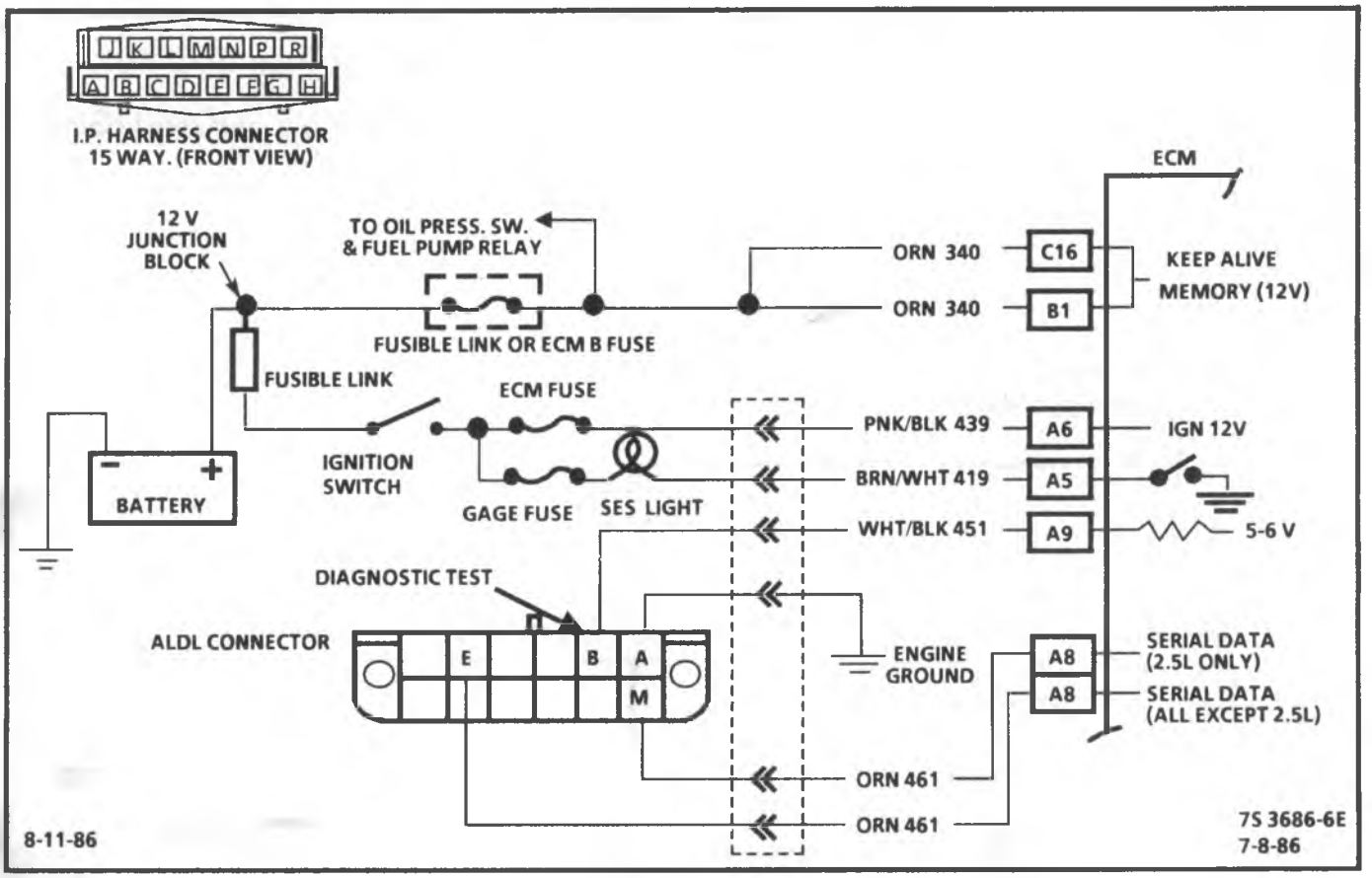


CHART A-2

NO ALDL DATA OR WON'T FLASH CODE 12 "SERVICE ENGINE SOON" LIGHT ON STEADY ALL ENGINES

Circuit Description:

There should always be a steady "Service Engine Soon" light when the ignition is "ON" and engine stopped. Battery ignition voltage is supplied 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.

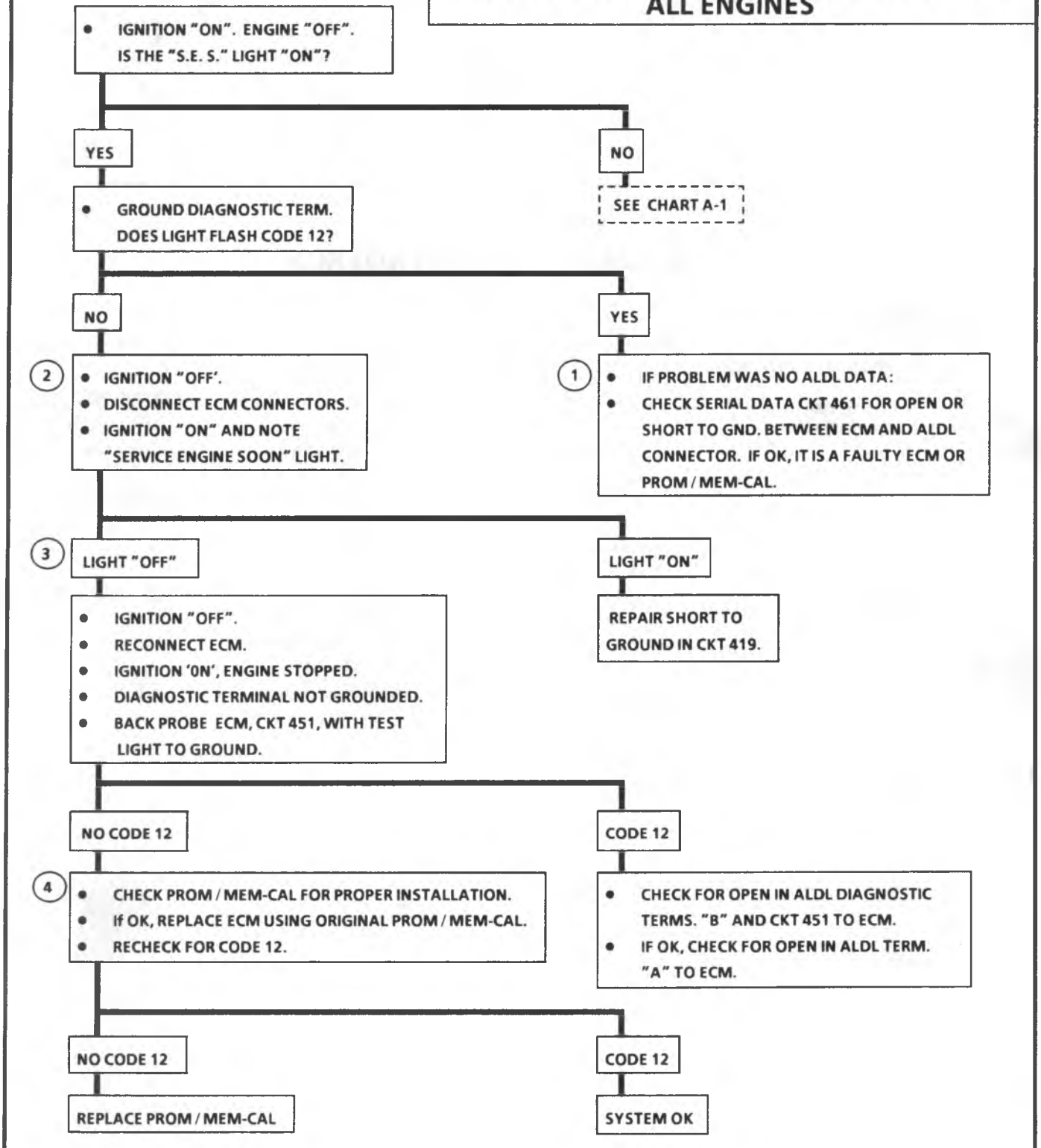
A steady light suggests a short to ground in the light control CKT 419, or an open in diagnostic CKT 451.

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 461 is OK, the PROM/Mem-Cal 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/Mem-Cal. If Code 12 does not flash, the ECM should be replaced using the original PROM/Mem-Cal. Replace the PROM/Mem-Cal only after trying an ECM, as a defective PROM/Mem-Cal is an unlikely cause of the problem.

CHART A-2

NO ALDL DATA OR WON'T FLASH CODE 12 "SERVICE ENGINE SOON" LIGHT ON STEADY ALL ENGINES



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

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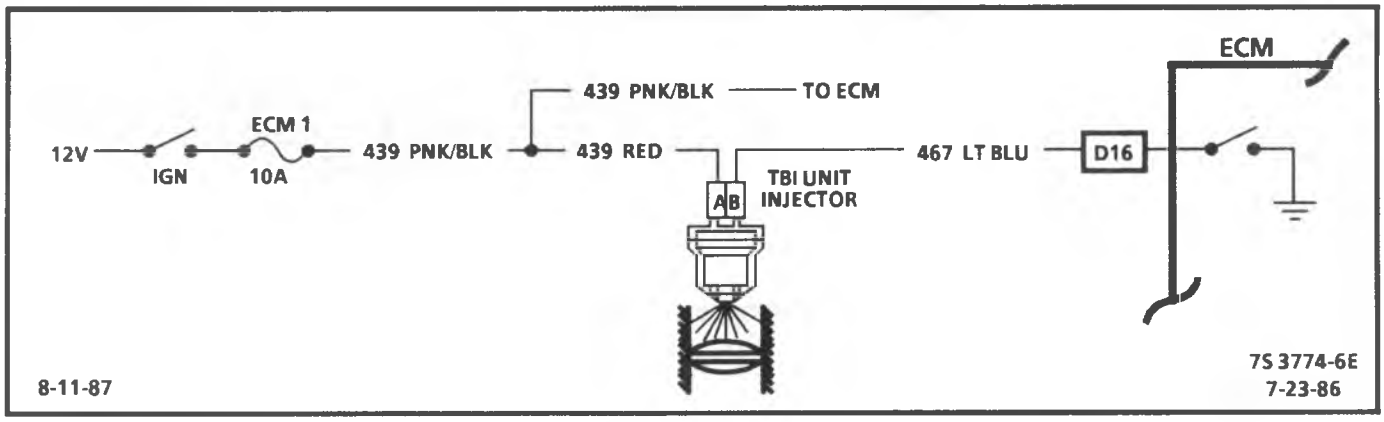


CHART A-3

ENGINE CRANKS BUT WILL NOT RUN
2.5L ENGINE

Circuit Description:

This chart assumes that battery condition and engine cranking speed are OK, and there is adequate fuel in the tank. This chart should be used on engines using the Model 700 throttle body.

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

1. A "Service Engine Soon" light "ON" is a basic test to determine if there is a 12 volt supply and ignition 12 volts to ECM. No ALDL may be due to an ECM problem and CHART A-2 will diagnose the ECM. If TPS is over 2.5 volts the engine may be in the clear flood mode which will cause starting problems. If coolant sensor is below -30°C, the ECM will provide fuel for this extremely cold temperature which will severely flood the engine.
2. Voltage at the spark plug is checked using Spark Tester tool ST125 (J26792) or equivalent. No spark indicates a basic ignition problem.
3. While cranking engine there should be no fuel spray with injector disconnected. Replace an injector if it sprays fuel or drips like a leaking water faucet.
4. Use an injector test light like J34730, BT8329A or equivalent, to test injector circuit. A blinking light indicates the ECM is controlling the injector.
5. This test will determine if there is fuel pressure at the injector and that the injector is operating.

Diagnostic Aids:

If no trouble is found in the ECM, fuel pump and ignition systems, check for:

- Fouled spark plugs
- EGR valve stuck open
- Low fuel pressure. See CHART A-6.

CHART A-3

ENGINE CRANKS BUT WILL NOT RUN 2.5L ENGINE

IF CODE 54 IS STORED, USE THAT CHART FIRST

1. • IGN "ON" - IF S.E.S. LIGHT IS OFF, SEE CHART A-1.
   • INSTALL "SCAN" TOOL - IF "NO ALDL", SEE CHART A-2.
   • CHECK THE FOLLOWING:
   • TPS - IF OVER 2.5V AT CLOSED THROTTLE, SEE CODE 22.
   • COOLANT - IF BELOW -30°C, SEE CODE 15.
   • APPLY 12V TO FUEL PUMP TEST TERMINAL AND LISTEN FOR PUMP TO RUN. DOES IT?

YES

- PROBE FUEL PUMP TEST TERMINAL WITH A TEST LIGHT TO 12V.
- TEST LIGHT WILL LIGHT.
- IGN "OFF" FOR 10 SECONDS.
- IGN "ON". TEST LIGHT SHOULD GO OUT FOR 2 SEC. DOES IT?

YES

2. • CRANK ENGINE AND CHECK FOR SPARK WITH ST-125.
   • CHECK ONE WIRE. LEAVE THE OTHER WIRES CONNECTED TO THE SPARK PLUGS DURING CRANKING.
   IS THERE SPARK?

YES

3. • DISCONNECT INJECTOR CONNECTOR.
   • CRANK ENGINE.
   IS THERE FUEL SPRAY FROM INJECTOR?

NO

4. • CONNECT INJECTOR TEST LIGHT TO HARNESS CONNECTOR.
   • CRANK ENGINE.
   DOES TEST LIGHT BLINK?

YES

5. • RECONNECT INJECTOR CONNECTOR.
   • CRANK ENGINE.
   IS THERE FUEL SPRAY FROM INJECTOR?

YES

NO TROUBLE FOUND.
SEE DIAGNOSTIC AIDS ON FACING PAGE.

NO

- IGN "OFF:
- INSTALL FUEL PRESSURE GAGE AS OUTLINED IN SECTION 4.
- IGN "ON".
- FUEL PRESSURE SHOULD BE 62-90 KPa (9-13 psi)
  IS IT?

YES

FAULTY INJECTOR

NO

SEE FUEL SYSTEM DIAGNOSIS CHART A-6

NO

SEE INJECTOR CIRCUIT DIAGNOSIS CHART A-4

YES

FAULTY INJECTOR SEAL OR INJECTOR

NO

SEE IGNITION SYSTEM CHECK IN SECTION 6

NO

SEE FUEL PUMP RELAY CIRCUIT CHART A-5

7S 3775
7-23-86

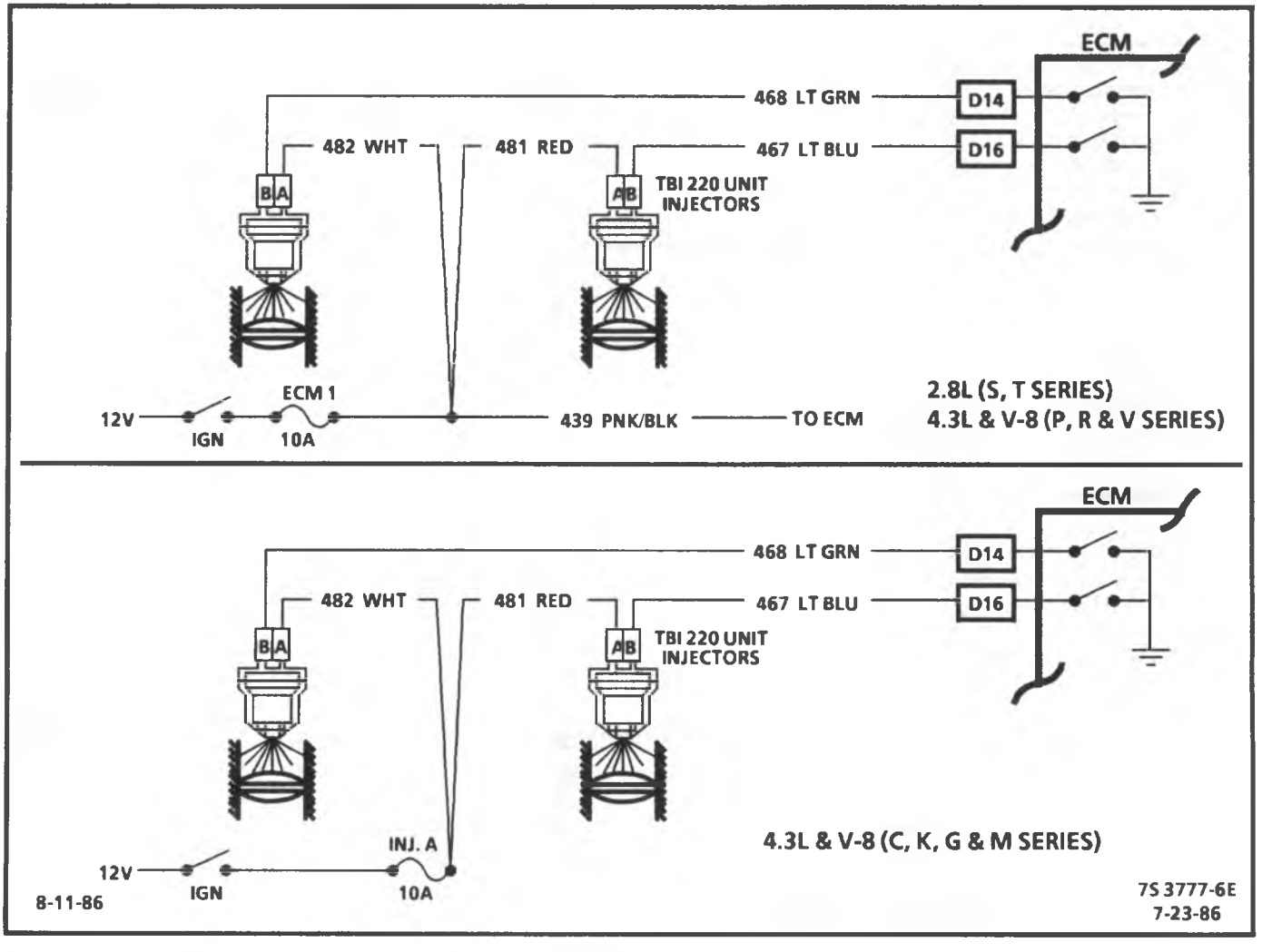


CHART A-3

ENGINE CRANKS BUT WILL NOT RUN
ALL ENGINES EXCEPT 2.5L

Circuit Description:

This chart assumes that battery condition and engine cranking speed are OK, and there is adequate fuel in the tank. This chart should be used on engines using the Model 220 throttle body.

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

1. A "Service Engine Soon" light "ON" is a basic test to determine if there is a 12 volt supply and ignition 12 volts to ECM. No ALDL may be due to an ECM problem and CHART A-2 will diagnose the ECM. If TPS is over 2.5 volts the engine may be in the clear flood mode which will cause starting problems. If coolant sensor is below -30°C, the ECM will provide fuel for this extremely cold temperature which will severely flood the engine.
2. Voltage at the spark plug is checked using Spark Tester tool ST125 (J26792) or equivalent. No spark indicates a basic ignition problem.
3. While cranking engine there should be no fuel spray with injectors disconnected. Replace an injector if it sprays fuel or drips like a leaking water faucet.
4. Use an injector test light like BT8320, or equivalent, to test each injector circuit. A blinking light indicates the ECM is controlling the injectors.
5. This test will determine if there is fuel pressure at the injectors and that the injectors are operating.

Diagnostic Aids:

If no trouble is found in the ECM, fuel pump and ignition systems, check for:

- Fouled spark plugs
- EGR valve stuck open
- Low fuel pressure. See CHART A-6.

CHART A-3

ENGINE CRANKS BUT WILL NOT RUN ALL ENGINES EXCEPT 2.5L

IF CODE 54 IS STORED, USE THAT CHART FIRST

(1)
- IGN "ON" - IF S.E.S. LIGHT IS OFF, SEE CHART A-1.
- INSTALL "SCAN" TOOL - IF "NO ALDL", SEE CHART A-2.
- CHECK THE FOLLOWING:
  - TPS - IF OVER 2.5V AT CLOSED THROTTLE, SEE CODE 22.
  - COOLANT - IF BELOW -30°C, SEE CODE 15.
- APPLY 12V TO FUEL PUMP TEST TERMINAL AND LISTEN FOR PUMP TO RUN. DOES IT?

YES

- PROBE FUEL PUMP TEST TERMINAL WITH A TEST LIGHT TO 12V.
- TEST LIGHT WILL LIGHT.
- IGN "OFF" FOR 10 SECONDS.
- IGN "ON". TEST LIGHT SHOULD GO OUT FOR 2* SEC. DOES IT?

NO

SEE FUEL PUMP RELAY CIRCUIT CHART A-5

YES

(2)
- CRANK ENGINE AND CHECK FOR SPARK WITH ST-125.
- CHECK ONE WIRE. LEAVE THE OTHER WIRES CONNECTED TO THE SPARK PLUGS DURING CRANKING. IS THERE SPARK?

NO

SEE IGNITION SYSTEM CHECK IN SECTION 6

YES

(3)
- DISCONNECT INJECTOR CONNECTORS.
- CRANK ENGINE. IS THERE FUEL SPRAY FROM ONE OR BOTH INJECTORS?

NO

YES

FAULTY INJECTOR SEAL OR INJECTOR

(4)
- CONNECT INJECTOR TEST LIGHT TO ONE HARNESS CONNECTOR.
- CRANK ENGINE.
- REPEAT TEST ON OTHER CONNECTOR DOES TEST LIGHT BLINK ON BOTH TESTS?

YES

NO

SEE INJECTOR CIRCUIT DIAGNOSIS CHART A-4

(5)
- RECONNECT INJECTOR CONNECTORS.
- CRANK ENGINE. IS THERE FUEL SPRAY FROM INJECTORS?

YES

NO TROUBLE FOUND. SEE DIAGNOSTIC AIDS ON FACING PAGE.

ONE ONLY

FAULTY INJECTOR

NO

- IGN "OFF:.
- INSTALL FUEL PRESSURE GAGE AS OUTLINED IN SECTION 4.
- IGN "ON".
- FUEL PRESSURE SHOULD BE 62-90 KPa (9-13 psi) IS IT?

YES

FAULTY INJECTORS

NO

SEE FUEL SYSTEM DIAGNOSIS CHART A-6

* ON SOME VEHICLES THE PUMP WILL RUN FOR APPROXIMATELY 20 SECONDS.

7S 3778
7-23-86

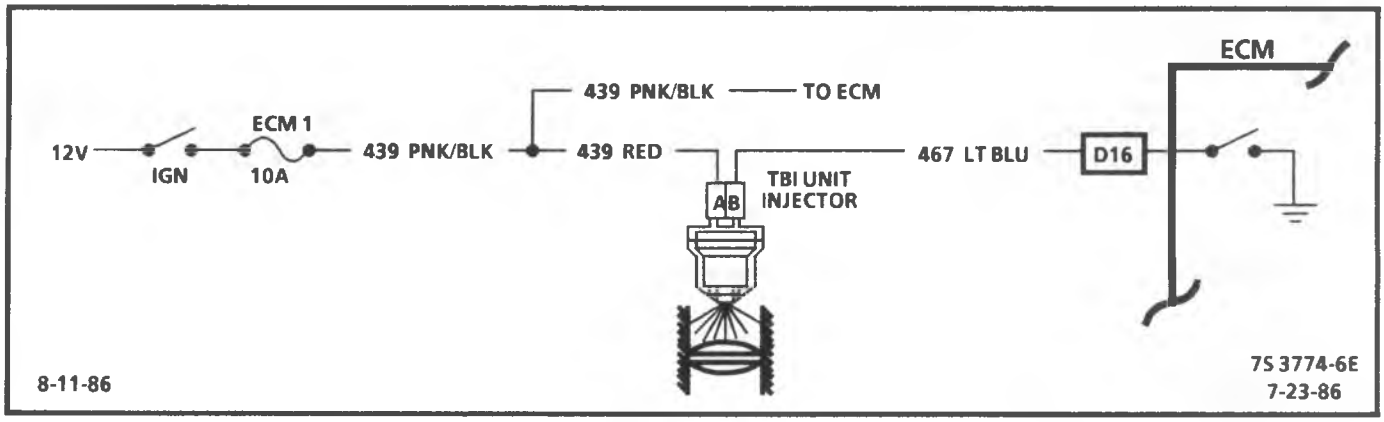


CHART A-4

INJECTOR CIRCUIT DIAGNOSIS
2.5L ENGINE

Circuit Description:

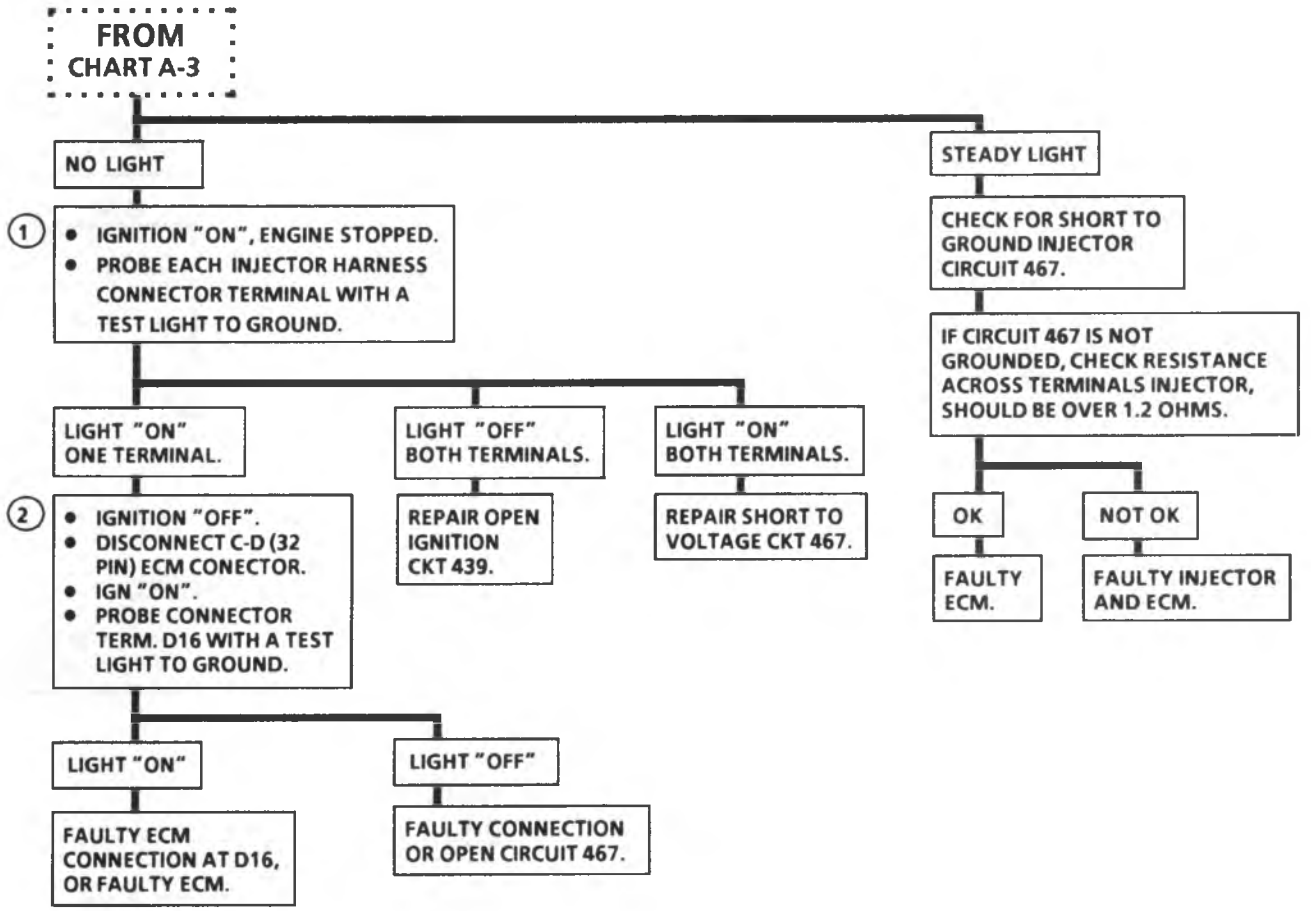
This chart should only be used if diagnosis in CHART A-3 indicated an injector circuit problem.

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

1. This step tests for 12 volts to the injector. It will also determine if there is a short to voltage on the ECM side of the circuit.
2. This test checks for continuity to the ECM.

CHART A-4

INJECTOR CIRCUIT DIAGNOSIS 2.5L ENGINE



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

* 75 3776
7-25-86

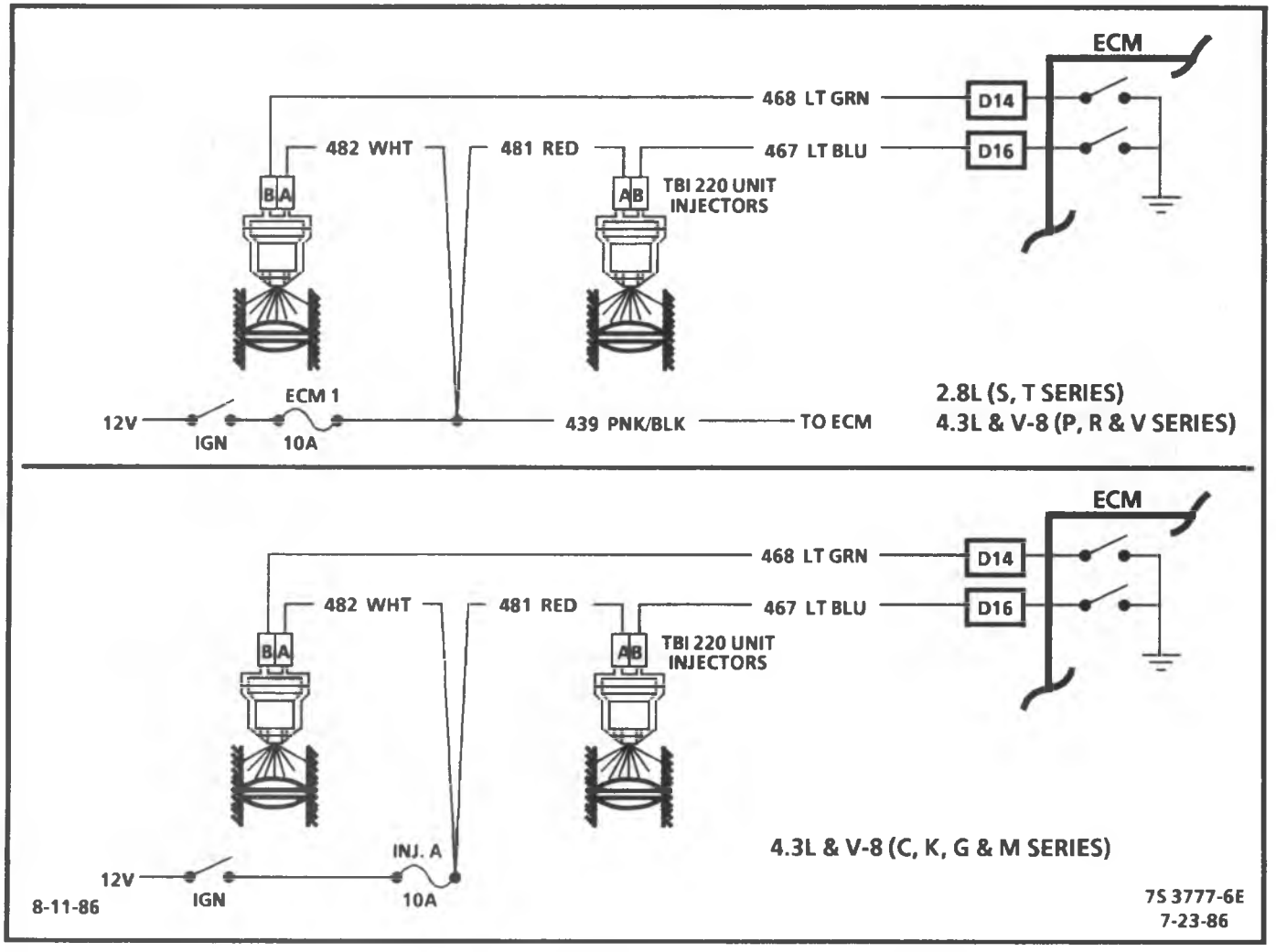


CHART A-4

INJECTOR CIRCUIT DIAGNOSIS ALL ENGINES EXCEPT 2.5L

Circuit Description:

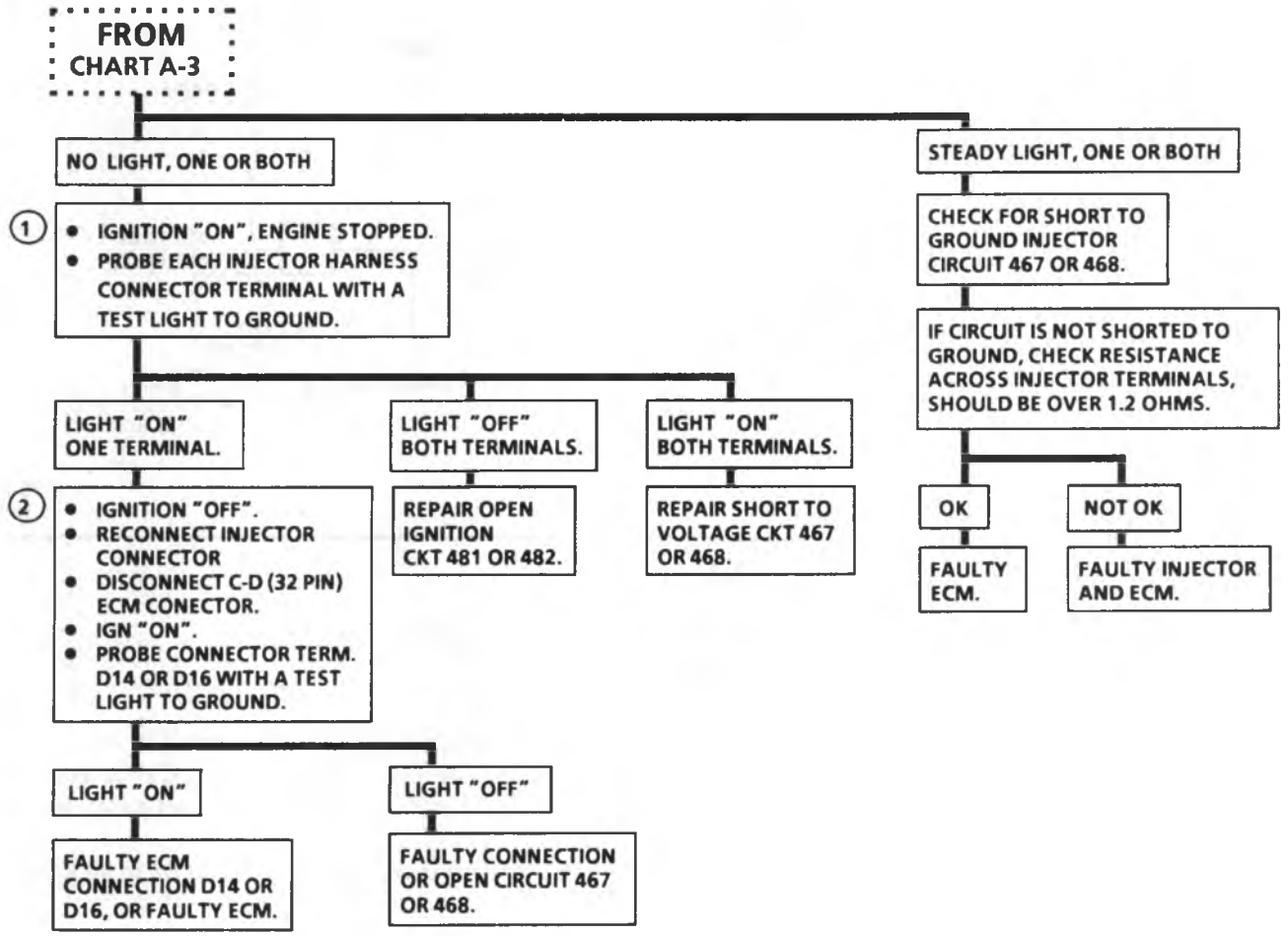
This chart should ony be used if diagnosis in CHART A-3 indicated an injector circuit problem. If both injector circuits fail to blink when tested, diagnose one injector circuit at a time.

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

1. This step tests for 12 volts to the injector. It will also determine if there is a short to voltage on the ECM side of the circuit.
2. This test checks for continuity to the ECM.

CHART A-4

INJECTOR CIRCUIT DIAGNOSIS ALL ENGINES EXCEPT 2.5L



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

* 7S 3779
7-25-86

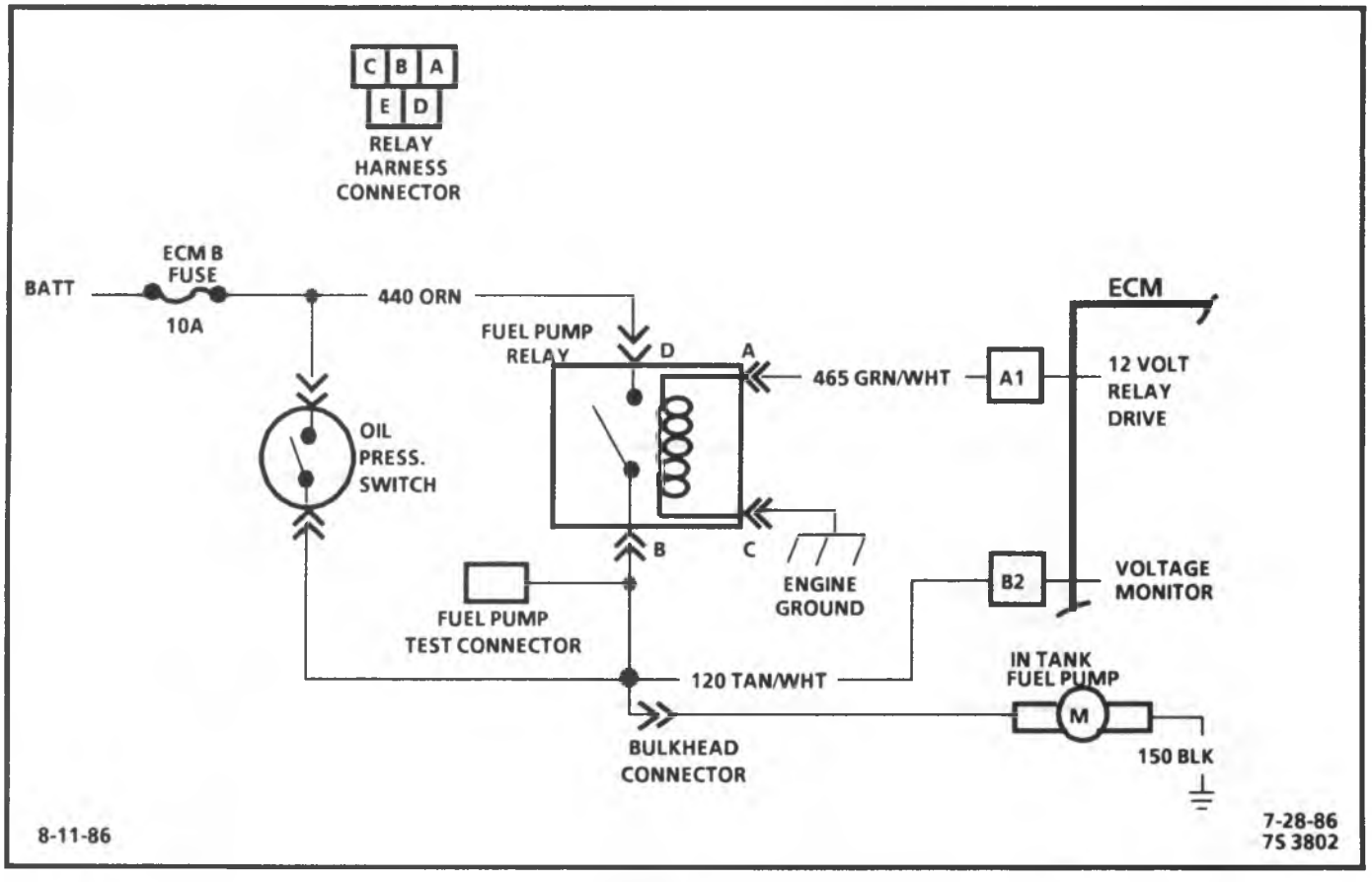


CHART A-5

FUEL PUMP RELAY CIRCUIT
S, T & M SERIES

Circuit Description:

When the ignition switch is turned "ON", the Electronic Control Module (ECM) will turn "ON" the in-tank fuel pump. It will remain "ON" as long as the engine is cranking or running, and the ECM is receiving distributor reference pulses. If there are no reference pulses, the ECM will shut "OFF" the fuel pump within 2 seconds after ignition "ON" or engine stops.

The pump will deliver fuel to the TBI unit where the system pressure is controlled to about 62 to 90 kPa (9 to 13 psi). Excess fuel is then returned to the fuel tank.

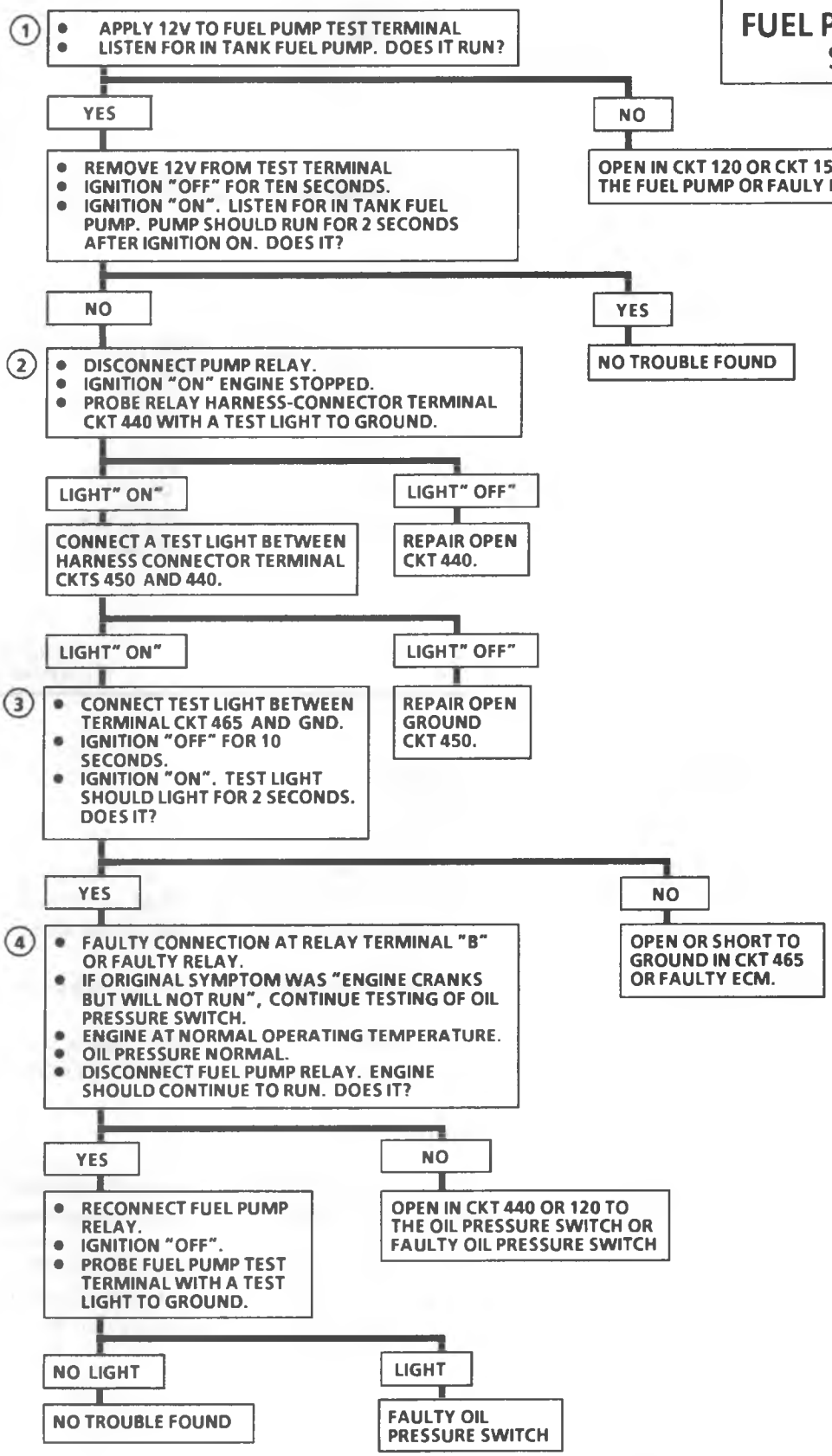
Test Description: Step numbers refer to step numbers on diagnostic chart.

1. Turns "ON" the fuel pump if CKT 120 wiring is OK. If the pump runs, it maybe a fuel pump relay circuit problem, which the following steps will locate.
2. The next two steps check for power and ground circuits to the relay.
3. Determines if ECM can control the relay.
4. The oil pressure switch serves as a backup for the fuel pump relay to help prevent a no start situation. If the fuel pump relay was found to be inoperative, the oil pressure switch circuit should also be tested to determine why it did not operate the fuel pump.

CHART A-5

FUEL PUMP RELAY CIRCUIT S, T & M SERIES

THIS CHART ASSUMES NO CODE 54 STORED



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

7S 3803
7-28-86

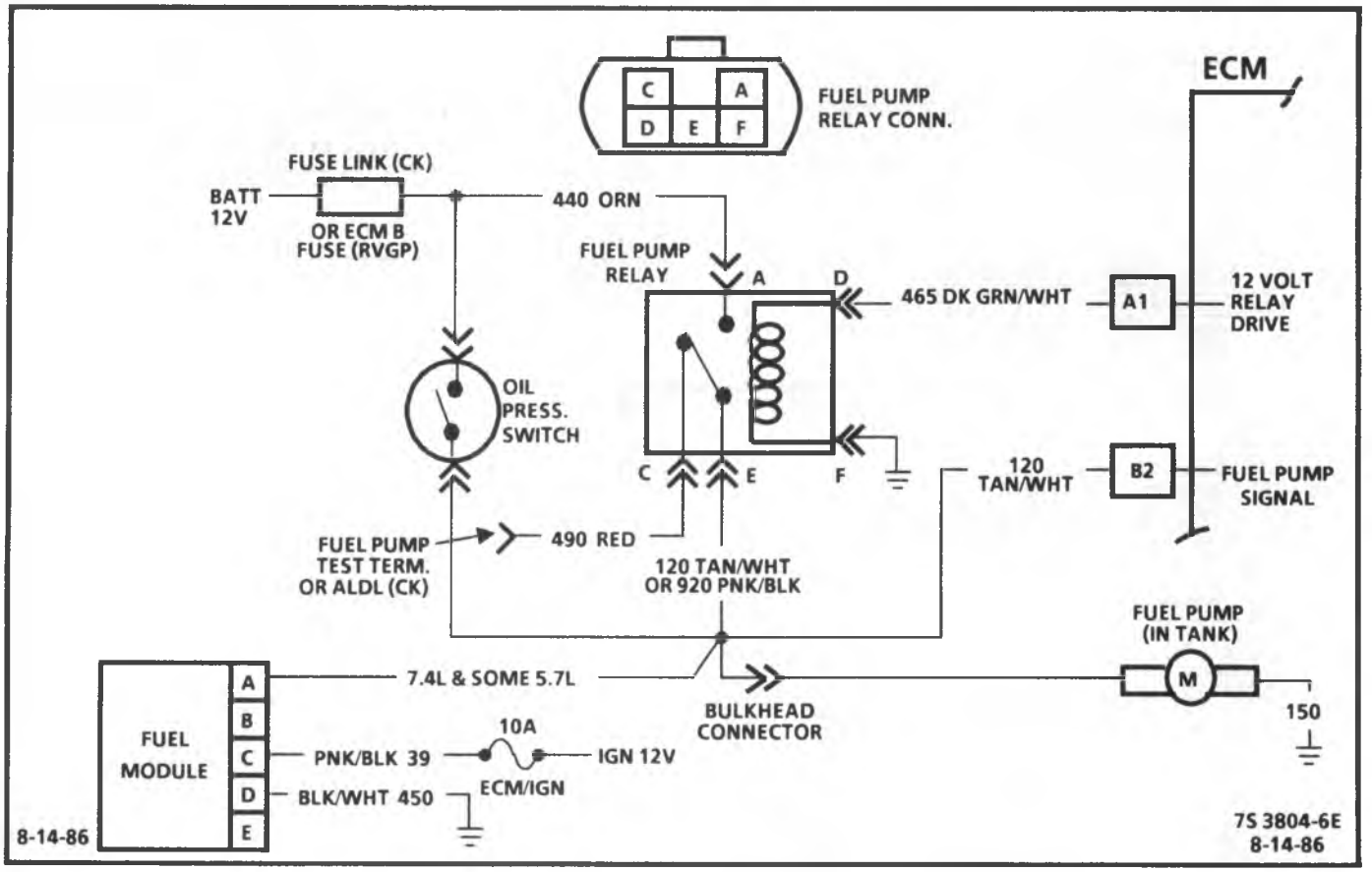


CHART A-5

FUEL PUMP RELAY CIRCUIT
C, K, R, V, G & P SERIES

Circuit Description:

When the ignition switch is turned "ON", the Electronic Control Module (ECM) will turn "ON" the in-tank fuel pump. It will remain "ON" as long as the engine is cranking or running, and the ECM is receiving distributor reference pulses. If there are no reference pulses, the ECM will shut "OFF" the fuel pump within 2 seconds after ignition "ON" or engine stops.

The pump will deliver fuel to the TBI unit where the system pressure is controlled to about 62 to 90 kPa (9 to 13 psi). Excess fuel is then returned to the fuel tank.

A fuel module is used on all 7.4L and some 5.7L engines to correct a hot restart (vapor lock) during a high ambient condition. It is designed to over-ride the ECM 2 second pump operation and will run the fuel pump for 20 seconds at initial ignition "ON".

Test Description:

Step numbers refer to step numbers on diagnostic chart.

1. Turns "ON" the fuel pump if CKT 120 wiring is OK. If the pump runs, it maybe a fuel pump relay circuit problem, which the following steps will locate.
2. The next two steps check for power and ground circuits to the relay.
3. Determines if ECM can control the relay.
4. The oil pressure switch serves as a backup for the fuel pump relay to help prevent a no start situation. If the fuel pump relay was found to be inoperative, the oil pressure switch circuit should also be tested to determine why it did not operate the fuel pump.

Diagnostic Aids:

- An inoperative fuel module may be the cause of a hot stall/no start condition. Check for power and ground circuit to the fuel module and a complete circuit to the pump from terminal "A". If OK, and the pump does not run for the specified 20 seconds at initial ignition "ON", replace the Fuel Module.

CHART A-5

FUEL PUMP RELAY CIRCUIT C, K, R, V, G & P SERIES

THIS CHART ASSUMES NO CODE 54 STORED

1. • APPLY 12V TO FUEL PUMP TEST TERMINAL
   • LISTEN FOR IN TANK FUEL PUMP. DOES IT RUN?
   - NO → OPEN IN CKT 120 OR CKT 150 TO THE FUEL PUMP OR FAULY PUMP.
   - YES →
     • REMOVE 12V FROM TEST TERMINAL
     • IGNITION "OFF" FOR TEN SECONDS.
     • IGNITION "ON". LISTEN FOR IN TANK FUEL PUMP. PUMP SHOULD RUN FOR 2 * SECONDS AFTER IGNITION ON. DOES IT?
     - YES → NO TROUBLE FOUND
     - NO →
2. • DISCONNECT PUMP RELAY.
   • IGNITION "ON" ENGINE STOPPED.
   • PROBE RELAY HARNESS-CONNECTOR TERMINAL CKT 440 WITH A TEST LIGHT TO GROUND.
   - LIGHT" OFF" → REPAIR OPEN CKT 440.
   - LIGHT" ON" → CONNECT A TEST LIGHT BETWEEN HARNESS CONNECTOR TERMINAL CKTS 450 AND 440.
3. • CONNECT TEST LIGHT BETWEEN TERMINAL CKT 465 AND GND.
   • IGNITION "OFF" FOR 10 SECONDS.
   • IGNITION "ON". TEST LIGHT SHOULD LIGHT FOR 2 * SECONDS. DOES IT?
   - LIGHT" OFF" → REPAIR OPEN GROUND CKT 450.
   - LIGHT" ON" →
4. • FAULTY CONNECTION AT RELAY TERMINAL "B" OR FAULTY RELAY.
   • IF ORIGINAL SYMPTOM WAS "ENGINE CRANKS BUT WILL NOT RUN", CONTINUE TESTING OF OIL PRESSURE SWITCH.
   • ENGINE AT NORMAL OPERATING TEMPERATURE.
   • OIL PRESSURE NORMAL.
   • DISCONNECT FUEL PUMP RELAY. ENGINE SHOULD CONTINUE TO RUN. DOES IT?
   - NO → OPEN OR SHORT TO GROUND IN CKT 465 OR FAULTY ECM.
   - YES →
     • RECONNECT FUEL PUMP RELAY.
     • IGNITION "OFF".
     • PROBE FUEL PUMP TEST TERMINAL WITH A TEST LIGHT TO GROUND.
     - LIGHT → FAULTY OIL PRESSURE SWITCH
     - NO LIGHT → NO TROUBLE FOUND
   - NO → OPEN IN CKT 440 OR 120 TO THE OIL PRESSURE SWITCH OR FAULTY OIL PRESSURE SWITCH

* ON SOME VEHICLES THE PUMP WILL RUN FOR APPROXIMATELY 20 SECONDS. ON THESE VEHICLES, DISCONNECT FUEL MODULE BEFORE USING THIS CHART.

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

7S 3805
7-29-86

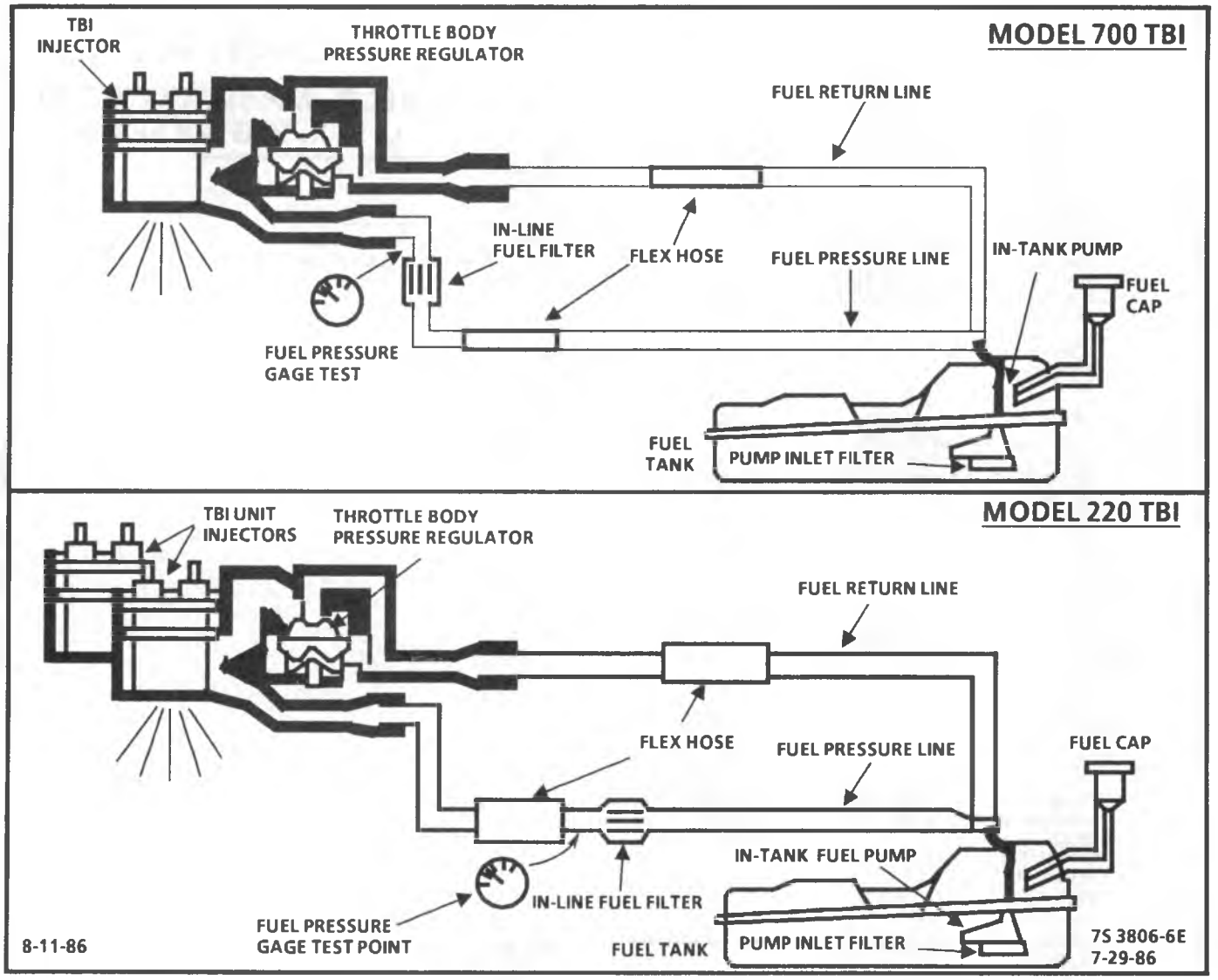


CHART A-6

FUEL SYSTEM PRESSURE TEST ALL ENGINES

Circuit Description:

When the fuel pump is running, fuel is delivered to the injector(s) and then to the regulator where the system pressure is controlled to about 62 to 90 kPa (9 to 13 psi). Excess fuel is then returned to the fuel tank.

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

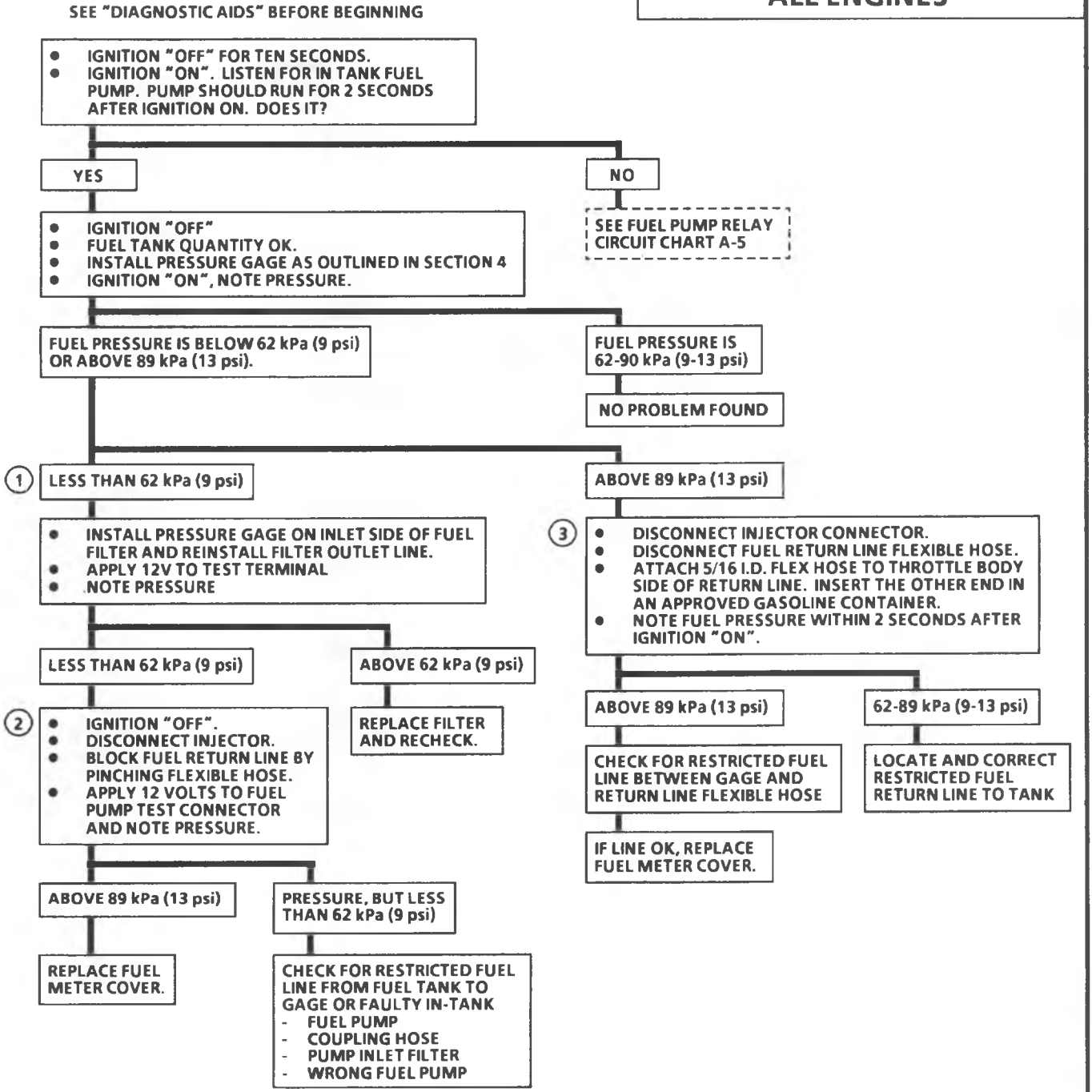
1. Pressure but less than 62 kPa (9 psi) falls into two areas:
   - Regulated pressure but less than 62 kPa (9 psi) - Amount of fuel to injector OK but pressure is too low. System will be lean running and may set Code 44. Also, hard starting cold and poor overall performance.
   - Restricted flow causing pressure drop - Normally, a vehicle with a fuel pressure of less than 62 kPa (9 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.
2. 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 connector, pressure should be from 90 to 124 kPa (13 to 18 psi).
3. This test determines if the high fuel pressure is due to a restricted fuel return line or a throttle body pressure regulator problem.

Diagnostic Aids:

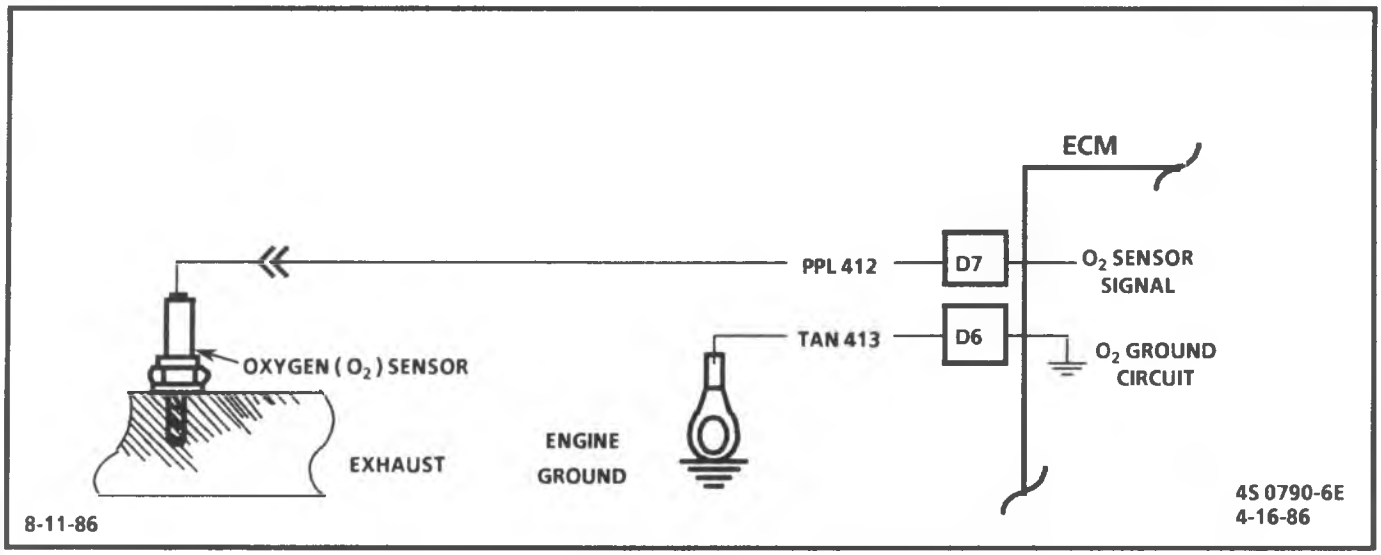
- If the vehicle is equipped with a fuel module, the module must be disconnected before performing the fuel system pressure test. Refer to Section 4.
- Fuel system is under pressure. To avoid fuel spillage, refer to procedures in Section 4 for testing or making repairs requiring disassembly of fuel lines or fittings.

CHART A-6

FUEL SYSTEM PRESSURE TEST ALL ENGINES



7S 3807
7-29-86



CODE 13

OPEN OXYGEN SENSOR CIRCUIT ALL ENGINES

Circuit Description:

The ECM supplies a voltage of about .45 volt between terminals "D7" and "E15".(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 volt if exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below 315° 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
   - At least 2 minutes engine time after start.
   - Oxygen sensor signal voltage steady between .35 and .55 volts .
   - Throttle position sensor signal above 4%.
   - 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 is at fault or the wiring or ECM is the cause of 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:

Normal "Scan" voltage varies between 100 mv to 999 mv (.1 and 1.0 volt) while in closed loop. Code 13 sets in one minute if voltage remains between .35 and .55 volts, but the system will go "Open Loop" in about 15 seconds. Refer to ECM "Intermittents" in Section 2.

"SCAN" DIAGNOSTICS

CODE 13

OPEN OXYGEN SENSOR CIRCUIT ALL ENGINES

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

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

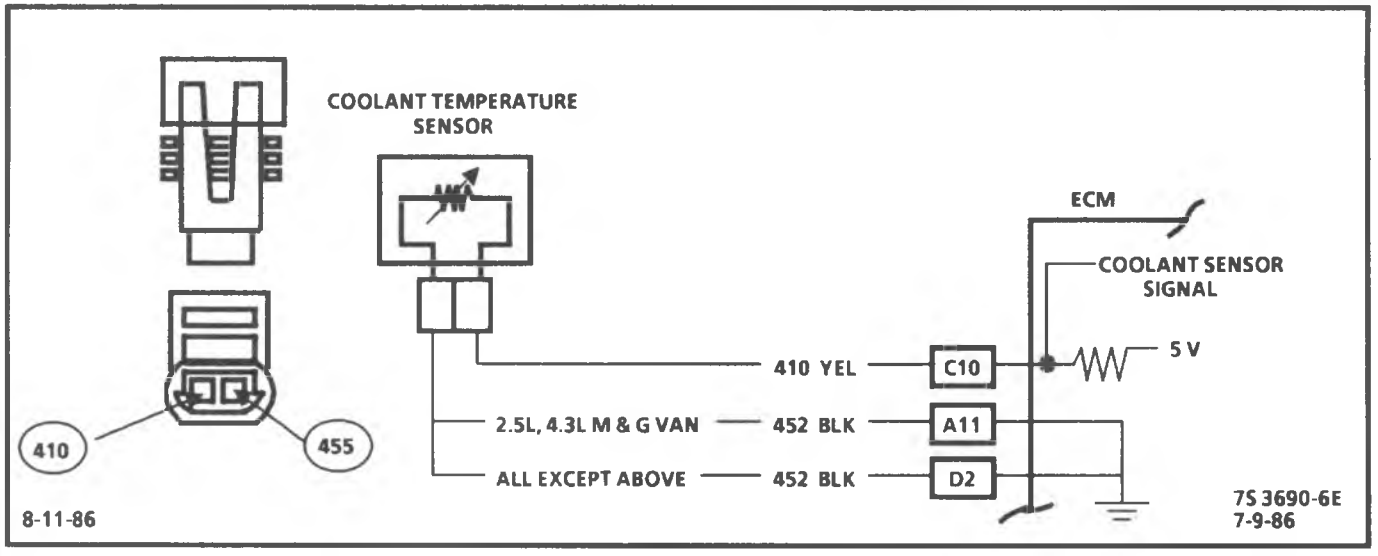
2. • DISCONNECT O_2 SENSOR
   • JUMPER HARNESS CIRCUIT 412 TO GROUND
   • "SCAN" SHOULD DISPLAY O_2 BELOW .2 VOLT (200 MV) WITH ENGINE RUNNING. DOES IT?

- YES → FAULTY O^2 SENSOR CONNECTION OR SENSOR.
- NO →

3. • IGNITION "ON", ENGINE "OFF".
   • CHECK VOLTAGE OF CKT 412 AT O_2 SENSOR HARNESS CONNECTOR USING A DVOM. IT SHOULD BE .3-.6V (300 - 600MV).

- .3-.6 VOLTS (300 - 600 MV) → FAULTY ECM
- OVER .6 VOLT (600 MV) → OPEN CKT. 413, FAULTY CONNECTION OR FAULTY ECM.
- LESS THAN .3 VOLT (300 MV) → OPEN CKT. 412, FAULTY ECM CONNECTION OR ECM.

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



CODE 14

COOLANT TEMPERATURE SENSOR
(HIGH TEMPERATURE INDICATED)
ALL ENGINES

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 130°C (266°F) for 3 seconds.
2. This test will determine if CKT 410 is shorted to ground which will cause the conditions for Code 14.

Diagnostic Aids:

Check harness routing for a potential short to ground in CKT 410.

"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.

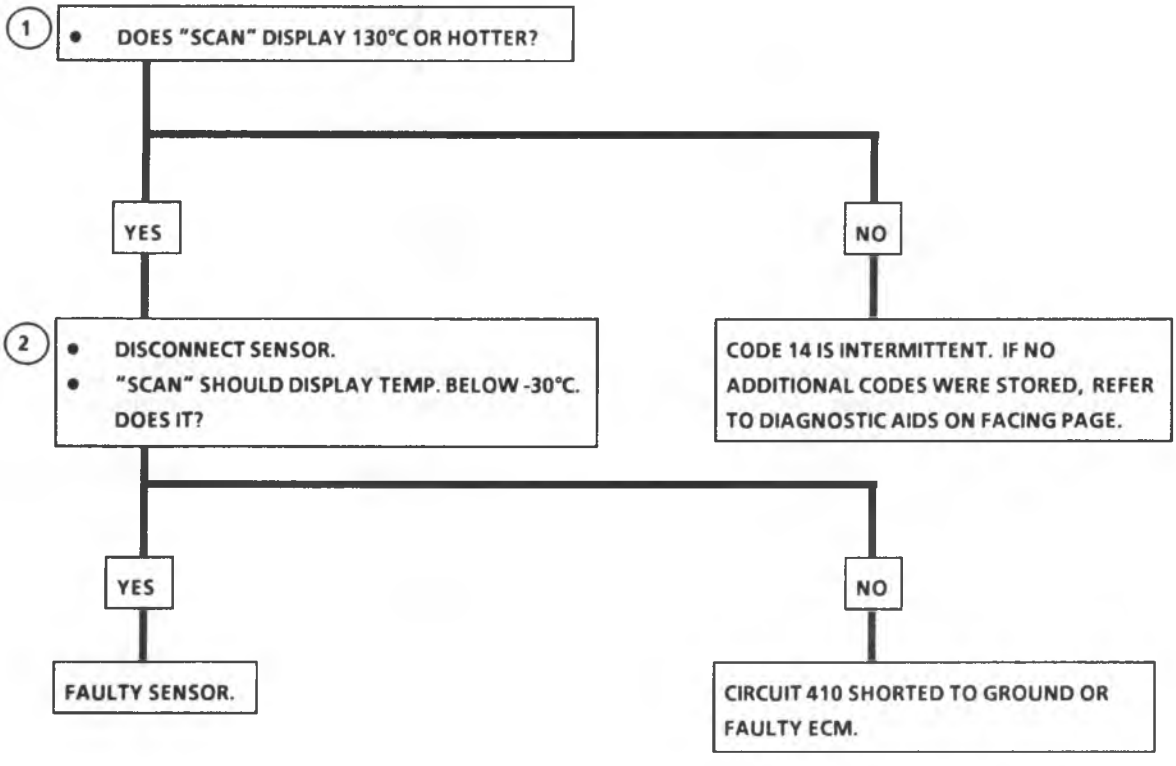
See "ECM Intermittent Codes or Performance" in Section 2.

The "Temperature to Resistance Value" scale at the right may be used to test the coolant sensor at various temperature levels to evaluate the possibility of a "slewed" (mis-scaled) sensor. A "slewed" sensor could result in poor driveability complaints.

"*SCAN*" DIAGNOSTICS

CODE 14

COOLANT TEMPERATURE SENSOR
(HIGH TEMPERATURE INDICATED)
ALL ENGINES

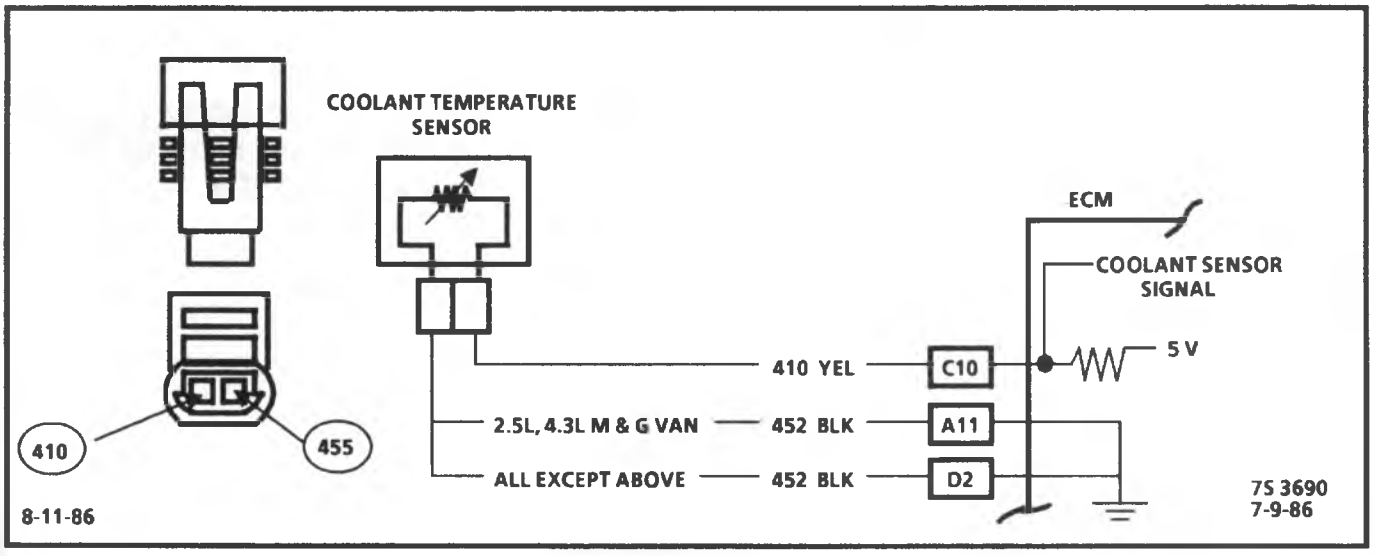


DIAGNOSTIC AID

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.

3-5-86
*7S 3055



CODE 15

COOLANT TEMPERATURE SENSOR (LOW TEMPERATURE INDICATED) ALL ENGINES

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 15 will set if:
   - Signal voltage indicates a coolant temperature less than -44°C (-47°F) for 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 or above, 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.

A faulty connection, or an open in CKT 410 or 452 will results in a Code 15.

See "ECM Intermittent Codes on Performance" in Section 2.

The "Temperature To Resistance Value" scale at the right may be used to test the coolant sensor at various temperature levels to evaluate the possibility of a "slewed" (mis-scaled) sensor. A "slewed" sensor could result in poor driveability complaints.

"SCAN" DIAGNOSTICS

CODE 15

COOLANT SENSOR CIRCUIT (LOW TEMPERATURE INDICATED) ALL ENGINES

1. • DOES "SCAN" DISPLAY COOLANT -30°C OR COLDER?

YES

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.

NO

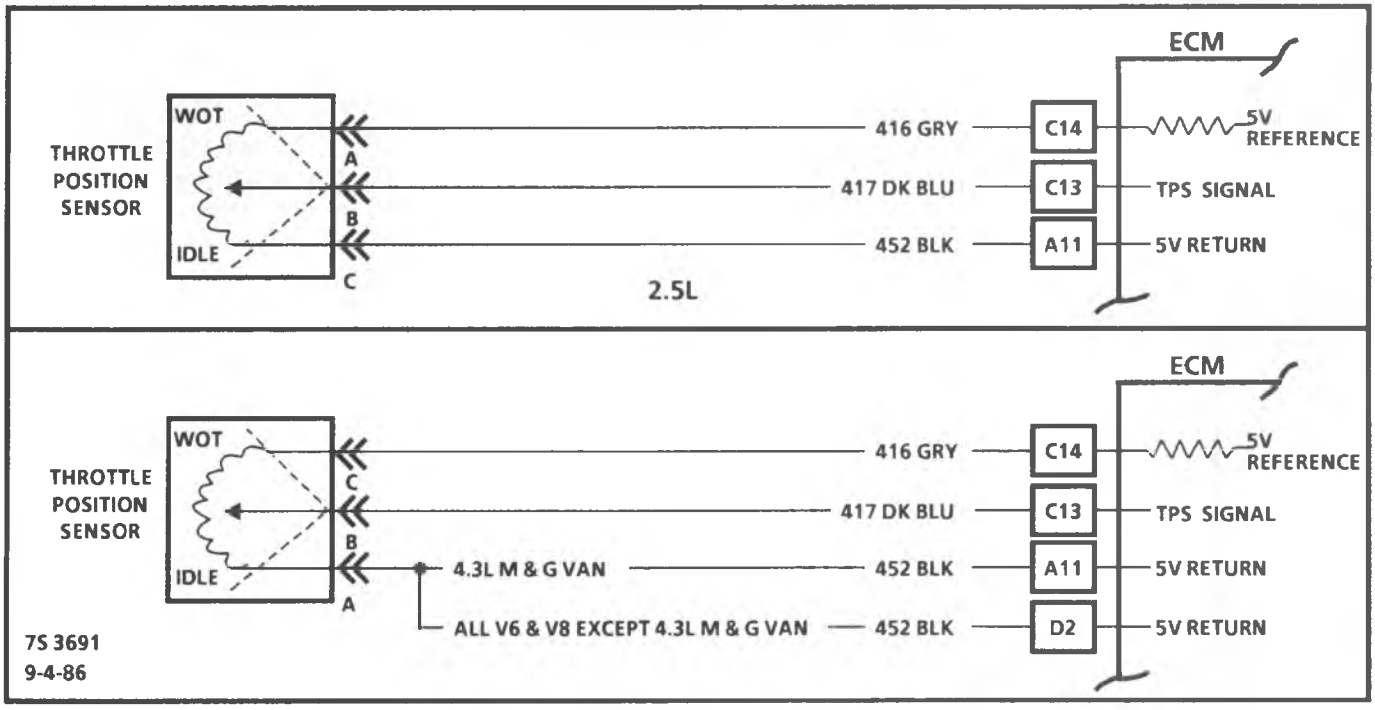
CODE 15 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO DIAGNOSTIC AIDS ON FACING PAGE.

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.

3-19-86
*7S 3261



CODE 21

THROTTLE POSITION SENSOR
(SIGNAL VOLTAGE HIGH)
ALL ENGINES

Circuit Description:

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

Test Description:

Step numbers refer to step numbers on diagnostic chart.

1. Code 21, will set if:
   - Engine running
   - TPS signal voltage is greater than about 3.5 volts
   - All conditions met for 5 seconds.

   OR
   - TPS signal voltage over 4.5 volts with ignition "ON".

   With throttle closed, the TPS should read less than .70 volts. If it doesn't, 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 5 volts return CKT, because a faulty 5 volts return will cause a Code 21.

Diagnostic Aids:

A "Scan" tool reads throttle position in volts. Should read about .73 volts (2.5L), .45 volts (2.8L), .60 volts (4.3L & V8) ± .75 volts with throttle closed and ignition on or at idle. 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.

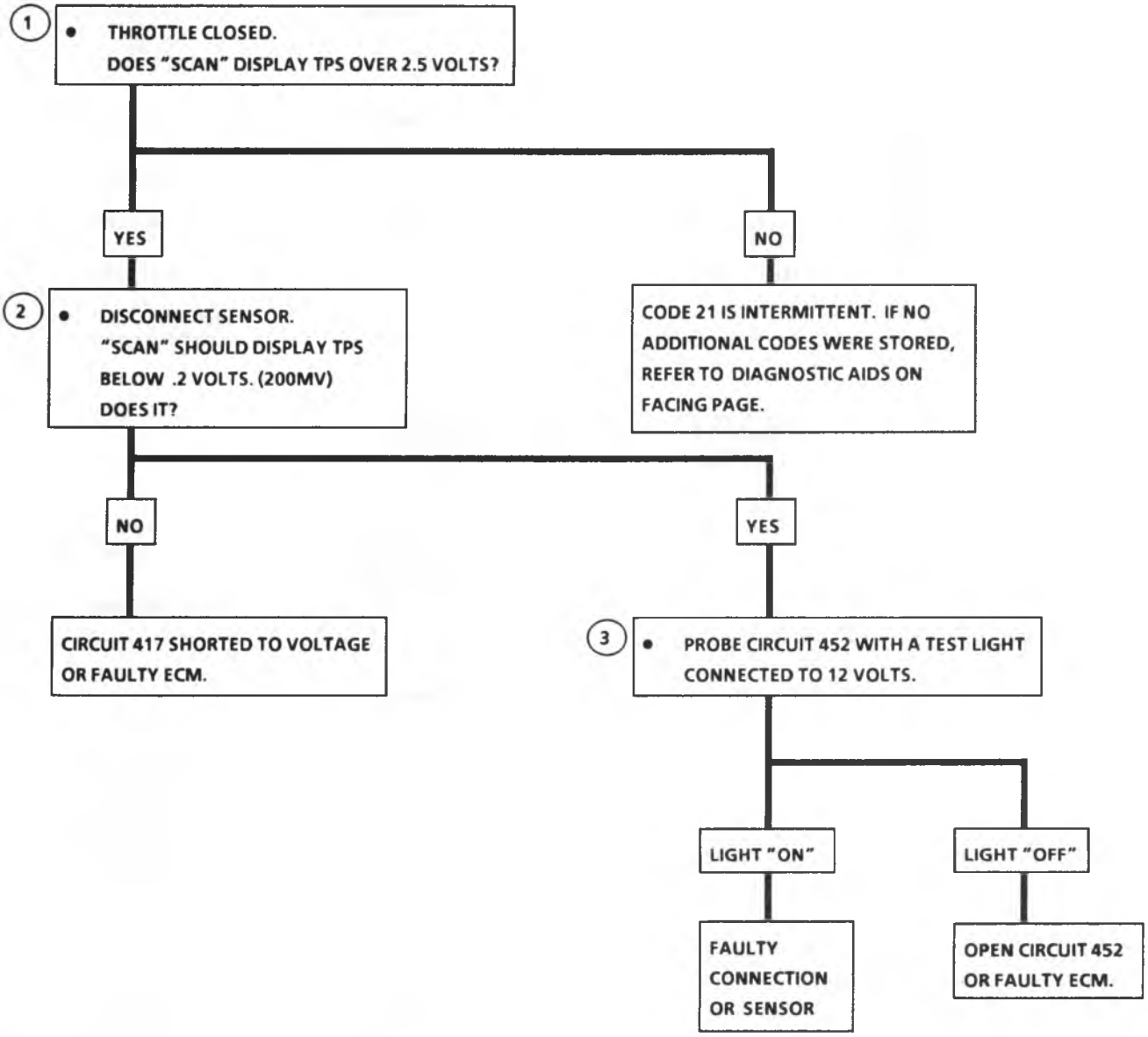
Refer to Section 2 for "ECM Intermittent Codes or Performance".

"Scan" TPS while depressing accelerator pedal with engine stopped and ignition "ON". Display should vary from below 2.5 volts (2500 mv) when throttle was closed, to over 4.5 volts (4500 mv) when throttle is held at wide open throttle position.

"*SCAN*" DIAGNOSTICS

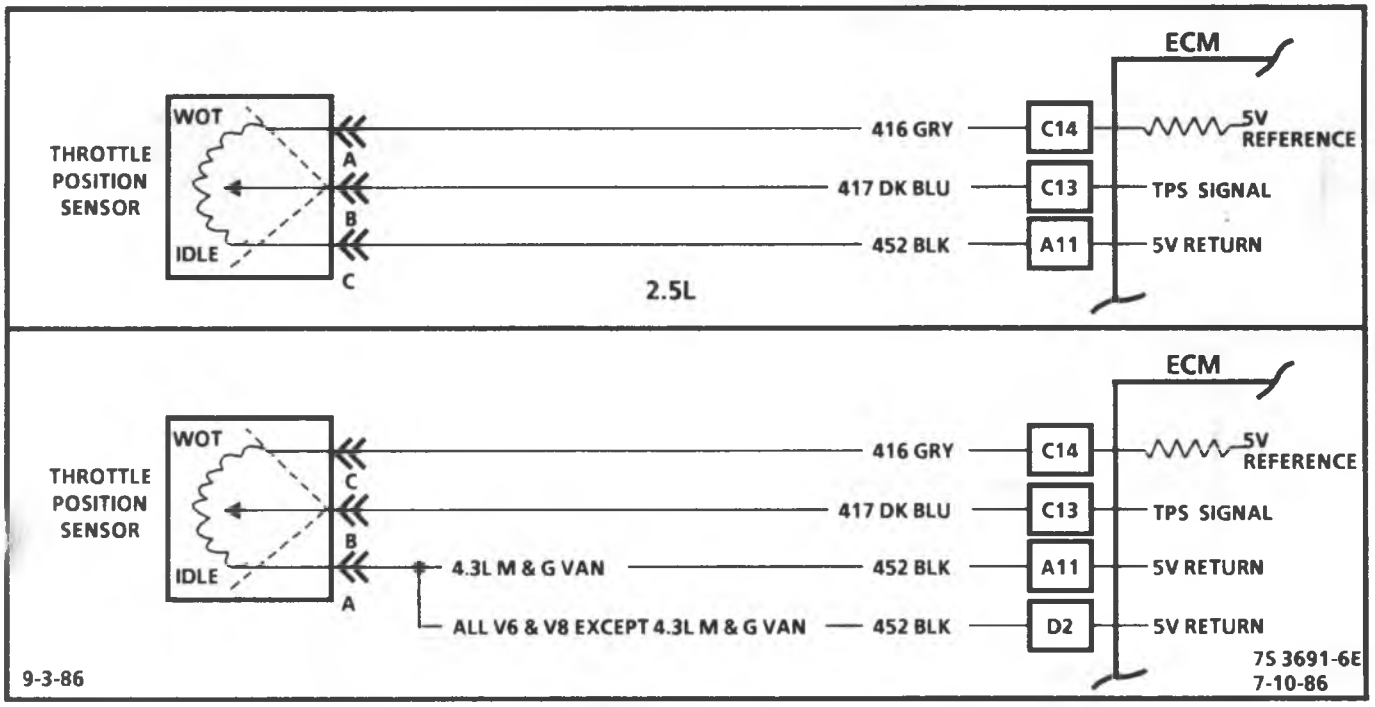
CODE 21

THROTTLE POSITION SENSOR
(SIGNAL VOLTAGE HIGH)
ALL ENGINES



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

3-5-86
*7S 3057



CODE 22

THROTTLE POSITION SENSOR
(SIGNAL VOLTAGE LOW)
ALL ENGINES

Circuit Description:

The Throttle Position Sensor (TPS) provides a voltage signal that changes relative to the throttle blade. Signal voltage will vary from about .5 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.

Test Description:

Step numbers refer to step numbers on diagnostic chart.

1. Code 22, will set if:
   - Engine running
   - TPS signal voltage is less than about .2 volt for 3 seconds.
2. Simulates Code 21: (high voltage) If the ECM recognizes the high signal voltage the ECM and wiring are OK.
3. TPS adjustment: (2.8L) With throttle closed, the TPS voltage reading should be .48 volts ± .06 volts.
4. This simulates a high signal voltage to check for an open in CKT 417.

Diagnostic Aids:

A "Scan" tool reads throttle position in volts. Should read about .73 volts (2.5L), .48 volts (2.8L), .60 volts (4.3L & V8) ± .08 volts with throttle closed and ignition on or at idle. Voltage should increase at a steady rate as throttle is moved toward WOT.

An open or short to ground in CKTs 416 or 417 will result in a Code 22.

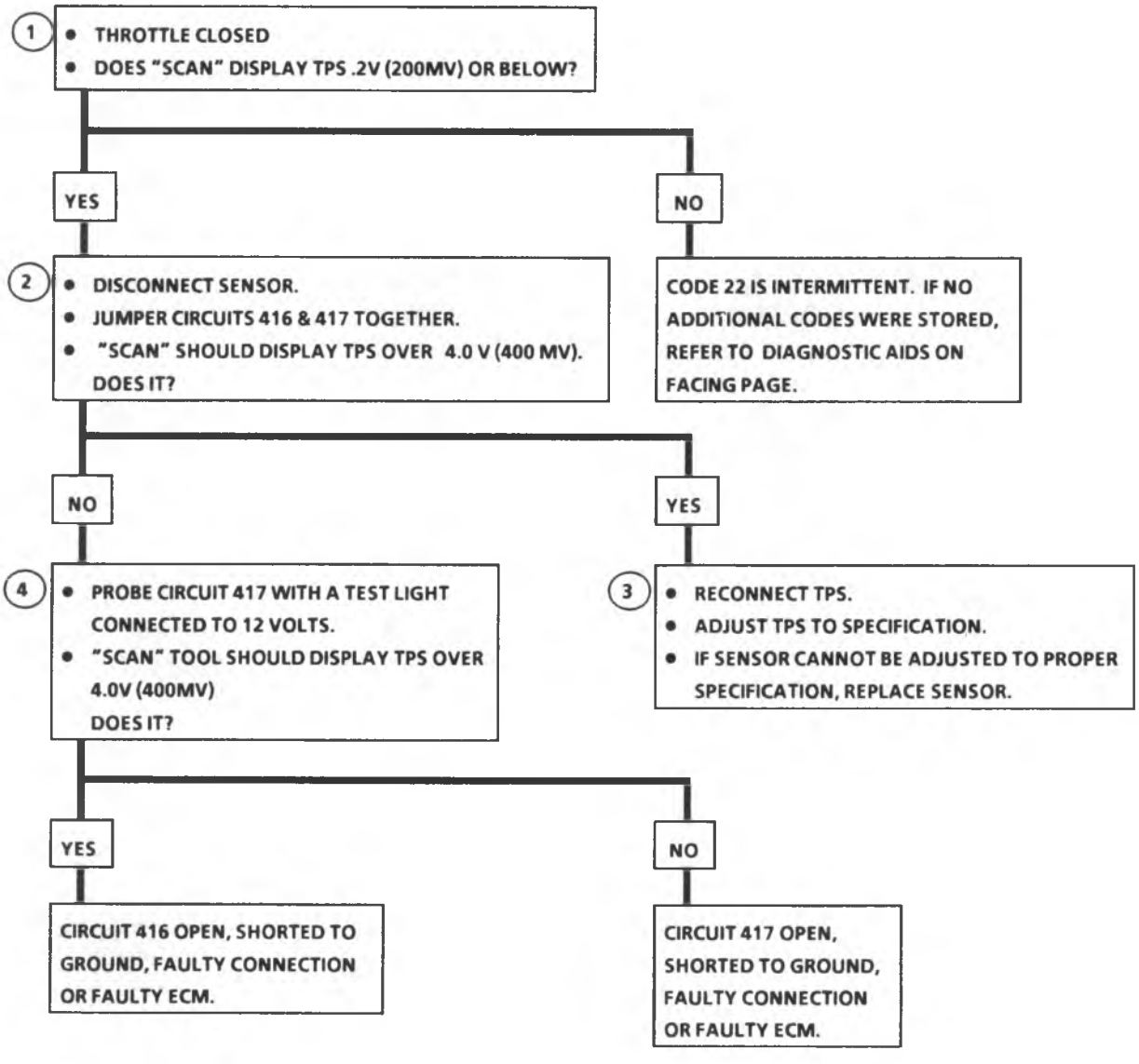
Refer to Section 2 for "ECM Intermittent Codes or Performance".

"Scan" TPS while depressing accelerator pedal with engine stopped and ignition "ON". Display should vary from below 2.5 volts (2500 mv) when throttle was closed, to over 4.5 volts (4500 mv) when throttle is held at wide open throttle position.

"SCAN" DIAGNOSTICS

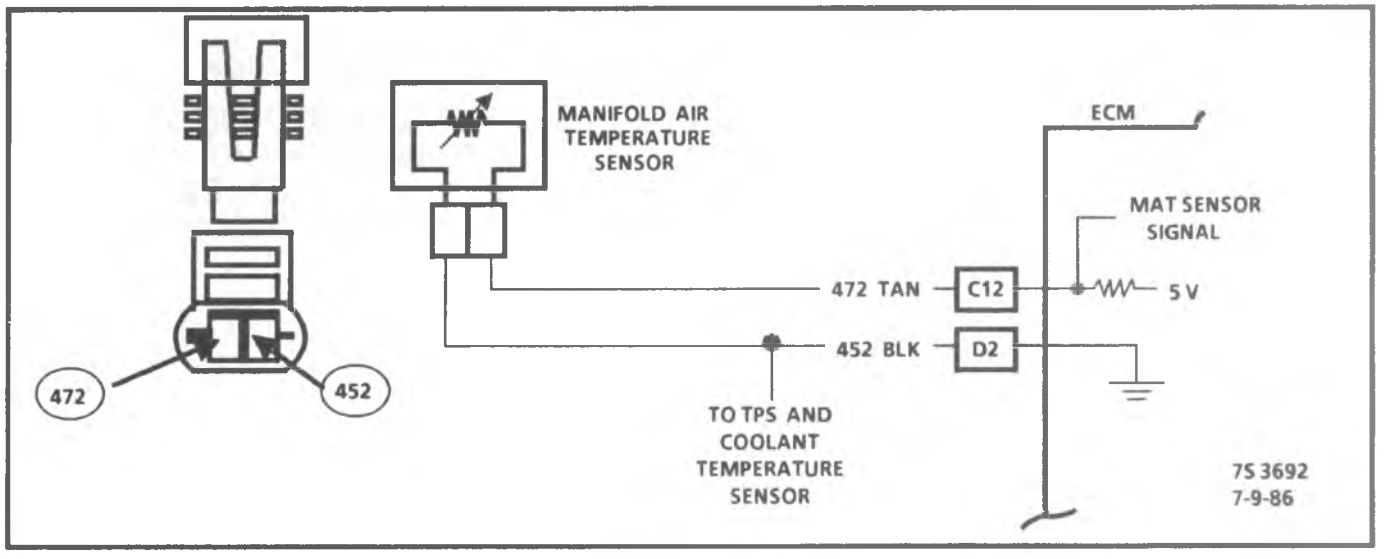
CODE 22

THROTTLE POSITION SENSOR
(SIGNAL VOLTAGE LOW)
ALL ENGINES



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

4-24-86
*75 3365



CODE 23

MANIFOLD AIR TEMPERATURE SENSOR
(LOW TEMPERATURE INDICATED)
2.5L ENGINE

Circuit Description:

The Manifold Air Temperature (MAT) Sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies a voltage (4-6 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.

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

1. Code 23 will set if all conditions are met:
   - A signal voltage indicates a manifold air temperature below -30°C (-22°F) for 12 seconds.
   - Time since engine start is 1 minute or longer.
   - No VSS (vehicle not moving)
2. A Code 23 will set, due to an open sensor, wire, or connection. This test will determine if the wiring and ECM are OK.
3. This will determine if the signal CKT 472 or the 5V return CKT 452 is open.

Diagnostic Aids:

A "Scan" tool reads temperature of the air entering the engine and should read close to ambient air temperature when engine is cold, and rises as underhood temperature increases.

Carefully check harness and connections for possible open CKT 472 or 452.

Refer to Section 2 for "ECM Intermittent Codes or Performance.

The "Temperature to Resistance Value" scale at the right may be used to test the MAT sensor at various temperature levels to evaluate the possibility of a "slewed" (mis-scaled) sensor. A "slewed" sensor could result in poor driveability complaints.

"SCAN" DIAGNOSTICS

CODE 23

MANIFOLD AIR TEMPERATURE SENSOR
(LOW TEMPERATURE INDICATED)
2.5L ENGINE

1. • DOES "SCAN" TOOL DISPLAY MAT -30°C OR COLDER?

YES

2. • DISCONNECT SENSOR.
   • JUMPER HARNESS TERMINALS TOGETHER.
   • "SCAN" SHOULD DISPLAY TEMPERATURE OVER 130°C. DOES IT?

YES

FAULTY CONNECTION OR SENSOR.

NO

CODE 23 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO DIAGNOSTIC AIDS ON FACING PAGE.

NO

3. • JUMPER CIRCUIT 452 TO GROUND.
   • "SCAN" SHOULD DISPLAY TEMP. OVER 130°C.
   DOES IT?

YES

OPEN CIRCUIT 452, FAULTY CONNECTION OR FAULTY ECM.

NO

OPEN CIRCUIT 472, FAULTY CONNECTION OR FAULTY ECM.

DIAGNOSTIC AID

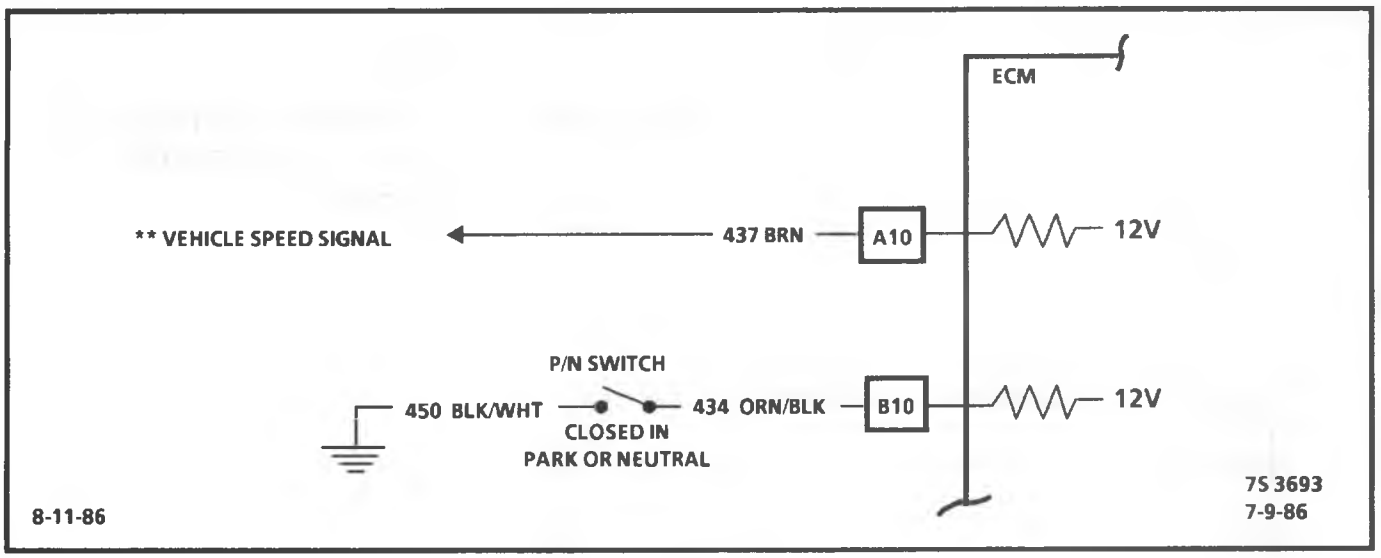
MAT SENSOR

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

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

4-2-86
*7S 3285



CODE 24

VSS CIRCUIT FAULT
ALL ENGINES

Circuit Description:

The ECM applies and monitors 12 volts on CKT 437. CKT 437 connects to the Vehicle Speed Sensor (VSS) which alternately grounds CKT 437 when drive wheels are turning. This pulsing action takes place about 2000 times per mile and the ECM will calculate vehicle speed based on the time between "pulses".

A "Scan" tool reading should closely match with speedometer reading with drive wheels turning.

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

Code 24 will set if:

- CKT 437 voltage is constant.
- Engine speed between 900 and 4400 rpm.
- Less than 2% throttle opening.
- Low load condition (low air flow).
- Not in park or neutral.
- All conditions must be met for 3 seconds.

These conditions are met during a road load deceleration.

1. This test monitors the ECM voltage on CKT 437. With the wheels turning, the pulsing action will result in a varying voltage. The variation will be greater at low wheel speeds to an average of 4-6 volts at about 20 mph (32 km/h).
2. A voltage of less than 1 volt at the ECM connector indicates that the CKT 437 wire is shorted to ground. Disconnect CKT 437 at the Vehicle Speed Sensor. If voltage now reads above 10 volts, the Vehicle Speed Sensor is faulty. If voltage remains less than 10 volt, then CKT 437 wire is grounded. If 437 is not grounded, check for a faulty ECM connector or ECM.
3. A steady 8-12 volts at the ECM connector indicates CKT 437 is open or a faulty Vehicle Speed Sensor.
4. This is normal voltage which indicates a possible intermittent condition.

Diagnostic Aids:

1. "Scan" reading should closely match with speedometer reading, with drive wheels turning.
2. Check park/neutral switch diagnosis chart if vehicle equipped with automatic transmission.
3. If park/neutral switch is OK, refer to ECM Intermittent codes in Section 2.

"SCAN" DIAGNOSTICS

CODE 24

VSS CIRCUIT FAULT ALL ENGINES

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

- ASSUMES SPEEDOMETER IS WORKING OK.
- CRUISE CONTROL "OFF".
- RAISE DRIVE WHEELS.
- WITH ENGINE IDLING IN GEAR, "SCAN" SHOULD DISPLAY MPH ABOVE 0.
  DOES IT?

NO

1. • BACK PROBE ECM CONNECTOR, CKT 437, WITH VOLTMETER TO GROUND AND DRIVE WHEELS STILL TURNING.

2. LESS THAN 1 VOLT
   - DISCONNECT CONNECTOR AT VSS ASSY. RECHECK VOLTAGE AT ECM.

   LESS THAN 1 VOLT
   - DISCONNECT A-B ECM CONNECTOR. WITH A TEST LIGHT TO 12 VOLTS, PROBE CKT 437.
   - IS THERE A LIGHT?

   YES
   CHECK CKT 437 FOR SHORT TO GROUND, INCLUDING WIRE TO CRUISE CONTROL.

   NO
   ECM CONNECTIONS OR ECM.

3. 8 TO 12 VOLTS, NOT VARYING
   - CHECK CONNECTIONS AT VSS.
   - CHECK FOR OPEN CKT 437.
   - CHECK FOR 12V AND GND AT VSS.
   - FAULTY VSS.

   8 TO 12 VOLTS
   FAULTY VSS ASSY.

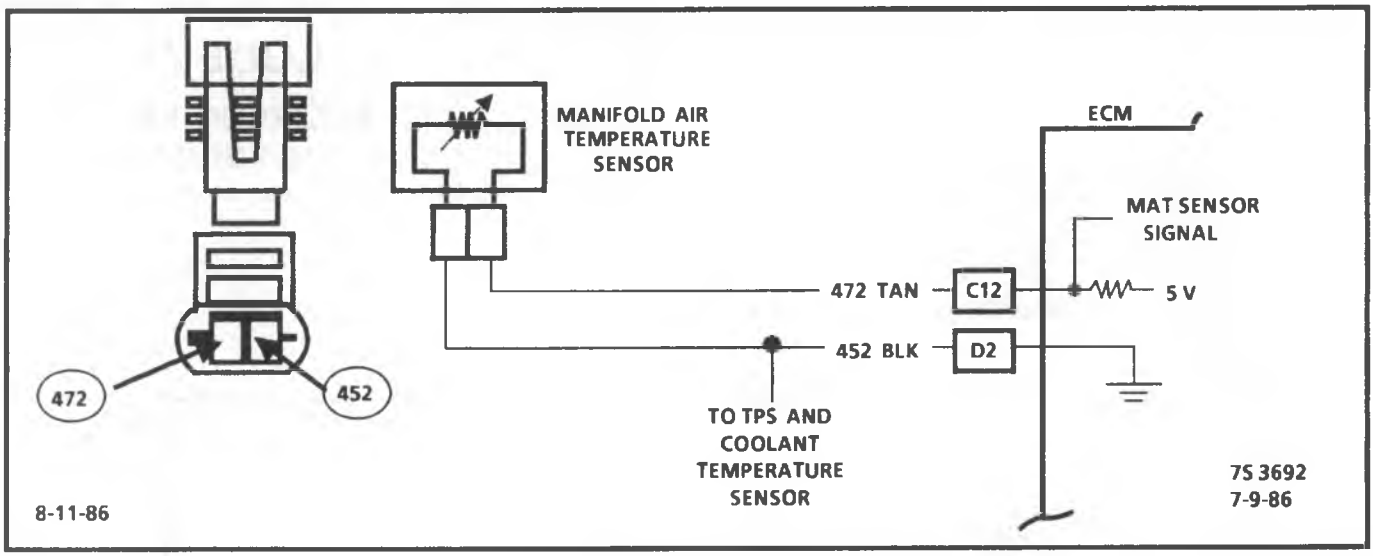
4. 0 TO 10 VOLTS AND VARYING

YES

CODE 24 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.

7S 3694
7-10-86



CODE 25

MANIFOLD AIR TEMPERATURE (MAT) SENSOR
(HIGH TEMPERATURE INDICATED)
2.5L ENGINE

Circuit Description:

The Manifold Air Temperature (MAT) Sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies a voltage (4-6 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. As the air warms, the sensor resistance becomes less, and the voltage drops.

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

1. Code 25 will set if:
   - Signal voltage indicates a manifold air temperature below 150°C (302°F) for 2 seconds.
   - Time since engine start is 1 minute or longer.
   - A vehicle speed is present.

Diagnostic Aids:

A "Scan" tool reads temperature of the air entering the engine and should read close to ambient air temperature when engine is cold, and rises as underhood temperature increases.

Check harness routing for possible short to ground in CKT 472.

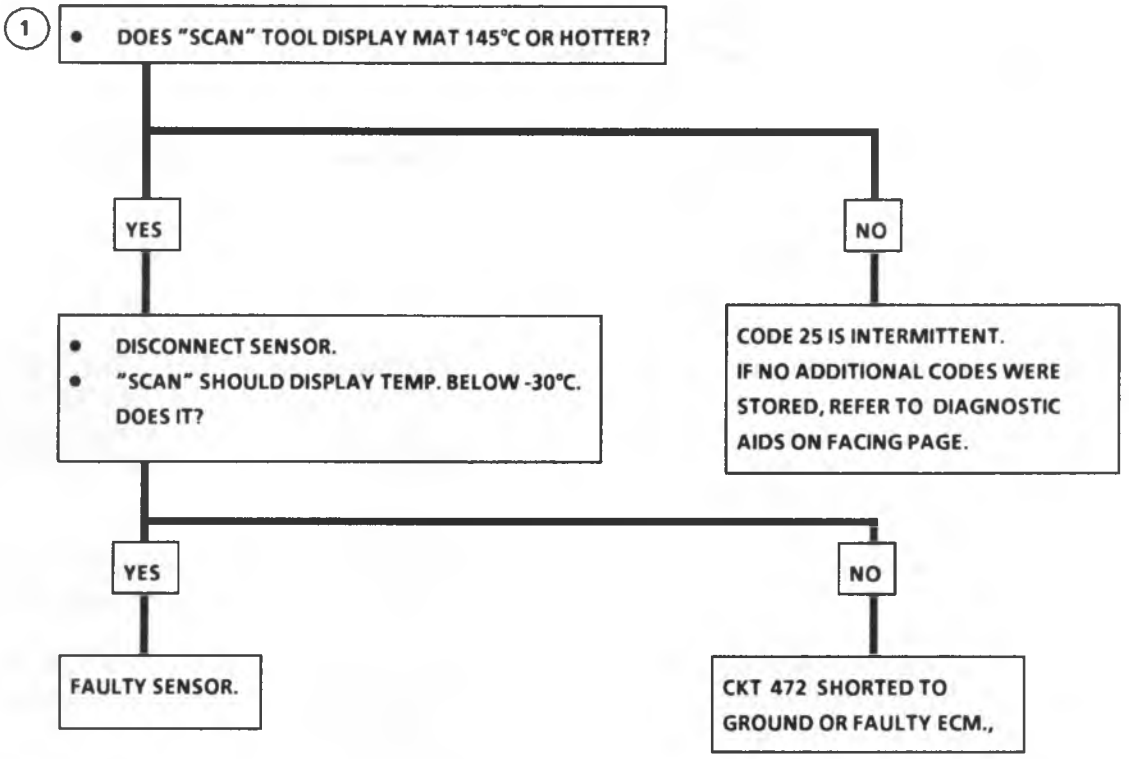
Refer to Section 2 for "ECM Intermittent Codes or Performance.

The "Temperature to Resistance Value" scale at the right may be used to test the MAT sensor at various temperature levels to evaluate the possibility of a "slewed" (mis-scaled) sensor. A "slewed" sensor could result in poor driveability complaints.

"SCAN" DIAGNOSTICS

CODE 25

MANIFOLD AIR TEMPERATURE (MAT) SENSOR (HIGH TEMPERATURE INDICATED) 2.5L ENGINE

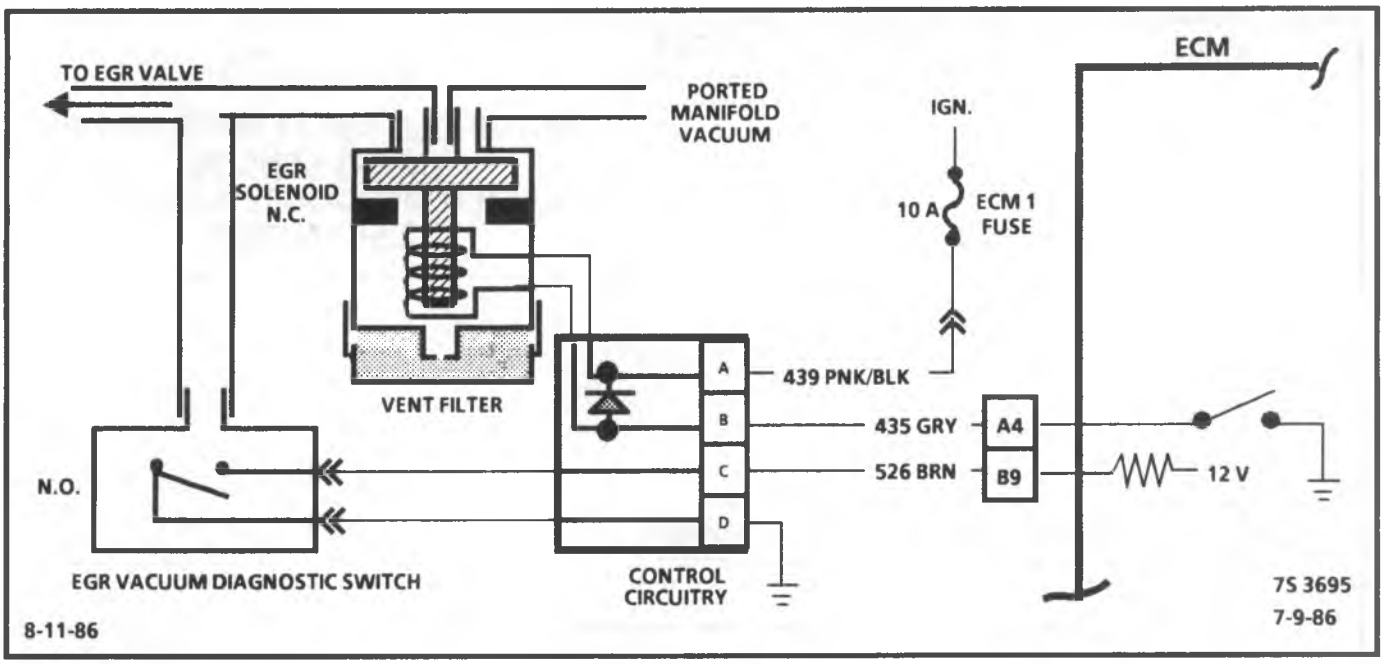


DIAGNOSTIC AID

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

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

6-18-86
*7S 3190



CODE 32

EGR SYSTEM FAILURE
2.8L ENGINE

Circuit Description:

The exhaust gas recirculation (EGR) valve is controlled by an ECM operated solenoid. The solenoid is normally closed and the vacuum source is a ported signal. The ECM will turn the EGR "ON" and "OFF" (Duty Cycle) by grounding CKT 435. The duty cycle is calculated by the ECM based on information from the coolant and MAP sensor and engine rpm. The duty cycle should be 0% (no EGR) when in Park or Neutral, TPS input below a specified value, or TPS indicating WOT.

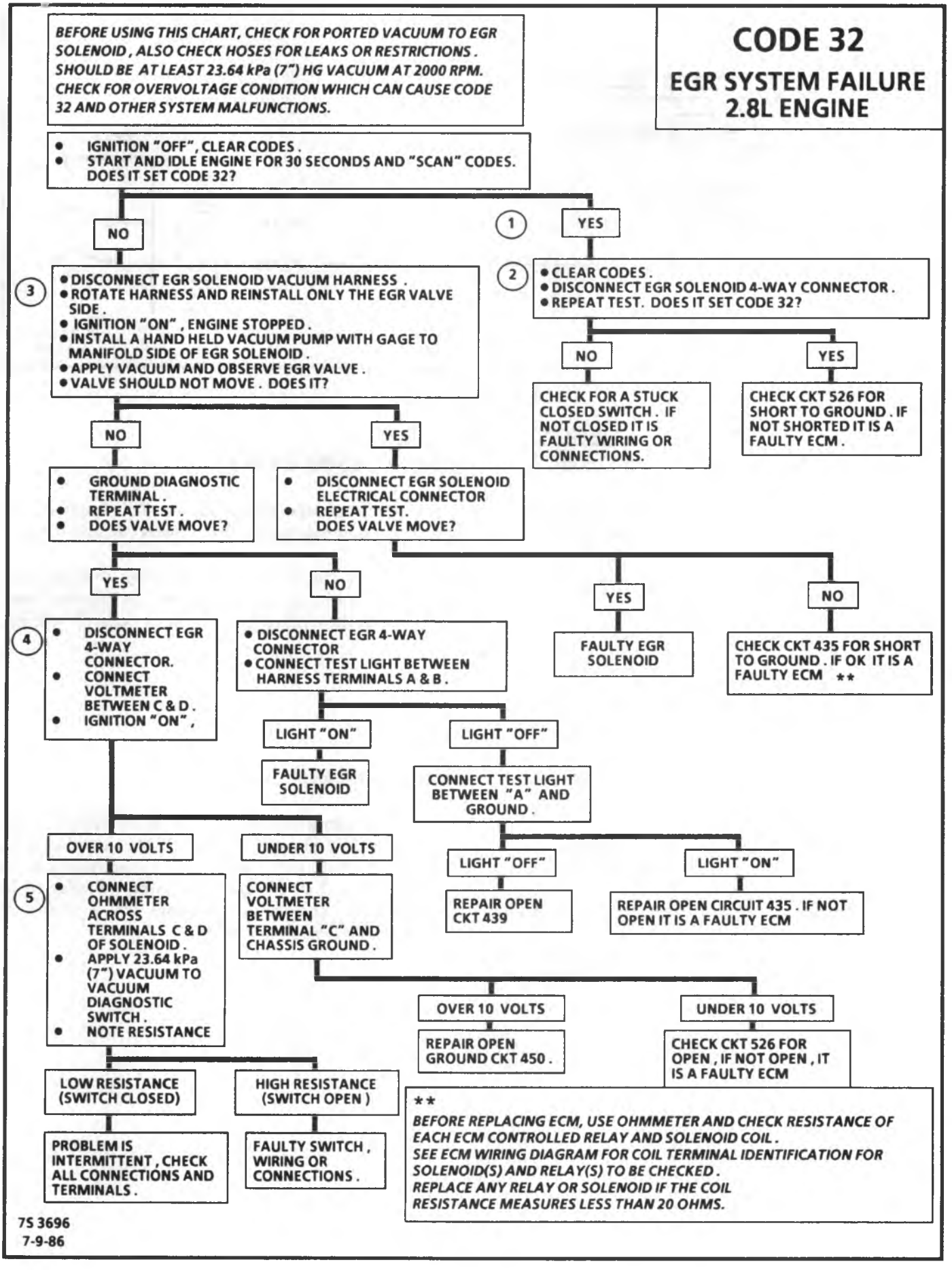
Test Description: Step numbers refer to step numbers on diagnostic chart.

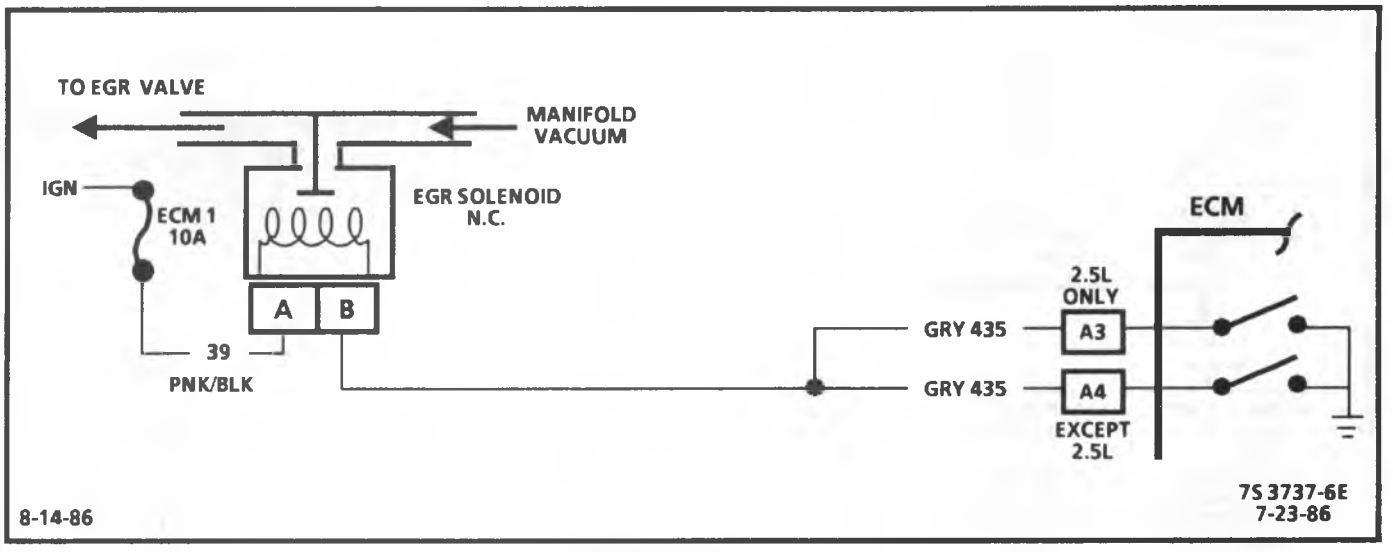
1. Code 32 means that the EGR vacuum switch was closed during start-up, or that the switch was not detected closed under the following conditions.
   - Coolant temperature greater than 85°C (185°F).
   - EGR duty cycle commanded by the ECM is greater than 70%.
   - TPS less than half throttle, but not at idle.
   - All conditions above must be met for 5 seconds.

   If the switch is detected closed during start-up, or, if the switch is detected open when the above conditions are met, the "Service Engine Soon" light will remain "ON" unless the switch changes state.
2. If the first step caused Code 32 to set, then the ECM has recognized a closed vacuum switch on start-up. This test will determine whether the EGR control valve is the cause or, if the wiring or the ECM is the cause.
3. With the ignition "ON", the solenoid should not be energized and vacuum should not pass to the EGR valve.
4. The EGR solenoid and valve are OK and the following check will check the vacuum switch portion of the system.
5. The switch should close at about 2" of vacuum. With vacuum applied, the switch should close and resistance go to near zero ohms and the vacuum should hold.

Diagnostic Aids:

With the ignition "ON", engine stopped, the EGR solenoid is de-energized unless the diagnostic terminal is grounded.


CODE 32
EGR SYSTEM FAILURE
2.8L ENGINE
BEFORE USING THIS CHART, CHECK FOR PORTED VACUUM TO EGR SOLENOID, ALSO CHECK HOSES FOR LEAKS OR RESTRICTIONS. SHOULD BE AT LEAST 23.64 kPa (7") HG VACUUM AT 2000 RPM. CHECK FOR OVERVOLTAGE CONDITION WHICH CAN CAUSE CODE 32 AND OTHER SYSTEM MALFUNCTIONS.
• IGNITION "OFF", CLEAR CODES.
• START AND IDLE ENGINE FOR 30 SECONDS AND "SCAN" CODES. DOES IT SET CODE 32?
NO
1
YES
3
• DISCONNECT EGR SOLENOID VACUUM HARNESS.
• ROTATE HARNESS AND REINSTALL ONLY THE EGR VALVE SIDE.
• IGNITION "ON", ENGINE STOPPED.
• INSTALL A HAND HELD VACUUM PUMP WITH GAGE TO MANIFOLD SIDE OF EGR SOLENOID.
• APPLY VACUUM AND OBSERVE EGR VALVE.
• VALVE SHOULD NOT MOVE. DOES IT?
2
• CLEAR CODES.
• DISCONNECT EGR SOLENOID 4-WAY CONNECTOR.
• REPEAT TEST. DOES IT SET CODE 32?
NO
YES
CHECK FOR A STUCK CLOSED SWITCH. IF NOT CLOSED IT IS FAULTY WIRING OR CONNECTIONS.
CHECK CKT 526 FOR SHORT TO GROUND. IF NOT SHORTED IT IS A FAULTY ECM.
NO
YES
• GROUND DIAGNOSTIC TERMINAL.
• REPEAT TEST.
• DOES VALVE MOVE?
• DISCONNECT EGR SOLENOID ELECTRICAL CONNECTOR
• REPEAT TEST.
DOES VALVE MOVE?
YES
NO
YES
NO
4
• DISCONNECT EGR 4-WAY CONNECTOR.
• CONNECT VOLTMETER BETWEEN C & D.
• IGNITION "ON",
• DISCONNECT EGR 4-WAY CONNECTOR
• CONNECT TEST LIGHT BETWEEN HARNESS TERMINALS A & B.
FAULTY EGR SOLENOID
CHECK CKT 435 FOR SHORT TO GROUND. IF OK IT IS A FAULTY ECM **
LIGHT "ON"
LIGHT "OFF"
FAULTY EGR SOLENOID
CONNECT TEST LIGHT BETWEEN "A" AND GROUND.
OVER 10 VOLTS
UNDER 10 VOLTS
LIGHT "OFF"
LIGHT "ON"
5
• CONNECT OHMMETER ACROSS TERMINALS C & D OF SOLENOID.
• APPLY 23.64 kPa (7") VACUUM TO VACUUM DIAGNOSTIC SWITCH.
• NOTE RESISTANCE
CONNECT VOLTMETER BETWEEN TERMINAL "C" AND CHASSIS GROUND.
REPAIR OPEN CKT 439
REPAIR OPEN CIRCUIT 435. IF NOT OPEN IT IS A FAULTY ECM
OVER 10 VOLTS
UNDER 10 VOLTS
REPAIR OPEN GROUND CKT 450.
CHECK CKT 526 FOR OPEN, IF NOT OPEN, IT IS A FAULTY ECM
LOW RESISTANCE (SWITCH CLOSED)
HIGH RESISTANCE (SWITCH OPEN)
PROBLEM IS INTERMITTENT, CHECK ALL CONNECTIONS AND TERMINALS.
FAULTY SWITCH, WIRING OR CONNECTIONS.
** BEFORE REPLACING ECM, USE OHMMETER 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.
75 3696
7-9-86



CODE 32

EGR SYSTEM FAILURE
2.5L, 4.3L, 5.0L & 5.7L (UNDER 8500 GVW)

Circuit Description:

The ECM operates a solenoid to control the Exhaust Gas Recirculation (EGR) valve. This solenoid is normally closed. By providing a ground path, the ECM energizes the solenoid which then allows vacuum to pass to the EGR valve.

The ECM monitors EGR effectiveness by de-energizing the EGR control solenoid thereby shutting off vacuum to the EGR valve diaphragm. With the EGR valve closed, fuel integrator counts will be greater than they were during normal EGR operation. If the change is not within the calibrated window, a Code 32 will be set.

The ECM will check EGR operation when:

- Vehicle speed is above 50 mph.
- Engine vacuum is between 40 and 51 kPa.
- No change in throttle position while test is being run.

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

1. Checks for solenoid stuck open.
2. Checks for solenoid always being energized.
3. Grounding test terminal should energize solenoid and vacuum should drop.
4. Negative backpressure valve should hold vacuum with engine "OFF".
5. When engine is started, exhaust backpressure should cause vacuum to bleed off and valve to fully close.

Diagnostic Aids:

- Before replacing ECM, use an ohmmeter and check the resistance of each ECM controlled relay and solenoid coil. See ECM wiring diagram for coil term. I.D. of solenoid(s) and relay(s) to be checked. Replace any solenoid where resistance measures less than 20 ohms.

CODE 32

EGR SYSTEM FAILURE 2.5L, 4.3L, 5.0L & 5.7L (UNDER 8500 GVW)

IF ANY OTHER CODES ARE STORED, DIAGNOSE THEM FIRST.

1. CHECK VACUUM SOURCE TO EGR SOLENOID (IF NOT OK, REPAIR).
   - IGNITION "OFF".
   - DISCONNECT EGR SOLENOID VACUUM HARNESS.
   - INSTALL HAND HELD VACUUM PUMP ON MANIFOLD SIDE OF SOLENOID.
   - APPLY VACUUM.
   - DOES SOLENOID HOLD VACUUM?

   - NO → FAULTY SOLENOID
   - YES →

2. IGNITION "ON", ENGINE STOPPED.
   - DOES VACUUM DROP?

   - YES → CKT 435 SHORTED TO GROUND OR FAULTY ECM. SEE DIAGNOSTIC AIDS.
   - NO →

3. GROUND DIAGNOSTIC TEST TERMINAL.
   - DOES VACUUM DROP?

   - NO →
     - REMOVE GROUND FROM DIAGNOSTIC TEST TERMINAL.
     - IGNITION "OFF".
     - CONNECT A VACUUM PUMP TO EGR SIDE OF VACUUM HARNESS.
     - USING A MIRROR, OBSERVE EGR DIAPHRAGM WHILE APPLYING VACUUM
     - DIAPHRAGM SHOULD MOVE FREELY AND HOLD VACUUM FOR AT LEAST 20 SECONDS.

     - NOT OK → CHECK VACUUM LINE TO VALVE. IF OK, REPLACE EGR VALVE.
     - OK →

4. APPLY VACUUM TO EGR VALVE.
   - START ENGINE AND IMMEDIATELY OBSERVE VACUUM AND VALVE POSITION.
   - VALVE IS GOOD IF VALVE MOVES TO SEATED POSITION (VALVE CLOSED) AND VACUUM DROPPED WHILE STARTING ENGINE.

   - NOT OK →
     - REMOVE EGR VALVE AND CHECK PASSAGES FOR BEING PLUGGED.
     - IF NOT PLUGGED REPLACE EGR VALVE.

     - NOT OK → REPAIR AS NECESSARY
     - OK → NO TROUBLE FOUND. SEE INTERMITTENTS IN SECTION 2.
   - OK → A/T CHECK P/N SWITCH

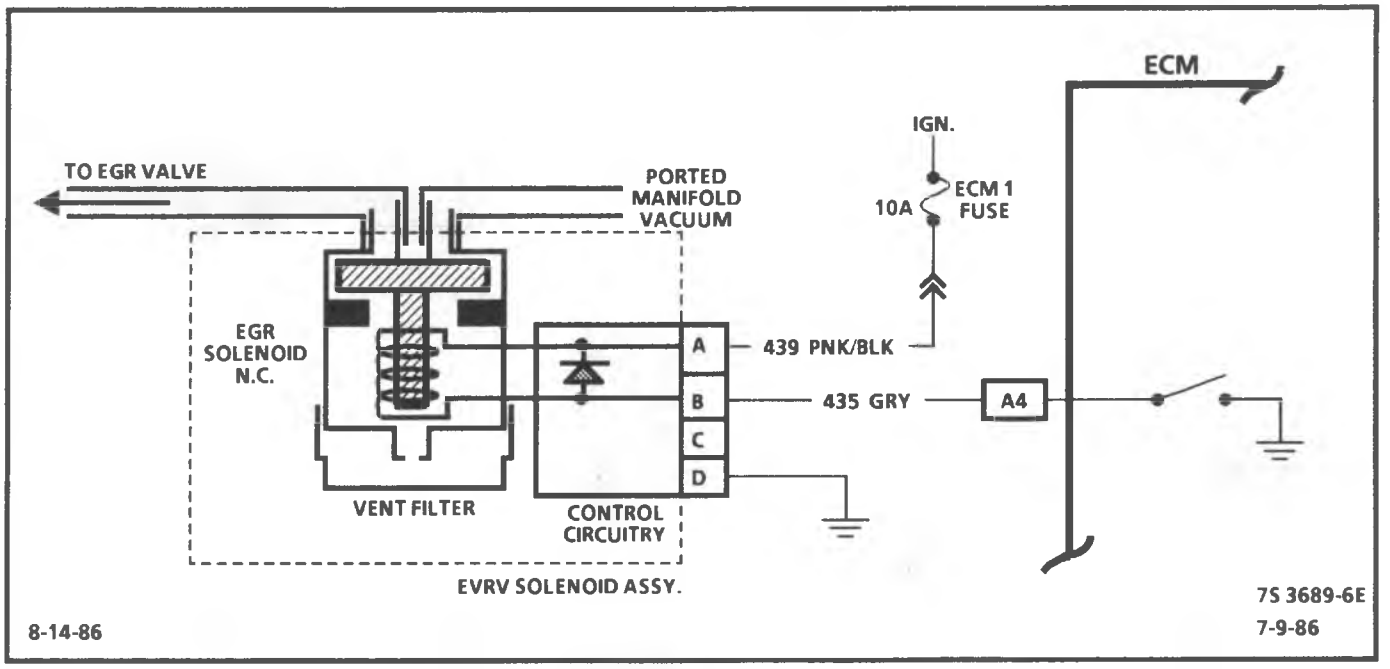
   - NO →
     - DISCONNECT SOLENOID ELECTRICAL CONNECTOR. PROBE CKT 39 WITH A TEST LIGHT TO GROUND.

     - LIGHT "OFF" → OPEN CKT 39
     - LIGHT "ON" → CONNECT TEST LIGHT BETWEEN HARNESS CONNECTOR TERMINALS.

     - LIGHT "OFF" → OPEN CKT 435 OR FAULTY ECM. SEE DIAGNOSTIC ADIS.
     - LIGHT "ON" → FAULTY SOLENOID

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

7S 3846
8-14-86



CODE 32

EGR SYSTEM FAILURE
7.4L & 5.7L (OVER 8500 GVW)

Circuit Description:

The ECM operates a solenoid to control the Exhaust Gas Recirculation (EGR) valve. This solenoid is normally closed. By providing a ground path, the ECM energizes the solenoid which then allows vacuum to pass to the EGR valve.

The ECM monitors EGR effectiveness by de-energizing the EGR control solenoid thereby shutting off vacuum to the EGR valve diaphragm. With the EGR valve closed, fuel integrator counts will be greater than they were during normal EGR operation. If the change is not within the calibrated window, a Code 32 will be set.

The ECM will check EGR operation when:

- Vehicle speed is above 50 mph.
- Engine vacuum is between 40 and 51 kPa.
- No change in throttle position while test is being run.

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

1. With the ignition "ON", engine stopped, the solenoid should not be energized and vacuum should not pass to the EGR valve.
   Grounding the diagnostic terminal will energize the solenoid and allow vacuum to pass to valve.
2. Checks for plugged EGR passages. If passages are plugged, the engine may have severe detonation on acceleration.
3. The EGR solenoid will not be energized in Park or Neutral. This test will determine if the Park/Neutral switch input is being received by the ECM.

Diagnostic Aids:

- Before replacing ECM, use ohmmeter and check the resistance of each ECM controlled relay and solenoid coil.
  See ECM wiring diagram for coil terminal identification of solenoid(s) and relay(s) to be checked.
  Replace any relay or solenoid if the coil resistance measures less than 20 ohms.

CODE 32

EGR SYSTEM FAILURE 7.4L & 5.7L (OVER 8500 GVW)

IF ANY OTHER CODES ARE STORED, DIAGNOSE THEM FIRST.

(1)
- DISCONNECT EGR SOLENOID VACUUM HOSE (MANIFOLD SIDE)
- CHECK PORTED VACUUM SOURCE TO SOLENOID (IF NOT OK , REPAIR).
- CHECK VACUUM HOSE BETWEEN SOLENOID AND VALVE FOR RESTRICTIONS.
- INSTALL A HAND HELD VACUUM PUMP WITH GAGE ON MANIFOLD SIDE OF EGR SOLENOID .
- IGNITION "ON" ENGINE STOPPED .
- DIAGNOSTIC TERMINAL GROUNDED .
- APPLY VACUUM .
- OSBSERVE EGR VALVE .
- VALVE SHOULD MOVE . DOES IT?

NO

- INSTALL A VACUUM GAGE IN VACUUM LINE AT VALVE
- REPEAT TEST
- DOES GAGE INDICATE VACUUM

NO

- DISCONNECT SOLENOID CONNECTOR
- PROBE HARNESS CONNECTOR TERMINAL "A" WITH A TEST LIGHT TO GROUND.

LIGHT "ON"

CONNECT A TEST LIGHT BETWEEN HARNESS CONNECTOR TERMINALS "A" & "D".

LIGHT "ON"

- CONNECT TEST LIGHT BETWEEN HARNESS CONNECTOR TERMINALS "A" & "B"
- GROUND DIAGNOSTIC TERMINAL

LIGHT "ON"

REPLACE SOLENOID

LIGHT "OFF"

OPEN CKT 435 OR FAULTY ECM. SEE DIAGNOSTIC AIDS.

LIGHT "OFF"

REPAIR OPEN IN GROUND CKT

LIGHT "OFF"

REPAIR OPEN IN CKT 439

YES

REPLACE EGR VALVE

YES

(2)
- START AND IDLE ENGINE.
- LIFT UP ON EGR VALVE AND OBSERVE IDLE.

IDLE ROUGHENS

(3)
- RECONNECT EGR SOLENOID .
- CONNECT VACUUM GAGE TO VACUUM HOSE AT EGR VALVE ,
- ENGINE AT NORMAL OPERATING TEMP.
- IN DRIVE (AUTOMATIC TRANS.)
- HOLD BRAKES AND ACCELERATE MOMENTARILY UP TO ABOUT 1800 RPM.
- OBSERVE GAGE
- SHOULD HAVE OVER 2" VACUUM BUT LESS THAN 10"

OK

NO TROUBLE FOUND. SEE INTERMITTENTS IN SECTION 2.

NOT OK

OVER 10" VACUUM

REPLACE EGR FILTER

NO VACUUM OR LESS THAN 2"

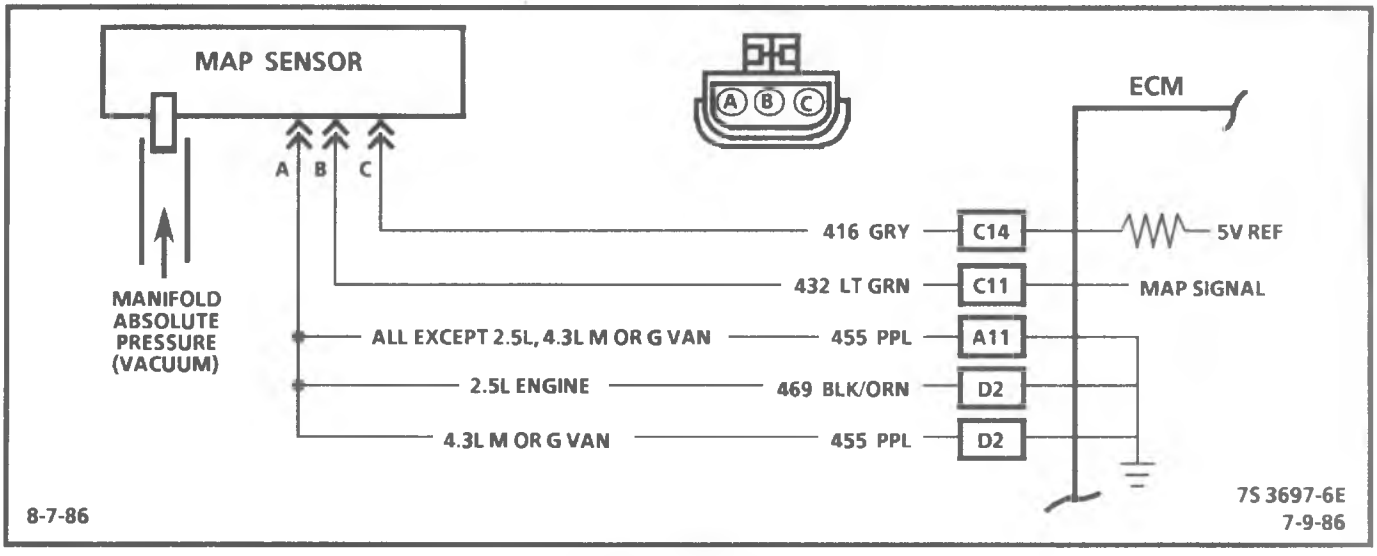
IF THERE ARE NO RESTRICTIONS IN VACUUM LINES , PERFORM P/N SWITCH CHECK .

NO CHANGE

- REMOVE EGR VALVE .
- CHECK PASSAGES FOR BEING PLUGGED . IF NOT PLUGGED REPLACE EGR VALVE .

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

7S 3847-6E
8-14-86



CODE 33

MAP SENSOR CIRCUIT SIGNAL VOLTAGE HIGH (LOW VACUUM) ALL ENGINES

Circuit Description:

The Manifold Absolute Pressure (MAP) Sensor responds to changes in manifold pressure (vacuum). The ECM receives this information as a signal voltage that will vary from about 1 to 1.5 volts at idle to 4-4.5 volts at wide open throttle.

Test Description:

Step numbers refer to step numbers on diagnostic chart.

1. Code 33 will set when:
   - Signal is too high for a time greater than 6 seconds.
     Engine misfire or a low unstable idle may set Code 33.
   - Engine Running:
     Manifold pressure greater than 75.3 kPa (A/C "OFF") 81.2 kPa (A/C "ON")
     Throttle angle less than 2%
     Conditions met for 2 seconds.
2. With the MAP sensor disconnect the ECM; should see a low voltage if the ECM and wiring is OK.

Diagnostic Aids:

The "Altitude To Voltage" scale at the right may be used to test the MAP sensor at a specific altitude level to evaluate the possibility of a "slewed" (mis-scaled) sensor. A "slewed" sensor could result in poor driveability complaints.

Engine misfire or a low unstable idle may set Code 33. Disconnect MAP sensor and system will go into backup mode. If the misfire or idle condition remains, see Symptoms in Section 2.

"SCAN" DIAGNOSTICS

CODE 33

MAP SENSOR CIRCUIT SIGNAL VOLTAGE HIGH (LOW VACUUM) ALL ENGINES

(1)
- IF ENGINE IDLE IS ROUGH, UNSTABLE OR INCORRECT, CORRECT BEFORE USING CHART. SEE SYMPTOMS IN SECTION 2.
- ENGINE IDLING.
- DOES "SCAN" DISPLAY A MAP OF 2.5 VOLTS OR OVER?

YES

(2)
- IGNITION "OFF".
- DISCONNECT MAP SENSOR ELECTRICAL CONNECTOR.
- IGNITION "ON".
- "SCAN" SHOULD READ A VOLTAGE OF 1 VOLT OR LESS. DOES IT?

YES

- PROBE CKT 455/469 WITH A TEST LIGHT TO 12 VOLTS.
- TEST LIGHT SHOULD LIGHT. DOES IT?

YES

PLUGGED OR LEAKING SENSOR VACUUM HOSE OR FAULTY MAP SENSOR.

NO

OPEN CIRCUIT 455/469.

NO

CKT 432 SHORTED TO VOLTAGE, SHORTED TO CKT 416, OR FAULTY ECM.

NO

CODE 33 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO DIAGNOSTIC AIDS ON FACING PAGE.

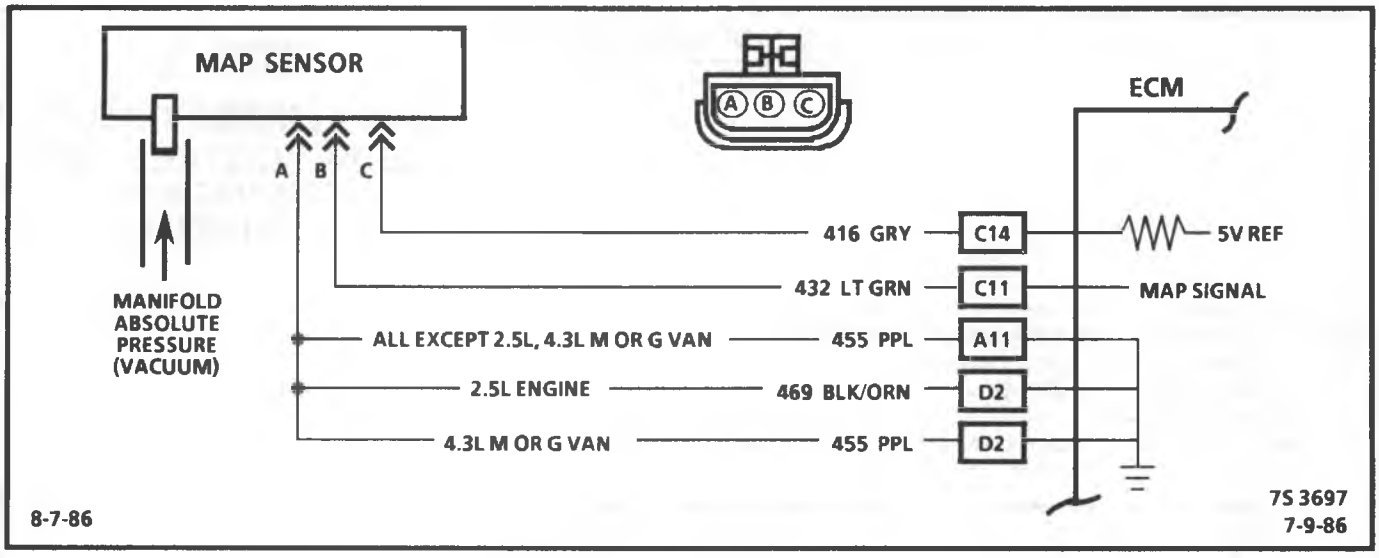
IGNITION "ON" ENGINE STOPPED VOLTAGES

ALTITUDE Meters	ALTITUDE Feet	VOLTAGE RANGE
Below 305	Below 1,000	3.8---5.5V
305--- 610	1,000--2,000	3.6---5.3V
610--- 914	2,000--3,000	3.5---5.1V
914--1219	3,000--4,000	3.3---5.0V
1219--1524	4,000--5,000	3.2---4.8V
1524--1829	5,000--6,000	3.0---4.6V
1829--2133	6,000--7,000	2.9---4.5V
2133--2438	7,000--8,000	2.8---4.3V
2438--2743	8,000--9,000	2.6---4.2V
2743--3048	9,000--10,000	2.5---4.0V

LOW ALTITUDE = HIGH PRESSURE = HIGH VOLTAGE

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

7S 3698
7-9-86



CODE 34

MAP SENSOR CIRCUIT SIGNAL VOLTAGE LOW (HIGH VACUUM) ALL ENGINES

Circuit Description:

The Manifold Absolute Pressure (MAP) Sensor responds to changes in manifold pressure (vacuum). The ECM receives this information as a signal voltage that will vary from about 1 to 1.5 volts at idle to 4-4.5 volts at wide open throttle.

If the MAP sensor fails the ECM will substitute a fixed MAP value and use the Throttle Position Sensor (TPS) to control fuel delivery.

Test Description:

Step numbers refer to step numbers on diagnostic chart.

1. Code 34 will set when:
   - When engine is less than 600 rpm.
   - Manifold pressure reading less than 13 kPa, conditions met for 1 second

     or
   - Engine is greater than 600 rpm.
   - Throttle angle over 20%.
   - manifold pressure less than 13 kPa conditions met for 1 second..
2. This tests to see if the sensor is at faulty for the low voltage or if there is a ECM or wiring problem.
3. This simulates a high signal voltage to check of an open in CKT 432. if the test light is bright during this test, CKT 432 is probable shorted to ground. If "Scan" reads over 4 volts at this lest CKT 416 can be checked by measuring the voltage at terminal "C". (should be 5 volts)

Diagnostic Aids:

An intermittent open in CKTs 416 will result in a Code 34.

Refer to ECM intermittents in Section 2.

The "Altitude to Voltage" scale at the right may be used to test the MAP sensor at a specific altitude level to evaluate the possibility of a "slewed" (mis-scaled) sensor. A "slewed" sensor could result in poor driveability complaints.

"SCAN" DIAGNOSTICS

CODE 34

MAP SENSOR CIRCUIT SIGNAL VOLTAGE LOW (HIGH VACUUM) ALL ENGINES

1. • IGNITION "OFF" FOR 10 SECONDS
   • START ENGINE AND IMMEDIATELY NOTE MAP VALUE ON "SCAN".
   DOES "SCAN" DISPLAY MAP BELOW .25 VOLTS?

   NO → CODE 34 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO DIAGNOSTIC AIDS ON FACING PAGE.

   YES →

2. • IGNITION "OFF".
   • DISCONNECT SENSOR ELECTRICAL CONNECTOR.
   • JUMPER HARNESS TERMINALS "B" TO "C".
   • IGNITION "ON".
   • MAP VOLTAGE SHOULD READ OVER 4 VOLTS.
   DOES IT?

   YES → FAULTY CONNECTION OR SENSOR.

   NO →

3. • IGNITION "OFF".
   • REMOVE JUMPER WIRE.
   • PROBE TERMINAL "B" (CKT 432) WITH A LIGHT TO 12 VOLTS.
   • IGNITION "ON".
   • "SCAN" SHOULD READ OVER 4 VOLTS.
   DOES IT?

   YES → CKT 416 OPEN OR SHORTED TO GROUND OR FAULTY ECM.

   NO → CIRCUIT 432 OPEN OR SHORTED TO GROUND OR FAULTY ECM.

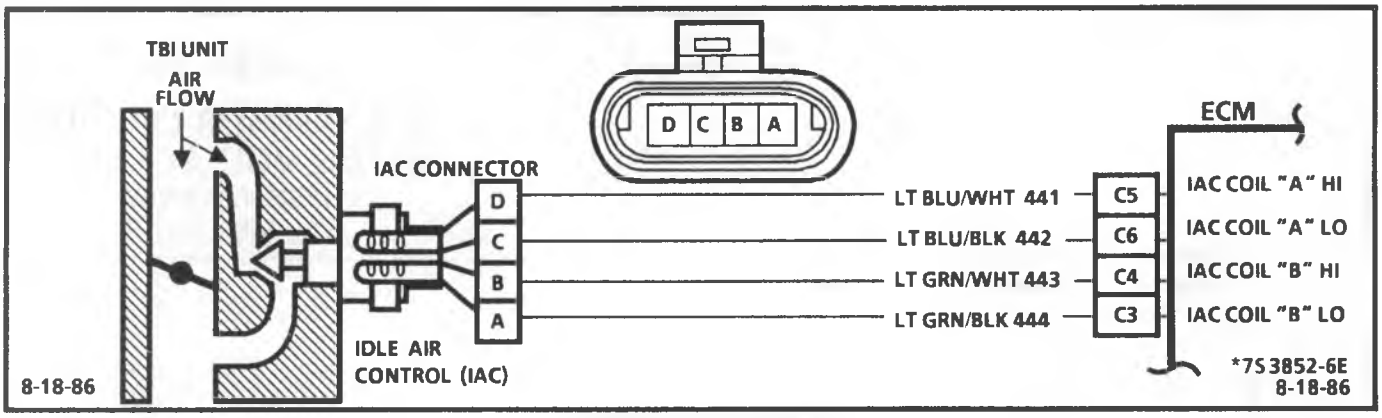
IGNITION "ON" ENGINE STOPPED VOLTAGES

ALTITUDE Meters	ALTITUDE Feet	VOLTAGE RANGE
Below 305	Below 1,000	3.8---5.5V
305--- 610	1,000--2,000	3.6---5.3V
610--- 914	2,000--3,000	3.5---5.1V
914--1219	3,000--4,000	3.3---5.0V
1219--1524	4,000--5,000	3.2---4.8V
1524--1829	5,000--6,000	3.0---4.6V
1829--2133	6,000--7,000	2.9---4.5V
2133--2438	7,000--8,000	2.8---4.3V
2438--2743	8,000--9,000	2.6---4.2V
2743--3048	9,000--10,000	2.5---4.0V

LOW ALTITUDE = HIGH PRESSURE = HIGH VOLTAGE

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

7S 3699
7-9-86



CODE 35

IDLE SPEED ERROR
2.5L ENGINE

Circuit Description:

Code 35 will set when the closed throttle engine speed is 100 rpm above or below the correct idle speed for 45 seconds. Review General Description in Section 4.

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

1. Continue with test even if engine will not idle. If idle is too 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 faulty, there is a system problem. Proceed to paragraph three below.
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 circuits is shorted to voltage which would have been indicated by a steady light. Disconnect ECM and turn the ignition "ON" and probe terminals to check for this condition.

Diagnostic Aids:

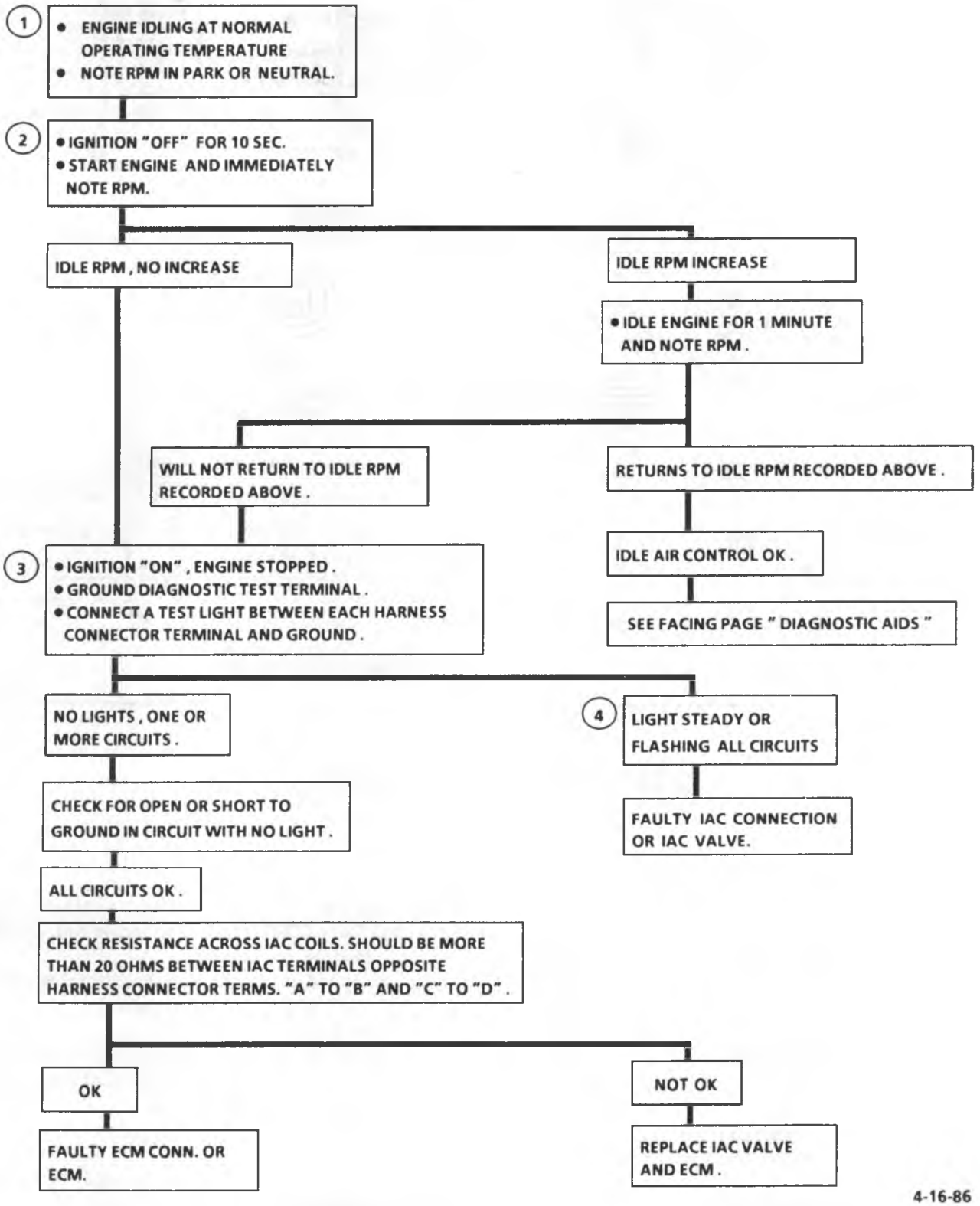
A slow unstable idle may be caused by a system problem that cannot be overcome by the IAC. "Scan" counts will be above 60 counts if too low and "0" counts if too high.

If idle is too high, stop engine. Ignition "ON". Ground diagnostic terminal. Wait a few seconds for IAC to seat, then disconnect IAC. 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 (.3 volts). Check for low regulated fuel pressure or water in fuel. A lean exhaust with an oxygen sensor output fixed above 800 mv (.8 volts) 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 (.8 volts).
  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.
- A/C Compressor or relay failure.
  See if A/C diagnosis circuit if shorted to ground. If the relay is faulty, an idle problem may exist.
- Refer to "Rough, Unstable, Incorrect Idle or Stalling" in Symptoms in Section 2.

CODE 35

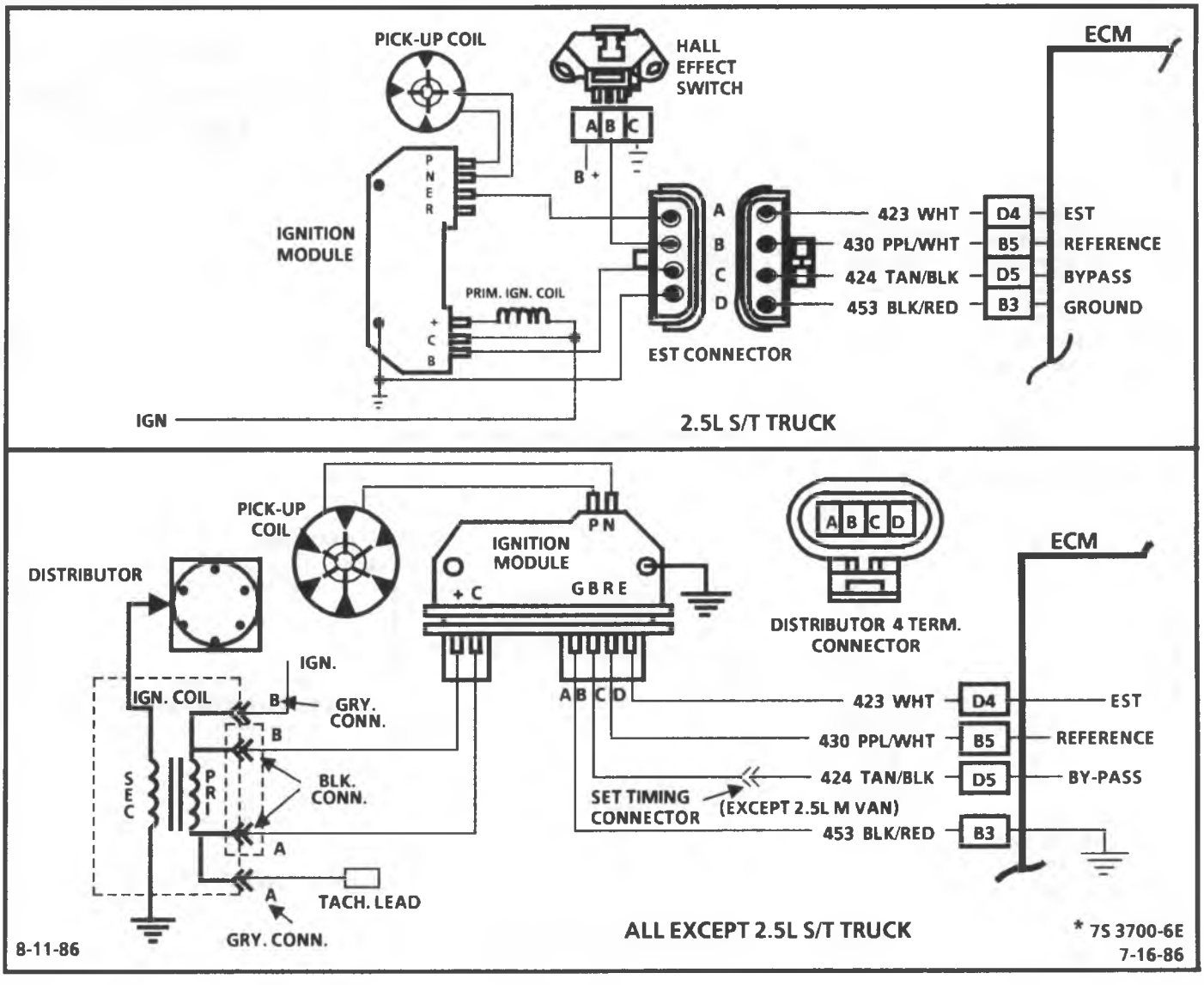
IDLE SPEED ERROR 2.5L ENGINE



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

4-16-86

* 75 3151-6E



CODE 42

ELECTRONIC SPARK TIMING (EST) ALL ENGINES

Circuit Description

Refer to page 3-9 for EST and Code 42.

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

1. Code 42 means the ECM has seen an open or short to ground in the EST or bypass circuits. This test confirms Code 42 and that the fault causing the code is present.
2. Checks for a normal EST ground path through the ignition module. An EST CKT 423 shorted to ground will also read less than 500 ohms; however, this will be checked later.
3. As the test light voltage touches CKT 424, the module should switch causing the ohmmeter to "overrange" if the meter is in the 100-200 ohms position.

   Selecting the 10-20,000 ohms position will indicate above 5000 ohms. The important thing is that the module "switched".
4. The module did not switch and this step checks for:
   - EST CKT 423 shorted to ground.
   - Bypass CKT 424 open.
   - Faulty ignition module connection or module.
5. Confirms that Code 42 is a faulty ECM and not an intermittent in CKTs 423 or 424.

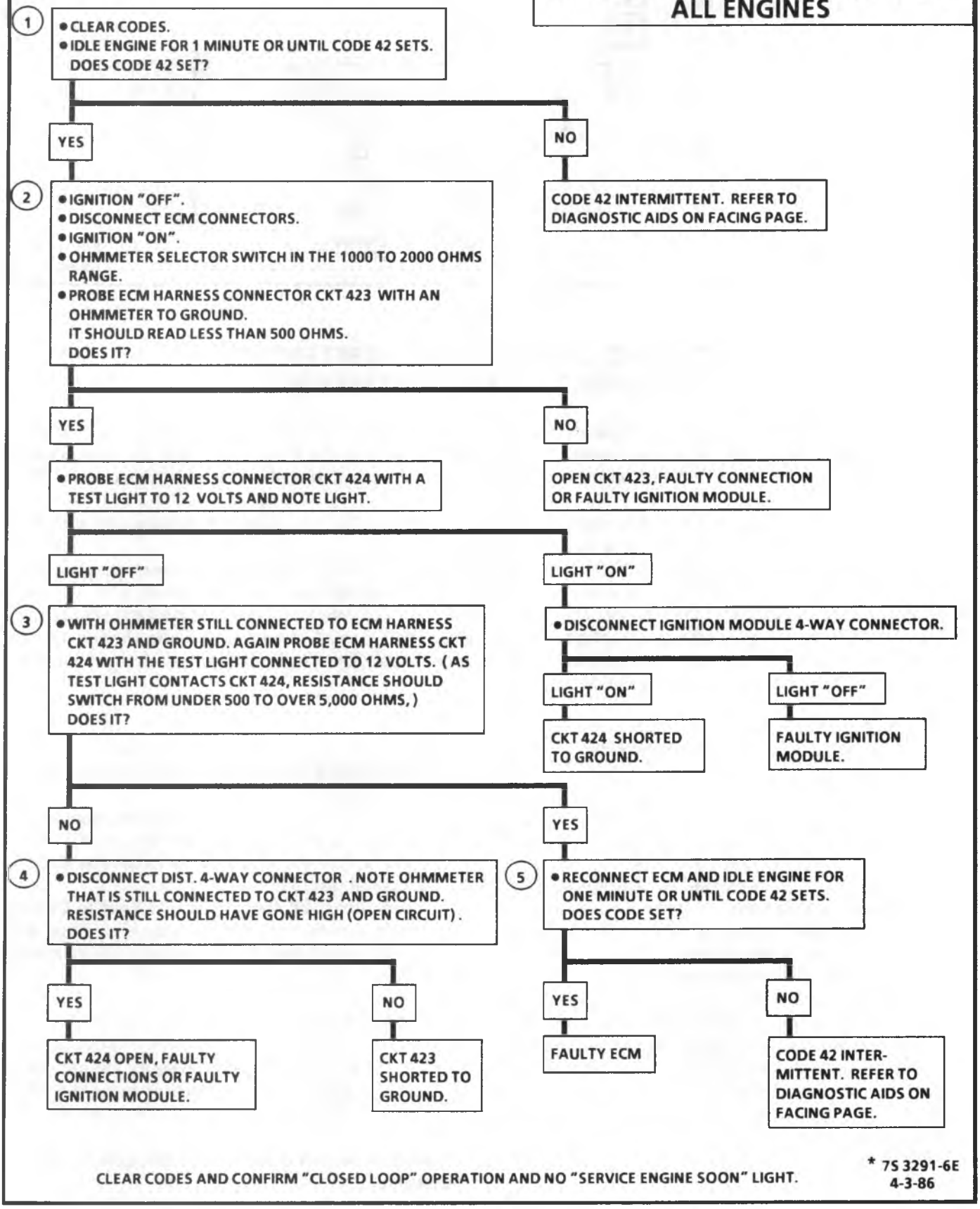
Diagnostic Aids:

The "Scan" tool does not have any ability to help diagnose a Code 42 problem.

Refer to Section 2 for ECM Intermittent Code or Performance.

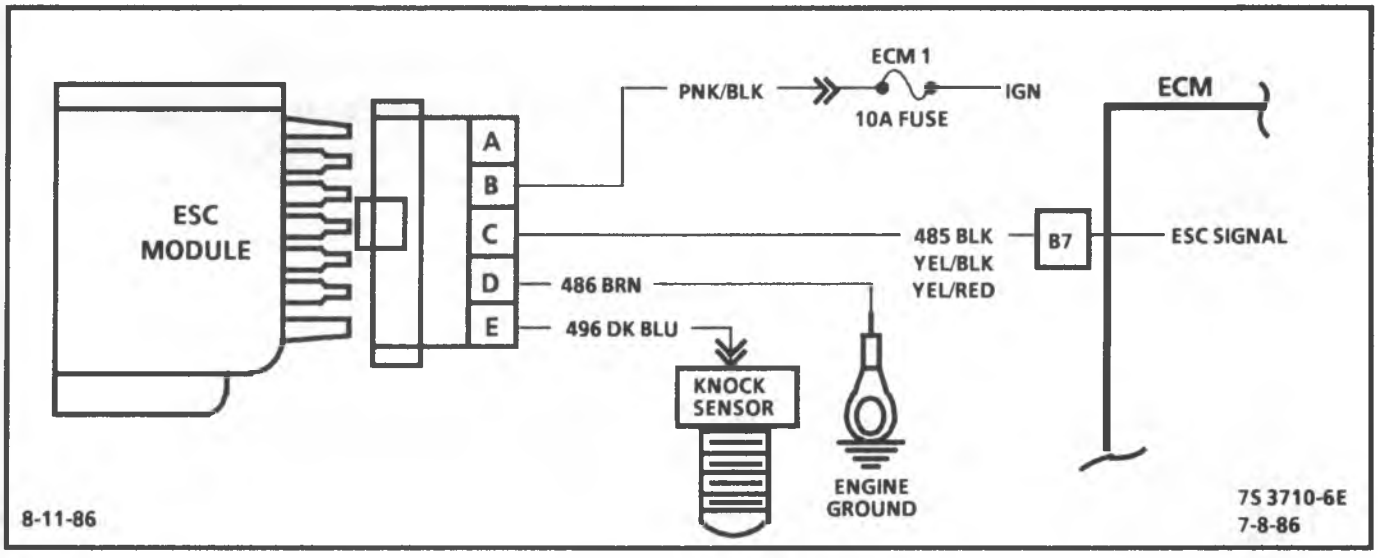
CODE 42

ELECTRONIC SPARK TIMING (EST) ALL ENGINES



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

* 7S 3291-6E
4-3-86



CODE 43

ELECTRONIC SPARK CONTROL (ESC) FAULT
ALL ENGINES EXCEPT 2.5L AND 7.4L

Circuit Description:

Electronic spark control is accomplished with a module that sends a voltage signal to the ECM. As the knock sensor detects engine knock, the voltage from the ESC module to the ECM drops, and this signals the ECM to retard timing. The ECM will retard the timing when knock is detected and rpm is above about 900 rpm.

Code 43 means the ECM has been low voltage at CKT 485 terminal "B7" for longer than 5 seconds with the engine running or the system has failed the functional check.

This system performs a functional check once per start-up to check the ESC system. To perform this test, the ECM will advance the spark when coolant is above 95°C and at a high load condition (near W.O.T.). The ECM then checks the signal at "B7" to see if a knock is detected. The functional check is performed once per start-up and if knock is detected when coolant is below 95°C (194°F), the test has passed and the functional check will not be run. If the functional check fails, the "Service Engine Soon" light will remain on until ignition is turned "OFF" or until a knock signal is detected.

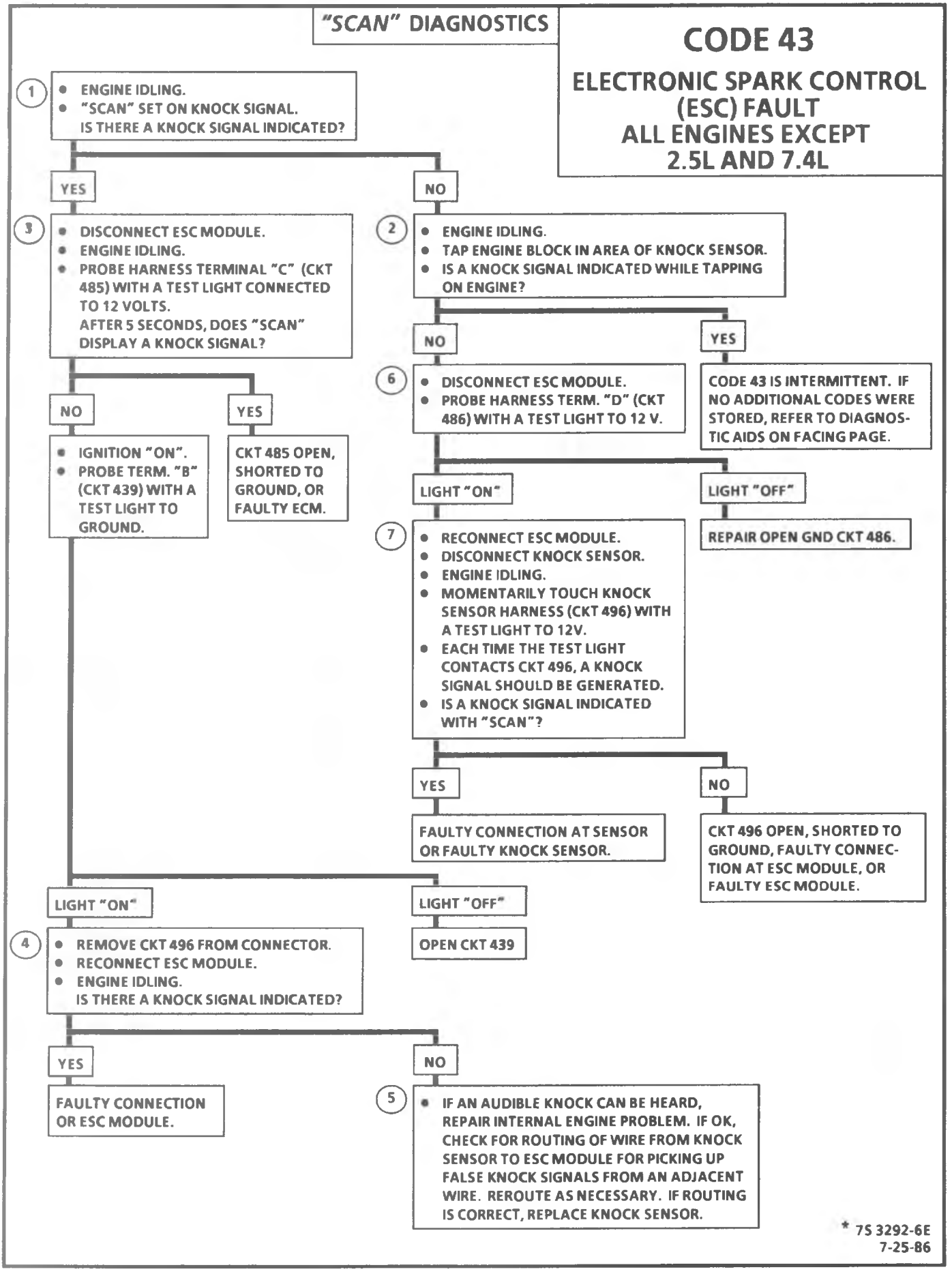
Test Description: Test numbers refer to step numbers on diagnostic chart.

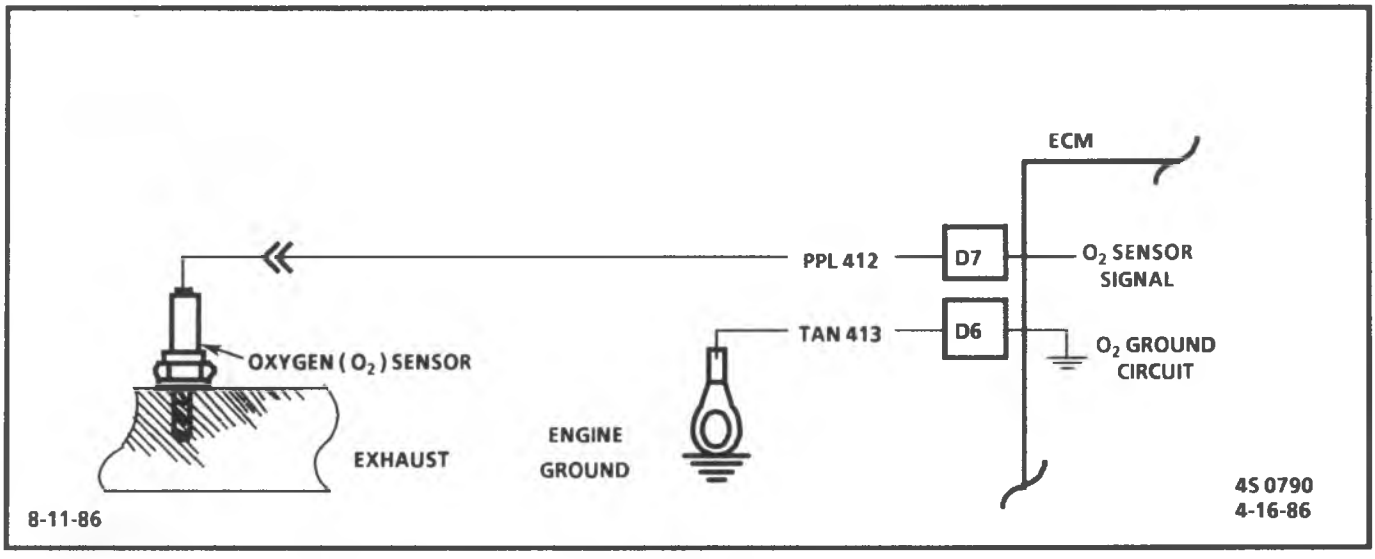
1. If the conditions for a Code 43 are present, the "Scan" will always display "yes". There should not be a knock at idle unless an internal engine problem, or a system problem exists.
2. This test will determine if the system is functioning at this time. Usually a knock signal can be generated by tapping on the right exhaust manifold. If no knock signal is generated, try tapping on block close to the area of the sensor.
3. Because Code 43 sets when the signal voltage on CKT 485 remains low, this test should cause the signal on CKT 485 to go high. The 12 volts signal should be seen by the ECM as "no knock" if the ECM and wiring are OK.
4. This test will determine if the knock signal is being detected on CKT 496 or if the ESC module is at fault.
5. If CKT 496 is routed to close to secondary ignition wires, the ESC module may see the interference as a knock signal.
6. This checks the ground circuit to the module. An open ground will cause the voltage on CKT 485 to be about 12 volts which would cause the Code 43 functional test to fail.
7. Connecting CKT 496 with a test light to 12 volts should generate a knock signal. This will determine if the ESC module is operating correctly.

Diagnostic Aids:

Code 43 can be caused by a faulty connection at the knock sensor at the ESC module or at the ECM. Also check CKT 485 for possible open or short to ground.

Refer to Section 2 for "ECM Intermittent Codes or Performance".


"SCAN" DIAGNOSTICS
CODE 43
ELECTRONIC SPARK CONTROL (ESC) FAULT
ALL ENGINES EXCEPT 2.5L AND 7.4L
1
ENGINE IDLING.
"SCAN" SET ON KNOCK SIGNAL.
IS THERE A KNOCK SIGNAL INDICATED?
YES
NO
3
DISCONNECT ESC MODULE.
ENGINE IDLING.
PROBE HARNESS TERMINAL "C" (CKT 485) WITH A TEST LIGHT CONNECTED TO 12 VOLTS.
AFTER 5 SECONDS, DOES "SCAN" DISPLAY A KNOCK SIGNAL?
NO
YES
IGNITION "ON".
PROBE TERM. "B" (CKT 439) WITH A TEST LIGHT TO GROUND.
CKT 485 OPEN, SHORTED TO GROUND, OR FAULTY ECM.
2
ENGINE IDLING.
TAP ENGINE BLOCK IN AREA OF KNOCK SENSOR.
IS A KNOCK SIGNAL INDICATED WHILE TAPPING ON ENGINE?
NO
YES
CODE 43 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO DIAGNOSTIC AIDS ON FACING PAGE.
6
DISCONNECT ESC MODULE.
PROBE HARNESS TERM. "D" (CKT 486) WITH A TEST LIGHT TO 12 V.
LIGHT "ON"
LIGHT "OFF"
REPAIR OPEN GND CKT 486.
7
RECONNECT ESC MODULE.
DISCONNECT KNOCK SENSOR.
ENGINE IDLING.
MOMENTARILY TOUCH KNOCK SENSOR HARNESS (CKT 496) WITH A TEST LIGHT TO 12V.
EACH TIME THE TEST LIGHT CONTACTS CKT 496, A KNOCK SIGNAL SHOULD BE GENERATED.
IS A KNOCK SIGNAL INDICATED WITH "SCAN"?
YES
NO
FAULTY CONNECTION AT SENSOR OR FAULTY KNOCK SENSOR.
CKT 496 OPEN, SHORTED TO GROUND, FAULTY CONNECTION AT ESC MODULE, OR FAULTY ESC MODULE.
LIGHT "ON"
LIGHT "OFF"
OPEN CKT 439
4
REMOVE CKT 496 FROM CONNECTOR.
RECONNECT ESC MODULE.
ENGINE IDLING.
IS THERE A KNOCK SIGNAL INDICATED?
YES
NO
FAULTY CONNECTION OR ESC MODULE.
5
IF AN AUDIBLE KNOCK CAN BE HEARD, REPAIR INTERNAL ENGINE PROBLEM. IF OK, CHECK FOR ROUTING OF WIRE FROM KNOCK SENSOR TO ESC MODULE FOR PICKING UP FALSE KNOCK SIGNALS FROM AN ADJACENT WIRE. REROUTE AS NECESSARY. IF ROUTING IS CORRECT, REPLACE KNOCK SENSOR.
* 7S 3292-6E
7-25-86



CODE 44

LEAN EXHAUST INDICATED ALL ENGINES

Circuit Description:

The ECM supplies a voltage of about .45 volts between terminals "D6" and "D7". (If measured with a 10 meg ohm 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 about 315°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 44 is set when the O_2 sensor signal voltage on CKT 412:
   - Remains below .2 volts for 20 seconds.
   - And the system is operating in "Closed Loop".

Diagnostic Aids:

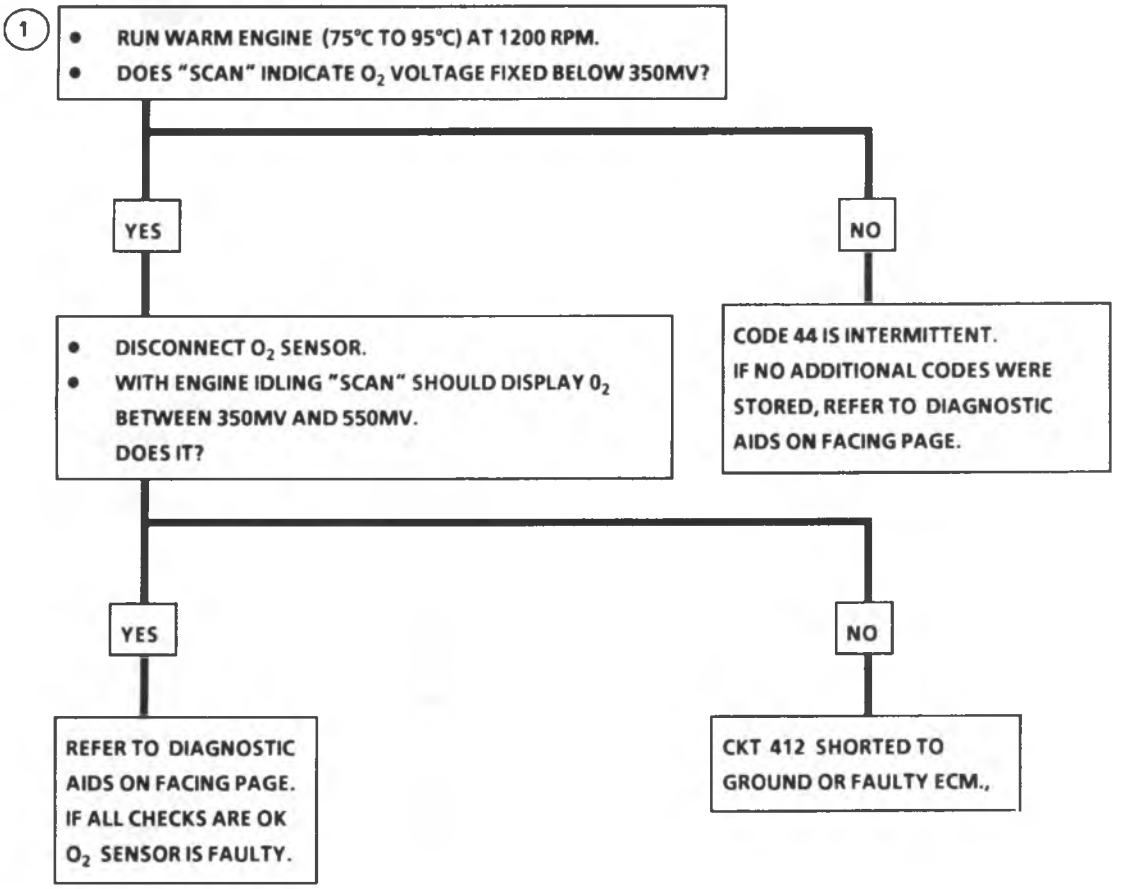
Using the "Scan", observe the block learn values at different rpm and air flow conditions. The "Scan" also displays the block cells, so the block learn values can be checked in each of the cells to determine when the Code 44 may have been set. If the conditions for Code 44 exists, the block learn values 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.
- 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 vehicle at various road speeds an/or loads to confirm. See Fuel System diagnosis.
- AIR System. 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 left side of exhaust ports, refer to Section 8. If the above are OK, it is a faulty oxygen sensor.
- CKT 413. If CKT 413 is open, the voltage at terminal "D7" will be over one volt.
- Sensor Harness. Sensor pigtail may be mispositioned and contacting the exhaust manifold.

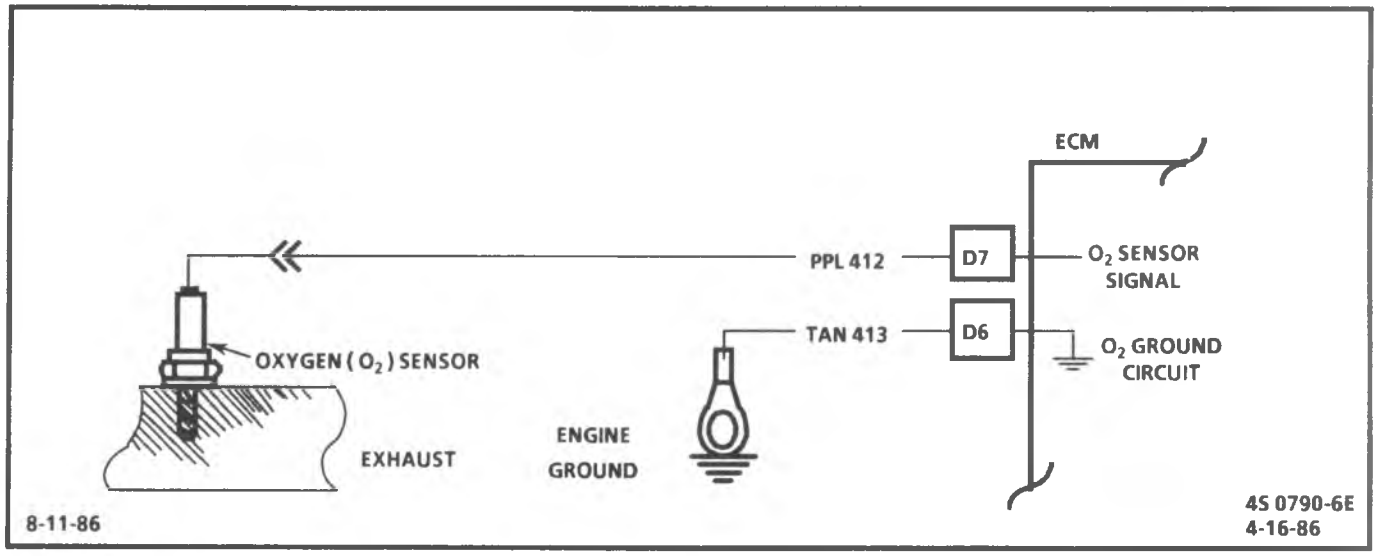
"*SCAN*" DIAGNOSTICS

CODE 44

LEAN EXHAUST INDICATED ALL ENGINES



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



CODE 45

RICH EXHAUST INDICATED ALL ENGINES

Circuit Description:

The ECM supplies a voltage of about .45 volts between terminals "D6" and "D7". (If measured with a 10 meg ohm 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 about 315 °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 45 is set when the O_2 sensor signal voltage or CKT 412:
   - Remains above .7 volts for 50 seconds, and in "Closed Loop".
   - Engine time after start is 1 minute or more.
   - Throttle angle greater than 2%. (about .2 volts above idle voltage)

Diagnostic Aids:

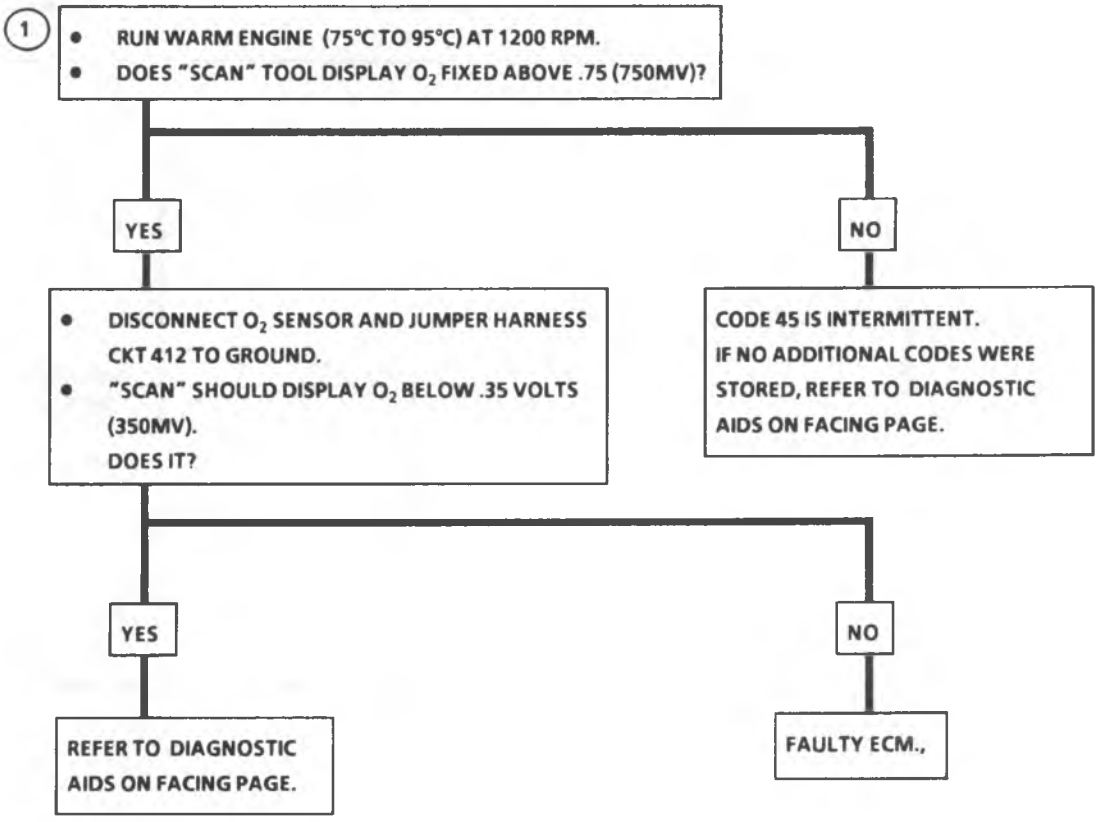
Using the "Scan", observe the block learn values at different rpm and air flow conditions. The "Scan" also displays the block cells, so the block learn values can be checked in each of the cells to determine when the Code 45 may have been set. If the conditions for Code 45 exists, the block learn values 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 45 may be set.
  See Fuel System diagnosis chart.
- Leaking Injector. See CHART A-4.
- 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 Evaporative Emission Control in Section 5.
- MAP Sensor. An output that causes the ECM to sensor a higher than normal manifold pressure (low vacuum) can cause the system to go rich. Disconnecting the MAP sensor will allow the ECM to set a fixed value for the MAP sensor. Substitute a different MAP sensor if the rich condition is gone while the sensor is disconnected.
- Pressure Regulator. Check for leaking fuel pressure regulator diaphragm by checking for presence of liquid fuel in the vacuum line to the regulator.
- 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.

"SCAN" DIAGNOSTICS

CODE 45

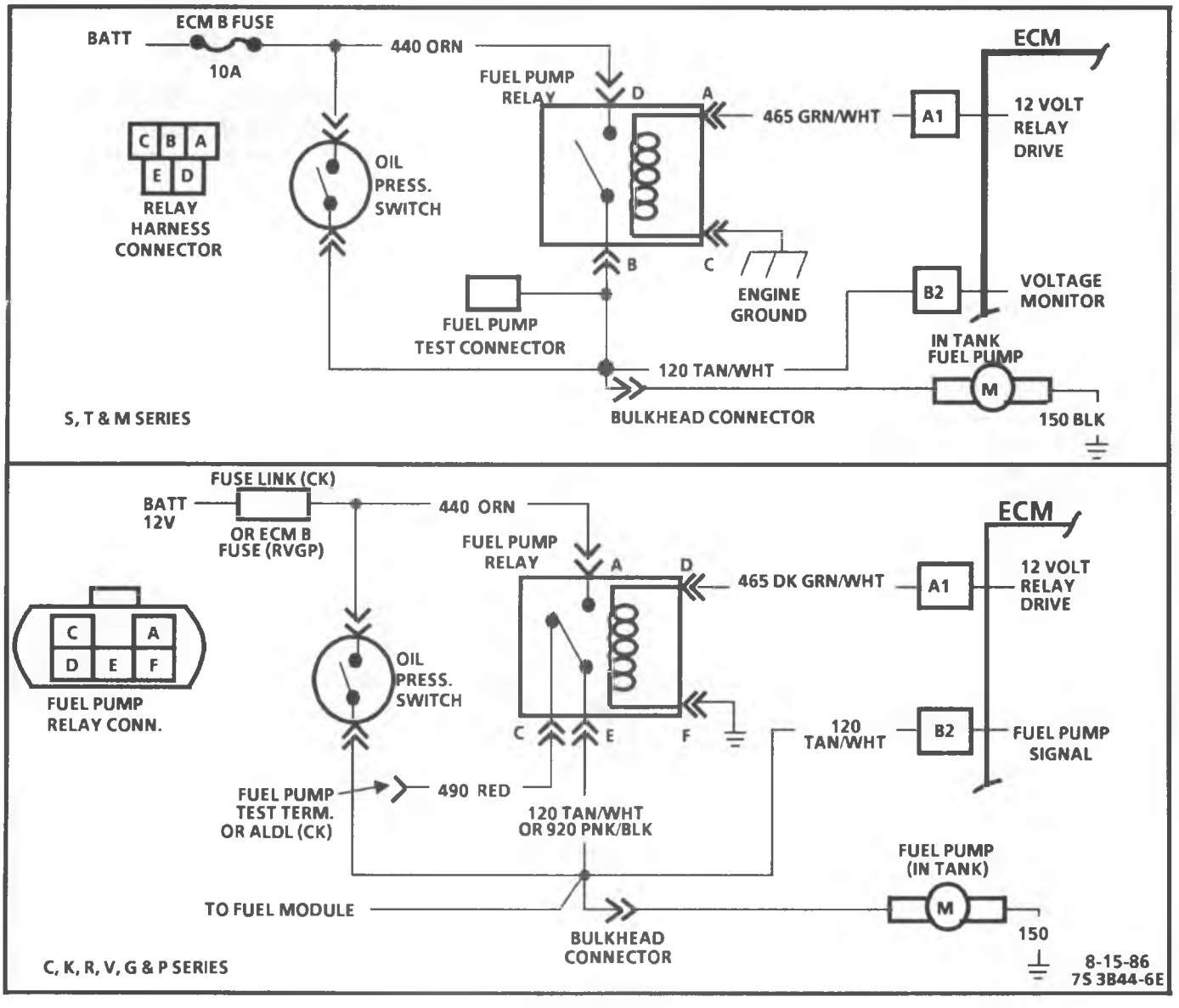
RICH EXHAUST INDICATED ALL ENGINES



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

3-6-86

*75 3192



CODE 54

FUEL PUMP CIRCUIT (LOW VOLTAGE) ALL ENGINES

Circuit Description

The status of the fuel pump CKT 120 is monitored by the ECM at terminal "B2" and is used to compensate fuel delivery based on system voltage. This signal is also used to store a trouble code if the fuel pump relay is defective or fuel pump voltage is lost while the engine is running. There should be about 12 volts on CKT 120 for at least 2 seconds after the ignition is turned, or any time reference pulses are being received by the ECM.

Code 54 will set if the voltage at terminal "B2" is less than 2 volts for 1.5 seconds since the last reference pulse was received. This code is designed to detect a faulty relay, causing extended crank time, and the code will help the diagnosis of an engine that "Cranks But Will Not Run."

If a fault is detected during start-up, the "Service Engine Soon" light will stay on until the ignition is cycled "OFF".

CODE 54

FUEL PUMP CIRCUIT (LOW VOLTAGE) ALL ENGINES

- IGN. "OFF" FOR 10 SECONDS
- IGN. "ON"
- LISTEN FOR IN-TANK FUEL PUMP.
- PUMP SHOULD RUN AFTER IGN. "ON". DOES IT?

NO

- IGN. "OFF".
- USING A FUSED JUMPER WIRE, CONNECT FUEL PUMP TEST CONN. TO 12 VOLTS.
- DOES PUMP RUN?

YES

- IGN. "OFF".
- DISCONNECT FUEL PUMP RELAY.
- PROBE CKT 440 WITH A TEST LIGHT TO GROUND.

LIGHT "ON"

CONNECT TEST LIGHT BETWEEN CKTS 440 & 450

LIGHT "OFF"

REPAIR OPEN IN CKT 440

NO

- DISCONNECT FUEL PUMP RELAY.
- USING THE FUSED JUMPER WIRE, CONNECT CKT 120 TO 12 VOLTS. DOES PUMP RUN?

YES

FAULTY RELAY

NO

OPEN CKT 120, FAULTY IN-TANK PUMP OR FAULTY PUMP GROUND.

YES

- CLEAR CODES.
- START AND RUN ENGINE FOR 30 SECONDS OR UNTIL CODE 54 SETS. DOES CODE SET?

YES

- BACK PROBE ECM TERM. B2 WITH A TEST LIGHT TO GROUND.
- IGN. "OFF" FOR 10 SEC.
- NOTE LIGHT AFTER IGN. "ON".

LIGHT "ON"

FAULTY CONNECTION AT ECM OR FAULTY ECM.

LIGHT "OFF"

OPEN CKT 120 TO ECM.

NO

CODE 54 IS INTERMITTENT. REFER TO DIAGNOSTIC AIDS ON FACING PAGE.

LIGHT "ON"

- CONNECT TEST LIGHT BETWEEN HARNESS CKT. 465 AND GND.
- IGN. "OFF" FOR 10 SECONDS.
- NOTE TEST LIGHT AFTER IGN. "ON".

LIGHT "ON"

- FAULTY RELAY.
- IF ORIGINAL SYMPTOM WAS "ENGINE CRANKS BUT WILL NOT RUN" CONTINUE TEST OF OIL PRESSURE SWITCH.
- ENGINE AT NORMAL OPERATING TEMPERATURE.
- OIL PRESSURE NORMAL.
- DISCONNECT FUEL PUMP RELAY. ENGINE SHOULD CONTINUE TO RUN. DOES IT?

YES

- RECONNECT FUEL PUMP RELAY.
- IGNITION "OFF".
- PROBE FUEL PUMP TEST TERMINAL WITH A TEST LIGHT TO GROUND.

LIGHT "OFF"

FUEL PUMP CIRCUIT OK

LIGHT "ON"

FAULTY OIL PRESSURE SWITCH

NO

FAULTY OIL PRESSURE SWITCH

LIGHT "OFF"

REPAIR OPEN CKT 450

LIGHT "OFF"

CKT 465 OPEN, SHORTED TO GROUND, OR FAULTY ECM.

CODE 51
CODE 52
CODE 55

CODE 51

FAULTY MEM-CAL

(2.5L ENGINE)

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

CODE 51

PROM PROBLEM

(EXCEPT 2.5L ENGINE)

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

CODE 52

FUEL CALPAK MISSING

(EXCEPT 2.5L ENGINE)

INSTALL MISSING OR FAULTY CALPAK .

CODE 55

ALL ENGINES

BE SURE ECM GROUNDS ARE OK AND THAT MEM-CAL IS PROPERLY LATCHED. IF OK REPLACE ELECTRONIC CONTROL MODULE (ECM).

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

7S 3784
7-24-86

RESTRICTED EXHAUST SYSTEM CHECK

ALL ENGINES

Proper diagnosis for a restricted exhaust system is essential before any components are replaced. Either of the following procedures may be used for diagnosis, depending upon engine or tool used:

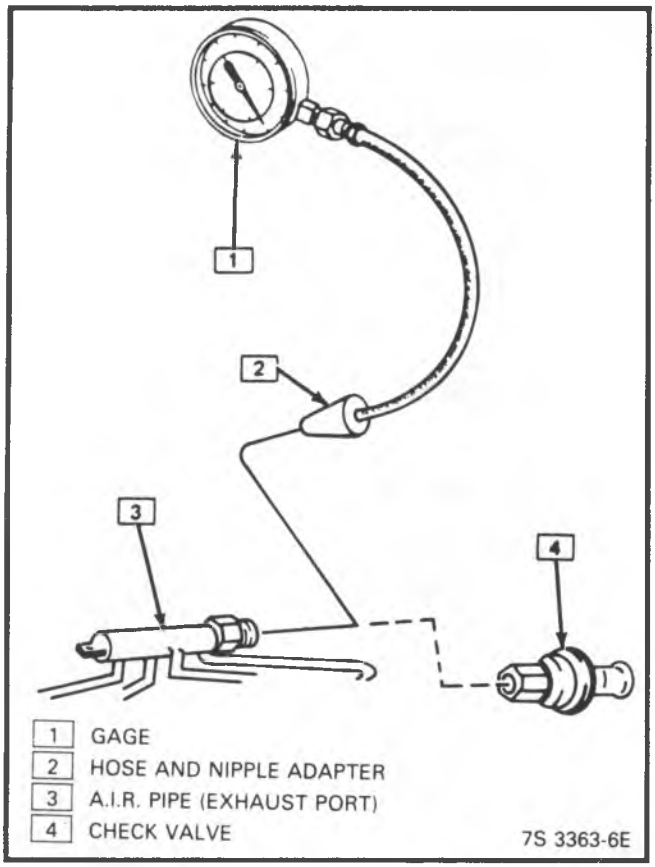
CHECK AT A. I. R. PIPE:

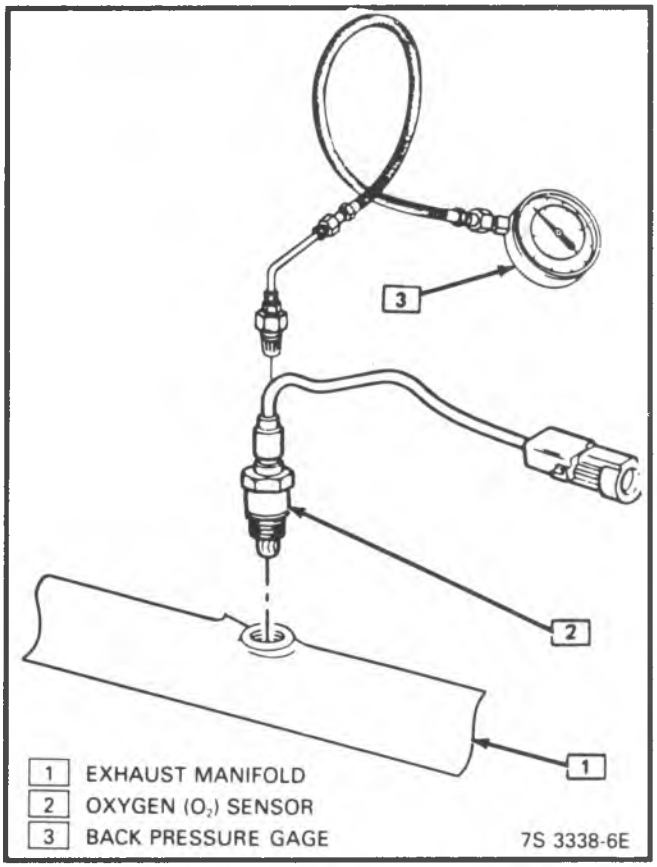
1. Remove the rubber hose at the exhaust manifold A.I.R. pipe check valve. Remove check valve.
2. Connect a fuel pump pressure gauge to a hose and nipple from a Propane Enrichment Device (J26911) (see illustration).
3. Insert the nipple into the exhaust manifold A.I.R. pipe.

OR

CHECK AT O_2 SENSOR:

1. Carefully remove O_2 sensor.
2. Install Borroughs 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.



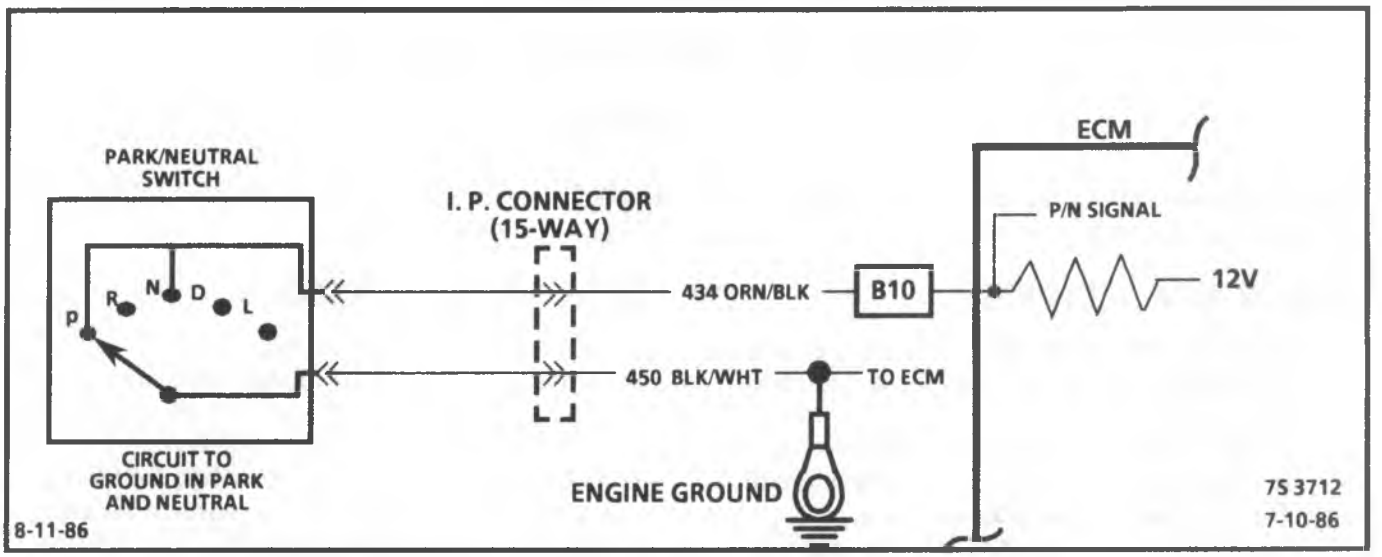


DIAGNOSIS:

1. With the engine idling at normal operating temperature, observe the exhaust system backpressure reading on the gauge. Reading should not exceed 1 $\frac{1}{4}$ psi (8.6 kPa).
2. Accelerate engine to 2000 rpm and observe gauge. Reading should not exceed 3 psi (20.7 kPa).
3. If the backpressure, at either rpm, exceeds specification, a restricted exhaust system is indicated.
4. Inspect the entire exhaust system for a collapsed pipe, heat distress, or possible internal muffler failure.
5. If there are no obvious reasons for the excessive backpressure, a restricted catalytic converter should be suspected and replaced using current recommended procedures.

4-24-86 7S 3340-6E

Figure 3-13 Exhaust System Check



PARK/NEUTRAL SWITCH DIAGNOSIS

ALL ENGINES
(AUTO TRANSMISSION ONLY)

Circuit Description:

The Park/Neutral Switch contacts 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

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 operators manual for type of display used for a specific tool.
2. Checks for an open switch in drive or reverse range.
3. Be sure "Scan" indicates drive, even while wiggling shifter to test for an intermittent or misadjusted switch in drive range.

Diagnostic Aids:

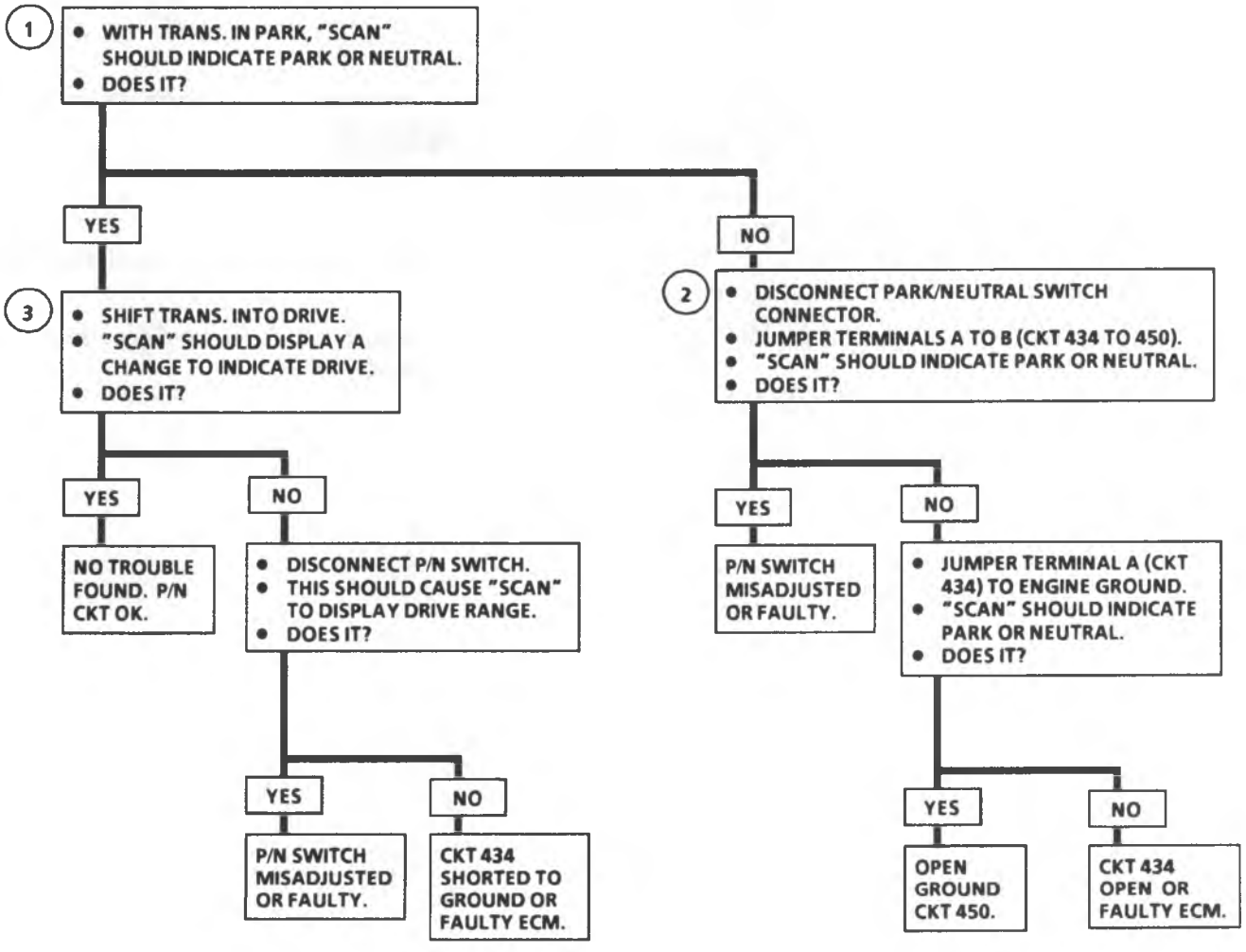
If CKT 434 indicates P/N (grounded), while in drive range, the EGR would be inoperative, resulting in possible detonation.

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

"SCAN" DIAGNOSTICS

PARK/NEUTRAL SWITCH DIAGNOSIS

ALL ENGINES
(AUTO TRANSMISSION ONLY)



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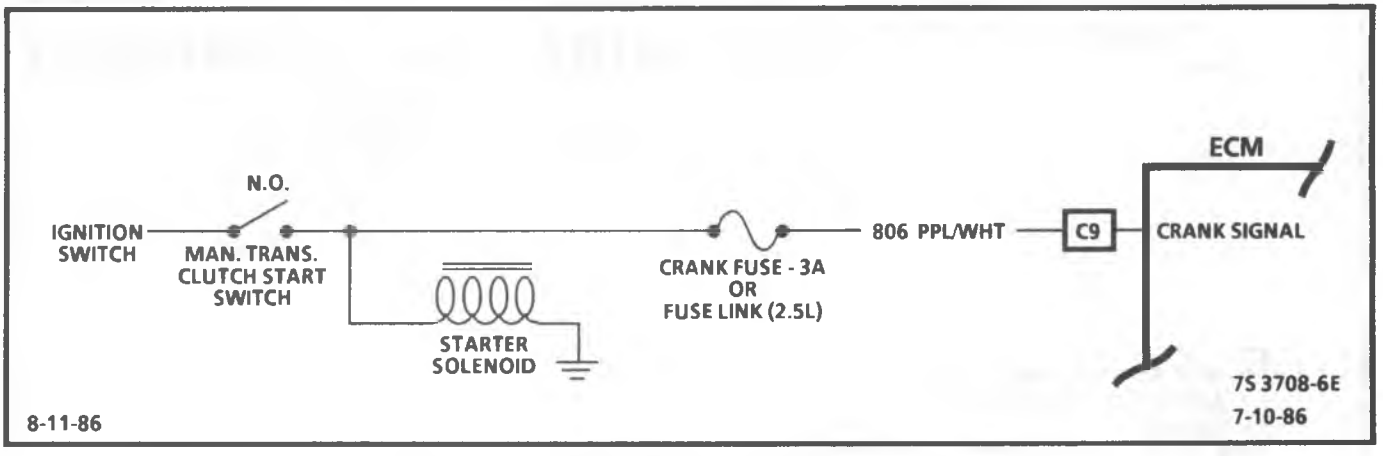
*7S 3161-6E



CRANK SIGNAL DIAGNOSIS

ALL ENGINES

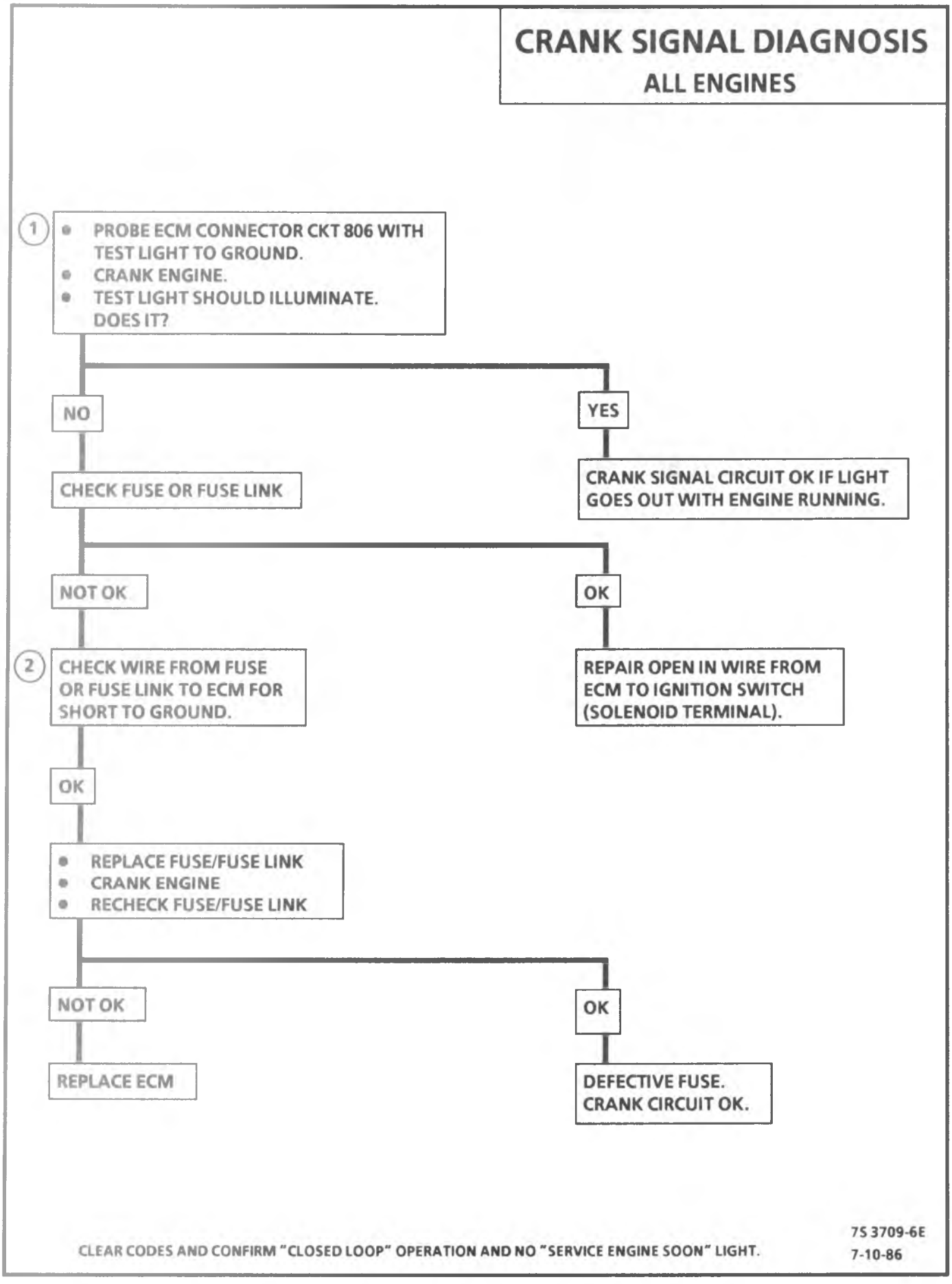
Circuit Description:

Crank signal is a 12 volts signal to the ECM during cranking to allow enrichment and cancel diagnostics until engine is running or 12 volts is no longer on circuit.

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

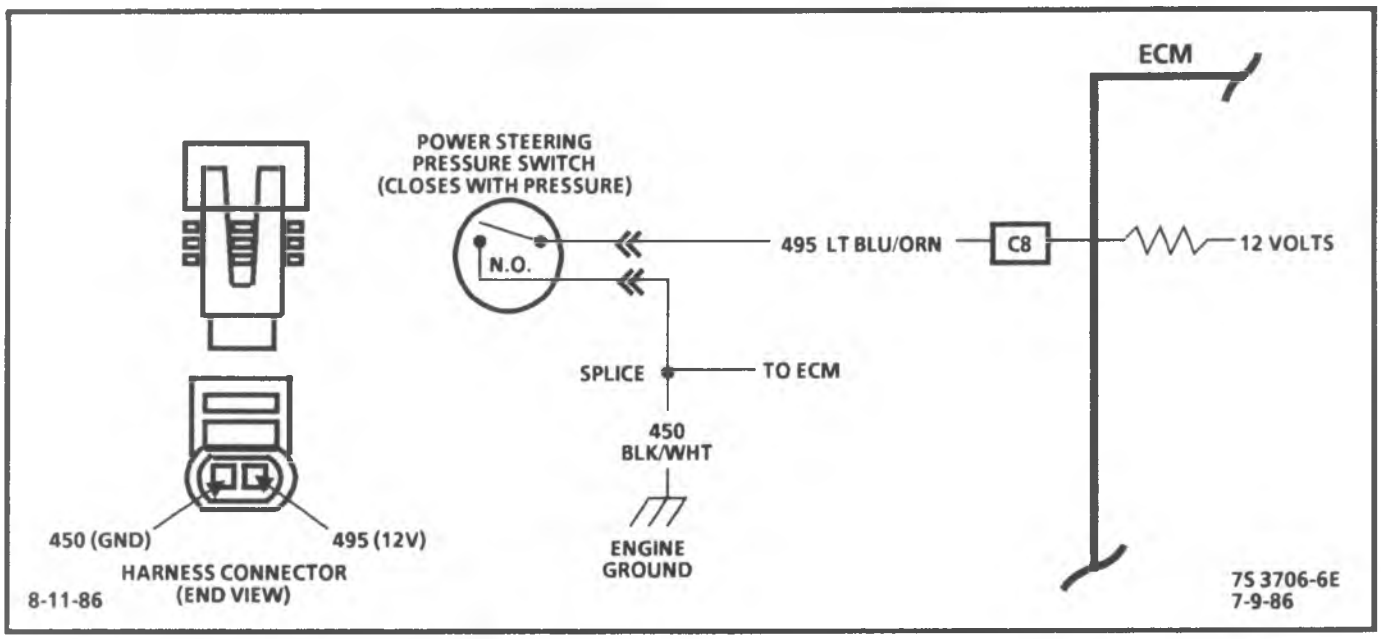
1. Checks for normal (cranking) voltage to terminal "C9" of ECM. Test light should be "ON" during cranking and then go "OFF" when engine is running.
2. Checks to determine if source of open fuse or fuse link was a faulty ECM.

CRANK SIGNAL DIAGNOSIS
ALL ENGINES



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

75 3709-6E
7-10-86



POWER STEERING (P/S) PRESSURE SWITCH CHECK

2.5L ENGINE

Circuit Description:

The power steering pressure switch is normally open to ground, and CKT 495 will be near battery voltage.

Turning the steering wheel increases power steering oil pressure and its load on an idling engine. The pressure switch will close before the load can cause an idle problem.

Closing the switch causes CKT 495 to read less than 1 volt. The ECM will increase the idle air rate and retard the timing.

Test Description:

Step numbers refer to step numbers on diagnostic chart.

1. Checks for ECM signal voltage on CKT 495 and confirms that ground CKT 450 is OK.
2. Maximum resistance, or infinity, indicates an open switch.
3. Less than 1 ohm indicates that the switch is closed when the power steering pressure is high. Switch is OK.

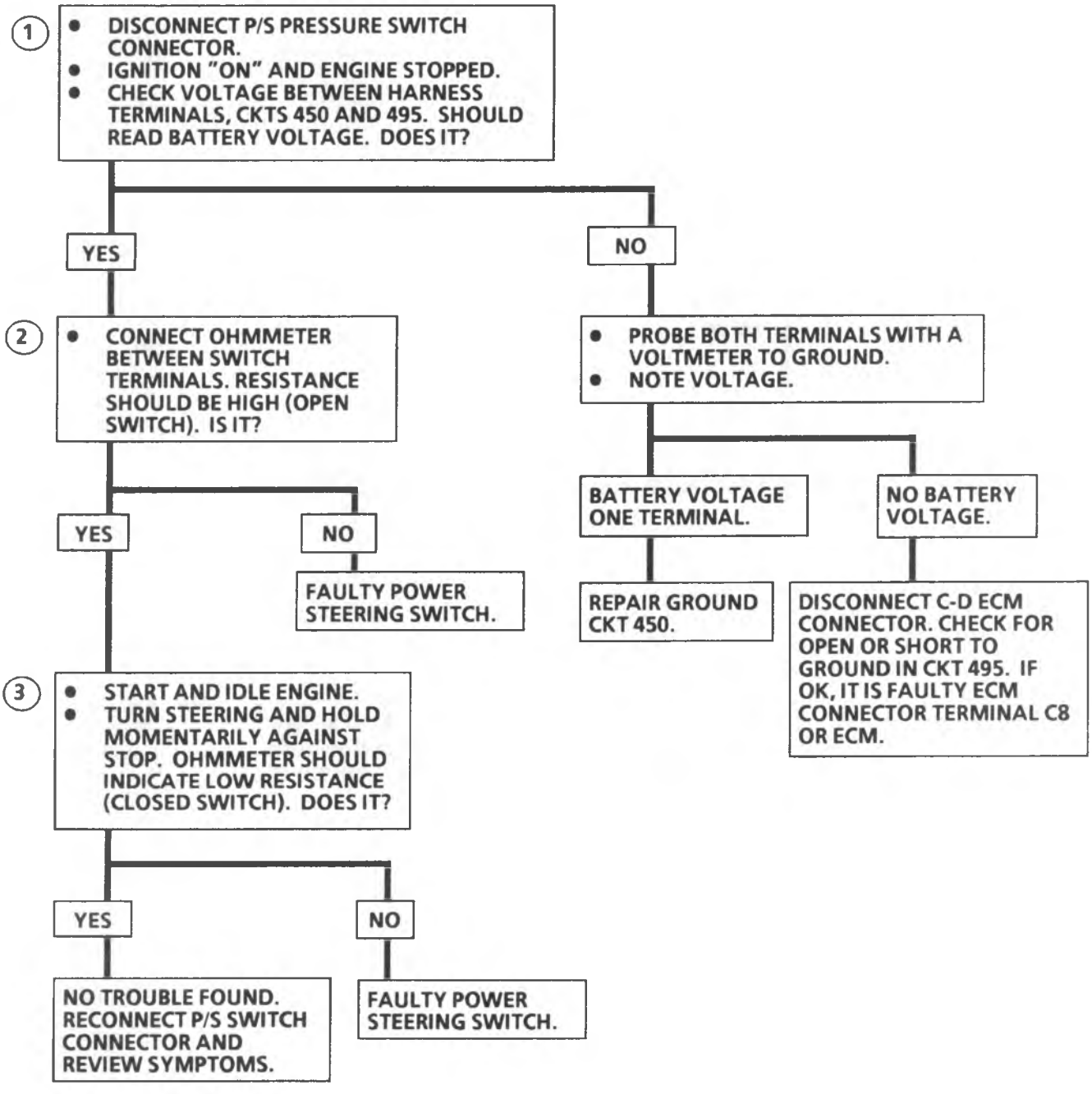
Diagnostic Aids:

A pressure switch that will not close, or an open CKT 495 or 450, may cause the engine to stop when power steering loads are high.

A switch that will not open, or a CKT 450 or 495, shorted to ground, will cause timing to retard at idle, and may affect idle quality.

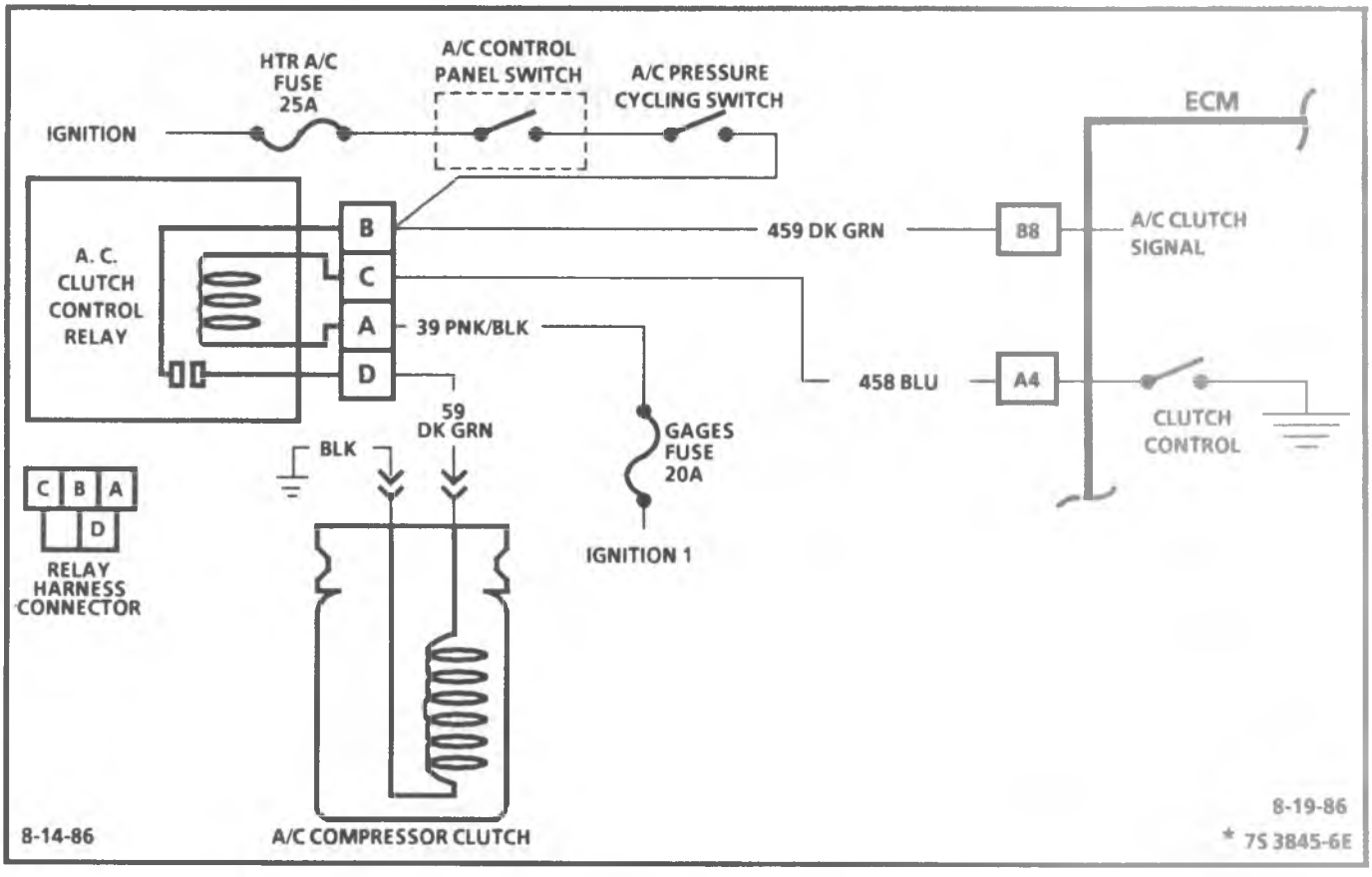
POWER STEERING (P/S) PRESSURE SWITCH CHECK

2.5L ENGINE



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

7S 3707-6E
7-9-86



A/C CLUTCH CONTROL DIAGNOSIS

(1 of 2)
2.5L ENGINE

Circuit Description:

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

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

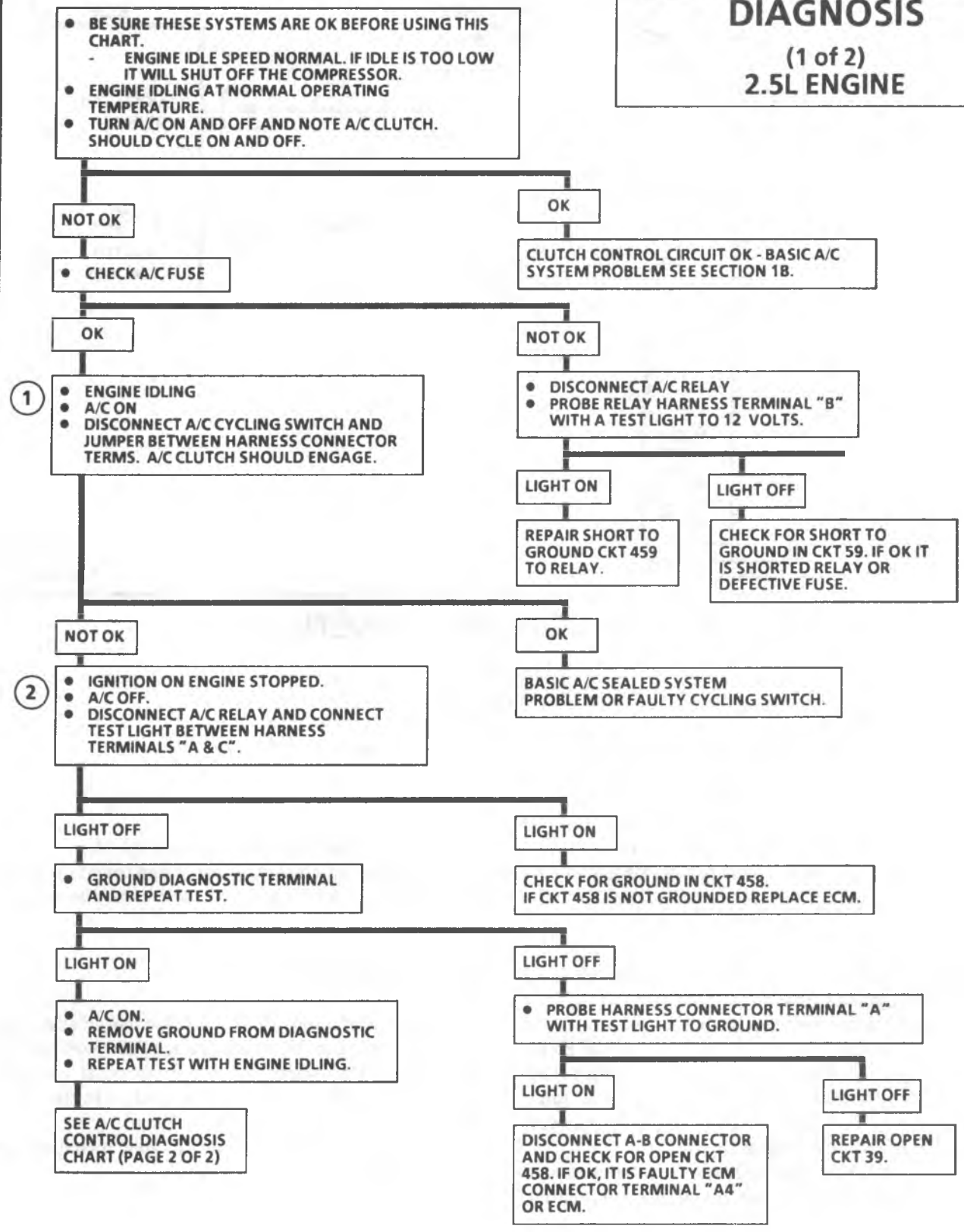
Turning on air conditioning supplies CKT 459 battery voltage to the clutch control relay and terminal B8. After a time delay of about 1/2 second the ECM will ground terminal "A4", CKT 458, and close the control relay. A/C compressor clutch will engage.

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

1. Checks for low refrigerant as cause for no A/C.
2. This and following tests check for faulty A/C control relay.

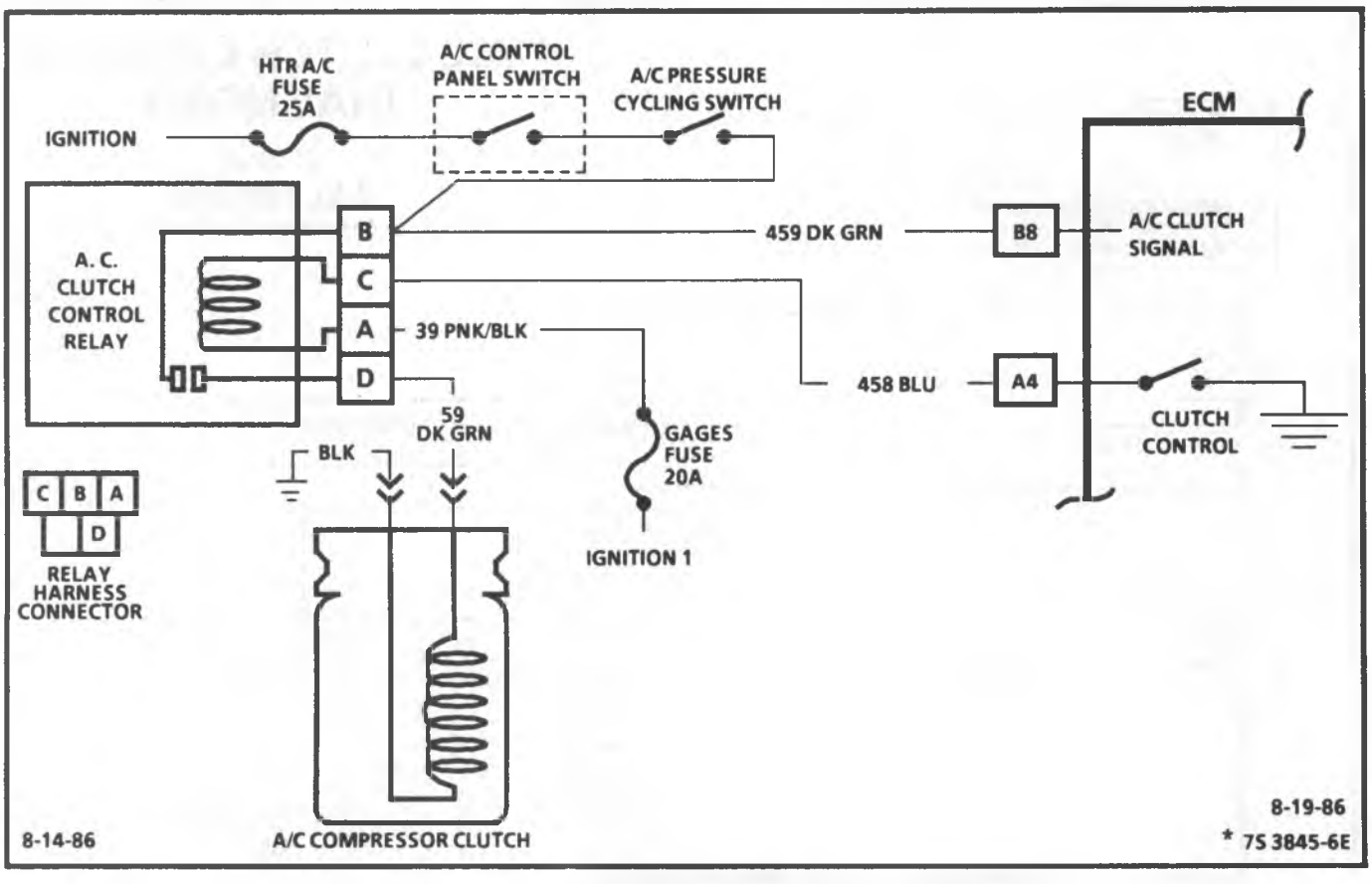
A/C CLUTCH CONTROL DIAGNOSIS

(1 of 2)
2.5L ENGINE



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

8-14-86
* 7S 3849-6E



A/C CLUTCH CONTROL DIAGNOSIS

(2 of 2)
2.5L ENGINE

Circuit Description:

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

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

Turning on air conditioning supplies CKT 459 battery voltage to the clutch control relay and terminal "B8". After a time delay of about 1/2 second, the ECM will ground terminal "A4", CKT 458, and close the control relay. A/C compressor clutch will engage.

Test Description:

Step numbers refer to step numbers on diagnostic chart.

3. Checks for faulty cycling switch.

- Solenoids and relays are turned "ON" or "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.

  Solenoid and relay coil resistance must measure more than 20 ohms. Less resistance will cause early failure of the ECM "driver". Using an ohmmeter, check the coil resistance of the A/C relay before replacing the ECM.

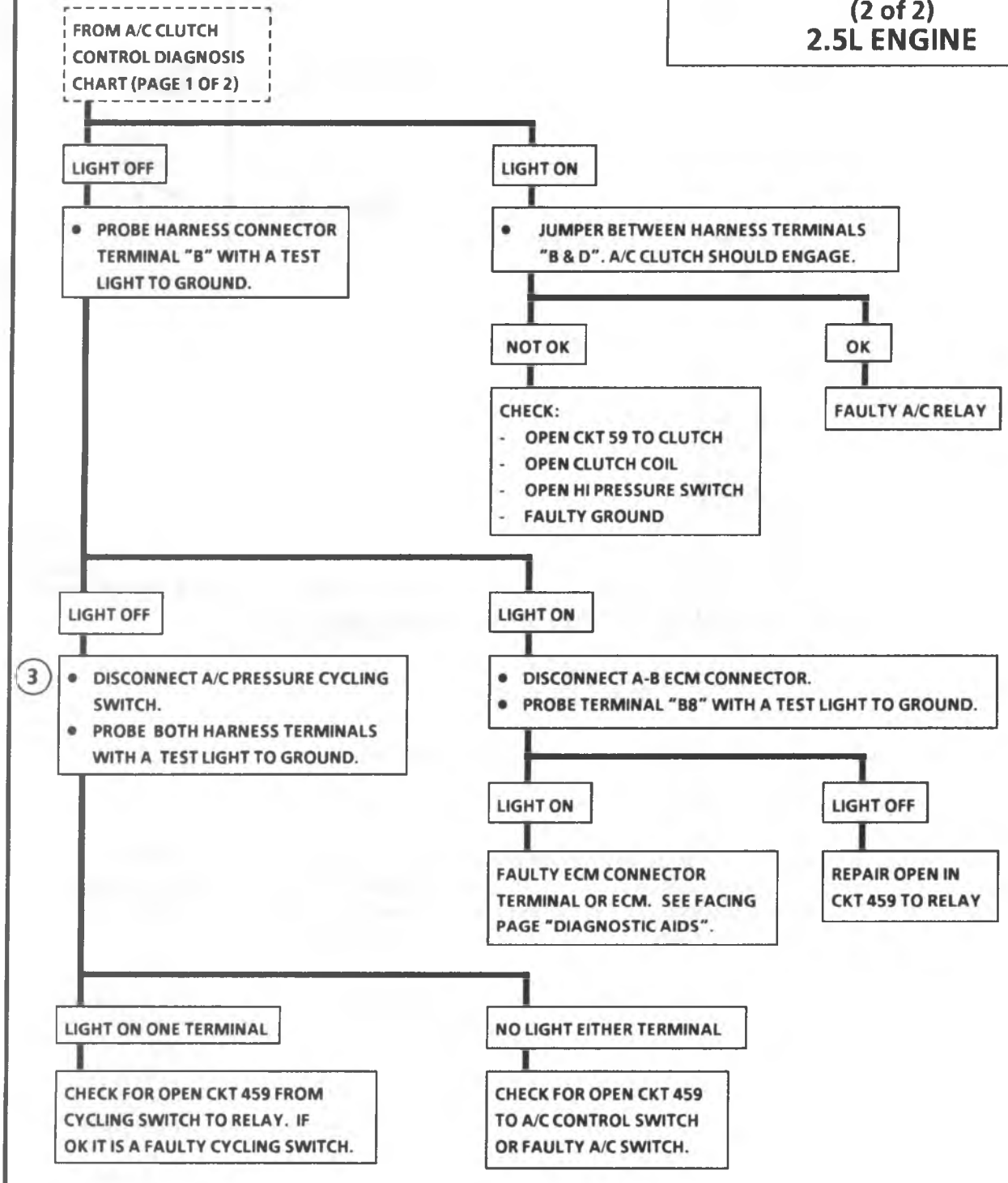
Diagnostic Aids:

Before replacing ECM, use ohmmeter and check resistance of each ECM controlled relay or solenoid coil. See ECM wiring diagram for coil terminal identification for solenoids(s) and relay(s) to be checked.

Replace any relay or solenoid that measures less than 20 ohms.

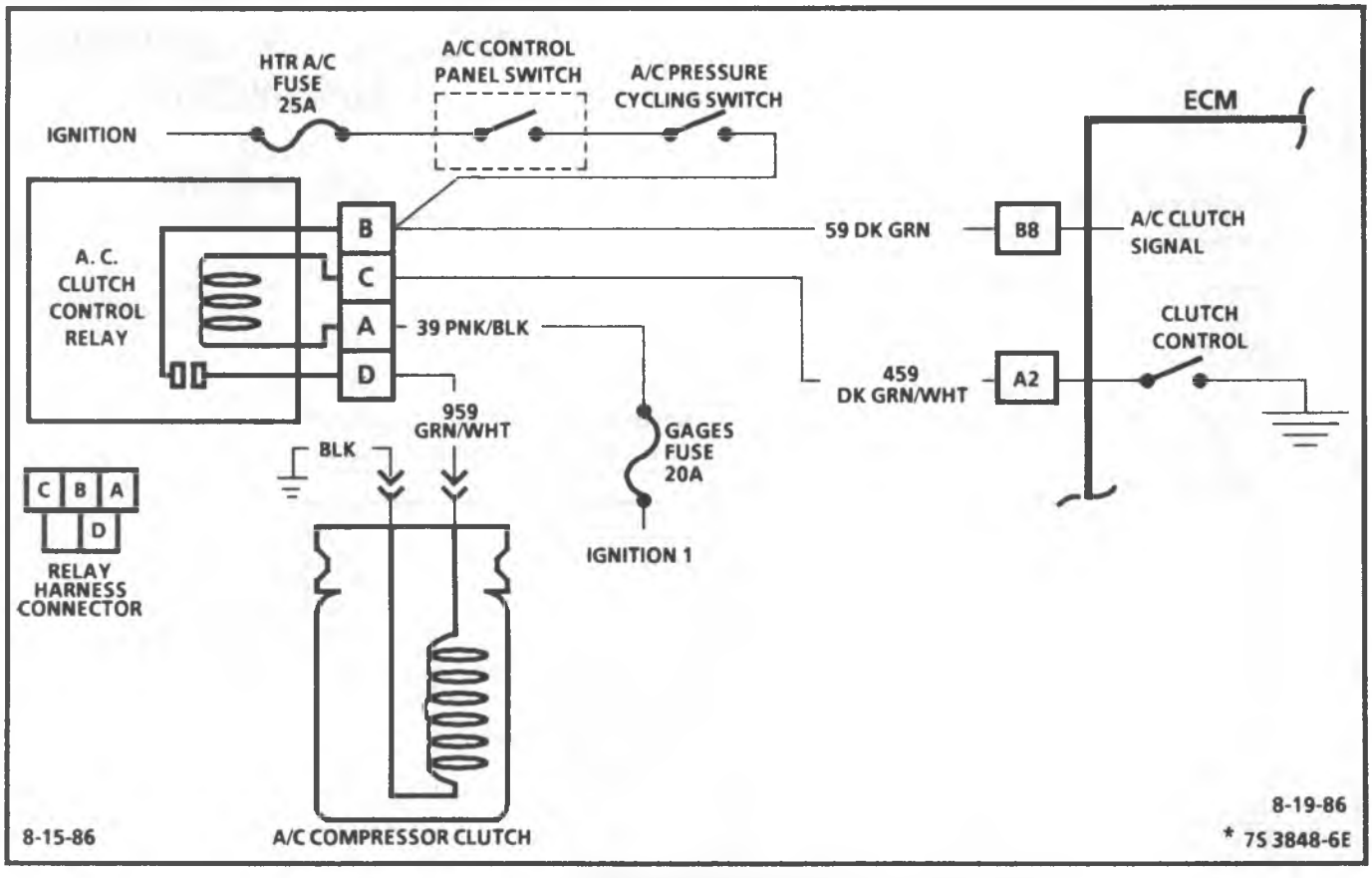
A/C CLUTCH CONTROL DIAGNOSIS

(2 of 2)
2.5L ENGINE



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

7S 3850-6E
8-14-86



A/C CLUTCH CONTROL DIAGNOSIS

(1 of 2)

2.8L ENGINE

Circuit Description:

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

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

Turning on air conditioning supplies CKT 59 battery voltage to the clutch control relay and terminal "B8" of the ECM connector. After a time delay of about 1/2 second the ECM will ground terminal "A2" of the ECM connector, CKT 459, and close the control relay. A/C compressor clutch will engage.

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

1. Checks for low refrigerant as cause for no A/C.
2. This and following tests check for faulty A/C control relay.

A/C CLUTCH CONTROL DIAGNOSIS

(1 of 2)
2.8L ENGINE

- BE SURE THESE SYSTEMS ARE OK BEFORE USING THIS CHART.
  - ENGINE IDLE SPEED NORMAL. IF IDLE IS TOO LOW IT WILL SHUT OFF THE COMPRESSOR.
  - ENGINE COOLING FAN RUNS WHEN A/C IS ON.
- ENGINE IDLING AT NORMAL OPERATING TEMPERATURE.
- TURN A/C ON AND OFF AND NOTE A/C CLUTCH. SHOULD CYCLE ON AND OFF.

NOT OK

- CHECK A/C FUSE

OK

(1)
- ENGINE IDLING
- A/C ON
- DISCONNECT A/C CYCLING SWITCH AND JUMPER BETWEEN HARNESS CONNECTOR TERMS. A/C CLUTCH SHOULD ENGAGE.

NOT OK

(2)
- IGNITION ON ENGINE STOPPED.
- A/C OFF.
- DISCONNECT A/C RELAY AND CONNECT TEST LIGHT BETWEEN HARNESS TERMINALS "A & C".

LIGHT OFF

- GROUND DIAGNOSTIC TERMINAL AND REPEAT TEST.

LIGHT ON

- A/C ON.
- REMOVE GROUND FROM DIAGNOSTIC TERMINAL.
- REPEAT TEST WITH ENGINE IDLING.

SEE CHART C-10B (2 of 2)

OK

CLUTCH CONTROL CIRCUIT OK - BASIC A/C SYSTEM PROBLEM SEE SECTION 1B.

NOT OK

- DISCONNECT A/C RELAY
- PROBE RELAY HARNESS TERMINAL "B" WITH A TEST LIGHT TO 12 VOLTS.

LIGHT ON

REPAIR SHORT TO GROUND CKT 59 TO RELAY.

LIGHT OFF

CHECK FOR SHORT TO GROUND IN CKT 959. IF OK IT IS SHORTED RELAY OR DEFECTIVE FUSE.

OK

BASIC A/C SEALED SYSTEM PROBLEM OR FAULTY CYCLING SWITCH.

LIGHT ON

CHECK FOR GROUND IN CKT 459. IF CKT 459 IS NOT GROUNDED REPLACE ECM.

LIGHT OFF

- PROBE HARNESS CONNECTOR TERMINAL "A" WITH TEST LIGHT TO GROUND.

LIGHT ON

DISCONNECT ECM A-B CONNECTOR AND CHECK FOR OPEN CKT 459. IF OK, IT IS FAULTY ECM CONNECTOR TERMINAL A2 OR ECM.

LIGHT OFF

REPAIR OPEN CKT 39.

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

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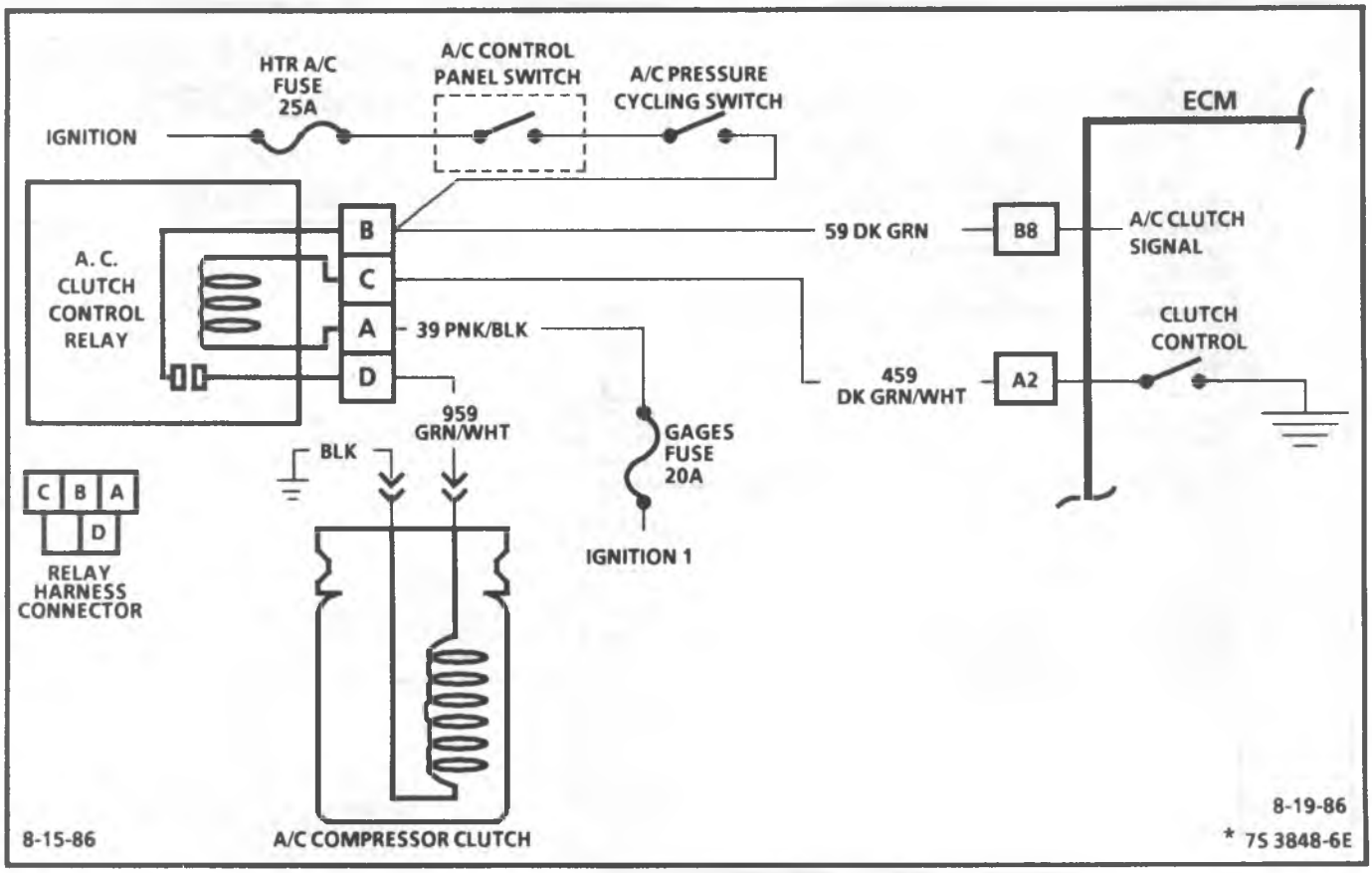
* 6S 2851-6E



A/C CLUTCH CONTROL DIAGNOSIS

(2 of 2)
2.8L ENGINE

Circuit Description:

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

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

Turning on air conditioning supplies CKT 59 battery voltage to the clutch control relay and terminal "B8" of the ECM connector. After a time delay of about 1/2 second the ECM will ground terminal "A2" of the ECM connector, CKT 459, and close the control relay. A/C compressor clutch will engage.

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

3. Checks for faulty cycling switch.

- Solenoids and relays are turned "ON" or "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.

  Solenoid and relay coil resistance must measure more than 20 ohms. less resistance will cause early failure of the ECM "driver". Using an ohmmeter, check the coil resistance of the A/C relay before replacing the ECM.

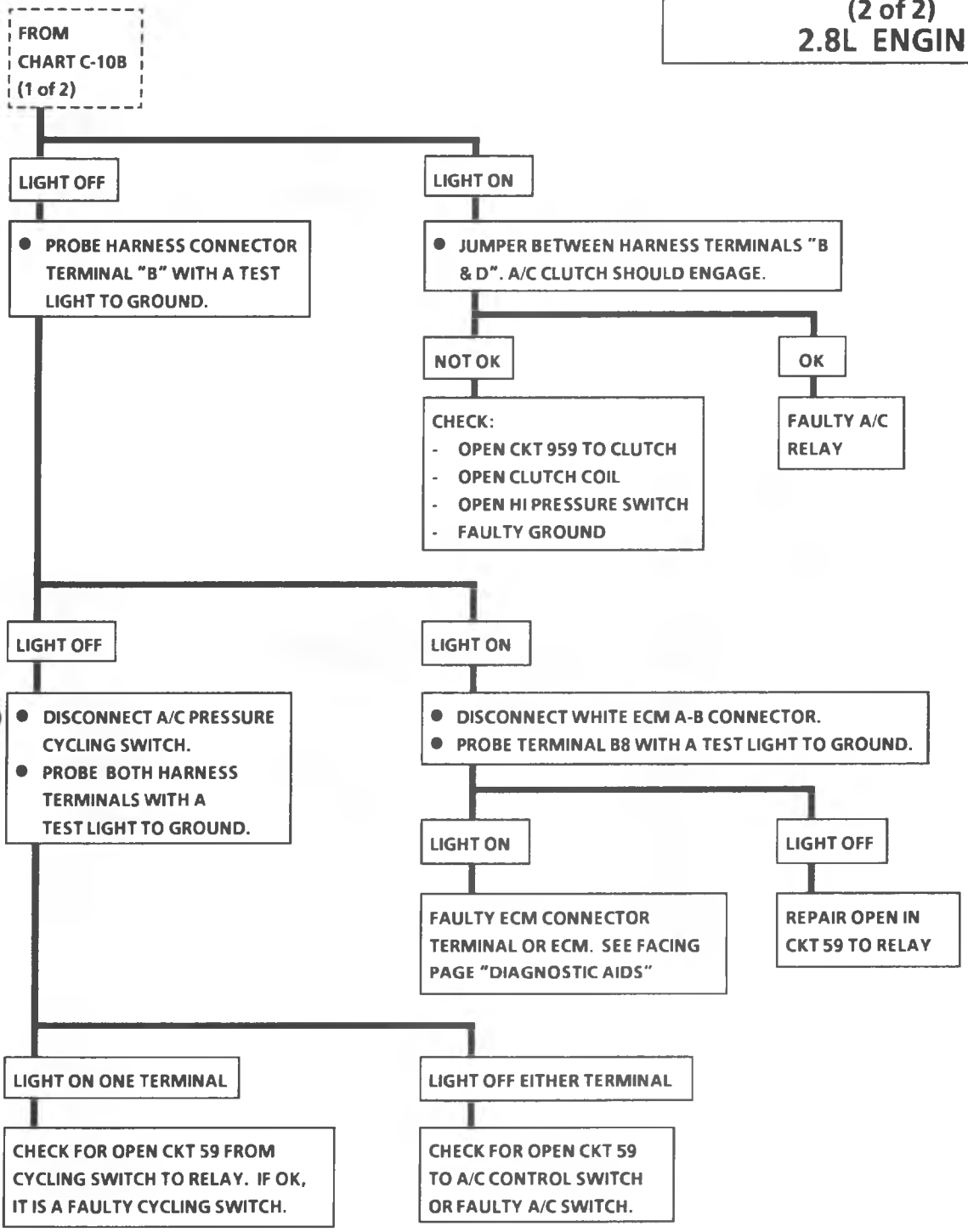
Diagnostic Aids:

Before replacing ECM, use ohmmeter and check resistance of each ECM controlled relay or solenoid coil. See ECM wiring diagram for coil terminal identification for solenoid(s) and relay(s) to be checked.

Replace any relay or solenoid that measures less than 20 ohms.

A/C CLUTCH CONTROL DIAGNOSIS

(2 of 2)
2.8L ENGINE



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

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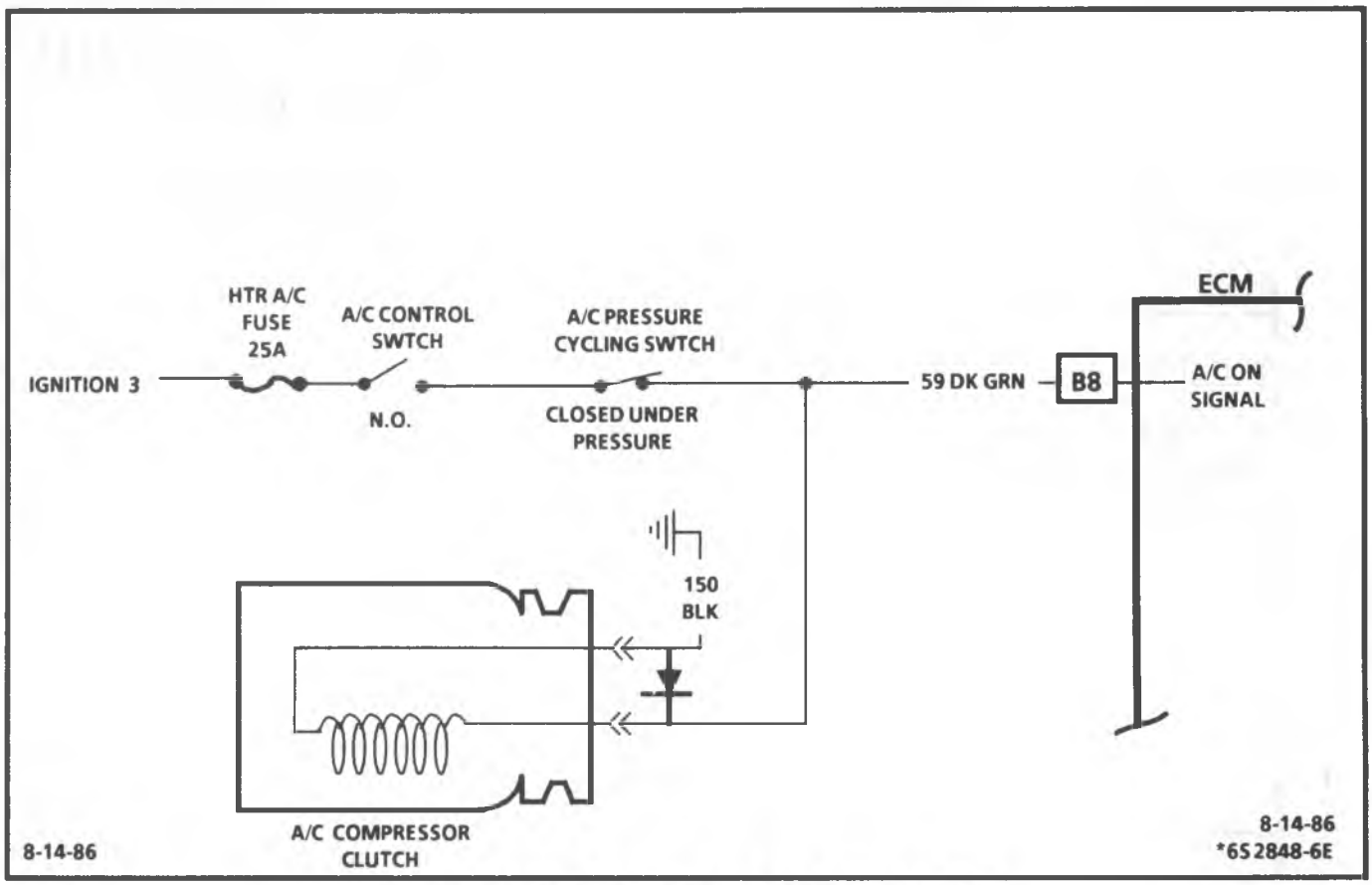
8-14-86



A/C "ON" SIGNAL DIAGNOSIS

4.3L AND V8 ENGINE

Circuit And Test Description:

Turning on the air conditioning supplies CKT 59 battery voltage to the A/C compressor clutch and to terminal "B8" of the ECM connector to increase idle air rate and maintain idle speed.

The ECM does not control the A/C compressor clutch, therefore, if A/C does not function, refer to the A/C section of the service manual for diagnosis of the system.

If A/C is operating properly and idle speed dips too low when the A/C compressor turns "ON" or flares too high when the A/C compressor turns "OFF", check for an open CKT 59 to the ECM. If circuits is OK, it is a faulty ECM connector terminal "B8" or ECM.

ON-VEHICLE SERVICE

WIRE HARNESS

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

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 3-14.

Molded on connectors require complete replacement of the connector. This means splicing a new connector assembly into the harness.

Refer to Figure 3-17 through 3-28, for wiring diagrams.

Replacement connectors and terminals are listed in Group 8.965, of the Standard Parts Catalog.

CONNECTORS AND TERMINALS

Use care, when probing a 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. Use tachometer adapter J35812, or equivalent, which provides an easy hook up of the tach. lead. The connector test adapter kit J35616, or equivalent, contains an assortment of flexible connectors, used to probe terminals during diagnosis. Fuse remover and test tool BT 8616, or equivalent, is used for removing a fuse and to adapt fuse holder, with a meter, for diagnosis.

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.

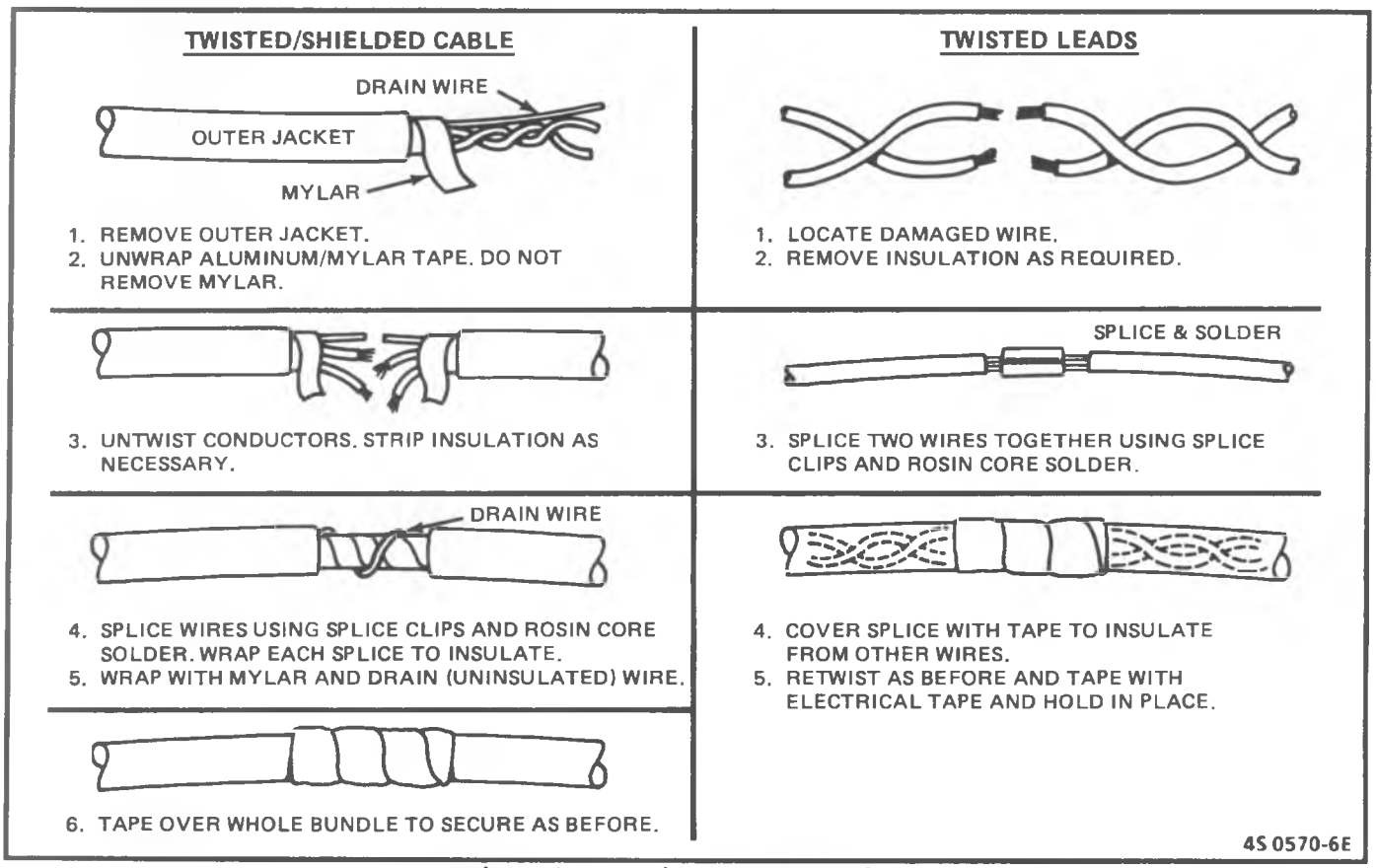


Figure 3-14 - Wire Harness Repair

Micro-Pack

Refer to Figure 3-15 ane repair procedure for repolacement of a Micro-Pack terminal.

Metri-Pack

Some connectors use terminals called Metri-Pack Series 150. (Figure 3-16). These may used at the Coolant Sensor, as well as TBI units.

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 conector to seat it in place.

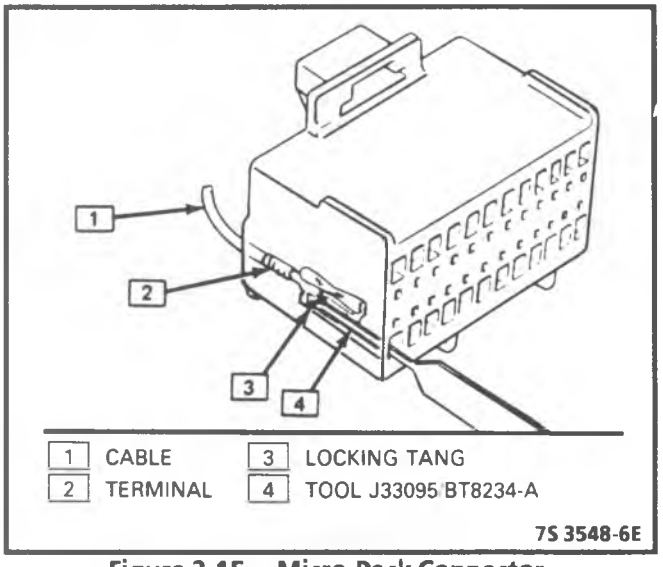


Figure 3-15 - Micro-Pack Connector

To remove a terminal:

1. Slide the seal back on the wire.
2. Insert tool (3) BT-8518, or J35689, 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).

Weather-Pack

A Weather-Pack connector can be identified by a rubber seal, at the rear of the connector. This connector, which is used in the engine compartment, protects against moisture and dirt, which could create oxidation and deposits on the temrinals. This protection is important, because of the very low voltage and current levels found in the electronic system.

Repair of a Weather-Pack terminal is shown in Figure 3-17. Use tool J28742, or BT8234-A, 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.

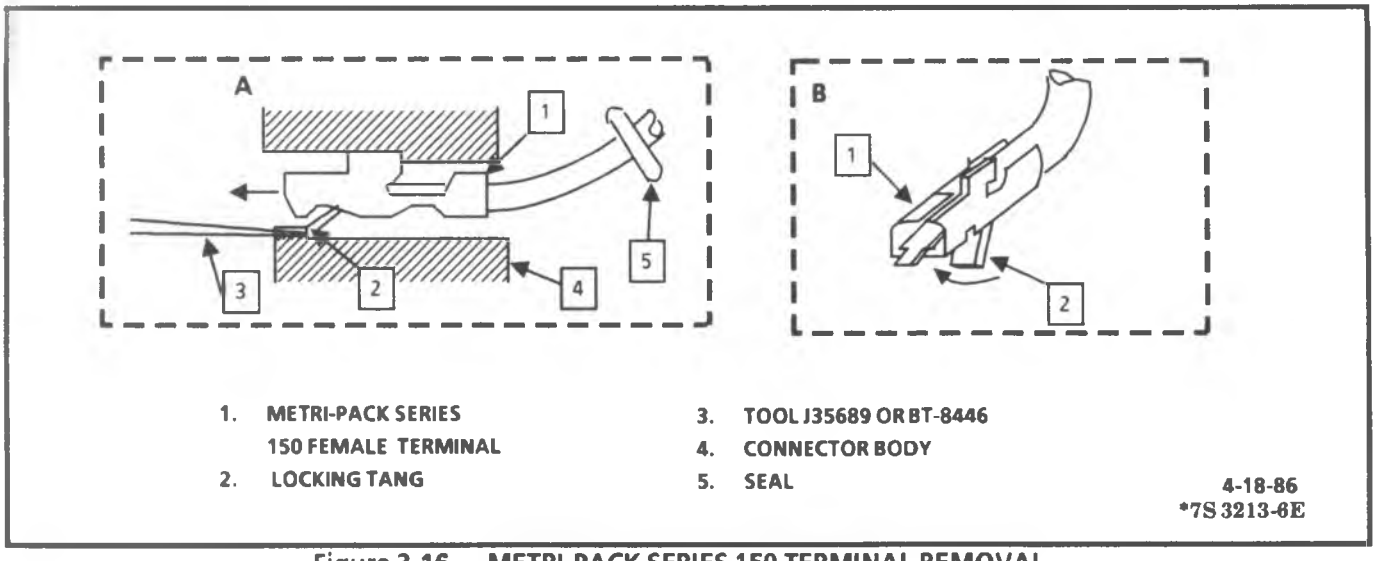


Figure 3-16 - METRI-PACK SERIES 150 TERMINAL REMOVAL

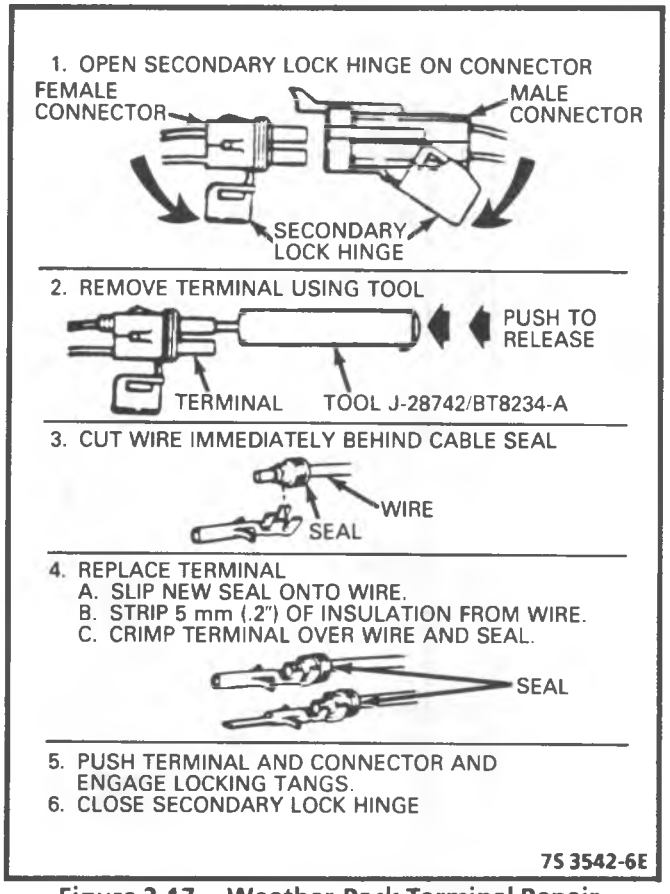


Figure 3-17 - Weather-Pack Terminal Repair

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 J28742, or BT8234-A, as these will damage the terminals.

ELECTRONIC CONTROL MODULE

Replacement of the Electronic Control Module (ECM) consists of a service controller, without a PROM/CALPAK, or Mem-Cal.

If the diagnostic procedures required the ECM to be replaced, the ECM, PROM, CALPAK, and Mem-Cal should be checked for the correct part number. If they are, remove the PROM and CALPAK, or Mem-Cal, and install them in the service controller. The service controller will not contain a PROM/CALPAK, or Mem-Cal.

Important

When replacing a production ECM with a service controller, transfer the broadcast code and production ECM part number to the controller label. Do not record information on the access cover.

NOTICE: The ignition must be "OFF", when disconnecting or reconnecting the ECM connector, to prevent internal damage to the ECM.

ECM Connector Terminal Voltages

Refer to Figure 3-28 through 3-30, for voltage charts, to aid in diagnosis.

ECM Replacement - with Mem-Cal Figures 3-31 and 3-32

Remove or Disconnect

1. Negative battery cable.
2. Connectors from ECM.
3. ECM mounting hardware.
4. ECM from passenger compartment.
5. ECM access cover (Figure 3-2).
6. Mem-Cal removal (Figure 3-33).

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.

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 3-34)

For alignment notches of the Mem-Cal and carefully set it aside. Do not open the Mem-Cal.

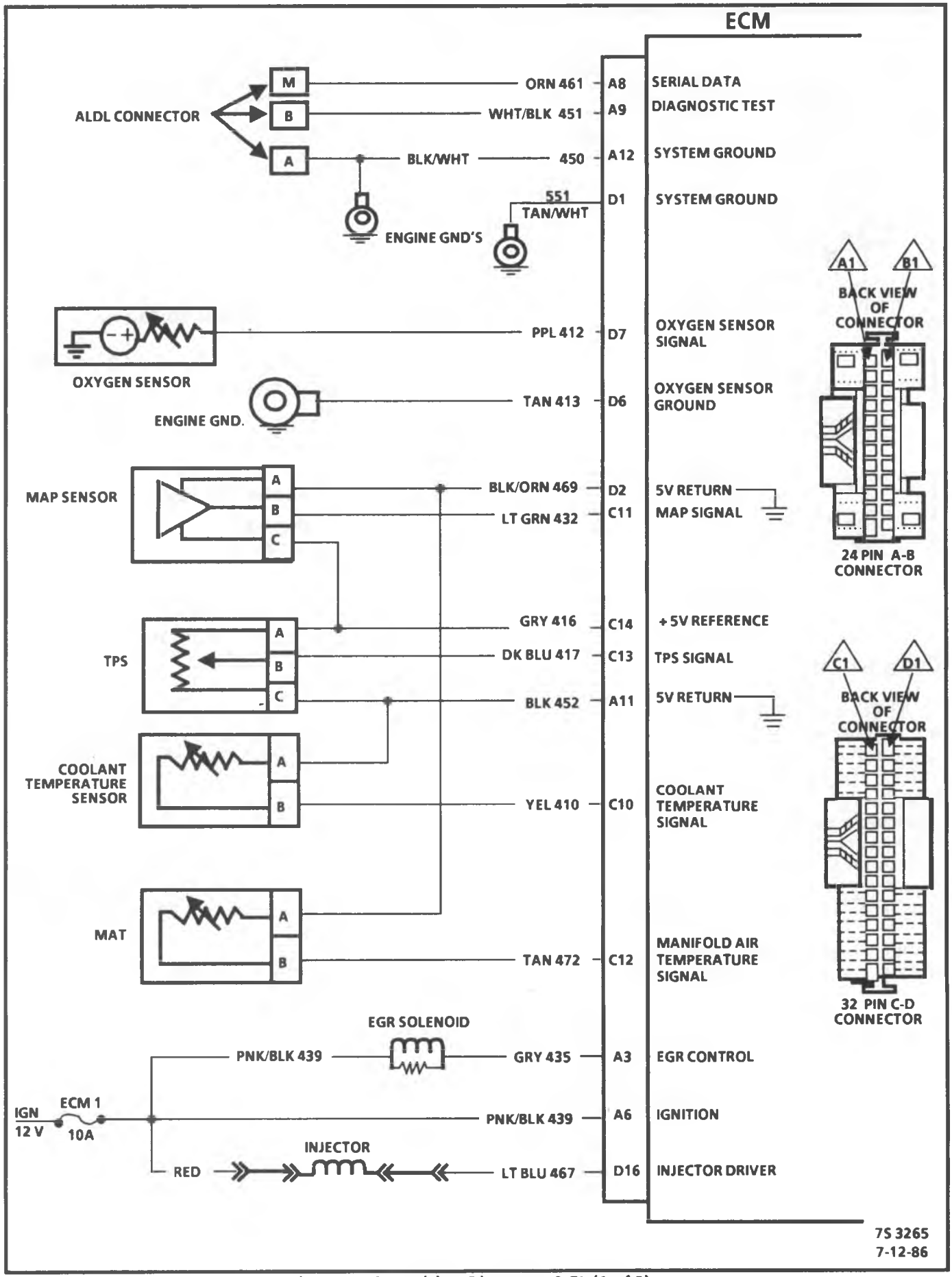


Figure 3-18 - Wiring Diagram - 2.5L (1 of 3)

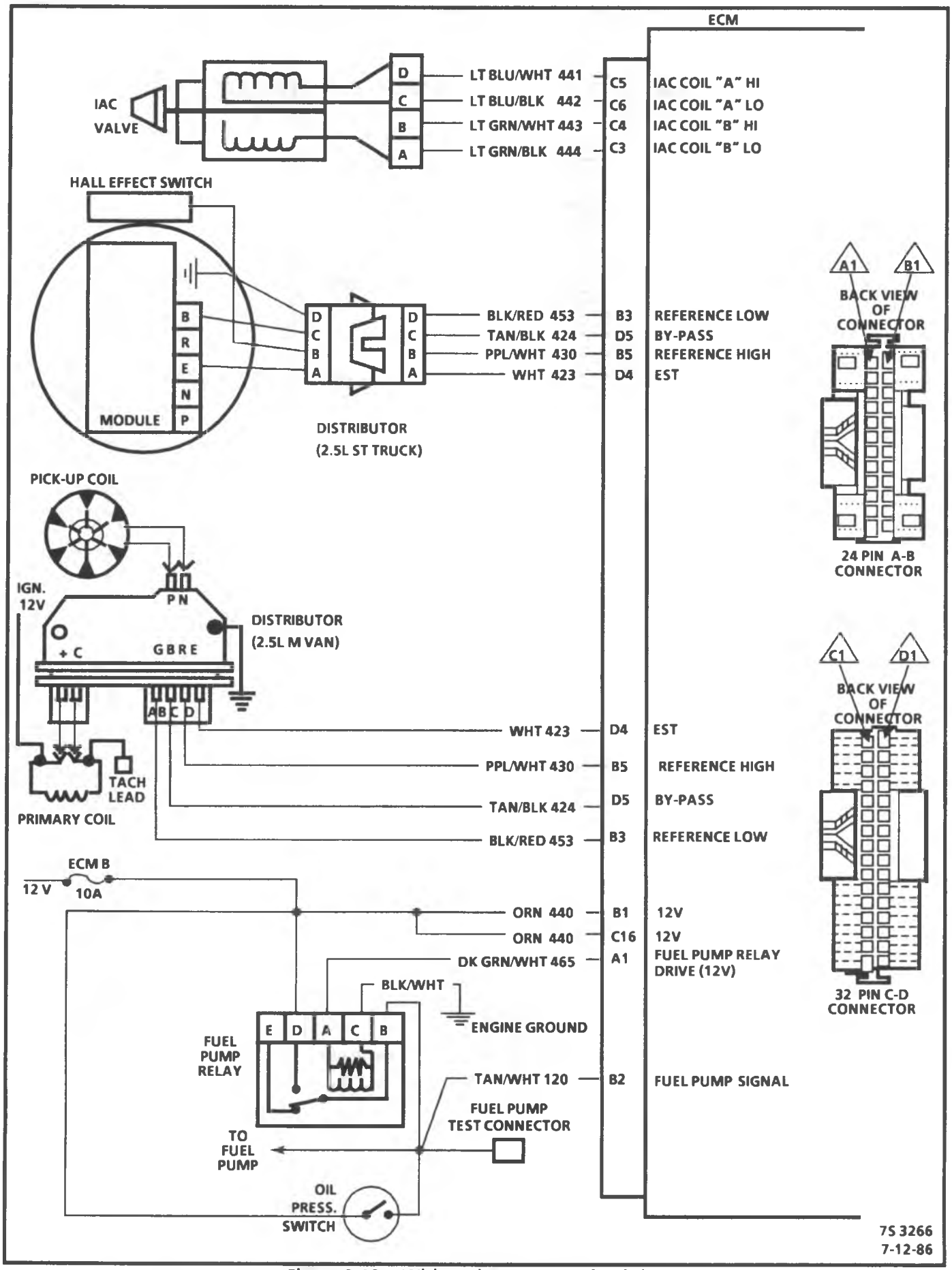


Figure 3-19 - Wiring Diagram - 2.5L (2 of 3)

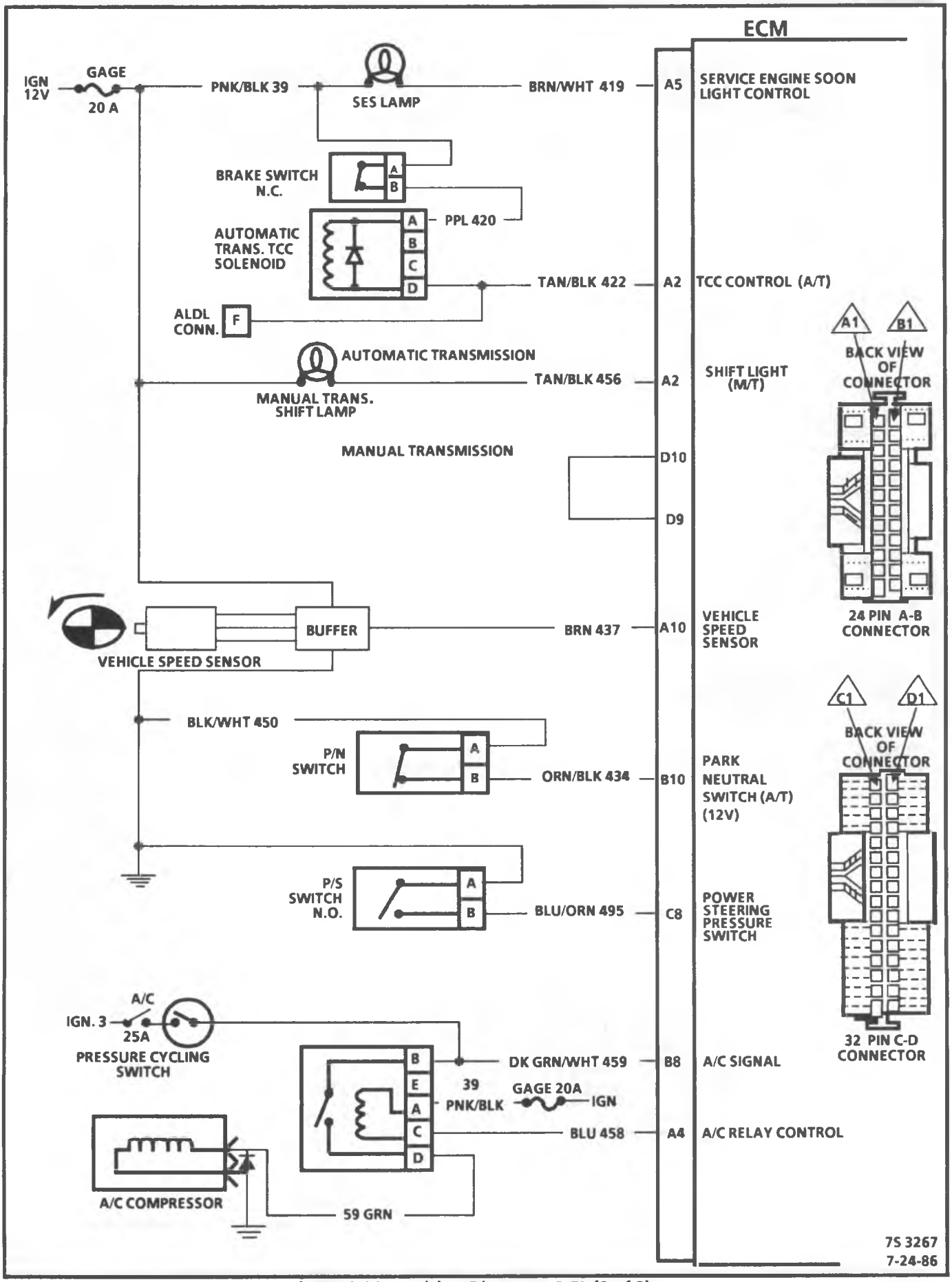


Figure 3-20 - Wiring Diagram - 2.5L (3 of 3)

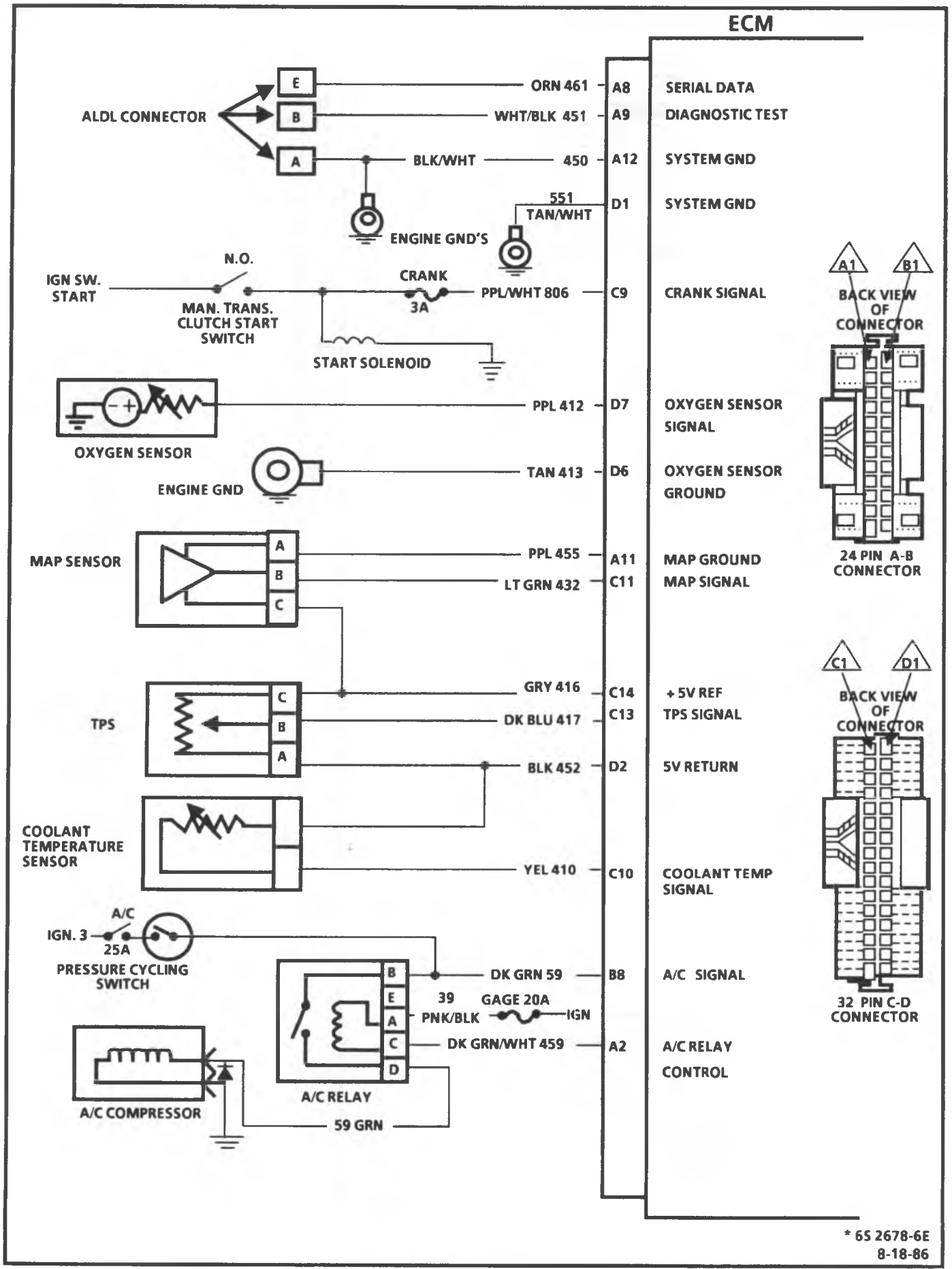


Figure 3-21 - Wiring Diagram - 2.8L (1 of 3)

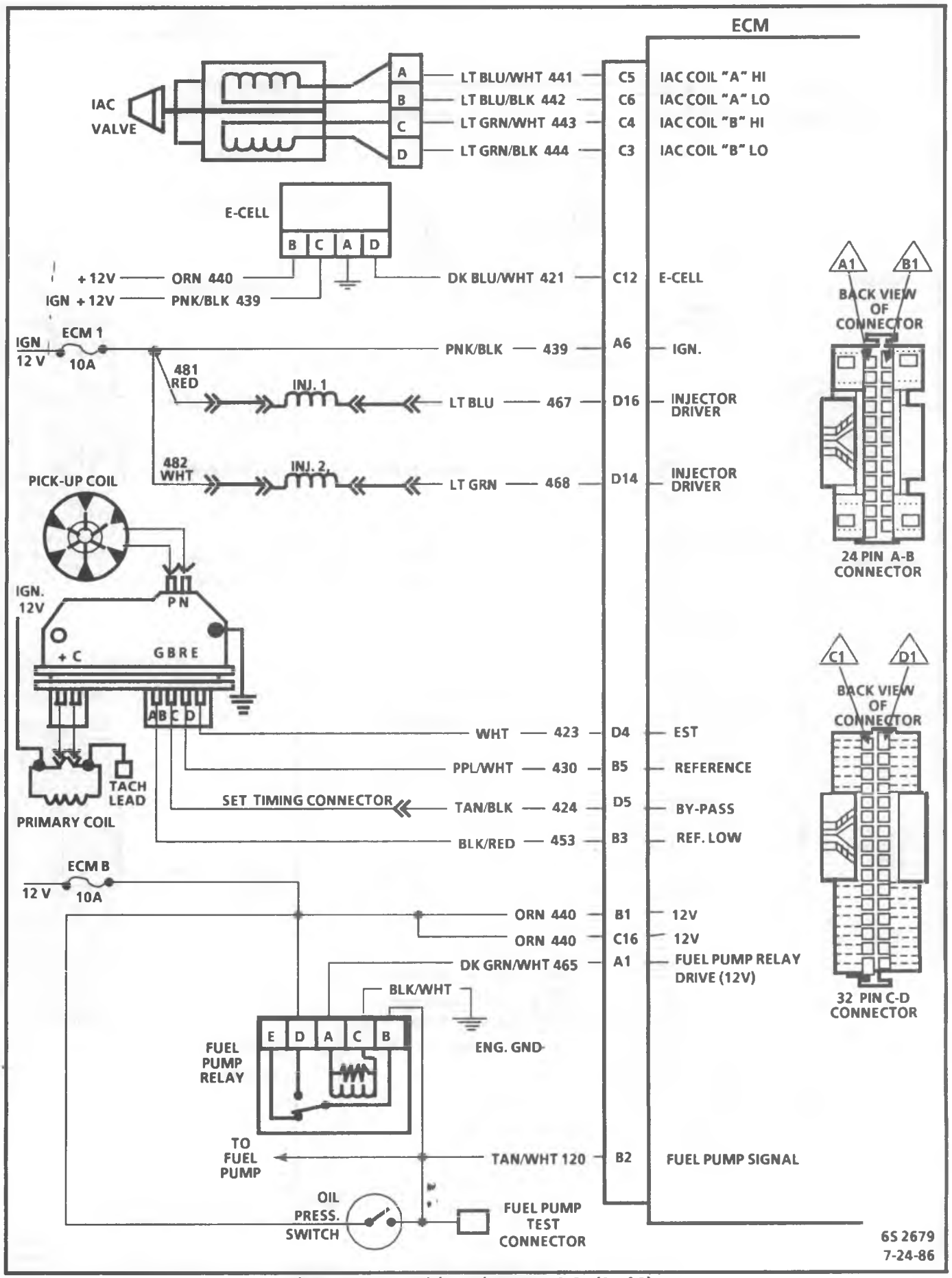


Figure 3-22 - Wiring Diagram - 2.8L (2 of 3)

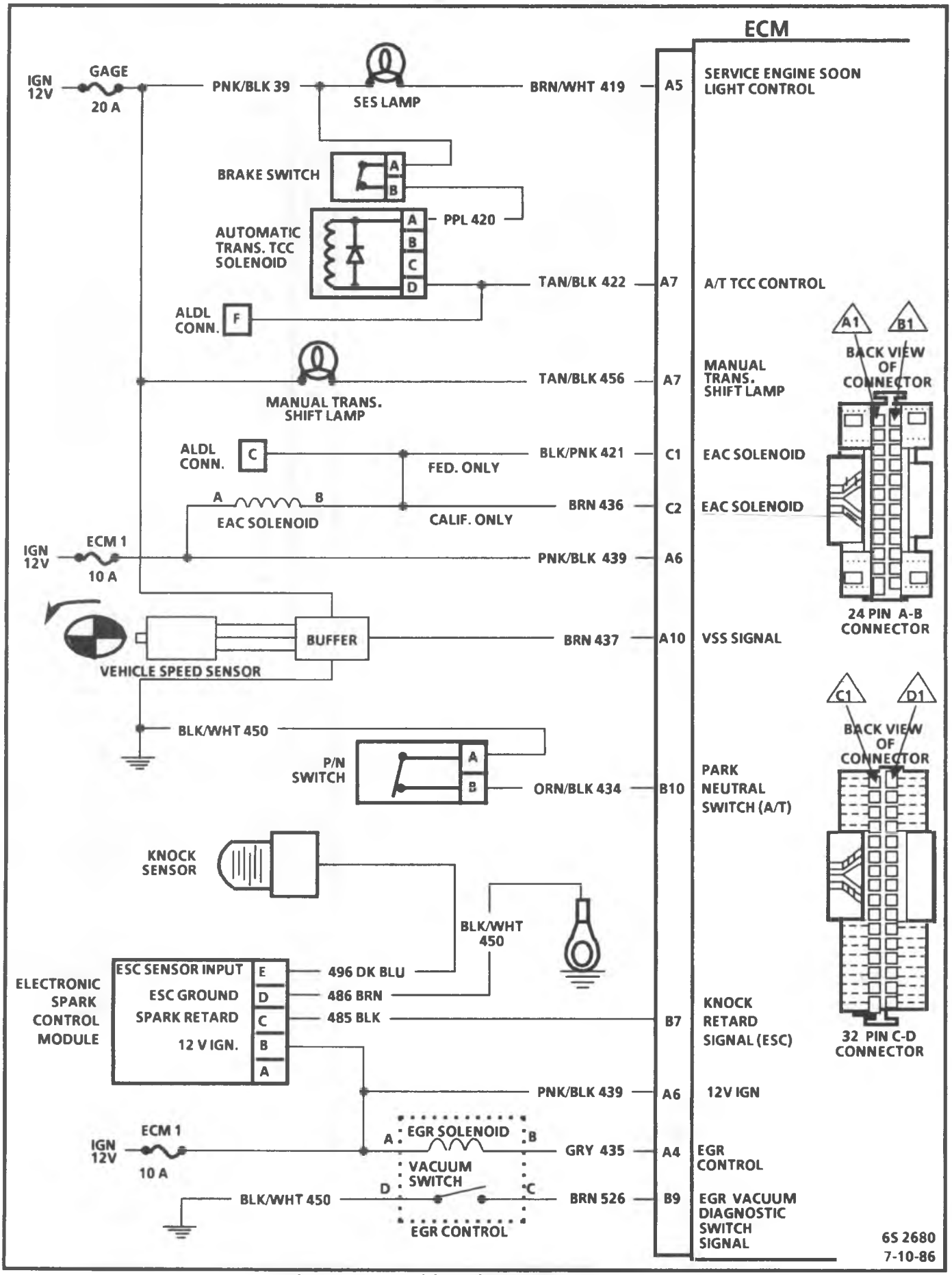


Figure 3-23 - Wiring Diagram - 2.8L (3 of 3)

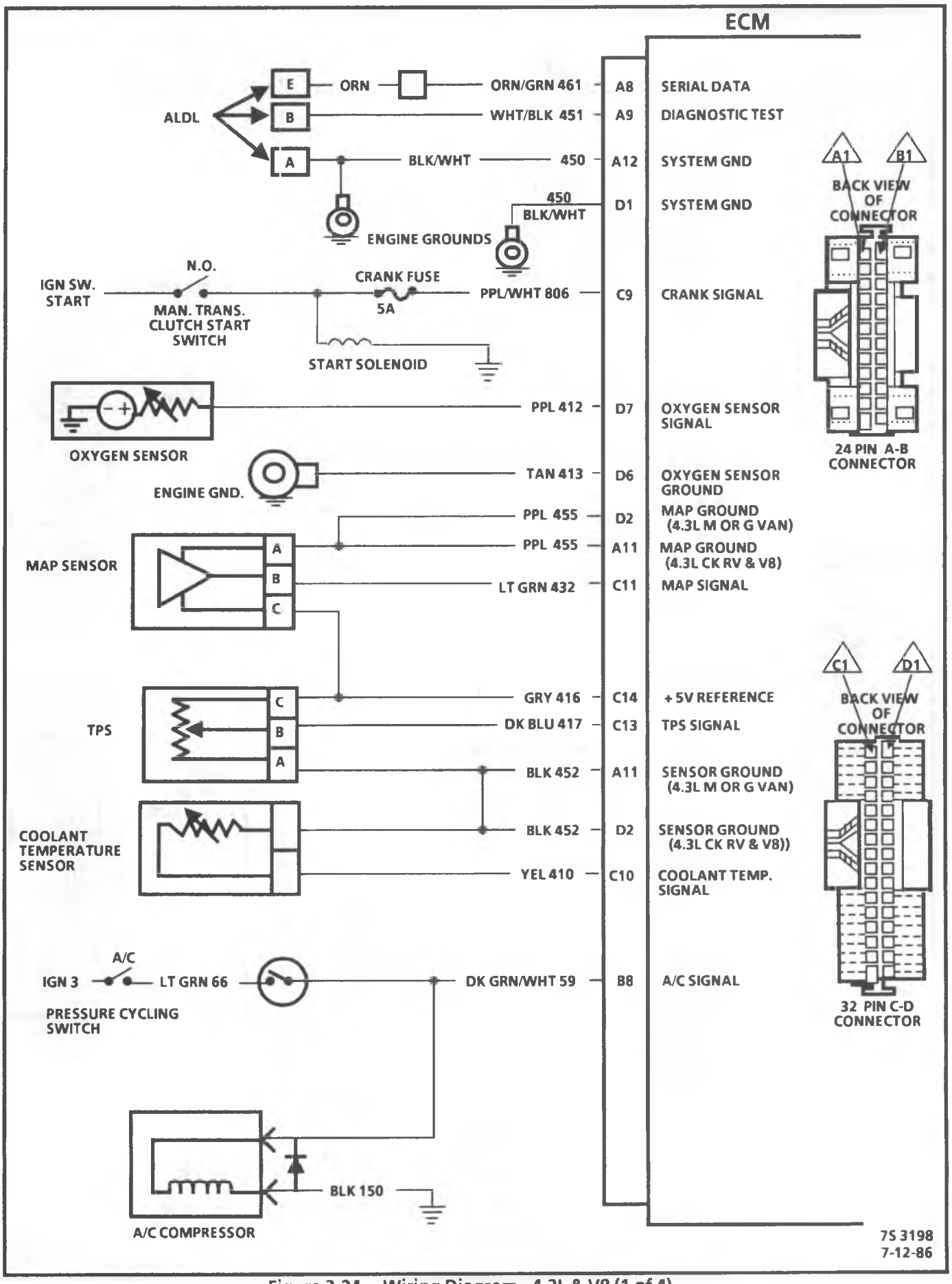


Figure 3-24 - Wiring Diagram - 4.3L & V8 (1 of 4)

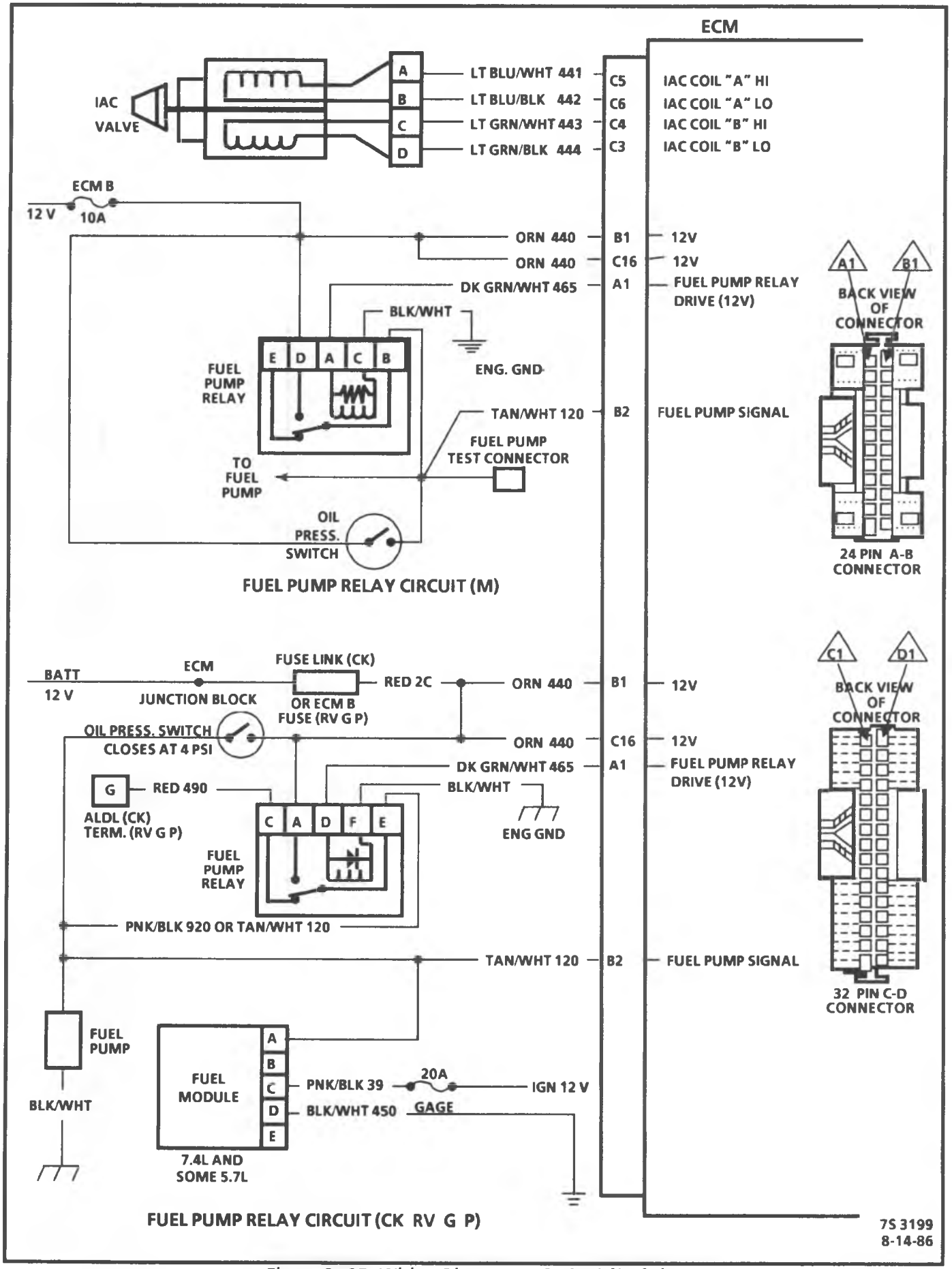


Figure 3 - 25 Wiring Diagram - 4.3L & V8 (2 of 4)

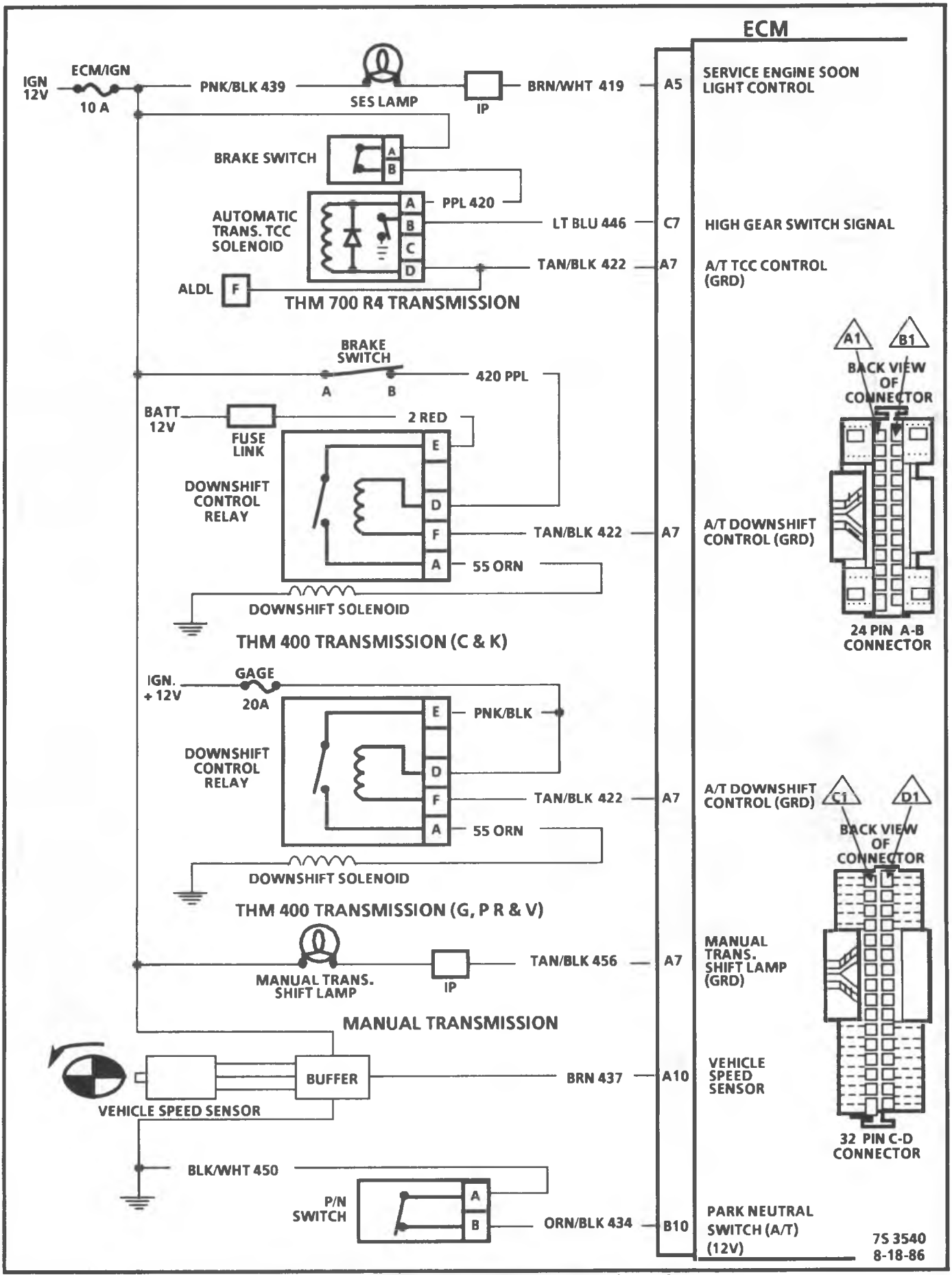


Figure 3-26 - Wiring Diagram - 4.3L & V8 (3 of 4)

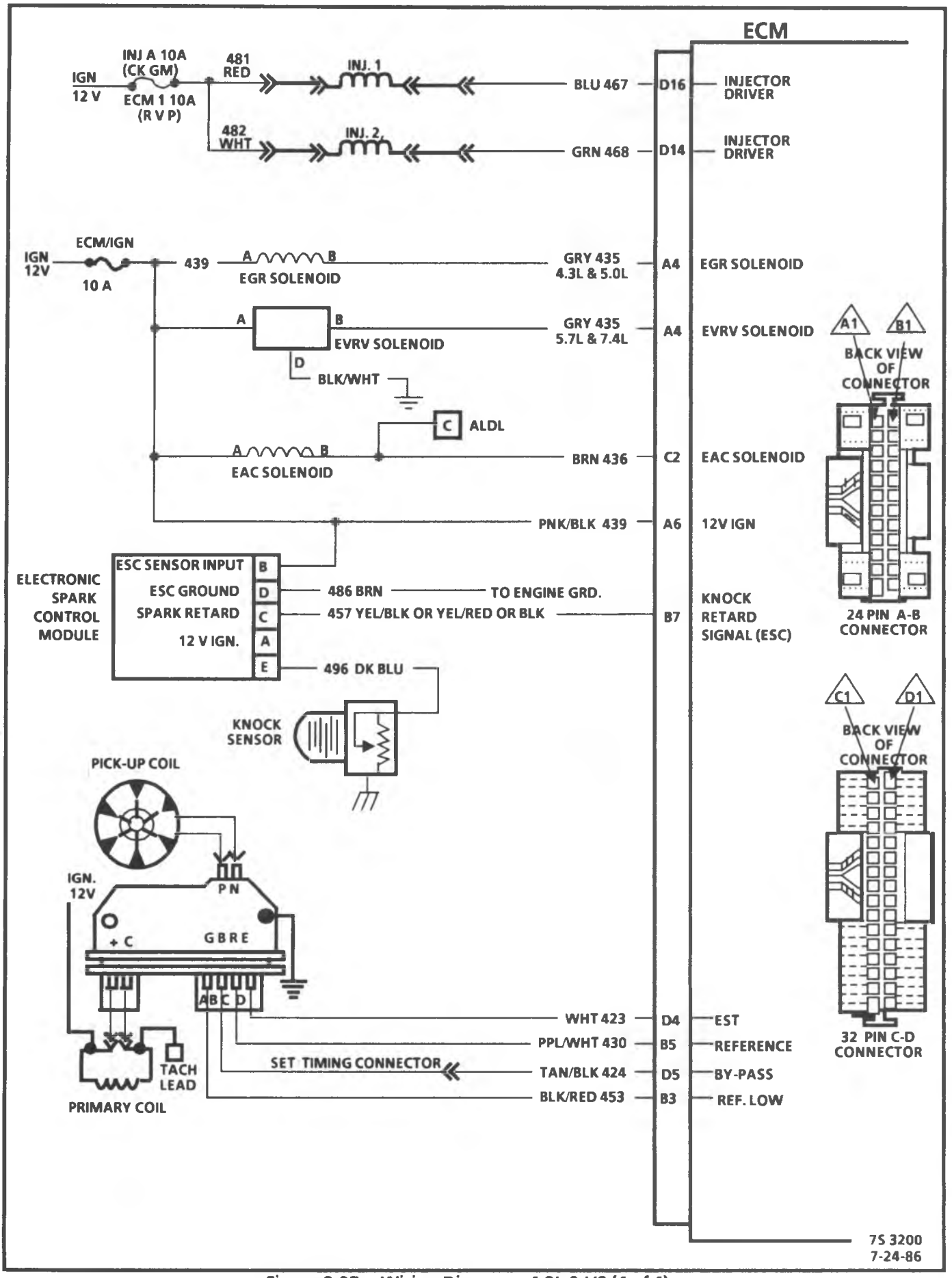


Figure 3-27 - Wiring Diagram - 4.3L & V8 (4 of 4)

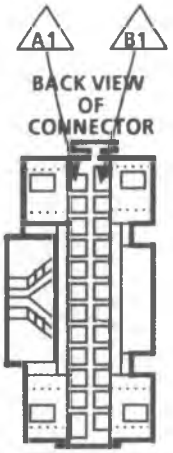
TBI FUEL INJECTION ECM CONNECTOR IDENTIFICATION

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:

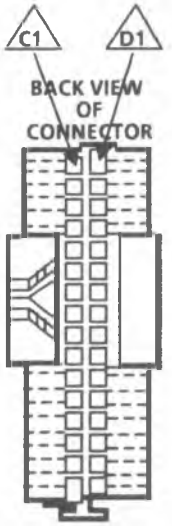
- Engine at operating temperature
- Engine idling in closed loop (for "Engine Run" column)
- Diagnostic terminal not grounded
- ALDL tool not installed

	VOLTAGE				
	KEY "ON"	ENG. RUN	CIRCUIT	PIN	WIRE COLOR
(4)	0	14	FUEL PUMP RELAY	A1	DK GRN/ WHT
	12	14	SHIFT LIGHT (MT) TCC CONTROL (AT)	A2	TAN/ BLK
	12	14	EGR SOLENOID	A3	GRY
	12	14	A/C RELAY	A4	BLU
	0	14	"SERVICE ENGINE SOON" CONTROL	A5	BRN/ WHT
	12	14	IGN - ECM FUSE	A6	PNK/ BLK
			NOT USED	A7	
	2-5	2-5	SERIAL DATA	A8	ORN
	5	5	DIAG. TERM.	A9	WHT/ BLK
	12	(1)	SPEED SENSOR SIGNAL	A10	TAN
	0	0	MAT & TPS GROUND	A11	BLK
	0	0	SYSTEM GROUND	A12	BLK/ WHT



	VOLTAGE				
	WIRE COLOR	PIN	CIRCUIT	KEY "ON"	ENG. RUN
	ORN	B1	BATT.12.VOLTS	12	14
(4)	TAN/ WHT	B2	FUEL PUMP SIGNAL	0	14
	BLK/ RED	B3	EST REF LOW	0	0
		B4	NOT USED		
	PPL/ WHT	B5	EST REFERENCE HI	0	1.6
		B6	NOT USED		
		B7	NOT USED		
	DK GRN/ WHT	B8	A/C SIGNAL	0	0
		B9	NOT USED		
	ORN/ BLK	B10	PARK/NEUTRAL SW.SIGNAL	0	0
		B11	NOT USED		
		B12	NOT USED		

			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
			NOT USED	C7	
	12.3	12.3	P/S SWITCH	C8	BLU/ YEL
			NOT USED	C9	
(2)	1.9	1.7	COOLANT TEMP. SIGNAL	C10	YEL
	4.7	2.0	MAP SIGNAL	C11	LT GRN
(2)	1.3	1.3	MAT SIGNAL	C12	TAN
(5)	.73 V	.73V	TPS SIGNAL	C13	DK BLU
		5	5 VOLT REFERENCE	C14	GRY
			NOT USED	C15	
	12	14	BATTERY 12 VOLTS	C16	ORN



	TAN/ WHT	D1	SYSTEM GROUND	0	0
	BLK/ ORN	D2	5V RETURN	0	0
		D3	NOT USED		
	WHT	D4	EST CONTROL	0	1.0
	TAN/ BLK	D5	EST BYPASS	0	4.75
	TAN	D6	GRN'D. (0_2)	0	0
	PPL	D7	0^2 SENSOR SIGNAL	0	(3)
		D8	NOT USED		
		D9	NOT USED		
		D10	NOT USED		
		D11	NOT USED		
		D12	NOT USED		
		D13	NOT USED		
		D14	NOT USED		
		D15	NOT USED		
	BLU	D16	INJECTOR A	12	14

1 Varies from .60 to battery voltage depending on position of drive wheels.
2 Varies with temperature.
3 Varies.
4 12V First two seconds.
5 Measured between terminals C13 and A11 (± 05V).

ENGINE 2.5L

VEHICLE S/T TRUCK M VAN

7S 3264
6-12-86

Figure 3-28 - ECM Connector Terminal End View - (2.5L)

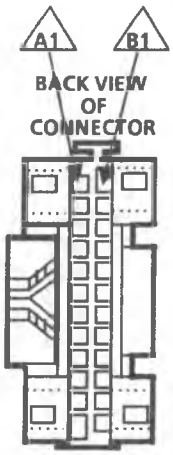
TBI FUEL INJECTION ECM CONNECTOR IDENTIFICATION

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
- ALCL tool not installed

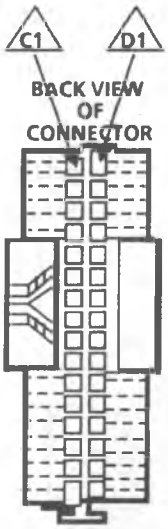
	VOLTAGE				
	KEY "ON"	ENG. RUN	CIRCUIT	PIN	WIRE COLOR
(4)	0	14	FUEL PUMP RELAY	A1	DK GRN/ WHT
(7)	12	14	A/C CLUTCH CONTROL	A2	DK BRN
			NOT USED	A3	
	12	14	EGR CONTROL	A4	GRY
	0	14	"SERVICE ENGINE SOON" CONTROL	A5	BRN/ WHT
	12	14	IGN - ECM FUSE	A6	PNK/ BLK
	12	14	SHIFT LIGHT OR TCC CONTROL	A7	TAN/ BLK
	2-5	2.5	SERIAL DATA	A8	ORN/ GRN
	5	5	DIAG. TERM.	A9	WHT/ BLK
	①	①	SPEED SENSOR SIGNAL	A10	BRN
	0	0	MAP GROUND	A11	PPL
	0	0	SYSTEM GROUND	A12	BLK/ WHT



24 PIN A-B CONNECTOR

	VOLTAGE				
	WIRE COLOR	PIN	CIRCUIT	KEY "ON"	ENG. RUN
	ORN	B1	BATT.12.VOLTS	12	14
(4)	TAN/ WHT	B2	FUEL PUMP SIGNAL	0	14
	BLK/ RED	B3	EST REF LOW	0	0
		B4	NOT USED		
	PPL/ WHT	B5	EST REFERENCE HI	0	1.6
		B6	NOT USED		
	BLK	B7	ESC SIGNAL	9	9
(8)	DK GRN	B8	A/C SIGNAL	0	0 / 12
	BRN	B9	EGR SWITCH SIGNAL	12	12
(6)	ORN/ BLK	B10	PARK/NEUTRAL SW.SIGNAL	0	0
		B11	NOT USED		
		B12			

(9)	0	0	EAC SOL. (FED)	C1	BLK/ PNK
(9)	0	0	EAC SOL. (CALIF)	C2	BRN
	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
			NOT USED	C7	
			NOT USED	C8	
	0	0	CRANK SIGNAL	C9	PPL/WHT
(2)	1.9	1.7	COOLANT TEMP. SIGNAL	C10	YEL
	4.9	2.0	MAP SIGNAL	C11	LT GRN
	.4	.4	ELAPSED TIMER MODULE	C12	DK BLU/ WHT
(5)	.45 V	.45V	TPS SIGNAL	C13	DK BLU
	5	5	5 VOLT REFERENCE	C14	GRY
			NOT USED	C15	
	12	14	BATTERY 12 VOLTS	C16	ORN



32 PIN C-D CONNECTOR

	TAN/ WHT	D1	SYSTEM GROUND	0	0
	BLK	D2	5V RETURN	0	0
		D3	NOT USED		
	WHT	D4	EST CONTROL	0	1.0
	TAN/ BLK	D5	EST BYPASS	0	4.75
	TAN	D6	GRN'D. (0_2)	0	0
	PPL	D7	0^2 SENSOR SIGNAL	0	③
		D8	NOT USED		
		D9	NOT USED		
		D10	NOT USED		
		D11	NOT USED		
		D12	NOT USED		
		D13	NOT USED		
	LT GRN	D14	INJECTOR B	12	14
		D15	NOT USED		
	BLU	D16	INJECTOR A	12	14

1 Varies from .60 to battery voltage depending on position of drive wheels.
2 Varies with temperature.
3 Varies. (toggles)
4 12V First two seconds.
5 Measured between terminals C13 and D2 (± .05V).
6 12 V in gear
7 0 V with A/C "on"
8 12 V with A/C "on"
9 12 V when cold

ENGINE 2.8L LL2

VEHICLE S/T TRUCK

* 6S 2819-6E
6-18-86

Figure 3-29 - ECM Connector Terminal End View - (2.8L)

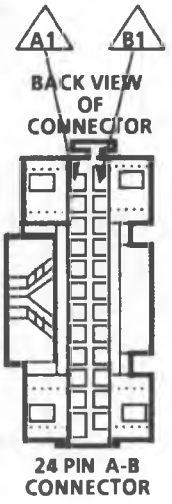
TBI FUEL INJECTION ECM CONNECTOR IDENTIFICATION

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)
- Diagnostic terminal not grounded
- ALDL tool not installed

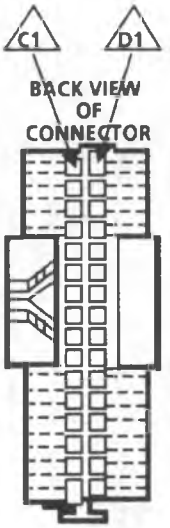
	VOLTAGE				
	KEY "ON"	ENG. RUN	CIRCUIT	PIN	WIRE COLOR
(4)	0	14	FUEL PUMP RELAY	A1	DK GRN/ WHT
			NOT USED	A2	
			NOT USED	A3	
	12	14	EGR CONTROL	A4	GRY
	0	14	"SERVICE ENGINE SOON" CONTROL	A5	BRN/ WHT
	12	14	IGN - ECM FUSE	A6	PNK/ BLK
(7)	12	14	SHIFT LIGHT OR TCC CONTROL	A7	TAN/ BLK
	2-5	2.5	SERIAL DATA	A8	ORN
	5	5	DIAG. TERM.	A9	WHT/ BLK
	①	①	SPEED SENSOR SIGNAL	A10	BRN
(8)	0	0	5V RETURN	A11	BLK
	0	0	SYSTEM GROUND	A12	BLK/ WHT



24 PIN A-B CONNECTOR

	VOLTAGE				
	WIRE COLOR	PIN	CIRCUIT	KEY "ON"	ENG. RUN
	ORN	B1	BATT.12.VOLTS	12	14
(4)	TAN/ WHT	B2	FUEL PUMP SIGNAL	0	14
	BLK/ RED	B3	EST REF LOW	0	0
		B4	NOT USED		
	PPL/ WHT	B5	EST REFERENCE HI	0	1.6
		B6	NOT USED		
(6)	YEL/BLK	B7	ESC SIGNAL	9	9
	DK GRN	B8	A/C SIGNAL	0	0
		B9	NOT USED		
	ORN/ BLK	B10	PARK/NEUTRAL SW SIGNAL	0	0
		B11	NOT USED		
		B12			

			NOT USED	C1	
	0	0	EAC SOL.	C2	BRN
	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
	12	14	HI GEAR SWITCH	C7	LT BLU
			NOT USED	C8	
	0	0	CRANK SIGNAL	C9	PPL/WHT
(2)	1.9	1.7	COOLANT TEMP. SIGNAL	C10	YEL
	4.9	2.0	MAP SIGNAL	C11	LT GRN
			NOT USED	C12	
(5)	.6 V	.6 V	TPS SIGNAL	C13	DK BLU
	5	5	5 VOLT REFERENCE	C14	GRY
			NOT USED	C15	
	12	14	BATTERY 12 VOLTS	C16	ORN



32 PIN C-D CONNECTOR

	TAN/ WHT	D1	SYSTEM GROUND	0	0
(8)	PPL	D2	MAP GROUND	0	0
		D3	NOT USED		
	WHT	D4	EST CONTROL	0	1.0
	TAN/ BLK	D5	EST BYPASS	0	4.75
	TAN	D6	GND (O_2)	0	0
	PPL	D7	O^2 SENSOR SIGNAL	0	③
		D8	NOT USED		
		D9	NOT USED		
		D10	NOT USED		
		D11	NOT USED		
		D12	NOT USED		
		D13	NOT USED		
	LT GRN	D14	INJECTOR B	12	14
		D15	NOT USED		
	BLU	D16	INJECTOR A	12	14

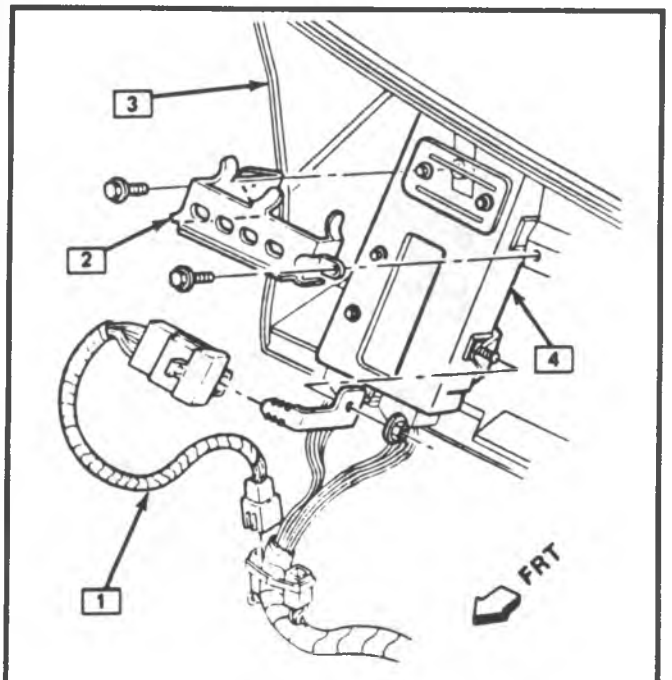
1 Varies from .60 to battery voltage depending on position of drive wheels.
2 Varies with temperature.
3 Varies.
4 12v First two seconds on 4.3L & 5.0L (12v first 20 seconds on 5.7L & 7.4L).
5 Measured between terminals C13 and A11 (± .05V).
6 Used on 4.3L, 5.0L or 5.7L engine. Wire color may also be black or yellow/red.
7 Also downshift control on THM 400
8 Except 4.3L M & G Van - this system is wired at opposite terminals.

ENGINE 4.3L, 5.0L, 5.7L, 7.4L

VEHICLE CKRVGPM

7S 3582
7-12-86

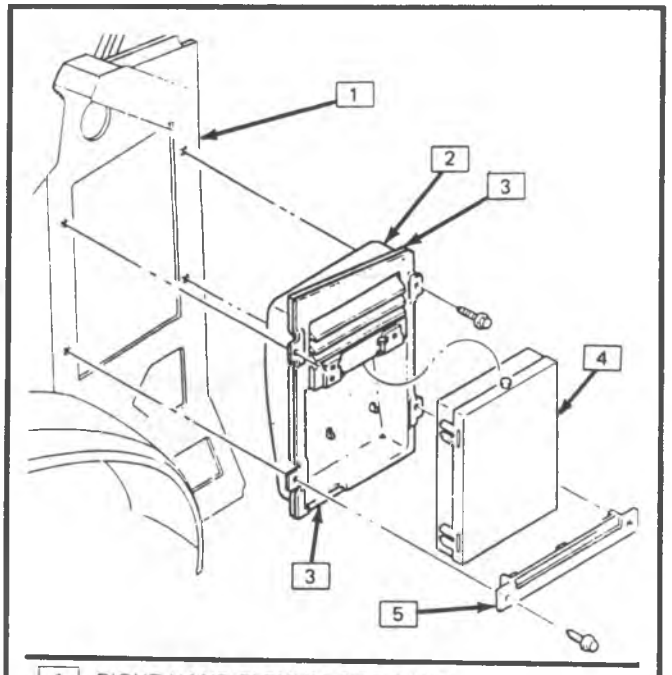
Figure 3-30 - ECM Connector Terminal End View, (4.3L, 5.0L, 5.7L, 7.4L)



1 ELAPSED TIMER MODULE
2 RETAINER
3 INSTRUMENT PANEL
4 ELECTRONIC CONTROL MODULE

6S 2886-6E

Figure 3-31 - Electronic Control Module (ST)



1 RIGHT HAND PLENUM SIDE PANEL
2 HOUSING ASSEMBLY
3 SEAL
4 ELECTRONIC CONTROL MODULE
5 RETAINER

7S 3761-6E

Figure 3-32 - Electronic Control Module (M)

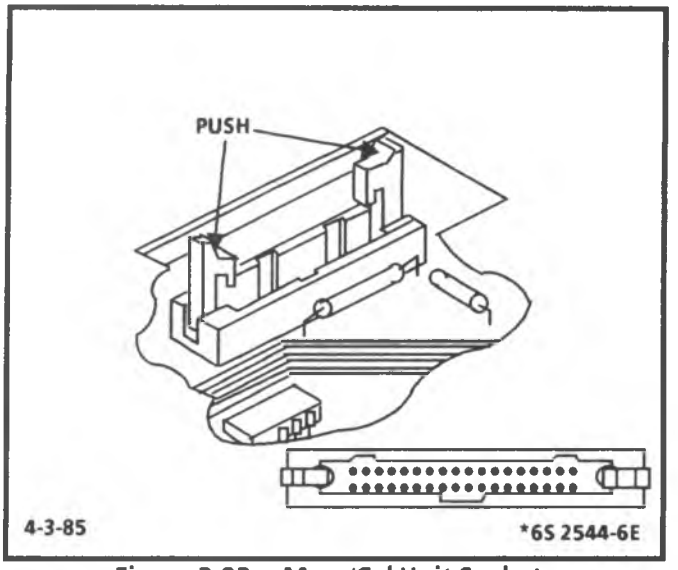


Figure 3-33 - Mem/Cal Unit Socket

IF ECM IS BEING REPLACED:

Remove or Disconnect

1. New ECM from its packaging and check the service number to make sure it is the same as the defective ECM.
2. Access cover.

Install or Connect

1. Mem-Cal in Mem-Cal socket.

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 the ends.

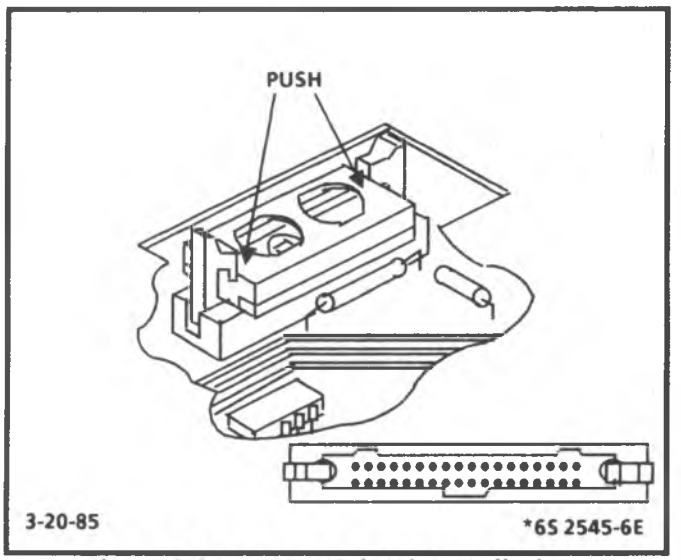


Figure 3-34 - Mem/Cal Unit Installation

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 Mem-Cal 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 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 - With PROM & CALPAK Figures 3-31 and 3-32; 3-35 through 3-38

Remove or Disconnect

1. Negative battery cable or ECM B fuse
2. Connectors from the ECM.
3. ECM. Refer to Figure 3-39, for servicing the ECM.

Install or Connect

1. ECM into vehicle.
2. Connector to the ECM.
3. Negative battery cable or ECM B fuse.
4. Perform System Check.

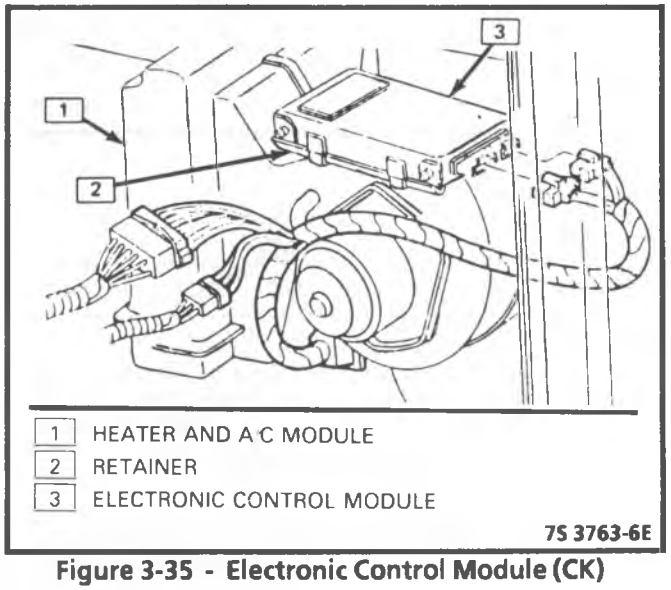


Figure 3-35 - Electronic Control Module (CK)

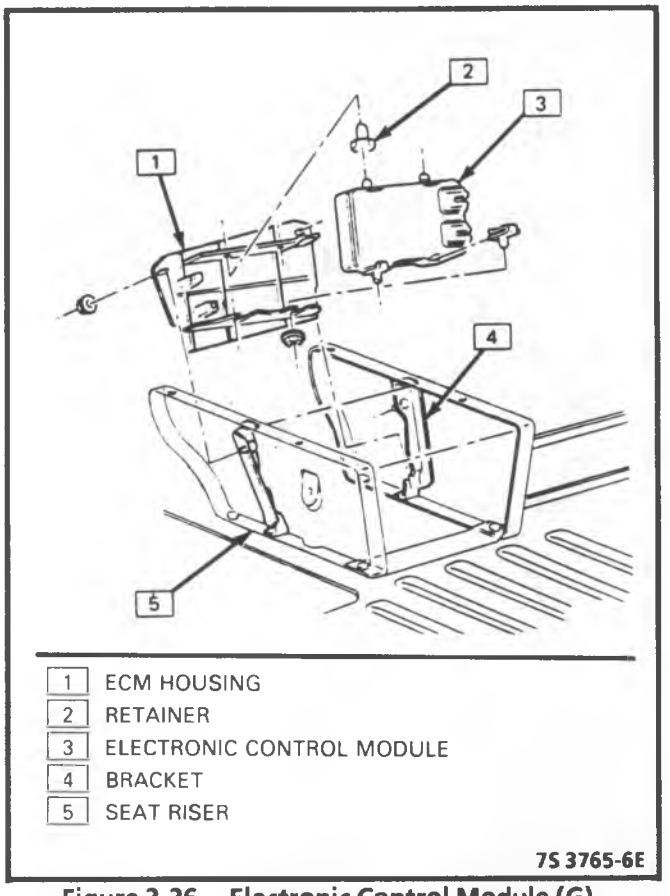


Figure 3-36 - Electronic Control Module (G)

PROM

Refer to Figure 3-39, for removal and installation of a PROM.

CALPAK

Refer to Figure 3-39, for removal and installation of a CALPAK.

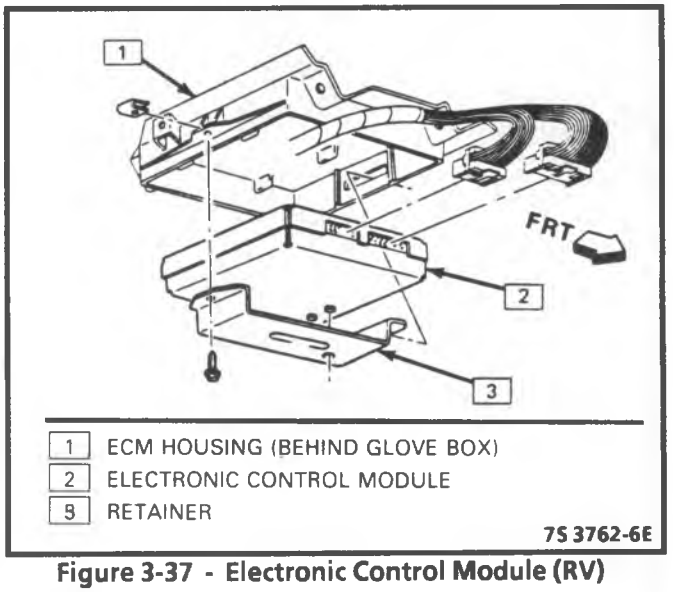
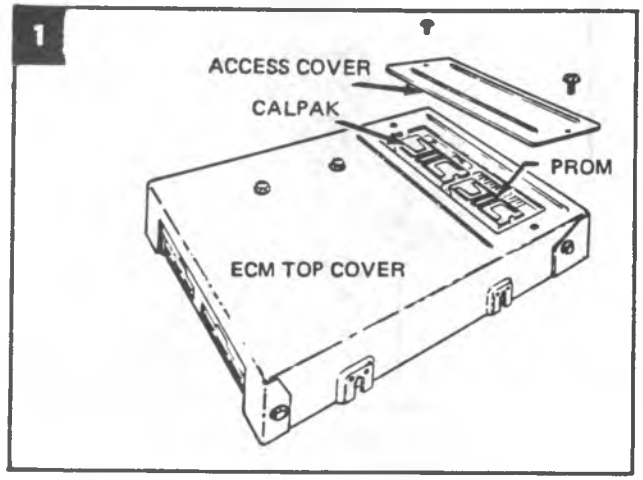
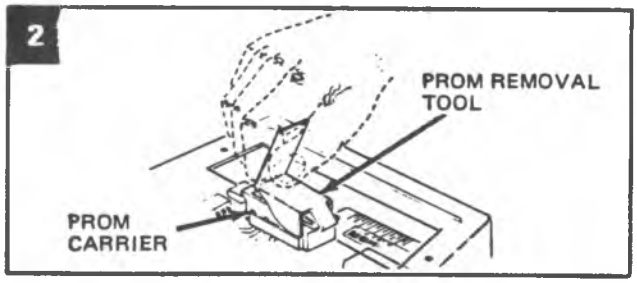


Figure 3-37 - Electronic Control Module (RV)

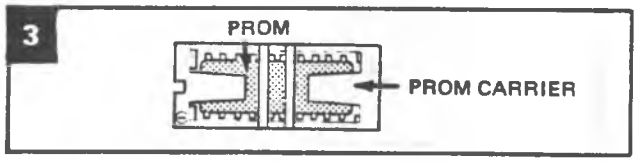
1. Remove ECM access cover.



2. Remove PROM using the rocker-type PROM removal tool shown. Engage one end of the PROM carrier with the hook end of the tool. 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.

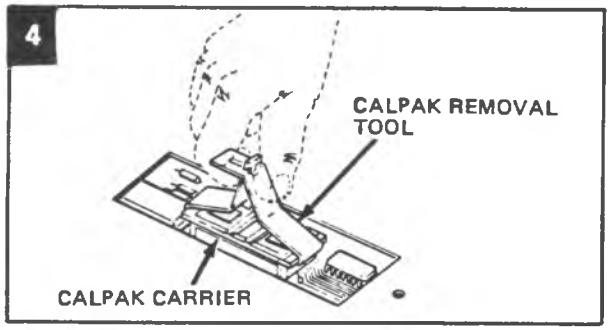


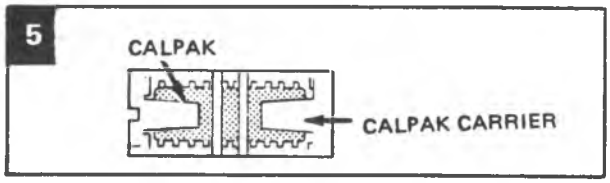
3. Inspect reference end of the PROM carrier and carefully set aside. Do not remove PROM from the carrier to confirm PROM correctness. Notch in PROM referenced to smaller notch in carrier and the (1)



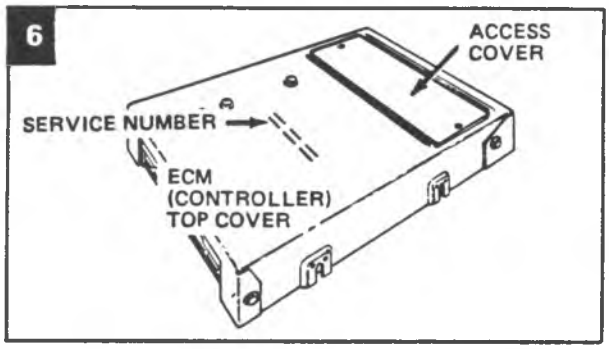
4. Remove CALPAK (if used) using removal tool shown. Grasp the CALPAK carrier of the narrow ends only. Gently rock the carrier from end to end while applying a firm upward force.
5. Inspect reference end of the CALPAK carrier and carefully set aside. Do not remove CALPAK from the carrier to confirm CALPAK correctness. Notch in CALPAK reference to smaller notch in carrier and the (1) .

11 19 84





6. If a service controller is being installed, check the service number on the controller to make sure it is the same as the removed ECM. Remove access cover.



7. Install PROM and CALPAK (if used). If a service PROM or CALPAK is being installed, make sure they have the same part number as the removed PROM or CALPAK.

Important (Before installing PROM)

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

Important

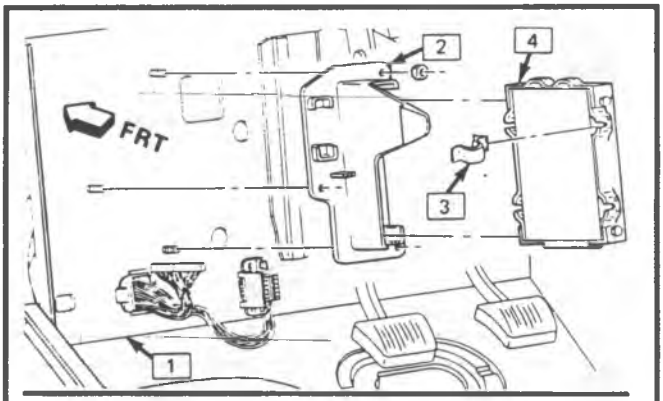
DO NOT press on PROM or CALPAK - ONLY CARRIER.

Small notch of carrier must be aligned with small notch in socket. Press on PROM or CALPAK carrier until it is dirmly seated in the socket. Do not press on PROM or CALPAK, only the carrier.

8. Install ECM access cover.
9. Install ECM in passenger compartment and perform a "DIAGNOSTIC CIRCUIT CHECK" to confirm proper installation.

6S 2511-6E

Figure 3-39 - Servicing the ECM - Except 2.5L



1 DASH AND TOE PANEL
2 BRACKET
3 RETAINER
4 ELECTRONIC CONTROL MODULE

7S 3760-6E

Figure 3-38 - Electronic Control Module (P)

COOLANT SENSOR
Figure 3-40

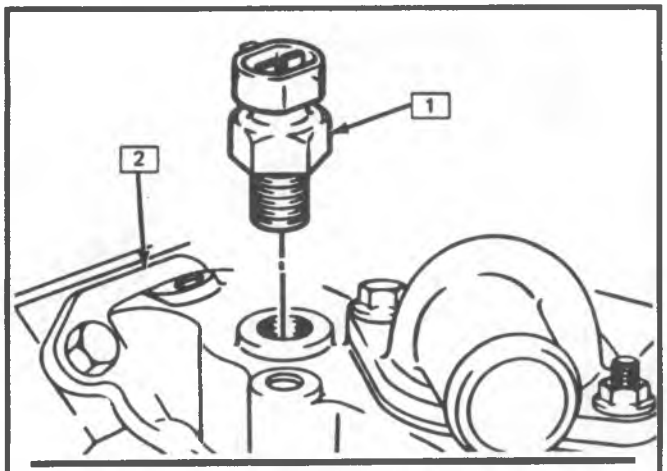
NOTICE: Care must be taken, when handling coolant sensor. Damage to coolant sensor will affect proper operation of the Fuel Control system.

Remove or Disconnect

1. Negative battery cable.
2. Drain cooling system below level of sensor.
3. Electrical connector.
4. Coolant sensor.

Install or Connect

1. Sensor in engine.
2. Electrical connector.
3. Refill coolant system.
4. Negative battery cable.



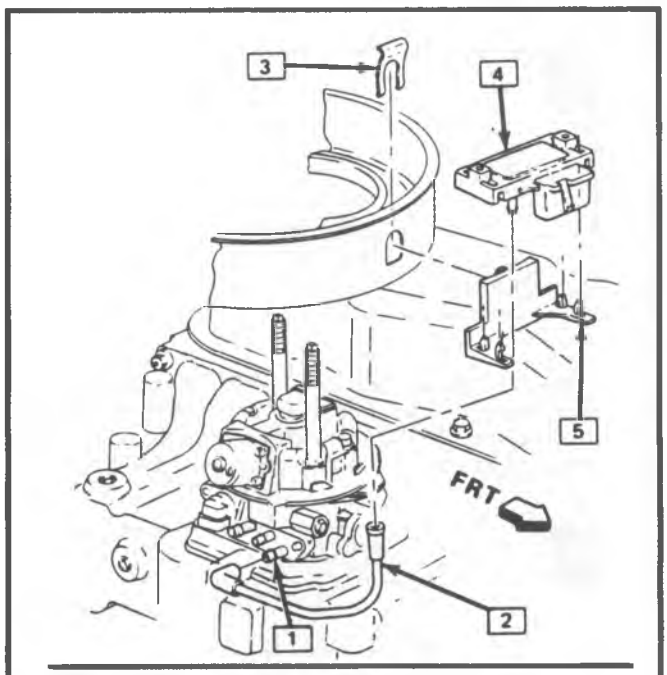
1 COOLANT TEMPERATURE SENSOR
2 INLET MANIFOLD

7S 3815-6E

Figure 3-40 - Coolant Sensor

MAP SENSOR
Figure 3-41 through 3-47

Other than checking for loose hoses and electrical connections, the only service possible is unit replacement, if diagnosis shows sensor to be faulty.



1 PORT "J"
2 HARNESS ASSEMBLY
3 RETAINER
4 MAP SENSOR
5 BRACKET

7S 3754-6E

Figure 3-41 - MAP Sensor - 2.5L (ST)

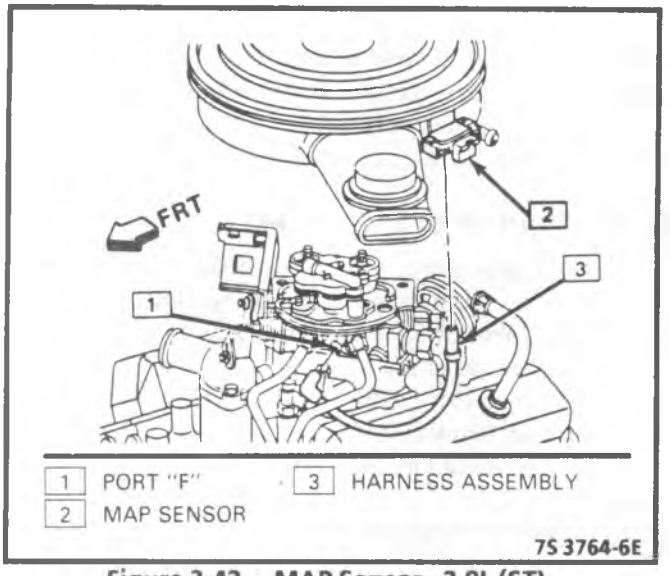


Figure 3-42 - MAP Sensor - 2.8L (ST)

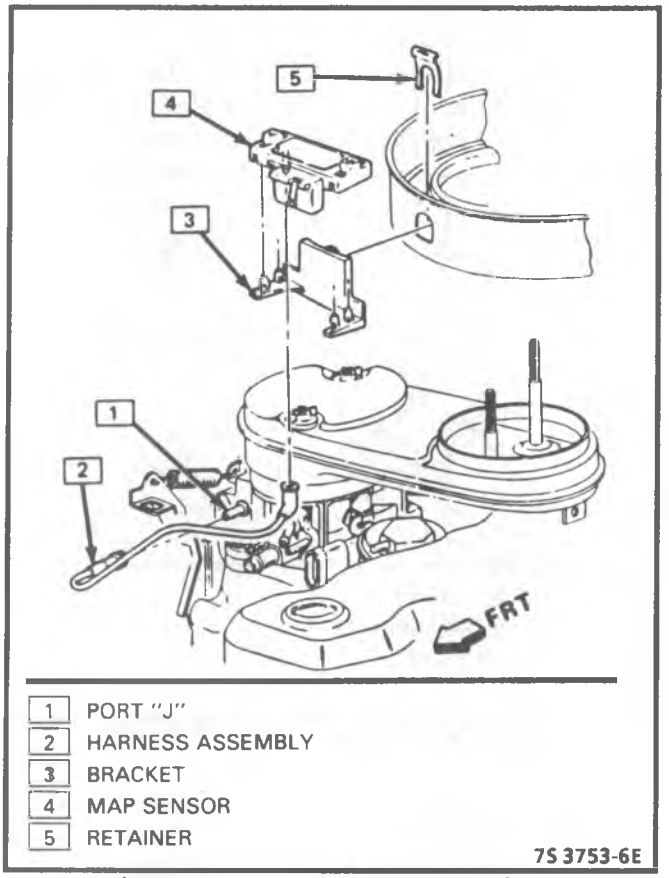


Figure 3-43 - MAP Sensor - 2.5L (M)

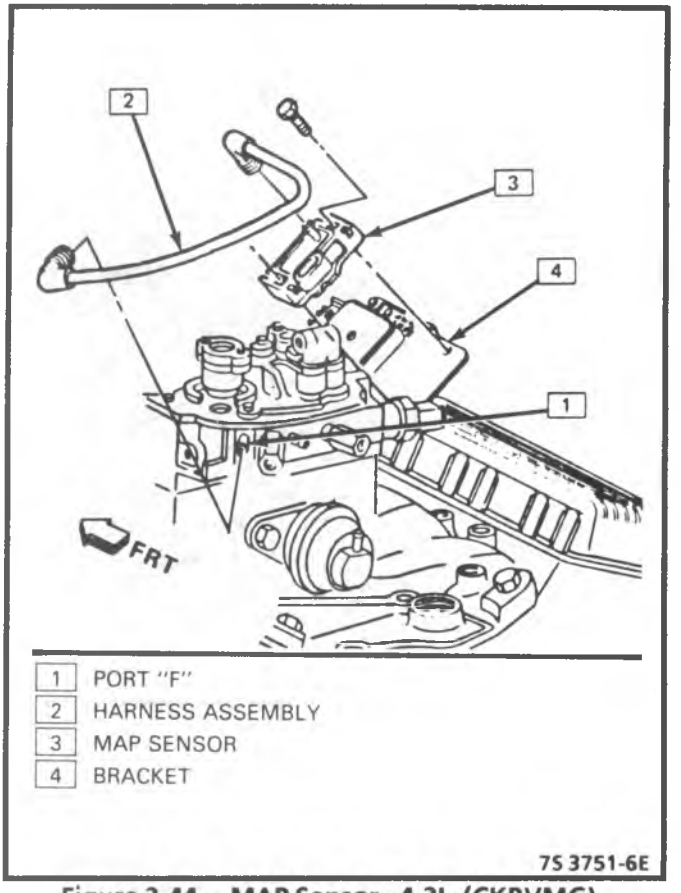


Figure 3-44 - MAP Sensor - 4.3L (CKRVMG)

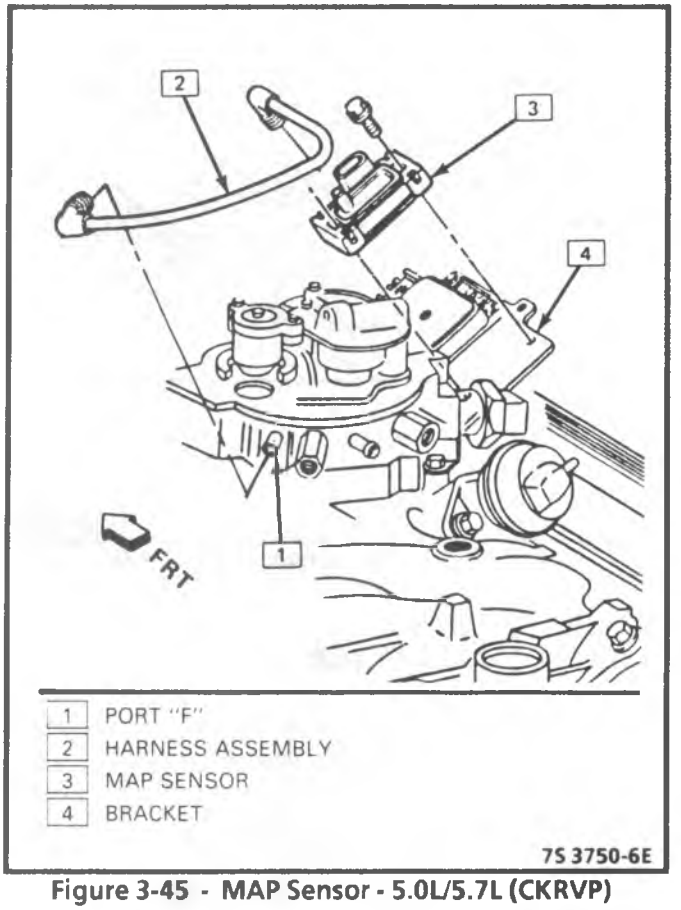
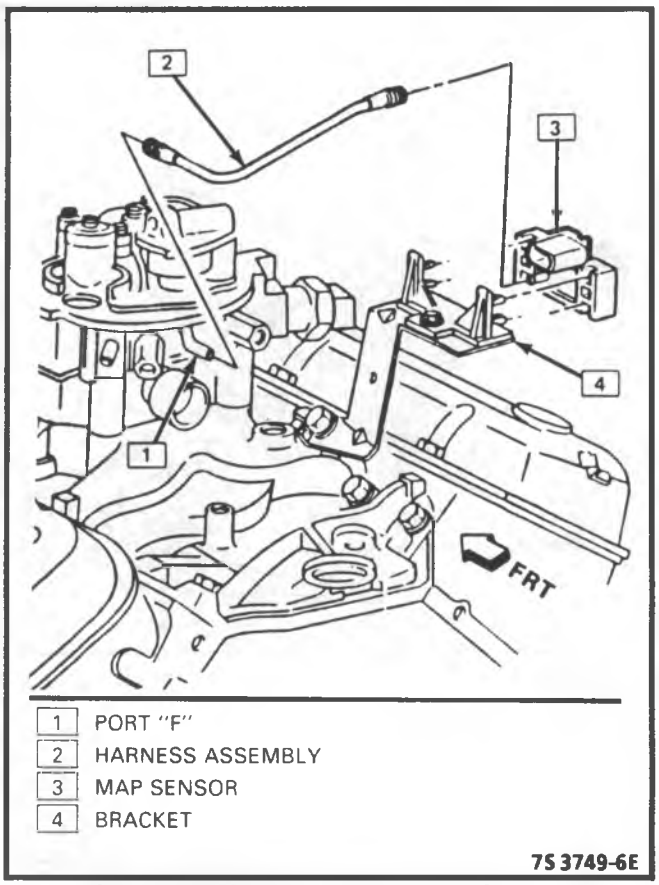


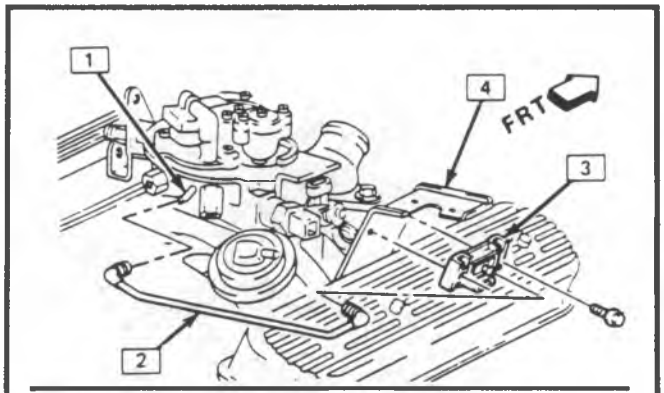
Figure 3-45 - MAP Sensor - 5.0L/5.7L (CKRVP)



1 PORT "F"
2 HARNESS ASSEMBLY
3 MAP SENSOR
4 BRACKET

7S 3749-6E

Figure 3-46 - MAP Sensor - 7.4L (CKRV)



1 PORT "F"
2 HARNESS ASSEMBLY
3 MAP SENSOR
4 BRACKET

7S 3752-6E

Figure 3-47 - MAP Sensor 5.0L/5.7L (G)

OXYGEN SENSOR
Figure 3-48 through 3-56

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.

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

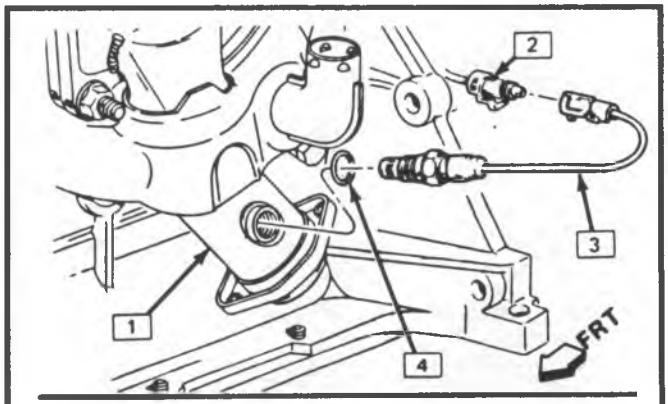
The oxygen sensor may be difficult to remove, when engine temperature is below 48°C (120°F). Excessive force may damage threads in exhaust manifold or exhaust pipe.

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 bead. The graphite will tend to burn away, but the glass beads will remain, making the sensor easier to remove.



1 EXHAUST MANIFOLD
2 ELECTRICAL CONNECTOR
3 OXYGEN SENSOR
4 GASKET

7S 3743-6E

Figure 3-48 - Oxygen Sensor - 2.5L (ST)

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 3613695, or equivalent, if necessary.
2. Sensor, and torque to 41 N•m (30 ft. lbs.).
3. Electrical connector.
4. Negative battery cable.

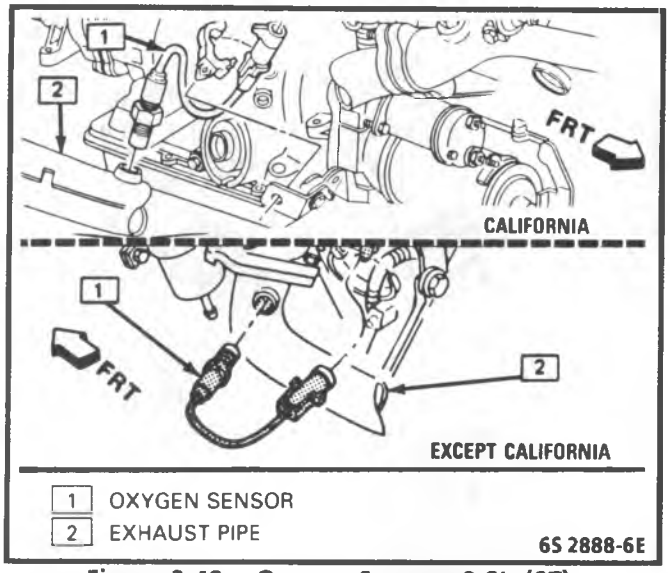


Figure 3-49 - Oxygen Sensor - 2.8L (ST)

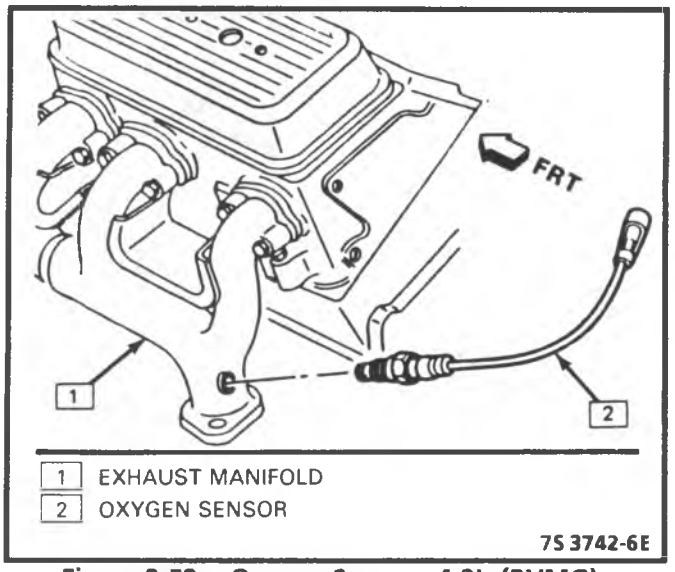


Figure 3-52 - Oxygen Sensor - 4.3L (RVMG)

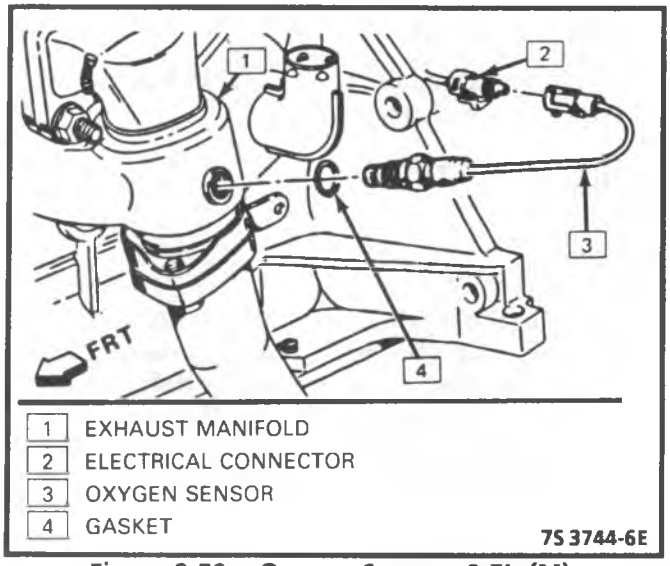


Figure 3-50 - Oxygen Sensor - 2.5L (M)

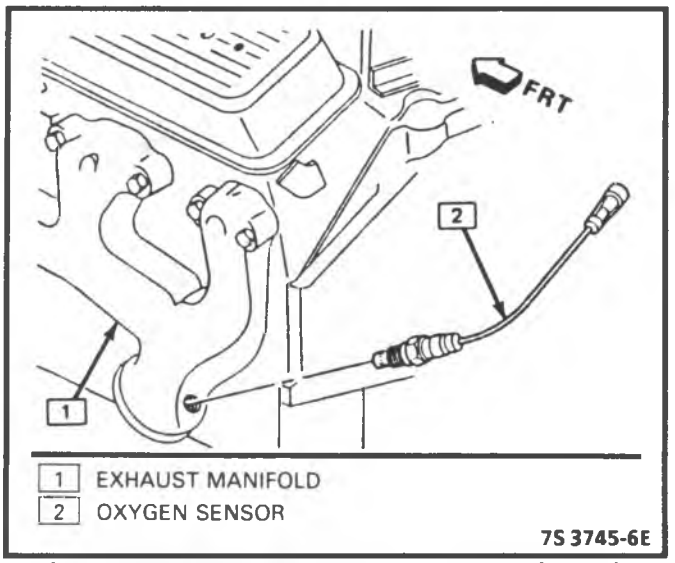


Figure 3-53 - Oxygen Sensor - 5.0L/5.7L (RVPG)

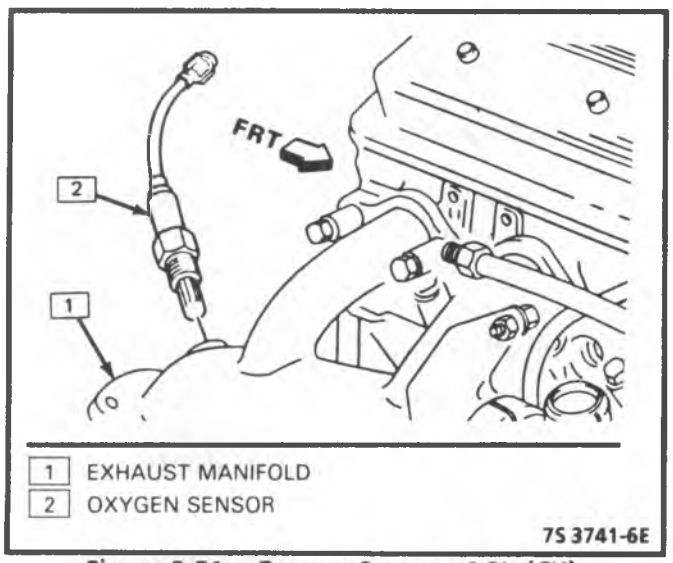


Figure 3-51 - Oxygen Sensor - 4.3L (CK)

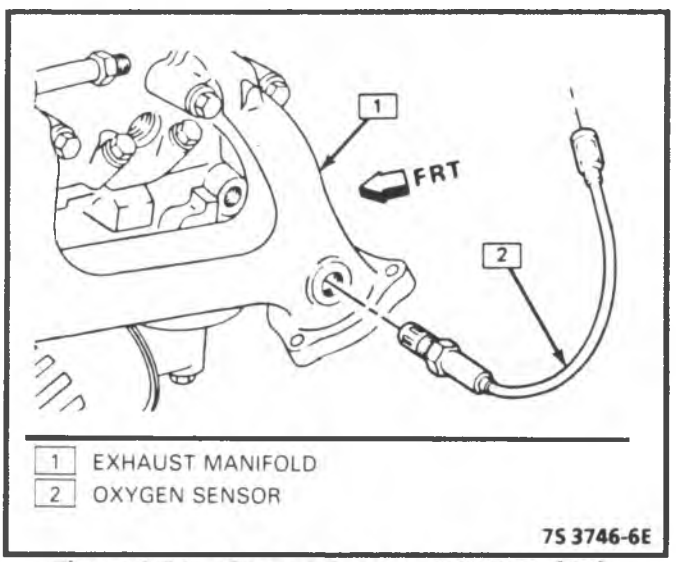


Figure 3-54 - Oxygen Sensor - 5.0L/5.7L (CK)

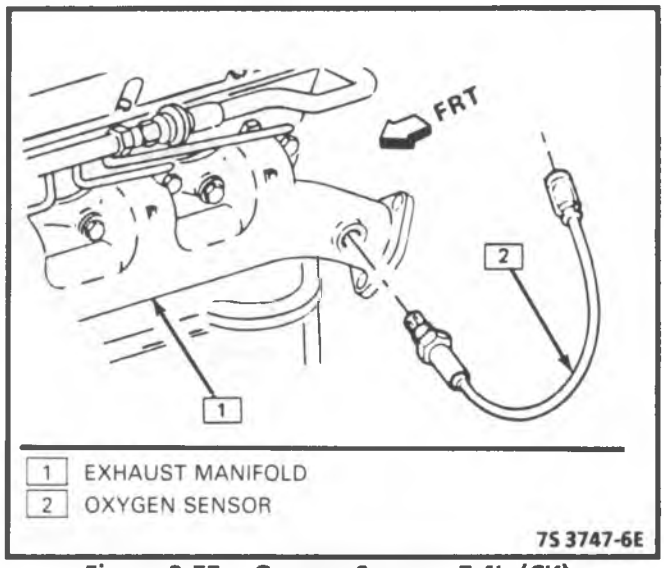


Figure 3-55 - Oxygen Sensor - 7.4L (CK)

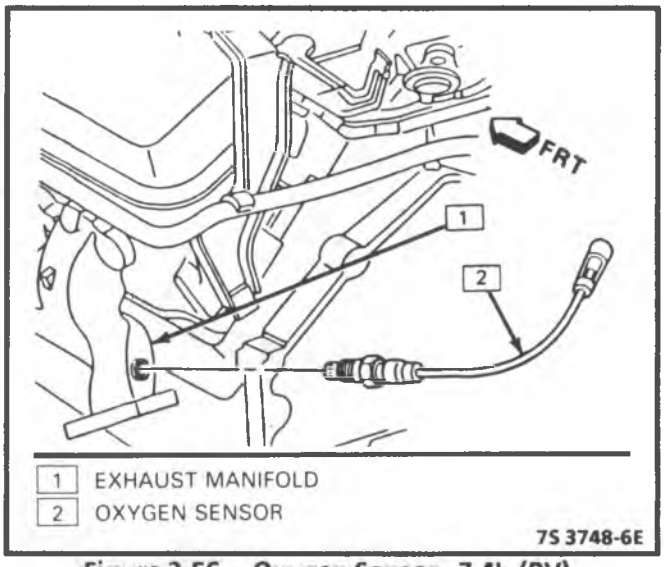


Figure 3-56 - Oxygen Sensor - 7.4L (RV)

THROTTLE POSITION SENSOR
Replacement - TBI 700
Figure 3-57

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

Remove or Disconnect

1. Air cleaner and gasket. Discard gasket.
2. Two TPS attaching screw assemblies.
3. TPS from throttle body assembly.

Install or Connect

1. With throttle valve closed, install TPS on throttle shaft. Rotate counter-clockwise, to align mounting holes.
2. Two TPS attaching screw assemblies.

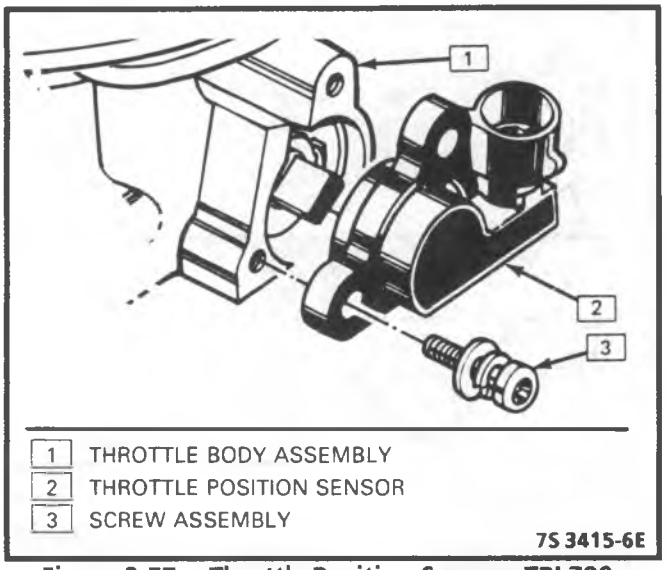


Figure 3-57 - Throttle Position Sensor - TBI 700

Tighten

- Screw assemblies to 2.0 N•m (18.0 in. lbs.).

3. Air cleaner and new gasket.

Replacement - TBI 220
Figure 3-58

Important

On 2.8L (V-6) engines, the TPS is adjustable and is supplied with attaching screw retainers. On all other engines, it is non-adjustable, without retainers. In addition, on 2.8L (V-6) and 7.4L (V-8) engines, the TPS has a horizontal electrical connector; on all other engines, the connector is vertical.

Remove or Disconnect

1. Air cleaner, adapter, and gaskets. Discard gaskets.
2. Two TPS attaching screw assemblies and retainers (if applicable).
3. TPS from throttle body assembly.

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

Install or Connect

1. TPS on throttle body assembly, while lining up TPS lever with TPS drive lever, on throttle body.
2. Two TPS attaching screw assemblies and retainers (if applicable).

Adjust - (2.8L V-6 engines only)

- Follow "Adjustable TPS Output Check" procedure, below.

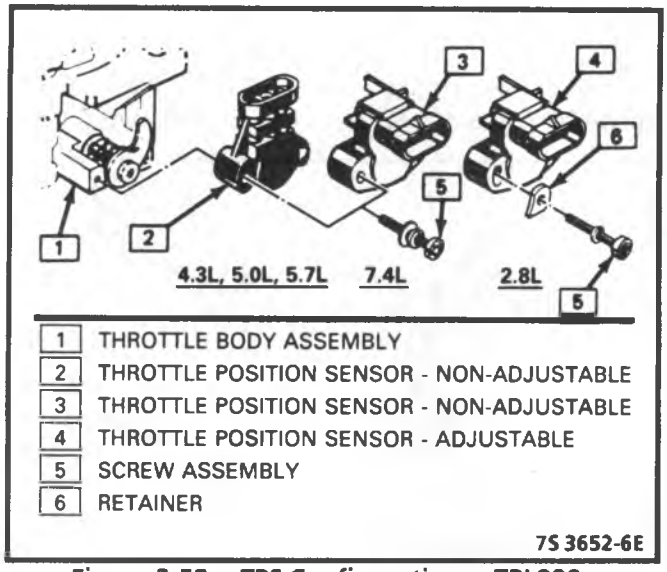


Figure 3-58 - TPS Configurations - TBI 220

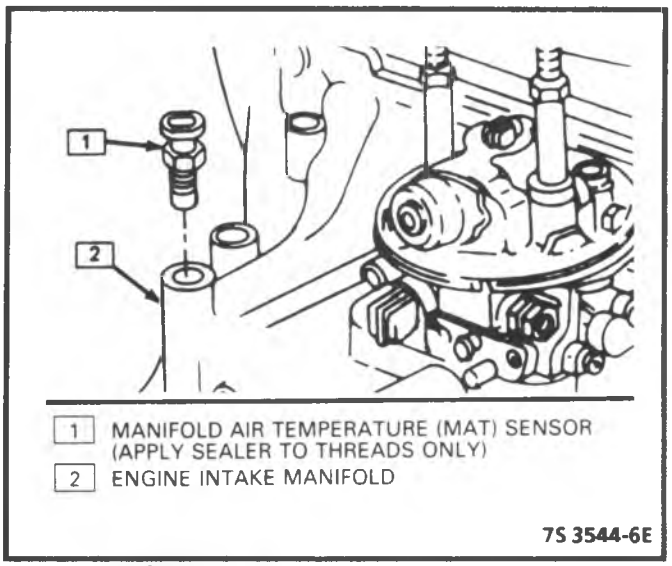


Figure 3-59 - MAT Sensor - 2.5L

Tighten

- Screw assemblies to 2.0 N•m (18.0 in. lbs.).

3. Air cleaner, adapter, and new gaskets.

ADJUSTABLE TPS OUTPUT CHECK - TBI 220 2.8L Engines Only

This check should be performed, only, when throttle body parts have been replaced, or after the minimum idle speed has been adjusted.

1. Connect digital voltmeter J29125-A, or equivalent, from TPS connector, center terminal "B" to outside terminal "A", (jumpers for terminal access can be made using terminals 1214836 and 12014837). ALDL Scanner can be used, to read TPS output voltage.
2. With ignition "ON", engine stopped, TPS voltage should be less than 1.25 volts.
3. If voltage is more than 1.25 volts, rotate TPS until 0.48 ± .06 volts are obtained.
4. If above voltage limitation cannot be obtained, replace TPS.
5. Remove voltmeter and jumpers, reconnect TPS connector to sensor.

MAT SENSOR

Refer to Figure 3-59, for replacement of the MAT sensor.

E-CELL

Refer to Figure 3-32, for replacement of the E-Cell (Elapsed Timer module).

KNOCK SENSOR

Refer to Section 7, Electronic Spark Control, for replacement of the Knock Sensor.

VEHICLE SPEED SENSOR
Figure 3-60

Refer to "Section 8C, in Service Manual, for vehicle speed sensor service, which is part of the speedometer and instrument cluster.

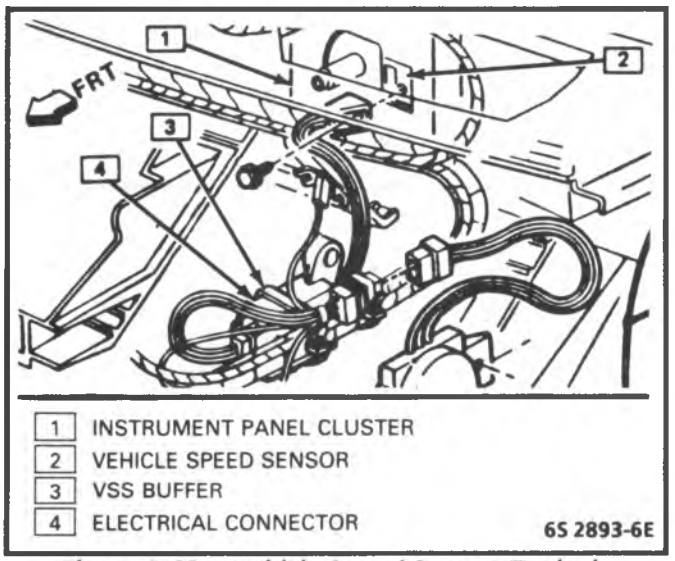


Figure 3-60 - Vehicle Speed Sensor, Typical

PARK/NEUTRAL SWITCH

The Park/Neutral switch is located on the steering column.

Adjustment

1. Move the switch housing all the way toward "low gear" position.
2. Move gear selector to "park" position. The main housing and housing back should ratchet, providing proper switch adjustment.

Remove or Disconnect

1. Place gear selector in "neutral".
2. Electrical connectors.
3. Spread tangs on housing and pull switch.

Install and Connect

1. Align actuator on switch, with hole in shift tube.
2. Position rearward portion of the switch (connector side) to fit into cutout in lower jacket.
3. Push down on front of switch to engage the two tangs.
4. Move gear selection to "park" and switch is adjusted.
5. Electrical connectors.

POWER STEERING PRESSURE SWITCH
Figure 3-61

The switch is located in the inlet pipe of the power steering gear.

Remove or Disconnect

1. Electrical connector.
2. Power Steering Pressure switch.

Install and Connect

1. Power Steering Pressure switch.
2. Electrical connector.

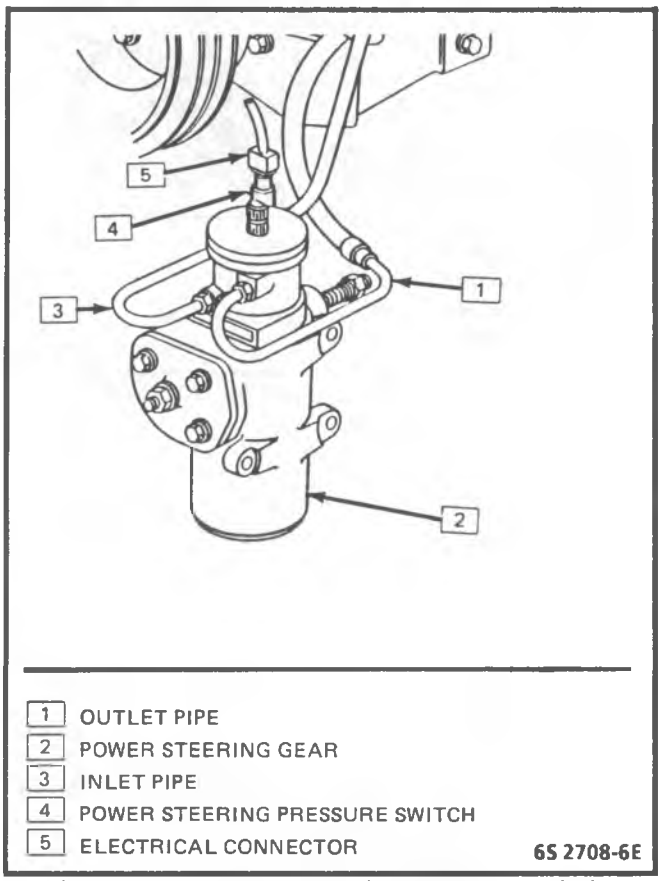


Figure 3-61 - Power Steering Pressure Switch

A/C CONTROL

Refer to Figure 3-62 and 3-63, for replacement of the A/C clutch control relay, on S/T Truck and M Van.

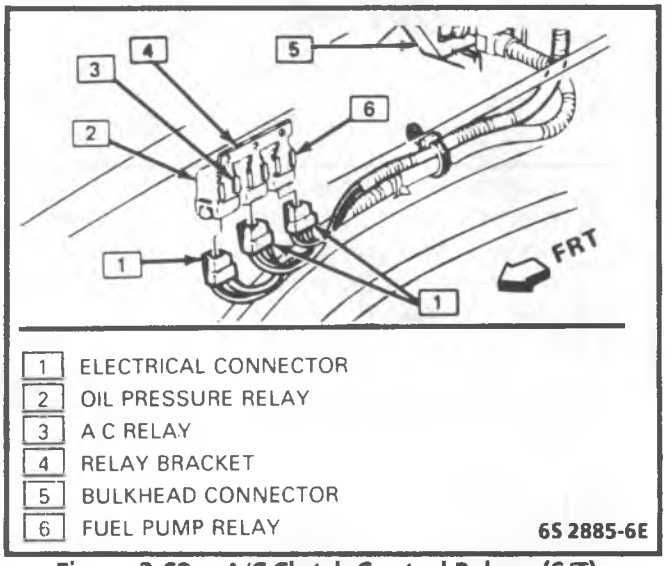


Figure 3-62 - A/C Clutch Control Relay - (S/T)

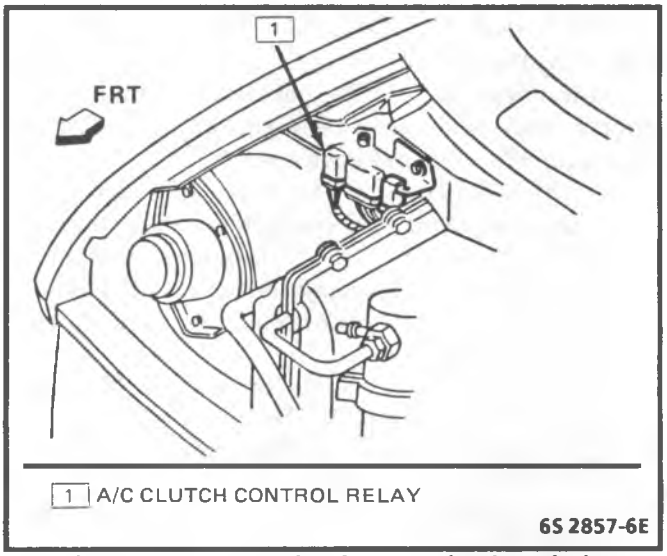


Figure 3-63 - A/C Clutch Control Relay - (M)

PARTS INFORMATION

PART NAME	GROUP
Controller, ECM	3.670
Calibrator, PROM	3.670
Sensor, Coolant Temp.	3.670
Sensor, Exhaust Oxygen	3.670
Sensor, MAP	3.670
Sensor, Throttle Position: Part of Sensor Kit, Throttle Position	3.440
Switch, Neu. St. & Backing LP	2.698

SECTION 4
FUEL CONTROL
TBI 220 (V-6 & V-8)
TBI 700 (L-4)
CONTENTS

GENERAL DESCRIPTION

The following is general information required when working on the fuel system:

- Any time the fuel system is being worked on, disconnect the negative battery cable or cables, except for those tests where battery voltage is required.
- Always keep a dry chemical (Class B) fire extinguisher near the work area.
- The torque on a screw fitting is 30 N•m (22 ft. lbs.).
- Fuel pipe fittings require the use of an O-ring.
- All fuel pipe must meet the GM Specification 124-M, or its equivalent.
- All fuel hose must meet GM Specification 6163-M, or its equivalent.
- Do not replace fuel pipe with fuel hose.
- Always allow fuel pressure to bleed off before servicing any fuel system components.
- Do not do any repairs on the fuel system until you have read the copy and checked the pictures relating to that repair.
- Adhere to all Notices and Cautions.

All gasoline engines are designed to use only unleaded gasoline. Unleaded gasoline must be used for proper emission control system operation. Its use will also minimize spark plug fouling and extend engine oil life. Using leaded gasoline can damage the emission control system and could result in loss of emission warranty coverage.

All vehicles in the manual are equipped with an Evaporative Emission System. The purpose of the system is to minimize the escape of fuel vapors to the atmosphere. Information on this system will be found in Section 5.

PURPOSE

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

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

- Throttle Body Injection (TBI) Unit
  - Fuel Injector
  - Fuel Pressure Regulator
  - Idle Air Control (IAC) Valve
- Fuel Pump
- Fuel Pump Relay
- Fuel Tank
- Accelerator Control
- Fuel Lines
- Fuel Filters
- Evaporative Emission Control System

BASIC SYSTEM OPERATION

Fuel is delivered to the engine by a Throttle Body Injection (TBI) unit.

The main control sensor is the Oxygen (O_2) Sensor, which is located in the exhaust manifold. The O_2 sensor tells the ECM the ratio of oxygen in the exhaust gas, and the ECM changes the air/fuel ratio to the engine by controlling the fuel injector. A 14.7:1 air/fuel ratio is required, for efficient Catalytic Converter operation. Because of the constant measuring and adjusting of the air/fuel ratio, the Fuel Control system is called a "Closed Loop" System (Figure 4-1).

The fuel control system (Figure 4-2) has an electric fuel pump, located in the fuel tank with

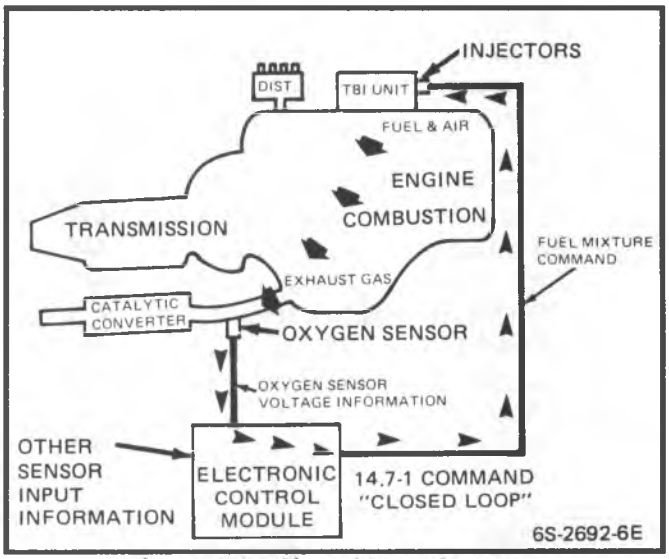


Figure 4-1 - Closed Loop System.

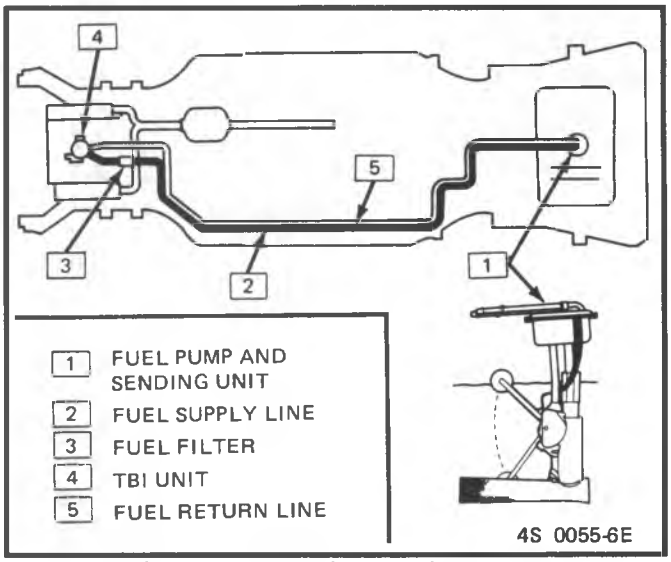


Figure 4-2 - Fuel Control System

the gage sending unit, which pumps fuel to the TBI through the fuel supply line, then through an in-line fuel filter. The pump is designed to provide pressurized fuel at about 125 kPa (18 psi). A pressure regulator in the TBI keeps fuel available to the injector(s) at a constant pressure between 62 and 90 kPa (9 and 13 psi). Fuel, in excess of injector(s) needs, is returned to the fuel tank by a separate line.

The ECM controls the injector(s) and is located in the fuel meter body assembly of the TBI. The injector(s) deliver fuel in one of several modes, as described below.

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

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.

Starting Mode

When the key is first turned "ON", the ECM will turn on the fuel pump relay and fuel pump for two seconds for most systems. On some vehicles, the fuel pump will run for twenty seconds. This will build up fuel pressure to the TBI unit. 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 injector is turned "ON" and "OFF". This is done by "pulsing" the injector 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 injector at a 20:1 air/fuel ratio. The ECM holds this injector rate as long as the throttle stays wide open, and the engine is below 600 rpm. 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".

Open Loop

When the engine is first started, and engine 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 calculates the air/fuel ratio based on inputs from the Coolant and MAP Sensors. At idle, the 2.8L and the 7.4L engine will run in an "Open Loop" condition.

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.

Closed Loop

The specific values for the above conditions vary with different engines, and are stored in the PROM. When these conditions are met, the system goes into "Closed Loop" operation. In "Closed Loop", the ECM will calculate the air/fuel ratio (injector on-time) based on the signal from the 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, and provides extra fuel.

Deceleration Mode

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

Battery Voltage Correction Mode

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

- Increasing injector on time of fuel delivered;
- Increasing the idle rpm; and
- Increasing ignition dwell time.

Fuel Cutoff Mode

No fuel is delivered by the injectors, 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. Fuel cutoff will also occur at high engine rpm, to protect internal engine components from damage.

TBI UNIT OPERATION

Model 220 TBI

The Model 220 TBI unit, used on the the V-6 and V-8 engines (Figure 4-3), consists of three major casting assemblies:

1) A fuel meter cover with:
   - A pressure regulator.
2) A fuel meter body with:
   - Two fuel injectors.
3) A throttle body with:
   - Two throttle valves (TV)
   - An idle air control (IAC) valve
   - A throttle position sensor (TPS).

Model 700 TBI

The Model 700 TBI unit, used on the L-4 engine (Figure 4-4), is made up of <u>two</u> major casting assemblies:

1) A fuel meter body with:
   - A fuel meter assembly, including a pressure regulator
   - A fuel injector.
2) A throttle body with:
   - A throttle valve (TV)
   - An idle air control (IAC) valve
   - A throttle position sensor (TPS).

The throttle body portion of the TBI unit may contain ports located above, or below, the throttle valve. These ports generate the vacuum signals for the EGR valve, MAP sensor, and the canister purge system.

Fuel Injector(s) (Figure 4-3 or 4-4)

A fuel injector is a solenoid operated device controlled by the ECM. The ECM turns on the solenoid, which lifts a normally closed ball valve off a seat. The fuel, under pressure, is injected in a conical spray pattern at the walls of the throttle body bore above the throttle valve. The fuel, which is not used by the injector(s), passes through the pressure regulator, before being returned to the fuel tank.

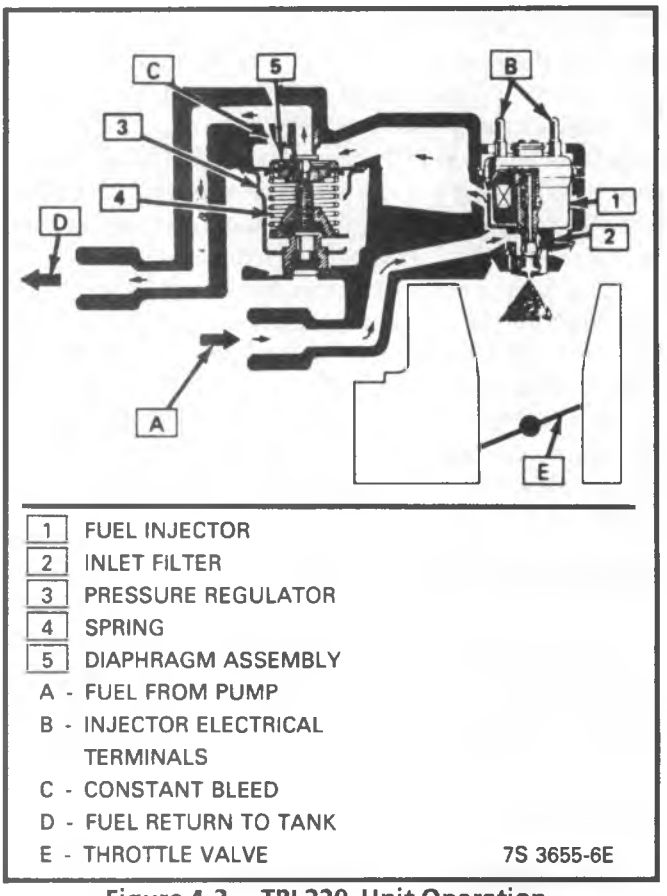


Figure 4-3 - TBI 220 Unit Operation

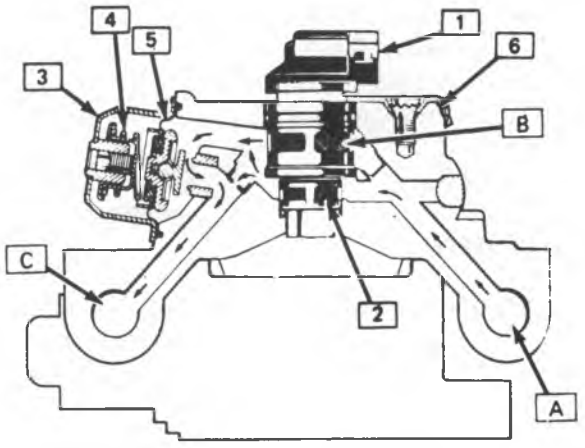
A fuel injector, which does not open, may cause a no-start condition. An injector, which is stuck partly open, could cause loss of pressure after sitting, so, long crank times would be noticed on some engines. Also, dieseling could occur, because some fuel could be delivered to the engine after the key is turned "OFF".

Pressure Regulator (Figure 4-3 or 4-4)

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

The pressure regulator is serviced as part of the fuel meter cover (TBI 220 units), or fuel meter assembly (TBI 700 units). On TBI 220 units, the pressure regulator should not be disassembled. However, disassembly is permitted on TBI 700 units.

If the pressure regulator in the TBI supplies pressure which is too low (below 62 kPa or 9 psi), poor performance could result. If the pressure is too high, unpleasant exhaust odor may result.



1 FUEL INJECTOR
2 INLET FILTER
3 PRESSURE REGULATOR
4 SPRING
5 DIAPHRAGM ASSEMBLY
6 FUEL METER ASSEMBLY
A - FUEL FROM PUMP
B - PURGE FILTER
C - FUEL RETURN TO TANK

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Figure 4-4 - TBI 700 Unit Operation

IAC Valve (Figure 4-21 or 4-34)

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

The IAC valve, mounted on the throttle body, controls bypass air around the throttle valve. By moving a conical valve IN (to decrease air flow) or OUT (to increase air flow), a controlled amount of air can move around the throttle valve. 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, which plugs into the ALDL.

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

If the IAC valve is disconnected or connected with the engine running, the idle rpm may be wrong. In this case, the IAC valve may be reset by turning the ignition switch "ON" and "OFF" one time.

The IAC valve affects only the idle characteristics of the engine. If it is open fully, too much air will be allowed to 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.

On 2.5L (TBI 700) and 7.4L (TBI 220) engines, the IAC valve is flange-mounted. On all other engines, it is thread mounted. The IAC valve is available in several different pintle shapes. However, on TBI 220 and 700 applications, a dual taper pintle shape is used. The diameter of the pintle is 10mm (with the exception of the 7.4L engine, which has an IAC valve with a 12mm pintle diameter). If replacement is necessary, only an IAC valve with the appropriate pintle shape and diameter should be used.

TPS (Throttle Position Sensor) (Figure 4-20 or 4-33)

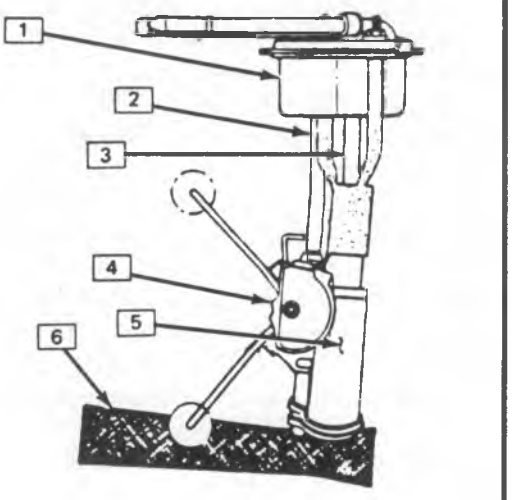
The Throttle Position Sensor (TPS), is mounted on the side of the throttle body opposite the throttle lever assembly. Its function is to sense the current throttle valve position and relay that information to the ECM. Knowledge of throttle position is needed by the ECM to generate the required injector control signals (pulses). Should the TPS sense a wide open throttle, a voltage signal indicating this condition is sent to the ECM. The ECM will then widen the injector pulses or increase the repetition rate (frequency of the applied pulses) permitting increased fuel flow.

As the throttle valve rotates in response to movement of the accelerator pedal, the throttle shaft transfers this rotational movement to the TPS. A potentiometer (variable resistor) within the TPS assembly changes its resistance (voltage drop) in proportion to throttle movement. By applying a reference voltage (5.0 VDC) to the TPS input, a varying voltage (reflecting throttle position) is available at the TPS output. For example, approximately 2.5 VDC results from a 50% throttle valve opening (depending on TPS calibration). The voltage output from the TPS assembly is routed to the ECM for use in determining throttle position.

FUEL PUMP OPERATION (Figure 4-5 and 4-6)

The fuel pump is a turbine type, low pressure, electric pump, mounted in the fuel tank. Fuel is pumped at a positive pressure (above 62kPa or 9psi) from the fuel pump through the in-line filter to the pressure regulator in the TBI assembly. Excess fuel is returned to the fuel tank, through the fuel return line.

The fuel pump is attached to the fuel gage sender assembly. A fuel strainer is attached to the fuel pump inlet line and prevents dirt particles from entering the fuel line and tends to separate water from the fuel.



1 VAPOR SEPARATOR
2 FUEL RETURN TUBE
3 FUEL FEED TUBE
4 FUEL LEVEL SENDER
5 ELECTRIC FUEL PUMP
6 FILTER STRAINER

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Figure 4-5 Fuel Pump

Vapor lock problems are reduced, when using an electric pump, because the fuel is pushed from the tank under pressure rather than pulled under vacuum, a condition that produces vapor.

An inoperative fuel pump would cause a no start condition. A fuel pump which does not provide enough pressure can result in poor performance. (See "Fuel System Pressure Test" procedure).

Fuel Pump Electrical Circuit

When the key is first turned on, without the engine running, the ECM will turn the fuel pump relay on for two seconds, on most vehicles. On some 5.7L and 7.4L engines, a fuel module circuit is installed so that the fuel pump will run for about 20 seconds, when ignition switch is turned "ON". If the engine is not started within two seconds, the ECM will shut the fuel pump off. As soon as the engine is cranked, the ECM will turn the relay on and run the fuel pump.

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

An inoperative fuel pump relay can result in long cranking times, particularly if the engine is cold. The oil pressure switch will turn "ON" the fuel pump, as soon as oil pressure reaches about 28 kPa (4psi).

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

FUEL FILTER

Inline Filters

CAUTION: To reduce the risk of fire and personal injury, it is necessary to allow fuel pressure to bleed off before servicing fuel system components. (See Fuel System Pressure Relief.)

The inline filter is located in the fuel feed line. It prevents dirt from entering the TBI unit.

In Tank Filter

A woven plastic filter is located on the lower end of the fuel pickup tube in the fuel tank. This filter prevents dirt from entering the fuel line and, also, stops water, unless the filter becomes completely submerged in water. This filter is self-cleaning and normally requires no maintenance. Fuel stoppage, at this point, indicates that the fuel tank contains an abnormal amount of sediment or water; the tank should, therefore, be thoroughly cleaned.

FUEL AND VAPOR PIPES

The fuel feed and return pipes and hoses extend from the fuel pump and sender to the TBI unit. They are secured with clamps and are routed along the frame side member.

The vapor pipe and hoses extend from fuel pump and sender unit to the canister.

FUEL TANK

The fuel tank, at the rear of the underbody, is held in place by two metal straps. Anti-squeak pieces are used on top of the tank to reduce rattles.

Filler Neck

To help prevent refueling with leaded gasoline, the fuel filler neck on gasoline engine vehicles has a built-in restrictor and deflector. The opening in the restrictor will only admit the smaller unleaded gas nozzle spout, which must be fully inserted to bypass the deflector. Attempted refueling with a leaded gas nozzle, or failure to fully insert the unleaded gas nozzle, will result in gasoline splashing back out of the filler neck.

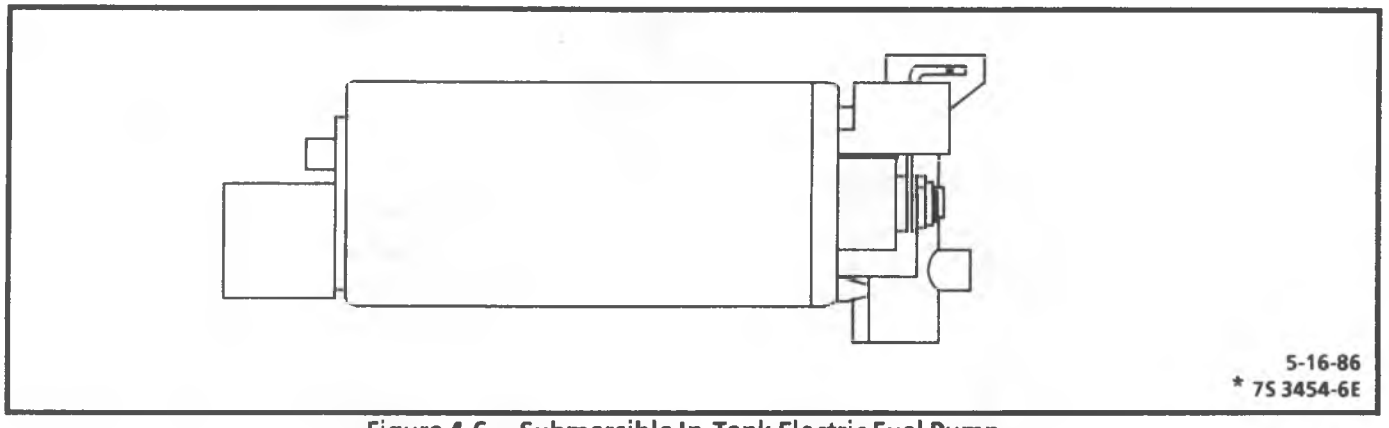


Figure 4-6 - Submersible In-Tank Electric Fuel Pump

Fuel Filler Cap

The fuel tank filler neck is equipped with a screw-type cap. The threaded part of the cap requires several turns counterclockwise to remove. The long threaded area was designed to allow any remaining fuel tank pressure to escape, while the cap was being removed. A built-in torque-limiting device prevents overtightening. To install, turn the cap clockwise until a clicking noise is heard. This signals that the correct torque has been reached and the cap is fully seated.

ACCELERATOR CONTROL

The accelerator control system is a control cable type, attached to a accelerator pedal assembly.

EVAPORATIVE EMISSION CONTROL SYSTEM

This system transfers fuel vapors from the fuel tank into a vapor canister and then vapors are purged into the intake manifold air flow and consumed in combustion. Refer to Section 5, for additional information, diagnosis, and on-vehicle service.

DIAGNOSIS

FUEL CONTROL

The diagnosis of fuel control and the TBI unit is in Section 3, because the Computer Command Control system controls fuel delivery. This system has a built in diagnostic system in the ECM to indicate a failed circuit. This section will explain the system check and the codes related to fuel control.

The fuel control can be the reason that the engine cranks, but will not run and the diagnosis is, also, in Section 3. If diagnosis indicates that the engine will not run because there is a fuel delivery problem, the diagnosis of the fuel system is, also, included in Section 3.

Idle Air Control

The diagnosis of idle air control can be found in Code 35, Section 3, for the 2.5L engine and in this section for all other engines.

Throttle Position Sensor

Refer to Section 3 for diagnosis of the throttle position sensor.

Driveability Symptoms

Refer to Section 2, for additional fuel control diagnosis.

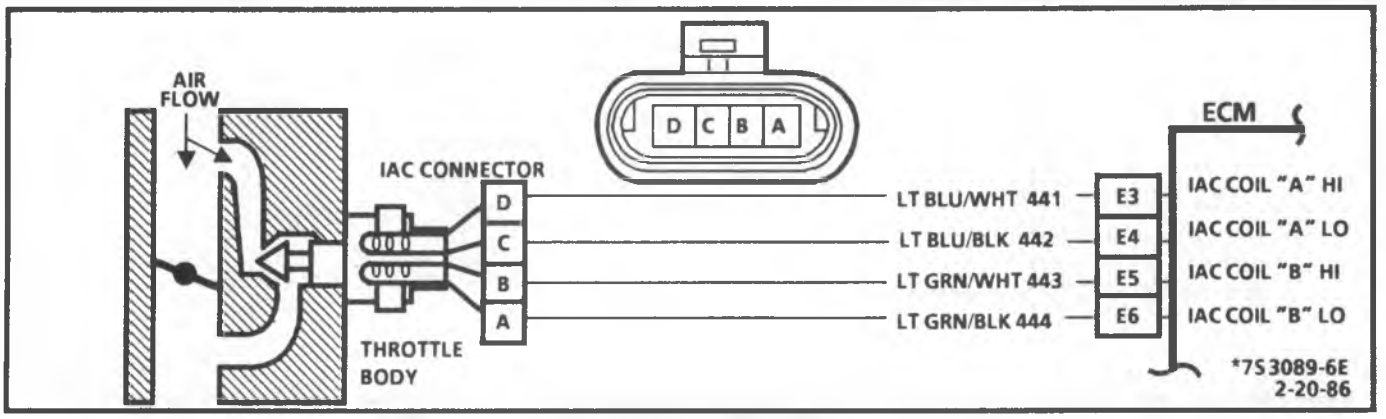
Fuel System Pressure Relief

Whenever there is fuel system service required for the fuel lines, the TBI unit, fuel pump, or pressure test, the following procedure should be followed:

V-6 and V-8 Engines

The TBI 220 for the V-6 and V-8 engines contains a constant bleed feature in the pressure regulator that relieves pressure. Therefore, no special procedures are required for relieving fuel pressure, other than disconnecting the fuel line fittings.

CAUTION: A small amount of fuel may still be released, when the fuel line is disconnected. To reduce the chance of personal injury, cover the fitting to be disconnected with a shop cloth. Place the cloth in an approved container, when disconnect is completed.



IDLE SPEED ERROR

ALL ENGINES EXCEPT 2.5L

Circuit Description:

The ECM sends voltage pulses to the proper IAC motor winding, which causes the motor shaft and valve to move "in" and "out" a given distance for each pulse (called counts) received. This movement controls air flow around the throttle plate, which, in turn, controls engine idle speed.

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

1. Continue with test, even if engine will not idle. If idle is too low, "Scan" will display 80, or more, counts or steps. 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. There is a system problem. Proceed to paragraph three below.
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 circuits is shorted to voltage, which would have been indicated by a steady light. Disconnect ECM and turn the ignition "ON" and probe terminals to check for this condition.

Diagnostic Aids:

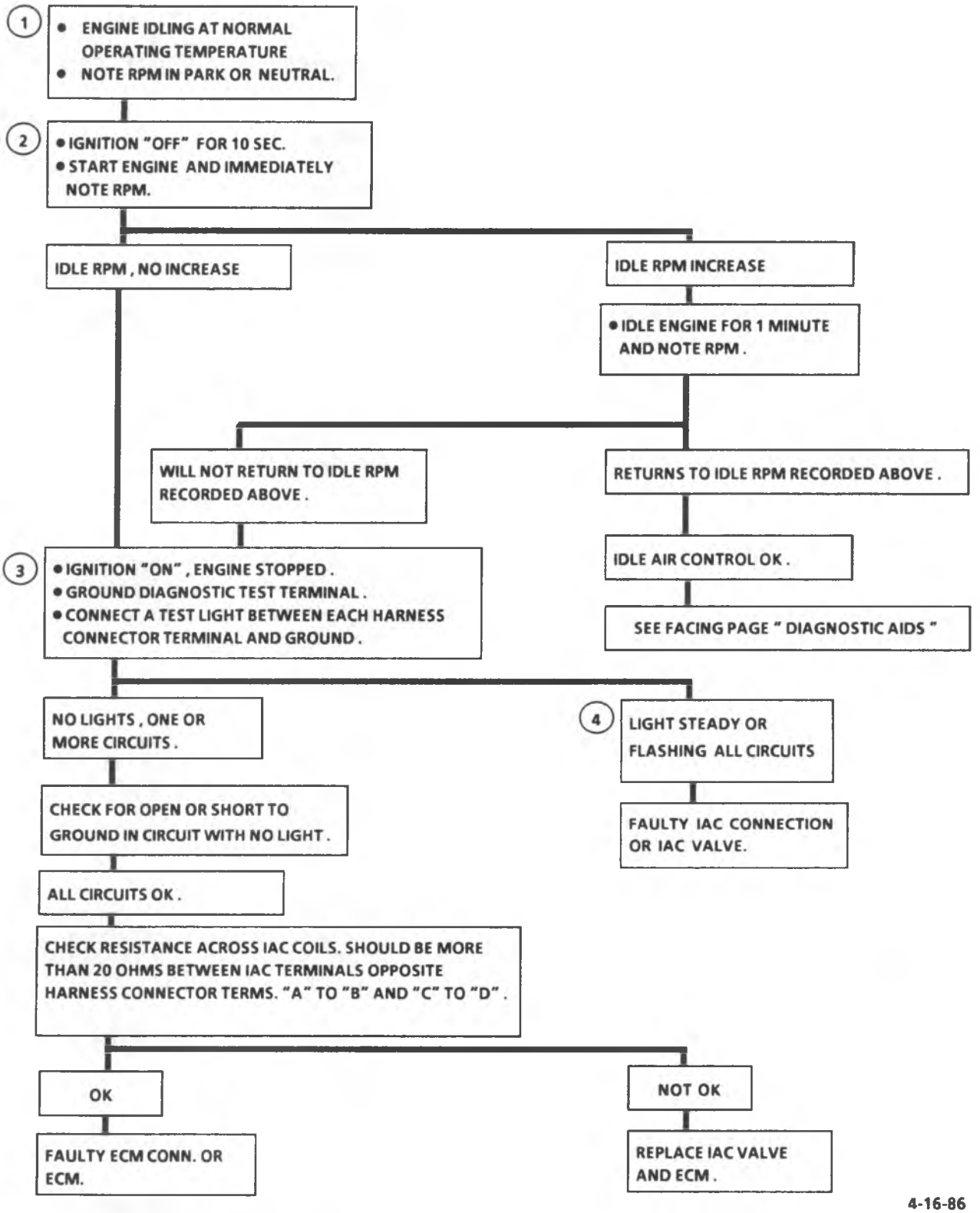
A slow unstable idle may be caused by a system problem that cannot be overcome by the IAC. "Scan" counts will be above 60 counts, if too low, and 0 counts, if too high.

If idle is too high, stop engine. Ignition "ON". Ground diagnostic terminal. Wait a few seconds for IAC to seat, then disconnect IAC. 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 300mv (.3v). Check for low regulated fuel pressure or water in fuel. A lean exhaust with an oxygen sensor output fixed above 800mv (.8v) will be a contaminated sensor, usually silicon. 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 800mv (.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.
- A/C Compressor or Relay Failure - See A/C diagnosis if circuit is shorted to ground. If the relay is faulty, idle problem may exist.
- Refer to Rough, Unstable, Incorrect Idle or Stalling, in Symptoms in Section 2.

IDLE SPEED ERROR

ALL ENGINES EXCEPT 2.5L



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

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L-4 Engine

The TBI 700, for the L-4 engine, contains no constant bleed feature and requires relieving the fuel pressure as follows:

1. Place transmission selector in Park (Neutral on manual transmissions), set parking brake, and block drive wheels.
2. Disconnect three terminal electrical connector at fuel tank.
3. Start engine and allow to run a few seconds, until it stops for lack of fuel.
4. Engage starter for three seconds to dissipate fuel pressure in lines. Fuel connections are now safe for servicing.

CAUTION: A small amount of fuel may be released, after the fuel line is disconnected. In order to reduce the chance of personal injury, cover the fitting to be disconnected with a shop cloth. Place the cloth in a approved container, when disconnect is completed.

5. When pressure is relieved, and servicing is complete, connect electrical connector at the fuel tank.

Fuel System Pressure Test

Several system checks and diagnoses require observing the fuel system pressure. This test provides a visual fuel pressure reading.

1. Turn engine "OFF" and relieve fuel pressure.

CAUTION: A small amount of fuel may be released, after the fuel line is disconnected. In order to reduce the chance of personal injury, cover the fitting to be disconnected with a shop cloth. Place the cloth in a approved container, when disconnect is completed.

2. Remove air cleaner, adapter, and gaskets, and plug THERMAC vacuum port on TBI 700 unit.
3. Install fuel pressure gage J-29658A/BT8205, or equivalent, at the outlet side of the in-line fuel filter (Figure 4-51 through 4-57).

Measure

- Start engine and observe fuel pressure reading. It should be 62-90 kPa (9-13 psi); if not, refer to CHART A-6, in Section 3.

4. Relieve fuel pressure.
5. Remove fuel pressure gage.
6. Re-install fuel hose, or pipe assembly, to in-line fuel filter.
7. Start engine and check for fuel leaks.
8. Remove plug covering THERMAC vacuum port, on TBI 700 unit, and install air cleaner.

FUEL PUMP

Refer to fuel system diagnosis in Section 3, for fuel pump diagnosis.

Fuel Pump Relay

Refer to fuel pump relay circuit check in Section 3, for relay diagnosis.

Oil Pressure Switch

Refer to fuel pump relay circuit check in Section 3, for switch diagnosis.

Fuel Module

Refer to fuel pump relay circuit check in Section 3 for fuel module diagnosis.

FUEL FILTER

The diagnosis of the fuel filter is covered in Section 3, as part of the fuel system diagnosis.

A plugged fuel filter may cause a restricted fuel delivery, or a no start condition.

FUEL PIPES AND HOSES

The diagnosis of gasoline odor may be a condition of a leaking fuel feed, or return pipe or hose. Fuel pipes that are pinched, plugged, or mis-routed may cause restricted fuel delivery.

FUEL TANK

The diagnosis of gasoline odor may be a condition of a leaking fuel tank, filler neck, or filler cap.

A defective filler cap, or plugged, or pinched vapor pipe can cause a collapsed fuel tank.

Loose mounting straps, or foreign material in tank, may be the cause of a rattle at the fuel tank.

ACCELERATOR CONTROL

Check for correct cable routing, or binding, and correct as necessary.

EVAPORATIVE EMISSION CONTROL

Refer to Section 5, for diagnosis of the Evaporative Emission Control system.

ON-VEHICLE SERVICE

GENERAL SERVICE INFORMATION

CAUTION: **Before servicing, refer to the "Fuel Pressure Relief Procedure", whenever service on the fuel lines, or fuel handling components of the TBI unit components are to be accomplished. To reduce the chance of personal injury, cover the fuel line with a shop cloth to collect the fuel during servicing, and then, place the cloth in an approved container, when work is completed.**

The TBI unit repair procedures cover component replacement with the unit on the vehicle. However, throttle body replacement requires that the complete unit be removed from the engine.

Refer to the disassembled view (Figure 4-7 or 4-8), for identification of parts during repair procedures. Service repair of individual components is performed without removing the TBI unit from the engine. If removed, it is essential that the unit be placed on a holding fixture, such as J-9789-118, BT-3553, or equivalent, to prevent damage to the throttle valves, before performing any service.

CLEANING AND INSPECTION

All TBI component parts, with the exception of those noted below, should be cleaned in a cold immersion cleaner such as Carbon X (X-55), or equivalent.

NOTICE: The throttle position sensor (TPS), idle air control (IAC) valve, pressure regulator diaphragm assembly, fuel injectors or other components containing rubber, SHOULD NOT be placed in a solvent or cleaner bath. A chemical reaction will cause these parts to swell, harden or distort. Do not soak the throttle body with the above parts attached. If the throttle body assembly requires cleaning,soaking time in the cleaner should be kept to a minimum. Some models have hidden throttle shaft dust seals that could lose their effectiveness by extended soaking.

1. Clean all metal parts thoroughly and blow dry with shop air. Be sure that all fuel and air passages are free of dirt or burrs.
2. Inspect mating casting surfaces for damage that could affect gasket sealing.

Thread Locking Compound

Service repair kits are supplied with a small vial of thread locking compound with directions for use. If material is not available, use Loctite 262, or GM part number 10522624, or equivalent.

NOTICE: Do not use a higher strength locking compound than recommended, since to do so could make removing the screw extremely difficult, or result in damaging the screw head.

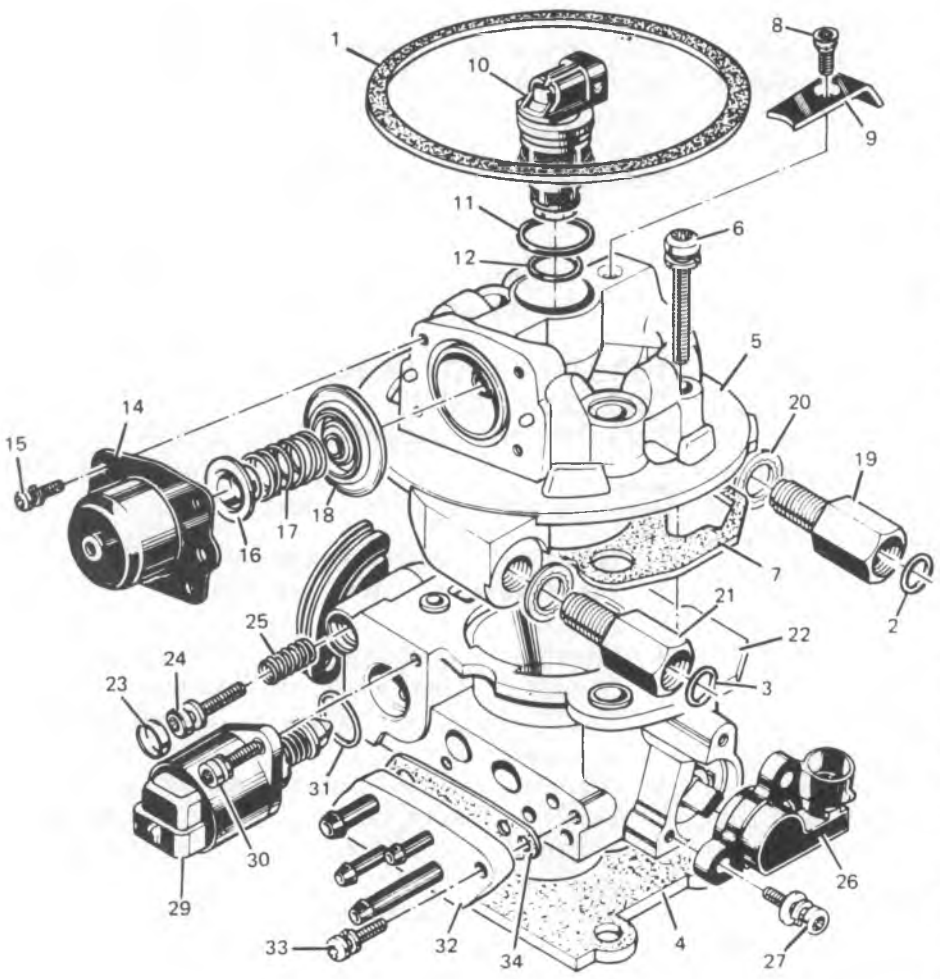
THROTTLE BODY INJECTION UNIT
TBI 220 and 700
Replacement (Figures 4-9 through 4-13)

Remove or Disconnect

1. THERMAC hose from engine fitting (TBI 700).
2. Air cleaner, adapter, and gaskets. Discard gasket.
3. Electrical connectors - Idle Air Control valve, Throttle Position Sensor, and Fuel Injectors. (On TBI 220 units, squeeze plastic tabs on injectors and pull straight up.)
4. Grommet with wires from throttle body.
5. Throttle linkage, return spring(s), transmission control cable, and cruise control (wherever applicable).
6. Vacuum hoses, noting positions of hoses.
7. Inlet and outlet fuel line nuts, using back-up wrench J-29698-A or BT-8251-A.

CAUTION: **Refer to fuel pressure relief procedure, (above), before disconnecting fuel lines.**

8. Fuel line O-rings from nuts and discard.
9. TBI mounting hardware.
10. TBI unit from intake manifold and place on holding fixture J-9789-118 or BT-3553.

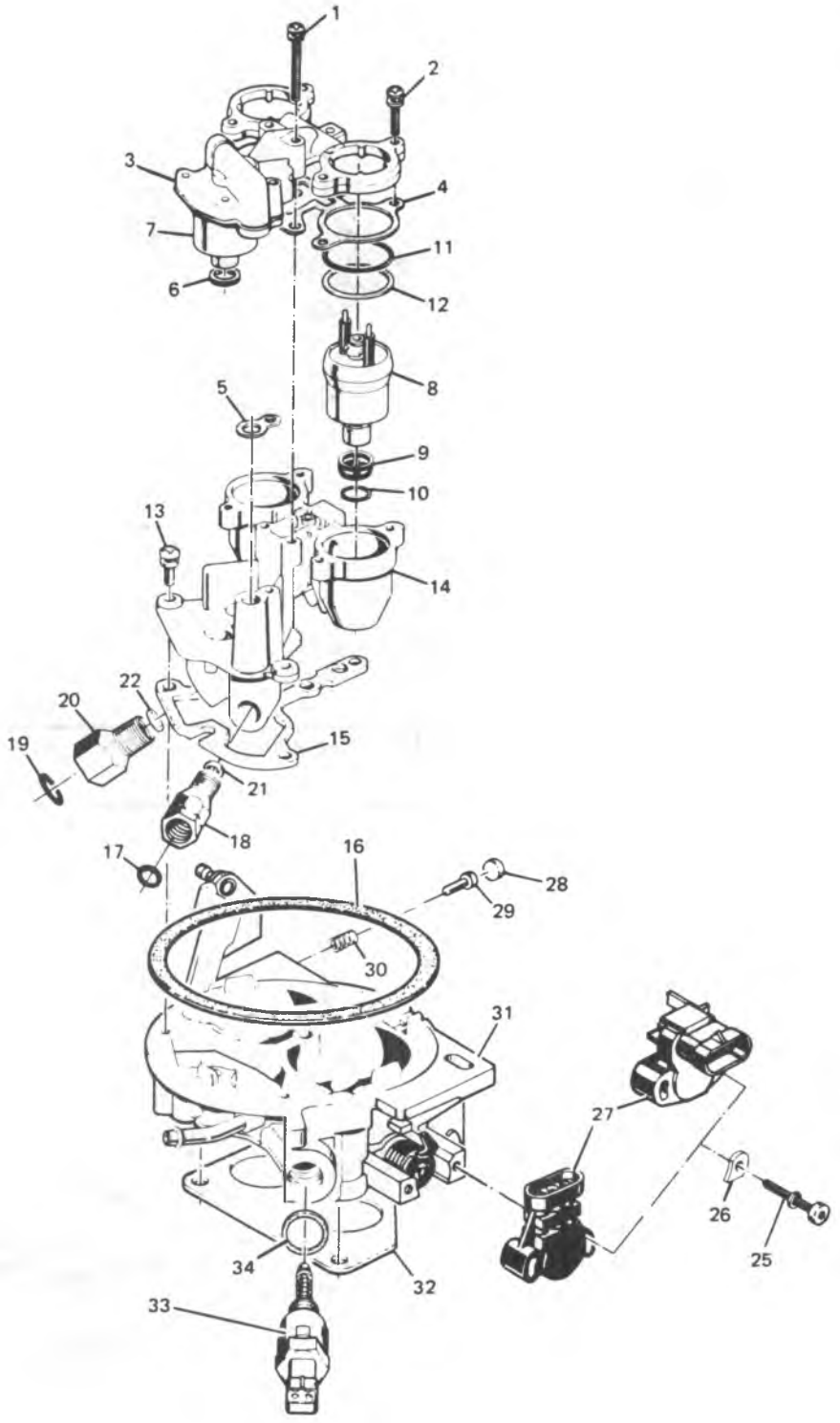


Model 700 TBI

1 Gasket — Air Filter
2 O-Ring — Fuel Line Inlet Nut
3 O-Ring — Fuel Line Outlet Nut
4 Gasket — Flange
5 Fuel Meter Assembly
6 Screw & Washer Assembly — Fuel Meter Body Attaching
7 Gasket — Fuel Meter Body to Throttle Body
8 Screw — Injector Retainer
9 Retainer — Injector
10 Fuel Injector
11 O-Ring — Fuel Injector — Upper
12 O-Ring — Fuel Injector — Lower
13 Filter — Injector
14 Pressure Regulator Cover · Assembly
15 Screw — Pressure Regulator Attaching
16 Seat — Spring
17 Spring — Pressure Regulator
18 Pressure Regulator Diaphragm Assembly
19 Nut — Fuel Inlet
20 Seal — Fuel Nut
21 Nut — Fuel Outlet
22 Throttle Body Assembly
23 Plug — Idle Stop Screw
24 Screw & Washer Assembly — Idle Stop
25 Spring — Idle Stop Screw
26 Sensor — Throttle Position (TPS)
27 Screw & Washer Assembly — TPS Attaching
28 Screw — TPS
29 Idle Air Control Valve (IACV)
30 Screw — IACV Attaching
31 O-Ring — IACV
32 Tube Module Assembly
33 Screw — Manifold Attaching
34 Gasket — Tubes Manifold

7S 3656-6E

Figure 4-7 - Model 700 TBI Parts Identification (L-4 Engine)

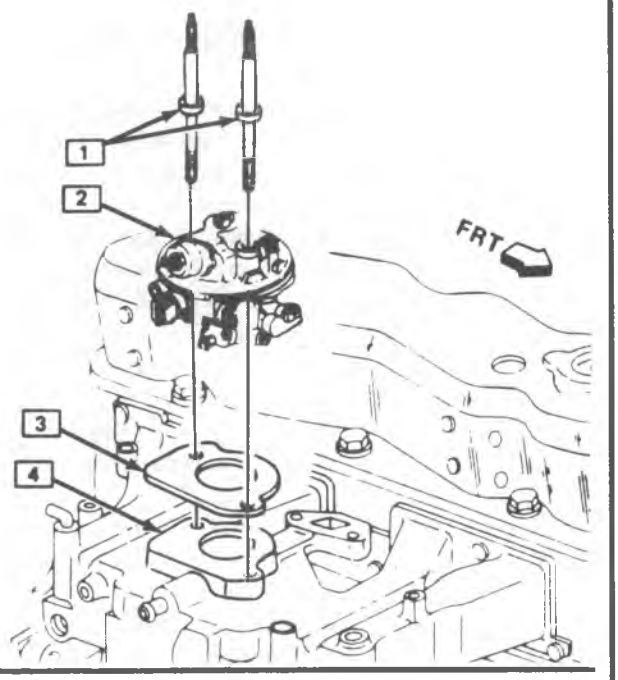


Model 220 TBI

1 Screw Assembly — Fuel Meter Cover Attaching — Long
2 Screw Assembly — Fuel Meter Cover Attaching — Short
3 Fuel Meter Cover Assembly
4 Gasket — Fuel Meter Cover
5 Gasket — Fuel Meter Outlet
6 Seal — Pressure Regulator
7 Pressure Regulator
8 Injector — Fuel
9 Filter — Fuel Injector Inlet
10 O-ring — Fuel Injector — Lower
11 O-ring — Fuel Injector — Upper
12 Washer — Fuel Injector
13 Screw Assembly — Fuel Meter Body — Throttle Body Attaching
14 Fuel Meter Body Assembly
15 Gasket — Throttle Body to Fuel Meter Body
16 Gasket — Air Filter
17 O-ring — Fuel Return Line
18 Nut — Fuel Outlet
19 O-ring — Fuel Inlet Line
20 Nut — Fuel Inlet
21 Gasket — Fuel Outlet Nut
22 Gasket — Fuel Inlet Nut
23 Screw — TPS Lever Attaching
24 Lever — TPS
25 Screw Assembly — TPS Attaching
26 Retainer — TPS Attaching Screw
27 Sensor — Throttle Position (TPS)
28 Plug — Idle Stop Screw
29 Screw Assembly — Idle Stop
30 Spring — Idle Stop Screw
31 Throttle Body Assembly
32 Gasket — Flange
33 Valve Assembly — Idle Air Control (IAC)
34 Gasket — Idle Air control Valve Assembly

7S 3658-6E

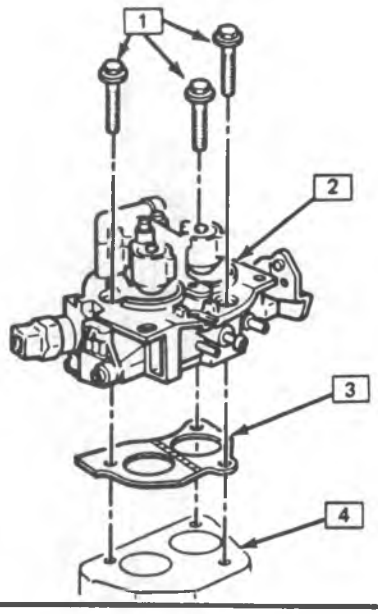
Figure 4-8 - Model 220 TBI Parts Identification (V-6 and V-8 Engine)



1 STUD - TIGHTEN TO 17 N·m (12 FT. LBS.)
2 TBI UNIT
3 GASKET
4 ENGINE INTAKE MANIFOLD

7S 3546-6E

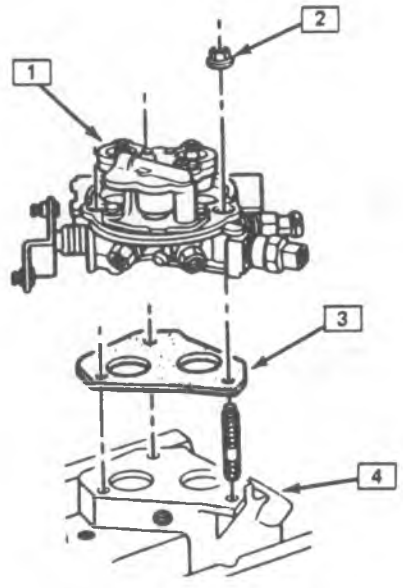
Figure 4-9 - Replacing TBI 700 Unit - 2.5L



1 BOLT - TIGHTEN TO 16 N·m (12 FT. LBS.)
2 TBI UNIT
3 GASKET (MUST BE INSTALLED WITH STRIPE FACING UP)
4 ENGINE INTAKE MANIFOLD

6S 2799-6E

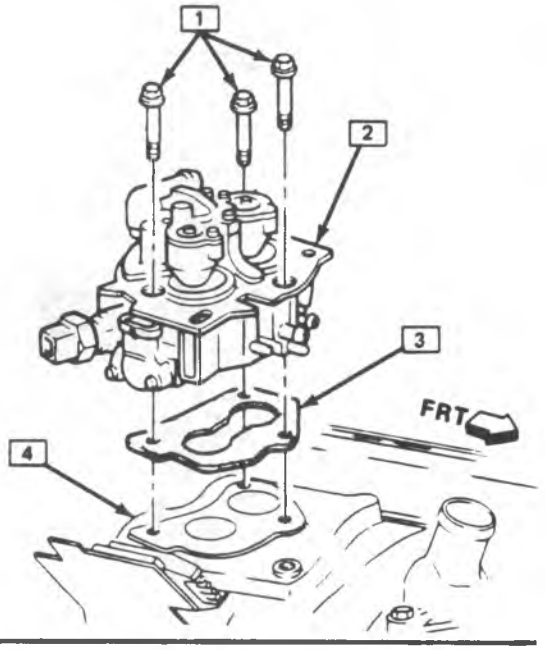
Figure 4-11 - Replacing TBI 220 Unit - 4.3L



1 TBI UNIT
2 NUT-TIGHTEN TO 25 N·m (18 FT. LBS.)
3 GASKET
4 ENGINE INTAKE MANIFOLD

6S 2797-6I

Figure 4-10 - Replacing TBI 220 Unit - 2.8L



1 BOLT - TIGHTEN TO 16 N·m (12 FT. LBS.)
2 TBI UNIT
3 GASKET
4 ENGINE INLET MANIFOLD

7S 3547-6E

Figure 4-12 - Replacing TBI 220 Unit - 5.0L / 5.7L

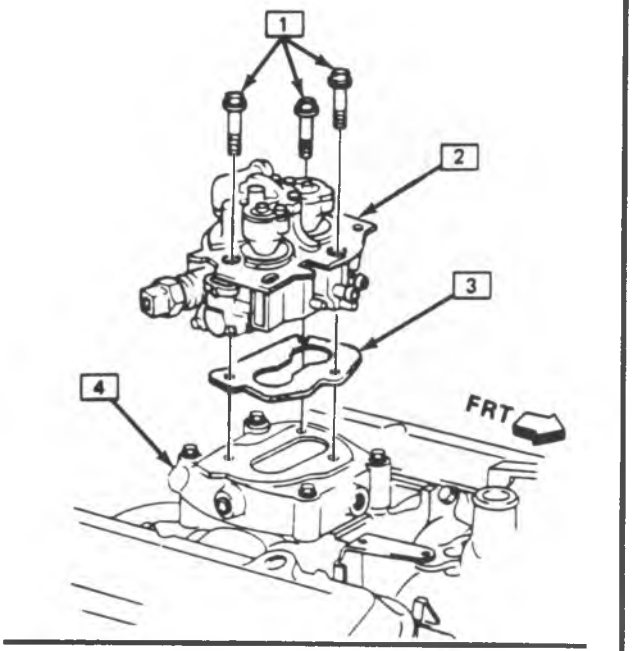


Figure 4-13 - Replacing TBI 220 Unit - 7.4L

NOTICE: To prevent damage to the throttle valve, it is essential that the unit be placed on a holding fixture, before performing service.

11. TBI flange (manifold mounting) gasket.

NOTICE: Stuff the manifold opening with a rag, to prevent material from entering the engine, and remove the old gasket material from surface of intake manifold.

Inspect

- Manifold bore for loose parts and foreign material, etc.
- Intake manifold sealing surface for cleanliness.

Install or Connect

1. TBI flange (manifold mounting) gasket.
2. TBI with mounting hardware.

Tighten

- Hardware on L-4 engine, 17 N·m (12 ft. lbs.).
- Hardware on 4.3L and V-8 engines, 16 N·m (12 ft. lbs.).
- Hardware on 2.8L engine, 25 N·m (18 ft. lbs.).

3. New O-rings on fuel line nuts.
4. Fuel line inlet and outlet nuts by hand.

Tighten

- Fuel line nut to 26 N·m (20 ft. lbs.). Use back-up wrench to keep TBI nuts from turning).

5. Vacuum hoses.
6. Throttle linkage, return spring(s), transmission control cable, and cruise control (wherever applicable).
7. Grommet, with wire harness, to throttle body.
8. Electrical connectors, making sure connectors are fully seated and latched.
9. Check to see if accelerator pedal is free, by depressing pedal to the floor and releasing, while engine is "OFF".
10. With engine "OFF", and ignition "ON," check for leaks around fuel line nuts.
11. Air cleaner, adapter, and new gaskets.
12. Start engine and check for fuel leaks.

FUEL METER COVER ASSEMBLY-TBI 220

Replacement (Figure 4-14)

The fuel meter cover assembly contains the fuel pressure regulator assemble. The regulator has been adjusted at the factory and should only be serviced as a complete preset assembly.

CAUTION: **Do not remove the four screws securing the pressure regulator to the fuel meter cover. The fuel pressure regulator includes a large spring under heavy compression, which, if accidentally released, could cause personal injury. Disassembly might, also, result in a fuel leak between the diaphragm and the regulator container.**

Remove or Disconnect

1. Relieve fuel line pressure, per instructions under "Fuel System Pressure Relief Procedure".
2. Air cleaner, adapter, and gaskets. Discard gaskets.
3. Electrical connectors to fuel injectors.
4. Long and short fuel meter cover screw assemblies.
5. Fuel meter cover assembly.

NOTICE: DO NOT immerse the fuel meter cover (with pressure regulator) in cleaner, as damage to the regulator diaphragm and gasket could occur.

6. Fuel meter outlet passage gasket, cover gasket, and pressure regulator seal. Discard gaskets and seal.

Inspect

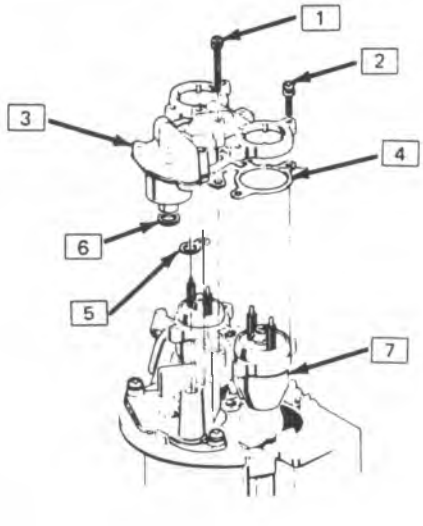
- Cover for dirt, foreign material, and casting warpage.

Install or Connect

1. New pressure regulator seal, fuel meter outlet passage gasket, and cover gasket.
2. Fuel meter cover assembly.
3. Attaching screw assemblies, coated with appropriate locking compound to threads. (Short screws are next to injectors.)

Tighten

- Screw assemblies to 3.0 N ·m (28.0 in. lbs.).



1 ATTACHING SCREW-LONG
2 ATTACHING SCREW-SHORT
3 FUEL METER COVER ASSEMBLY
4 COVER GASKET
5 OUTLET GASKET
6 DUST SEAL
7 FUEL METER BODY ASSEMBLY

5S 1700-6E

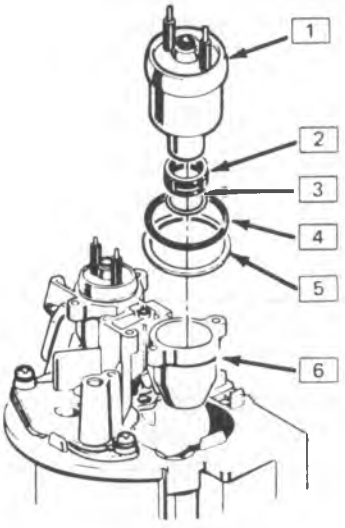
Figure 4 - 14 Replacing Fuel Meter Cover - TBI 220

4. Electrical connectors to fuel injectors.
5. With engine "OFF", and ignition "ON", check for leaks around gasket and fuel line couplings.
6. Air cleaner, adapter, and new gaskets.

FUEL INJECTOR ASSEMBLY - TBI 220

Replacement (Figure 4-15)

NOTICE: Use care in removing the fuel injectors, to prevent damage to the electrical connector terminals, the injector filter, and the fuel nozzle. The fuel injector is serviced as a complete assembly only. Also, since the assembly is an electrical component, it should not be immersed in any type of cleaner.



1 FUEL INJECTOR
2 INLET FILTER
3 LOWER "O" RING
4 UPPER "O" RING
5 WASHER
6 FUEL METER BODY ASSEMBLY

5S 1698-6E

Figure 4 - 15 Fuel Injector Parts - TBI 220

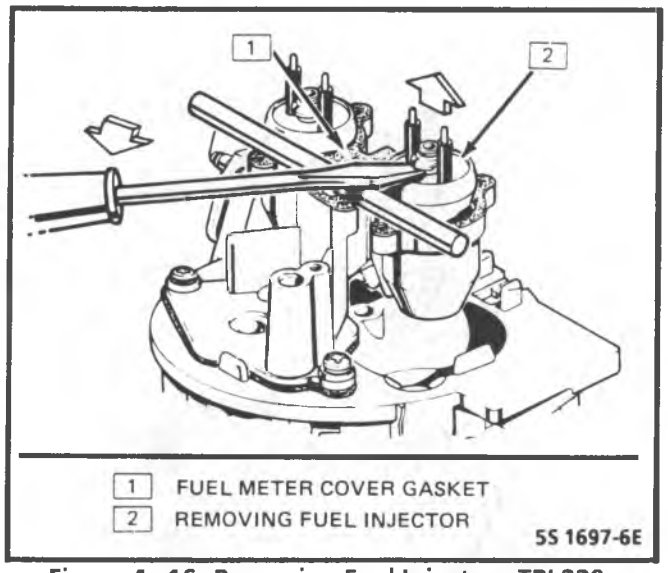


Figure 4 - 16 Removing Fuel Injector - TBI 220

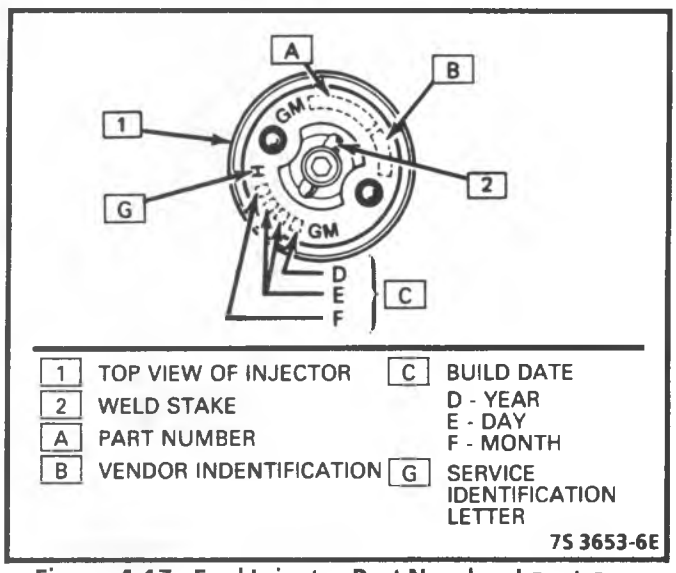


Figure 4-17 - Fuel Injector Part Number Location TBI 220

Remove or Disconnect

1. Relieve fuel line pressure, per instructions, under "Fuel Pressure Relief Procedure".
2. Air cleaner, adapter, and gaskets. Discard gaskets.
3. Electrical connectors to fuel injectors. (Squeeze plastic tabs and pull straight up.)
4. Fuel meter cover attaching screws.
5. Fuel meter cover assembly and outlet gasket (see above procedure). Discard outlet gasket.
6. With fuel meter cover gasket in place to prevent damage to casting, use a screwdriver and fulcrum to carefully lift out each injector, as shown in Figure 4-16.
7. Lower (small) O-rings from nozzle of injectors and discard.
8. Fuel meter cover gasket and discard.
9. Upper (large) O-rings and steel backup washers from top of each fuel injector cavity and discard.

Inspect

- Fuel injector filter for evidence of dirt and contamination. If present, check for presence of dirt in fuel lines and fuel tank.

Important

Be sure to replace the injector with an identical part. Injectors from other models can fit in the Model 220 TBI, but are calibrated for different flow rates. (See Figure 4-17 for part number location.)

Install or Connect

1. Lubricate new lower (small) O-rings with automatic transmission fluid and push them on nozzle end of injectors, until they press against injector fuel filters.
2. Steel injector backup washers, in counterbores of fuel meter body.
3. Lubricate new upper (large) O-rings with automatic transmission fluid and install them directly over the backup washers. Be sure O-rings are seated properly and are flush with top of fuel meter body surface.

NOTICE: Backup washers and O-rings must be installed before injectors, or improper seating of large O-ring could cause fuel to leak.

4. Injectors, aligning raised lug on each injector base with notch in fuel meter body cavity. As shown in Figure 4-18, push down on injector until fully seated in fuel meter body. (Electrical terminals of injector should be parallel with throttle shaft.)
5. Fuel meter cover gasket.
6. Fuel meter cover (see above procedure).
7. Fuel meter cover attaching screws, coated with appropriate thread locking compound.
8. With engine "OFF", and ignition "ON", check for fuel leaks.
9. Electrical connectors to fuel injectors.
10. Air cleaner, adapter, and new gaskets.

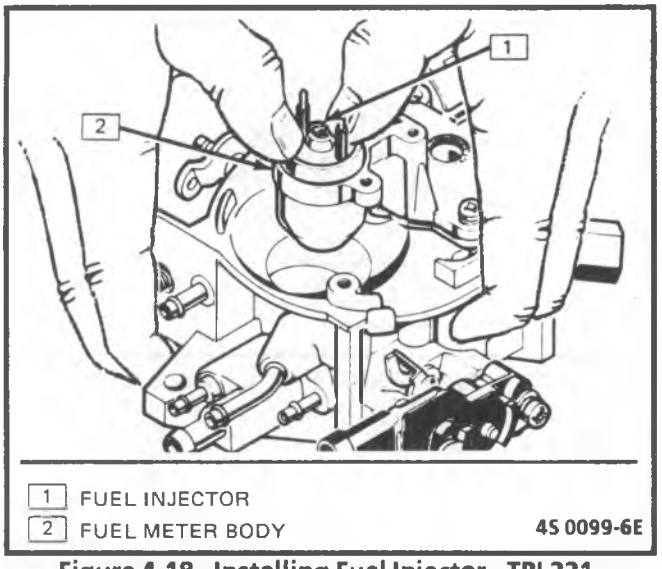


Figure 4-18 - Installing Fuel Injector - TBI 221

FUEL METER BODY ASSEMBLY - TBI 220 Replacement (Figure 4-19)

Remove or Disconnect

1. Relieve fuel line pressure, per instructions, under "Fuel System Pressure Relief" procedure.
2. Air cleaner, adapter, and gaskets. Discard gaskets.
3. Electrical connections to fuel injectors.
4. Fuel meter cover assembly, per above instructions.
5. Fuel meter cover gasket, fuel meter outlet gasket, and pressure regulator seal. Discard all.
6. Fuel injectors, per above instructions.
7. Fuel inlet and return lines and O-rings. Discard O-rings.
8. Fuel inlet and outlet nuts and gaskets from the fuel meter body assembly. Discard gaskets.

Important

Note locations of nuts, for proper re-assembly later. Inlet nut has a larger passage than outlet nut.

9. Fuel meter body to throttle body attaching screw assemblies.
10. Fuel meter body assembly from throttle body assembly.
11. Throttle body to fuel meter body gasket and discard.

Install or Connect

1. New throttle body to fuel meter body gasket. Match cut-out portions in gasket with openings in throttle body.

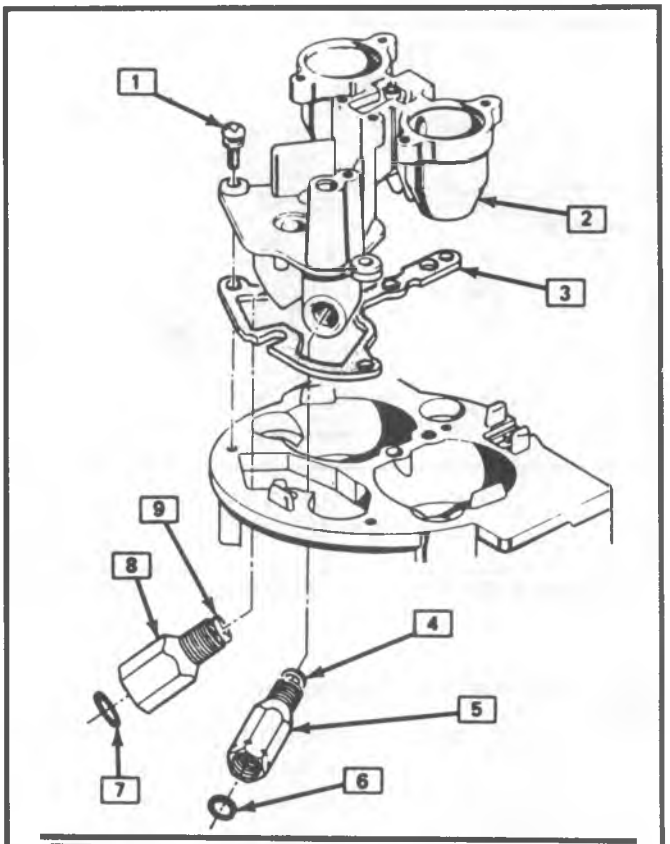


Figure 4-19 - Fuel Meter Body Assembly - TBI 220

2. Fuel meter body assembly, on throttle body assembly.
3. Fuel meter body-to-throttle body attaching screw assemblies, coated with appropriate locking compound.

Tighten

- Screw assemblies to 4.0 N•m (35.0 in. lb.).

4. Fuel inlet and outlet nuts, with new gaskets, to fuel meter body assembly. Use backup wrench to prevent nuts from turning.

Tighten

- Inlet nut to 40.0 N•m (30.0 ft. lbs.).
- Outlet nut to 29.0 N•m (21.0 ft. lbs.).

5. Fuel inlet and return lines and new O-rings. Use backup wrench to prevent nuts from turning.

Tighten

- Fuel line nuts to 26 N•m (20 ft. lbs.).

6. Injectors, with new upper and lower O-rings, in fuel meter body assembly.
7. Fuel meter cover gasket, fuel meter outlet gasket, and pressure regulator seal.
8. Fuel meter cover assembly.
9. Long and short fuel meter cover attaching screw assemblies, coated with appropriate thread locking compound.

Tighten

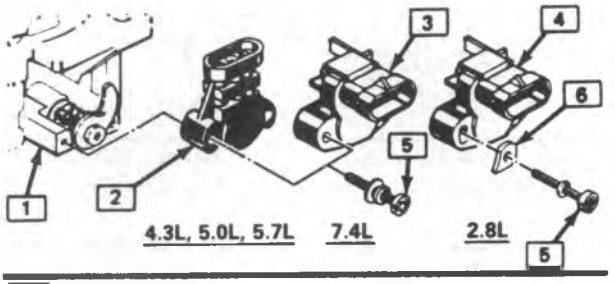
- Attaching screws to 3.0 N•m (27.0 in. lbs.).

10. Electrical connectors to fuel injectors.
11. With engine "OFF", and ignition "ON", check for leaks around fuel meter body, gasket, and around fuel line nuts.
12. Air cleaner, adapter, and new gaskets.

THROTTLE POSITION SENSOR (TPS) - TBI 220
Replacement (Figure 4-20)

Important

On 2.8L (V-6) engines, the TPS is adjustable, and is supplied with attaching screw retainers. On all other engines, it is non-adjustable, without retainers. In addition, on 2.8L (V-6) and 7.4 (V-8) engines, the TPS has a horizontal electrical connector; on all other engines, the connector is vertical.



1 THROTTLE BODY ASSEMBLY
2 THROTTLE POSITION SENSOR - NON-ADJUSTABLE
3 THROTTLE POSITION SENSOR - NON-ADJUSTABLE
4 THROTTLE POSITION SENSOR - ADJUSTABLE
5 SCREW ASSEMBLY
6 RETAINER

7S 3652-6E

Figure 4-20 - TPS Configurations - TBI 220

Remove or Disconnect

1. Air cleaner, adapter, and gaskets. Discard gaskets.
2. Two TPS attaching screw assemblies and retainers (if applicable).
3. TPS from throttle body assembly.

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

Install or Connect

1. TPS on throttle body assembly, while lining up TPS lever with TPS drive lever on throttle body.
2. Two TPS attaching screw assemblies and retainers (if applicable).

Adjust

- Follow "Adjustable TPS Output Check" procedure, below.

Tighten

- Screw assemblies to 2.0 N•m (18.0 in. lbs.).

3. Air cleaner, adapter, and new gaskets.

IAC VALVE - THREAD MOUNTED - TBI 220
(Except on 7.4L Engines)
Replacement (Figure 4-21)

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

Important

All pintle configurations, for thread-mounted IAC valves on Model 220 TBI units, have the same dual taper. However, with the exception of the pintle diameter on 7.4L engines (which is 12 mm), the pintle diameter on all other IAC valves, with TBI 220 applications, is 10 mm. (See dimension "B" in Figure 4-21). Any replacement of an IAC valve must have the appropriate pintle taper and diameter for proper seating of the valve in the throttle body.

Remove or Disconnect

1. Air cleaner, adapter, and gaskets. Discard gaskets.
2. Electrical connector from IAC valve.
3. IAC valve, using 32 mm (1 $\frac{1}{4}$") wrench.
4. IAC valve gasket and discard.

Clean

- Old gasket material from surface of throttle body assembly, to insure proper seal of new gasket.

NOTICE: Before installing a new IAC valve, measure the distance between the tip of the valve pintle and the housing mounting surface, when the pintle is fully extended. If dimension "A" distance (Figure 4-21) is greater than 28 mm (1.10 in.), it must be reduced to prevent damage to the valve.

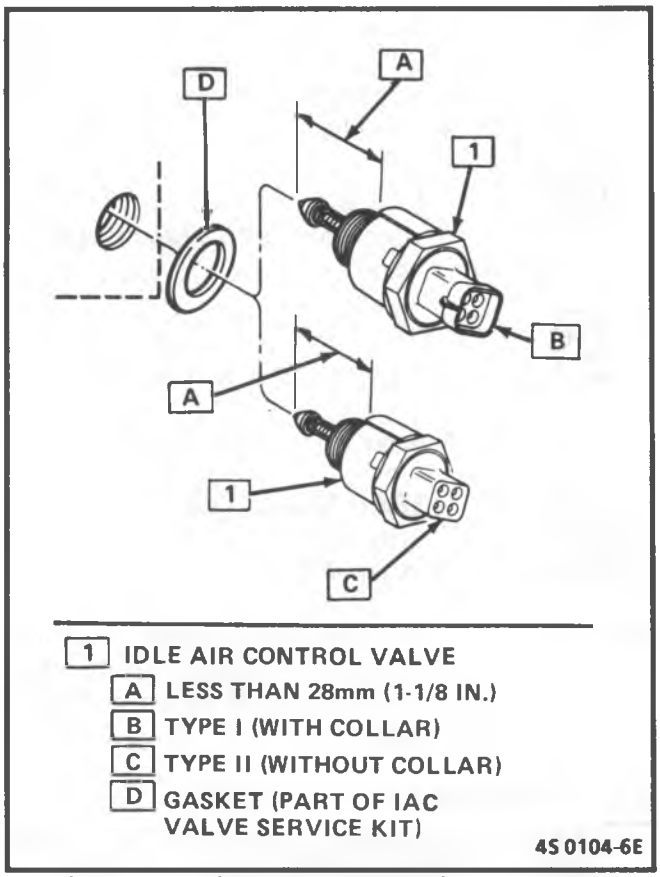


Figure 4-21 Thread Type IAC Valves - TBI 220

Adjust

Identify replacement IAC valve (Figure 4-21) as either the type with a collar at electric terminal end, or without one. Reduce distance "A" as follows:

ADJUSTING IAC VALVES WITH COLLAR

- Exert firm pressure, with a slight side-to-side movement on valve pintle to retract it (Figure 4-22).

ADJUSTING IAC VALVES WITHOUT COLLAR

- Compress valve retaining spring, while turning valve "in", clockwise (Figure 4-23). Return spring end to its original position, with straight portion aligned in slot, under flat surface of valve (Figure 4-24).

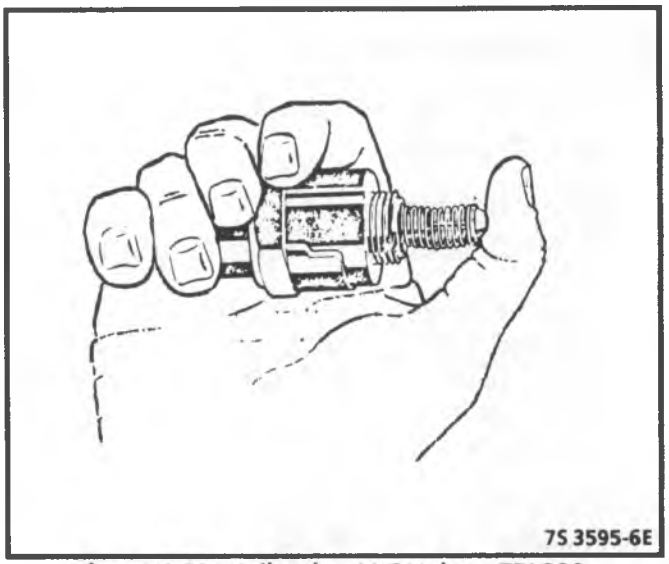


Figure 4-22 - Adjusting IAC Valve - TBI 220 (With Collar at Electric Terminal End)

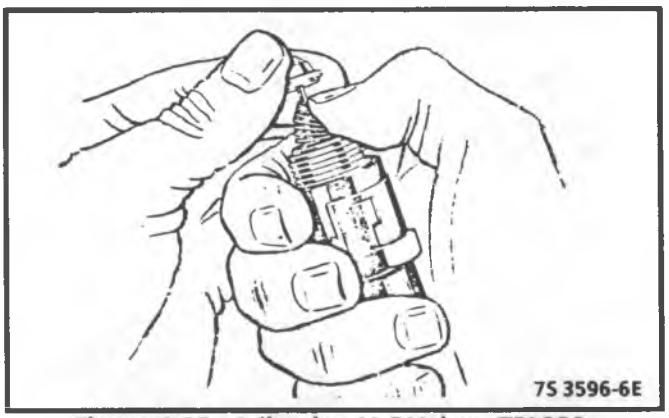


Figure 4-23 - Adjusting IAC Valve - TBI 220 (Without Collar at Electric Terminal End)

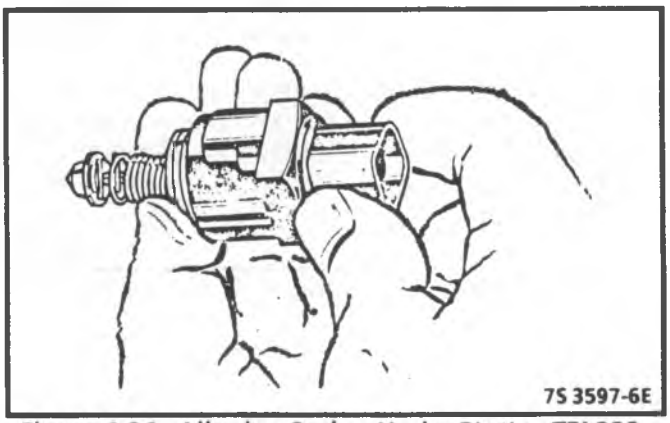


Figure 4-24 - Aligning Spring Under Pintle - TBI 220

Important

No physical adjustment of the IAC valve assembly is required, after installation. The IAC valve is reset, by the ECM.

Install or Connect

1. IAC valve, with new gasket into throttle body.

Tighten

- IAC valve assemble to 18.0N•m (13.0 ft. lbs.), with 32mm (1 $\frac{1}{4}$") wrench.

2. Electrical connector to IAC valve.
3. Air cleaner, adapter, and new gaskets.
4. Start engine and allow engine to reach operating temperature.

Important

When the engine is turned off, the IAC valve will be reset, by the ECM.

IAC VALVE - FLANGE MOUNTED - TBI 220 (Used on 7.4L Engines) Replacement (Figure 4-25)

Important

All pintle configurations, for IAC valves on Model 220 TBI units, have the same dual taper. However, on 7.4L engines, the pintle diameter is 12mm, rather than the 10mm diameter used for other engines (See Figure 4-25, dimension "B"). Any replacement of an IAC valve must have the appropriate pintle taper and diameter, for proper seating of the valve in the throttle body.

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

Remove or Disconnect

1. Air cleaner, adapter, and gaskets.
2. Electrical connector from Idle Air Control valve.
3. Screw assemblies and IAC valve.
4. IAC valve O-ring and discard.

Clean

- IAC valve sealing surfaces on throttle body, to assure proper seal of new O-ring and contact of IAC valve flange.

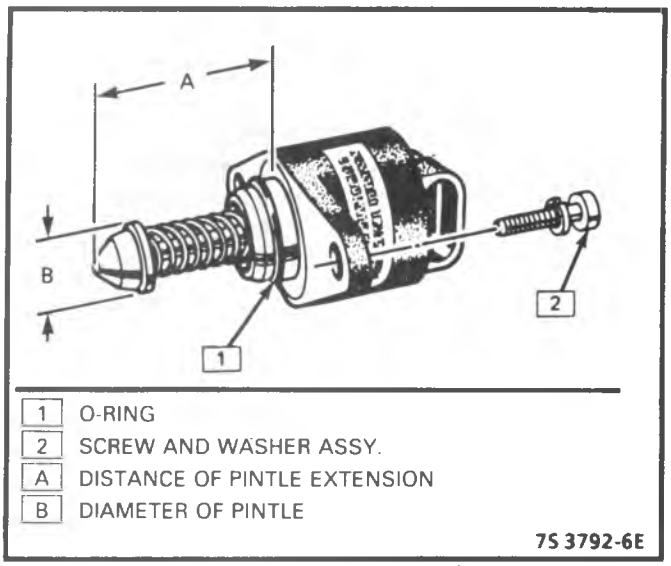


Figure 4-25 - Flange Type IAC Valve - TBI 220

NOTICE: Before installing a new IAC valve, measure the distance between the tip of the valve pintle and the flange mounting surface, when the pintle is fully extended. If dimension "A" distance (Figure 4-25) is greater than 28mm (1.10 in.), it must be reduced to prevent damage to the valve.

Adjust

- Exert firm pressure, with a slight side-to-side movement, on valve pintle to retract it (Figure 4-26).

Important

No physical adjustment of the IAC valve assembly is required, after installation. The IAC valve is reset, by the ECM.

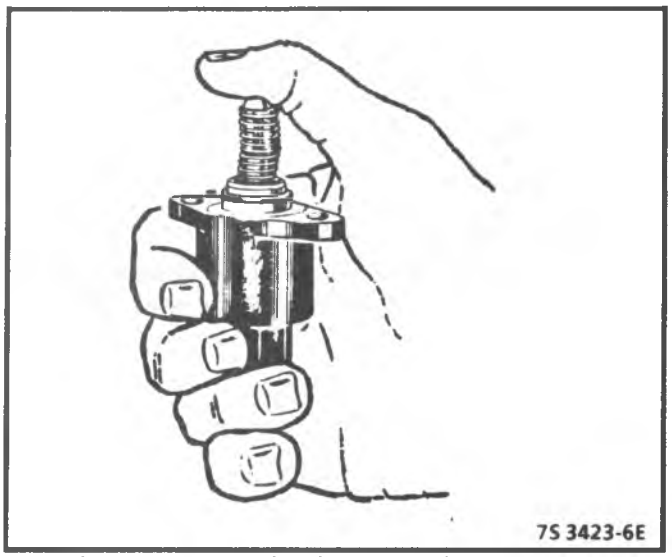


Figure 4-26 - Adjusting IAC Valve - TBI 220

Install or Connect

1. New O-ring on IAC valve.
2. IAC valve on throttle valve body.
3. IAC valve, attaching screw assemblies that have been coated with appropriate locking compound.

Tighten

- Screw assemblies to 3.2 N•m (28.0 in. lbs.).

4. Electrical connector to IAC valve.
5. Air cleaner, adapter, and new gaskets.
6. Start engine and allow engine to reach operating temperature.

Important

When the engine is turned "OFF", the IAC valve will be reset, by the ECM.

THROTTLE BODY ASSEMBLY-TBI 220
Replacement (Figure 4-8)

1. Relieve fuel line pressure, per instructions, under "Fuel Pressure Relief Procedure-V-6 and V-8 Engines".
2. Remove throttle body injection unit. (See instructions under "Throttle Body Unit".)
3. Place TBI unit on holding fixture J-9789-118, or BT-3553, or equivalent.

NOTICE: It is essential that the unit be placed on a holding fixture, to prevent damage to the throttle valve, before performing service.

Remove or Disconnect

1. Fuel meter body-to-throttle body attaching screw assemblies.
2. Fuel meter body assembly.
3. Throttle body-to-fuel meter body gasket. Discard gasket.
4. Throttle position sensor (TPS).
5. Invert throttle body on flat surface, for greater stability in removal of IAC valve assembly.

Clean

- Throttle body assembly in accordance with the instructions under "General Service Information".

Inspect

- Throttle lever and valve for dirt, binds, nicks, and other damage. Replace, if necessary.

Install or Connect

NOTICE: Procedures, related to replacement of the individual components below, have been described previously and should be followed, or damage could result.

1. Invert throttle body on flat surface, for stability and install IAC valve assembly and TPS.
2. New throttle body-to-fuel meter body gasket.
3. Fuel meter body assembly on throttle body assembly.
4. Fuel meter body-throttle body attaching screw assemblies that have been coated with locking compound.

Tighten

- Attaching screw assemblies to 4.0 N.m (35.0 in. lbs.).

5. TBI unit to engine as described previously under "Throttle Body Injection Unit".

MINIMUM IDLE SPEED ADJUSTMENT-TBI 220
(V-6 and V-8 Engine)

This adjustment should be performed, only when the throttle body assembly has been replaced. Engine should be at normal operating temperature, before making adjustment.

Important

The throttle stop screw, used for regulating minimum idle speed, is adjusted at the factory. The screw is covered, with a plug, to discourage unauthorized adjustments.

Adjust

1. Remove air cleaner, adapter, and gaskets. Discard gaskets.
2. Plug any vacuum line ports, as required.
3. With IAC valve connected, ground diagnostic terminal (ALDL connector).
4. Turn on ignition, do not start engine. Wait at least 30 seconds. (this allows IAC valve pintle to extend and seat in throttle body).
5. With ignition "ON", disconnect IAC valve electrical connector.
6. Remove ground from Diagnostic Terminal and start engine.
7. Remove plug by first piercing it with awl, then, applying leverage (Figure 4-27).
8. Adjust idle stop screw, to obtain 700 rpm ± 25 rpm in neutral for 2.8L engine, 500-550 rpm in drive with automatic trans. and 600-650 rpm in neutral with manual trans. for 4.3L & V8 engines.

9. Turn ignition "OFF", and reconnect IAC valve electrical connector.
10. Unplug any plugged vacuum line ports and install air cleaner, adapter, and new gaskets.

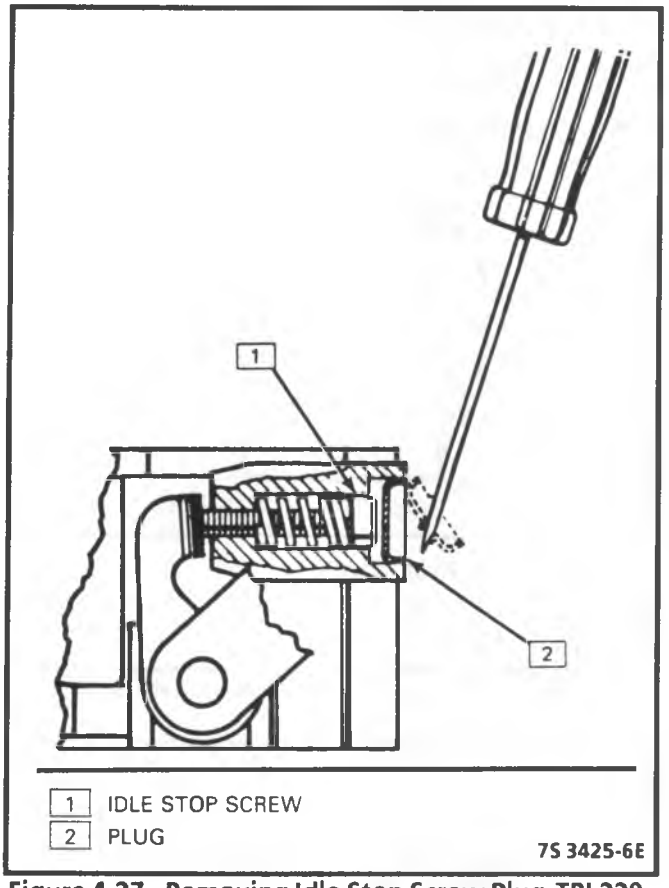


Figure 4-27 - Removing Idle Stop Screw Plug-TBI 220

NON-ADJUSTABLE TPS OUTPUT CHECK - TBI 220 (4.3L and V-8 Engine)

This check should be performed, only, when throttle body or TPS has been replaced or, after the minimum idle speed has been adjusted.

1. Connect digital voltmeter J-29125-A, or equivalent, from TPS connector, center terminal "B" to outside terminal "A", (jumpers for terminal access can be made using terminals 1214836 and 12014837). ALDL scanner can be used to read TPS output voltage.
2. With ignition "ON", and engine stopped, TPS voltage should be less than 1.0 volt. If more than 1.0 volt, check minimum idle speed before replacing TPS.
3. Remove voltmeter and jumpers and reconnect TPS connector to sensor.

ADJUSTABLE TPS OUTPUT CHECK-TBI 220 (2.8L Engine Only)

This check should be performed, only, when throttle body parts have been replaced or, after the minimum idle speed has been adjusted.

1. Connect digital voltmeter J-29125-A, or equivalent, from TPS connector, center terminal "B" to outside terminal "A", (jumpers for terminal access can be made using terminals 1214836 and 12014837). ALDL scanner can be used to read TPS output voltage.
2. With ignition "ON", engine stopped, TPS voltage should be between .42 and .54 volts.
3. If voltage is out of range, rotate TPS until 0.48 ± .06 volts are obtained.
4. If above voltage limitation cannot be obtained, replace TPS.
5. Remove voltmeter and jumpers, reconnect TPS connector to sensor.

FUEL INJECTOR ASSEMBLY - TBI 700 Replacement (Figure 4-28)

NOTICE: Use care in removing the fuel injector to prevent damage to the electrical connector terminal, the injector filter, and the fuel nozzle. The fuel injector is serviced as a complete assembly only. Also, since the assembly is an electrical component, it should not be immersed in any type cleaner.

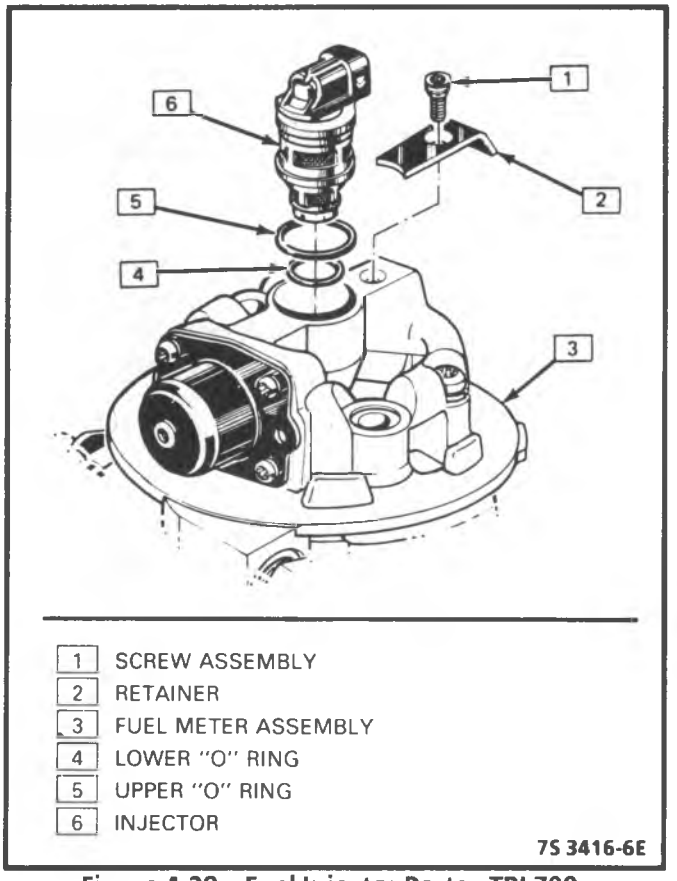


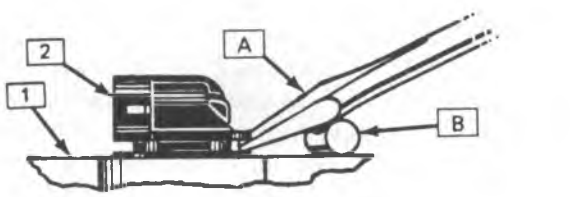
Figure 4-28 - Fuel Injector Parts - TBI 700

Remove or Disconnect

1. Relieve fuel line pressure, per instructions under "Fuel System Pressure Relief" procedure.
2. Air cleaner and gasket. Discard gasket.
3. Electrical connector to fuel injector.
4. Injector retainer screw and retainer.
5. Injector, by placing screwdriver blade under ridge opposite connector end and carefully prying it out (Figure 4-29).
6. Upper and lower O-rings, from injector and in fuel injector cavity and discard.

Inspect

- Fuel injector filter for evidence of dirt and contamination. If present, check for presence of dirt in fuel lines and fuel tank.



1 FUEL METER BODY
2 FUEL INJECTOR
A SCREWDRIVER
B FULCRUM

7S 3419-6E

Figure 4-29 - Removing Fuel Injector - TBI 700

Important

Be sure to replace the injector with an identical part. Injectors from other models can fit in the Model 700 TBI, but are calibrated for different flow rates. (See Figure 4-30, for part numbers location.)

Install or Connect

1. Lubricate new upper and lower O-rings, with automatic transmission fluid, and place them on injector. (Make sure upper O-ring is in groove and lower one is flush up against filter.)
2. Injector assembly, pushing it straight into fuel injector cavity.

Important

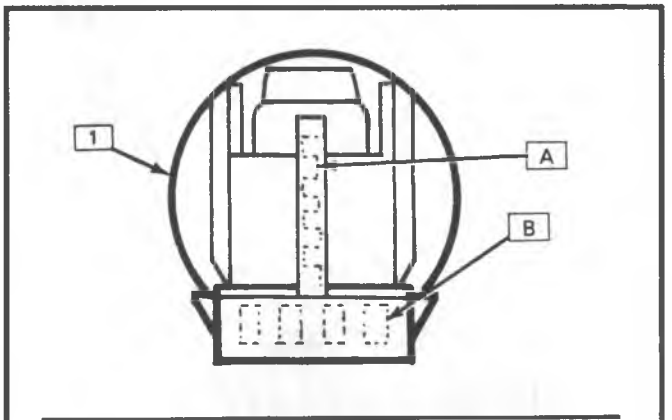
Be sure the electrical connector end, on the injector, is facing in the general direction to the cut-out in the fuel meter body for the wire grommet.

3. Injector retainer, using appropriate thread locking compound on retainer attaching screw.

Tighten

- Injector retainer attaching screw to 3.0 N•m (27.0 in. lbs.).

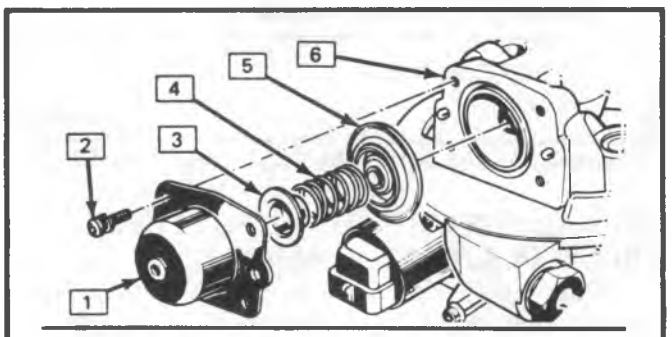
4. With engine "OFF", and ignition "ON", check for fuel leaks.
5. Air cleaner and new gasket.



1 TOP VIEW OF INJECTOR
A PART NUMBER
B BUILD DATE CODE

7S 3420-6E

Figure 4-30 - Fuel Injector Pat Number Location



1 PRESSURE REGULATOR COVER
2 SCREW ASSEMBLY
3 SPRING - SEAT
4 SPRING
5 DIAPHRAGM
6 FUEL METER ASSEMBLY

7S 3421-6E

Figure 4-31 - Pressure Regulator - TBI 700

PRESSURE REGULATOR ASSEMBLY - TBI 700

Replacement (Figure 4-31)

NOTICE: To prevent leaks, the pressure regulator diaphragm assembly must be replaced, whenever the cover is removed.

Remove or Disconnect

1. Relieve fuel line pressure, per instructions under "Fuel Pressure Relief Procedure-L-4 Engines".
2. Air cleaner and gasket. Discard gasket.
3. Four pressure regulator attaching screws, while keeping pressure regulator compressed.

CAUTION: **The pressure regulator contains a large spring, under heavy compression. Use care, when removing the screws to prevent personal injury.**

4. Pressure regulator cover assembly.
5. Pressure regulator spring.
6. Spring seat.
7. Pressure regulator diaphragm assembly.

Inspect

- Pressure regulator seat in fuel meter body cavity for pitting, nicks, or irregularities. (Use magnifying glass, if necessary, to do this.) If any of above is present, whole fuel body casting must be replaced.

Install or Connect

1. New pressure regulator diaphragm assembly, making sure it is seated in groove, in fuel meter body.
2. Regulator spring seat and spring into cover assembly.
3. Cover assembly over diaphragm, while aligning mounting holes.

NOTICE: Use care, while installing the pressure regulator, to prevent misalignment and possible leaks.

4. While maintaining pressure on regulator spring, four screw assemblies that have been coated with appropriate thread locking compound.

Tighten

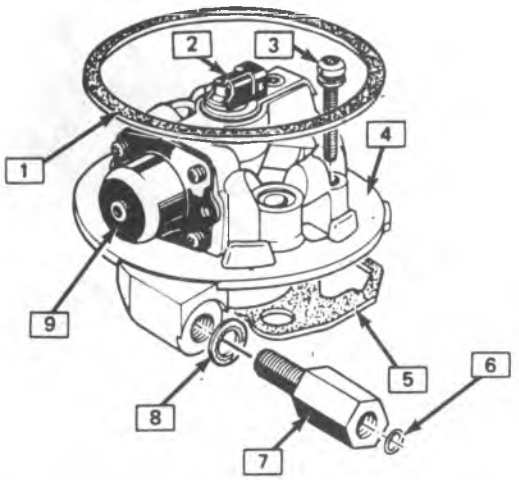
- Attaching screw assemblies to 2.5 N•m (22.0 in. lbs.).

6. With engine "OFF", and ignition "ON", check for fuel leaks.
7. Air cleaner and new gasket.

FUEL METER ASSEMBLY - TBI 700
Replacement (Figure 4-32)

Remove or Disconnect

1. Throttle body injection unit, as described previously.
2. Two fuel meter body attaching screw and washer assemblies.
3. Fuel meter assembly from throttle body assembly.
4. Fuel meter body to throttle body gasket and discard.



1	AIR FILTER GASKET
2	FUEL INJECTOR
3	SCREW AND WASHER ASSY.
4	FUEL METER ASSY.
5	GASKET
6	O-RING
7	FUEL OUTLET NUT
8	SEAL
9	PRESSURE REGULATOR COVER

7S 3783-6E

Figure 4-32 - Fuel Meter Assembly - TBI 700

Install or Connect

1. New fuel meter to throttle body gasket. Match cut-out portions of gasket with openings in throttle body assembly.
2. Fuel meter assembly onto throttle body assembly and gasket.

Tighten

- Attaching screws to 6.0 N•m (53 in. lbs.).

3. Throttle body injection unit to inlet manifold, as described previously.

THROTTLE POSITION SENSOR (TPS) - TBI 700
Replacement (Figure 4-33)

NOTICE: The TPS is an electrical component and must not be soaked in any liquid cleaner or solvent as damage may result.

Remove or Disconnect

1. Air cleaner and gasket. Discard gasket.
2. Two TPS attaching screw assemblies.
3. TPS from throttle body assembly.

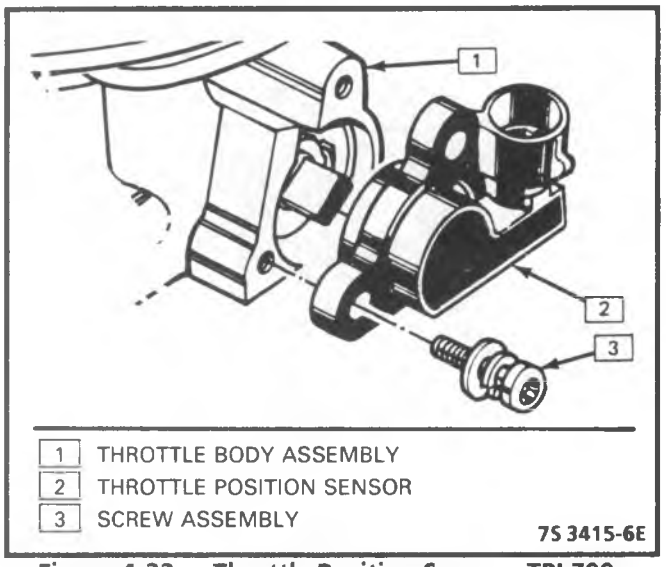


Figure 4-33 - Throttle Position Sensor - TBI 700

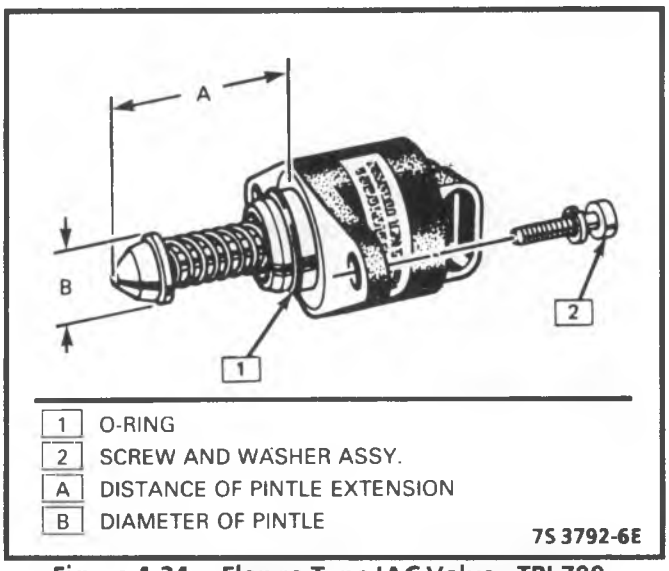


Figure 4-34 - Flange Type IAC Valve - TBI 700

Install or Connect

1. With throttle valve closed, install TPS on throttle shaft. Rotate counter-clockwise, to align mounting holes.
2. Two TPS attaching screw assemblies.

Tighten

- Screw assemblies to 2.0 N•m (18.0 in. lbs.).

3. Air cleaner and new gasket.

IAC VALVE-FLANGE MOUNTED - TBI 700 (Used on 2.5L Engines) Replacement (Figure 4-34)

Important

The IAC for valve on the Model 700 TBI unit, for 2.5L engines, has a dual taper, 10 mm diameter pintle (see "B" in Figure 4-34). Any replacement of an IAC valve must have the appropriate pintle shape and diameter. Otherwise, improper seating of the valve in the throttle body could occur.

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

Remove or Disconnect

1. Air cleaner and gasket. Discard gasket.
2. Electrical connector from IAC valve.
3. Screw assemblies and IAC valve.
4. IAC valve O-ring and discard.

Clean

- IAC valve seating surfaces on throttle body, to assure proper seal of new O-ring and contact of IAC valve flange.

NOTICE: Before installing a new IAC valve, measure the distance between the tip of the valve pintle and the flange mounting surface, when the pintle is fully extended. If dimension "A" distance (see Figure 4-34) is greater than 28mm (1.10 in.), it must be reduced, to prevent damage to the valve.

Adjust

- Exert firm pressure with a slight side-to-side movement, on valve pintle, to retract it (see Figure 4-35).

Important

No physical adjustment of the IAC valve assembly is required, after installation. The IAC valve is reset by the ECM. When the vehicle is operated at normal engine temperature, at approximately 30 mph (48 km/hr), the ECM causes the valve pintle to seat in the throttle body. The ECM, then, has a reset procedure to set the correct pintle position. Proper idle regulation should result.

Install or Connect

1. Lubricate new O-ring, with transmission fluid and install on IAC valve.
2. IAC valve to throttle body.

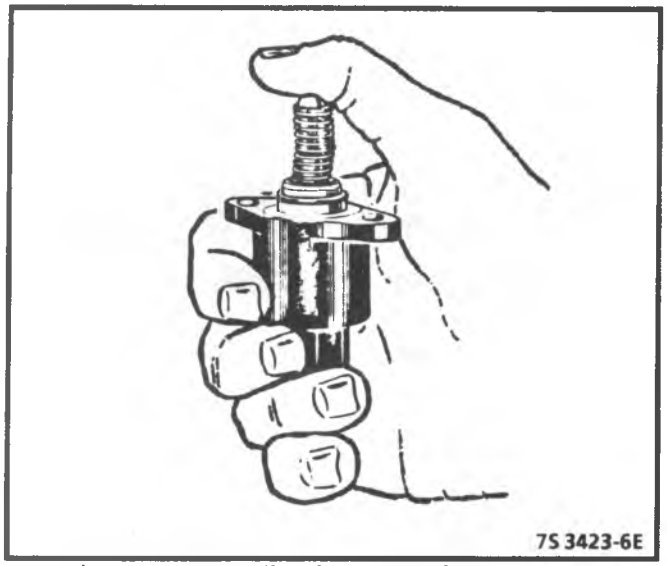


Figure 4-35 - Adjusting IAC Valve - TBI 700

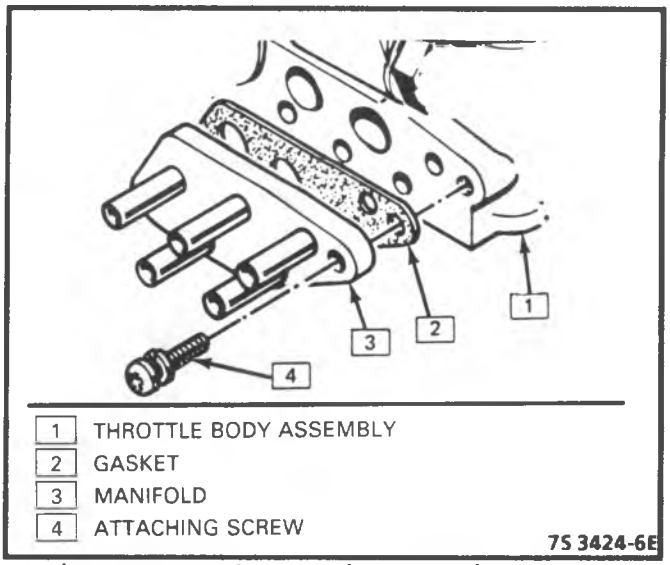


Figure 4-36 - Tube Module Assembly - TBI 700

3. IAC valve attaching screw assemblies that have been coated with appropriate thread locking compound.

Tighten

- Screw assemblies to 3.2 N•m (28.0 in. lbs.).

4. Electrical connector to IAC valve.
5. Air cleaner and new gasket.
6. Start engine and allow engine to reach operating temperature.

TUBE MODULE ASSEMBLY - TBI 700 Replacement (Figure 4-36)

Remove or Disconnect

1. Air cleaner and gasket. Discard gasket.
2. Tube module assembly attaching screws.
3. Tube module assembly.
4. Tube module assembly gasket and discard.

Clean

- Old gasket material from surface of throttle body assembly to insure proper seal of new gasket.

Install or Connect

1. New tube module assembly gasket.
2. Tube module assembly.
3. Tube module assembly attaching screws

Tighten

- Screw assemblies to 3.0 N•m (28.0 in. lbs.).

4. Air cleaner and new gasket.

THROTTLE BODY ASSEMBLY - TBI 700 Replacement (Figure 4-37)

Remove or Disconnect

1. Throttle body injection unit, as previously described.

Important

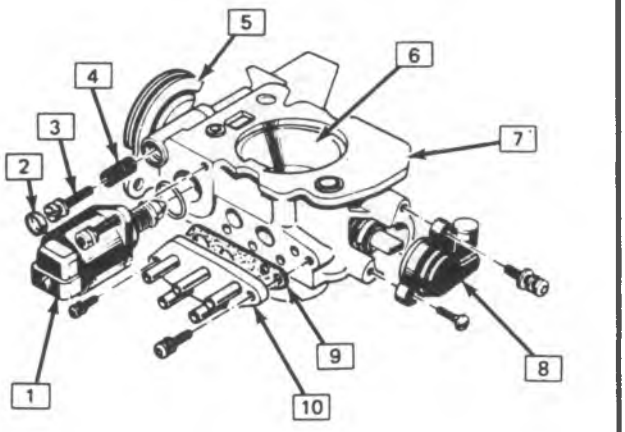
After removing from the engine, place TBI unit on a holding fixture, J-9789-118, BT-3553 or equivalent.

2. Fuel meter body attaching screw and washer assemblies.
3. Fuel meter assembly.
4. Fuel meter body to throttle body gasket and discard.
5. Throttle position sensor (TPS), per previous instructions.
6. Idle air control (IAC) valve, per previous instructions.
7. Tube module assembly, per previous instructions.

Install or Connect

NOTICE: Procedures related to replacement of the individual components below have been described previously and should be followed, or damage could occur.

1. Tube module assembly, idle air control (IAC) valve, and throttle position sensor (TPS), per previous instructions.
2. New fuel meter body to throttle body gasket.
3. Fuel meter assembly.



1	IDLE AIR CONTROL VALVE
2	IDLE STOP SCREW PLUG
3	SCREW AND WASHER ASSY.
4	SPRING
5	THROTTLE LEVER
6	THROTTLE BORE
7	THROTTLE BODY ASSEMBLY
8	THROTTLE POSITION SENSOR
9	GASKET
10	TUBE MODULE ASSY.

7S 3715-6E

Figure 4-37 - Throttle Body Assembly - TBI 700

4. Fuel meter body assembly attaching screw and washer assemblies.

Tighten

- Screw to 6.0 N•m (53 in. lbs.).

MINIMUM IDLE SPEED ADJUSTMENT - TBI 700 (L-4 Engines)

This adjustment should be performed only when the throttle body assembly has been replaced. Engine should be at normal operating temperature before making adjustment.

Important

The throttle stop screw,, used for regulating minimum idle speed, is adjusted at the factory. The screw is covered with a plug to discourage unauthorized adjustments.

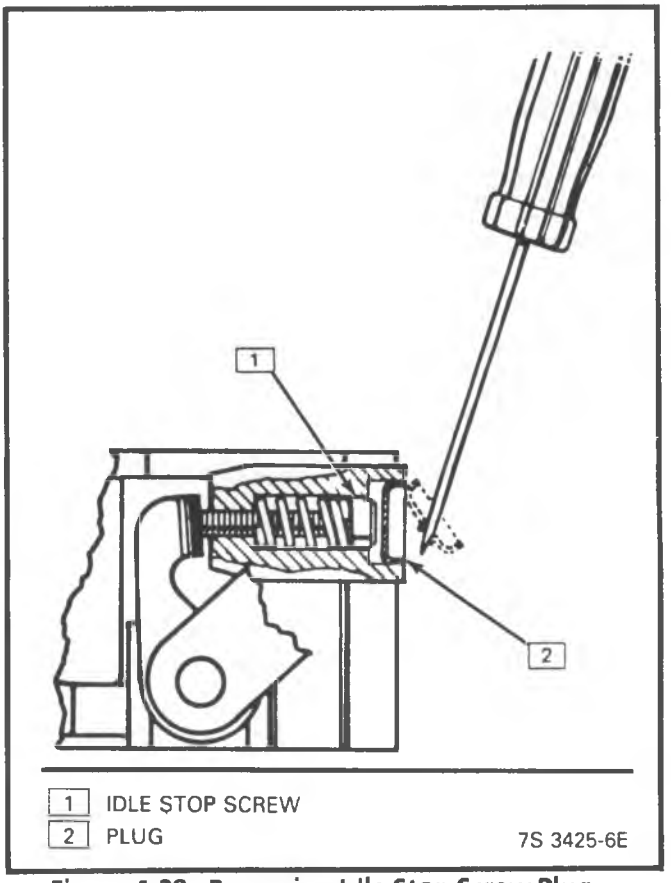
Adjust

1. Remove air cleaner and gasket. Disregard gasket.
2. Plug any vacuum line ports, as required.
3. With IAC valve connected, ground the diagnostic terminal (ALDL connector).
4. Turn ignition, do not start engine. Wait at least 30 seconds (this allows the IAC valve pintle to extend and seat in the throttle body).
5. With ignition "ON", disconnect IAC valve electrical connector.
6. Remove ground from Diagnostic Terminal and start engine.
7. Remove the plug, by first piercing it with an awl, then applying leverage (Figure 4-38).
8. Adjust idle stop screw to obtain 650 rpm ± 25 rpm in neutral.
9. Turn ignition "OFF", and reconnect IAC valve electrical connector.
10. Unplug any plugged vacuum line ports and install air cleaner and new gasket.

NON-ADJUSTABLE TPS OUTPUT CHECK - TBI 700

This check should be performed, only, when throttle body parts have been replaced, or, after the minimum idle speed has been adjusted.

1. Connect digital voltmeter J29125-A or equivalent, from TPS connector, center terminal "B" to outside terminal "A" (jumpers for terminal access can be made using terminals 1214836 and 12014837). An ALDL scanner can be used to read the TPS output voltage.



1	IDLE STOP SCREW
2	PLUG

7S 3425-6E

Figure 4-38 - Removing Idle Stop Screw Plug - TBI 700

2. With ignition "ON", engine stopped, the TPS voltage should be less than 1.25 volts. If more than 1.25 volts, replace TPS.
3. Remove the voltmeter and jumpers, reconnect the TPS connector to the sensor.

FUEL PUMP

Remove or Disconnect

- Relieve fuel system pressure (2.5L Engine only).
- Raise the vehicle on a hoist.

1. Negative battery cable.
2. Fuel tank.
3. Sender unit and pump by turning the cam lock counterclockwise.
4. Fuel pump from the sending unit.
   - Pull the fuel pump up into the attaching hose while pulling outward from the bottom support.
   - Do not damage the rubber insulator or the strainer.

Inspect

1. Fuel pump attaching hose for signs of deterioration,
2. Rubber sound insulation at the bottom of the pump.

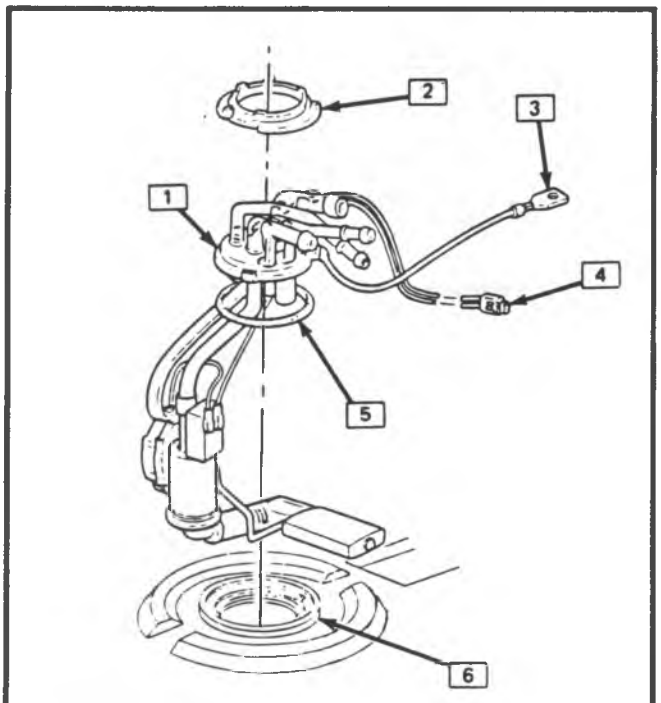


Figure 4-39 - Fuel Pump - Typical

Install or Connect

1. Fuel pump assembly into the attaching hose.

NOTICE: Care should be taken not to fold over or twist the strainer, when installing the sending unit as this will restrict fuel flow.

2. Sending unit and fuel pump assembly into the fuel tank.
   - Use a new O-ring seal.
3. Cam lock assembly.
   - Turn the cam lock clockwise to lock it.
4. Fuel tank.
5. Negative battery cable.

Fuel Pump Relay

Refer to Figures 4-40 through 4-45, for replacement of the fuel pump relay.

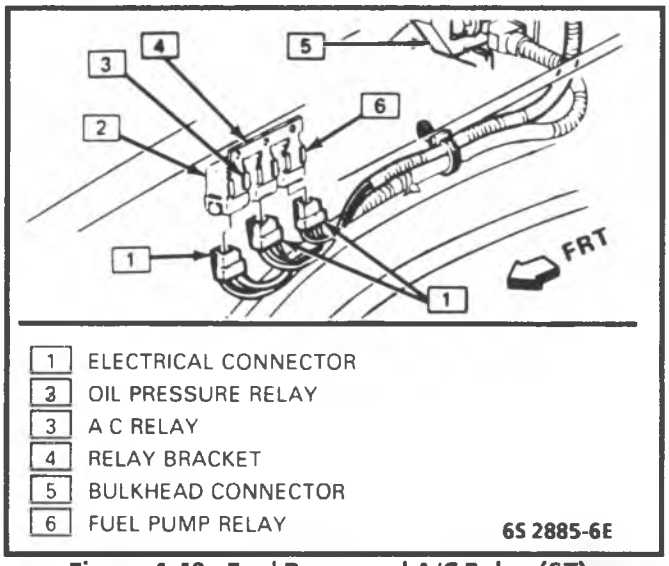


Figure 4-40 - Fuel Pump and A/C Relay (ST)

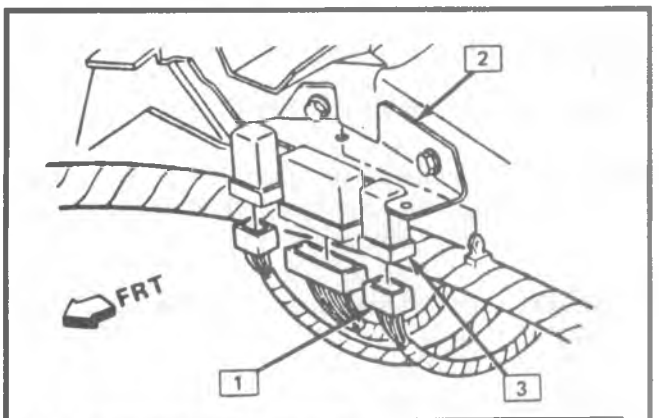


Figure 4-41 - Fuel Pump Relay (M)

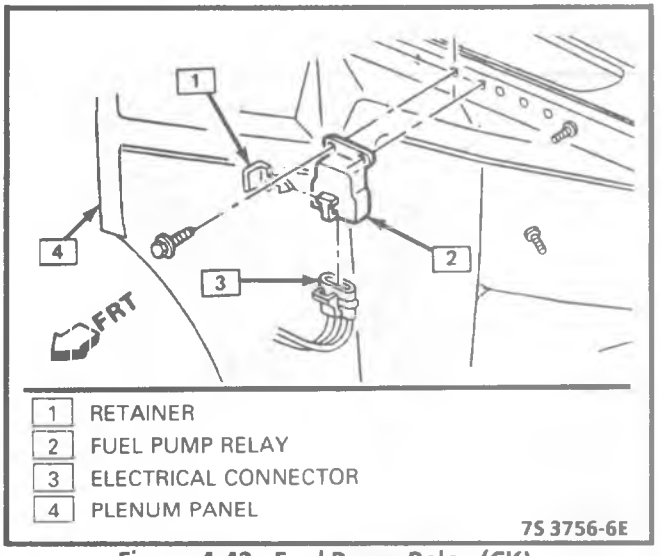


Figure 4-42 - Fuel Pump Relay (CK)

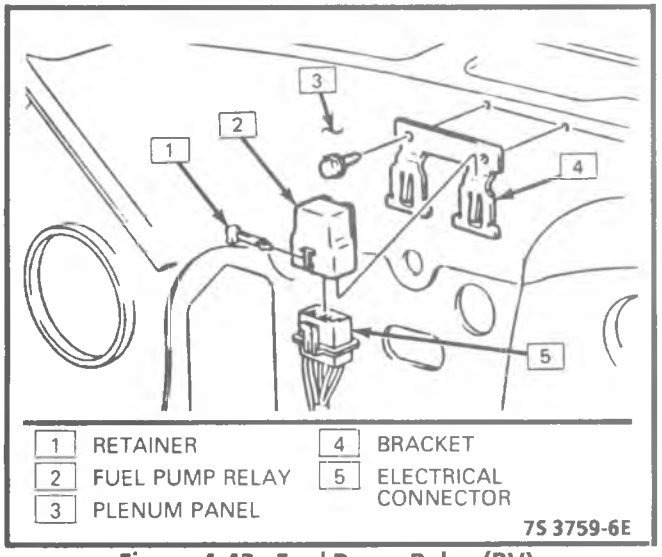


Figure 4-43 - Fuel Pump Relay (RV)

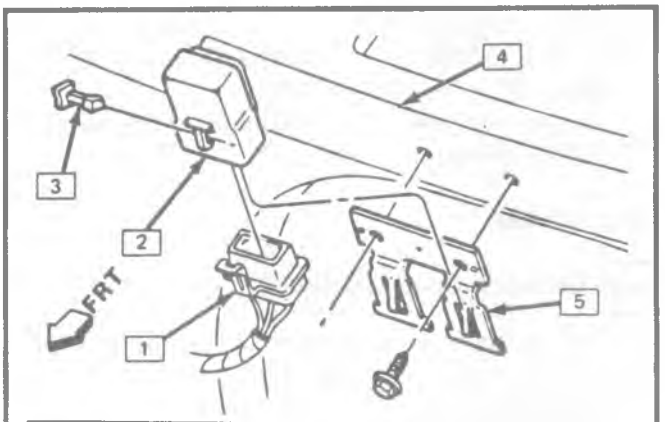


Figure 4-44 - Fuel Pump Relay (G)

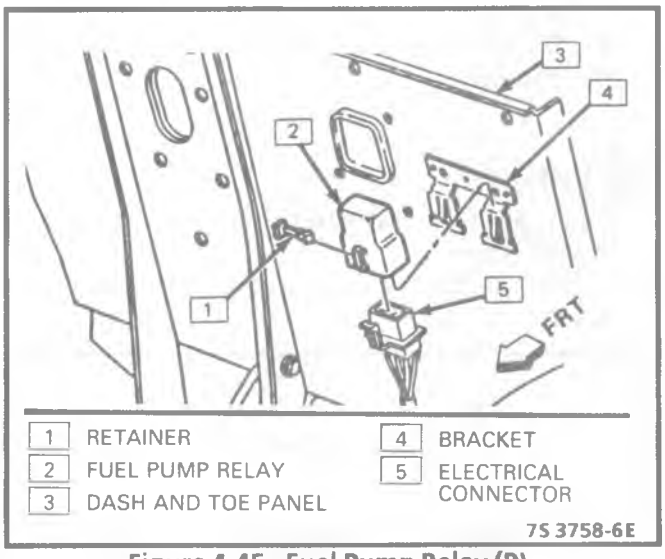


Figure 4-45 - Fuel Pump Relay (P)

FUEL MODULE

Refer to Figure 4-46, for replacement of the fuel module on "R,V,C,K" Series.

Refer to Figure 4-47, for replacement of the fuel module on "G" Series.

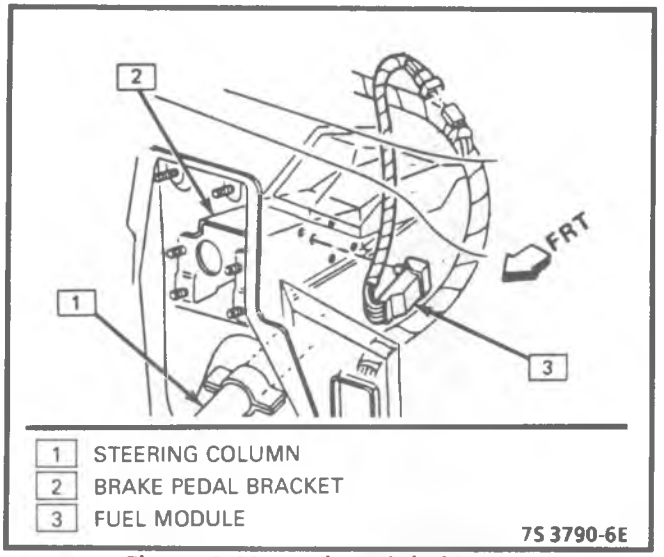


Figure 4-46 - Fuel Module (CKRV)

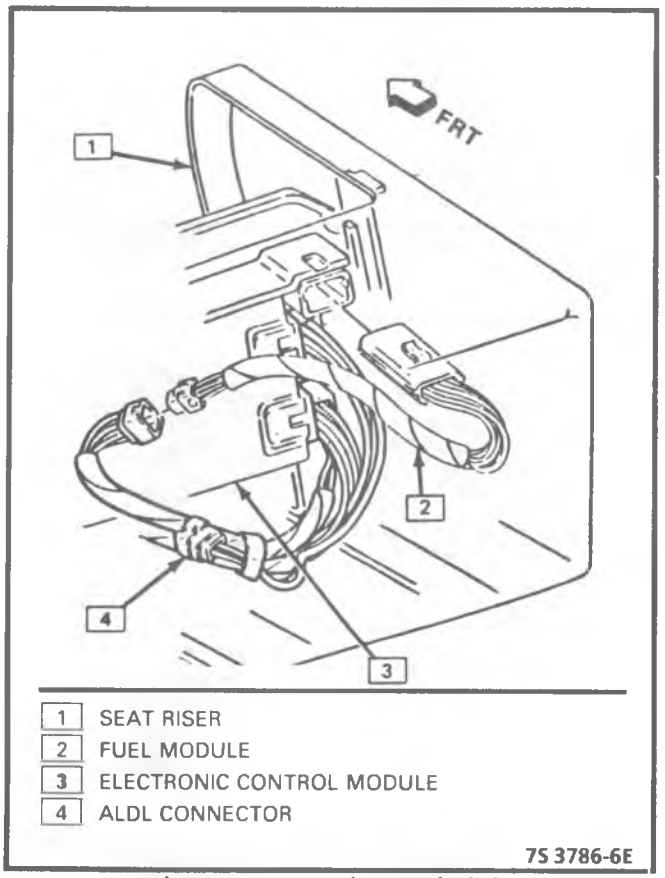


Figure 4-47 - Fuel Module (G)

OIL PRESSURE SWITCH

Refer to Figure 4-48 through 4-50, for replacement of the oil pressure switch.

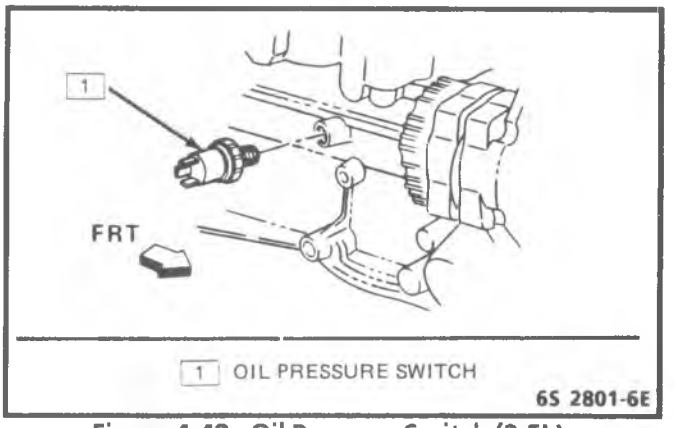


Figure 4-48 - Oil Pressure Switch (2.5L)

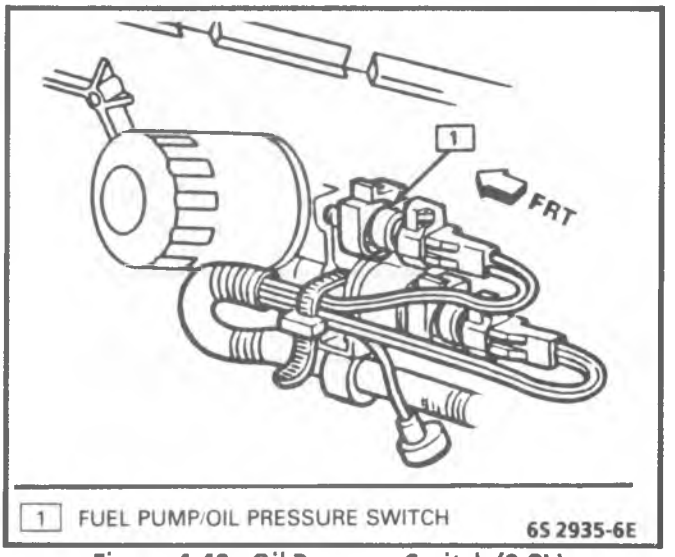


Figure 4-49 - Oil Pressure Switch (2.8L)

FUEL FILTER

In-line Filter (Figures 4-51 through 4-57)

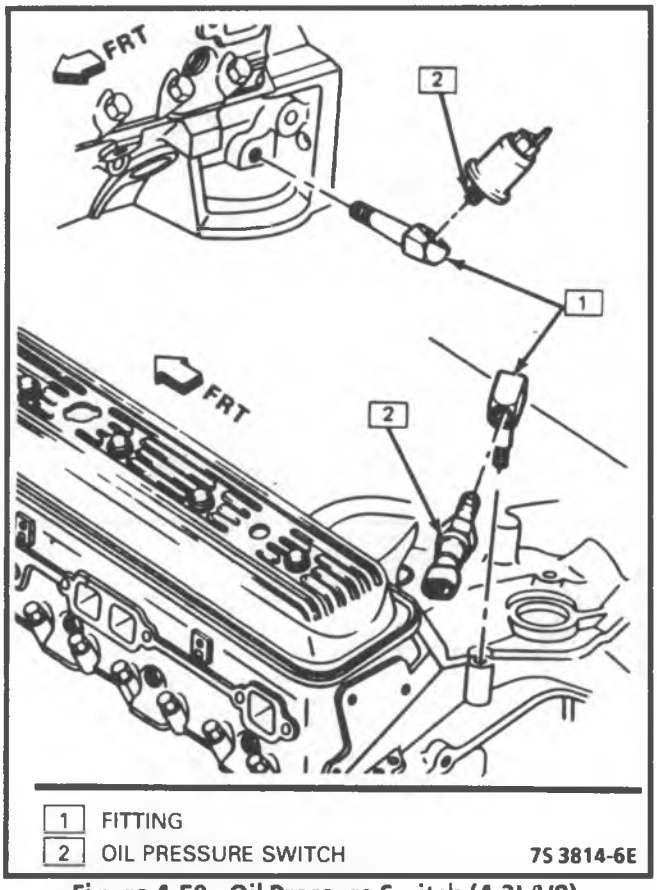
Remove or Disconnect

- On 2.5L engine, relieve fuel system pressure.

1. Fuel Filler cap.
2. Fuel feed nuts.
3. Clamp bolt.
4. Filter and clamp.
5. Clamp from filter.

Install or Connect

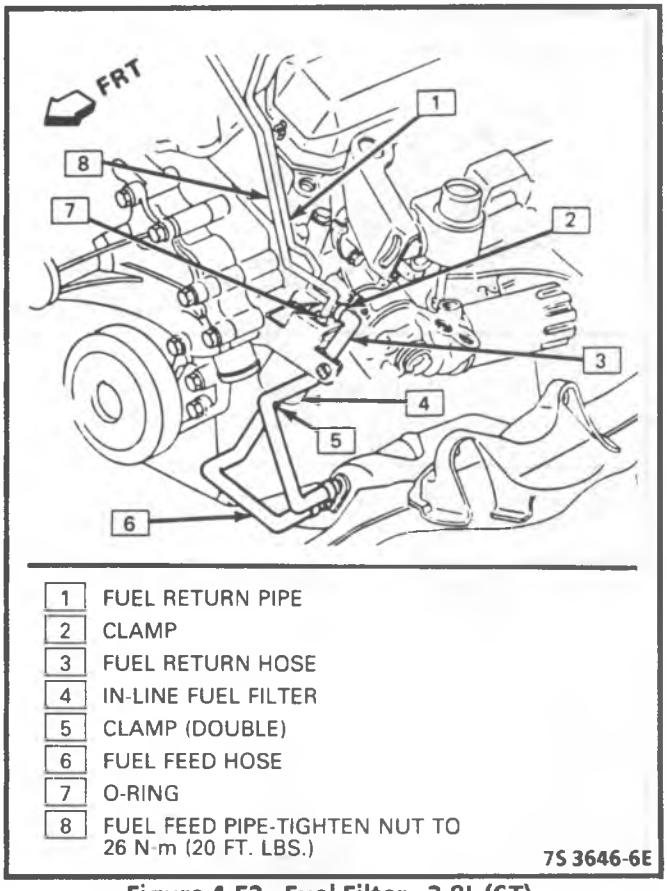
1. Clamp to filter.
2. Clamp bolt.
3. Fuel feed nuts.
4. Fuel filler cap.



1 FITTING
2 OIL PRESSURE SWITCH

7S 3814-6E

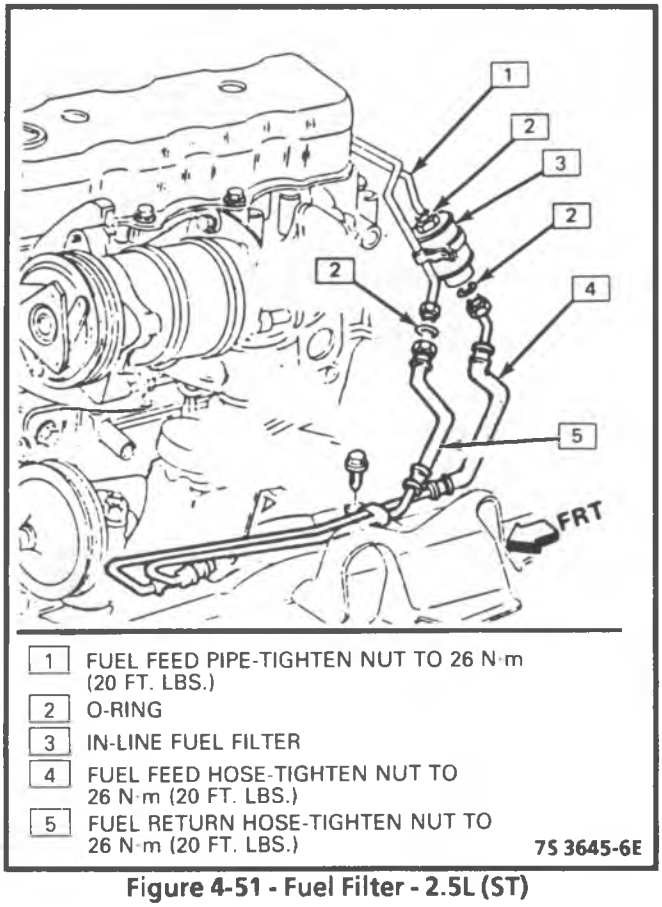
Figure 4-50 - Oil Pressure Switch (4.3L/V8)



1 FUEL RETURN PIPE
2 CLAMP
3 FUEL RETURN HOSE
4 IN-LINE FUEL FILTER
5 CLAMP (DOUBLE)
6 FUEL FEED HOSE
7 O-RING
8 FUEL FEED PIPE-TIGHTEN NUT TO 26 N·m (20 FT. LBS.)

7S 3646-6E

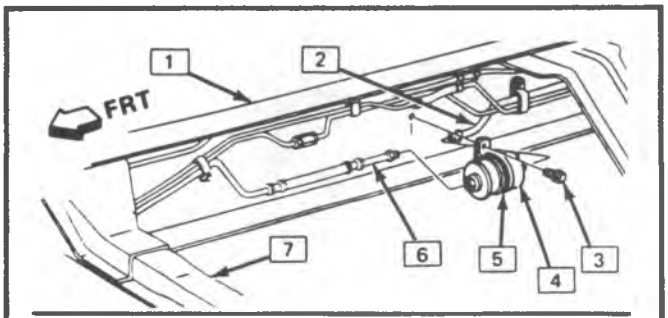
Figure 4-52 - Fuel Filter - 2.8L (ST)



1 FUEL FEED PIPE-TIGHTEN NUT TO 26 N·m (20 FT. LBS.)
2 O-RING
3 IN-LINE FUEL FILTER
4 FUEL FEED HOSE-TIGHTEN NUT TO 26 N·m (20 FT. LBS.)
5 FUEL RETURN HOSE-TIGHTEN NUT TO 26 N·m (20 FT. LBS.)

7S 3645-6E

Figure 4-51 - Fuel Filter - 2.5L (ST)



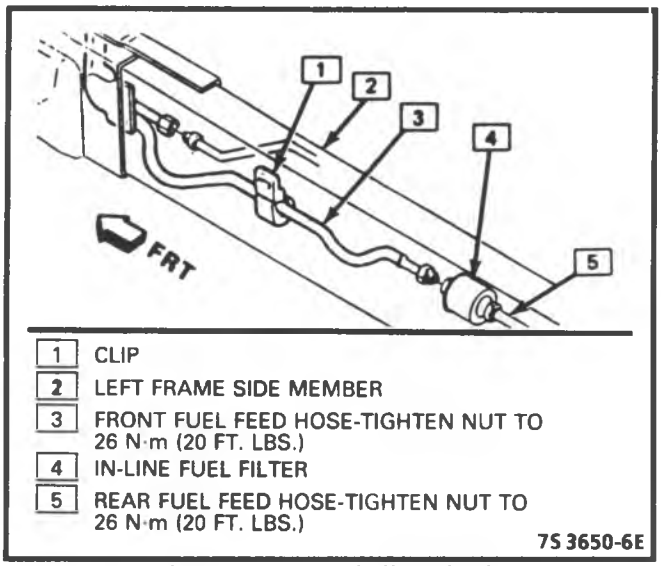
1 RIGHT FRAME SIDE MEMBER
2 REAR FUEL FEED PIPE-TIGHTEN NUT TO 26 N·m (20 FT. LBS.)
3 BOLT-TIGHTEN TO 16 N·m (24 FT. LBS.)
4 IN-LINE FUEL FILTER
5 CLAMP
6 INTERMEDIATE FUEL FEED PIPE-TIGHTEN NUT TO 26N·m (20 FT. LBS.)
7 TRANSMISSION SUPPORT

7S 3644-6E

Figure 4-53 - Fuel Filter (RV)

In-Tank Filter

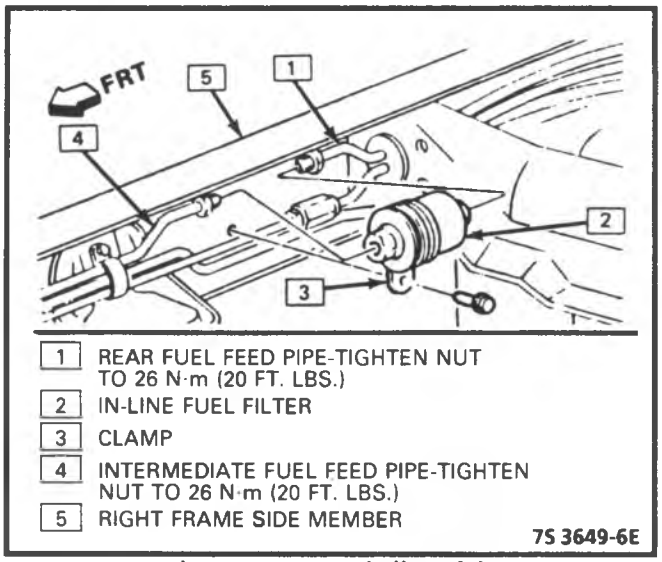
Refer to fuel pump replacement, if the in-tank filter required service.



1 CLIP
2 LEFT FRAME SIDE MEMBER
3 FRONT FUEL FEED HOSE-TIGHTEN NUT TO 26 N·m (20 FT. LBS.)
4 IN-LINE FUEL FILTER
5 REAR FUEL FEED HOSE-TIGHTEN NUT TO 26 N·m (20 FT. LBS.)

7S 3650-6E

Figure 4-54 - Fuel Filter (CK)



1 REAR FUEL FEED PIPE-TIGHTEN NUT TO 26 N·m (20 FT. LBS.)
2 IN-LINE FUEL FILTER
3 CLAMP
4 INTERMEDIATE FUEL FEED PIPE-TIGHTEN NUT TO 26 N·m (20 FT. LBS.)
5 RIGHT FRAME SIDE MEMBER

7S 3649-6E

Figure 4-55 - Fuel Filter (P)

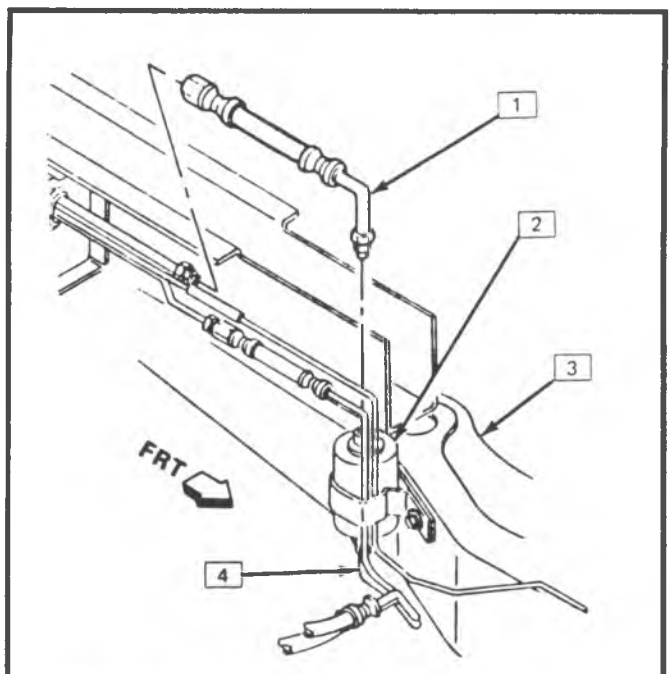
FUEL HOSE/PIPE ASSEMBLIES

Materials

Fuel Lines - These are welded steel tubes, meeting GM Specification 124-M, or its equivalent. The fuel feed line is 3/8" diameter and the fuel return line is 5/16" diameter. Do not use copper or aluminum tubing to replace steel tubing. Those materials do not have satisfactory durability to withstand normal vehicle vibration.

Coupled Hose - These are not to be repaired and are replaced only as an assembly.

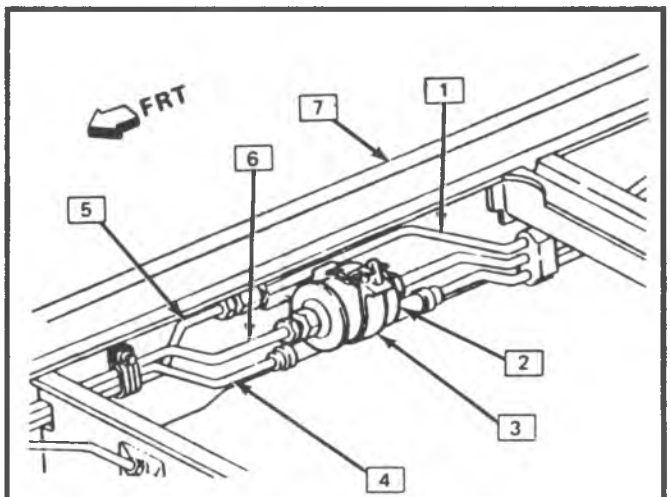
Uncoupled Hose - Use only reinforced fuel resistant hose, made of "Fluroelastomer" material. Do not use a hose within 4 inches (100 mm) of any part



1 FUEL FEED PIPE-TIGHTEN NUT TO 26 N·m (20 FT. LBS.)
2 IN-LINE FUEL FILTER
3 LEFT FRAME SIDE MEMBER
4 FRONT FUEL FEED PIPE-TIGHTEN NUT TO 26 N·m (20 FT. LBS.)

7S 3647-6E

Figure 4-56 - Fuel Filter (M)



1 REAR FUEL FEED PIPE-TIGHTEN NUT TO 26 N·m (20 FT. LBS.)
2 IN-LINE FUEL FILTER
3 BRACKET
4 VAPOR PIPE
5 FUEL RETURN PIPE
6 INTERMEDIATE FUEL FEED PIPE-TIGHTEN NUT TO 26 N·m (20 FT. LBS.)
7 RIGHT FRAME SIDE MEMBER

7S 3648-6E

Figure 4-57 - Fuel Filter (G)

of the exhaust system, or within 10 inches (254 mm) of the catalytic converter. The hose's inside diameter must match the outside diameter of the steel tubing.

Clamps - These are stainless steel, screw band-type clamps, #2494772, or equivalent.

Fuel Line Repair

1. Cut a piece of fuel hose 4 inches (100 mm) longer than the section of line to be removed. If more than 6 inches (152 mm) is to be removed, use a combination of steel pipe and hose. The hose length should not be more than 10 inches total.
2. Cut a section of pipe to be replaced with a tube cutter. Use the first step of a double flaring tool to form a bead on the ends of the pipe and, also, on the new section of pipe, if used.
3. Slide the hose clamps onto the pipe and push the hose 2 inches (51 mm) onto each portion of the fuel pipe. Tighten a clamp on each side of the repair.
4. Secure fuel line to the frame.

FUEL TANK

Draining

1. Disconnect the negative battery cable.
   - Have a dry chemical (Class B) fire extinguisher nearby.

CAUTION: Never drain or store gasoline or diesel fuel in an open container, due to the possibility of fire or explosion.

2. Use a hand operated pump device to drain as much fuel as possible through the filler neck. On some fuel tank installations, the filler neck is too long to gain access to the fuel. If the tank is not full, disconnect filler neck nose, at the fuel tank, to gain access to the fuel.
   Alternate method:
   a. Disconnect fuel feed pipe and attach a hand operated pump device.
   b. Energize the fuel pump relay.
   c. With fuel pump running, operate hand pump to remove fuel.
3. After servicing fuel tank, install removed hose, lines, and fuel filler cap.

Replacement
Figure 4-58 through 4-67

Remove or Disconnect

1. Fuel from the fuel tank.
2. Clamps from filler neck hose and vent line. (Fig. 4-68 through 4-75).
3. Fuel tank retaining straps.
   - Support the fuel tank.
4. Sender unit wires, hoses, and ground strap.
   - Lower the fuel tank to gain access.
5. Fuel tank from the vehicle.
6. Fuel sender and pump from the fuel tank.
7. Purge tank, if being repaired.

Install or Connect

1. Fuel sender and pump into fuel tank.
2. Fuel tank into the vehicle.
3. Sender unit wires, hoses, and ground straps.
4. Fuel tank retaining straps with insulator strips in place.
5. Clamp to filler neck hose and vent line.
6. Bolts and nuts.

Tighten

Bolts, as shown in the illustrations.

Purging

The fuel tank should be purged, before being repaired.

Remove or Disconnect

1. Fuel tank from the vehicle.
2. Fuel gage sending and pump unit.
3. All remaining fuel from the tank.

Inspect

- Fuel tank for any remaining fuel.

Install or Connect

1. Tap water into the tank, until it is full.
   - Move the tank to the flushing area (wash rack).
   - Agitate the water vigorously, and then, drain it.
2. Gasoline emulsifiying agent into the tank.
   - Use an available emulsifying agent, such as Product-Sol No. 913, or equivalent.
3. Water to the fuel tank.
   - Refer to the emulsifying agent specifications for the mixture ratio.
   - Agitate the mixture for ten minutes.
   - Drain the tank completely.
   - Fill the tank with water, until it overflows.
   - Completely flush out any remaining mixture.
   - Drain the fuel tank.
   - Use an explosion meter (if available) to check for a negative reading.
   - Perform the required service work.

4. Repair fuel tank.
5. Fuel gage sending and pump unit.
6. Fuel tank into vehicle.

FUEL SYSTEM CLEANING

Remove or Disconnect

1. Negative battery cable.
2. Engine harness connector on the distributor.
   - Have a dry chemical (Class B) fire extinguisher near the work area.
3. Fuel system pressure (2.5L engine only).
4. Fuel from the fuel tank.
5. Fuel tank.
6. Fuel gage sending and pump unit.
7. Purge fuel tank.

In Line Fuel Filter

Inspect

- In-line filter, for contamination.
- Replace the filter, if it is plugged.

Clean

- Fuel lines, by applying air pressure in the opposite direction of fuel flow.

Install or Connect

1. New strainer (if necessary) on the fuel gage sending and pump unit.

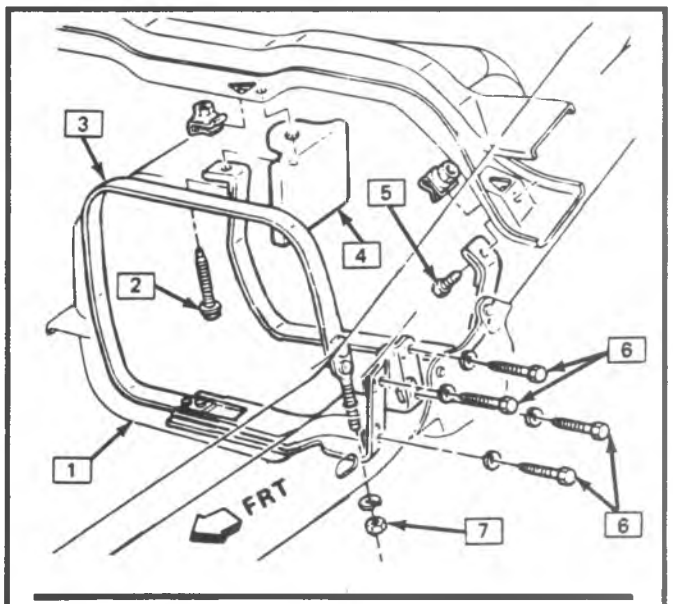
NOTICE: Care should be taken not to fold over or twist the strainer, when installing the sending unit, as this will restrict fuel flow.

2. Fuel gage sender and pump unit, with a new seal into the fuel tank.
3. Fuel tank.
4. Disconnect the fuel feed line at the front of the vehicle.
5. Hose to the fuel feed line at the front of the vehicle and insert the other end of the hose into a 3.8 liter (one gallon) fuel can.
6. Negative battery cable.
7. Twenty three liters (six gallons) of clean fuel into the fuel tank.
8. Energize fuel pump relay, to operate the fuel pump, until two liters (½ gallon) of fuel flows into the fuel can. This will purge the fuel pump.
9. Fuel line, at the front of the vehicle.
10. Engine harness connector to the distributor.
    - Check all connections, for leaks, and tighten all hose clamps.

Leak Test

If fuel is leaking, from the tank, the tank should be replaced. Make sure that the fuel lines are not leaking onto the tank.

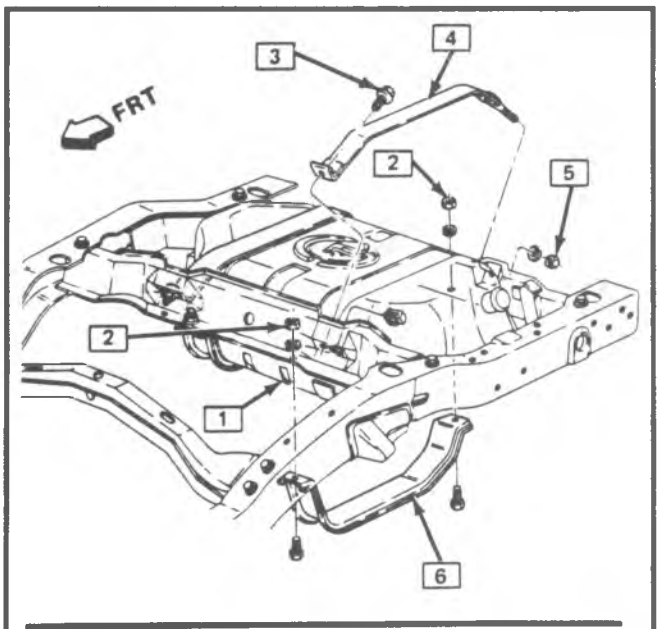
1. Remove the fuel tank.
2. Drain the tank.
3. Plug all of the outlets.
4. Apply 7 to 10 kPa (1 to 1½ psi) air pressure through the vent tube.
5. Test for leaks, with a soap solution, or by submersion.
6. Replace the tank, if a leak is found.



1 FUEL TANK
2 BOLT — TIGHTEN TO 18 N·m (13 FT. LBS.)
3 STRAP
4 PROTECTOR
5 BOLT — TIGHTEN TO 35 N·m (26 FT. LBS.)
6 BOLT — TIGHTEN TO 35 N·m (26 FT. LBS.)
7 NUT — TIGHTEN TO 7 N·m (5 FT. LBS.)

7S 3820-6E

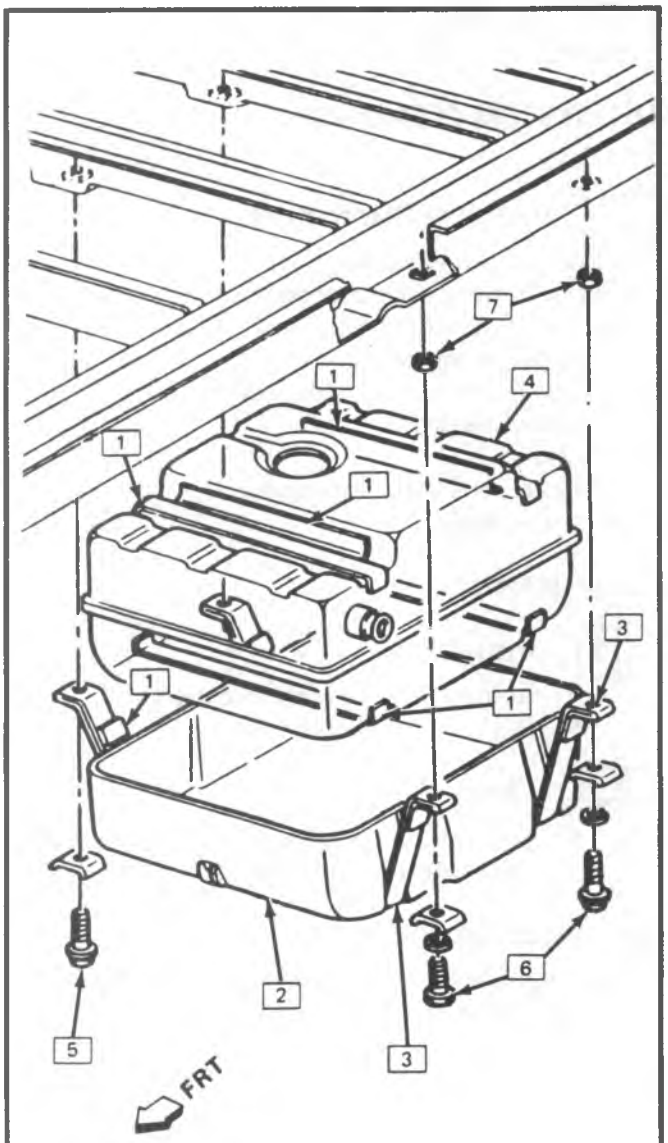
Figure 4-58 - Fuel Tank - ST (except Utility)



1 FUEL TANK
2 NUT — TIGHTEN TO 45 N·m (33 FT. LBS.)
3 BOLT — TIGHTEN TO 35 N·m (26 FT. LBS.)
4 STRAP
5 NUT — TIGHTEN TO 7 N·m (5 FT. LBS.)
6 BRACKET

7S 3821-6E

Figure 4-59 - Fuel Tank - ST Utility



COMPLETELY INSTALL ONE STRAP PRIOR TO INSTALLATION OF THE SECOND STRAP, HOWEVER, THE TANK MUST REMAIN SUPPORTED UNTIL ALL FOUR BOLTS ARE TORQUED TO SPECIFICATIONS.

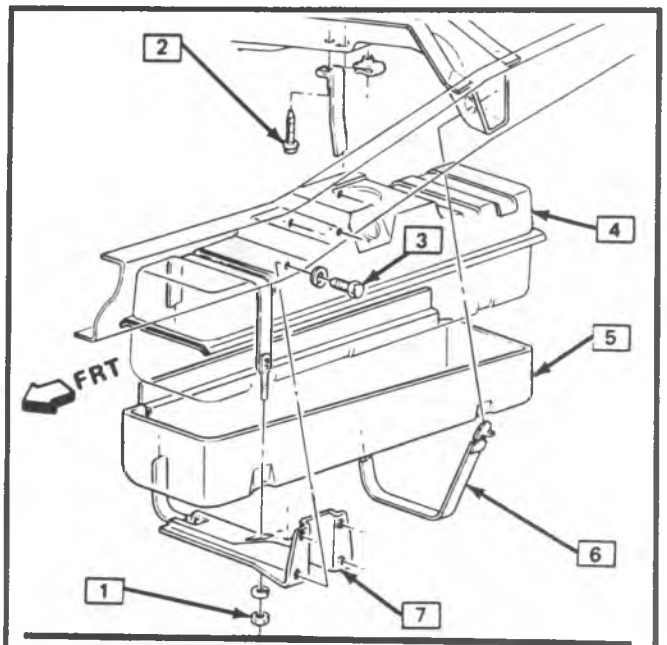
1 INSULATOR
2 LOWER SHIELD
3 STRAP
4 FUEL TANK

INSTALLATION SEQUENCE

5 BOLT — TIGHTEN TO 35 N·m (26 FT. LBS.)
6 BOLT — TIGHTEN TO 3.4 N·m (30 IN. LBS.)
7 NUT — TIGHTEN TO 35 N·m (26 FT. LBS.)

7S 3819-6E

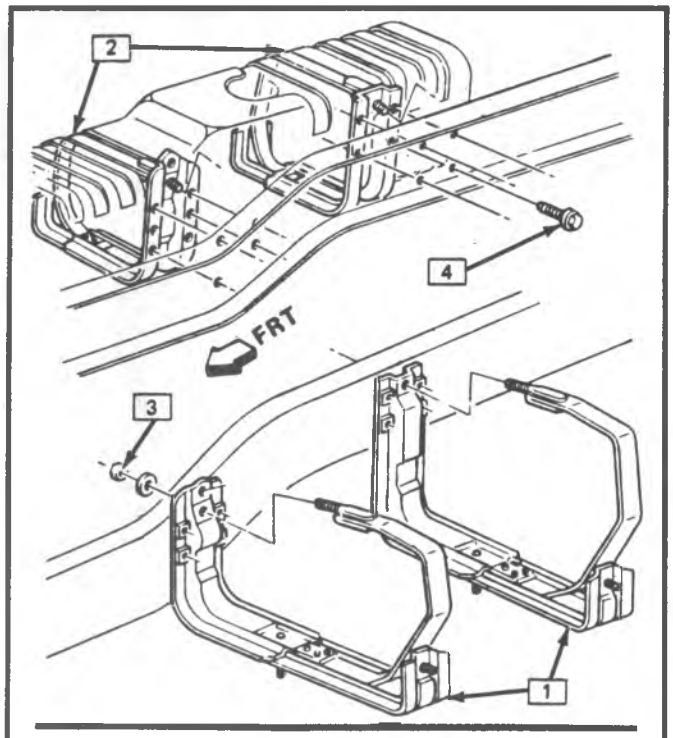
Figure 4-60 - Fuel Tank - M



1 NUT — TIGHTEN TO 12 N·m (10 FT. LBS.)
2 BOLT — TIGHTEN TO 12 N·m (10 FT. LBS.)
3 BOLT — TIGHTEN TO 33 N·m (24 FT. LBS.)
4 FUEL TANK
5 SHIELD
6 REAR STRAP
7 FRONT STRAP

7S 3829-6E

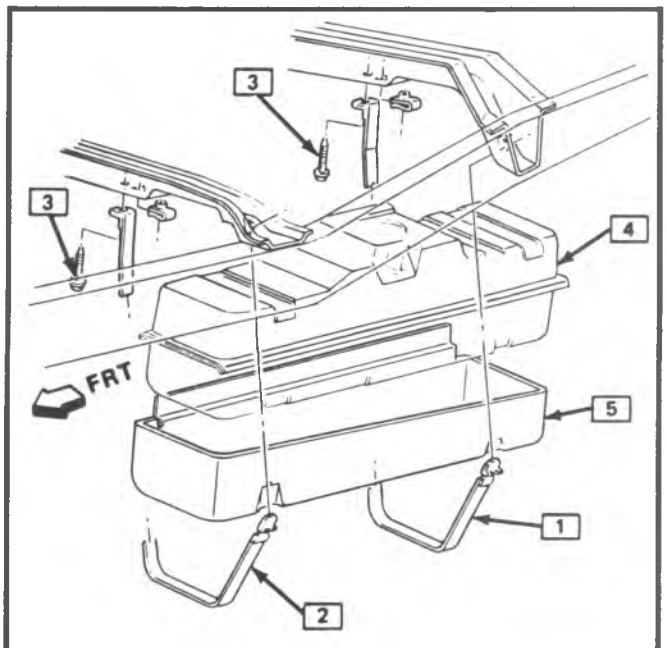
Figure 4-61 - Fuel Tank - CK Chassis Cab



1 STRAP — BASE FUEL TANK LOCATION
2 STRAP — 33 GAL. FUEL TANK LOCATION
3 NUT — TIGHTEN TO 7 N·m (60 IN. LBS.)
4 BOLT — TIGHTEN TO 33 N·m (22 FT. LBS.)

7S 3817-6E

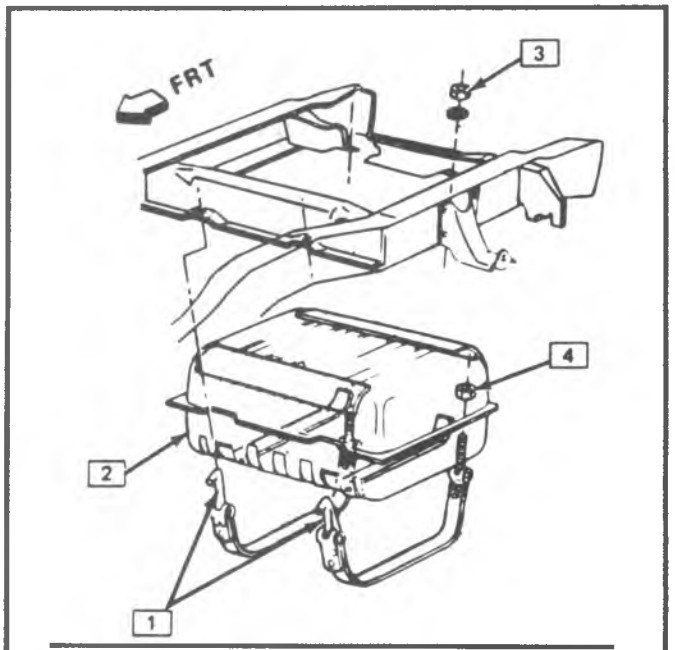
Figure 4-63 - Fuel Tank - RV Pickup



1 REAR STRAP
2 FRONT STRAP
3 BOLT — TIGHTEN TO 12 N·m (10 FT. LBS.)
4 FUEL TANK
5 SHIELD

7S 3830-6E

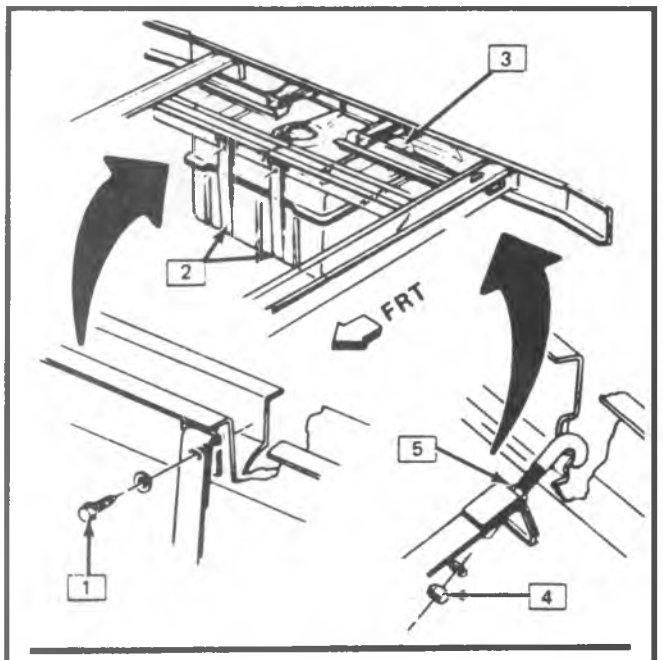
Figure 4-62 - Fuel Tank - CK (except Chassis Cab)



1 STRAP — HOOK MUST FACE FORWARD
2 FUEL TANK
3 UPPER NUT — TIGHTEN TO 14 N·m (10 FT. LBS.) AND THEN TIGHTEN LOWER NUT 4 TO 14 N·m (10 FT. LBS.)

7S 3818-6E

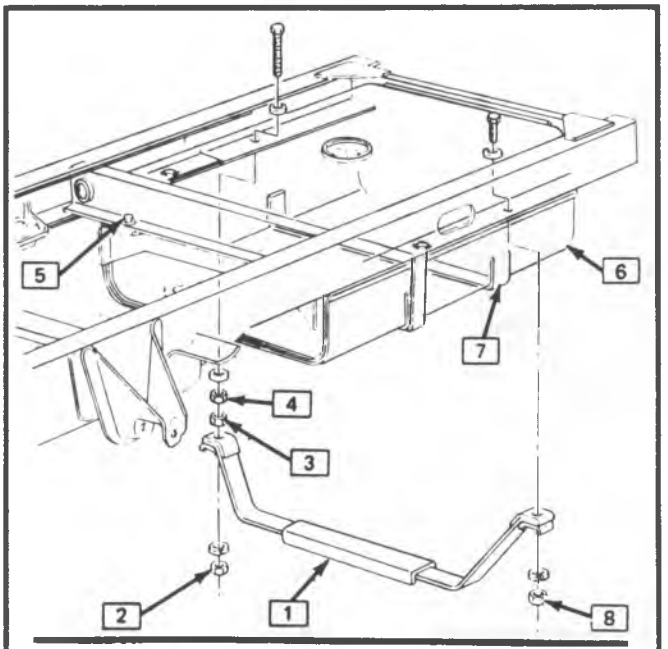
Figure 4-64 - Fuel Tank - RV Utility & Suburban



1 BOLT — TIGHTEN TO 9.5 N·m (85 IN. LBS.)
2 STRAP
3 FUEL TANK
4 LOWER NUT — TIGHTEN TO 14 N·m (10 FT. LBS.) AND THEN TIGHTEN UPPER NUT 5 TO 14 N·m (10 FT. LBS.)

7S 3816-6E

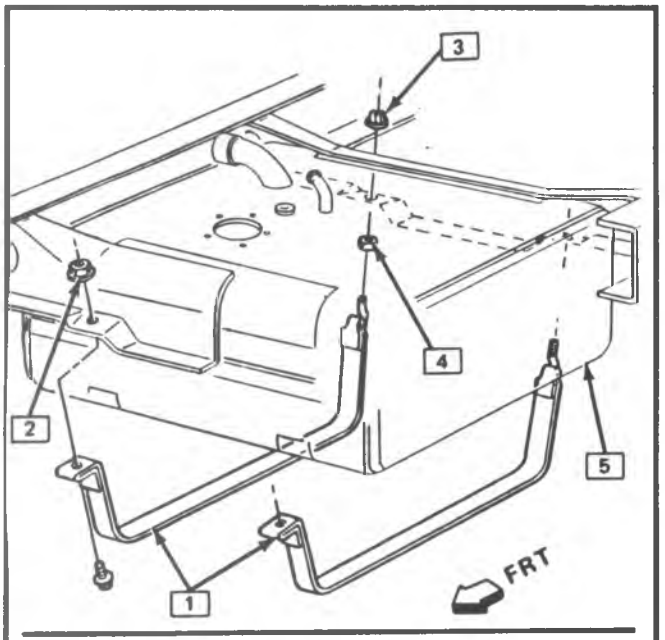
Figure 4-65 - Fuel Tank - G



1 STRAP
2 LOWER NUT — TIGHTEN TO 12 N·m (10 FT. LBS.), THEN TIGHTEN MIDDLE NUT 3 TO 58 N·m (42 FT. LBS.) AND THEN TIGHTEN LOWER AND UPPER NUT 4 TO 58 N·m (42 FT. LBS.)
5 NUT — TIGHTEN TO 58 N·m (42 FT. LBS.)
6 FUEL TANK
7 INSULATOR
8 NUT — TIGHTEN TO 58 N·m (42 FT. LBS.)

7S 3841-6E

Figure 4-67 - Fuel Tank - P (42)



1 STRAP
2 NUT TIGHTEN TO 12 N·m (10 FT. LBS.)
3 UPPER NUT — TIGHTEN TO 35 N·m (23 FT. LBS.) AND THEN TIGHTEN LOWER NUT 4 TO 35 N·m (25 FT. LBS.)
5 FUEL TANK

7S 3839-6E

Figure 4-66 - Fuel Tank - P (32)

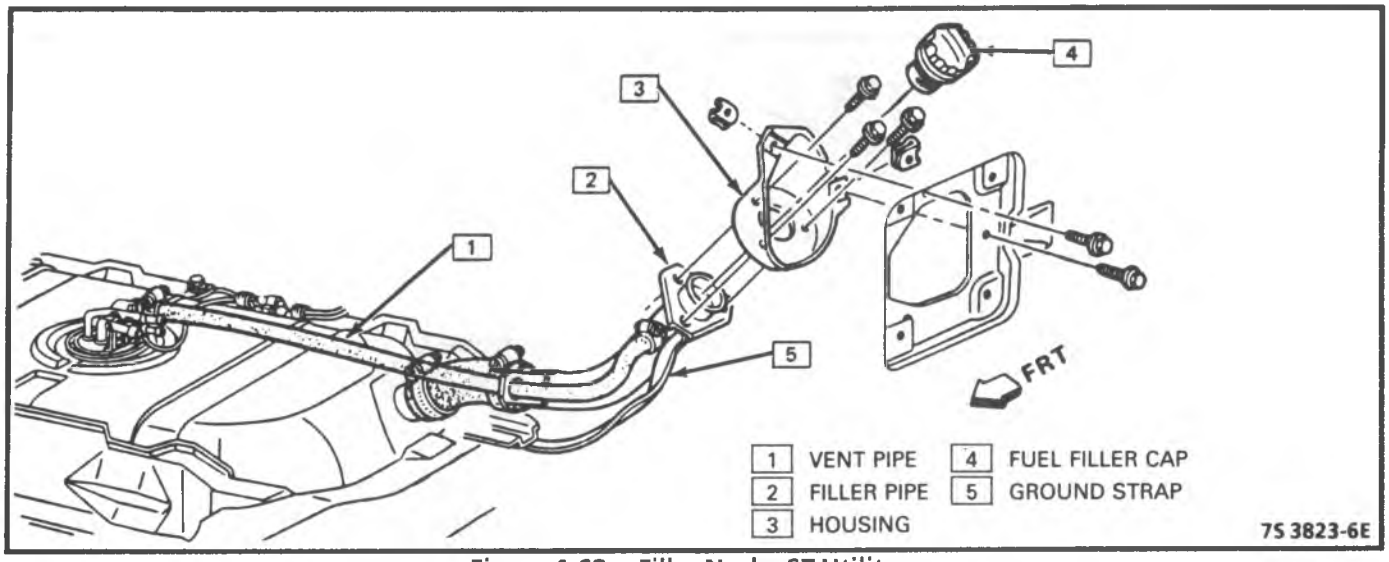


Figure 4-68 - Filler Neck - ST Utility

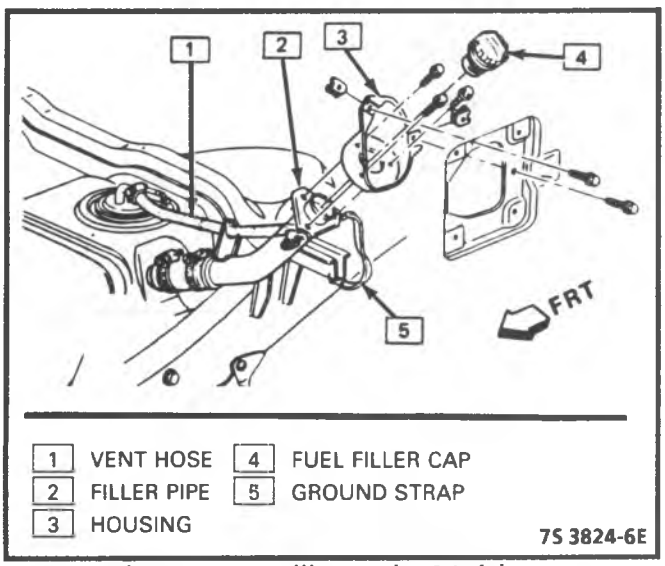


Figure 4-69 - Filler Neck - ST Pickup

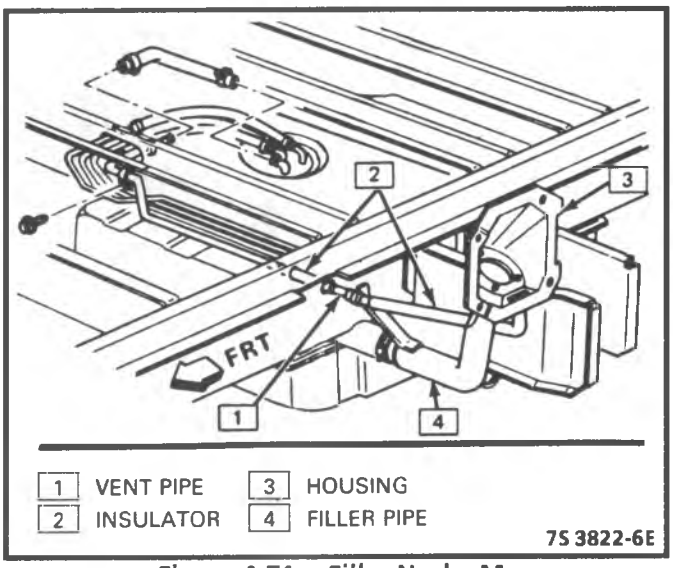


Figure 4-71 - Filler Neck - M

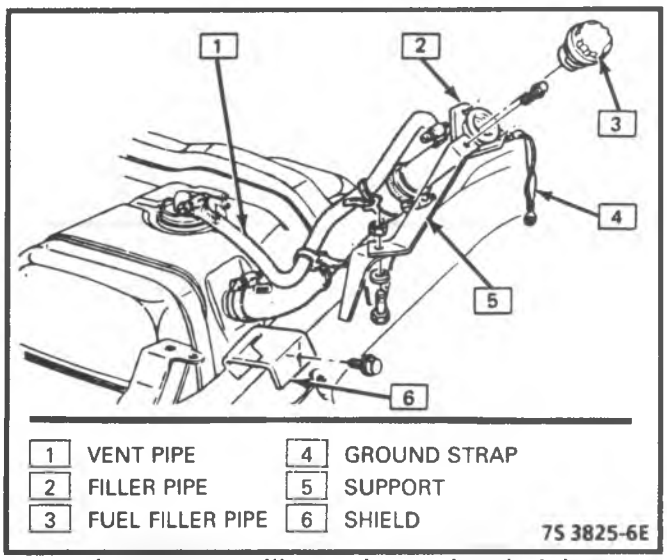


Figure 4-70 - Filler Neck - ST Chassis Cab

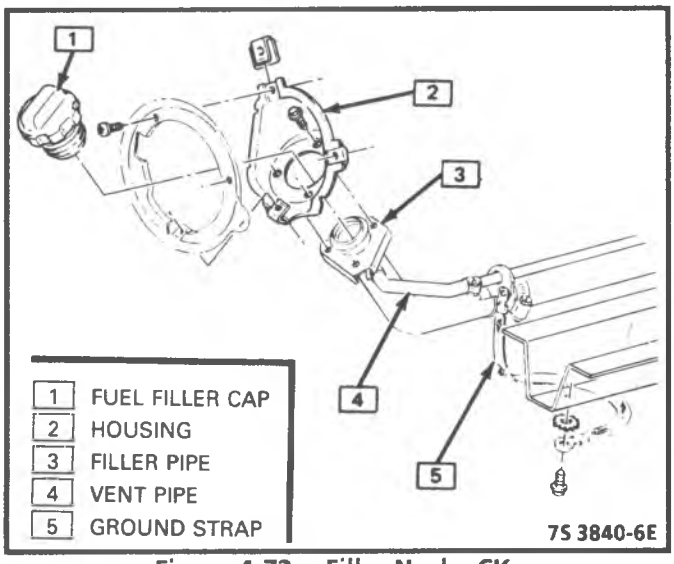


Figure 4-72 - Filler Neck - CK

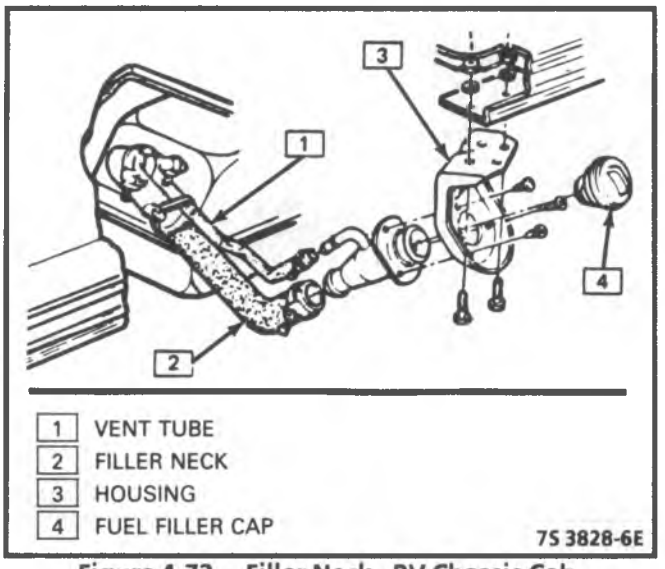


Figure 4-73 - Filler Neck - RV Chassis Cab

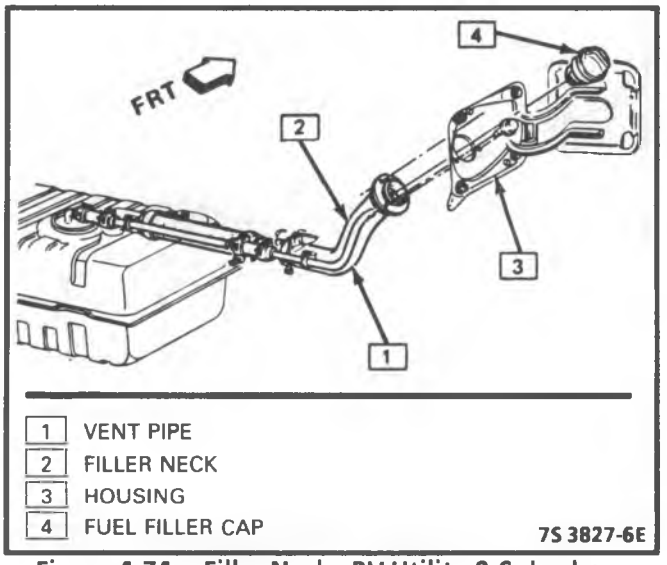


Figure 4-74 - Filler Neck - RV Utility & Suburban

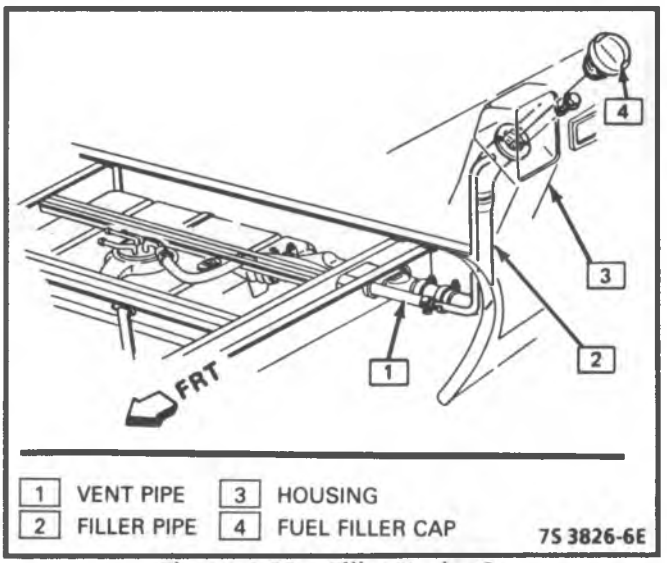


Figure 4-75 - Filler Neck - G

AUXILIARY FUEL TANK CONTROL
Figure 4-77

The auxiliary fuel tank selector switch, located on the instrument panel, activate either the left hand or right hand fuel tank fuel pump and a selector valve and meter switch to select right, or left, fuel feed and return lines.

Remove or Disconnect
Selector Valve Replacement
Figure 4-76

1. Battery.
2. Hose shield, if required.
3. Electrical connector from valve.
4. Fuel feed and return hose. Note position and color of hoses.
5. Selector valve from frame.

Install and Connect

1. Selector valve.
2. Fuel feed and return hoses.
3. Electrical connector.
4. Hose shield.
5. Battery.

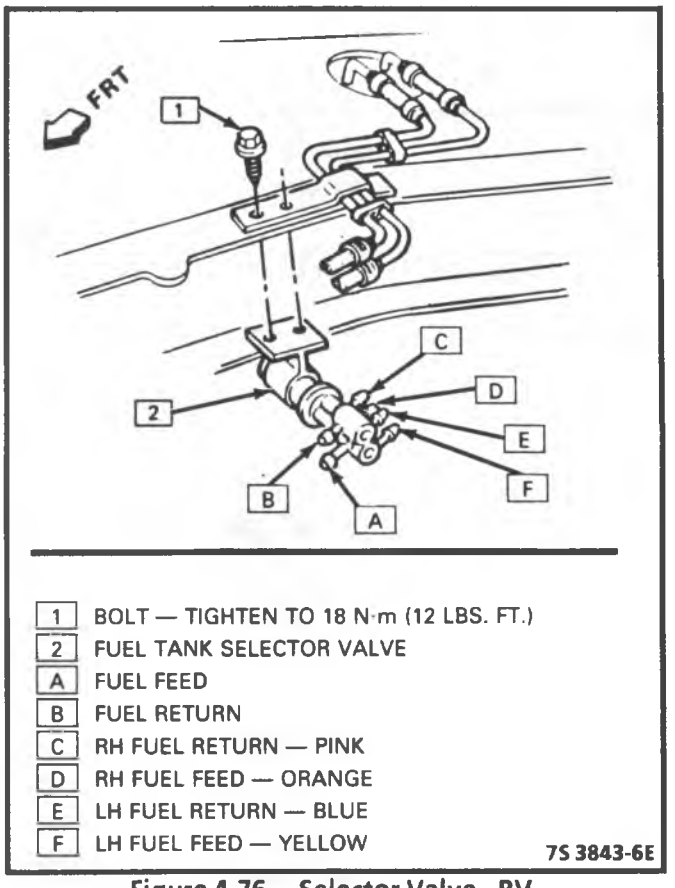


Figure 4-76 - Selector Valve - RV

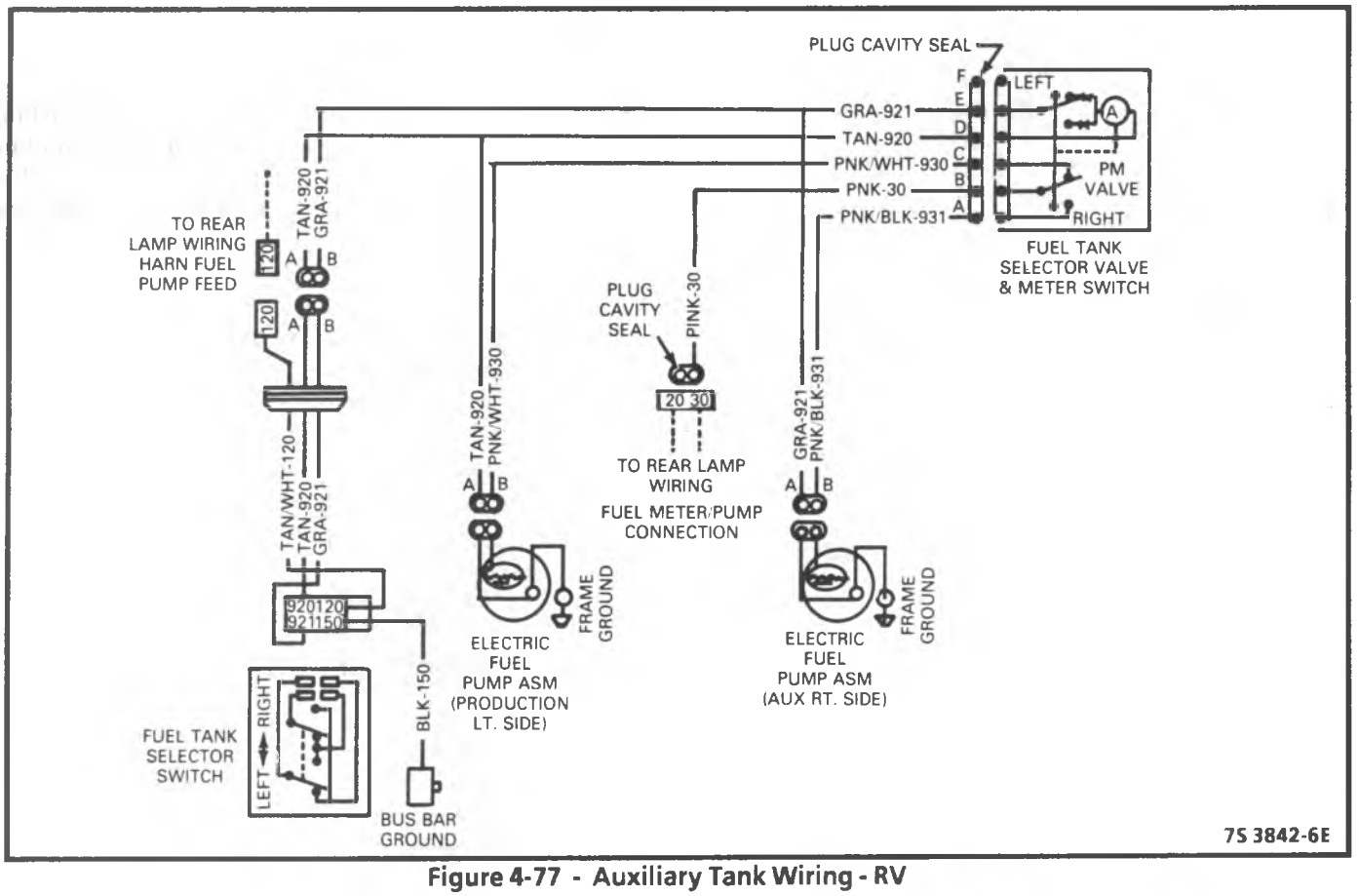


Figure 4-77 - Auxiliary Tank Wiring - RV

ACCELERATOR CONTROLS

Accelerator Control Cable
Figures 4-78 through 4-80

There are no linkage adjustments. The throttle cable must be replaced with an identical replacement part.

All linkages and cables must be checked, to assure free movement, with no rubbing, chafing, or binding. The throttle must operate freely, without binding between full closed and side open throttle.

Observe the following, when performing service on the accelerator control cable.

- The retainer must be installed with the tangs secured over the head of the stud.
- The conduit fitting, at both ends of the cable, must have the locking tangs expanded and locked into the attaching holes.
- The braided portion of the cable must not come into contact with the front of dash sealer during replacement.
- Flexible components (hoses, wires, conduit, etc.) must not be routed within 50 mm (2 inches) of the moving parts of the accelerator linkage, unless routing is positively controlled.

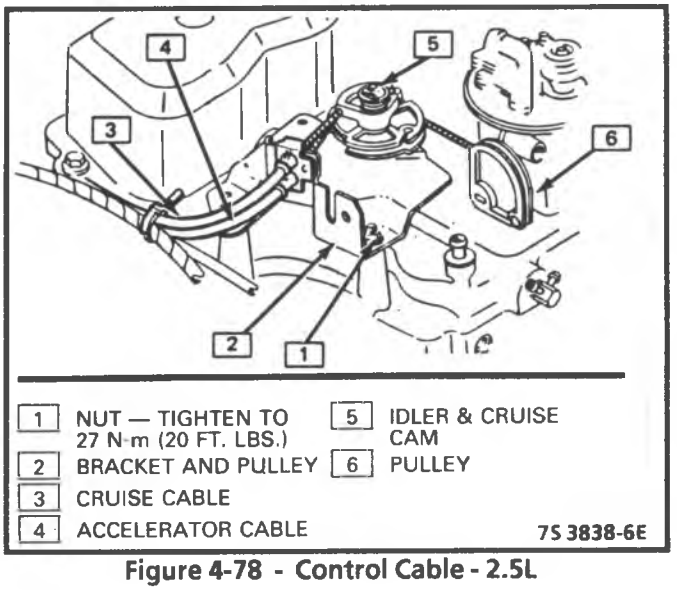


Figure 4-78 - Control Cable - 2.5L

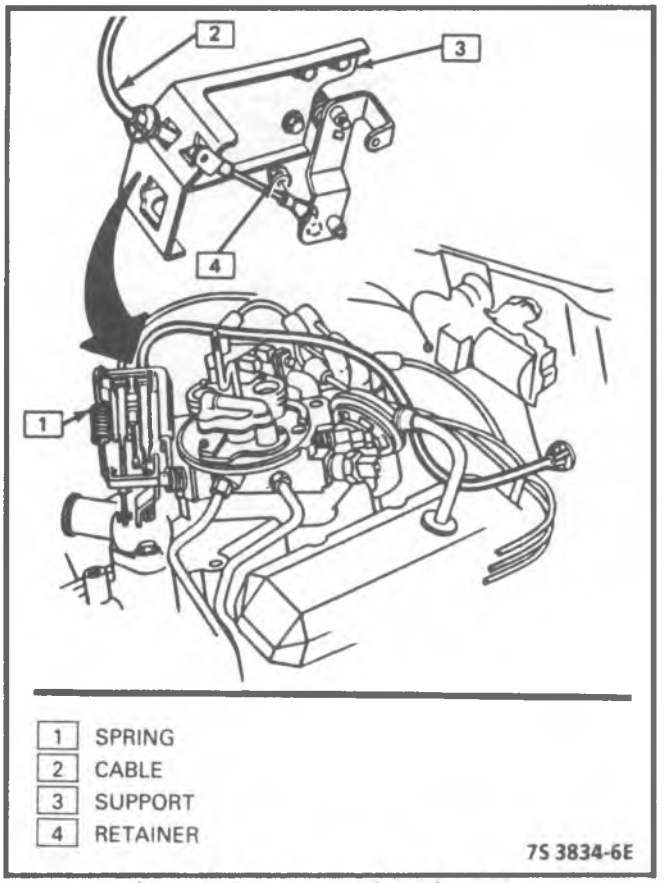


Figure 4-79 - Control Cable - 2.8L

Accelerator Pedal
Figure 4-81 through 4-87

The accelerator pedal controls the throttle, through a cable. There are no linkage adjustments. The throttle cable must be replaced with an identical replacement part.

All linkages and cables must be checked, to assure free movement with no rubbing, chafing, or binding. The throttle must operate freely, without binding, between full closed and wide open throttle.

Observe the following, when performing service on the accelerator pedal.

- The mounting surface between the support and the dash panel, must be free of insulation. The carpet and padding in the pedal and tunnel area must be positioned to lay flat and be free of wrinkles and bunches.
- Slip the accelerator control cable through the slot in the rod, before installing the retainer in the rod. Make sure it is seated properly. Use care in pressing retainer into the hole, so the cable is not kinked, or damaged.
- The linkage must operate freely, without binding, between closed throttle and full throttle.
- Wire, hoses, cable, and other flexible components, must not be placed within 13 mm (0.52 inch) of the cable or rod, at any point, in their travel.

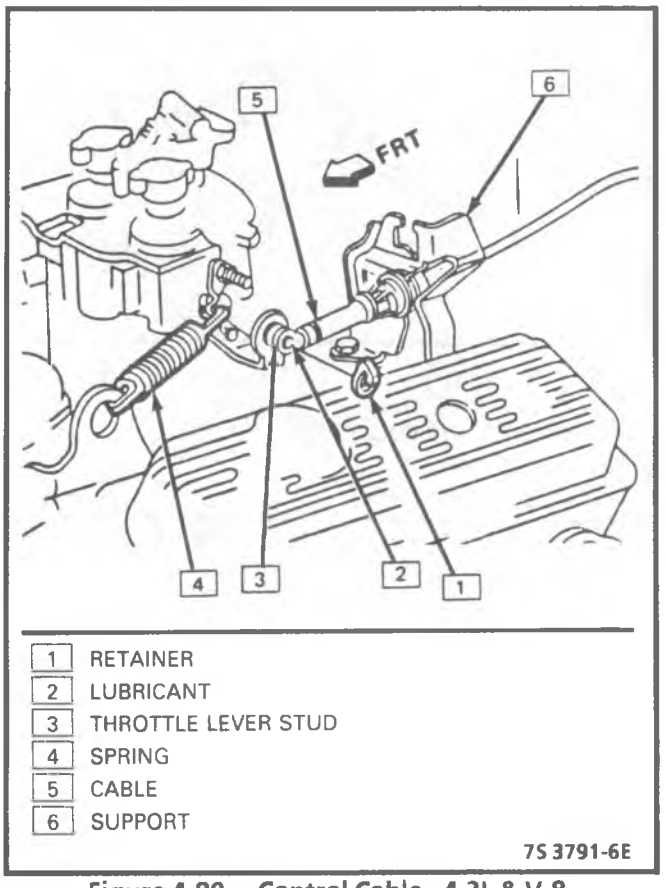


Figure 4-80 - Control Cable - 4.3L & V-8

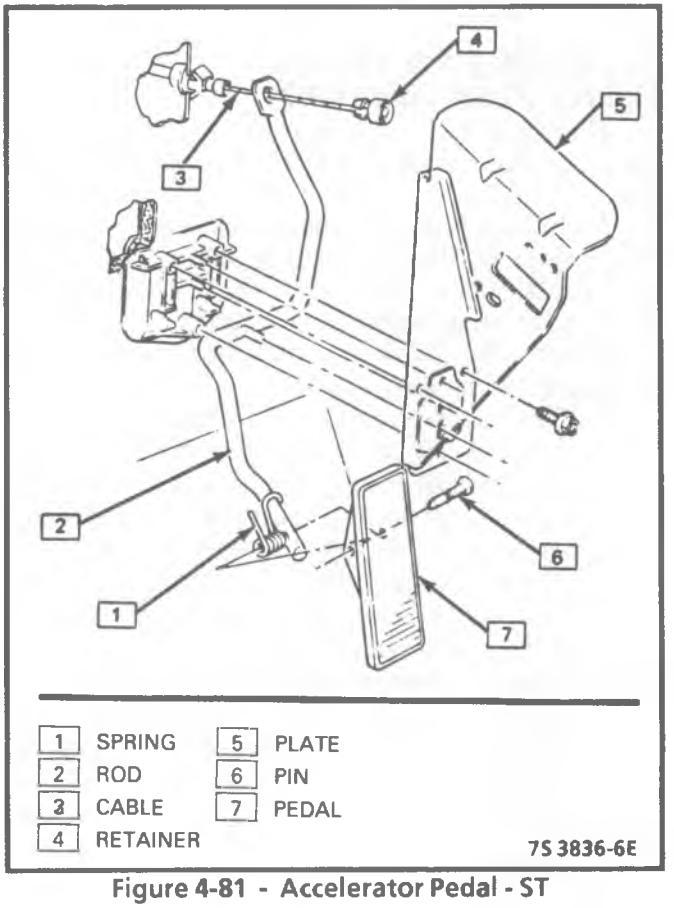
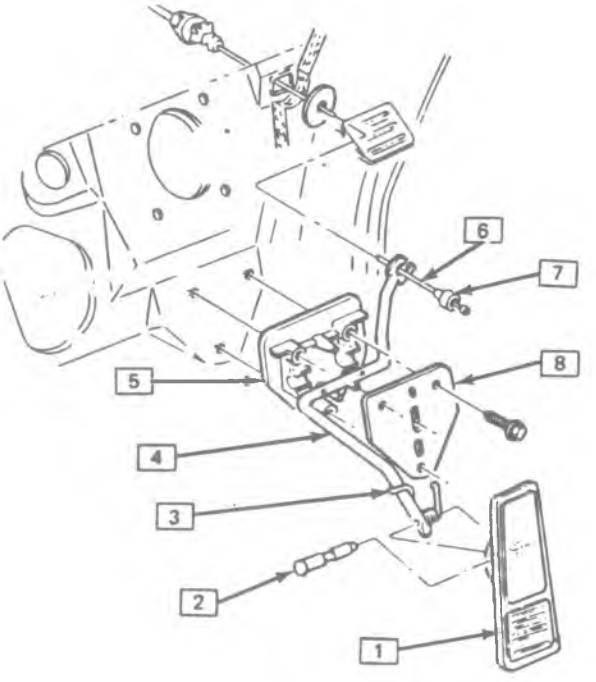


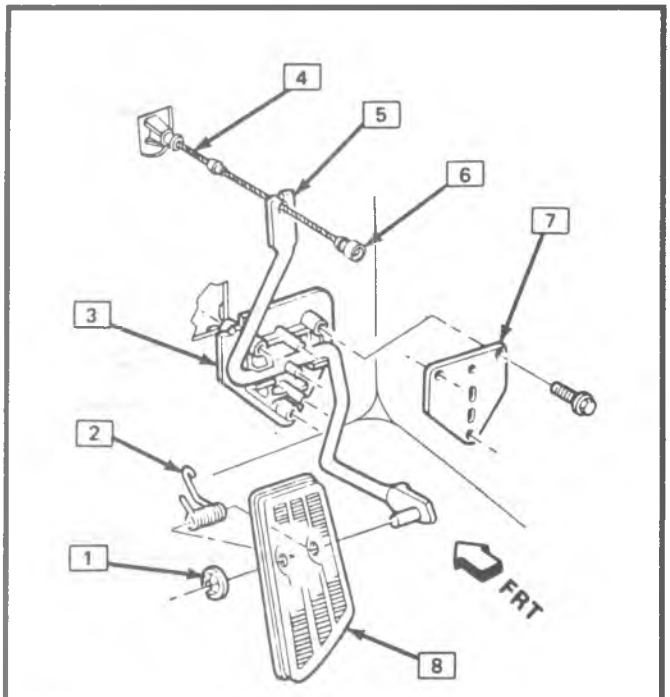
Figure 4-81 - Accelerator Pedal - ST



1	PEDAL	5	SUPPORT
2	PIN	6	CABLE
3	SPRING	7	RETAINER
4	ROD	8	PLATE

7S 3837-6E

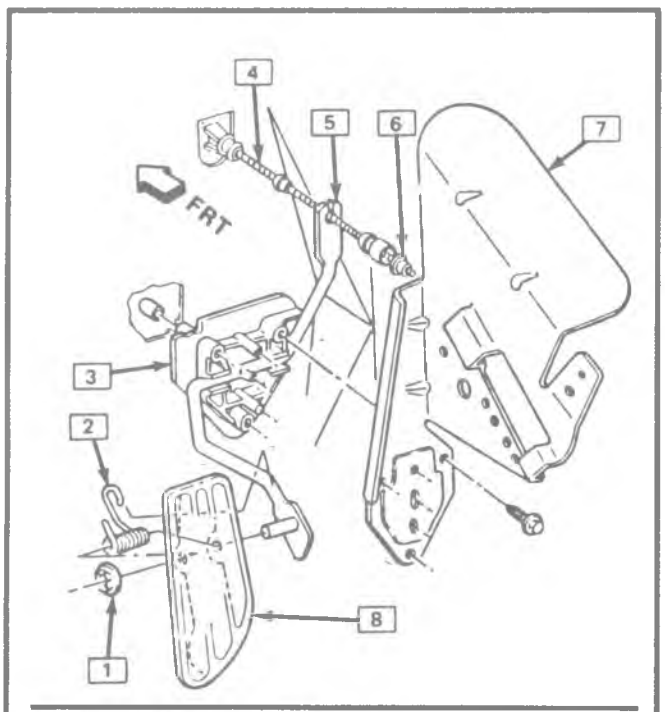
Figure 4-82 - Accelerator Pedal - M



1	RETAINER	5	ROD
2	SPRING	6	RETAINER
3	SUPPORT	7	PLATE
4	CABLE	8	PEDAL

7S 3788-6E

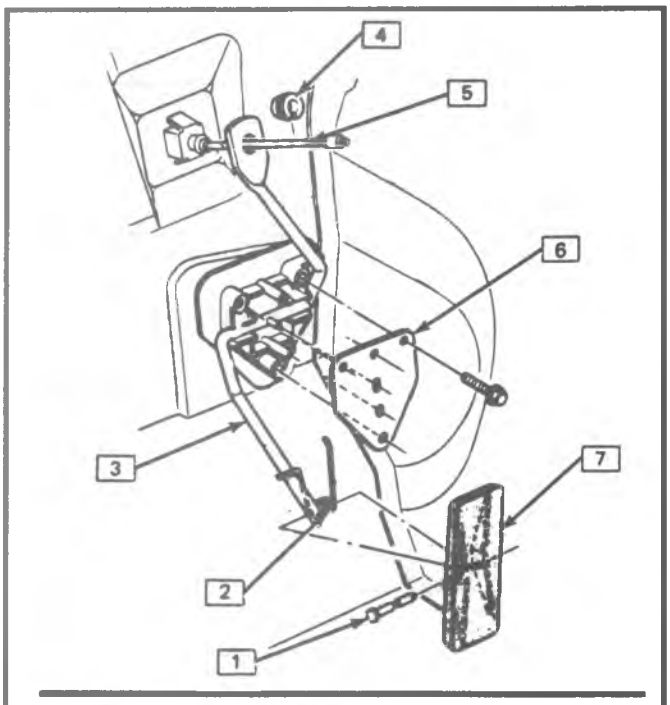
Figure 4-84 - Accelerator Pedal - CK



1	RETAINER	5	ROD
2	SPRING	6	RETAINER
3	SUPPORT	7	PLATE
4	CABLE	8	PEDAL

7S 3787-6E

Figure 4-83 - Accelerator Pedal - RV



1	PIN	5	CABLE
2	SPRING	6	REINFORCEMENT
3	ROD	7	PEDAL
4	RETAINER		

7S 3835-6E

Figure 4-85 - Accelerator Pedal - G

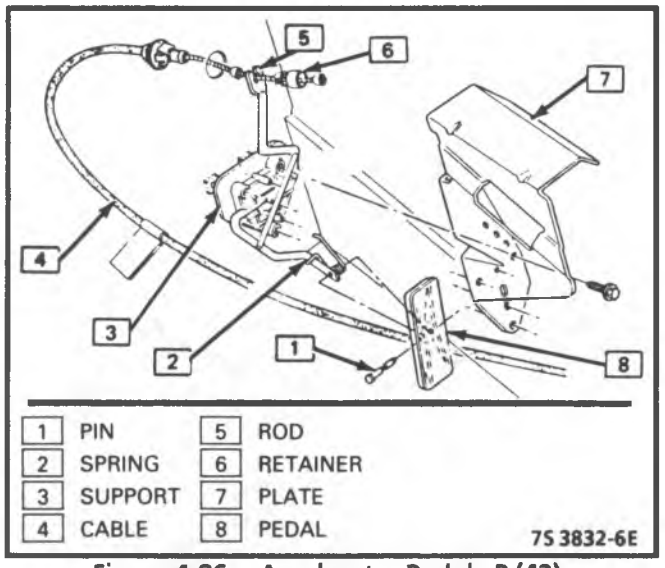


Figure 4-86 - Accelerator Pedal - P (42)

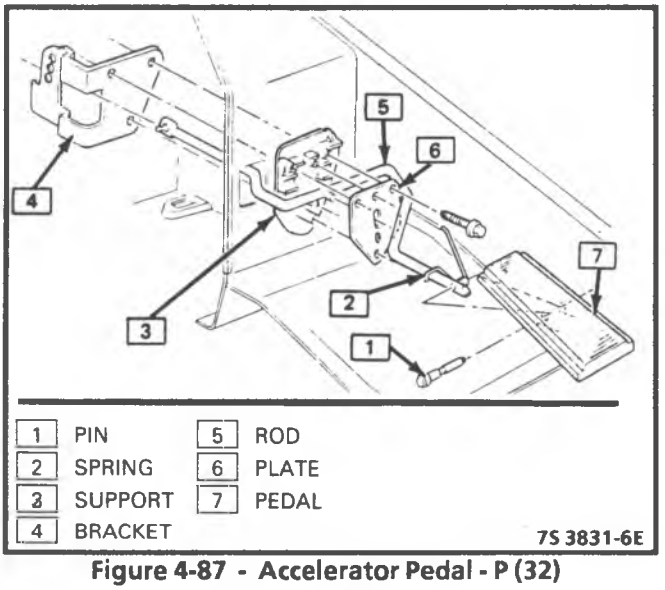


Figure 4-87 - Accelerator Pedal - P (32)

PARTS INFORMATION

PART NAME	GROUP
Cover, w/Regulator, Fuel Meter:	
Part of Meter Kit, Fuel	3.734
Injector, Fuel: Part of	
Injector Kit, Fuel	3.774
Pump, Fuel (In Tank)	3.990
Relay, Fuel Pump	3.990
Switch, Oil Press.	1.800
Throttle Body Injection Unit	3.725
Valve Asm, Idle Air Control: Part of	
Control Kit, Idle Air Valve	3.820

SECTION 5
EVAPORATIVE EMISSION CONTROL SYSTEM (EECS)

CONTENTS

GENERAL DESCRIPTION

PURPOSE

The Evaporative Emission Control System limits fuel vapor escape into the atmosphere. The system (EECS) transfers fuel vapor from a sealed fuel tank, through a single vapor pipe to an activated carbon (charcoal) storage device (vapor canister) to store 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.

The fuel tank has a fuel cap that is not vented to the atmosphere, but has a valve which allows both pressure and vacuum relief.

OPERATION

Evaporative System 2.5L & 2.8L (Figure 5-5)

Fuel vapors from the fuel tank are purged and flow into the vapor canister tube labeled "fuel tank" and are absorbed by the carbon. The canister (Figure 5-1) is purged when the engine is running above idle speed. A timed vacuum source is applied to the vapor canister tube labeled "canister purge" to draw fresh air through the bottom of the canister. The air mixes with vapor and the mixture is drawn into the intake manifold to be consumed in the normal combustion process.

2.8L Only (Figure 5-6)

This system has a thermostatic vacuum switch (TVS) installed in the intake manifold coolant passage to sense engine coolant temperature. This TVS has two ports and is located between the canister and the

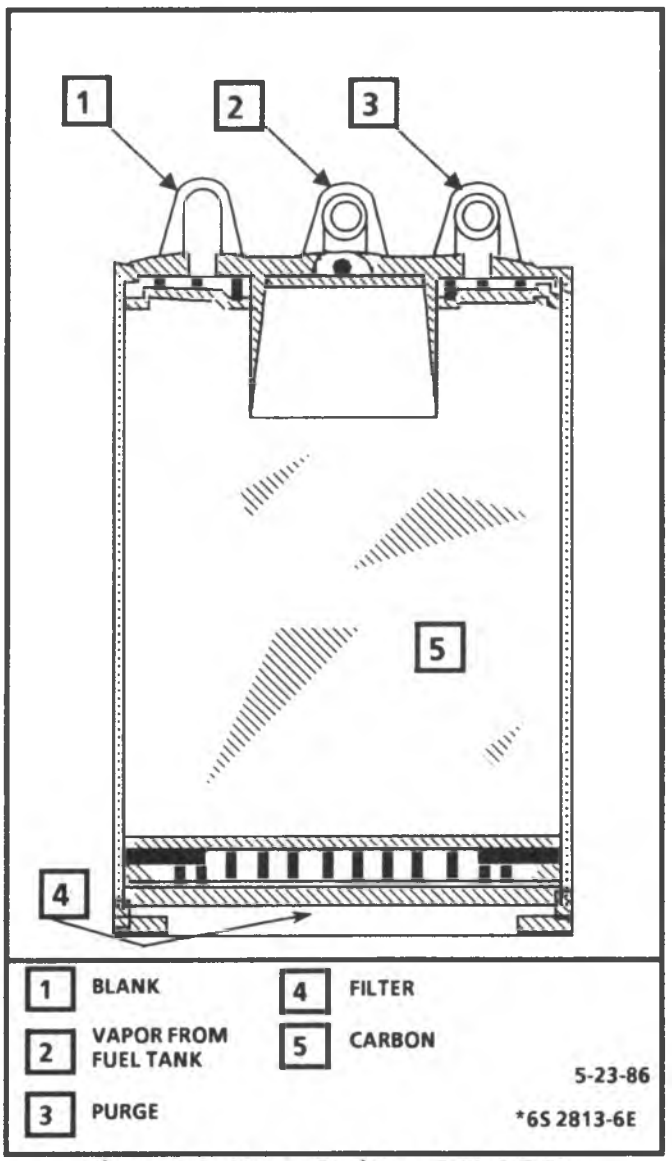


Figure 5-1 - Vapor Canister - 2.5L & 2.8L

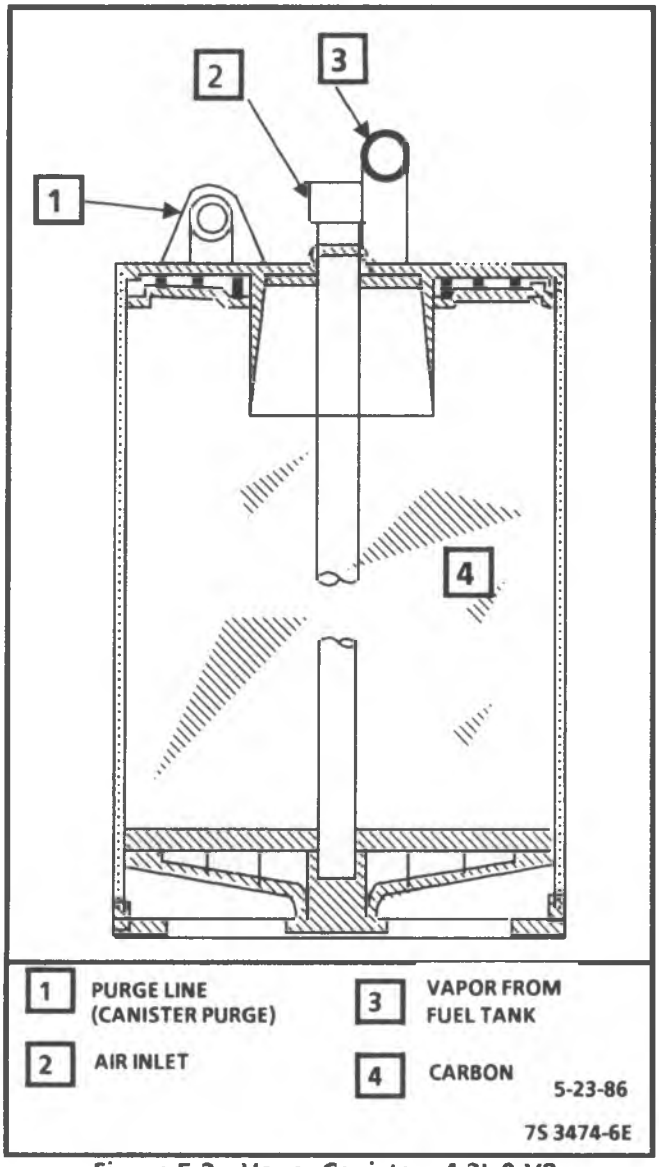


Figure 5-2 - Vapor Canister - 4.3L & V8 Except Altitude

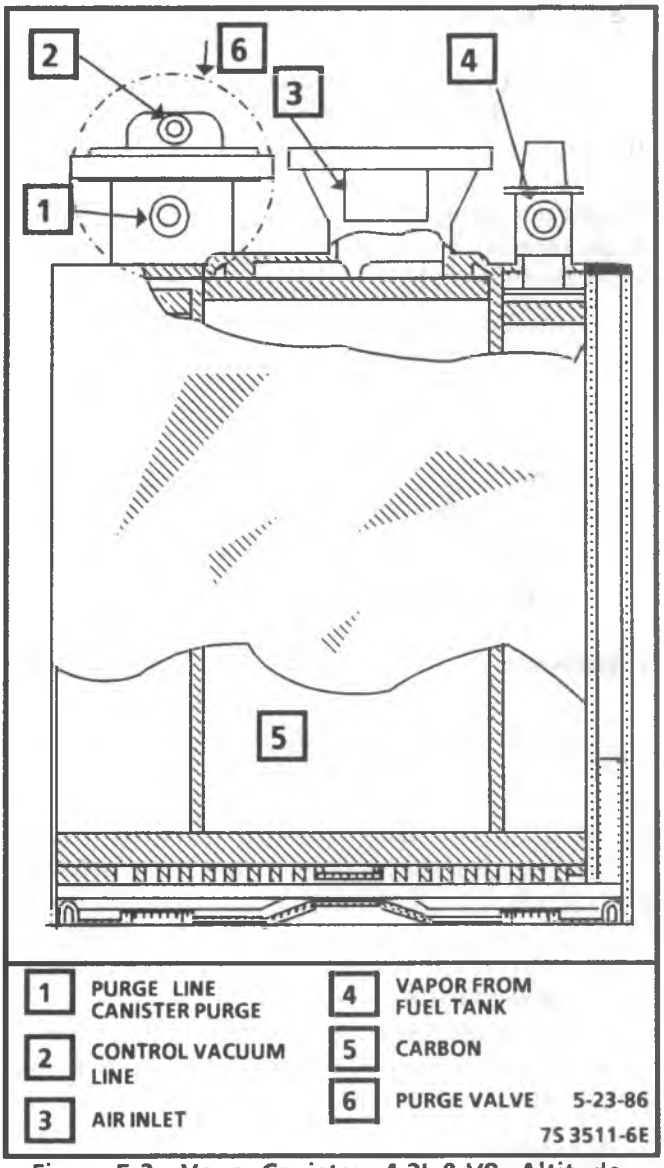


Figure 5-3 - Vapor Canister - 4.3L & V8 - Altitude

TBI unit. When the engine is below 46° C (115° F), the TVS is closed preventing purge of the canister. When engine temperature is above 46° C (115° F), the TVS opens, allowing purge of the canister.

Evaporative System - Except Altitude 4.3L & V8 (Figure 5-7)

Fuel vapors from the fuel tank are purged and flow into the vapor canister tube labeled "fuel tank" and are absorbed by the carbon. The canister (Figure 5-2) is purged when the engine is running above idle speed. A timed vacuum source is applied to the vapor canister tube labeled "canister purge" to draw fresh air through the air inlet, at the top of the canister. This air flows through a tube to the bottom of the canister and forces the vapors out the purge line.

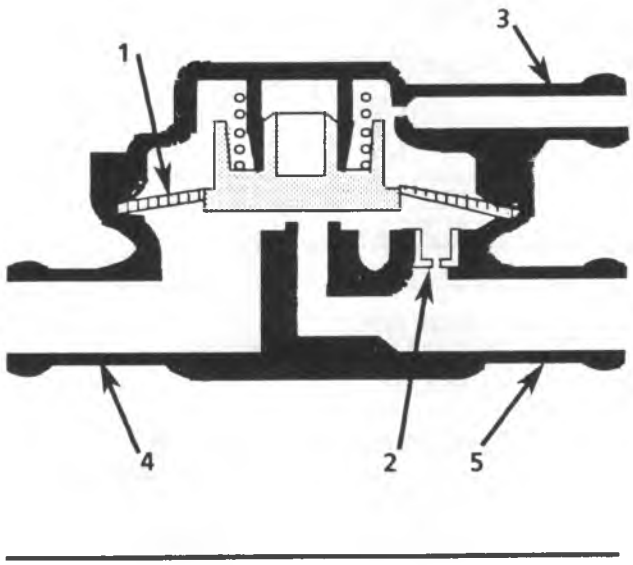
Evaporative System - Altitude 4.3L & V8 (Figure 5-8)

Fuel vapors from the fuel tank are purged and flow into the vapor canister tube labeled "fuel tank" and are absorbed by the carbon. When the canister (Figure 5-3) is purging, fresh air is drawn in through the air inlet, at the top of the canister. This air flows to the bottom of the canister and forces the vapors out the purge line.

The purge valve is an integral part of the canister. When the engine is running, full manifold vacuum is supplied to the top tube of the purge valve (Control Vacuum Signal) which lifts the valve diaphragm and opens the valve. The lower Tube on the purge valve is connected to a timed port above the TBI throttle valve. The rate of purge is controlled through this port by throttle valve location (throttle opening).

Tank Pressure Control Valve

The Tank Pressure Control Valve (Fig. 5-4), used only on altitude applications, allows vapors to flow from the fuel tank into the system. When fuel tank pressure exceeds the spring pressure on the valve diaphragm (4.3 kPa), the valve opens and allows vapors to enter the canister or go directly to the engine when purge is enabled.



1 DIAPHRAGM
2 VENT RESTRICTION
3 TUBE TO MANIFOLD VACUUM
4 TUBE TO FUEL TANK
5 TUBE TO CANISTER

6S 2971-6E

Figure 5-4 Fuel Tank Pressure Control Valve

DIAGNOSIS

RESULTS OF INCORRECT OPERATION

- Poor idle, stalling and poor driveability can be caused by:
  - 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, fuel pump or TBI
  - Cracked or damaged vapor canister
  - Disconnected, misrouted, kinked, deteriorated or damaged vapor pipe, or canister hoses
  - Air cleaner or air cleaner gasket improperly seated.

VISUAL CHECK OF VAPOR CANISTER

- Replace vapor canister if cracked or damaged.
- Replace vapor canister if fuel is leaking from bottom and check operation of the total system.
- Replace filter at the bottom of the canister if dirty, plugged or damaged. (2.5L & 2.8L)

FUNCTIONAL TESTS

Vapor Canister - Altitude Only

Apply a short length of hose to the lower tube of purge valve, and attempt to blow through it. Little or no air should pass into the canister. (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) to the control valve tube (upper tube). If the diaphragm does not hold vacuum for at least 20 seconds, the diaphragm is leaking, and the canister must be replaced.

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

Tank Pressure Control Valve

Install a short piece of hose on the valve inlet tube (fuel tank side) and blow into hose. You should feel the diaphragm pop open and air should pass through the valve. If the valve does not open, it should be replaced.

ON-VEHICLE SERVICE

VAPOR CANISTER

Remove or Disconnect

1. Hoses from canister. Mark hoses for installation on new canister.
2. Screw from bracket and canister.

Install or Connect

1. Canister and bracket screw.
2. Hoses to canister.

VAPOR CANISTER HOSES

Refer to Vehicle Emission Control Information Label for routing of canister hoses. When replacing hoses, use hose identified with the word "Fluoroelastomer".

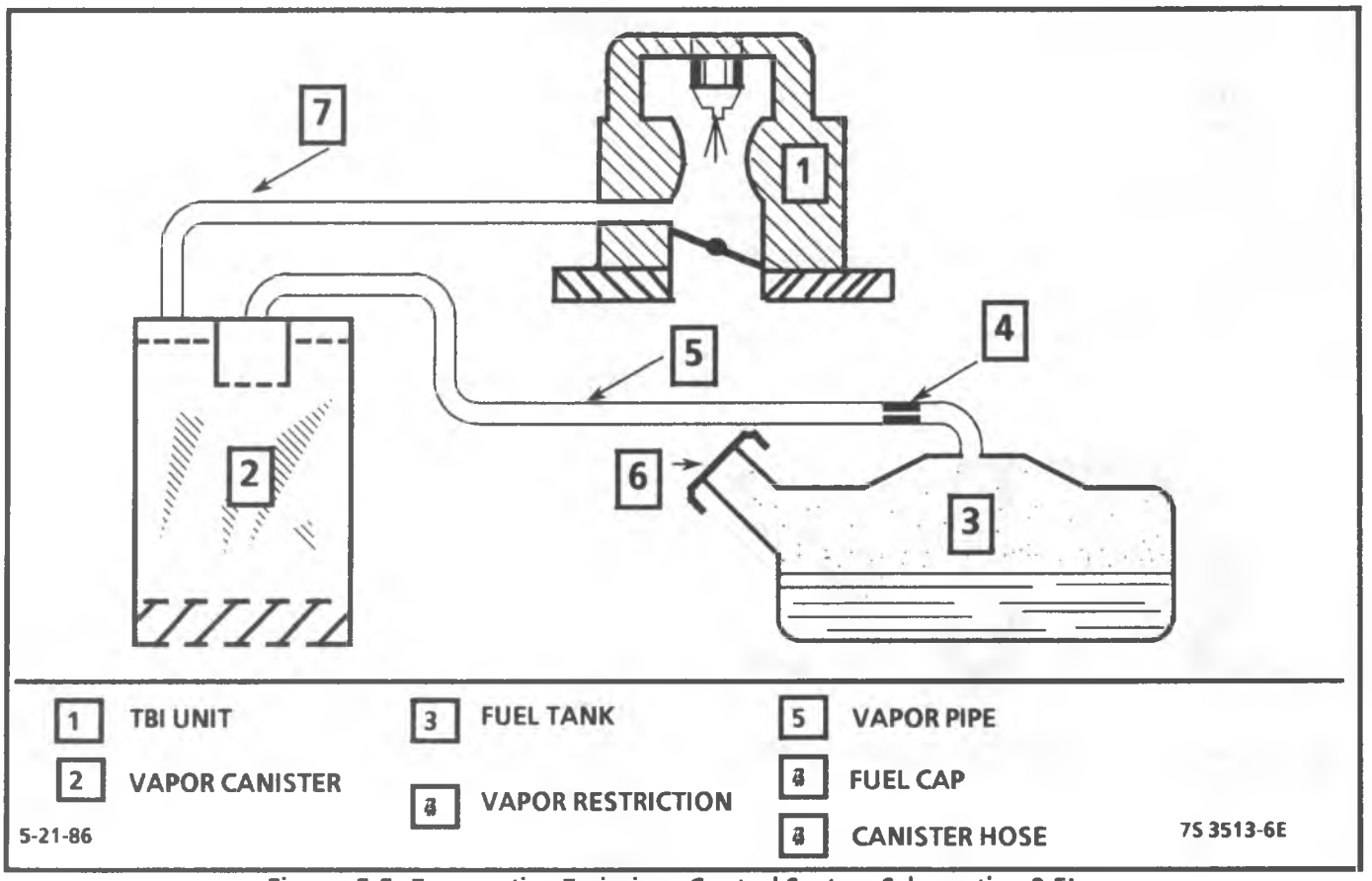


Figure 5-5 Evaporative Emissions Control System Schematic - 2.5L

VAPOR PIPE

The vapor pipe is secured to the underbody with clamp and screw assemblies. Flexible hoses are connected at the fuel tank and the fuel vapor canister. The pipe should be inspected occasionally for leaks, kinks, or dents and repaired as required.

Vapor Pipe Repair

Repair vapor pipe in sections using brazed seamless steel tubing meeting GM Specification 123M or its equivalent or hose identified with the words "Fluoroelastomer". Hose not so marked could cause early failure or failure to meet emission standard.

- Do not use copper or aluminum tubing to replace steel tubing. Those materials do not have satisfactory durability to withstand normal vehicle vibrations.
- Do not use rubber hose within 4" (100mm) of any part of the exhaust system or within 10" (254mm) of the catalytic converter. Hose inside diameter must match steel tubing outside diameter.

1. In repairable areas, cut a piece of fuel hose 4" (100mm) longer than portion of the line removed. If more than a 6 inch (152 mm) length of pipe is removed, use a combination of steel tubing and hose so that hose lengths will not be more than 10 inches (254mm).
2. Cut ends of pipe remaining on vehicle square with a tube cutter. Using the first step of a double flaring tool, form a bead on the end of both pipe sections. If pipe is too corroded to withstand bead operation without damage, the pipe should be replaced. If a new section of pipe is used, form a bead on both ends of it also.
3. Use screw type hose clamp, Part Number 2494772 or equivalent. Slide clamps onto pipe and push hose 2" (51mm) onto each portion of fuel pipe. Tighten clamps on each side of repair.

FUEL CAP

If a fuel tank filler cap requires replacement, use only a cap with the same features. Failure to use the correct cap can result in a malfunctioning of the system.

PARTS INFORMATION

PART NAME	GROUP
Canister, Fuel Vapor	3.130
Valve,Tank Pressure Control	3.140

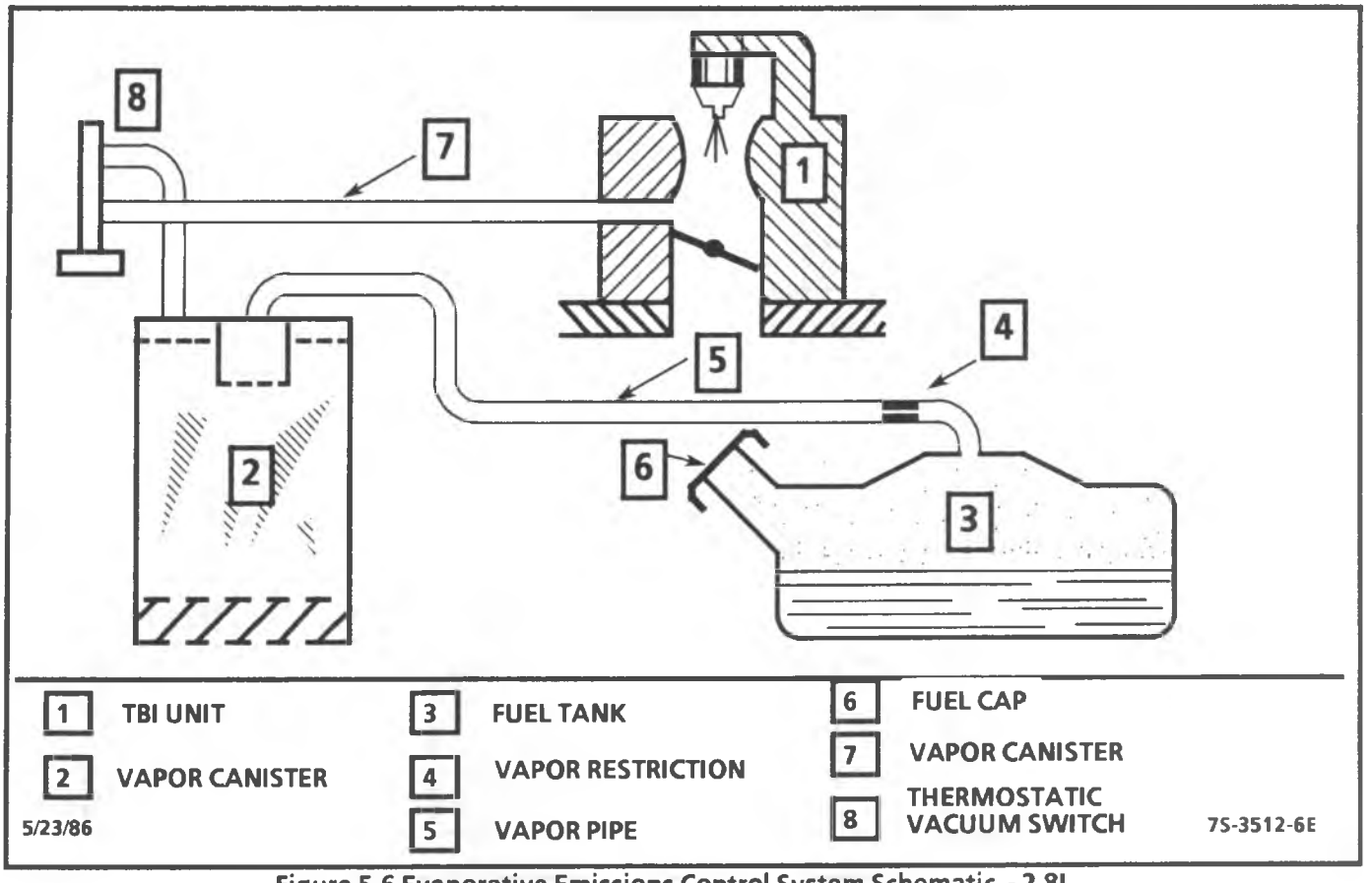


Figure 5-6 Evaporative Emissions Control System Schematic - 2.8L

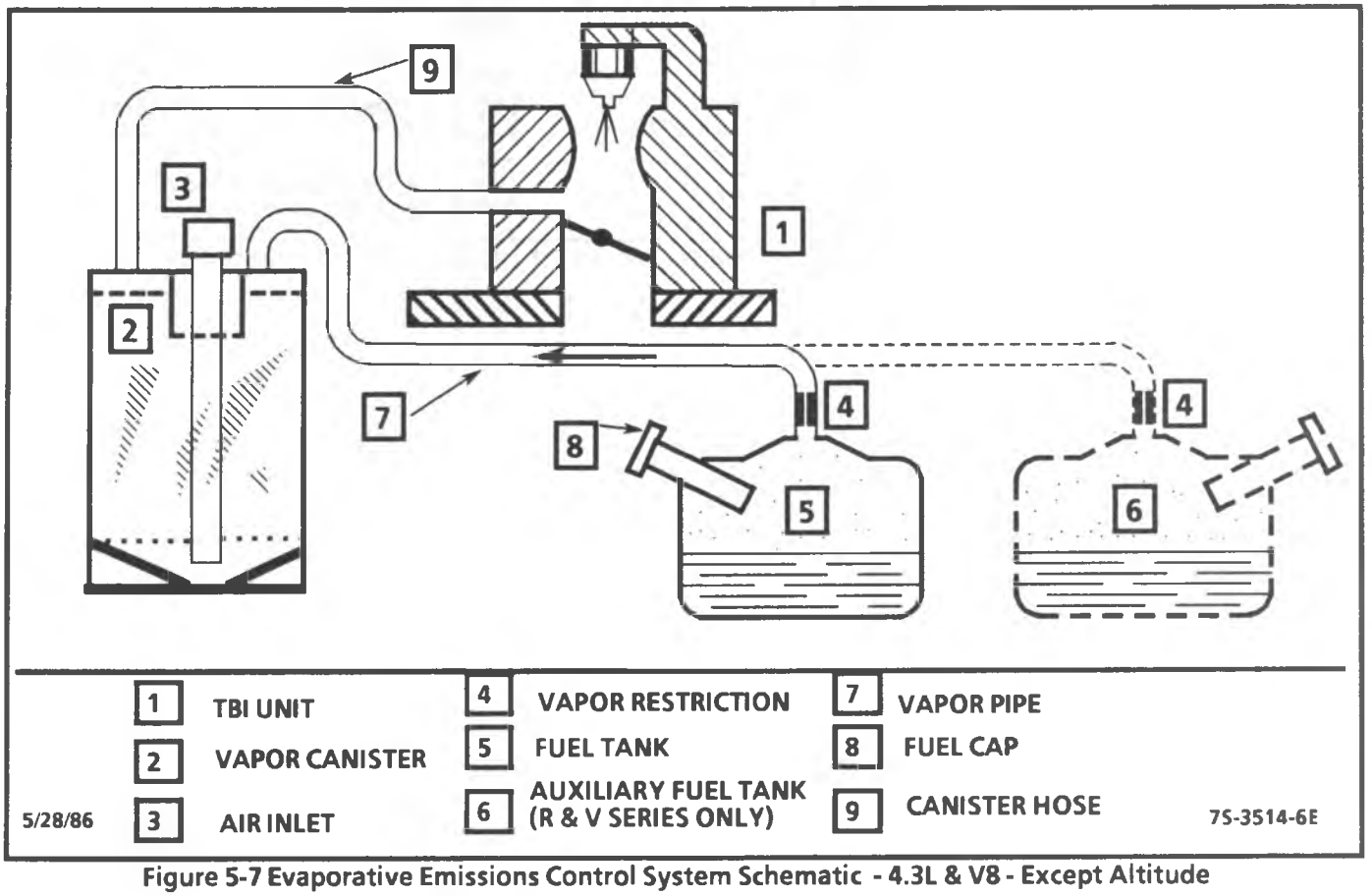


Figure 5-7 Evaporative Emissions Control System Schematic - 4.3L & V8 - Except Altitude

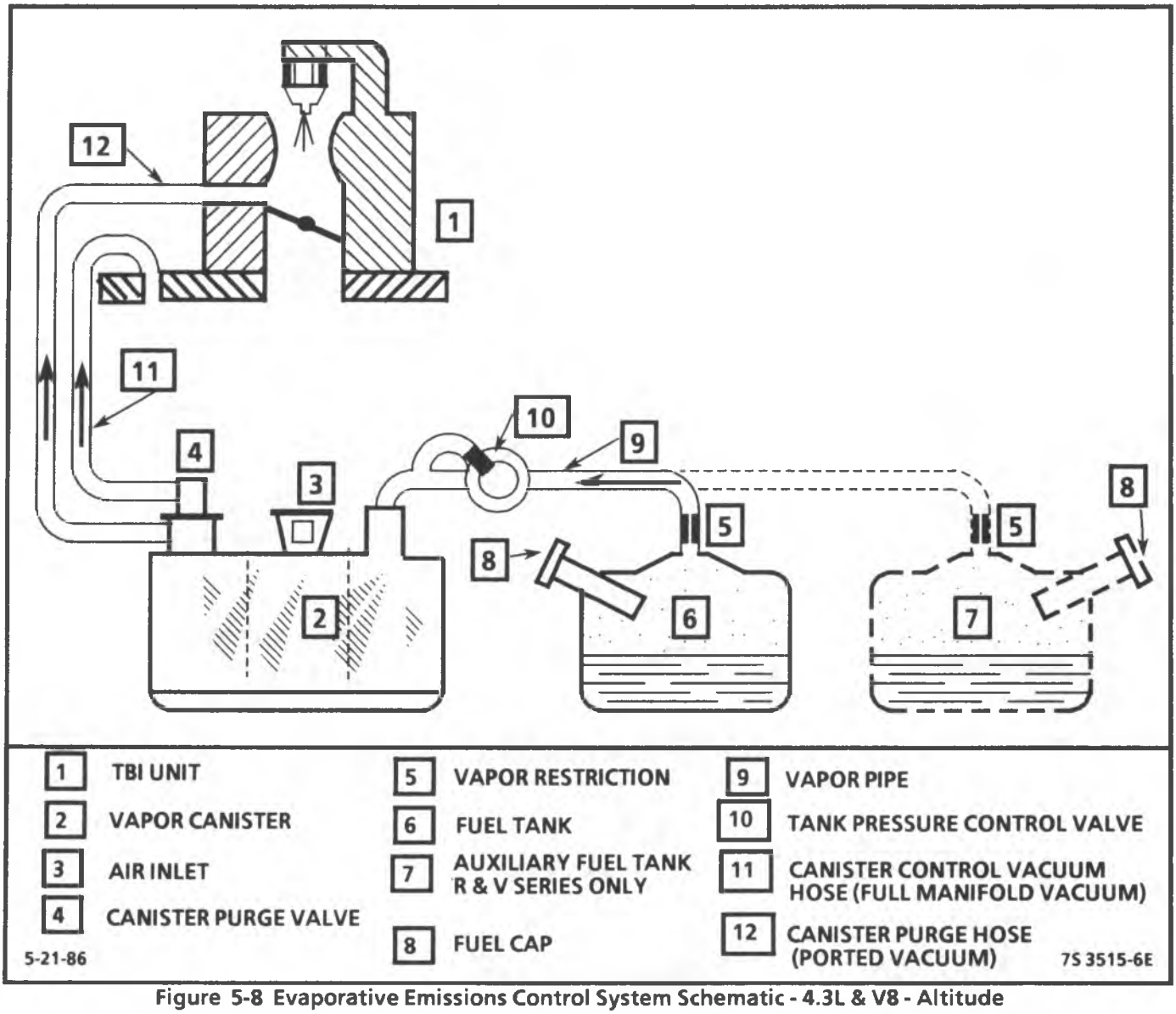


Figure 5-8 Evaporative Emissions Control System Schematic - 4.3L & V8 - Altitude

SECTION 6
IGNITION SYSTEM / EST

CONTENTS

GENERAL DESCRIPTION

PURPOSE

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

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

OPERATION

The ignition system has a distributor module with four terminals for the EST system (Figure 6-1 and 6-2) that are connected by the Electronic Control Module (ECM).

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

- Crankshaft position
- Engine speed (rpm)
- Engine load (manifold pressure or vacuum)
- Atmospheric (barometric) pressure
- Engine coolant temperature

All engines except 2.5L S/T Truck

The EST system consists of the distributor module, an ECM, and connecting wires. The four terminals for EST are lettered in the module.

The distributor four terminal connector is lettered A-B-C-D.

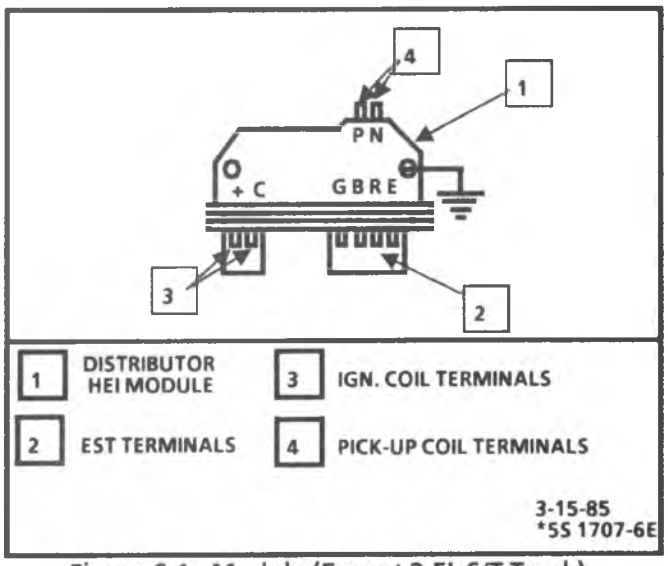


Figure 6-1 - Module (Except 2.5L S/T Truck)

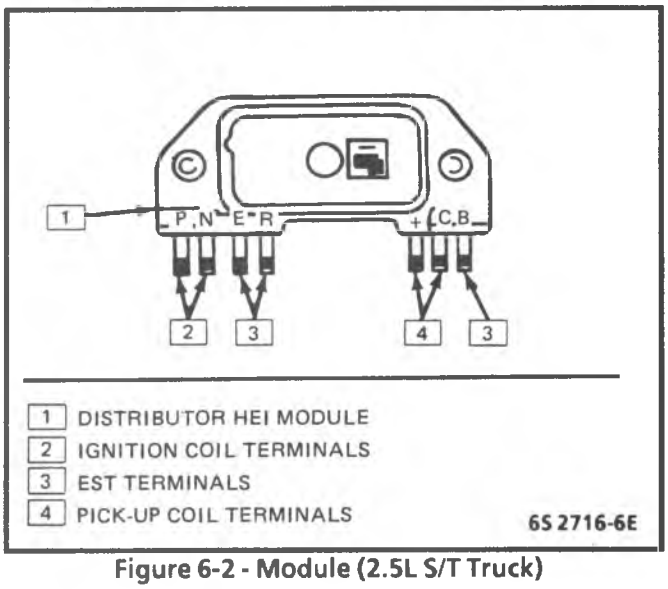


Figure 6-2 - Module (2.5L S/T Truck)

These circuits perform the following functions:

- TERMINAL A - Reference Ground Lo
  This wire is grounded in the distributor and makes sure the ground circuit has no voltage drop which could affect performance. If it is open, it may cause poor performance.
- TERMINAL B - Bypass
  At about 400 rpm, the ECM applies 5 volts to this circuit to switch spark timing control from the module to the ECM. An open or grounded by-pass circuit will set a Code 42 and the engine will run at base timing, plus a small amount of advance built into the module.
- TERMINAL C - Distributor Reference Hi
  This provides the ECM with rpm and crankshaft position information.
- TERMINAL D - EST
  This circuit triggers the module. The ECM does not know what the actual timing is, but it does know when it gets the reference signal. It then advances or retards the spark from that point. Therefore, if the base timing is set incorrectly, the engine spark curve will be incorrect.

S/T Truck with 2.5L

The EST system consists of a hall effect switch, the distributor module, an ECM, and connecting wires.

The four terminal connector is lettered A-B-C-D.

These circuits perform the following functions:

- TERMINAL A - EST
  This circuit triggers the module. The ECM does not know what the actual timing is, but it does know when it gets the reference signal. It then advances or retards the spark from that point. Therefore, if the base timing is set incorrectly, the engine spark curve will be incorrect.
- TERMINAL B - Distributor Reference Hi
  This provides the ECM with rpm and crankshaft position information.
- TERMINAL C - Bypass
  At about 400 rpm, the ECM applies 5 volts to this circuit to switch spark timing control from the module to the ECM. An open or ground bypass circuit will set a Code 42 and the engine will run at base timing, plus a small amount of advance built into the module.
- TERMINAL D - Reference Ground Lo
  This wire is grounded in the distributor and makes sure the ground circuit has no voltage drop which could affect performance. If it is open, it may cause poor performance.

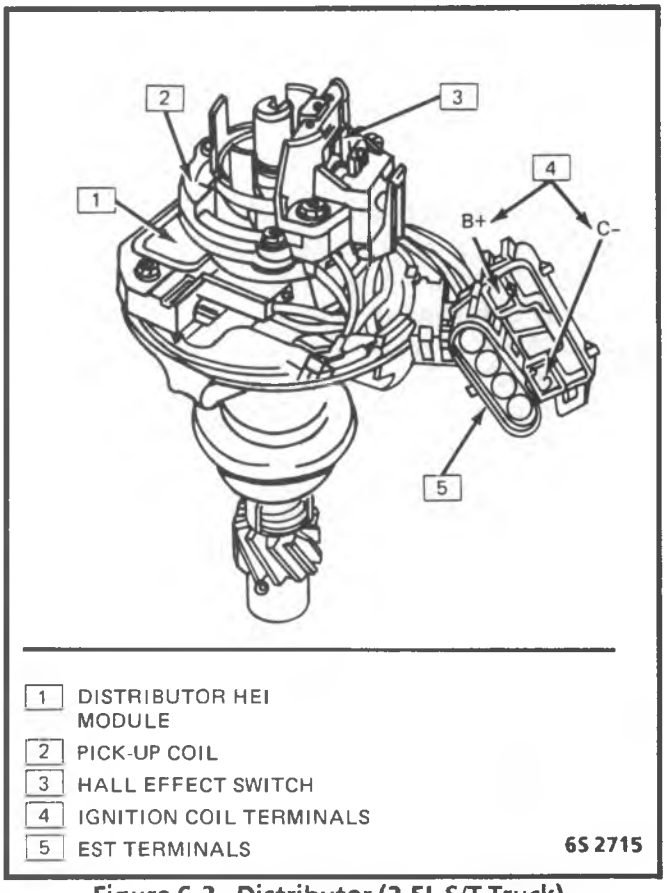


Figure 6-3 - Distributor (2.5L S/T Truck)

Hall Effect Switch (Figure 6-3)

The hall effect switch used on the 2.5L engine for S/T Truck is mounted above the pick-up coil in the distributor. It takes the place of the reference "R" terminal on the module. The switch is an electronic device, which puts out a voltage signal controlled by the presence or absence of a magnetic field on an electronic circuit. This system tells the ECM which cylinder is next to fire.

DIAGNOSIS

The description and operation of the ignition system can be found in Section 6D.

Refer to charts in this section for Ignition System Check.

EST SYSTEM

Code 12 is used during the System Check in Section 3 procedure to test the code display ability of the ECM. This code indicates that the ECM is not receiving the engine rpm (REFERENCE) signal.

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

Results of Incorrect EST Operation

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

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

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

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

CODE 42

A fault in the EST system will usually set a Code 42, as diagnosed in Section 3.

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

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

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

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

An open in the EST circuit will set a Code 42 and cause the engine to run on the distributor module timing. This will cause poor performance and poor fuel economy. A ground may set a Code 42, but the engine will not run.

EST PERFORMANCE CHECK

The ECM will set a specified value timing when the ALDL diagnostic terminal is grounded. To check the EST operation, record the timing at 2000 rpm with the diagnostic terminal not grounded. Then, ground the diagnostic terminal and the timing should change at 2000 rpm, indicating that EST is operating.

ON-VEHICLE SERVICE

IGNITION SYSTEM

Refer to Section 6D for On-Vehicle Service of distributor, pick-up coil, distributor cap, ignition coil, hall effect switch, rotor, or distributor module.

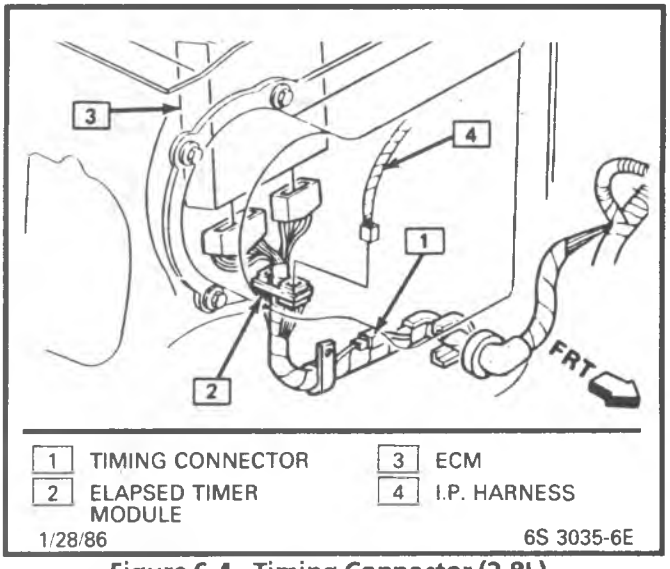


Figure 6-4 - Timing Connector (2.8L)

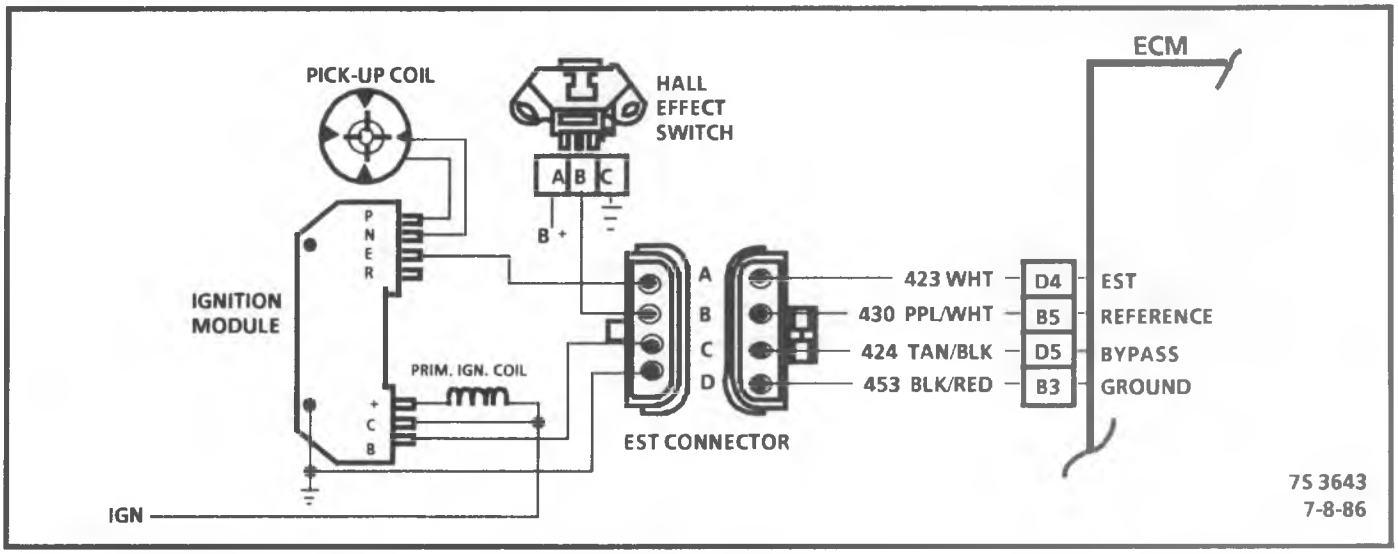
SETTING TIMING

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

Timing specifications for each engine are listed on the Vehicle Emissions Control Information label on the radiator support. When using a timing light, connect an adapter between the No. 1 spark plug and the No. 1 spark plug wire, or use an inductive type pickup. Do not pierce the plug lead. Once the insulation of the spark plug cable has been broken, voltage will jump to the nearest ground, and the spark plug will not fire properly. Always follow Vehicle Emissions Control Information label procedures when adjusting timing.

Some engines incorporate a magnetic timing probe hole for use with special electronic timing equipment. Consult manufacture's instructions for use of this equipment.

Put the EST system in Bypass Mode on the 2.5L engine by connecting terminal "B" to "A" at the ALDL connector. On the V6 and V8 engines, the system will go into Bypass Mode by disconnecting the timing connector. This is a single wire sealed connector that has a tan with black stripe lead. On the 4.3L and V8 engine, this connector breaks out of the engine wiring harness conduit adjacent to the distributor. On the 2.8L engine, the connector breaks out of a taped section below the heater case in the passenger compartment (Figure 6-4).



IGNITION SYSTEM CHECK
(REMOTE COIL)
2.5L S/T TRUCK

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

1. Two wires are checked, to ensure that an open is not present in a spark plug wire.

1A. If spark occurs with 4 terminal distributor connector disconnected, pick-up coil output is too low for EST operation.

2. A spark indicates the problem must be the distributor cap or rotor.

3. Normally, there should be battery voltage at the "C" and "+" terminals. Low voltage would indicate an open or a high resistance circuit from the distributor to the coil or ignition switch. If "C" term. voltage was low, but "+" term. voltage is 10 volts or more, circuit from "C" term. to ignition. coil or ignition coil primary winding is open.

4. Checks for a shorted module or grounded circuit from the ignition coil to the module. The dist. module should be turned "OFF", so normal voltage should be about 12 volts.
   If the module is turned "ON", the voltage would be low, but above 1 volt. This could cause the ign. coil to fail from excessive heat.
   With an open ignition coil primary winding, a small amount of voltage will leak through the module from the "Bat." to the tach terminal.

5. Applying a voltage (1.5 to 8 volts) to module terminal "P" should turn the module "ON" and the tach. term. voltage should drop to about 7-9 volts. This test will determine whether the module or coil is faulty or if the pick-up coil is not generating the proper signal to turn the module "ON". This test can be performed by using a DC battery with a rating of 1.5 to 8 volts. The use of the test light is mainly to allow the "P" terminal to be probed more easily.
   Some digital multi-meters can also be used to trigger the module by selecting ohms, usually the diode position. In this position, the meter may have a voltage across its terminals which can be used to trigger the module. The voltage in the ohm's position can be checked by using a second meter or by checking the manufacture's specification of the tool being used.

6. This should turn "OFF" the module and cause a spark. If no spark occurs, the fault is most likely in the ignition coil because most module problems would have been found before this point in the procedure. A module tester (J24642) could determine which is at fault.

Diagnostic Aids:

The "Scan" tool does not have any ability to help diagnose a ignition system check.

Refer to Section 2 for "ECM Intermittent Codes or Performance".

IGNITION SYSTEM CHECK
(REMOTE COIL)
2.5L S/T TRUCK

1 ● Perform System Check before proceeding with this test. (If a tachometer is connected to the Tach term., disconnect it before proceeding with the test).
● Check spark at plug with spark tester J-26792 or equivalent (ST-125) while cranking (if no spark on one wire, check a second wire) A few sparks and then nothing is considered no spark.

- **No Spark** → **1A** ● Disconnect 4 term. distributor connector and check for spark.
  - **No spark** → **2** ● Check for spark at coil wire with tester while cranking. (Leave spark tester connected to coil wire for Steps 3-6).
    - **No Spark** → **3** ● Disconnect distributor 2 term. "C / + " connector. ● Ignition switch "on", Engine stopped. ● Check volts at " + " and "C" term's. of dist. harn. conn.
      - **Both term's. 10 volts or more** → **4** ● Reconnect dist. 2 term. conn. ● With ign. "ON", check voltage from tach. term. to gnd. (term. may be taped back in harness).
        - **Over10 volts** → ● Connect test light from tach. term. to ground. ● Crank engine and observe light.
          - **Light on steady** → **5** ● Disconnect distributor 4 term. connector. ● Remove dist. cap. ● Disconnect pick-up coil connector from module. ● Connect voltmeter from tach. term. to ground. ● Ignition on. ● Insulate a test light probe to 1/4" from tip and note voltage, as test light is momentarily connected from a voltage source (1.5 to 8V) to module term. "P". (Fig. 1).
            - **Voltage drops** → **6** ● Check for spark from coil wire with spark tester as test light is removed from module term.
              - **No Spark** → ● If no module tester (J24642) is available; Replace ign. coil and repeat Step 5.
                - **No Spark** → Ign. coil removed is OK, reinstall coil and check coil wire from dist. cap. if OK, replace dist. module.
                - **Spark** → System OK
              - **Spark** → ● If module tester (J24642) is available: test module
                - **OK** → Check coil wire from cap to coil. If OK, replace coil.
                - **Bad** → Replace module
            - **No drop in voltage** → Check module ground. If OK, replace module.
          - **Light blinks** → Replace ignition coil and recheck for spark with spark tester. If still no spark, re-install original coil and replace dist. module..
        - **Under 1 volt** → Repair open tach. lead or conn and repeat test #4.
        - **1 to 10 volts** → Replace module and check for spark from coil as in Step 6.
          - **Spark** → System OK
          - **No Spark** → Replace ign. coil, it too is faulty
      - **Both term's. under 10 volts** → Repair wire from module " + " term. to "B" term. of black Ign. coil connector or primary ckt. to ign. sw.
      - **Under 10 volts "C" term. only** → Check for open or gnd. in ckt. from "C" term. to ign. coil. If Ckt. is OK, fault is. ign. coil or conn..
    - **Spark** → Inspect cap for water, cracks, etc. If OK, replace rotor.
  - **Spark** → Replace pick-up coil
- **Spark** → Check fuel,spark plugs, etc. See Section 2 symptoms.

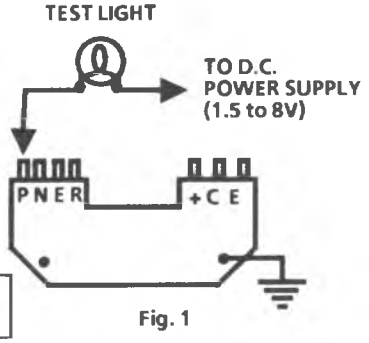


Fig. 1

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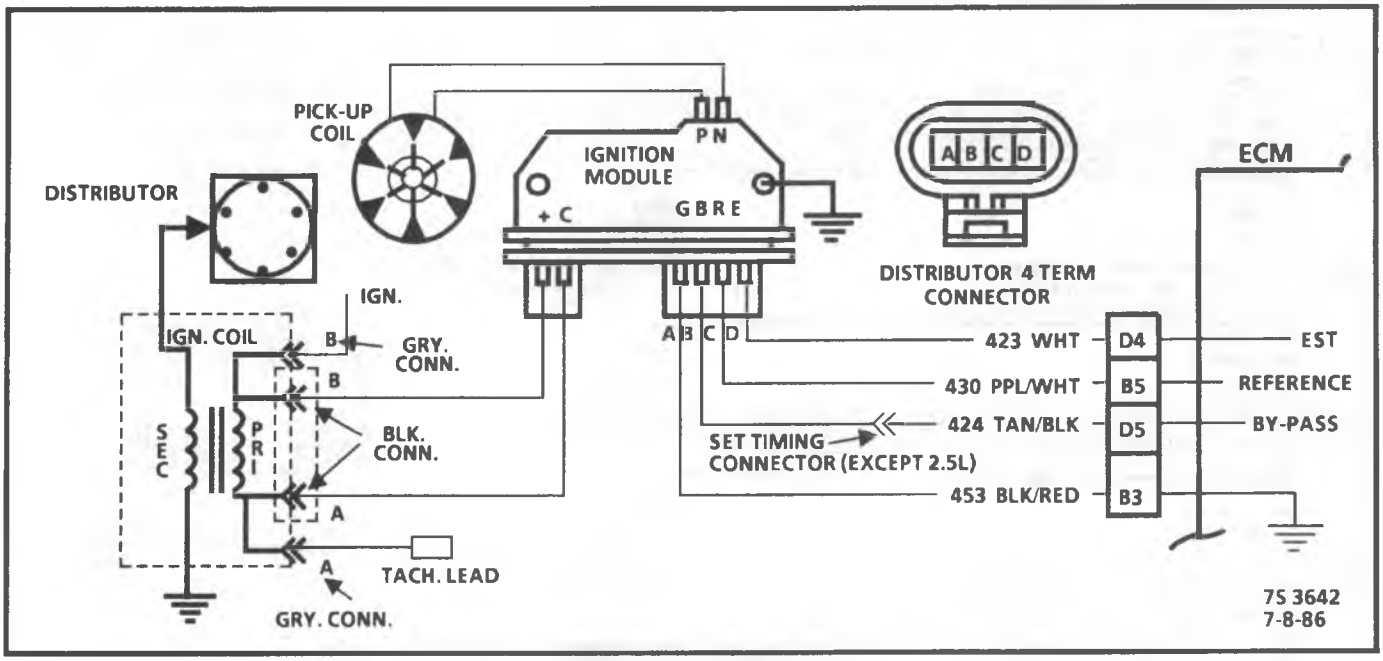

IGNITION SYSTEM CHECK

(REMOTE COIL / SEALED MODULE CONNECTOR DISTRIBUTOR)

ALL ENGINES EXCEPT 2.5L S/T TRUCK

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

1. Two wires are checked, to ensure that an open is not present in a spark plug wire.

1A. If spark occurs with EST connector disconnected, pick-up coil output is too low for EST operation.

2. A spark indicates the problem must be the distributor cap or rotor.

3. Normally, there should be battery voltage at the "C" and "+" terminals. Low voltage would indicate an open or a high resistance circuit from the distributor to the coil or ignition switch. If "C" term. voltage was low, but "+" term. voltage is 10 volts or more, circuit from "C" term. to ignition coil or ignition coil primary winding is open.

4. Checks for a shorted module or grounded circuit from the ignition coil to the module. The distributor module should be turned "OFF", so normal voltage should be about 12 volts.
   If the module is turned "ON", the voltage would be low, but above 1 volt. This could cause the ignition coil to fail from excessive heat.
   With an open ignition coil primary winding, a small amount of voltage will leak through the module from the "Bat." to the tach terminal.

5. Checks for an open module, or circuit to it. 12 volts applied to the module "P" terminal should turn the module "ON" and the voltage should drop to about 7-9 volts.

6. This should turn "OFF" the module and cause a spark. If no spark occurs, the fault is most likely in the ignition coil because most module problems would have been found before this point in the procedure. A module tester could determine which is at fault.

Diagnostic Aids:

The "Scan" tool does not have any ability to help diagnose a ignition system check.

Refer to Section 2 for "ECM Intermittent Codes or Performance".

IGNITION SYSTEM CHECK
(REMOTE COIL / SEALED MODULE CONNECTOR DISTRIBUTOR)
ALL ENGINES EXCEPT 2.5L S/T TRUCK

1 • Perform System Check before proceeding with this test. (If a tachometer is connected to the Tach term., disconnect it before proceeding with the test).
• Check spark at plug with spark tester J-26792 or equivalent (ST-125) while cranking (if no spark on one wire, check a second wire) A few sparks and then nothing is considered no spark.

- **No Spark** → **1A** • Disconnect 4 term. distributor connector and check for spark.
  - **No spark** → **2** • Check for spark at coil wire with tester while cranking. (Leave spark tester connected to coil wire for Steps 3-6).
    - **No Spark** → **3** • Disconnect distributor 2 term. "C / + " connector. • Ignition switch "on", Engine stopped. • Check volts at " + " and "C" term's. of dist. harn. conn.
      - **Both term's. 10 volts or more** → **4** • Reconnect dist. 2 term. conn. • With ign. "ON", check voltage from tach. term. to gnd. (term. may be taped back in harness).
        - **Over10 volts** → • Connect test light from tach. term. to ground. • Crank engine and observe light.
          - **Light on steady** → **5** • Disconnect distributor 4 term. connector. • Remove dist. cap. • Disconnect pick-up coil connector from module. • Connect voltmeter from tach. term. to ground. • Ignition on. • Insulate a test light probe to 1/4" from tip and note voltage, as test light is momentarily connected from a voltage source (1.5 to 8V) to module term. "P". (Fig. 1).
            - **Voltage drops** → **6** • Check for spark from coil wire with spark tester as test light is removed from module term.
              - **No Spark** → • If no module tester (J24642) is available; Replace ign. coil and repeat Step 5.
                - **No Spark** → Ign. coil removed is OK, reinstall coil and check coil wire from dist. cap. if OK, replace dist. module.
                - **Spark** → System OK
              - **Spark** → • If module tester (J24642) is available: test module
                - **OK** → Check coil wire from cap to coil. If OK, replace coil.
                - **Not OK** → Replace module
            - **No drop in voltage** → Check module ground. If OK, replace module.
          - **Light blinks** → Replace ignition coil and recheck for spark with spark tester. If still no spark, re-install original coil and replace dist. module..
        - **Under 1 volt** → Repair open tach. lead or conn and repeat test #4.
        - **1 to 10 volts** → Replace module and check for spark from coil as in Step 6.
          - **Spark** → System OK
          - **No Spark** → Replace ign. coil, it too is faulty
      - **Both term's. under 10 volts** → Repair wire from module " + " term. to "B" term. of black Ign. coil connector or primary ckt. to ign. sw.
      - **Under 10 volts "C" term. only** → Check for open or gnd. in ckt. from "C" term. to ign. coil. If Ckt. is OK, fault is. ign. coil or conn..
    - **Spark** → Inspect cap for water, cracks, etc. If OK, replace rotor.
  - **Spark** → Replace pick-up coil
- **Spark** → Check fuel,spark plugs, etc. See Section 2 symptoms.

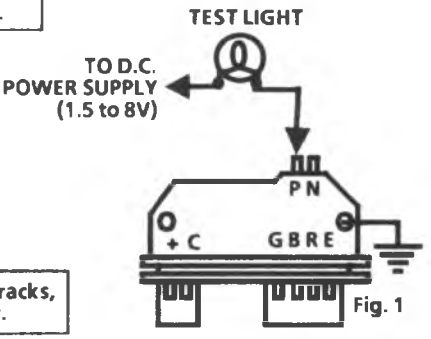

Fig. 1

- **Spark** → **Light blinks** → Replace ignition coil and recheck for spark with spark tester. If still no spark, re-install original coil and replace dist. module..
- **No Spark** → Replace ign. coil, it too is faulty

- **Spark** → **Is rotating pole piece still magnetized?**
  - **Yes** → Check pick-up coil or conns. (Coil resistance should be 500-1500 ohms and not grounded).
  - **No** → Replace pole piece and shaft assy.

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EST SYSTEM

Refer to Section 6D for replacement of the distributor module or hall effect switch.

Refer to Section 3 for repair of the EST wires or connectors.

Refer to Section 3 for replacement of the ECM.

Hall Effect Switch Test

1. Disconnect and remove hall effect switch from distributor.
2. Noting polarity marking on the switch, connect a 12 volt battery and voltmeter (Figure 6-5).
3. Voltmeter should read less than 0.5 volts without blade against magnet. Replace switch if above 0.5 volts.
4. With blade against magnet, voltage should be within 0.5 volts of battery voltage. Replace switch if there is a low voltage reading.

PARTS INFORMATION

PART NAME	GROUP
Distributor	1.150
Module, Distr	2.383
Coil, Distr	2.170

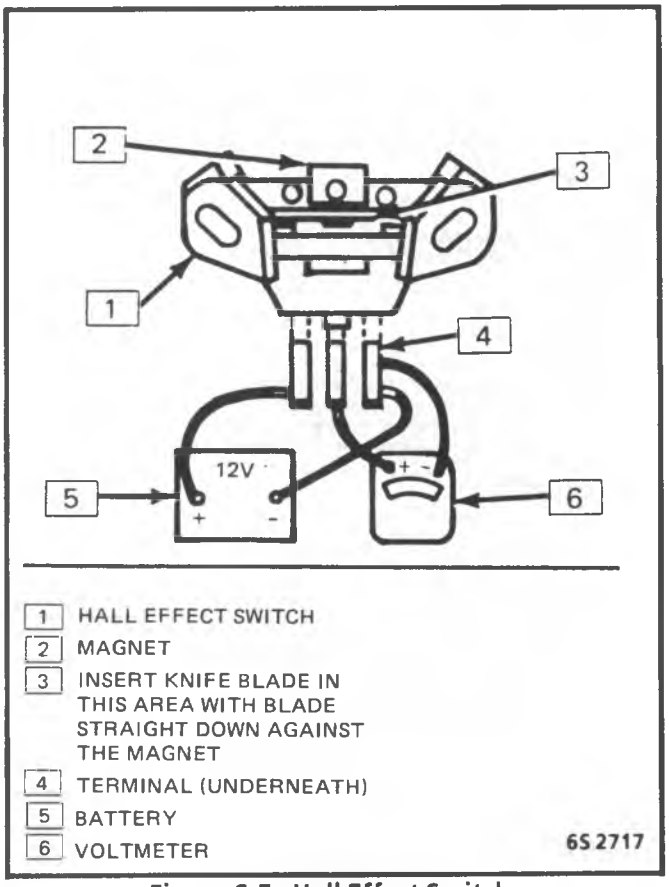


Figure 6-5 - Hall Effect Switch

SECTION 7
ELECTRONIC SPARK CONTROL
ALL ENGINES EXCEPT 2.5L AND 7.4L

CONTENTS

GENERAL DESCRIPTION

PURPOSE

The Electronic Spark Control (ESC) system is designed to retard spark timing up to 20° to reduce spark knock (detonation) in the engine. This allows the engine to use maximum spark advance to improve driveability and fuel economy.

Varying octane levels in today's gasoline can cause detonation in an engine. Detonation is called spark knock.

OPERATION

The ESC system has three components:

- ESC Module
- ESC Knock Sensor
- ECM

The ESC knock sensor (Figure 7-1) detects abnormal vibration (spark knocking) in the engine. The sensor is mounted in the engine block near the cylinders (Figures 7-2 or 7-3). The ESC module receives the knock sensor information and sends a signal to the ECM. The ECM then adjusts the electronic spark timing (EST) to reduce spark knocking.

The ESC module (Figures 7-4 through 7-6) sends a voltage signal (8 to 10 volts) to the ECM when no spark knocking is detected by the ESC knock sensor, and the ECM provides normal spark advance.

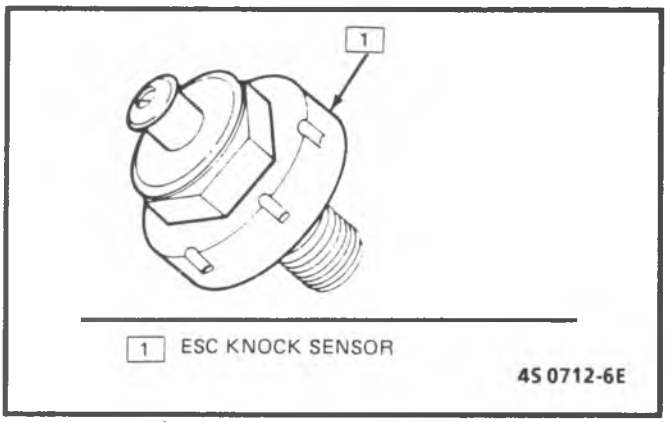


Figure 7-1 - ESC Knock Sensor

When the knock sensor detects spark knock, the module turns "OFF" the circuit to the ECM. The ECM then retards EST to reduce spark knock.

DIAGNOSIS

Loss of the ESC knock sensor signal or loss of ground at ESC module would cause the signal to the ECM to remain high. This condition would cause the ECM to control EST as if there was no spark knock. No retard would occur, and spark knocking could become severe under heavy engine load conditions.

Spark retard without the knock sensor connected could indicate a noise signal on the wire to the ECM or a malfunctioning ESC module.

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 be set.

When no Code 43 is present but the ESC system is a possible cause of excessive spark knock, refer to diagnosis chart for ESC system check.

CODE 43

Code 43 indicates that the ECM is receiving less than 6 volts for a 4 second period with the engine running. If code is present, refer to Code 43 chart in Section 3.

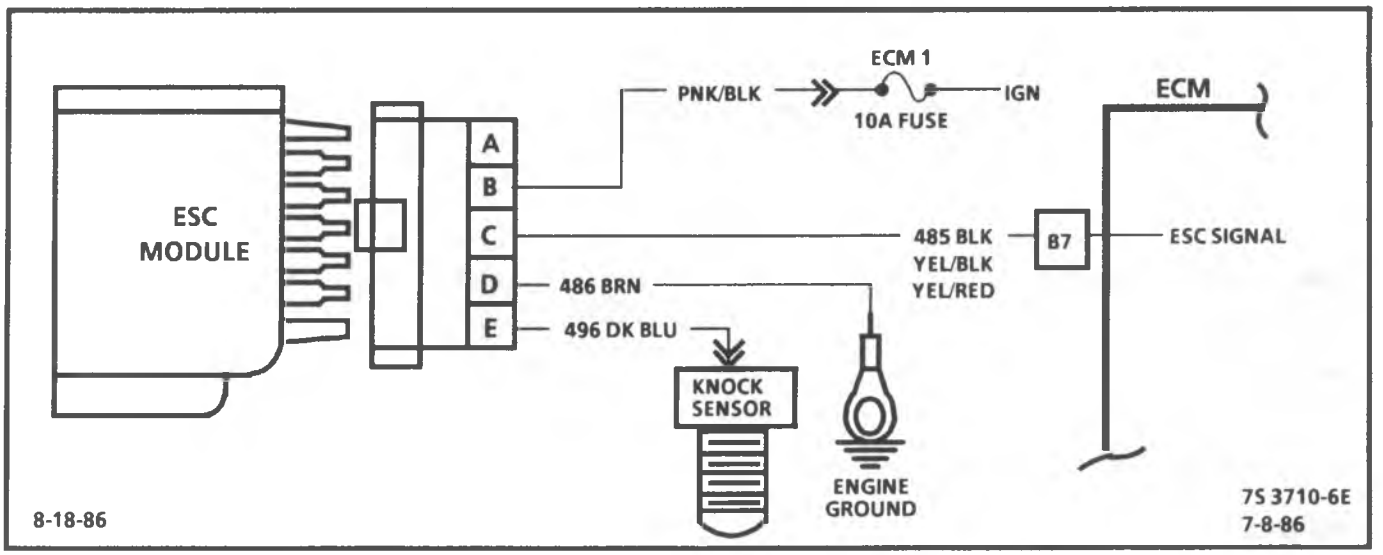
ON-VEHICLE SERVICE

ESC KNOCK SENSOR (Figures 7-2 or 7-3)

The ESC Knock Sensor is lcoated to the lower left of the engine block, below the spark plugs for the 4.3L engine and the lower right of the engine block for the 2.8L, 5.0L and 5.7L engine.

Remove or Disconnect

1. Negative battery cable.
2. Wiring harness connector from ESC knock sensor.
3. ESC knock sensor from engine block.



ELECTRONIC SPARK CONTROL SYSTEM CHECK

ALL ENGINES EXCEPT 2.5L AND 7.4L

Circuit Description:

Electronic spark control is accomplished with a module that sends a voltage signal to the ECM. As the knock sensor detects engine knock, the voltage from the ESC module to the ECM is shut "OFF" and this signals the ECM to retard timing, if engine rpm is over about 900.

Test Description:

Step numbers refer to step numbers in diagnostic chart.

1. If A Code 43 is not set, but a knock signal is indicated while running at 1500 rpm, listen for an internal engine noise. Under a no load condition there should not be any detonation, and if knock is indicated, an internal engine problem may exist.
2. Usually a knock signal can be generated by tapping on the right exhaust manifold. This test can also be performed at idle. Test number 1 was run at 1500 rpm to determine if a constant knock signal was present, which would affect engine performance.
3. This tests whether the knock signal is due to the sensor, a basic engine problem, or the ESC module.
4. If the module ground circuit is faulty, the ESC module will not function correctly. The test light should light indicating the ground circuit is OK.
5. Contacting CKT 496, with a test light to 12 volts, should generate a knock signal to determine whether the knock sensor is faulty, or the ESC module can't recognize a knock signal.

Diagnostic Aids:

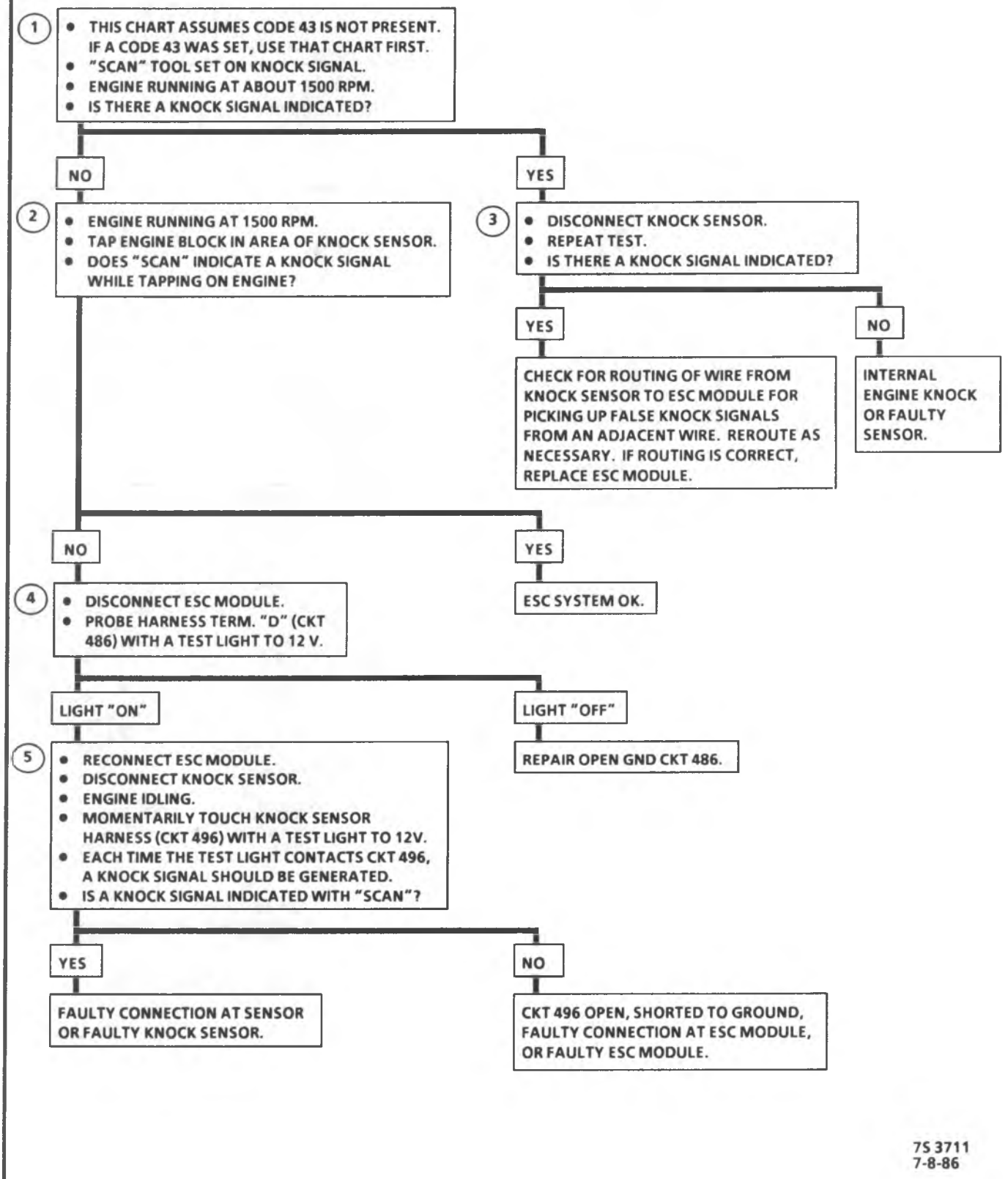
"Scan" tools have two positions to diagnose the ESC system. The knock signal can be monitored to see if the knock sensor is detecting a knock condition and if the ESC miodule is functioning, knock signal should display "yes", whenever detonation is present. The knock retard position on the "Scan" displays the amount of spark retard the ECM is commanding. The ECM can retard the timing up to 20 degrees.

If the ESC system checks OK, but detonation is the complaint, refer to Detonation/Spark knock in Section 2.

This check should be used after other causes of spark knock have been checked such as engine timing, EGR systems, engine temperature or excessive engine noise.

ELECTRONIC SPARK CONTROL SYSTEM CHECK

ALL ENGINES EXCEPT 2.5L AND 7.4L



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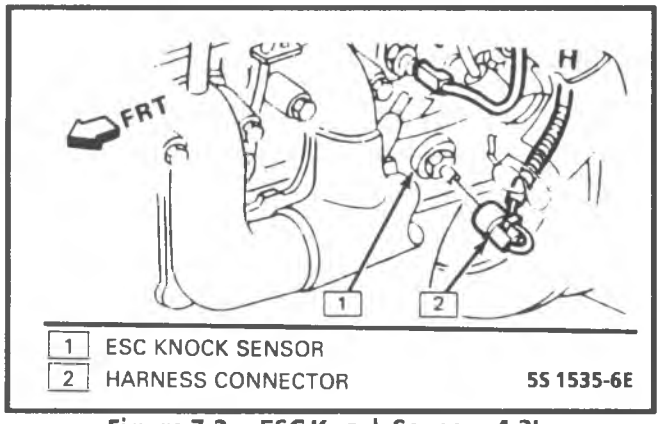


Figure 7-2 - ESC Knock Sensor - 4.3L

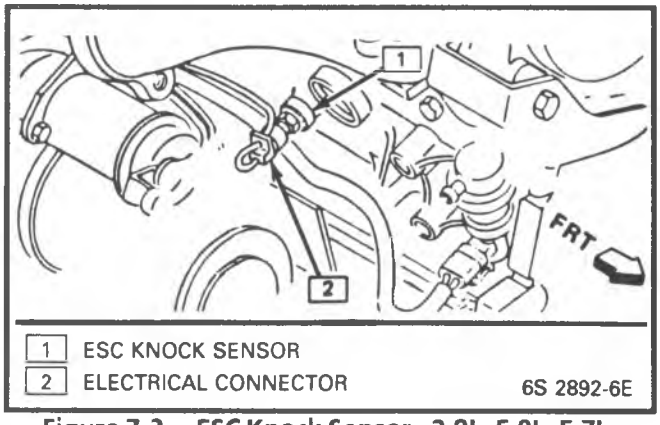


Figure 7-3 - ESC Knock Sensor - 2.8L, 5.0L, 5.7L

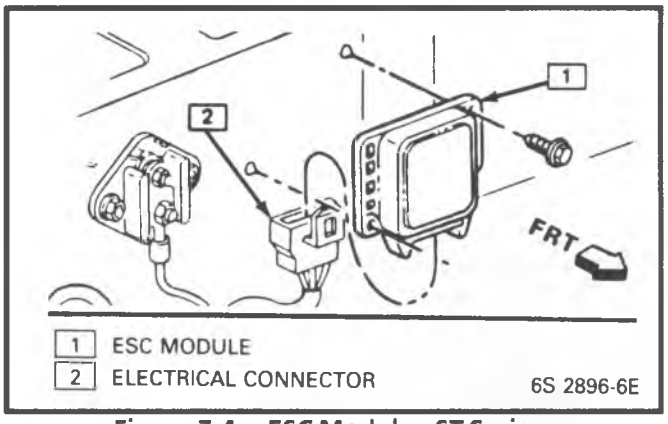


Figure 7-4 - ESC Module - ST Series

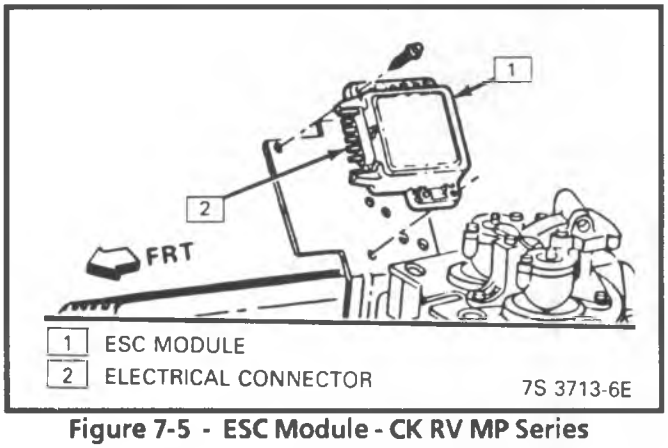


Figure 7-5 - ESC Module - CK RV MP Series

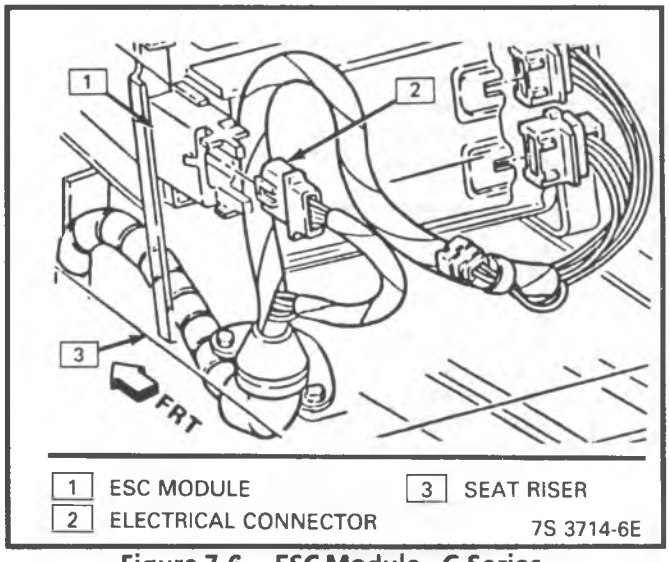


Figure 7-6 - ESC Module - G Series

Install or Connect

1. Knock sensor into engine block. Apply water base calk to sensor threads. Do not use silicon tape as this will insulate sensor from the engine block.
2. ESC wiring harness connector to the ESC knock sensor.
3. Negative battery cable.

ESC MODULE AND BRACKET (Figures 7-4 through 7-6)

Remove or Disconnect

1. ESC module connector.
2. Attaching screws.
3. ESC module.

Install or Connect

1. ESC module.
2. Attaching screws.
3. ESC module connector.

PARTS INFORMATION

PART NAME	GROUP
Sensor, ESC Knock	3.682
Module, Elek Spark Cont	2.383
Bracket, Elek Spark Cont Md	2.383
Shield, Elek Spark Cont Knock	2.383

SECTION 8
AIR MANAGEMENT SYSTEM
ALL ENGINES EXCEPT 2.5L

CONTENTS

GENERAL DESCRIPTION

PURPOSE

The air management system is used to reduce carbon monoxide and hydrocarbon emissions.

This system, air injection reaction (AIR), under certain conditions, adds air (oxygen) to the exhaust manifold to continue combustion after the exhaust gases leave the combustion chamber. This added air also brings the catalytic converter up to operating temperature more quickly when the engine is cold.

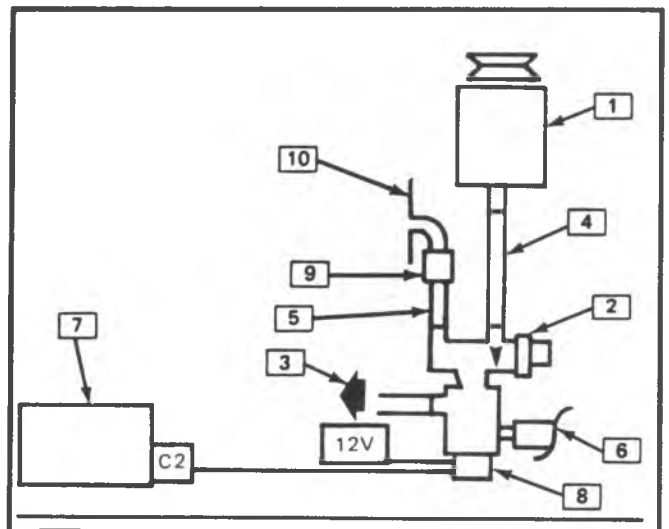


Figure 8-1 - AIR System - 2.8L

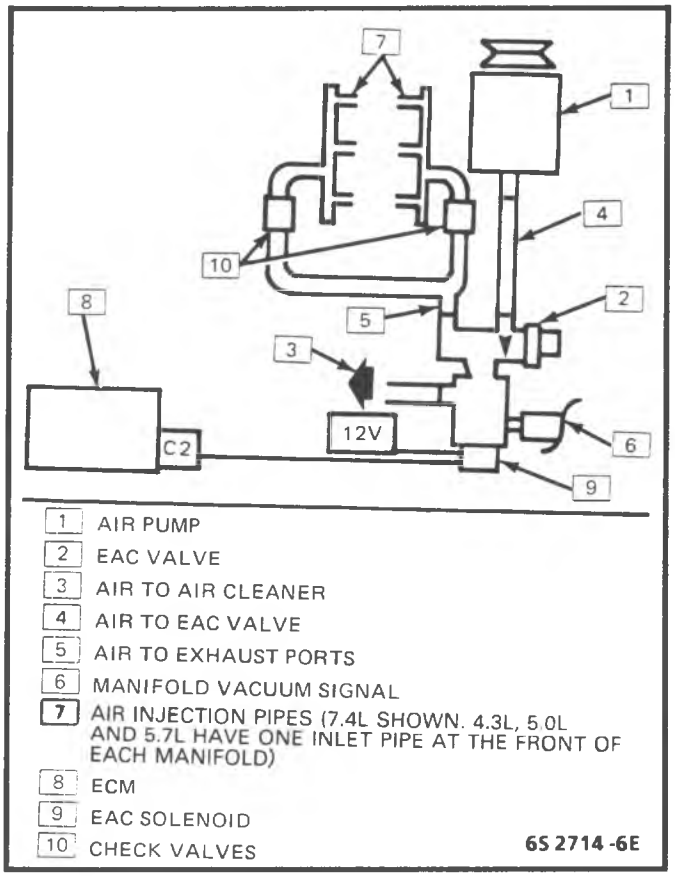


Figure 8-2 - AIR System - 4.3L & V8

AIR OPERATION

The system consists of an air pump, an (electric) air control valve with solenoid, check valve(s), and necessary plumbing.

A belt driven air pump supplies air through a centrifugal filter fan to the electric air control (EAC) valve 2.8L (Figure 8-3) or an electric air control valve with relief tube (ECT) 4.3L and V8 (Figure 8-4). This valve, directs the air to either the engine exhaust manifold ports or to the air cleaner.

NOTICE: On the EAC valve, the divert and signal tube locations are reversed from the previous model year.

When the engine is cold or in wide open throttle condition, the ECM energizes the solenoid on the valve and air is directed to the exhaust manifold ports. When the coolant temperature increases, the solenoid is de-energized and air goes into the air cleaner which also acts as a silencer. At higher engine speeds, air is directed to the air cleaner through the pressure relief valve even though the solenoid may be energized. There should be n o air going to the exhaust ports while operating in the "Closed Loop" mode.

During engine decel, when there is a rise in the manifold vacuum signal, air is directed to the air cleaner.

A Check valve, on the air injection pipe, prevents back flow of exhaust into the air pump if there is an exhaust backfire or pump drive belt failure.

If the engine is operating under a rich condition or the "Service Engine Soon" lamp lights, the solenoid is de-energized and air goes to the air cleaner.

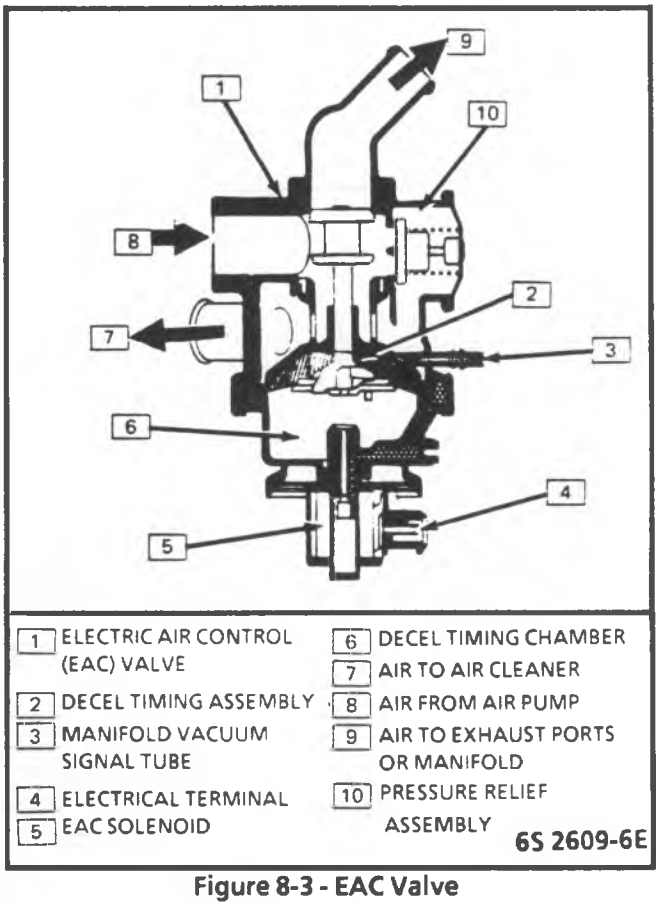


Figure 8-3 - EAC Valve

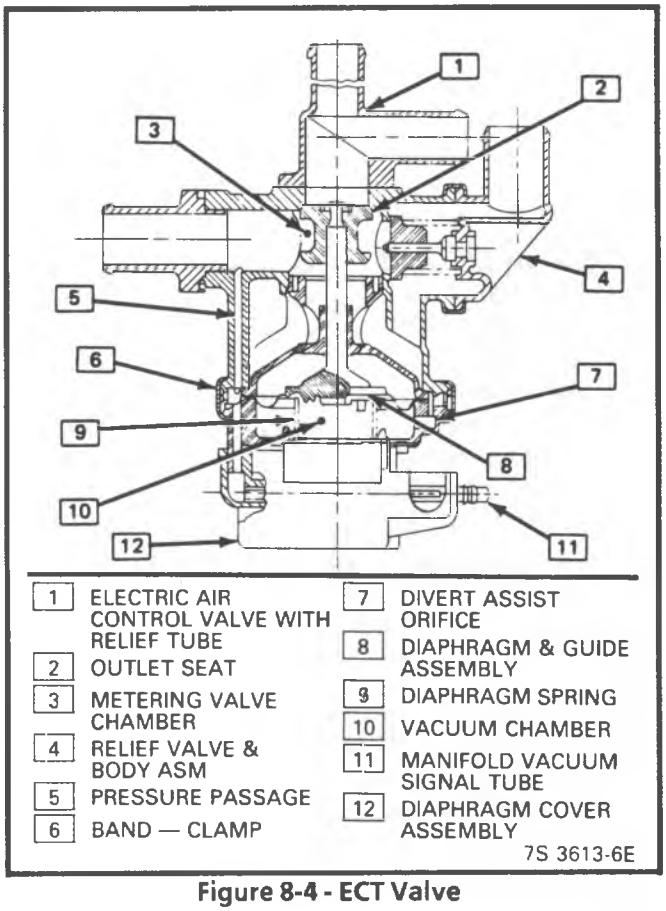


Figure 8-4 - ECT Valve

DIAGNOSIS

AIR SYSTEM

Refer to Air Management Check chart for the diagnosis of the AIR System.

NOTICE: If the engine or underhood compartment is to be cleaned with steam or high-pressure detergent, the centrifugal filter fan should be masked off to prevent liquids from entering the pump.

If no air (oxygen) flow enters the exhaust stream at the exhaust ports, HC and CO emission levels may be too high.

Air flowing to the exhaust ports at all times could cause a rich ECM command and increased temperature of the converter.

The AIR System is not completely noiseless. Under normal conditions, noise rises in pitch as engine speed increases. To determine if excessive noise is the fault of the AIR System pump, momentarily operate the engine with the pump drive belt removed.

If noise is caused by the AIR System pump, check for :

- A seized air pump.
- Proper mounting and bolt torque of pump.
- Proper routine and connections of hoses.

NOTICE: Do not oil air pump.

- Replace pump if there is excessive noise.

Air Pump

The air pump is a positive displacement vane type which is permanently lubricated and requires no periodic maintenance.

Accelerate engine to approximately 1500 rpm and observe air flow from hose. If air flow increases as engine is accelerated, pump is operating satisfactorily. If air flow does not increase or is not present, proceed as follows:

Inspect

1. For proper drive belt tension.
2. For a leaky pressure relief valve. Air may be heard leaking with the pump running.

Check Valve

Inspect

1. A check valve should be inspected whenever the hose is disconnected from it or whenever check valve failure is suspected (A pump that had become inoperative and had shown indications of having exhaust gases in the pump would indicate check valve failure).
2. Remove the check valve.
3. Blow through the check valve toward the exhaust manifold side. Air should pass freely. Turn the valve around and attempt to blow through the valve toward the air pump side. No air should pass through the valve.
4. Replace valve which does not operate properly.

Hoses and Pipes

Inspect

1. Hose or pipe for deterioration or holes.
2. All hoses or pipe connections, and clamp tightness.
3. Hose or pipe routing. Interference may cause wear.
4. If a leak is suspected on the pressure side of the system, or if a hose or pipe has been disconnected on the pressure side, the connections should be checked for leaks with a soapy water solution. With the pump running, bubbles will form if a leak exists.

ON-VEHICLE SERVICE

DRIVE BELT

Remove or Disconnect

Inspect drive belt for wear, cracks or deterioration and replace if required. When installing new belt, it must be seated and fully secured in grooves of A/C compressor, air pump, generator, and crankshaft pulleys.

PUMP CENTRIFUGAL FILTER FAN

The centrifugal filter fan should not be cleaned, either with compressed air or solvents.

CAUTION: Centrifugal fan should not be removed from pump unless it is damaged, as removal will destroy the fan.

Before starting replacement note the following:

- Do not allow any filter fragments to enter the air pump intake hole.
- Do not remove filter fan by inserting a screwdriver between pump and filter fan. Air damage to sealing lip pump will result.
- Do not remove metal drive hub from filter fan.
- It is seldom possible to remove the filter fan without destroying it.

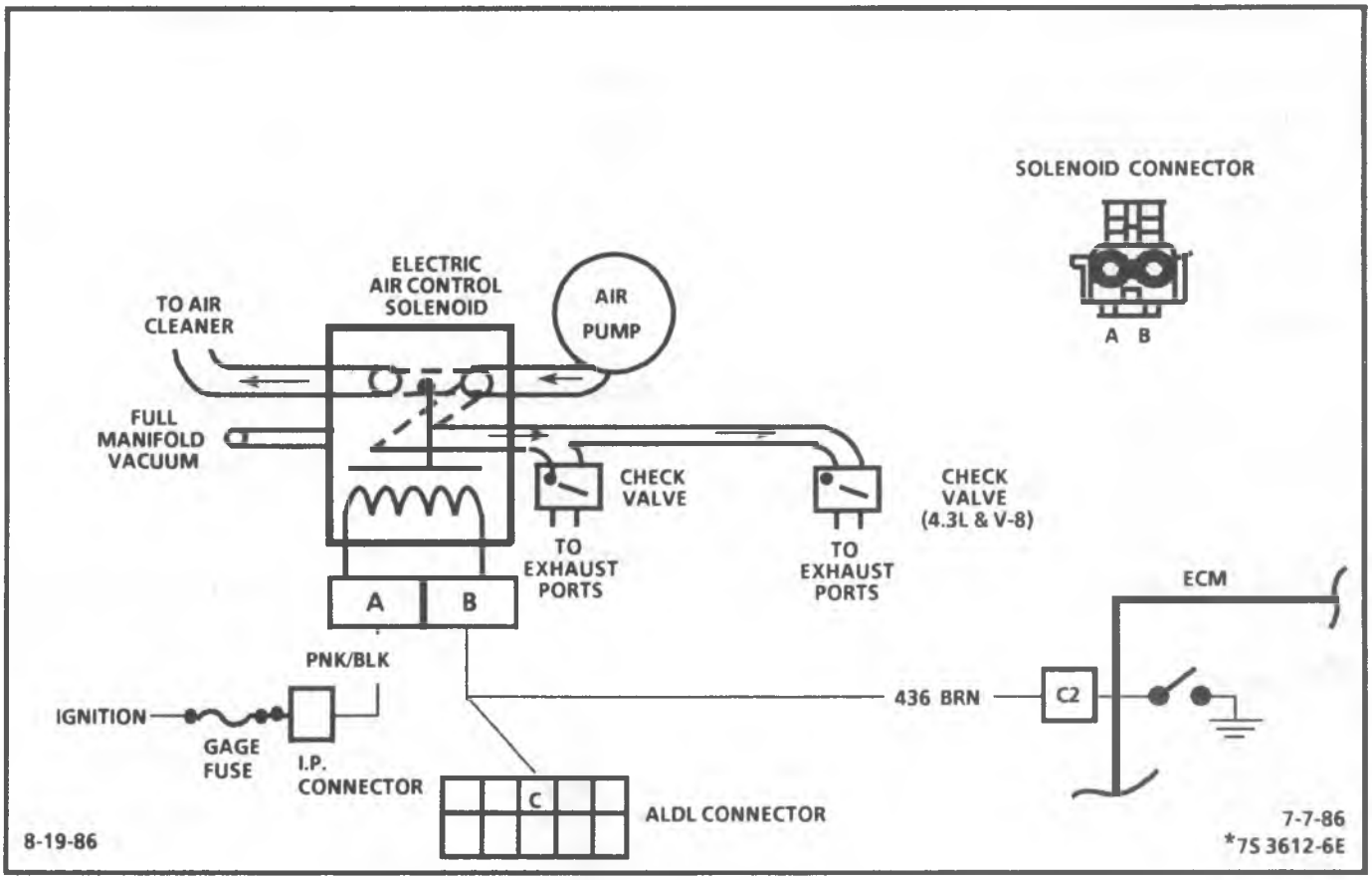
Remove or Disconnect

Figure 8-5

1. Air pump.
2. Pump pulley.
3. Insert needle nose pliers and pull filter fan from pump hub.

Install or Connect

1. New filter fan on pump hub.
2. Spacer and pump pulley against centrifugal filter fan.
3. Pump pulley bolts and tighten equal to torque spec. in Figure 8-6. This will compress the centrifugal filter fan onto the pump hole. Do not drive filter fan on with a hammer. A slight amount of interference with the housing bore is normal. After a new filter fan has been installed, it may squeal upon initial operation or until O.D. sealing lip has worn in. This may require a short period of pump operation at various engine speeds.
4. Air pump.



AIR MANAGEMENT CHECK

(ELECTRONIC AIR CONTROL VALVE)

Circuit Description:

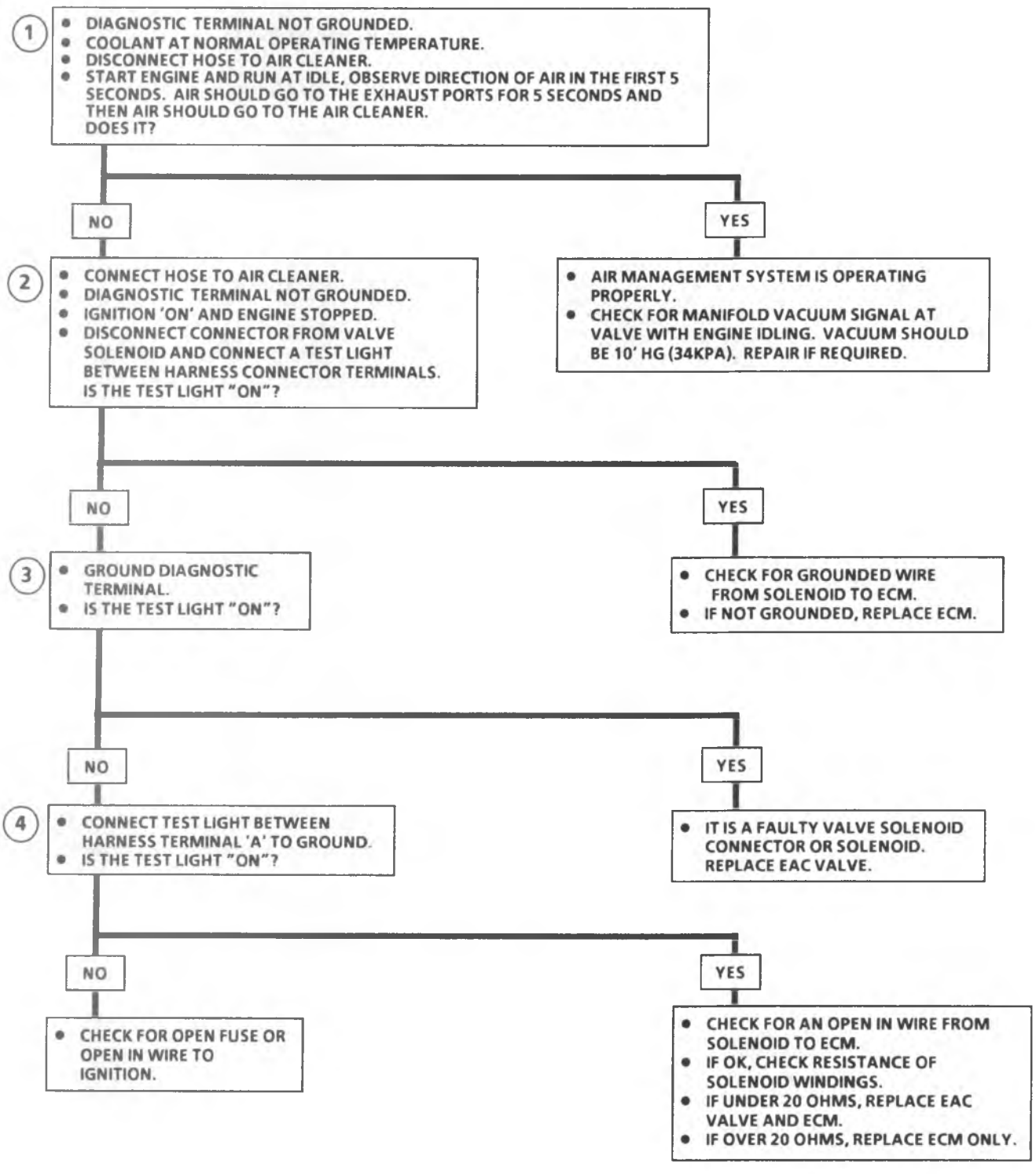
An electric air control valve solenoid directs air into the exhaust ports or the air cleaner. During cold start on all systems except 2.8L Federal engines, the ECM completes the ground circuit, the EAC solenoid is energized, and air is directed to the exhaust ports. As "coolant" temperature increases, or system goes to "Closed Loop", the ECM opens the ground circuit, the EAC solenoid is de-energized, and air goes to the air cleaner.

On 2.8L Federal engines, the ECM completes the ground circuit, the EAC solenoid is energized, and the valve directs air to the exhaust port whenever the engine is started. The only time the air is directed to the air cleaner, is during decel. If the system is not operating properly, check manifold vacuum signal (10"Hg/34kPa) at the valve and check the electrical circuit from the solenoid to the ECM.

Test Description: Step numbers refer to step numbers on diagnostic chart and to all systems except the 2.8L Federal engine.

1. This is a system performance test. When vehicle goes to "Closed Loop", air will switch from the ports and divert to the air cleaner.
2. Tests for a grounded electric divert circuit. Normal system light will be "OFF".
3. Checks for an open control circuit. Grounding diagnostic terminal will energize the solenoid, if ECM and circuits are normal. In this step, if test light is "ON", circuits are normal and fault is in valve connections or valve.
4. Checks for voltage from battery through a fuse to the solenoid.

AIR MANAGEMENT CHECK
(ELECTRONIC AIR CONTROL VALVE)



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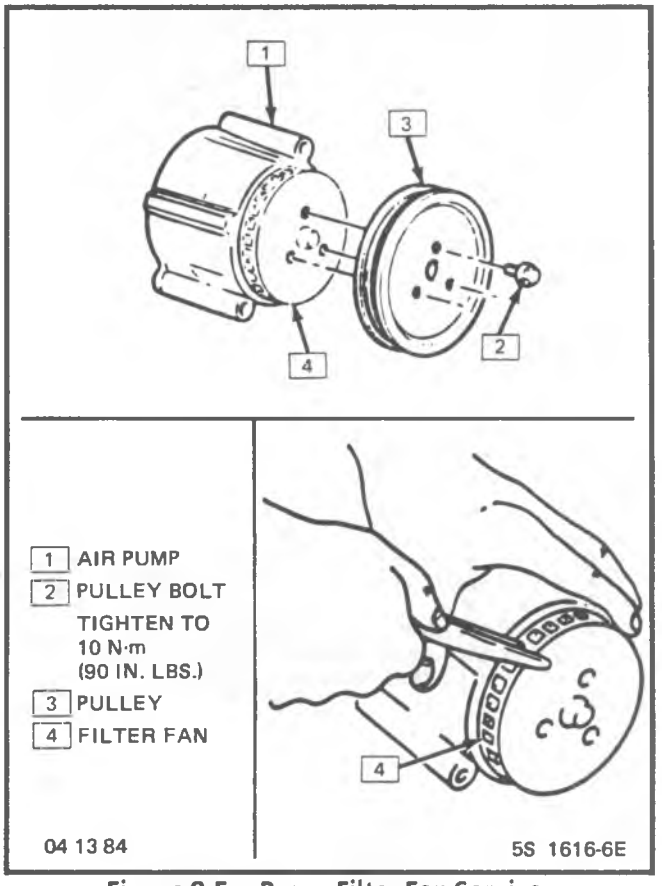


Figure 8-5 - Pump Filter Fan Service

AIR PUMP (Figure 8-6)

Remove or Disconnect

1. Hold pump pulley from turning by compressing drive belt, then loosen pump pulley bolts.
2. Loosen bolt, holding pump to mounting brackets, release tension on drive belts.
3. Move belts out of the way, then remove pump hoses, vacuum and electrical connections, and control valve.
4. Pulley, then pump.
5. If required, insert needle nose pliers and pull filter fan from hub (see Figure 8-5).

Install or Connect

1. Air pump assembly, and tighten mounting bolts.
2. Hose.
3. New filter fan on pump hub.
4. Spacer and pump pulley against centrifugal filter fan.
5. Pump pulley bolts and tighten equally to torque spec. in Figure 8-6. This will compress the centrifugal filter fan onto the pump hole. Do not drive filter fan on with a hammer. A slight amount of interference with the housing bore is normal. After a new filter fan has been installed, it may squeal upon initial operation or until O.D. sealing lip has worn in. This may require a short period of pump operation at various engine speeds.
6. Pump drive belt and adjust.
7. Check air management system for proper operation (see Air Management Check chart).

AIR CONTROL VALVE (Figures 8-7 thru 8-11)

Remove or Disconnect

1. Battery ground cable.
2. Electrical connector on control valve.
3. Manifold vacuum signal hose.
4. Air inlet and outlet hoses from valve.
5. Control valve.

Install or Connect

1. Control valve.
2. Air inlet and outlet hoses to valve.
3. Manifold vacuum signal hose.
4. Electrical connector on control valve.
5. Battery ground cable.
6. Check system operation (See Air Management Check chart).

CHECK VALVE (Figures 8-7 thru 8-11)

Remove or Disconnect

1. Any parts required for access.
2. Release clamp and disconnect air hoses from check valve.
3. Unscrew check valve from air injection pipe.

Install or Connect

1. Screw check valve onto air injection pipe.
2. Position air hose on check valve and secure with clamp.
3. Any parts removed for access.

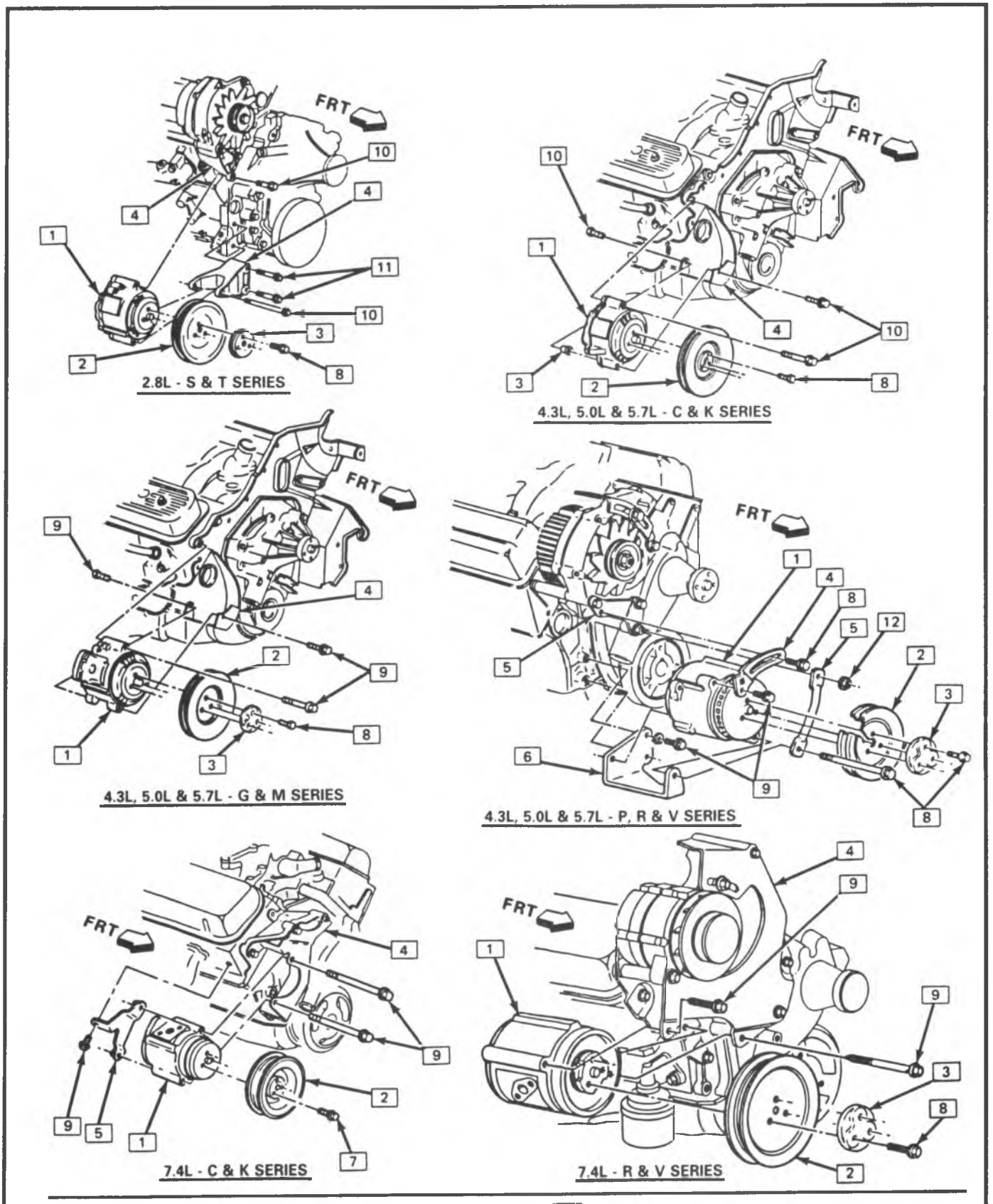
AIR INJECTION PIPE ASSEMBLY

Remove or Disconnect

1. Hose.
2. Check Valve.
3. Nuts attaching pipes-to-manifold.
4. Pipe Assembly.

Install or Connect

1. Nuts attaching pipes-to-manifold.
2. Check Valve.
3. Hose.



1	AIR PUMP	5	BRACE	9	BOLT - TORQUE TO 30 N·m (22 FT. LBS.)
2	PULLEY	6	SUPPORT	10	BOLT - TORQUE TO 40 N·m (29 FT. LBS.)
3	SPACER	7	BOLT - TORQUE TO 15 N·m (11 FT. LBS.)	11	BOLT - TORQUE TO 80 N·m (59 FT. LBS.)
4	BRACKET	8	BOLT - TORQUE TO 25 N·m (18 FT. LBS.)	12	NUT - TORQUE TO 30 N·m (22 FT. LBS.)

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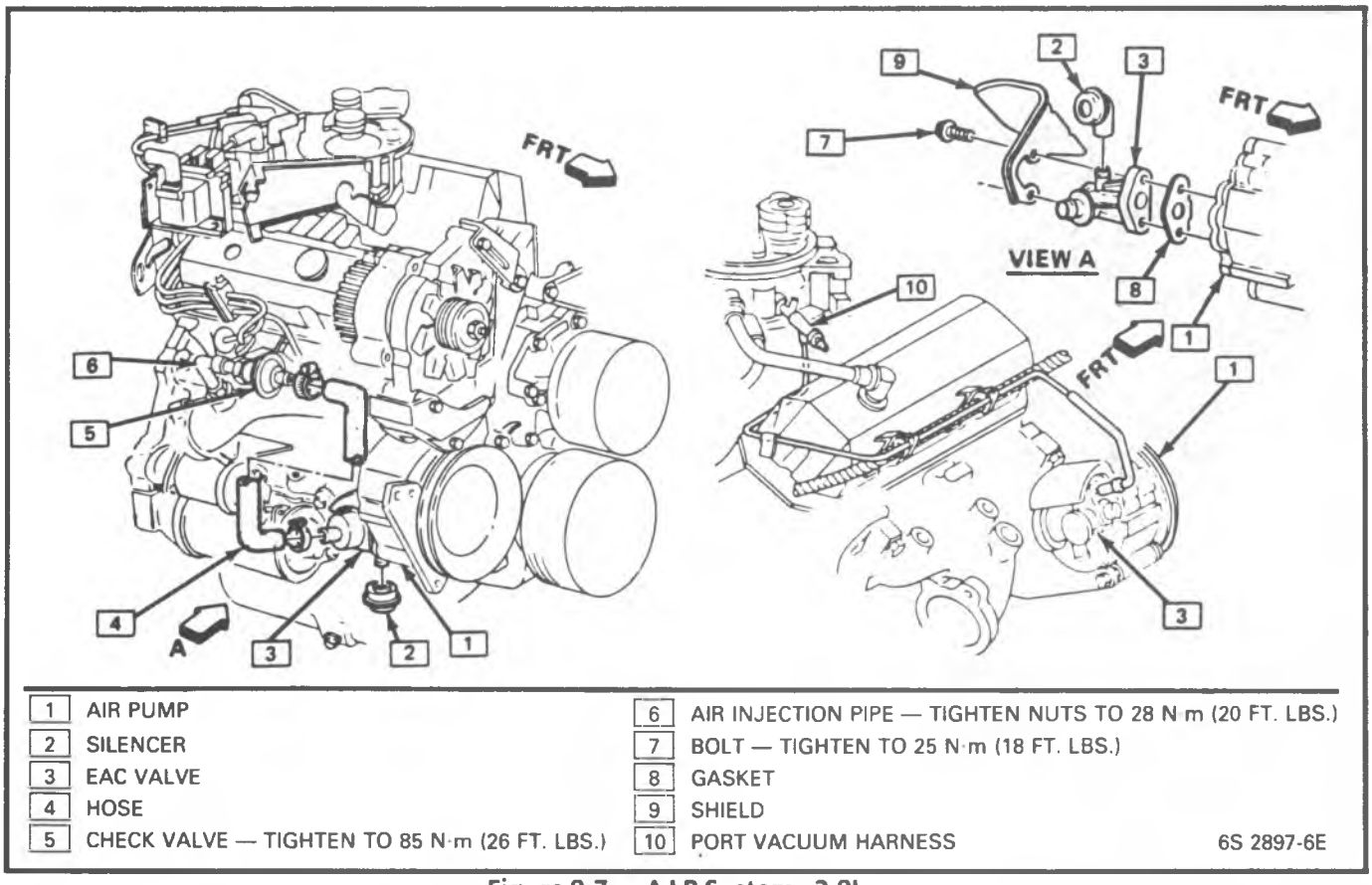
Figure 8-6 - AIR Pump Mounting



1	AIR PUMP	6	AIR INJECTION PIPE — TIGHTEN NUTS TO 28 N·m (20 FT. LBS.)
2	SILENCER	7	BOLT — TIGHTEN TO 25 N·m (18 FT. LBS.)
3	EAC VALVE	8	GASKET
4	HOSE	9	SHIELD
5	CHECK VALVE — TIGHTEN TO 85 N·m (26 FT. LBS.)	10	PORT VACUUM HARNESS

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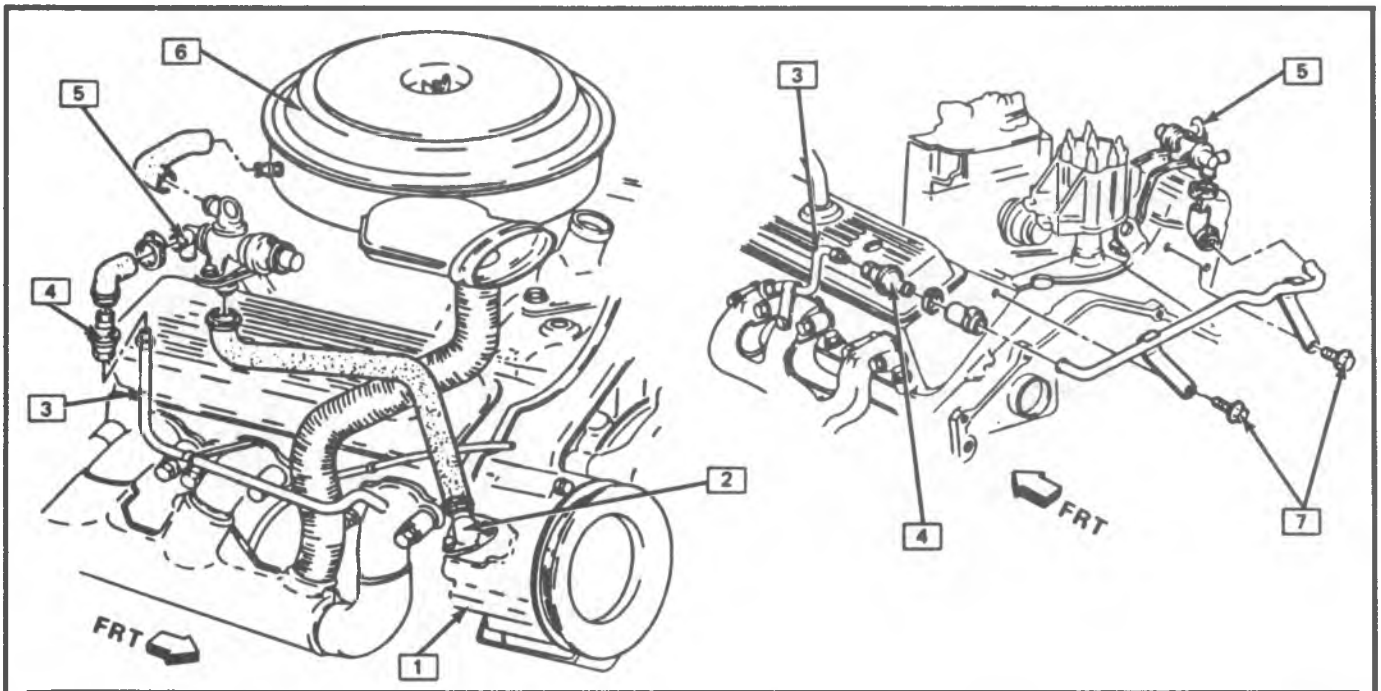
Figure 8-7 - AIR System - 2.8L



1	AIR PUMP	5	DIVERTER VALVE OR EAC VALVE
2	ADAPTER AND SEAL - TIGHTEN SCREWS TO 25 N·m (18 FT. LBS.)	6	AIR CLEANER
3	AIR INJECTION PIPE — TIGHTEN NUTS TO 28 N·m (20 FT. LBS.)	7	BOLT - TIGHTEN TO 34 N·m (25 FT. LBS.)
4	CHECK VALVE - TIGHTEN TO 25 N·m (18 FT. LBS.)		

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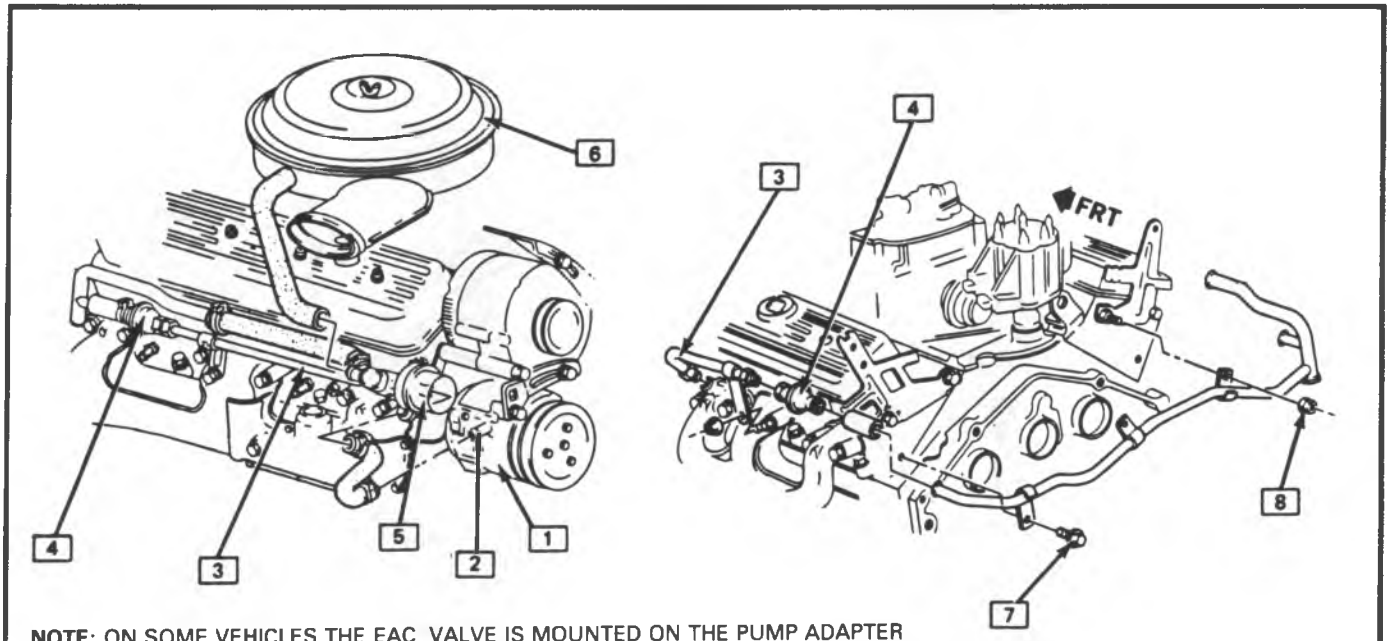
Figure 8-8 - AIR System - 4.3L - G & M Series



NOTE: ON SOME VEHICLES THE EAC VALVE IS MOUNTED ON THE PUMP ADAPTER

1. AIR PUMP
2. ADAPTER AND SEAL - TIGHTEN SCREWS TO 25 N·m (18 FT. LBS.)
3. AIR INJECTION PIPE — TIGHTEN NUTS TO 28 N·m (20 FT. LBS.)
4. CHECK VALVE - TIGHTEN TO 35 N·m (26 FT. LBS.)
5. DIVERTER VALVE OR EAC VALVE
6. AIR CLEANER
7. BOLT - TIGHTEN TO 34 N·m (25 FT. LBS.)
8. NUT - TIGHTEN TO 34 N·m (25 FT. LBS.)

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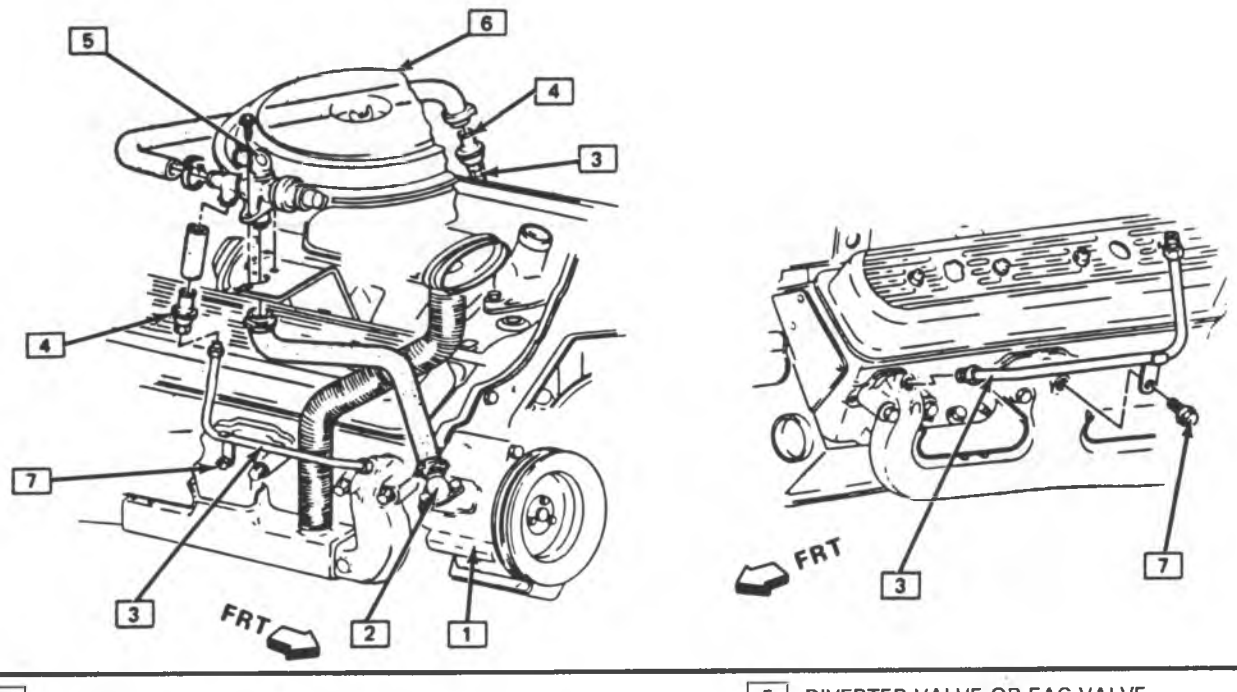
Figure 8-9 - A I R System - 4.3L, 5.0L, 5.7L - C, K, P, R, & V Series



1. AIR PUMP
2. ADAPTER AND SEAL - TIGHTEN SCREWS TO 25 N·m (18 FT. LBS.)
3. AIR INJECTION PIPE — TIGHTEN NUTS TO 28 N·m (20 FT. LBS.)
4. CHECK VALVE - TIGHTEN TO 25 N·m (18 FT. LBS.)
5. DIVERTER VALVE OR EAC VALVE
6. AIR CLEANER
7. BOLT - TIGHTEN TO 3 N·m (26 IN. LBS.)

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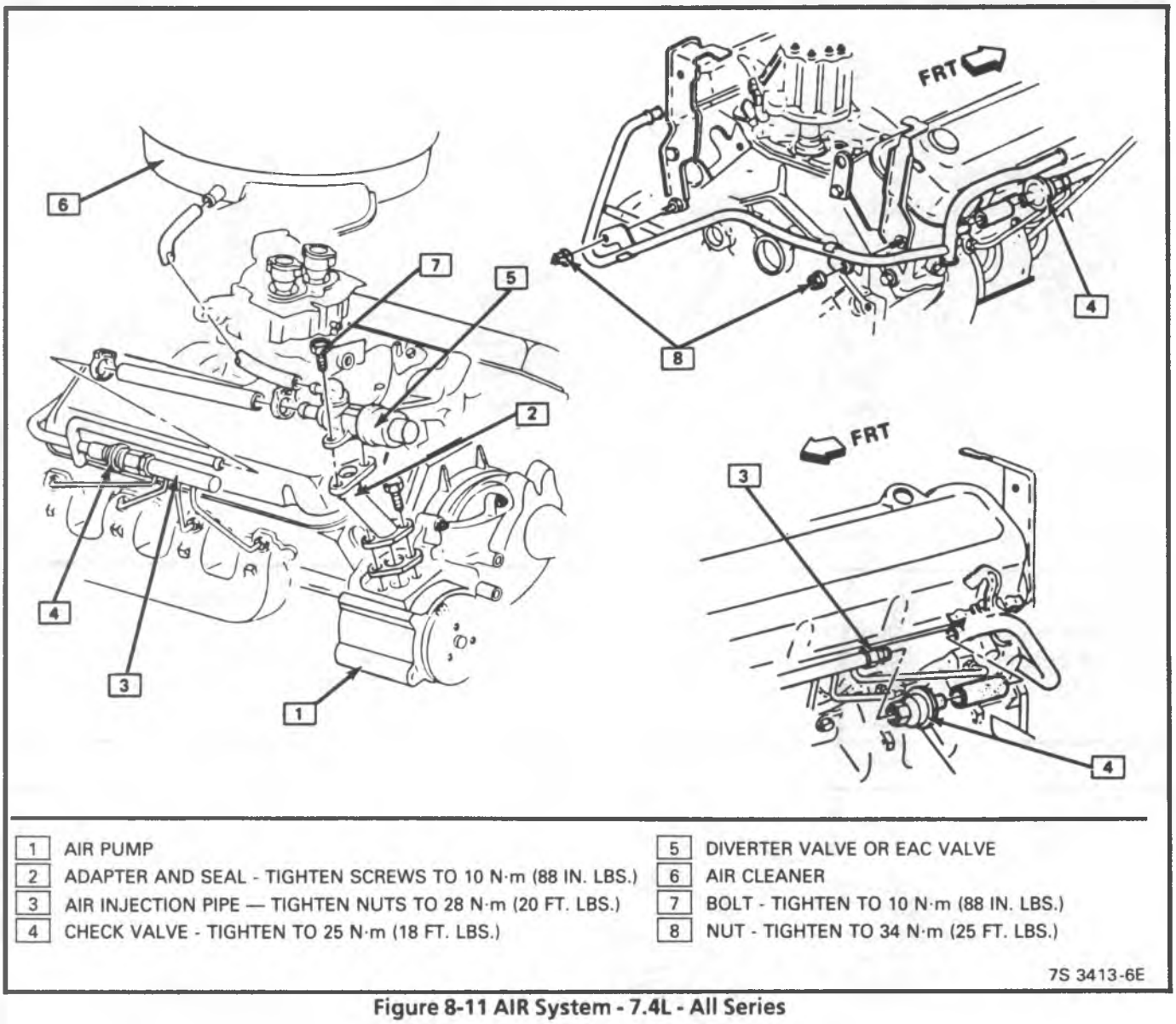
Figure 8-10 - A I R System - 5.0L, 5.7L - G Series



1	AIR PUMP	5	DIVERTER VALVE OR EAC VALVE
2	ADAPTER AND SEAL - TIGHTEN SCREWS TO 10 N·m (88 IN. LBS.)	6	AIR CLEANER
3	AIR INJECTION PIPE — TIGHTEN NUTS TO 28 N·m (20 FT. LBS.)	7	BOLT - TIGHTEN TO 10 N·m (88 IN. LBS.)
4	CHECK VALVE - TIGHTEN TO 25 N·m (18 FT. LBS.)	8	NUT - TIGHTEN TO 34 N·m (25 FT. LBS.)

7S 3413-6E

Figure 8-11 AIR System - 7.4L - All Series

PARTS INFORMATION

PART NAME	GROUP
Adapter, AIR Inj Cont Vlv	3.671
Bracket, AIR Inj Pump Supt	3.655
Bracket, AIR Inj Pump	3.655
Fan, AIR Pump	3.665
Gasket, AIR Inj Dvtr Vlv El	3.671
Harness, AIR Inj Cont Vlv Vac	3.675
Hose, AIR Inj Cont Vlv	3.675
Hose, AIR Inj Cont Vlv Dvtr	3.675
Pulley, AIR Inj Pump	3.650
Pump, AIR Inj	3.660
Valve, AIR Inj Cont	3.670
Valve, AIR Inj Eng Chk	3.670
Valve, AIR Inj Control (Divert)	3.670
Valve, AIR Inj Switching	3.670

SECTION 9
EXHAUST GAS RECIRCULATION (EGR) SYSTEM

CONTENTS

GENERAL DESCRIPTION

PURPOSE

The EGR system is used to lower NOx (oxides of nitrogen) emission levels caused by high combustion temperatures. The EGR valve feeds small amounts of exhaust gas back into the combustion chamber to decrease combustion temperature.

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

OPERATION

The EGR valve is opened by 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

EGR CONTROL

2.5L, 4.3L, 5.0L & 5.7L (under 8500 GVW)

To regulate EGR flow an ECM controlled solenoid is used in the vacuum line. This is a normally closed solenoid vacuum valve which is opened when the ECM completes the ground. The ECM will energize the EGR solenoid (EGR "ON") when the engine is warm and above idle, but not at wide open throttle due to lack of vacuum.

2.5L only

On cold engine start-up the ECM receives input from the MAT sensor (Manifold Air Temperature), and if the MAT reading is less than 12° C (57° F) the EGR solenoid is off until the coolant warms to 80° C (176°F). If there is a malfunction of the MAT sensor then the ECM receives input from the coolant sensor.

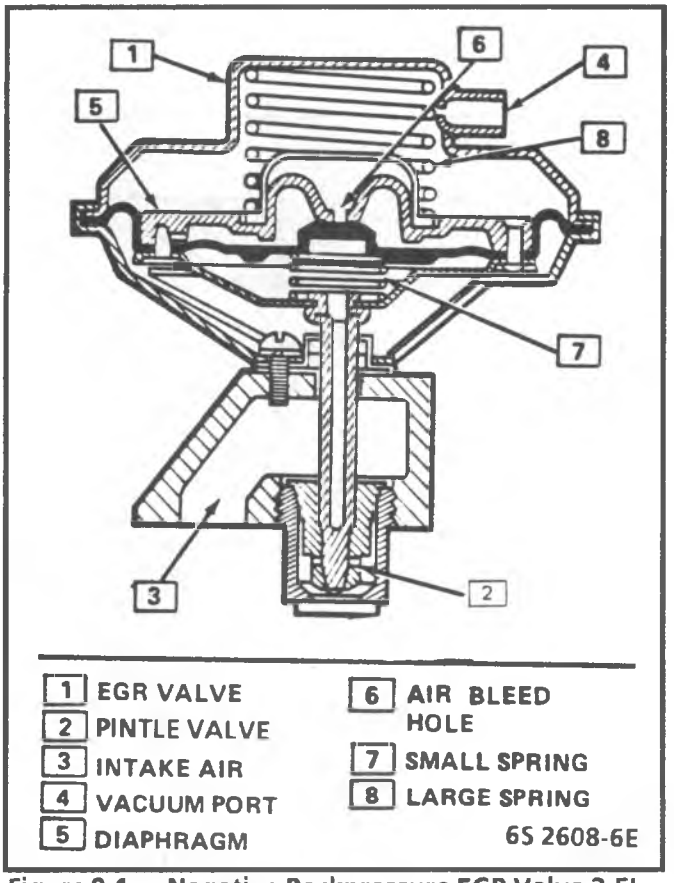


Figure 9-1 - Negative Backpressure EGR Valve 2.5L, 4.3L, 5.0L& 5.7L (under 8500 GVW) EVRV 2.8L, 7.4L & 5.7L (over 8500 GVW)

To regulate EGR flow, an ECM controlled Electronic Vacuum Regulator Valve (EVRV) solenoid is used in the vacuum line. The ECM uses information from the following sensors to regulate the solenoid:

- Coolant Temperature
- Throttle Position (TPS)
- P/N switch
- Distributor (rpm Signal)

The EGR vacuum control has an EVRV 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.

TYPES OF EGR VALVES

Two types of EGR valves are used on these engines:

- Ported (2.8L, 7.4L & 5.7L) (over 8500 GVW)
- Negative backpressure (2.5L, 4.3L, 5.0L & 5.7L) (under 8500 GVW)

Port EGR Valve

This valve 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.

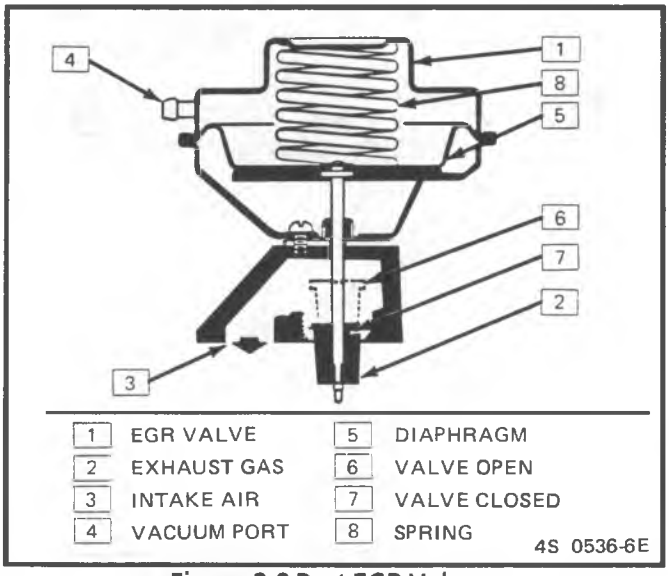


Figure 9-2 Port EGR Valve
2.8L, 7.4L & 5.7L(over 8500 GVW)

Negative Backpressure EGR Valve

The negative backpressure EGR valve has the bleed valve spring below the diaphragm, and the valve is normally closed. The negative backpressure valve varies the amount of exhaust gas flow into the manifold depending on manifold vacuum and variations in exhaust back pressure.

The diaphragm on this valve has an internal air bleed hole which is held closed by a small spring when there is no exhaust backpressure.

Engine vacuum opens the EGR valve against the pressure of a large spring. When manifold vacuum combines with negative exhaust backpressure, the vacuum bleed hole opens and the EGR valve closes.

This valve will open if vacuum is applied with the engine not running.

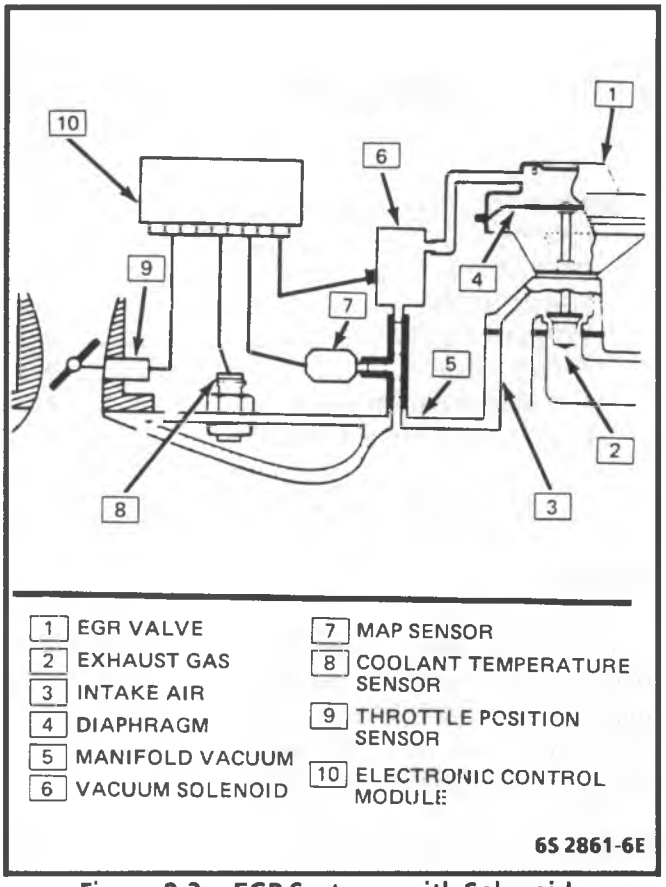


Figure 9-3 - EGR System - with Solenoid

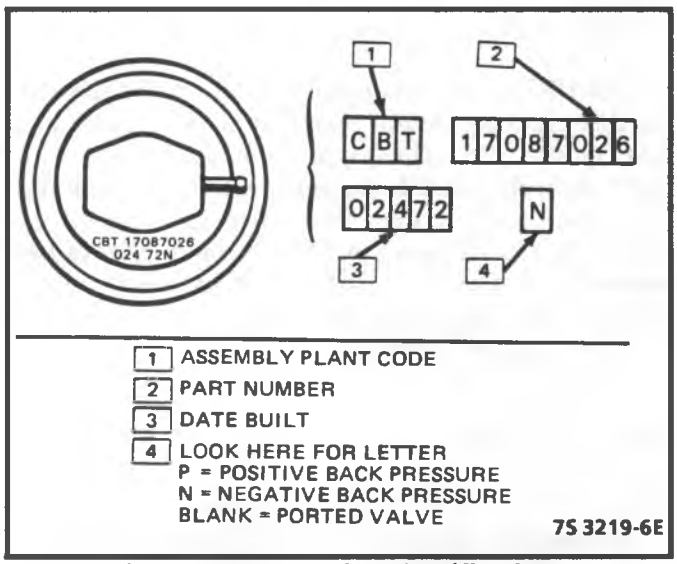


Figure 9-4 - EGR Valve Identification

EGR VALVE IDENTIFICATION

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

DIAGNOSIS

RESULTS OF INCORRECT OPERATION

With 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.
- Vehicle surges during cruise.
- Rough idle.

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

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

- Spark knock (detonation).
- Engine overheating.

SYSTEM CHECK

Diagnosis of the EGR system is covered in the following charts. These charts begin on page 9-4.

- EGR System Check on a 2.5L, 4.3L, 5.0L & 5.7L (under 8500 GVW) engine.
- EGR System Check on a 2.8L, 7.4L & 5.7L (over 8500 GVW) engine.

EGR Vacuum Switch and Solenoid

Refer to Code 32 CHART (2.8L engine) for diagnosis of the vacuum switch and solenoid assembly.

EGR Vacuum Control

Refer to EGR System Check for diagnosis of the vacuum solenoid.

ON-VEHICLE SERVICE

EGR VALVE

Remove or Disconnect

1. Air Cleaner.
2. EGR valve vacuum tube at valve. (Figure 9-5 to 9-10).
3. Bolts or nuts.
4. EGR valve from manifold. (Figures 9-11 to 9-15)

Important

Do not wash EGR valve in solvents or degreaser - permanent damage to valve diaphragm may result.

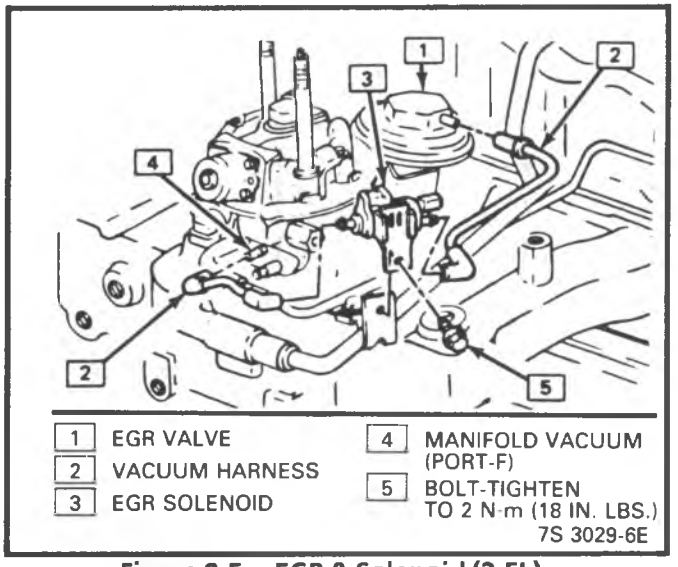


Figure 9-5 - EGR & Solenoid (2.5L)

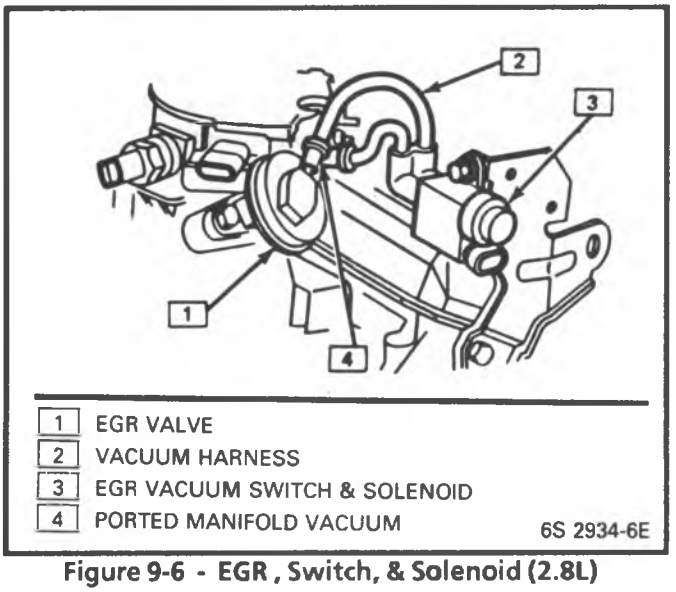


Figure 9-6 - EGR , Switch, & Solenoid (2.8L)

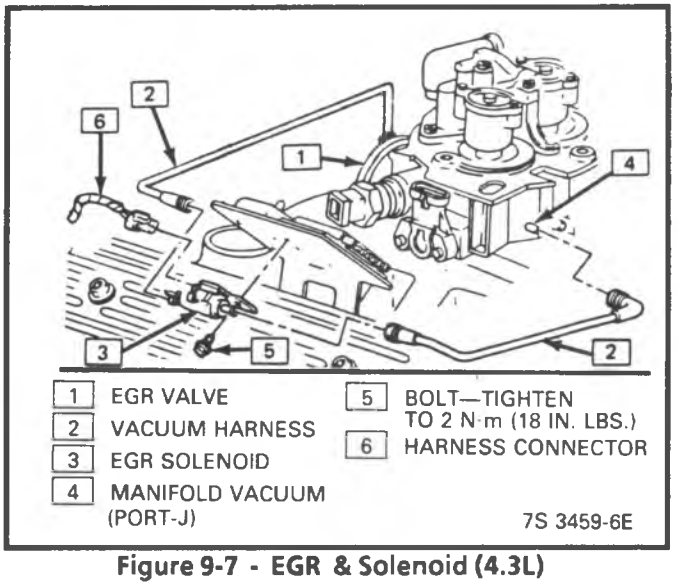
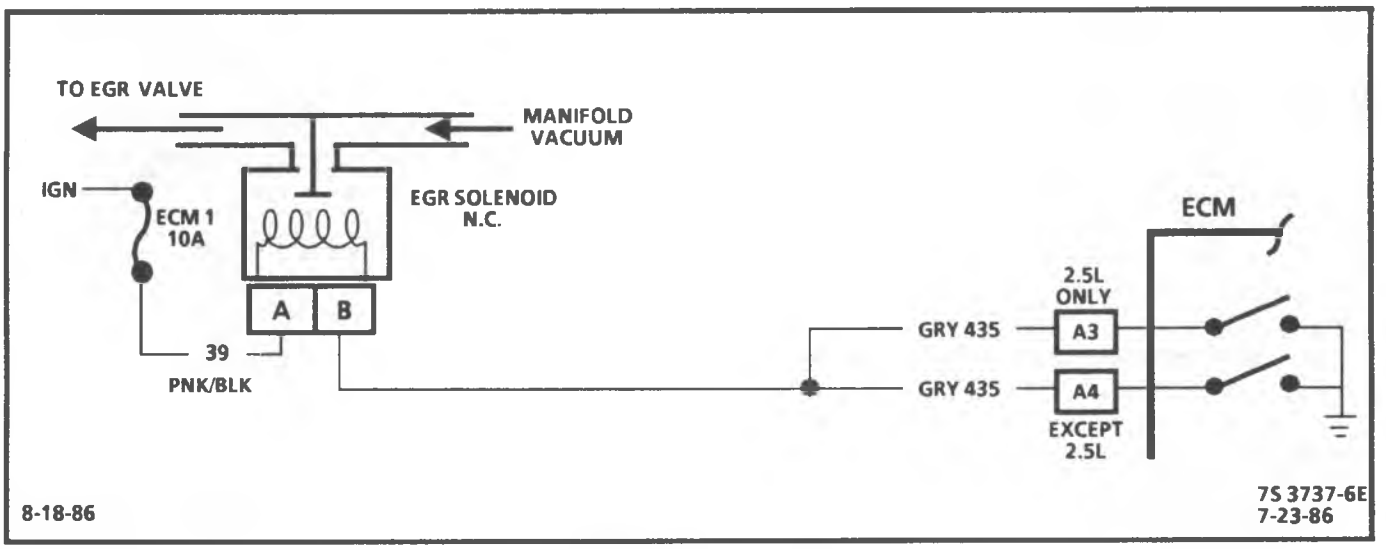


Figure 9-7 - EGR & Solenoid (4.3L)



EGR SYSTEM CHECK

2.5L, 4.3L, 5.0L & 5.7L (UNDER 8500 GVW)

Circuit Description:

The ECM operates a solenoid to control the Exhaust Gas Recirculation (EGR) valve. This solenoid is normally closed. By providing a ground path, the ECM energizes the solenoid which then allows vacuum to pass to the EGR valve. The ECM control of the EGR is based on the following inputs:

- Engine coolant temperature - above 25°C.
- TPS - "OFF" idle
- MAP

If Code 24 is stored, use that chart first.

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

1. Checks for solenoid stuck open.
2. Checks for solenoid always being energized.
3. Grounding test terminal should energize solenoid and vacuum should drop.
4. Negative backpressure valve should hold vacuum with engine "OFF".
5. When engine is started, exhaust backpressure should cause vacuum to bleed off and valve to fully close.

Diagnostic Aids:

- Before replacing ECM, use an ohmmeter and check the resistance of each ECM controlled relay and solenoid coil. See ECM wiring diagram for coil term. I.D. of solenoid(s) and relay(s) to be checked. Replace any solenoid where resistance measures less than 20 ohms.

EGR SYSTEM CHECK

2.5L, 4.3L, 5.0L & 5.7L (UNDER 8500 GVW)

ASSUMES NO CODE 32 IS STORED

1. • CHECK VACUUM SOURCE TO EGR SOLENOID (IF NOT OK, REPAIR).
   • IGNITION "OFF".
   • DISCONNECT EGR SOLENOID VACUUM HARNESS.
   • INSTALL HAND HELD VACUUM PUMP ON MANIFOLD SIDE OF SOLENOID.
   • APPLY VACUUM.
   DOES SOLENOID HOLD VACUUM?
   - YES
   - NO → FAULTY SOLENOID

2. • IGNITION "ON", ENGINE STOPPED.
   • DOES VACUUM DROP?
   - NO
   - YES → CKT 435 SHORTED TO GROUND OR FAULTY ECM. SEE DIAGNOSTIC AIDS.

3. • GROUND DIAGNOSTIC TEST TERMINAL. DOES VACUUM DROP?
   - YES
   - NO → DISCONNECT SOLENOID ELECTRICAL CONNECTOR. PROBE CKT 39 WITH A TEST LIGHT TO GROUND.
     - LIGHT "ON" → CONNECT TEST LIGHT BETWEEN HARNESS CONNECTOR TERMINALS.
       - LIGHT "ON" → FAULTY SOLENOID
       - LIGHT "OFF" → OPEN CKT 435 OR FAULTY ECM. SEE DIAGNOSTIC ADIS.
     - LIGHT "OFF" → OPEN CKT 39

4. • REMOVE GROUND FROM DIAGNOSTIC TEST TERMINAL.
   • IGNITION "OFF".
   • CONNECT A VACUUM PUMP TO EGR SIDE OF VACUUM HARNESS.
   • USING A MIRROR, OBSERVE EGR DIAPHRAGM WHILE APPLYING VACUUM
   • DIAPHRAGM SHOULD MOVE FREELY AND HOLD VACUUM FOR AT LEAST 20 SECONDS.
   - OK
   - NOT OK → CHECK VACUUM LINE TO VALVE. IF OK, REPLACE EGR VALVE.

5. • APPLY VACUUM TO EGR VALVE.
   • START ENGINE AND IMMEDIATELY OBSERVE VACUUM AND VALVE POSITION.
   • VALVE IS GOOD IF VALVE MOVES TO SEATED POSITION (VALVE CLOSED) AND VACUUM DROPPED WHILE STARTING ENGINE.
   - OK → A/T CHECK P/N SWITCH
     - OK → NO TROUBLE FOUND
     - NOT OK → REPAIR AS NECESSARY
   - NOT OK
     • REMOVE EGR VALVE AND CHECK PASSAGES FOR BEING PLUGGED.
     • IF NOT PLUGGED REPLACE EGR VALVE.

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

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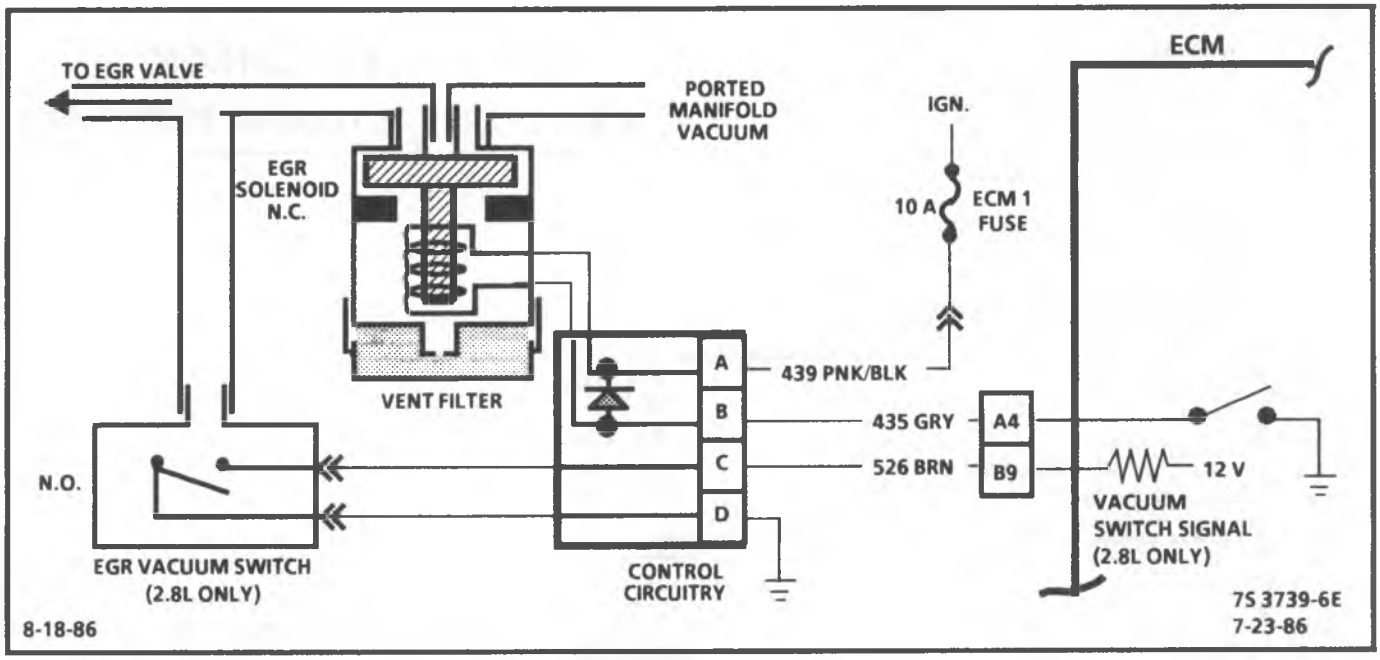


EGR SYSTEM CHECK

2.8L, 7.4L & 5.7L (OVER 8500 GVW)

Circuit Description:

The EGR valve is controlled by a normally closed solenoid (allows a vacuum to pass when energized). The ECM pulses the solenoid to turn "ON" and regulate the EGR. On 2.8L engine, the ECM monitors vacuum to the EGR with the EGR vacuum switch. On 5.7L & 7.4L, the ECM diagnoses the system using an internal EGR test procedure.

Code 32 will detect a faulty solenoid, vacuum switch (2.8L), vacuum supply, or EGR Valve (5.7L & 7.4L). This chart checks for plugged EGR passages, a sticking EGR valve, or a stuck open or inoperative solenoid.

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

1. With the ignition "ON", engine stopped, the solenoid should not be energized and vacuum should not pass to the EGR valve.
2. Grounding the diagnostic terminal will energize the solenoid and allow vacuum to pass to valve.
3. Checks for plugged EGR passages. If passages are plugged, the engine may have severe detonation on acceleration.
4. The EGR solenoid will not be energized in Park or Neutral. This test will determine if the Park/Neutral switch input is being received by the ECM.

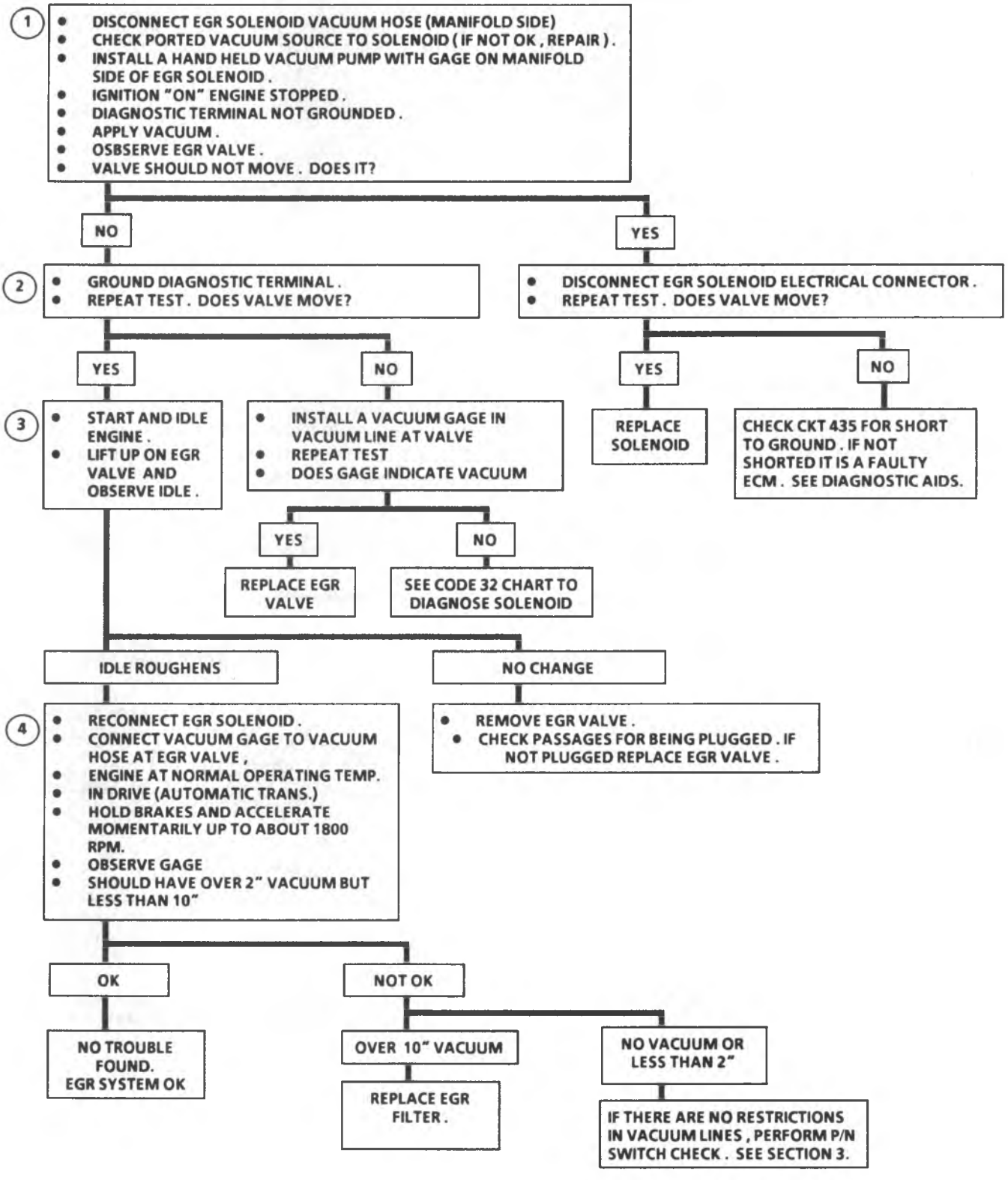
Diagnostic Aids:

- Before replacing ECM use ohmmeter and check resistance of each ECM controlled relay and solenoid coil.
  See ECM wiring diagram for coil terminal identification of solenoid(s) and relay(s) to be checked.
  Replace any relay or solenoid if the coil resistance measures less than 20 ohms.

EGR SYSTEM CHECK

2.8L, 7.4L & 5.7L (OVER 8500 GVW)

ASSUMES NO CODE 32 IS STORED



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

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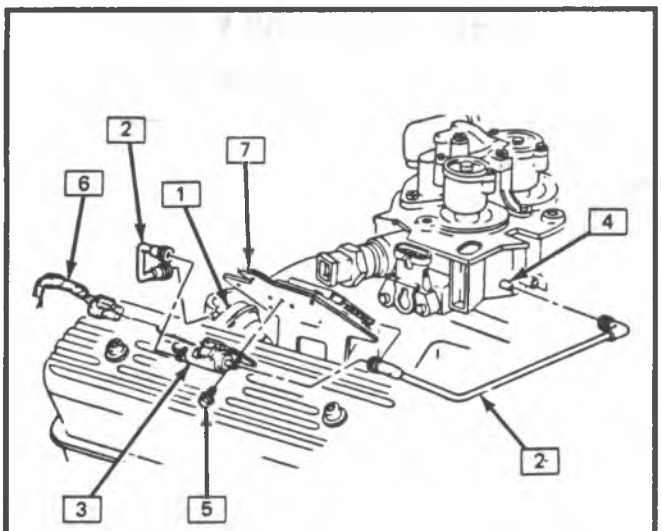
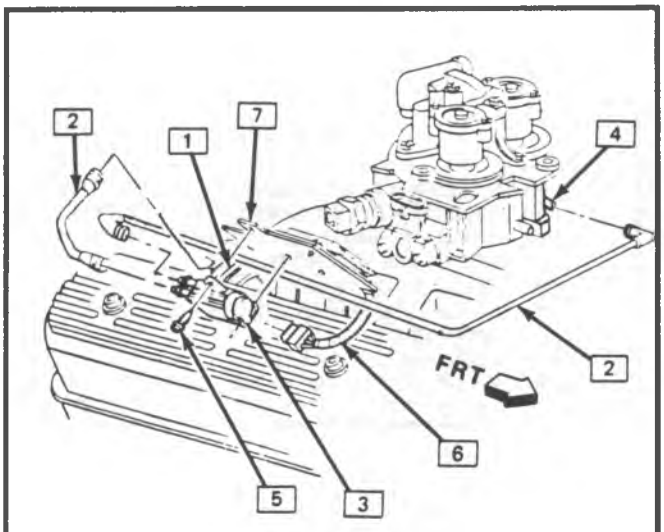


1. EGR VALVE
2. VACUUM HARNESS
3. EGR SOLENOID (MOUNTED ON TOP SIDE OF BRACKET ON G-SERIES)
4. MANIFOLD VACUUM (PORT-J)
5. BOLT—TIGHTEN TO 2 N·m (18 IN. LBS.)
6. HARNESS CONNECTOR
7. BRACKET

7S 3460-6E

Figure 9-8 - EGR & Solenoid (5.0L & 5.7L under 8500 GVW)



1. EGR VALVE
2. VACUUM HARNESS
3. EGR SOLENOID (MOUNTED ON TOP SIDE OF BRACKET ON G-SERIES)
4. PORTED MANIFOLD VACUUM (PORT-S)
5. BOLT—TIGHTEN TO 2 N·m (18 IN. LBS.)
6. HARNESS CONNECTOR
7. BRACKET

7S 3461-6E

Figure 9-9 - EGR & Solenoid (5.7L over 8500 GVW)

Also, sand blasting of the valve is not recommended since this can affect the operation of the valve.

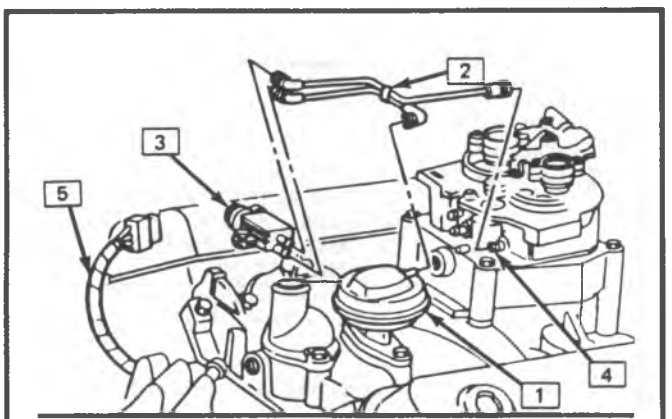
EGR Manifold Passage

Inspect

If EGR passage indicates excessive build-up of deposits, the passage 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.

Clean

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



1. EGR VALVE
2. VACUUM HARNESS
3. EGR SOLENOID
4. PORTED MANIFOLD VACUUM (PORT-S)
5. HARNESS CONNECTOR

7S 3462-6E

Figure 9-10 - EGR & Solenoid (7.4L)

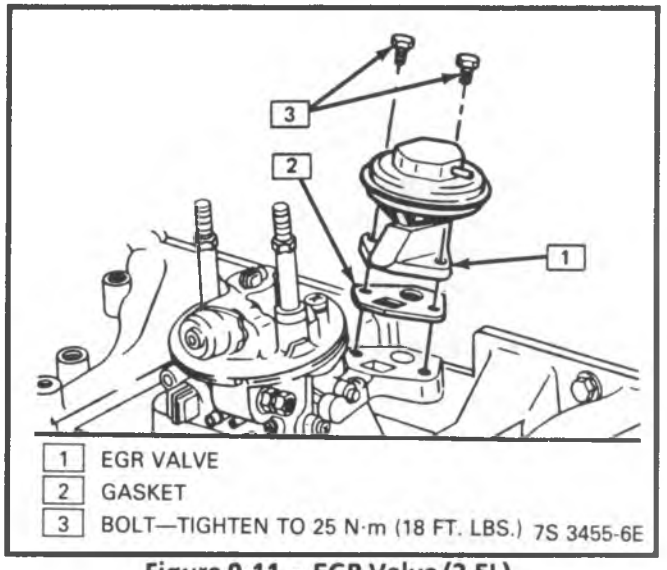


Figure 9-11 - EGR Valve (2.5L)

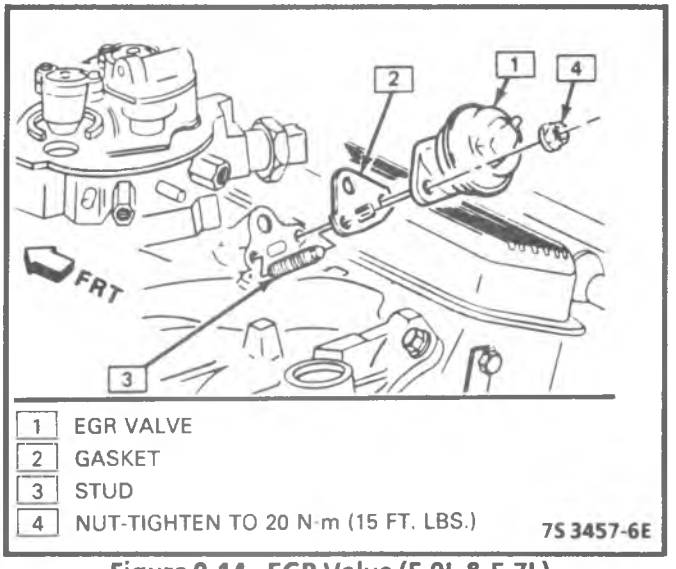


Figure 9-14 - EGR Valve (5.0L & 5.7L)

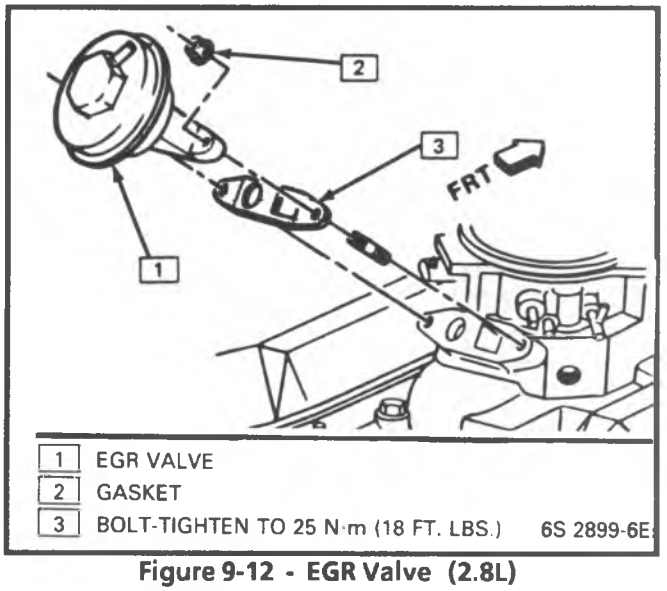


Figure 9-12 - EGR Valve (2.8L)

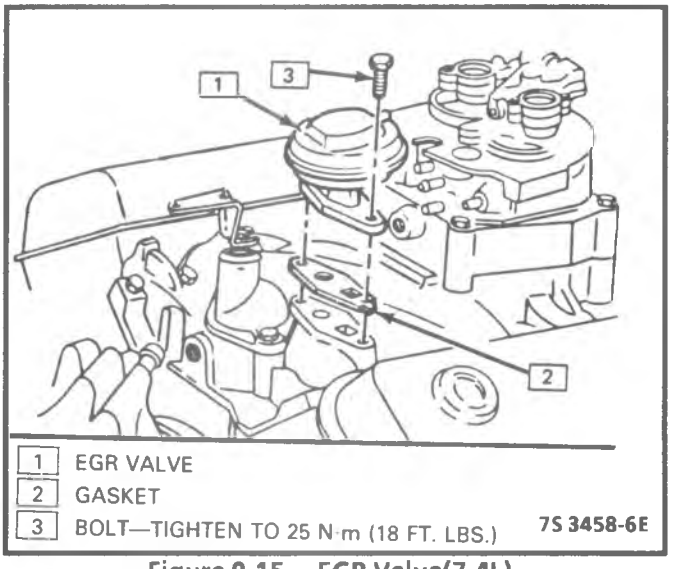


Figure 9-15 - EGR Valve(7.4L)

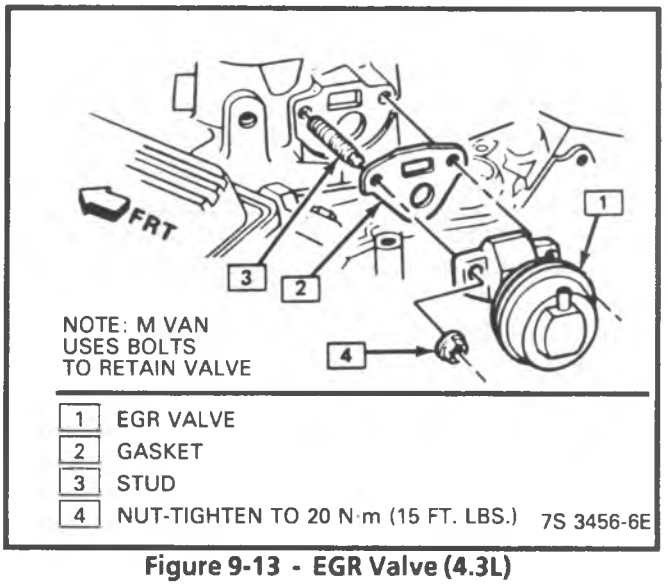


Figure 9-13 - EGR Valve (4.3L)

Install or Connect

1. EGR valve to manifold.
2. Bolts or nuts.
3. Vacuum tube to valve.
4. Air cleaner.

SYSTEM HOSES

Refer to Vehicle Emission Control Information label for routing of system hoses.

When replacing hoses, use hose identified with the word "Fluoroelastromer".

EGR VACUUM SWITCH AND SOLENOID 2.8L, 7.4L & 5.7L (over 8500 GVW) Figure 9-16

Remove or Disconnect

1. Negative battery cable.
2. Air cleaner, if necessary.
3. Electrical connector at solenoid.
4. Vacuum hoses.
5. Bolt(s) and solenoid.
6. Filter, if required.

Install or Connect

1. Filter, if required.
2. Solenoid. Tighten bolts to 24 N•m (17 ft. lbs).
3. Vacuum hoses.
4. Electrical connector.
5. Air cleaner, if removed
6. Negative battery cable.

EGR FILTER REPLACEMENT (SHOULD BE DONE EVERY 30,000 MILES)

1. Grasp and pull filter off with a rocking motion.
2. Push new filter on making sure cut-out for wires is properly aligned.

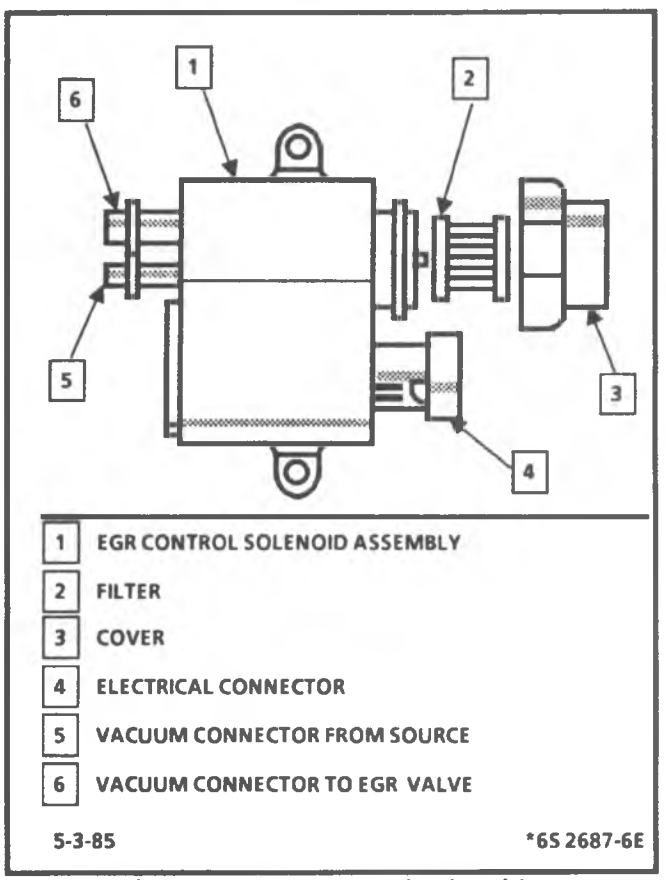


Figure 9-16 EGR Control Solenoid (2.8L, 7.4L, & 5.7L) (Over 8500 GVW)

EGR VACUUM SOLENOID 2.5L, 4.3L, 5.0L & 5.7L (under 8500 GVW) Figure 9-17

Remove or Disconnect

1. Negative battery cable.
2. Electrical connector at solenoid.
3. Vacuum hoses.
4. Bolt(s) and solenoid.

Install or Connect

1. Solenoid. See Figures 9-5 thru 9-10 for torque specification.
2. Vacuum hoses
3. Electrical connector.
4. Negative battery cable.

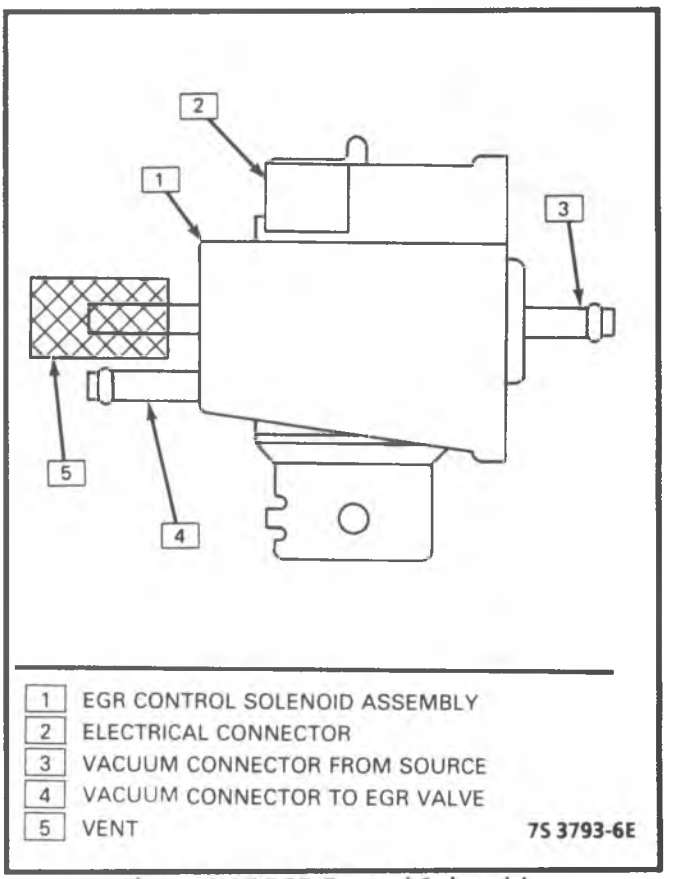


Figure 9-17 EGR Control Solenoid (2.5L, 4.3L, 5.0L & 5.7L Under 8500 GVW)

PARTS INFORMATION

PARTS NAME	GROUP
Valve, EGR	3.670
Solenoid, EGR cont VLV RLY	3.670
Solenoid, EGR Cont	3.670
Gasket, EGR Valve	3.680

SECTION 10
AUTOMATIC AND MANUAL TRANSMISSION CONTROLS

CONTENTS

GENERAL DESCRIPTION

AUTOMATIC TRANSMISSION

TCC System

The Transmission Converter Clutch (TCC) System, used on a 7004R transmission, uses a solenoid operated valve, in the automatic transmission, to couple the engine flywheel to the output shaft of the transmission through the torque converter. This reduces the slippage losses in the converter, which increases fuel economy.

Operation

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

- Internal transmission fluid pressure must be correct. For information on internal transmission operation, see Section 7A. This section will cover only the electrical operation of the TCC system.
- The ECM completes a ground circuit to energize a TCC apply solenoid in the transmission which moves a check ball in a fluid line (Figure 10-1). This allows 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:

- 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 vehicle is accelerating, or decelerating at a certain rate.
- Brake Switch. This switch in the TCC circuit opens, when the brake pedal is depressed. This de-energizes the TCC solenoid.
- Pulse switch. This is a downshift 4-3 pulse switch, which opens the TCC solenoid circuit, momentarily, during a downshift.

Downshift Control System

While operating a vehicle equipped with a THM 400 transmission, at speeds below 70 mph, a forced or detent downshift is possible, by depressing the accelerator fully.

The ECM will recognize the rapid increase in MAP sensor voltage, due to a drop in manifold vacuum, and turn on the downshift control relay. The relay will, then, send battery voltage to the detent solenoid, in the transmission, which opens an orifice and forces a transmission downshift.

MANUAL TRANSMISSION

Shift Light System

A vehicle, with manual transmission, has a shift light, on the instrument panel, to indicate the best shift point for maximum fuel economy. The light is controlled by the ECM and is turned "ON" by grounding CKT 456.

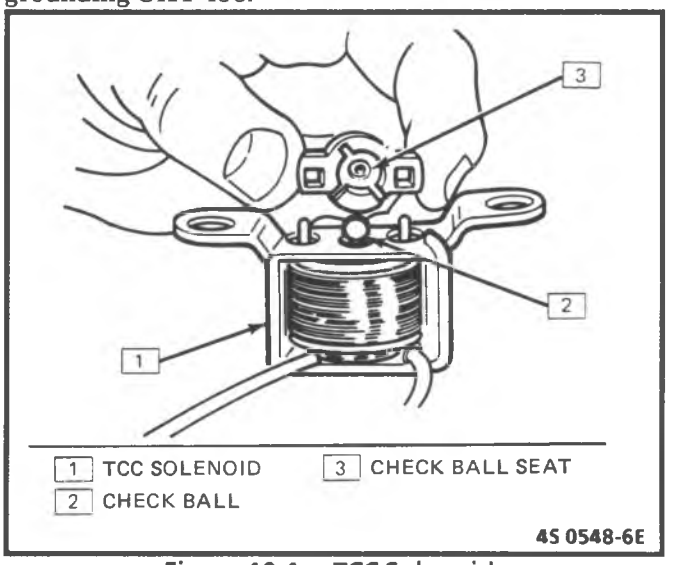
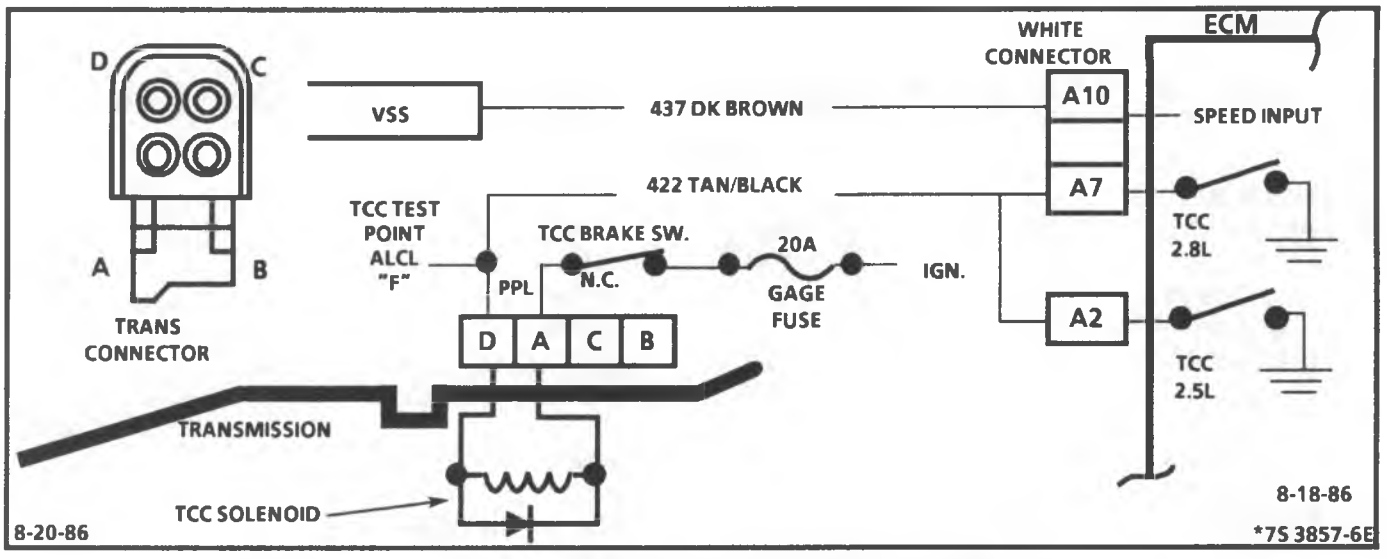


Figure 10-1 - TCC Solenoid



TRANSMISSION CONVERTER CLUTCH (TCC)

ELECTRICAL DIAGNOSIS
2.5L AND 2.8L ENGINES

Circuit Description:

The purpose of the automatic transmission 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 transmission and the fuel economy of a manual transmission.

Fused battery ignition is supplied to the TCC solenoid through the TCC brake switch.

The ECM will engage TCC by grounding CKT 422 to energize the solenoid.

TCC will engage when:

- Vehicle speed above 24 mph (39 km/h.)
- Engine at normal operating temperature (above 65°C) (149°F).
- Throttle position sensor output not changing, indicating a steady road speed.
- Brake switch closed.
- 3rd or 4th gears.

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

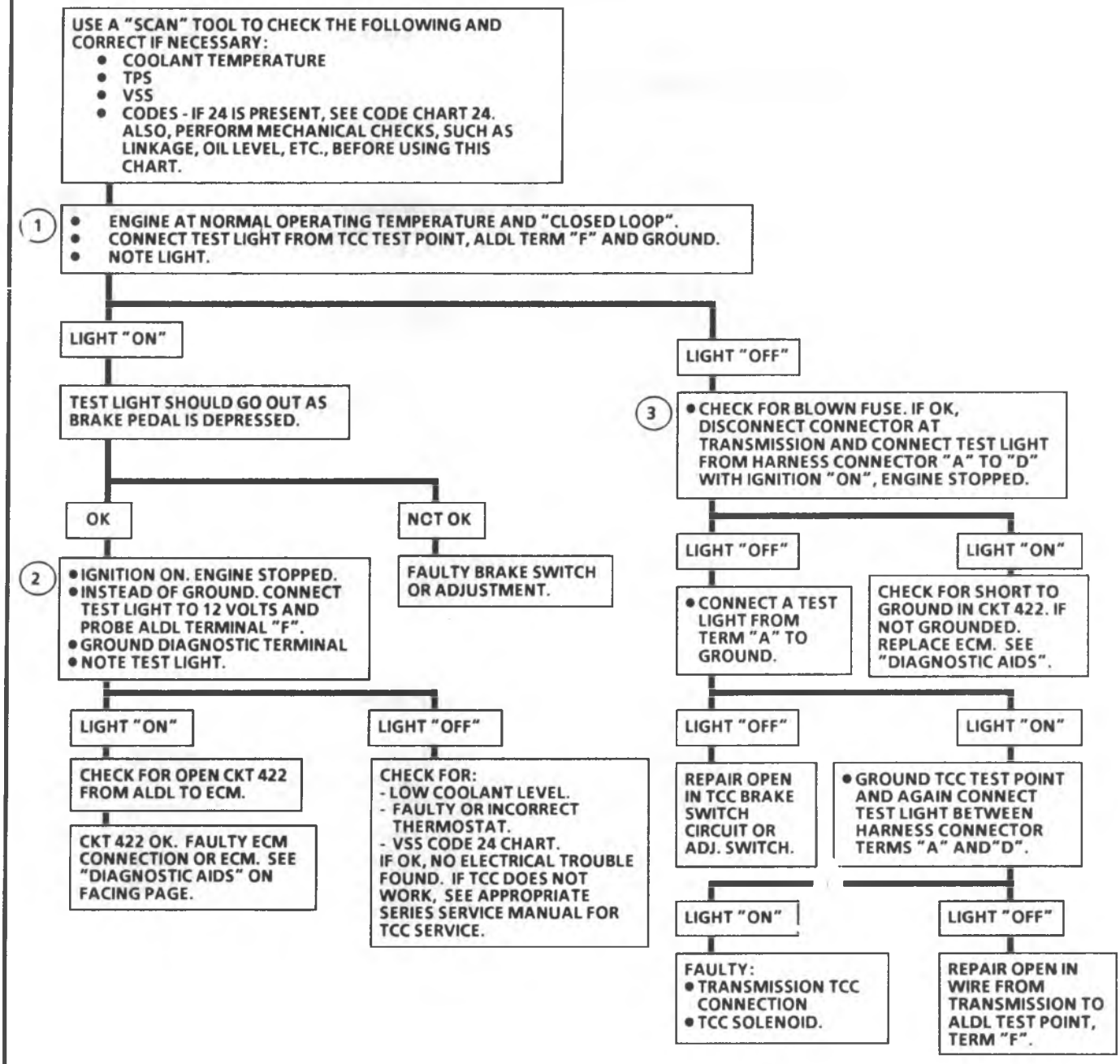
1. Checks continuity through brake switch and TCC solenoid.
2. Checks capability of ECM to energize solenoid. Grounding the diagnostic connector should energize the relay and cause the light to go out.
3. This test by-passes the TCC solenoid and checks for an open or short in CKT 422.

Diagnostic Aids:

Solenoid coil resistance must measure more than 20 ohms. Less resistance will cause early failure of the ECM "DRIVER". Using an ohm meter, check the solenoid coil resistance of all ECM controlled solenoids and relays, before installing a replacement ECM. Replace any solenoid, or relay, that measures less than 20 ohms resistance.

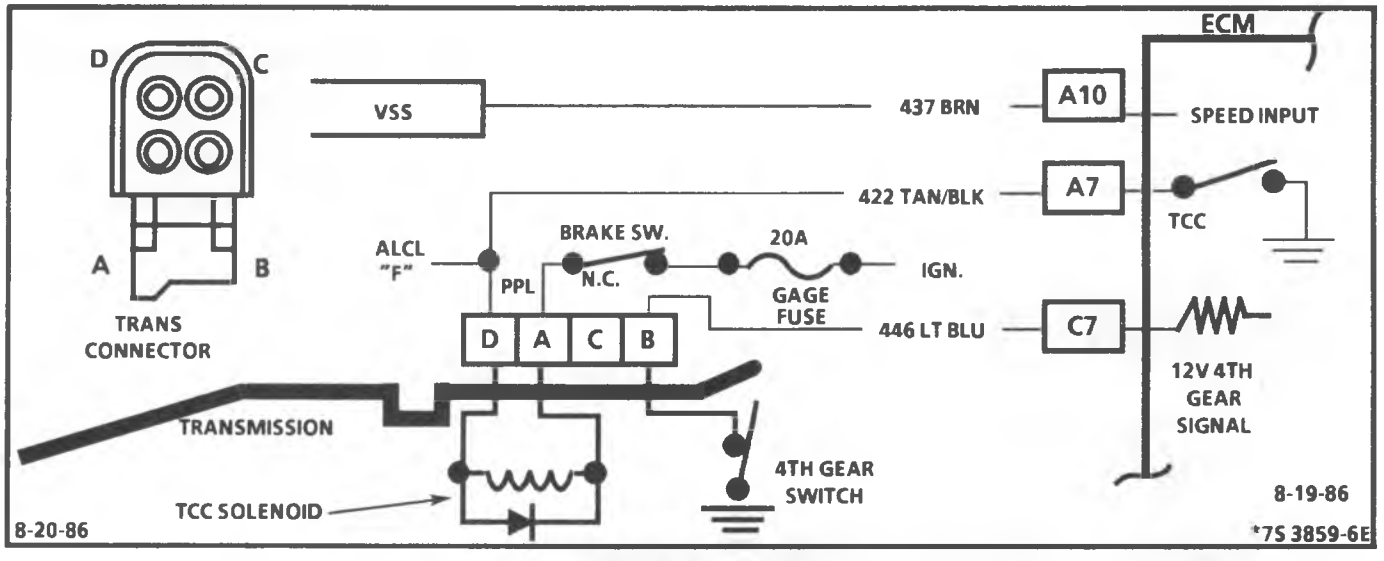
TRANSMISSION CONVERTER CLUTCH (TCC)

(ELECTRICAL DIAGNOSIS)
2.5L AND 2.8L ENGINES



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

9-5-86
7S 3858-6E



TRANSMISSION CONVERTER CLUTCH (TCC)

ELECTRICAL DIAGNOSIS
4.3L, 5.0L AND 5.7L (UNDER 8500 GVW)

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 transmission and the fuel economy of a manual transmission.

Fused battery ignition is supplied to the TCC solenoid through the TCC brake switch.

The ECM will engage TCC by grounding CKT 422 to energize the solenoid.

TCC will engage when:

- Vehicle speed above 30 mph (48 km/h.)
- Engine at normal operating temperature (above 65°C) (149°F).
- Throttle position sensor output not changing, indicating a steady road speed.
- Brake switch closed.
- 3rd or 4th gears.

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

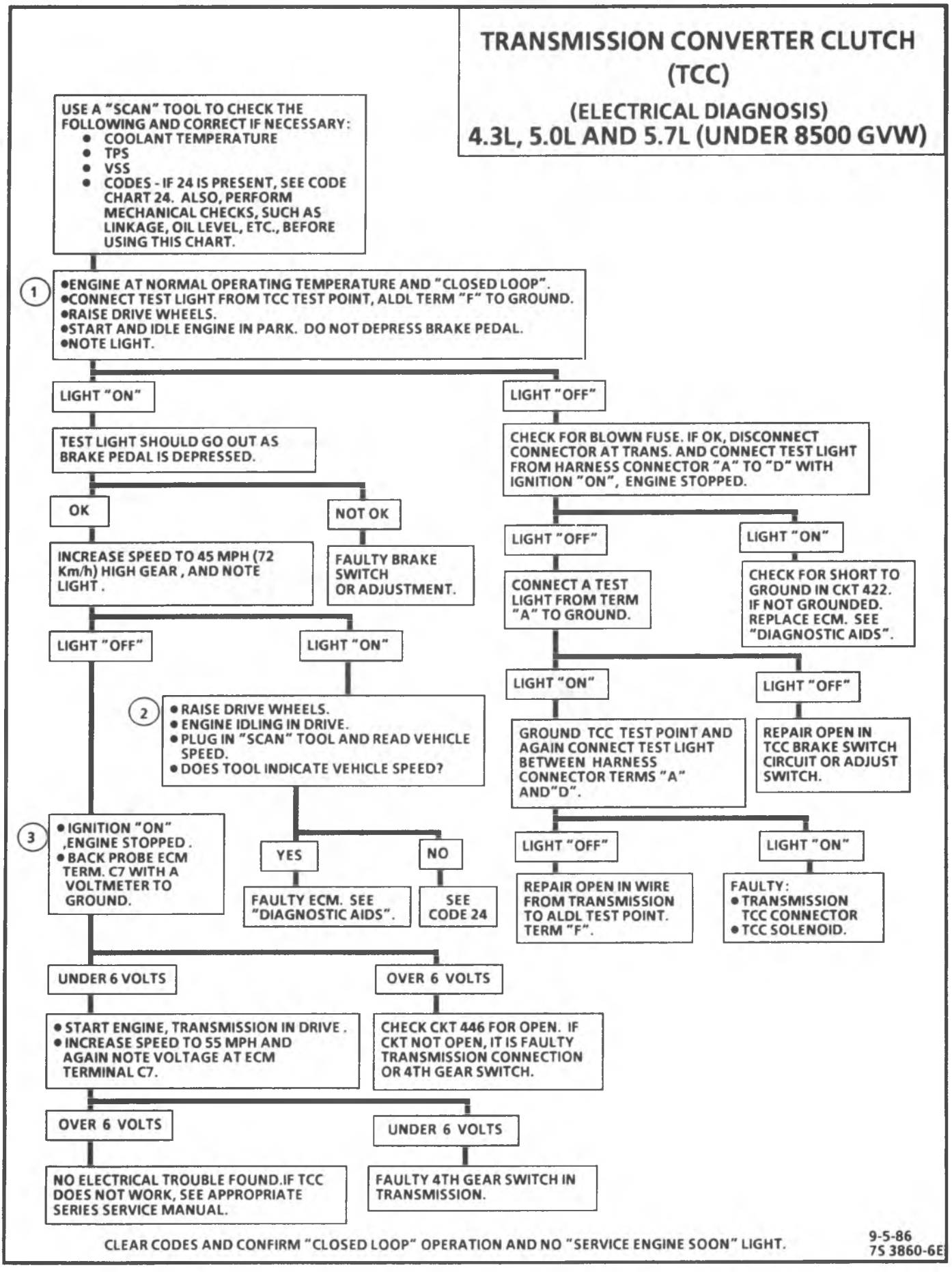
1. A test light on indicates battery voltage and continuithy through the TCC solenoid is OK.
2. Checks for vehicle speed sensor signal to ECM using a "Scan" tool.
3. Checks for 4th gear signal to ECM. This signal will not prevent TCC engagement, but could cause a change in the engage and disengage speed points.

Diagnostic Aids:

Solenoid coil resistance must measure more than 20 ohms. Less resistance will cause early failure of the ECM "DRIVER". Using an ohm meter, check the solenoid coil resistance of all ECM controlled solenoids and relays before installing a replacement ECM. Replace any solenoid or relay that measures less than 20 ohms resistance.

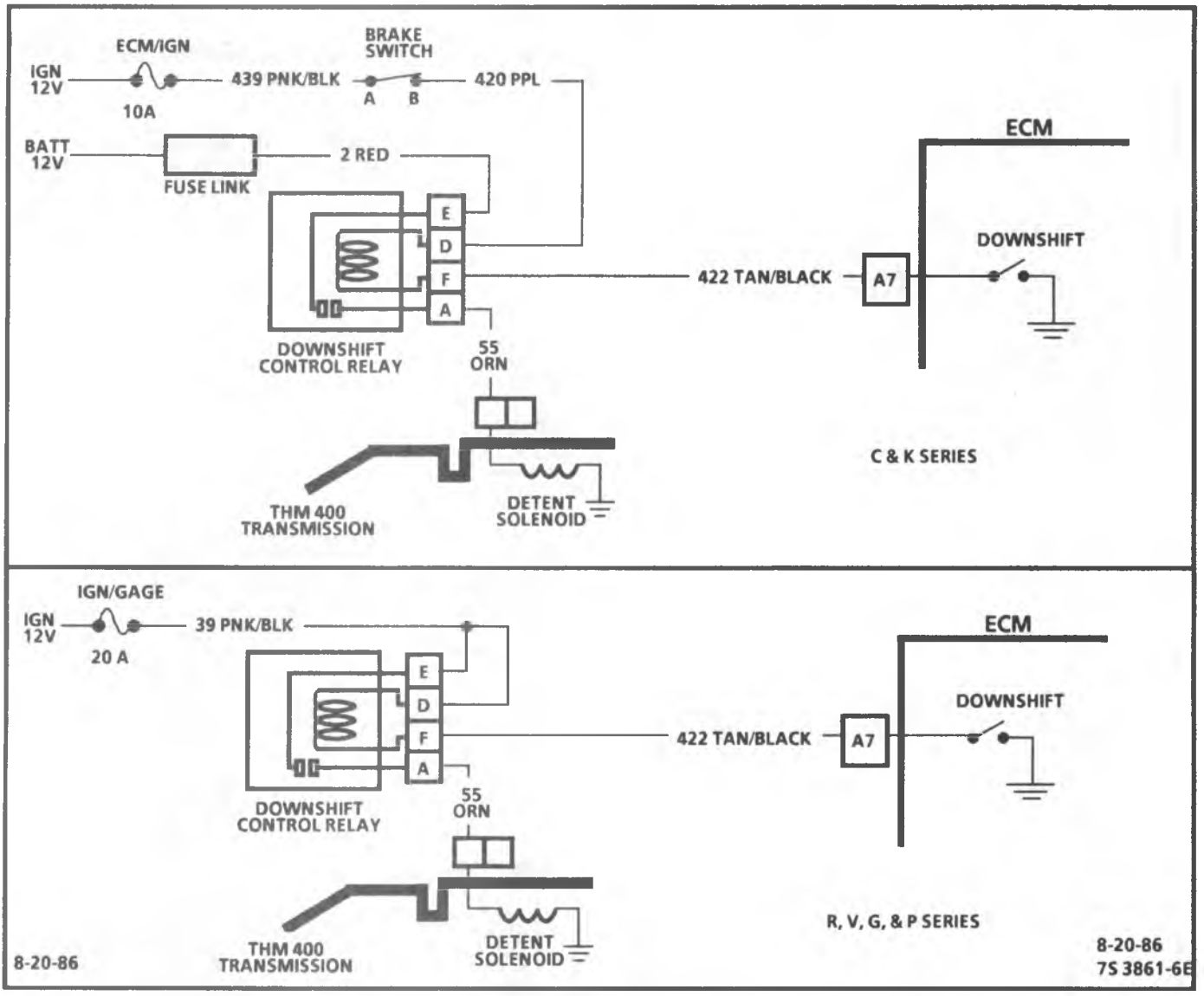
TRANSMISSION CONVERTER CLUTCH (TCC)

(ELECTRICAL DIAGNOSIS) 4.3L, 5.0L AND 5.7L (UNDER 8500 GVW)



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

9-5-86
7S 3860-6E



THM 400 TRANSMISSION DOWNSHIFT CONTROL

ELECTRICAL DIAGNOSIS

Circuit Description:

When the accelerator pedal is fully depressed, manifold vacuum in the engine drops causing the MAP sensor signal voltage to increase to approximately 4 volts. The ECM responds by grounding CKT 422 to turn "ON" the downshift control relay. The relay then sends battery voltage to the detent solenoid, which causes a forced transmission downshift.

Diagnostic Aids:

- If problem is diagnosed as being an internal transmission problem, see Section 7 of the appropriate series Service Manual as listed in the Forward.
- Relay coil resistance must measure more than 20 ohms. Less resistance will cause early failure of the ECM "Driver". Using an ohm meter, check the coil resistance of all ECM controlled solenoids and relays before installing a replacement ECM. Replace any solenoid or relay that measures less than 20 ohms resistance.

THM 400 TRANSMISSION DOWNSHIFT CONTROL

ELECTRICAL DIAGNOSIS

THIS CHART ASSUMES THERE IS NO CODE 33 OR 34 STORED

NO FORCED DOWNSHIFT

- DISCONNECT TRANSMISSION CONNECTOR
- CONNECT A TEST LIGHT FROM CKT 55 TO GROUND
- START AND IDLE ENGINE
- MOMENTARILY HOLD THROTTLE WIDE OPEN
- TEST LIGHT SHOULD COME ON. DOES IT?

NO

- GROUND CKT 422 AT ECM
- NOTE TEST LIGHT

LIGHT "OFF"

- REMOVE TEST LIGHT AND REINSTALL CONNECTOR AT TRANSMISSION
- DISCONNECT RELAY HARNESS CONNECTOR
- CONNECT TEST LIGHT FROM HARNESS TERMINAL "A" TO "12V"

LIGHT "ON"

CONNECT TEST LIGHT FROM HARNESS TERMINAL "E" TO GROUND

LIGHT "ON"

CONNECT TEST LIGHT FROM HARNESS TERMINAL "D" TO GROUND

LIGHT "ON"

CHECK FOR OPEN IN CKT 422 BETWEEN HARNESS CONNECTOR AND ECM. IF NOT OPEN, REPLACE RELAY

LIGHT "OFF"

REPAIR OPEN IN CIRCUIT TO TERMINAL "D"

LIGHT "OFF"

REPAIR OPEN IN CKT 55

LIGHT "OFF"

REPAIR OPEN IN CIRCUIT TO TERMINAL "E"

YES

INTERNAL TRANSMISSION PROBLEM. SEE DIAGNOSTIC AIDS

LIGHT "ON"

FAULTY CONNECTION AT "A7" OR ECM. SEE DIAGNOSTIC AIDS

TRANSMISSION WILL NOT UPSHIFT

- IGNITION "ON", ENGINE STOPPED
- DISCONNECT TRANSMISSION CONNECTOR
- CONNECT A TEST LIGHT FROM CKT 55 TO GROUND

LIGHT "ON"

- DISCONNECT RELAY
- NOTE TEST LIGHT

LIGHT "OFF"

- CONNECT A TEST LIGHT FROM RELAY HARNESS CONNECTOR TERMINAL "F" TO "12V"

LIGHT "OFF"

USE AN OHM METER TO CHECK FOR CONTINUITY BETWEEN RELAY TERMINALS "E" AND "A"

NO CONTINUITY

NO PROBLEM FOUND

CONTINUITY

REPLACE RELAY

LIGHT "ON"

CHECK FOR SHORT TO GROUND IN CKT 422. IF NOT GROUNDED, REPLACE ECM. SEE DIAGNOSTIC AIDS

LIGHT "ON"

SHORT TO VOLTAGE IN CKT 55

LIGHT "OFF"

INTERNAL TRANSMISSION PROBLEM. SEE DIAGNOSTIC AIDS

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

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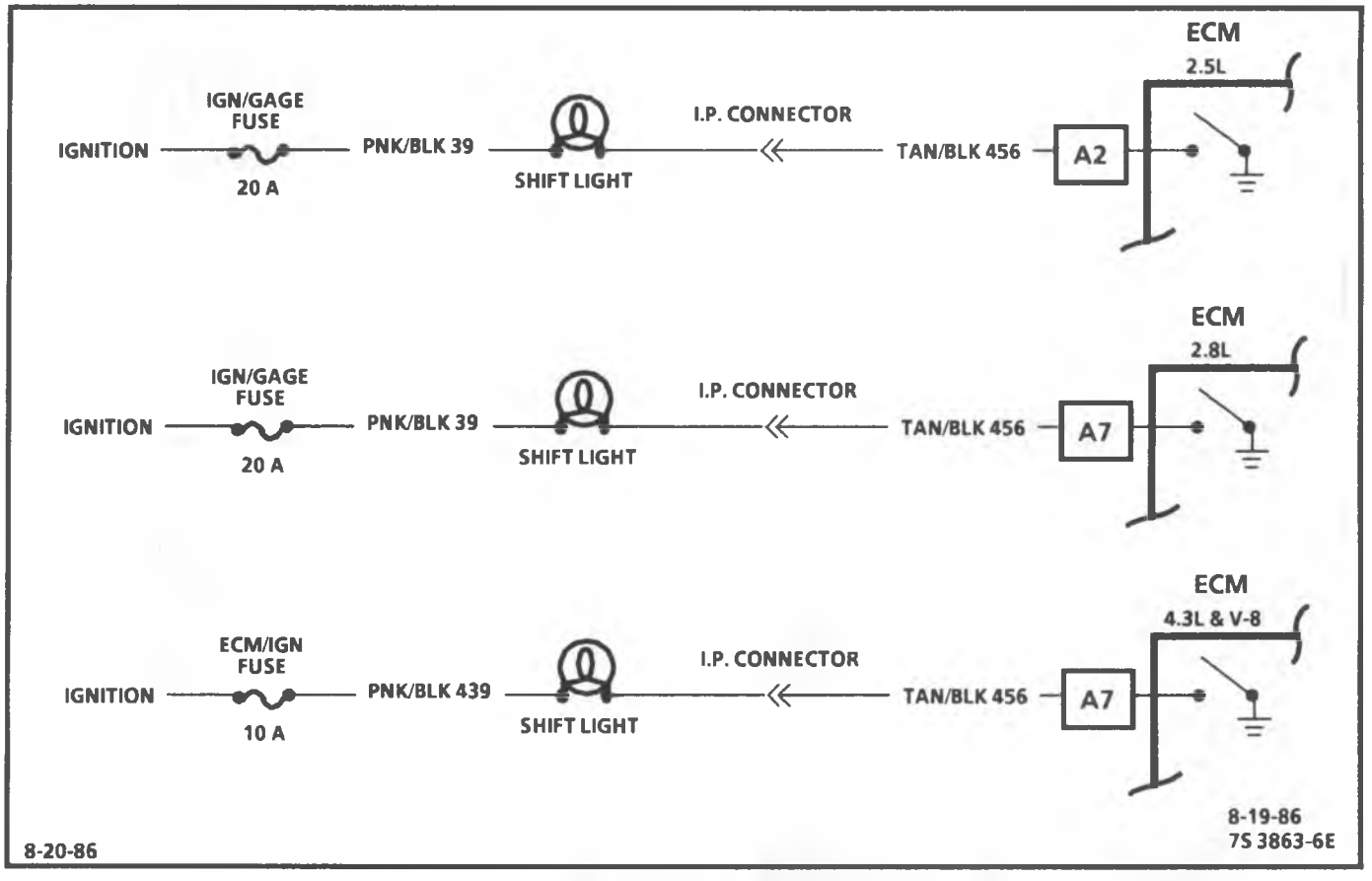


MANUAL TRANSMISSION SHIFT LIGHT CHECK

ALL ENGINES

Circuit Description:

The ECM uses information from the following inputs to control the Shift light:

- Coolant temperature
- TPS
- VSS
- RPM

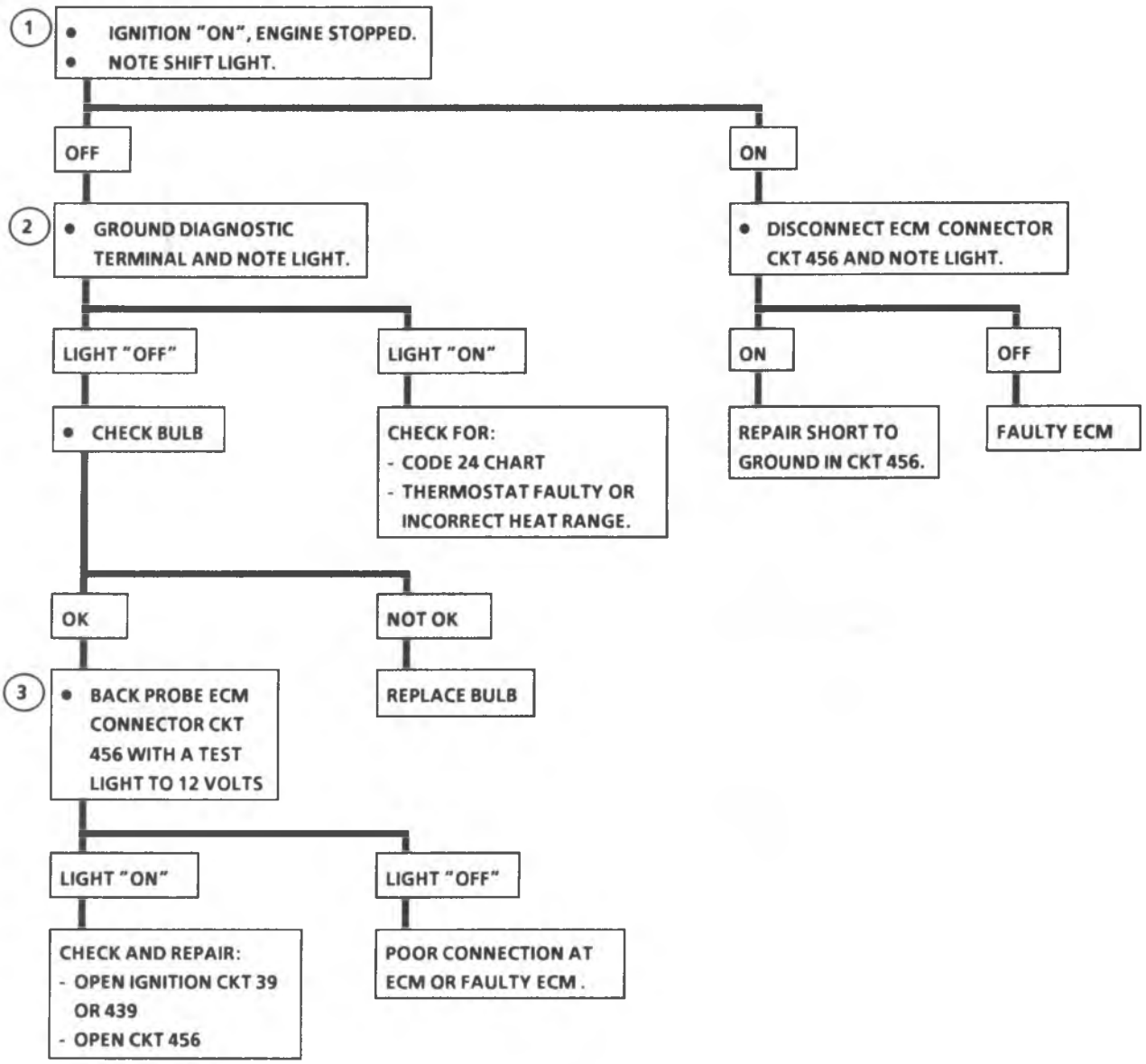
The ECM uses the meassured rpm and the vehicle speed to calculate what gear the vehicle is in. It's this calculation that determines when the Shift light should be turned on.

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

1. This should not turn "ON" the Shift light. If the light is "ON", there is a short to ground in CKT 456 wiring, or a fault in the ECM.
2. This should turn "ON" the Shift light.
3. This checks for an open in the Shift light circuit, or a faulty ECM.

MANUAL TRANSMISSION SHIFT LIGHT CHECK

ALL ENGINES



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DIAGNOSIS

TCC SYSTEM

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 4th gear switch does not operate, the TCC will 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 vehicle should be road tested and compared to a similar vehicle to see if a real problem exists. The Owner's Manual section on TCC operation should be reviewed with the driver. Another TCC complaint may be a downshift felt when going up a grade, especially with cruise control. This may not be a downshift, but a clutch disengagement due to the change in TPS to maintain cruising speed.

The electrical diagnosis of the TCC system is covered in the appropriate "Transmission Converter Clutch Electrical Diagnosis" chart.

If the ECM detects a problem in the VSS system, a Code 24 should set. In this case see Code 24 Chart.

DOWNSHIFT CONTROL SYSTEM

If the downshift control system is "ON", at all times, the transmission will not upshift.

If the downshift control system is inoperative, a forced downshift of the transmission will not occur.

In either case, refer to the "THM400 Transmission Downshift Control Electrical Diagnosis" chart.

SHIFT LIGHT SYSTEM

If the manual transmission shift light does not illuminate, or is "ON" all the time, while driving the vehicle, refer to "Manual Transmission Shift Light Check" chart.

ON-VEHICLE SERVICE

TCC SYSTEM

- Refer to Section 3, for repair of wiring.
- Refer to Section 3, for replacement of the ECM.
- For replacement of the TCC solenoid, Vehicle Speed Sensor, or Brake Switch, refer to the appropriate series Service Manual, as listed in the forward.

DOWNSHIFT CONTROL SYSTEM

- Refer to Section 3, for repair of wiring.
- Refer to Section 3, for replacement of the ECM.

Downshift Control Relay

Remove or Disconnect

1. Harness connector
2. Retaining bolt(s).

Install or Connect

1. Retaining bolt(s).
2. Harness connector.

SHIFT LIGHT SYSTEM

- Refer to Section 3, for repair of wiring.
- Refer to Section 3, for replacement of the ECM.

PARTS INFORMATION

PART NAME	GROUP
Sensor, VSS (1)	9.761
Valve, Clutch and Cruise Vac. Sw	3.885
Solenoid, TCC	4.122

SECTION 11
POSITIVE CRANKCASE VENTILATION (PCV)

CONTENTS

GENERAL DESCRIPTION

A Positive Crankcase Ventilation (PCV) system is used to provide more complete scavenging of crankcase vapors. Fresh air from the air cleaner through a filter 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 11-1 or 11-2).

The primary control is through the PCV valve (Figure 11-3), 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.

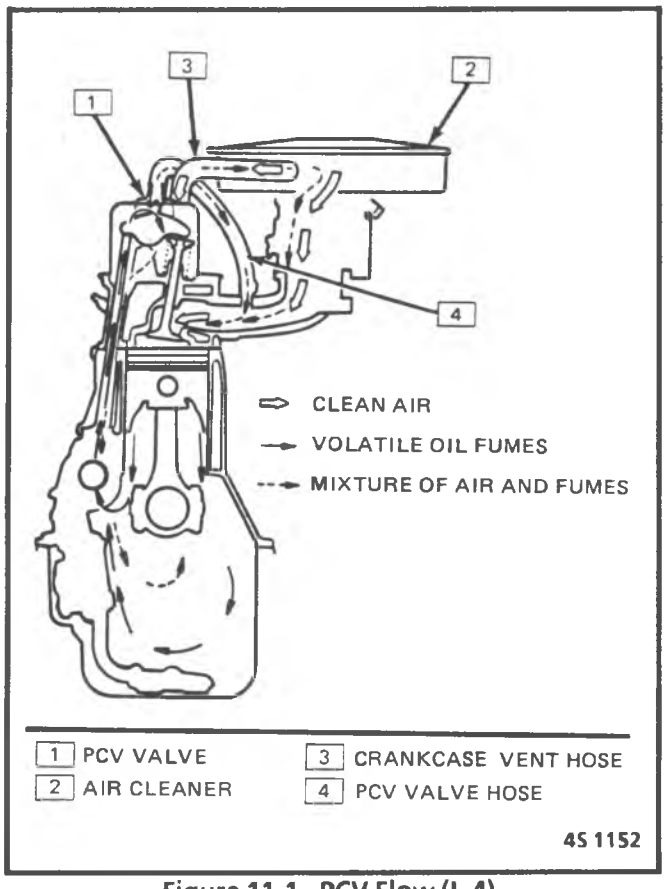


Figure 11-1 - PCV Flow (L-4)

DIAGNOSIS

RESULTS OF INCORRECT OPERATION

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

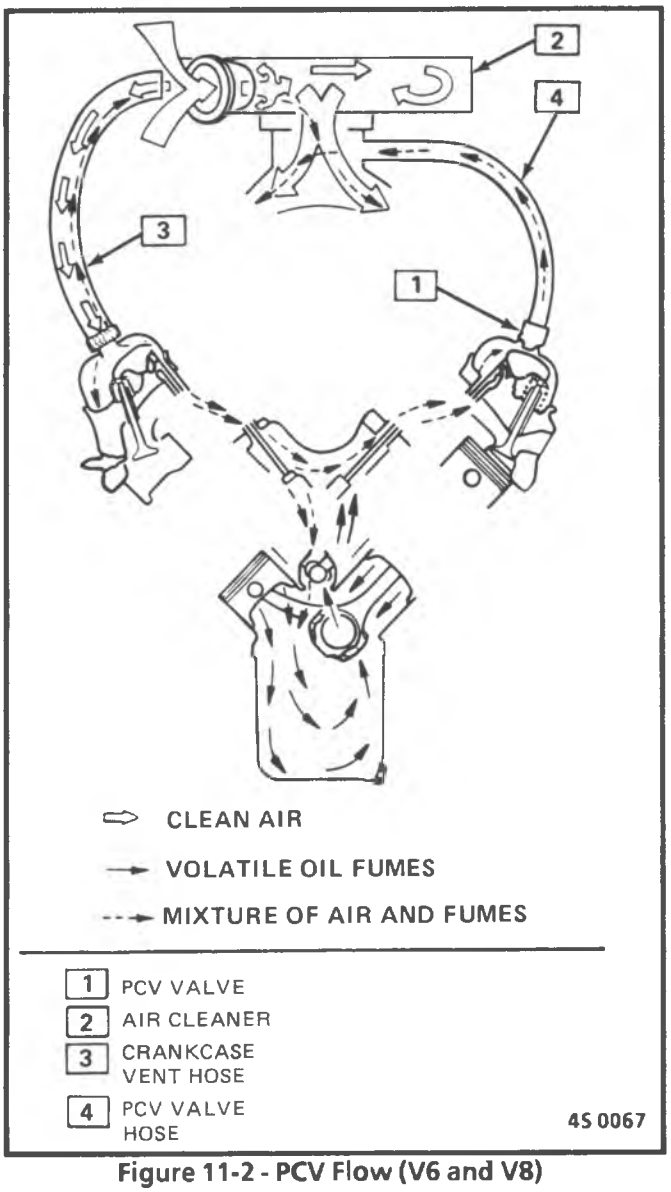


Figure 11-2 - PCV Flow (V6 and V8)

- A leaking valve or hose would cause:
  - Rough idle.
  - Stalling.
  - High idle speed.

FUNCTIONAL CHECK

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

1. Remove PCV valve from rocker arm cover.
2. Run the engne 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, manifold port at TBI unit, or PCV valve. Replace plugged or deteriorated hoses or plugged PCV valve.
4. Turn "OFF" the engine and remove PCV valve. Shake valve and listen for the rattle of check needle inside the valve. If valve does not rattle, replace valve.

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

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

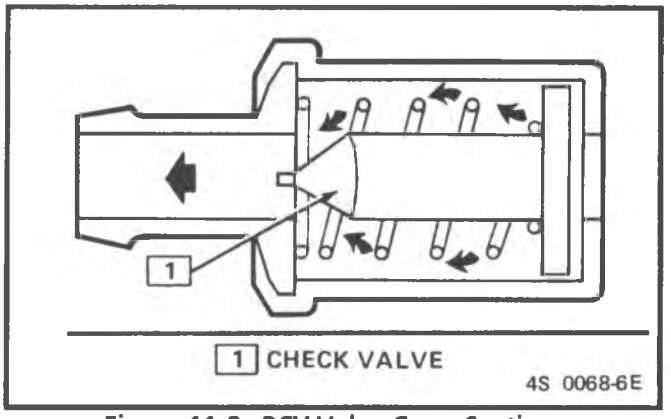


Figure 11-3 - PCV Valve Cross Section

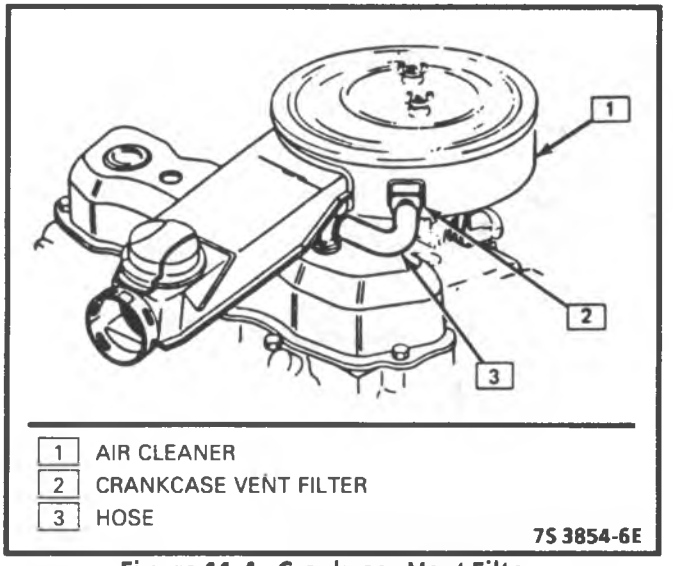


Figure 11-4 - Crankcase Vent Filter

ON-VEHICLE SERVICE

An engine can be damaged if it is operated without crankcase ventilation. Therefore, it is important to perform the "Functional Check" at intervals shown in Section 0B of the appropriate Service Manual or the vehicle's maintenance schedule.

Replace PCV components as diagnosis requires. The recommended replacement parts are listed in the Specifications section of the vehicle's owners manual.

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

PARTS INFORMATION

PART NAME	GROUP
Air Cleaner	1.150
Tube, C/Case Vent	2.383
Hose, C/Case Vent Vlv	2.170

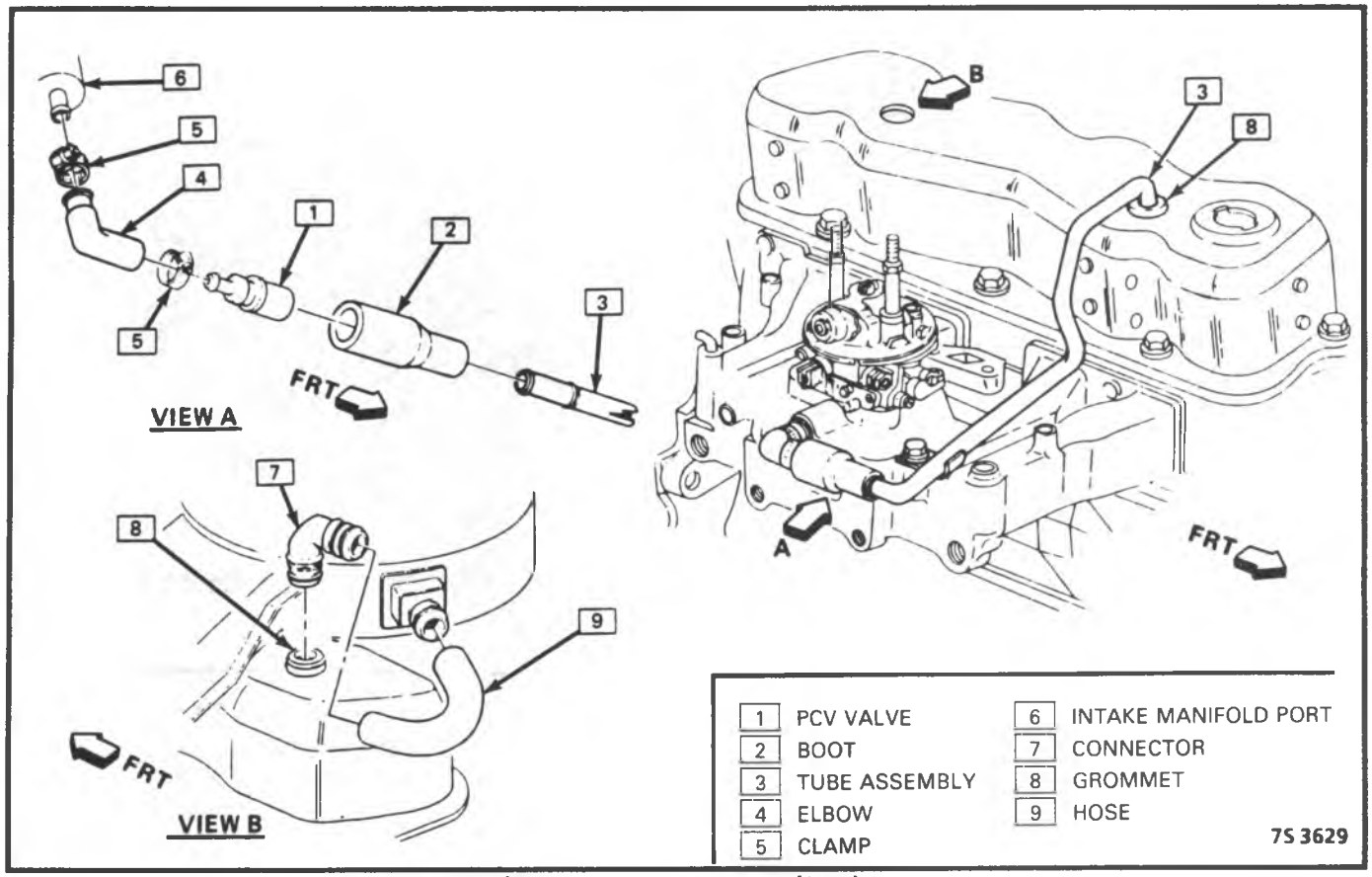


Figure 11-5 - PCV System (2.5L)

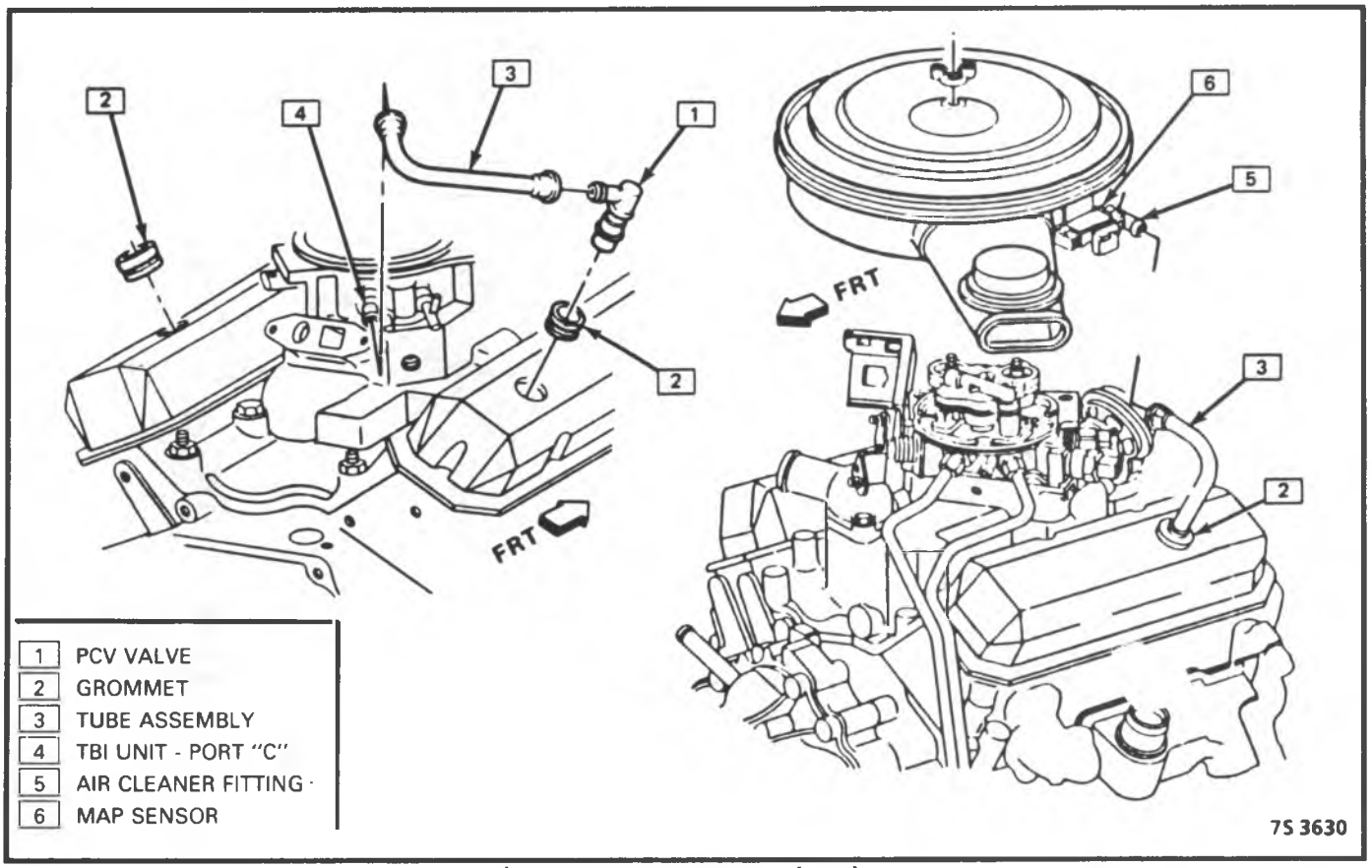


Figure 11-6 - PCV System (2.8L)

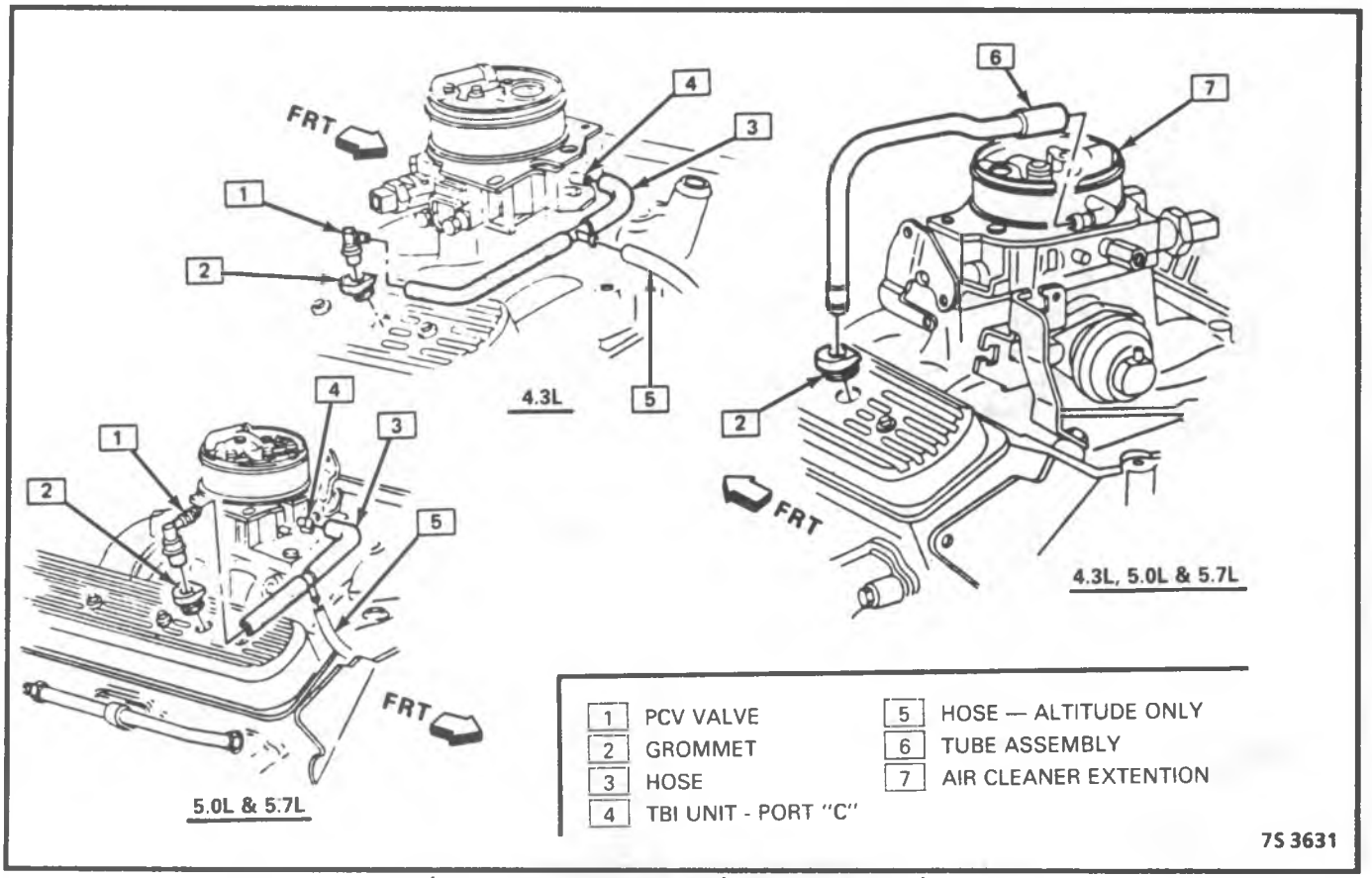


Figure 11-7 - PCV System (4.3L, 5.0L & 5.7L)

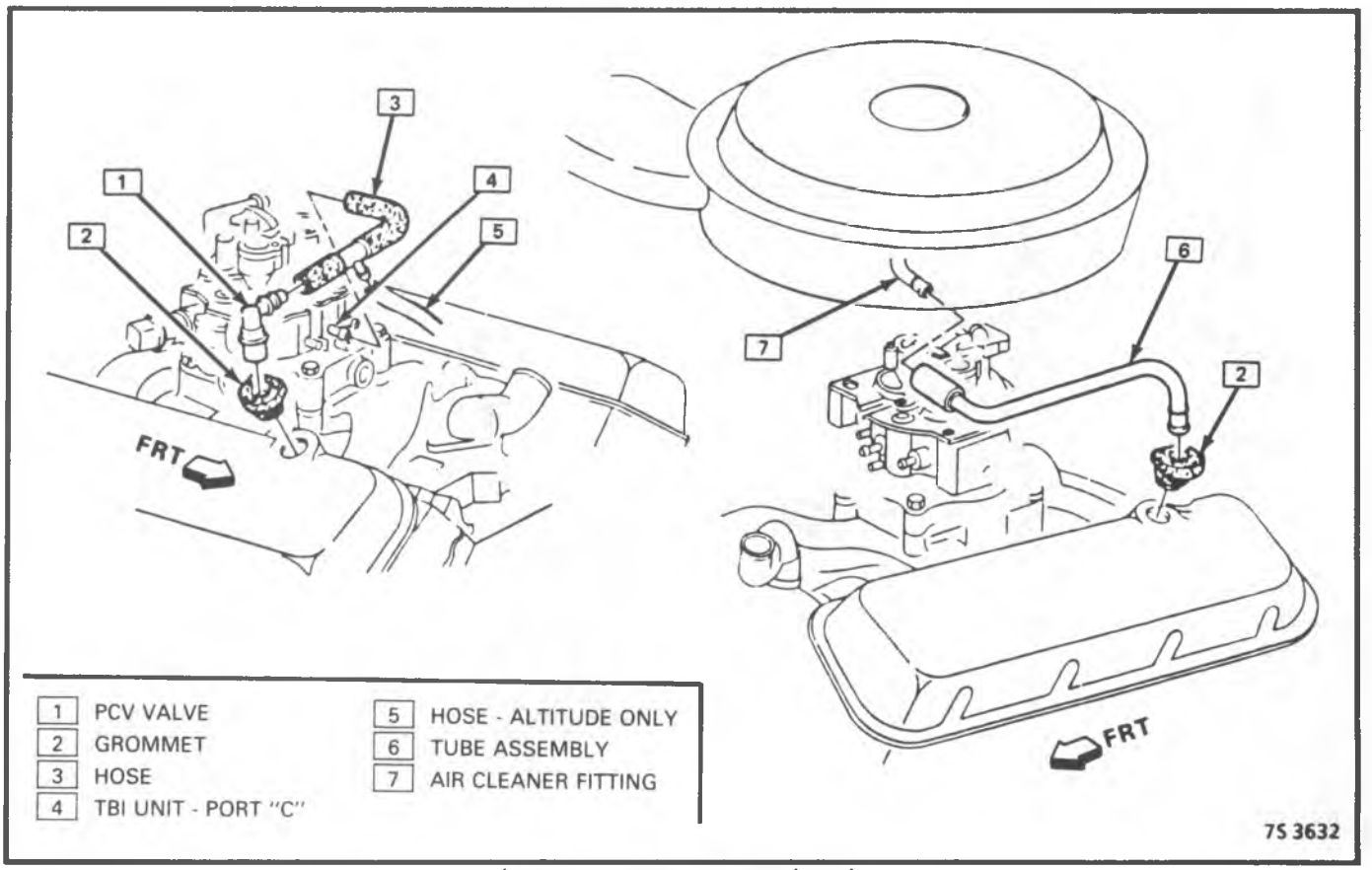


Figure 11-8 - PCV System (7.4L)

SECTION 12
THERMOSTATIC AIR CLEANER (THERMAC)

CONTENTS

GENERAL DESCRIPTION

PURPOSE

A heated intake air system is used to give good driveability under varying climatic conditions. Having a uniform inlet air temperature improves fuel vaporization.

OPERATION

All Except S/T Series

The THERMAC system (Figure 12-1) regulates incoming air temperature without the use of vacuum. The air regulating damper is controlled by means of a self-contained, wax-pellet actuated assembly mounted in the air cleaner. When incoming air is cold, the wax material sealed in the actuator is in a solid (contracted) phase and the damper closes off the cold air inelt. This causes all incoming air to be heated by the exhaust manifold. As the incoming air warms, the wax material expands by changing to liquid phase which forces out a piston to reposition the damper allowing a cold and hot air mix or all cold air to enter the engine.

S/T Series

The THERMAC system (Figure 12-2) uses a sensor, vacuum motor, and damper to regulate intake air temperature. The sensor monitors air temperature and controls the vacuum motor which in turn positions the damper. When the incoming air is cold, the sensor will apply manifold vacuum to the vacuum motor, cutting off the cold air supply. This causes all incoming air to be heated up by the exhaust manifold. As the incoming air warms up, the sensor will reduce the vacuum to the motor via an air bleed valve, thus re-positioning the damper to allow a cold and hot air mix or all cold air to enter the engine.

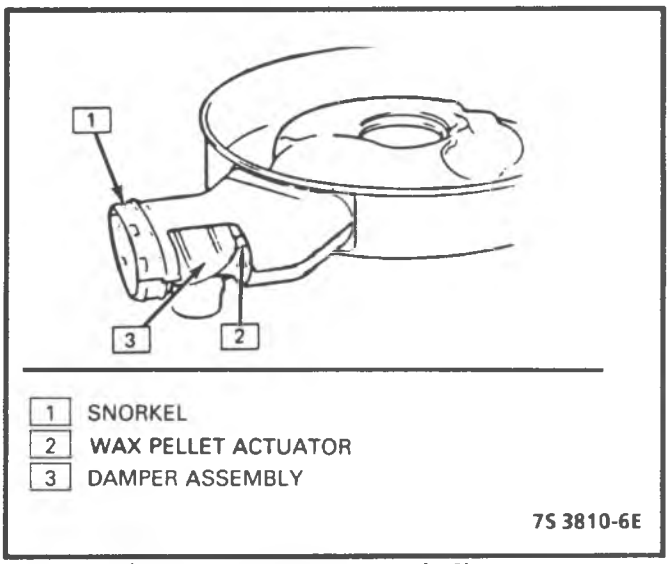


Figure 12-1 - THERMAC Air Cleaner
All Except S/T Series

DIAGNOSIS

RESULTS OF INCORRECT OPERATION

All Except S/T Series

- Hesitation during warm-up can be caused by:
  - Heat stove tube disconnected.
  - Missing or damaged air cleaner-to-TBI gasket.
  - Loose air cleaner cover & air cleaner.
  - Missing air cleaner cover seal.
  - Damper door does not close.
- Lack of power, sluggish, or spongy (on a hot engine) can be caused by:
  - Damper door does not open to outside air.

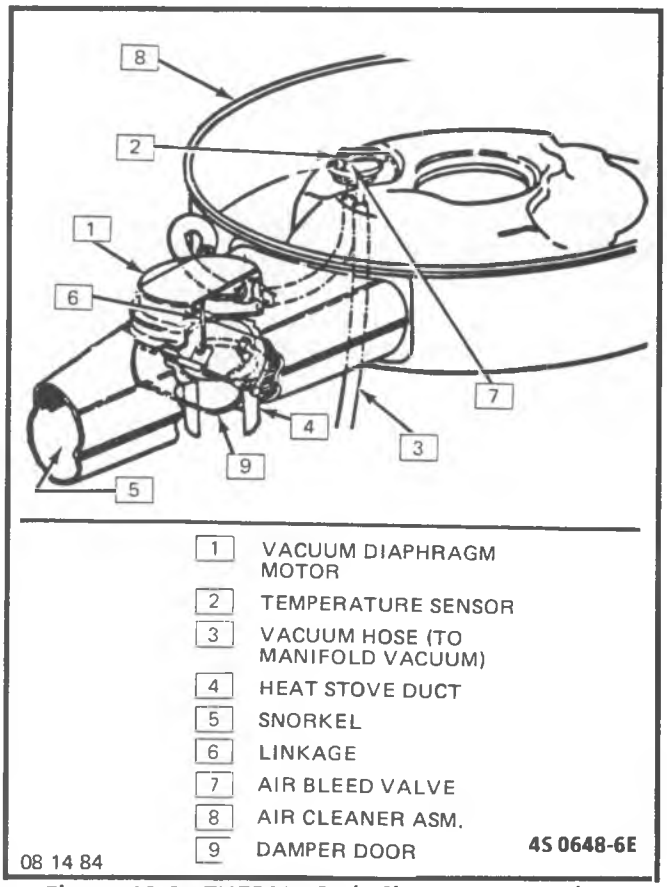


Figure 12-2 - THERMAC Air Cleaner - S/T Series

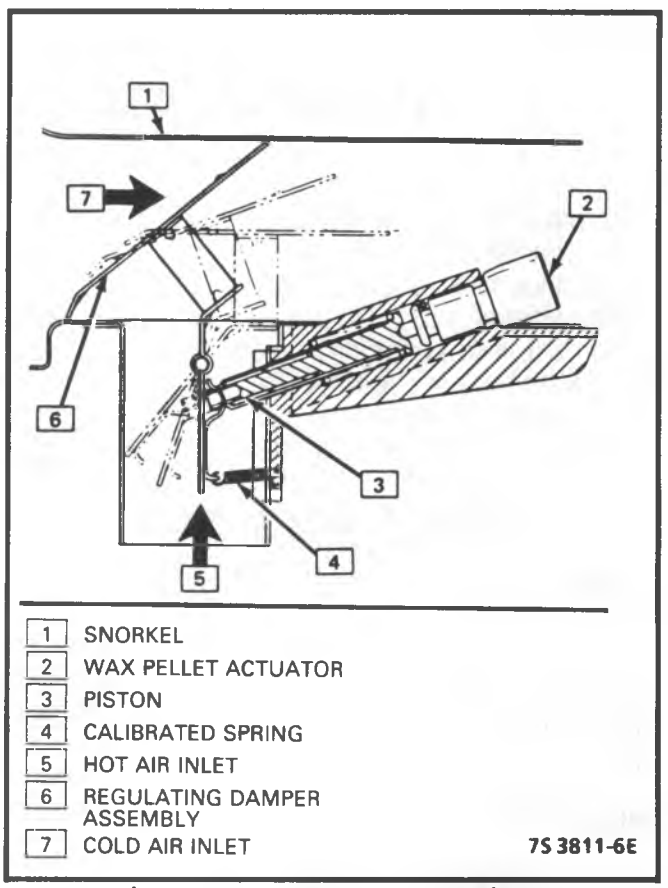


Figure 12-3 - THERMAC Operation All Except S/T Series

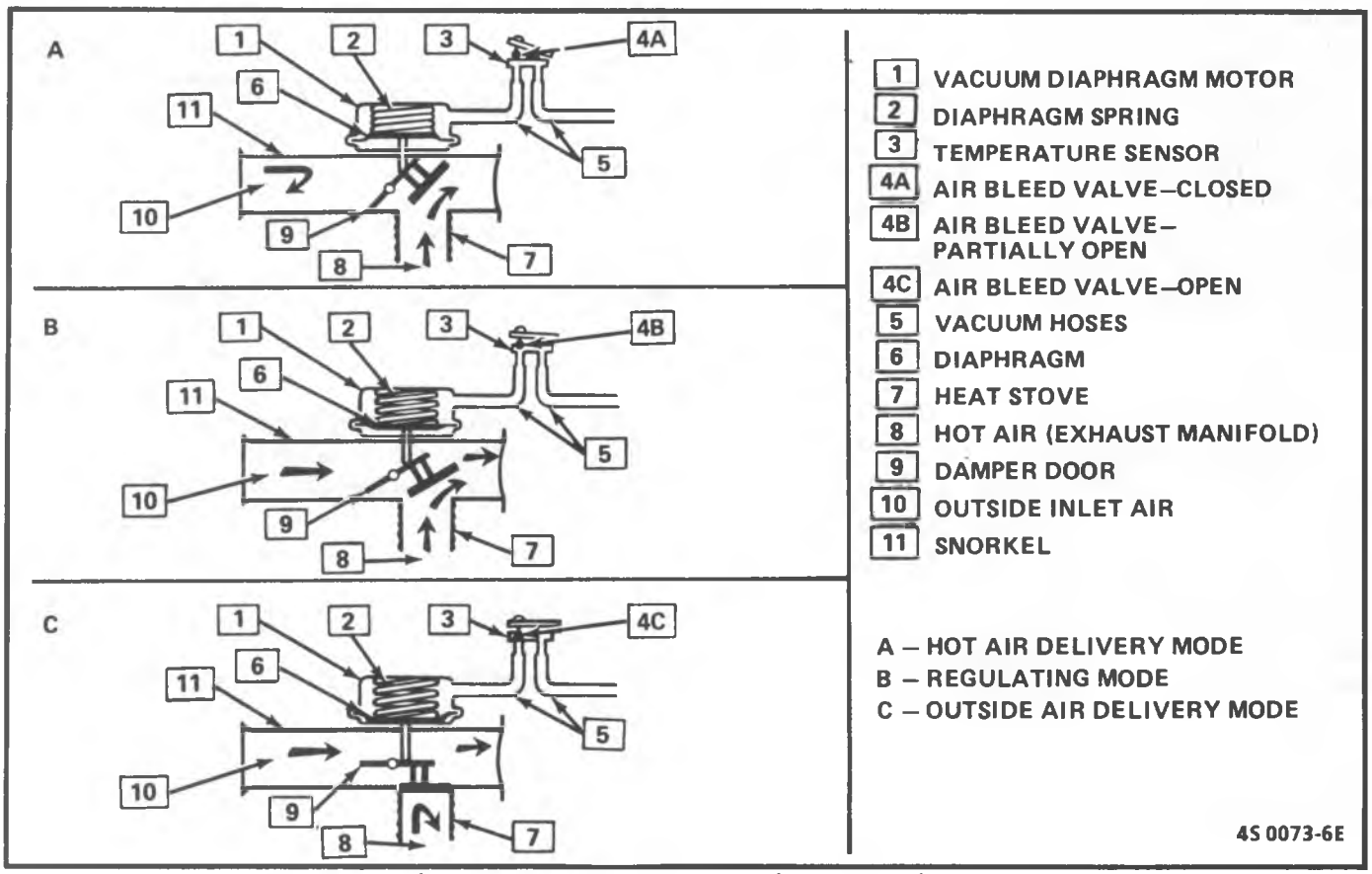


Figure 12-4 - THERMAC Operation - S/T Series

S/T Series

- Hesitation during warm-up can be caused by:
  - Heat stove tube disconnected.
  - Vacuum diaphragm motor inoperative (open to snorkel).
  - No manifold vacuum.
  - Damper door does not move.
  - Missing air cleaner to TBI seal.
  - Missing air cleaner cover seal or loose cover.
  - Loose air cleaner.
- Lack of power, sluggish, or spongy (on a hot engine) can be caused by:
  - Damper door does not open to outside air.
  - Temperature sensor doesn't bleed off vacuum.

THERMAC AIR CLEANER FUNCTIONAL CHECK

All Except S/T Series

1. Remove air cleaner assembly and cool to below 4°C (40°F). The damper door should be closed to outside air (cold air).
2. Check for presence and condition of air cleaner to throttle body gasket.
3. Reinstall air cleaner assembly and be sure heat stove tube is connected at air cleaner snorkel and exhaust manifold.
4. Start engine. Watch damper door in air cleaner snorkel. As air cleaner warms up, damper door should open slowly to outside air (cold air).
5. If air cleaner fails to operate as described, be sure calibrated spring is properly installed and damper is not binding. If OK, replace wax pellet actuator assembly.

S/T Series

1. Inspect system to be sure all hoses and heat stove tube are connected. Check for kinked, plugged or deteriorated hoses.
2. Check for presence and condition of air cleaner to throttle body gasket seal.
3. With air cleaner assembly installed, damper door should be open to outside air.
4. Start engine. Watch damper door in air cleaner snorkel. When engine is first started, damper door should move and close off outside air. As air cleaner warms up, damper door should open slowly to outside air.
5. If the air cleaner fails to operate as described above, perform vacuum motor check. If it operates, the door may not be moving at the right temperature. If the driveability problem is during warm-up, make the temperature sensor check below.

VACUUM MOTOR FUNCTIONAL CHECK

S/T Series

1. With engine off, disconnect vacuum hose at vacuum diaphragm motor.
2. Apply at least 23 kPa (7 in. Hg.) of vacuum to the vacuum diaphragm motor. Damper door should completely block off to outside air when vacuum is applied. If not, check to see if linkage is hooked up correctly.
3. With vacuum still applied, trap vacuum in vacuum diaphragm motor by bending hose. Damper door should remain closed. If not, replace vacuum diaphragm motor assembly. (Failure of the vacuum diaphragm motor assembly is more likely to be caused from binding linkage or a corroded snorkel than from a failed diaphragm. This should be checked first, before replacing the diaphragm.)
4. If vacuum motor checks OK, check vacuum hoses and connections. If OK, replace the temperature sensor.

TEMPERATURE SENSOR CHECK

S/T Series

1. Start test with air cleaner temperature below 86°F (30°C). If engine has been run recently, remove air cleaner cover and place thermometer as close as possible to the sensor. Let air cleaner cool until thermometer reads below 86°F (30°C) about 5 to 10 minutes. Reinstall air cleaner on engine and continue to Step 2.
2. Start and idle engine. Damper door should move to close off outside air immediately, if engine is cool enough. When damper door starts to open (in a few minutes), remove air cleaner cover and read thermometer. It must read about 131°F (55°C).
3. If the damper door is not open to outside air at temperature indicated, temperature sensor is malfunctioning and must be replaced.

ON-VEHICLE SERVICE

AIR CLEANER ELEMENT

Remove or Disconnect

1. Air cleaner cover.
2. Old element.
3. Clean Housing.

Install or Connect

1. New element.
2. Air cleaner cover. Do not over-torque nuts (install finger-tight).

AIR CLEANER

Refer to Figures 12-8 to 12-13 for repair or replacement of air cleaner.

VACUUM DIAPHRAGM MOTOR

S/T Series (Figure 12-5)

Remove or Disconnect

1. Air cleaner.
2. Vacuum hose from motor.
3. Drill out the two spot welds initially with a 1.6mm (1/16") drill, then enlarge as required to remove the retaining strap. Do not damage the snorkel tube.
4. Motor retaining strap.
5. Lift up motor, cocking it to one side to unhook the motor linkage at the control damper assembly.

Install or Connect

1. Drill a 2.8mm (7/64") hole in snorkel tube at center of vacuum motor retaining strap.
2. Vacuum motor linkage into control damper assembly.
3. Use the motor retaining strap and sheet metal screw provided in the motor service package to secure motor to the snorkel tube. Make sure the screw does not interfere with the operation of the damper assembly. Shorten screw if required.
4. Vacuum hose to motor and install air cleaner.

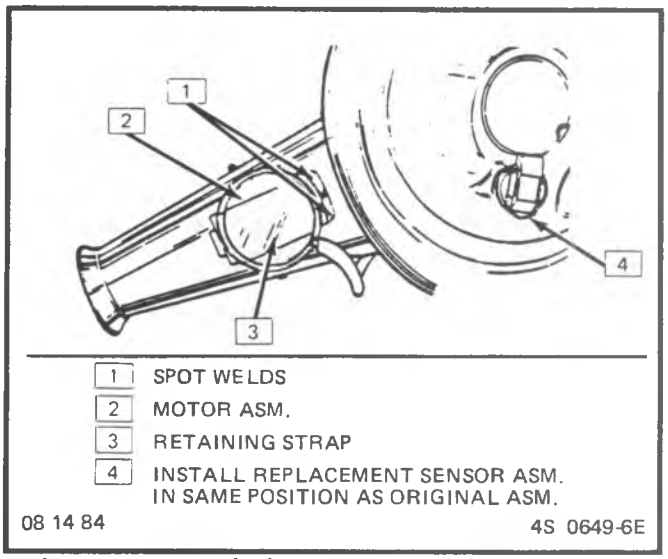


Figure 12-5 - Replacing THERMAC Vacuum Motor S/T Series

WAX PELLET ACTUATOR

All Except S/T Series (Figure 12-6)

Remove or Disconnect

1. Air cleaner.
2. Spring.
3. Rivits retaining actuator
4. Actuator.

Install or Connect

1. Actuator.
2. Spring.
3. Rivits
4. Air cleaner.

SENSOR

S/T Series (Figure 12-7)

Remove or Disconnect

1. Air cleaner.
2. Hoses at sensor.
3. Pry up tabs on sensor retaining clip. Remove clip and sensor from air cleaner. Note position of sensor for installation.

Install or Connect

1. Sensor and gasket assembly in original position.
2. Retainer clip on hose connectors.
3. Vacuum hoses and air cleaner on engine.

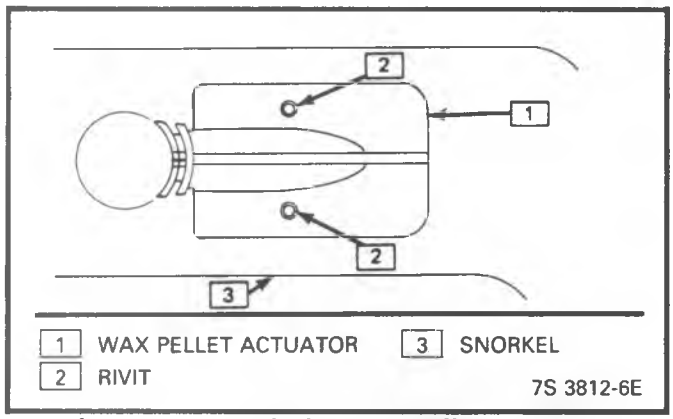


Figure 12-6 - Replacing Wax Pellet Actuator All except S/T Series

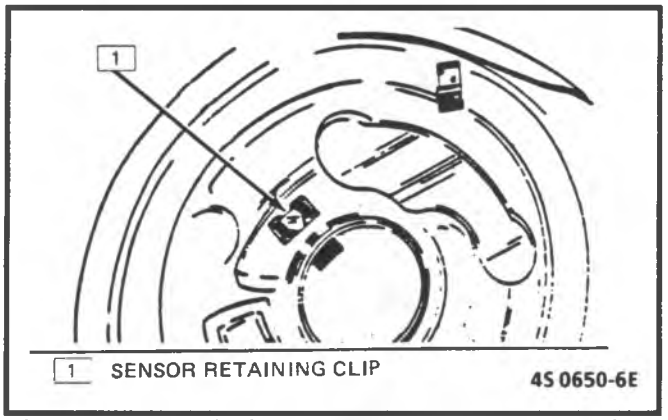


Figure 12-7 - Replacing THERMAC Sensor - S/T Series

PARTS INFORMATION

PART NAME	GROUP
Air Cleaner	3.402
Element (Paper)	3.410
Nut, A/Cl	3.403
Seal, Air Cleaner	3.403
Sensor, A/Cl	3.415
Motor, A/Cl Vac Diaph	3.415
Tube, Eng Air Heat Stove	3.417
Stove, Eng Air Heat	3.417

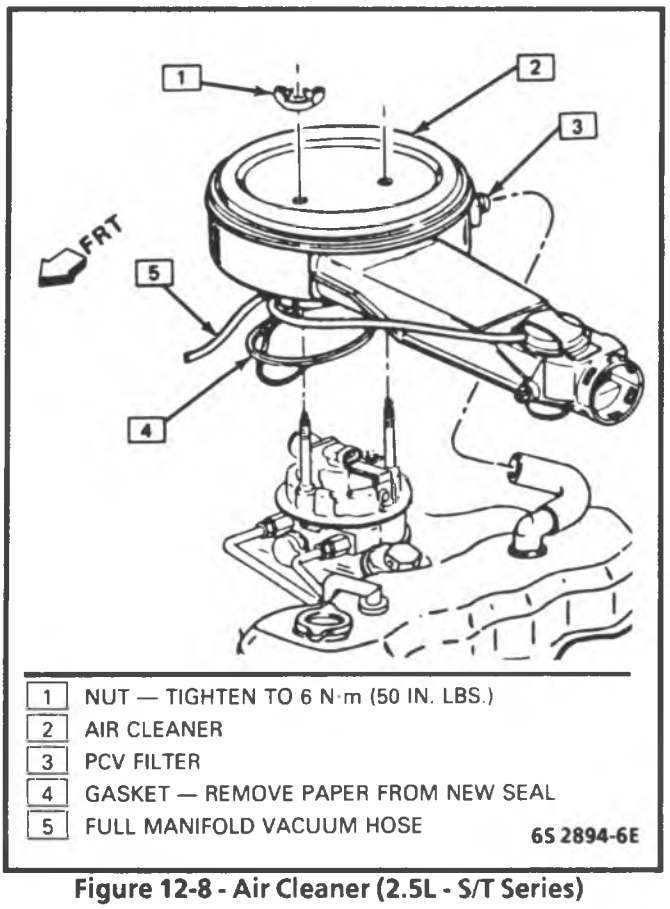


Figure 12-8 - Air Cleaner (2.5L - S/T Series)

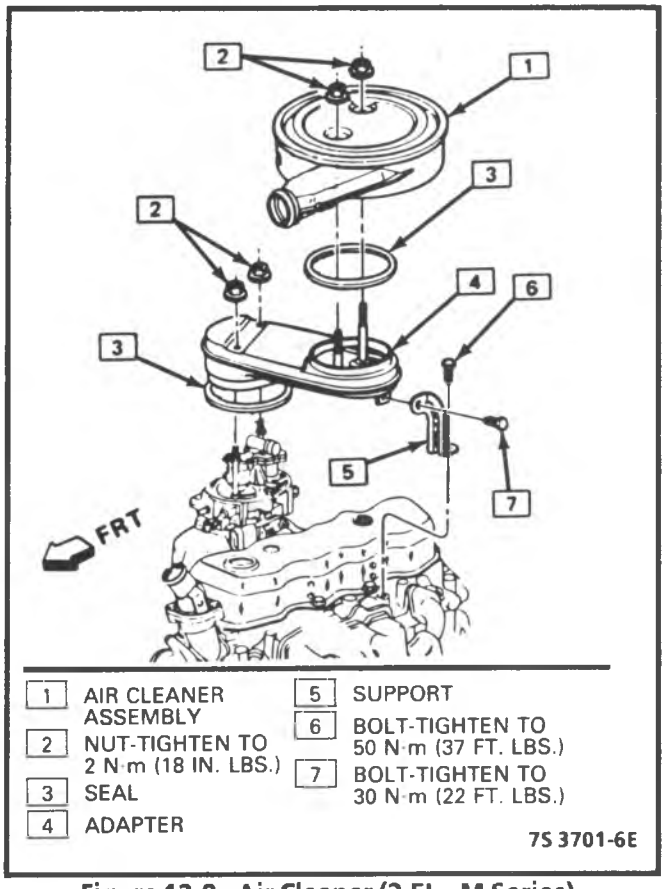


Figure 12-9 - Air Cleaner (2.5L - M Series)

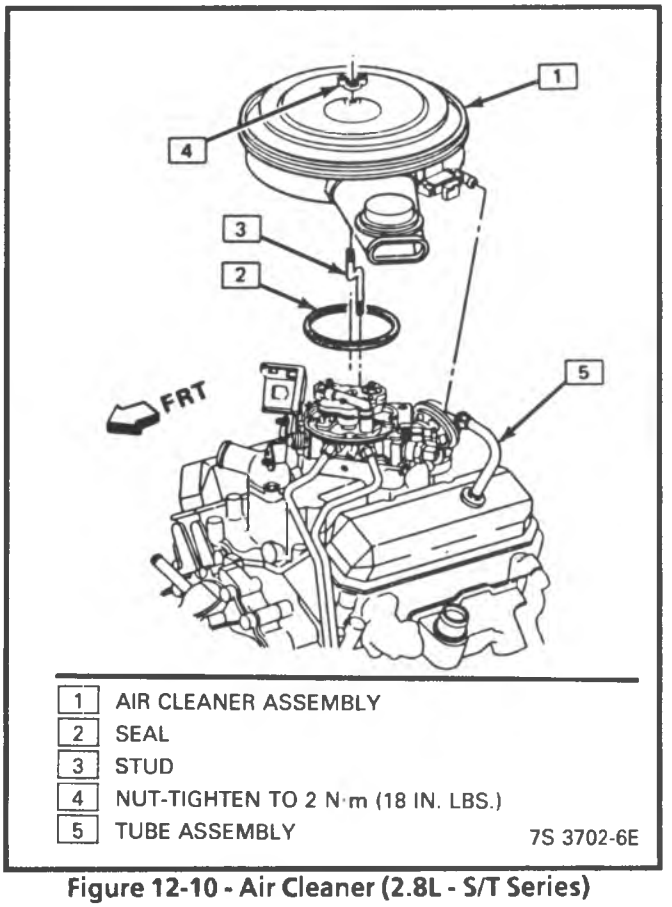
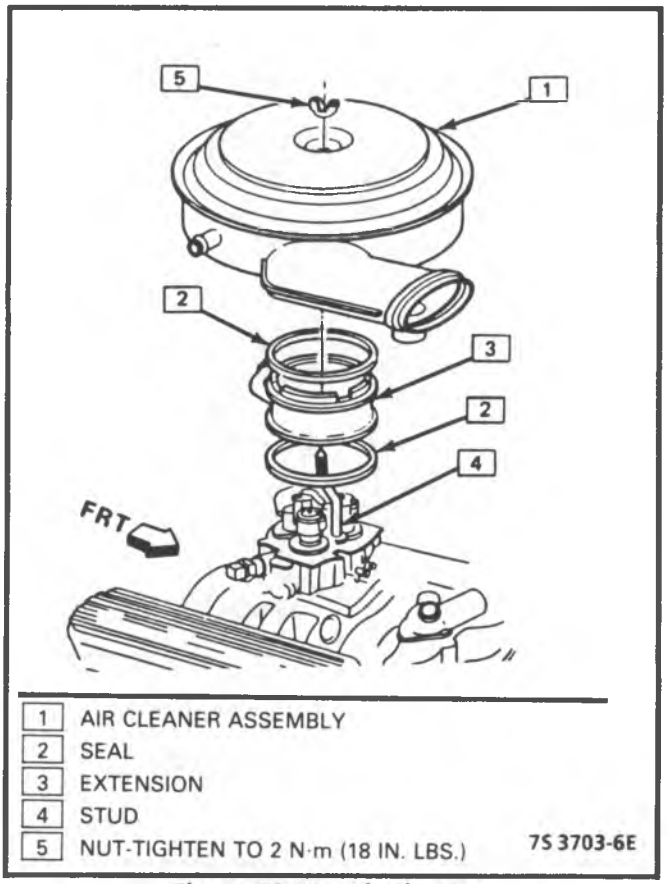


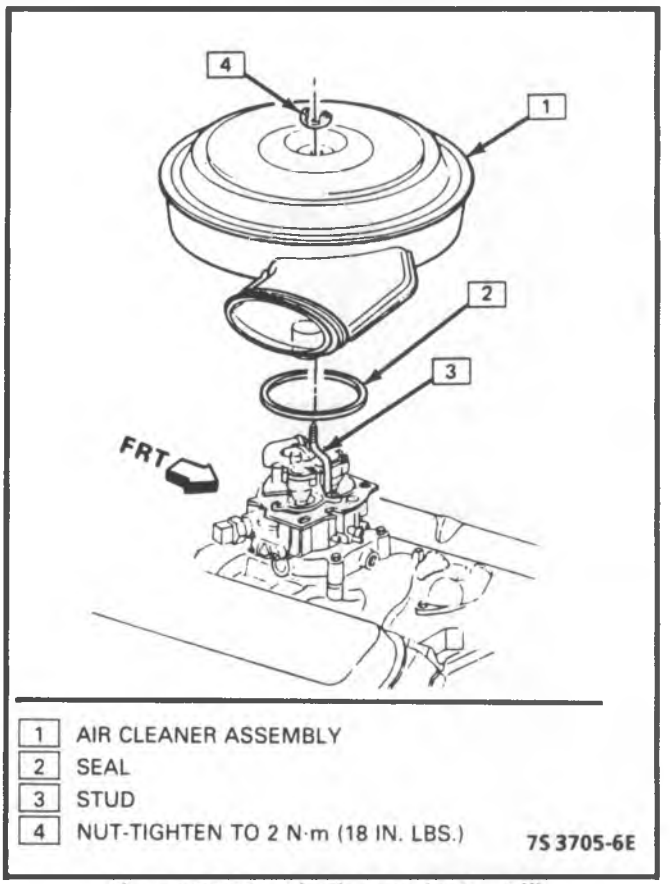
Figure 12-10 - Air Cleaner (2.8L - S/T Series)



1 AIR CLEANER ASSEMBLY
2 SEAL
3 EXTENSION
4 STUD
5 NUT-TIGHTEN TO 2 N·m (18 IN. LBS.)

7S 3703-6E

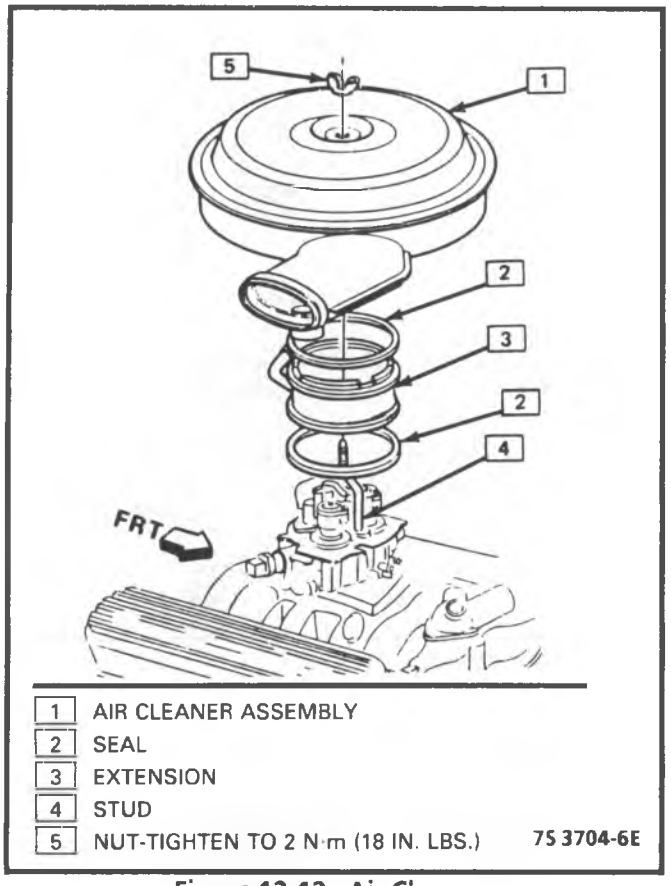
Figure 12-11 - Air Cleaner (4.3L, 5.0L & 5.7L - M & G Series)



1 AIR CLEANER ASSEMBLY
2 SEAL
3 STUD
4 NUT-TIGHTEN TO 2 N·m (18 IN. LBS.)

7S 3705-6E

Figure 12-13 - Air Cleaner (7.4L - All)



1 AIR CLEANER ASSEMBLY
2 SEAL
3 EXTENSION
4 STUD
5 NUT-TIGHTEN TO 2 N·m (18 IN. LBS.)

7S 3704-6E

Figure 12-12 - Air Cleaner (4.3L, 5.0L & 5.7L - C, K, P, R & V Series)

SECTION 13
SPECIAL TOOLS
CONTENTS

GENERAL

The special tools required to service the fuel and emission systems are illustrated in Figures 13-1 through 13-3.

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. A test light or voltmeter must be used when specified in the procedures. They must NOT be interchanged. Care should be taken to not deform terminals when testing.

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.

"SCAN" TOOL

The Computer Command Control ALDL connector under the dash, has a variety of information available on Serial Data line terminal "E" or "M" (depending on engine). There are several "Scan" tools available 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.

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.

Tree Code Charts incorporate diagnosis procedures using an ALDL "Scan" tool where possible.

Some Electronic Control Modules 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.

"SCAN" TOOL MODES

Normal (Open) Mode

Not all systems will transmit information on the Serial Data Line while in this mode.

On systems 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 in ECM are bypassed
- EST (spark) is advanced
- IAC will control engine idle to 1000 rpm ± -50 RPM.
- P/N restrict 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 MEM-CAL. The Calpak MEM-CAL 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 manipulation of 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:

A/C Clutch

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

A/C Request

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

AD Bat

Displays the battery voltage detected at the ECM ignition input.

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.

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.

Codes

Will display any code stored in the ECM memory.

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.

Desired RPM

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

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.

4th gear

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

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.

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).

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.

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.

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) Sensor

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 ±.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.

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.

MPH

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

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.

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.

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.

PPSW

This is the voltage on the fuel pump feed circuit.

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.

Shift Light

Displays "YES" when the ECM is commanding the shift light to turn "ON".

Throttle Angle

Displays in percent the amount the throttle is open.

Throttle Position Sensor (TPS)

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).

Transmission 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".

HIGH IMPEDANCE MULTIMETER
(DIGITAL VOLTMETER-DVM)
J34029-A/BT8623

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-A/BT8334

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.

J35616/BT8256

CONNECTOR TEST ADAPTER KIT
Used to make electrical test connections in current Weather Pack, Metri - Pack and Micro-Pack style terminals.

8-15-86
*7S 3534-6E

Figure 13-1 Special Tools (1 of 3)

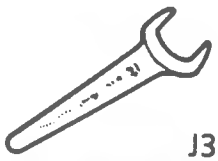
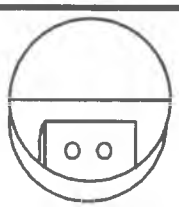
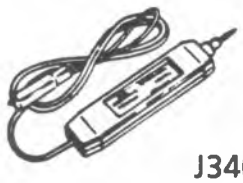
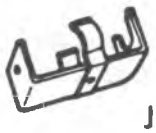
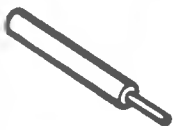
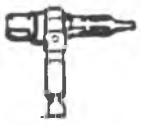
 J29533A/BT8127	**OXYGEN SENSOR WRENCH** Used to remove or install the oxygen sensor.
 J33031/BT8130	**IDLE AIR CONTROL WRENCH** Used to remove or install IAC valve on throttle body.
 BT8320	**INJECTOR TEST LIGHT** Used to check electrical circuit to a TBI 220 fuel injector
 J34730-2A/ BT8329A	**INJECTOR TEST LIGHT** Used to check electrical circuit to a TBI 700 fuel injector.
 J34636/BT8405	**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/BT8446	**METRI-PACK TERMINAL REMOVER** Used to remove 150 series Metri-Pack "pull-to-seat" terminals from connectors. Refer to wiring harness service in Section 3 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 3 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. 8-19-86 * 7S 3535-6E

Figure 13-2 Special Tools (2 of 3)



J26792/BT7220-1

SPARK TESTER

Use to check available secondary ignition voltage. Also called an ST125.

J29698-A/BT8251

FUEL LINE WRENCH

Used to disconnect or connect 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.

J29658A/BT8205

FUEL PRESSURE GAGE

Used to check and monitor fuel line pressure.

J34020

FUEL PRESSURE GAGE

Used to check and monitor fuel line pressure.

J24187

FUEL TANK SENDING AND PUMP UNIT

Used to remove and install cam lock nut on the fuel tank sending and pump unit in Section 4.

J24642-F/BT7220

IGNITION MODULE TESTER

Used to test ignition module in Section 5.

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Figure 13-3 Special Tools (3 of 3)

SPECIFICATIONS

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.

6-4-86
7S 3536-6E

SECTION 14

ABBREVIATIONS AND GLOSSARY OF TERMS

Abbreviations used in this manual 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) - The amount of air-to-fuel for combustion of fuel. Ideal ration is 14.7 parts of air to 1 part of fuel.

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)

BLOCK LEARN - ECM memory that adjusts the air/fuel ratio on a semipermanent basis.

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.

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 - Designed with feedback information to the ECM to maintain an optimum air/fuel ratio (14.7:1), output.

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

CONV. - CATALYTIC CONVERTER - Containing platinum and palladium to speed up conversion of HC and CO.

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. - Grounding terminal "B" of ALDL Connector will flash or display a code. When grounded with the engine running will enter the "Field Service Mode".

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.

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.

ECU - ENGINE CALIBRATION UNIT - An electronic component which can be specifically programmed to the design of each vehicle model to control the M/C solenoid. The ECU plugs into the electronic control module (ECM). The ECU is usually called a PROM.

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.

ENERGIZE/DE-ENERGIZE - When current is passed through a coil (energized) such as a solenoid, a plunger is pulled or pushed. When the voltage to the solenoid is turned off, (de-energized), a spring raises or lowers 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.

FI - FUEL INJECTION - Computer Command Control using throttle body fuel injection.

GROUND - A Wire shorted to ground. A comon return for an eclectrical circuit.

HC - HYDROCARBONS - One of the pollutants found in engine exhaust. Hydrogen and carbon in gasoline.

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.

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 a fuel injected system 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 - Refers to ignition switch and lock.

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 - Contains instrument gages and indicator lights to indicate performance of the vehicle.

KM/H - 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

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.

MEM-CAL - Contains specific calibrations to meet the requirements of a specific engine..

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.

N•m - 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. Nitrogen that combines with oxygen to form oxdes of nitrogen.

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

O LOOP - 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 (0_2) in the exhaust stream.

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

P/N - PARK/NEUTRAL - Refers to switch used to indicate to the ECM the position of the automatic transmission.

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 - A device for indicating speed for rotation.

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 - A measurement of electrical pressure.

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 - Appears on a plate attached to the windshield pillar.

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.

NOTES


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