ECM REPLACEMENT

— NOTE —

When replacing a production ECM with a service controller, transfer the Production Broadcast Code and Production ECM Number to the service controller label. Do not record on the removable cover. This provides identification of the ECM throughout the service life of the vehicle.

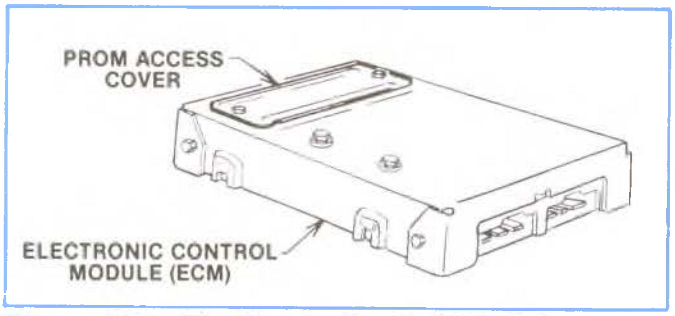


Figure 5-31, **Electronic Control Module.**

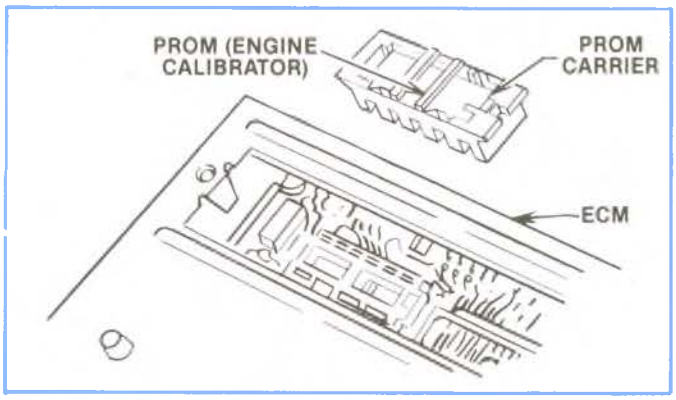


Figure 5-32, **Calibrator.**

• REMOVE OR DISCONNECT

— NOTE —

To prevent internal ECM damage, the ignition must be off when disconnecting or reconnecting the ECM connector.

See Figure 5-31 and 5-32.

1. ECM mounting hardware.
2. Connector from ECM.
3. ECM
4. Calibrator access cover.
5. Calibrator. Grasp the calibrator carrier and gently rock from side to side and upward.

• INSTALL OR CONNECT

Record Production Broadcast Code and Production ECM Number from removed ECM to service controller. Any time a calibrator is installed backwards and the ignition is turned on, the calibrator will be destroyed.

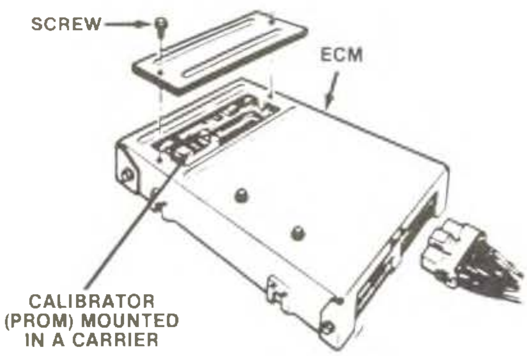
1. Calibrator removed from previous ECM. Position carrier squarely over the socket and press down firmly on the top of the carrier. While pressing down on carrier, use a narrow blunt tool and alternately pressing down on either end of the calibrator body to seat into socket.
2. Access cover.
3. Connector to ECM.
4. ECM with mounting hardware.

• PART INFORMATION

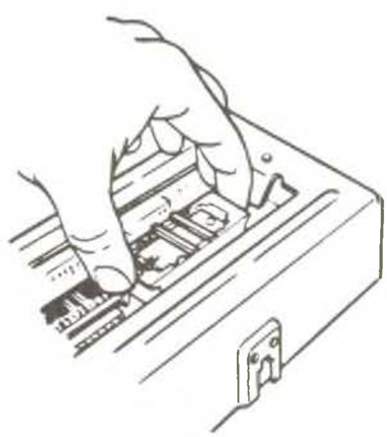
PART NAME — GROUP
Controller, ECM — 3.670
Calibrator, PROM — 3.670

— NOTE —
To prevent internal damage, the ignition must be off when disconnecting or reconnecting the ECM connector.

1. Remove ECM mounting hardware.
2. Disconnect the connector from the ECM.
3. Remove ECM.
4. Remove calibrator access cover.

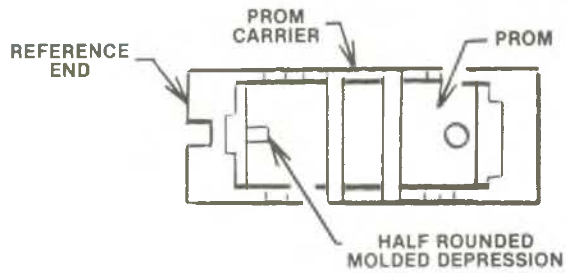


5. Remove calibrator. Grasp the calibrator carrier and gently rock from side to side and upward.



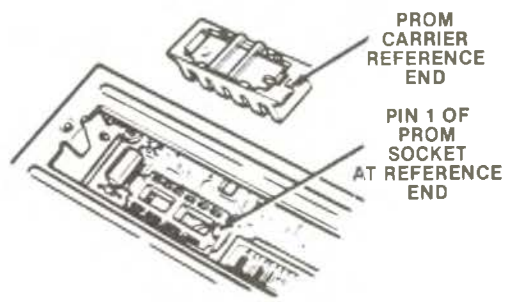
- Replacement ECM (called controller) is supplied without a PROM. Care should be taken when removing a PROM from and ECM that is being replaced as this PROM will be used in a service controller.

6. A correct PROM in a carrier is where the squared off symmetrical end of the carrier is at the same end as the half-rounded molded depression on the PROM. If a new PROM is to be installed, check to see that the installation of the PROM to-carrier is correct. Check for correct PROM part number.

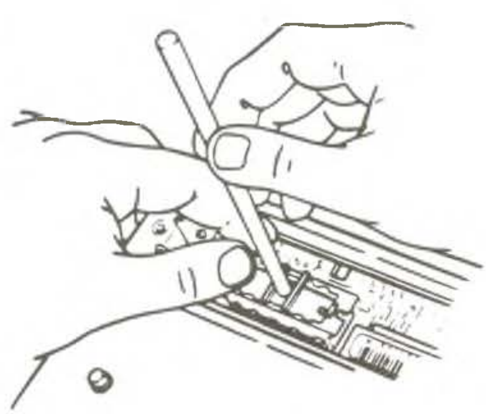


7. If a service controller is to be installed, check the service part number to make sure that it is the correct controller for the replaced ECM.
8. Position the carrier squarely over the PROM socket with the squared off symmetrical end of the carrier aligned with the small notch in the socket at the pin 1 end.

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



9. Press down firmly on the top of the carrier.
10. While firmly pressing down on the carrier, take a narrow blunt tool and press down on the body of the PROM. Try to seat the PROM in the socket squarely by alternately pressing on either end of it.



11. Install access cover.
12. Install mounting hardware.
13. Install ECM and connect the connector.

Figure 5-33, Calibrator Replacement.

1984 ECM Check 6.2L (LH6)

See Figures 5-34 and 5-35. The ECM check is made to determine why the "Check Engine" light remains "ON" after the engine is started. Normally, the ECM will not recognize a fault for at least 10 seconds after start-up. If the CEL remains "ON", the ECM has lost power, ground or the signal that turns the CEL "OFF" has been lost. Since the CEL is remote from the ECM, it can recognize faulty ECM power or ECM.

1. Check for proper CEL signal at ALCL. It should normally be about battery voltage until the vehicle is started.
2. Check for 12 volts to ECM ignition feed terminals. Battery voltage should normally be present at both terminals.
3. Check for good ECM ground. Light should normally be "ON". If ECM power and ground terminals are OK, check for good ECM to connector terminal contact.
4. When the vehicle is started, the ECM turns the CEL "OFF" and voltage at ALCL should normally drop under 6 volts.

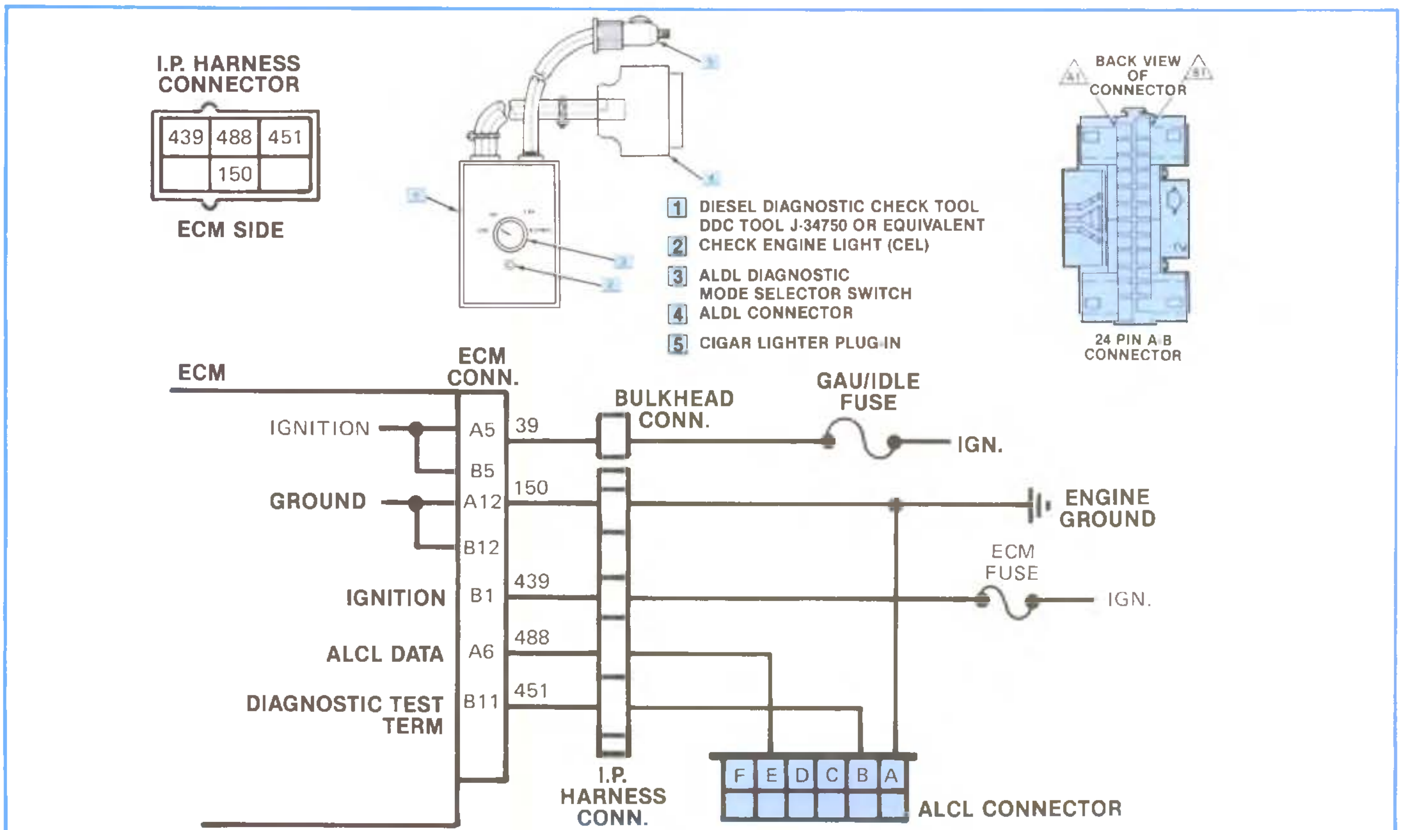


Figure 5-34, 1984 ECM Check Schematic.

1984 DECS
6.2L (LH6)
ECM CHECK

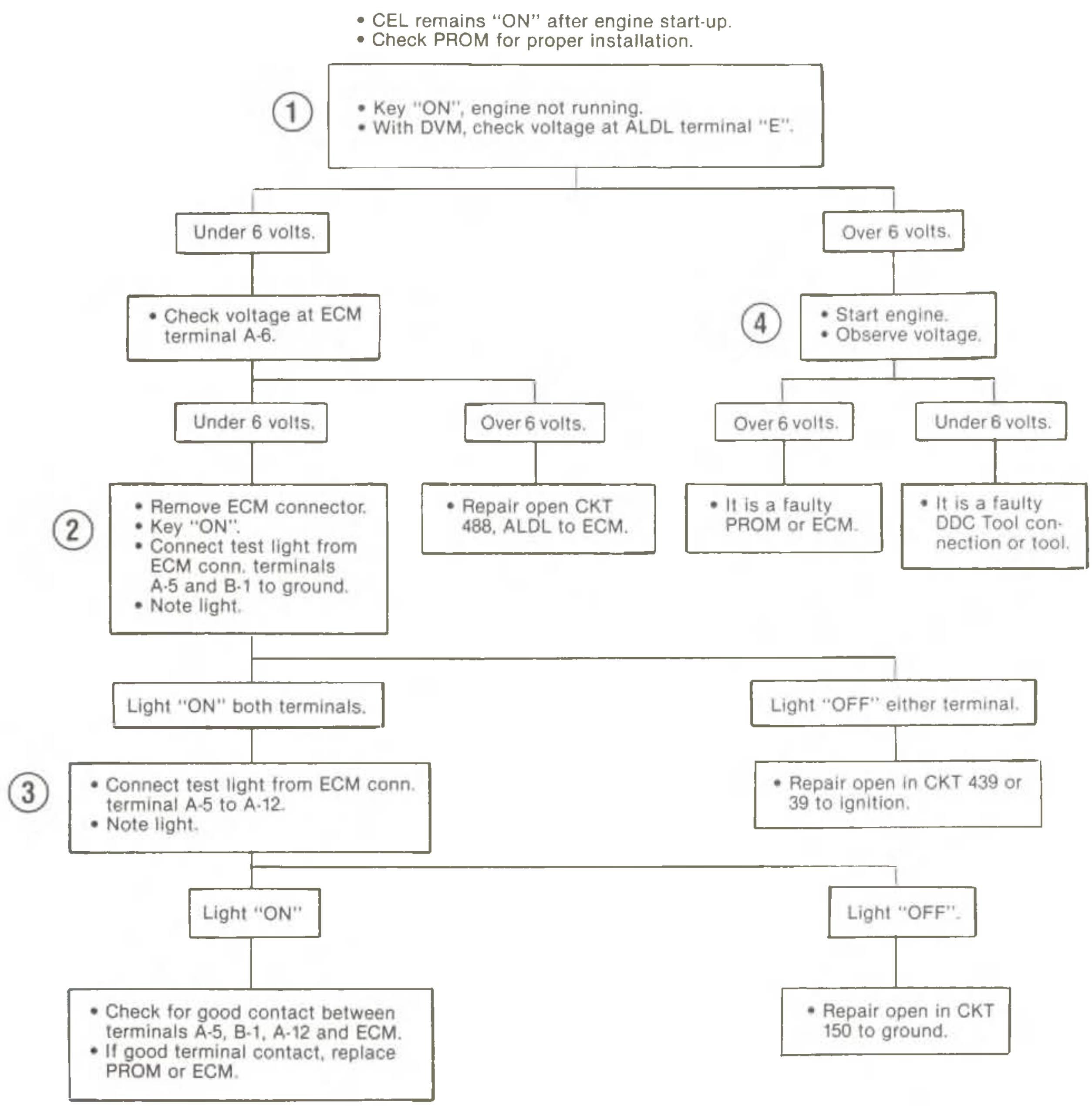


Figure 5-35, **ECM Check.**

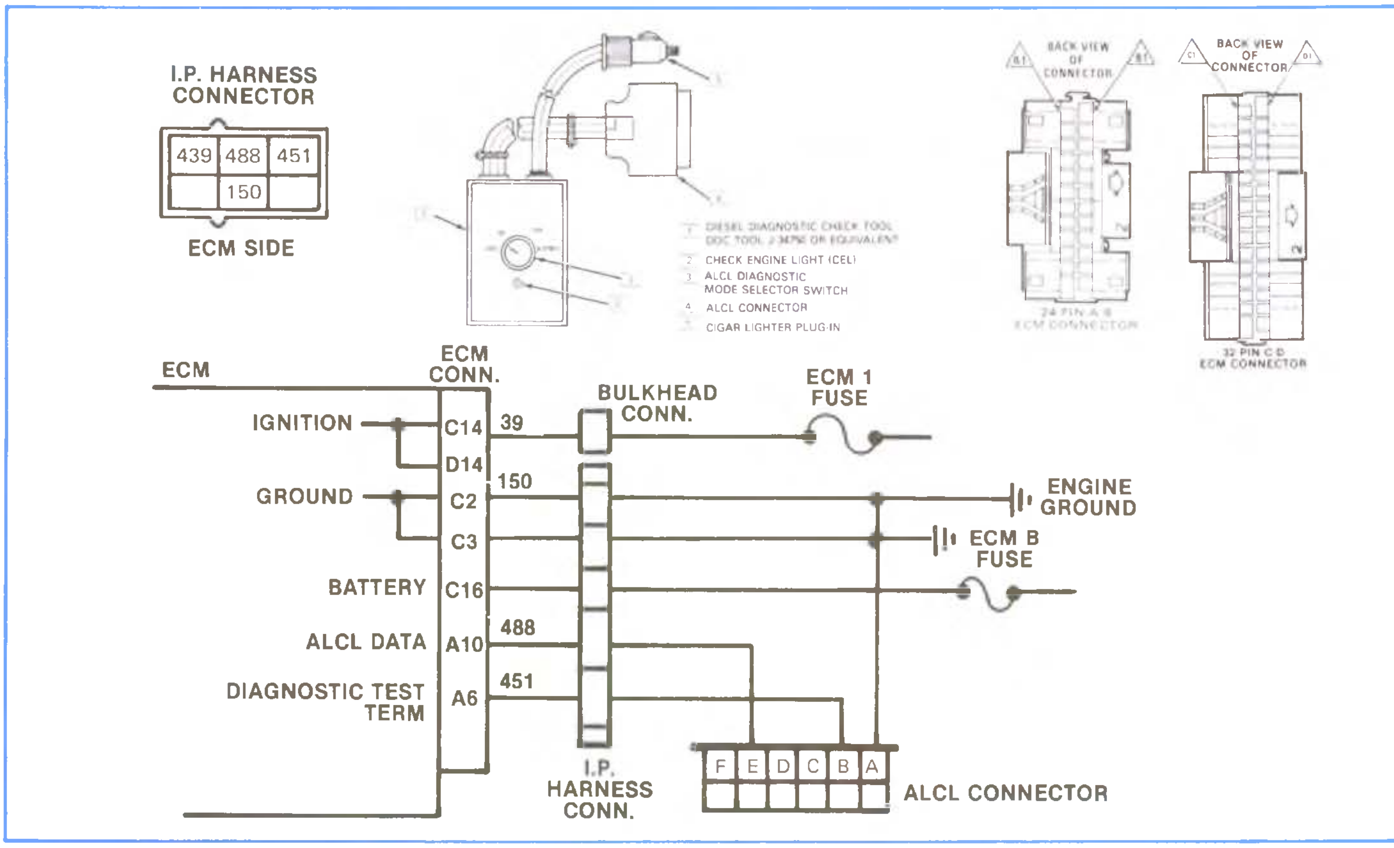


Figure 5-36, 1985 ECM Check Schematic.

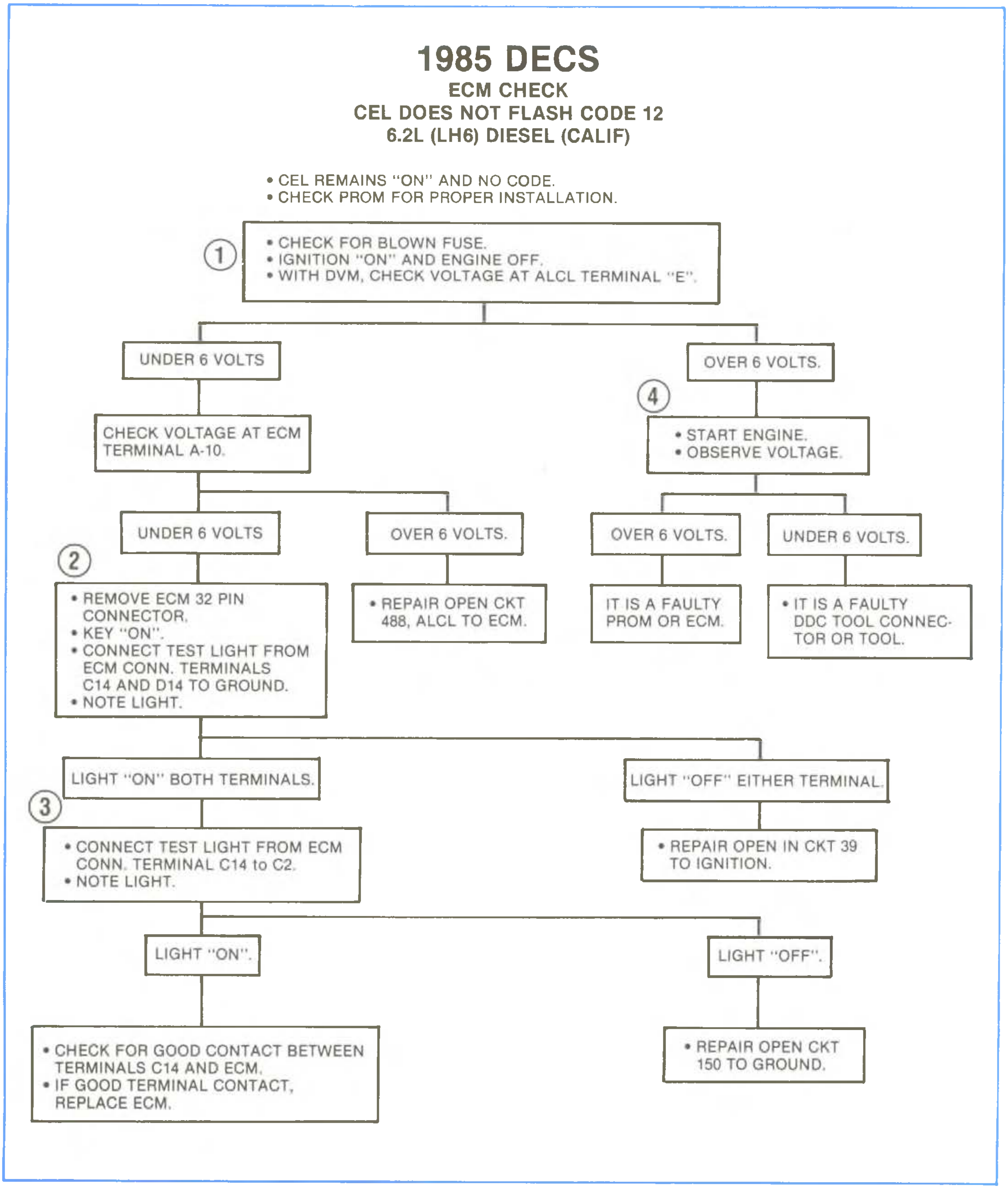


Figure 5-37, 1985 ECM Check Chart.

CODE 51
PROM PROBLEM
6.2L (LH6) DIESEL (CALIF.)

- CHECK THAT ALL PINS ARE FULLY INSERTED IN SOCKET.
- IF OK, REPLACE PROM AND RECHECK.
- IF PROBLEM NOT CORRECTED, REPLACE ECM.

THE IGNITION SHOULD ALWAYS BE OFF WHEN INSTALLING OR REMOVING THE ECM CONNECTORS

Remove or Disconnect (Figures 1 and 2)

1. Connectors from ECM
2. ECM mounting hardware.

Important

ELECTRONIC CONTROL MODULE (ECM) MOUNTING HARDWARE NOT ILLUSTRATED.

3. ECM from passenger compartment
4. ECM Access cover

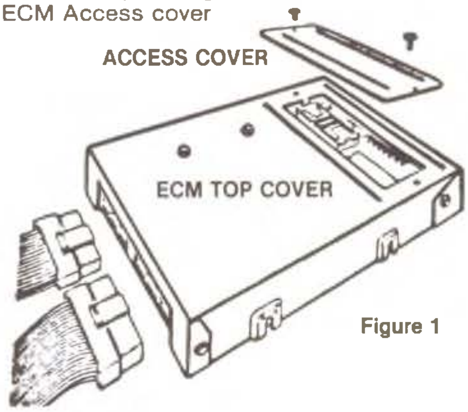


Figure 1

5. PROM removal

Important

Using the rocker-type PROM Removal tool, 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 the PROM socket easily. PROM Carrier should only be removed by using the pictured PROM removal tool (Figure 2). Other methods could cause damage to the PROM or PROM socket.

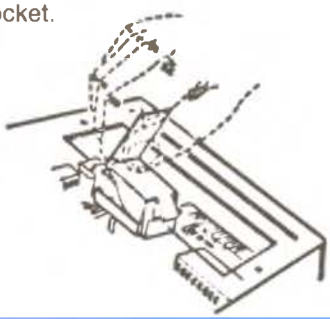


Figure 2

Inspect (Figure 3)

For correct indexing of reference end of the PROM Carrier and carefully set aside. Do not remove PROM from carrier to confirm PROM correctness.

Figure 3

Important (Before installing new PROM)

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

Install or Connect (Figures 1 and 3)

1. PROM in PROM socket.

Important

DO NOT press on PROM — ONLY CARRIER.

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

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

Functional Check

1. Turn ignition on
2. Enter diagnostics
   A. Code 12 should flash four times. (No other codes present.) This indicates the PROM is installed properly.
   B. If trouble code 51 occurs or if the check engine light is on constantly with no codes, the PROM is not fully seated. Installed backwards, has bent pins or is faulty.

Figure 5-38, Code 51.

CODE 52
6.2L (LH6) DIESEL (CALIF.)

- CHECK THAT ECM CONNECTOR ARE FULLY INSERTED.
- CLEAR MEMORY.
- DDC TOOL CONNECTED AND IN "NORMAL" MODE.
- START ENGINE AND CHECK FOR LIGHT.
- IF LIGHT REAPPEARS AND DDC TOOL INDICATES CODE 52, REPLACE ECM.
- CLEAR MEMORY AFTER REPAIR TO CONFIRM NO "CEL".

Figure 5-39, Code 52.

CODE 53
Y REF OVERLOAD

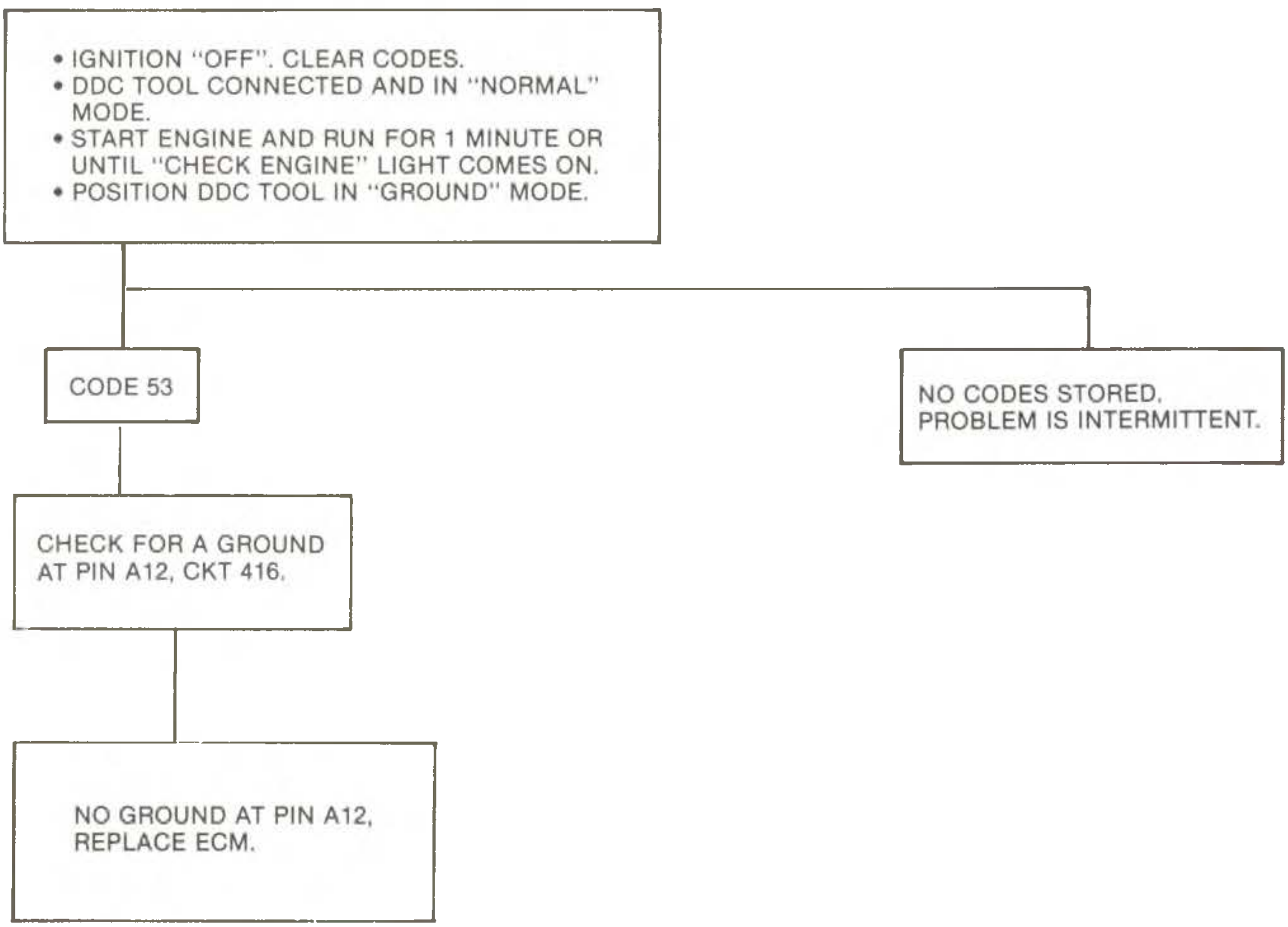


Figure 5-40, Code 53.

Engine Speed Sensor (RPM)

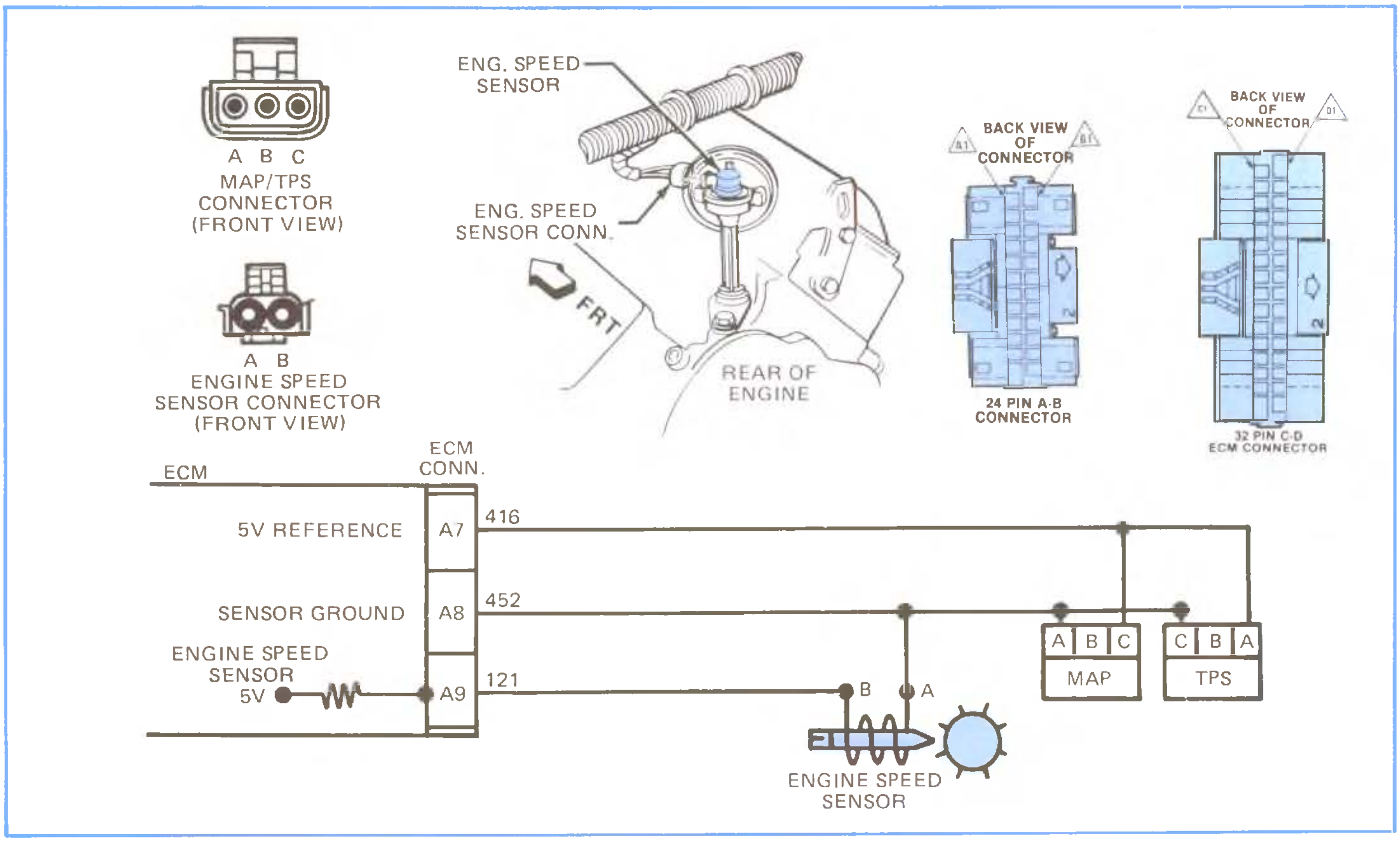


Figure 5-41, 1984 Engine Speed Sensor Check Schematic.

See Figure 5-41.

The ECM monitors engine RPM through a permanent magnet (P.M.) generator. It is located in the top of the vacuum pump, or oil pump drive. Engine RPM is one of the inputs to the ECM to calculate the duty cycle of the EGR. It is 500 milli-volt peak to peak. There are 4 reference pulses per revolution.

1984 ENGINE SPEED SENSOR CHECK

The Engine Speed Sensor is a camshaft driven pick-up mounted at the center rear of the engine.

It is sourced by 5 V-reference and allows the ECM to measure engine RPM by the number of times the voltage is pulsed. The Engine Speed Sensor pulses 4 times per revolution.

See Figure 5-42:

1. Checks for a good 5 V-reference. Normally, the ECM should be at about 5 volts for fully charged batteries.
2. Checks for proper ECM voltage to the Engine Speed Sensor. If the circuit to the ECM is complete, normal voltage will be about 5 volts with the harness disconnected from the sensor.
3. Checks for a good sensor ground circuit (CKT 452) from sensor to ECM. Since Step 2 indicated an open, the results of this step indicates whether the open is in the wire or at the ECM.

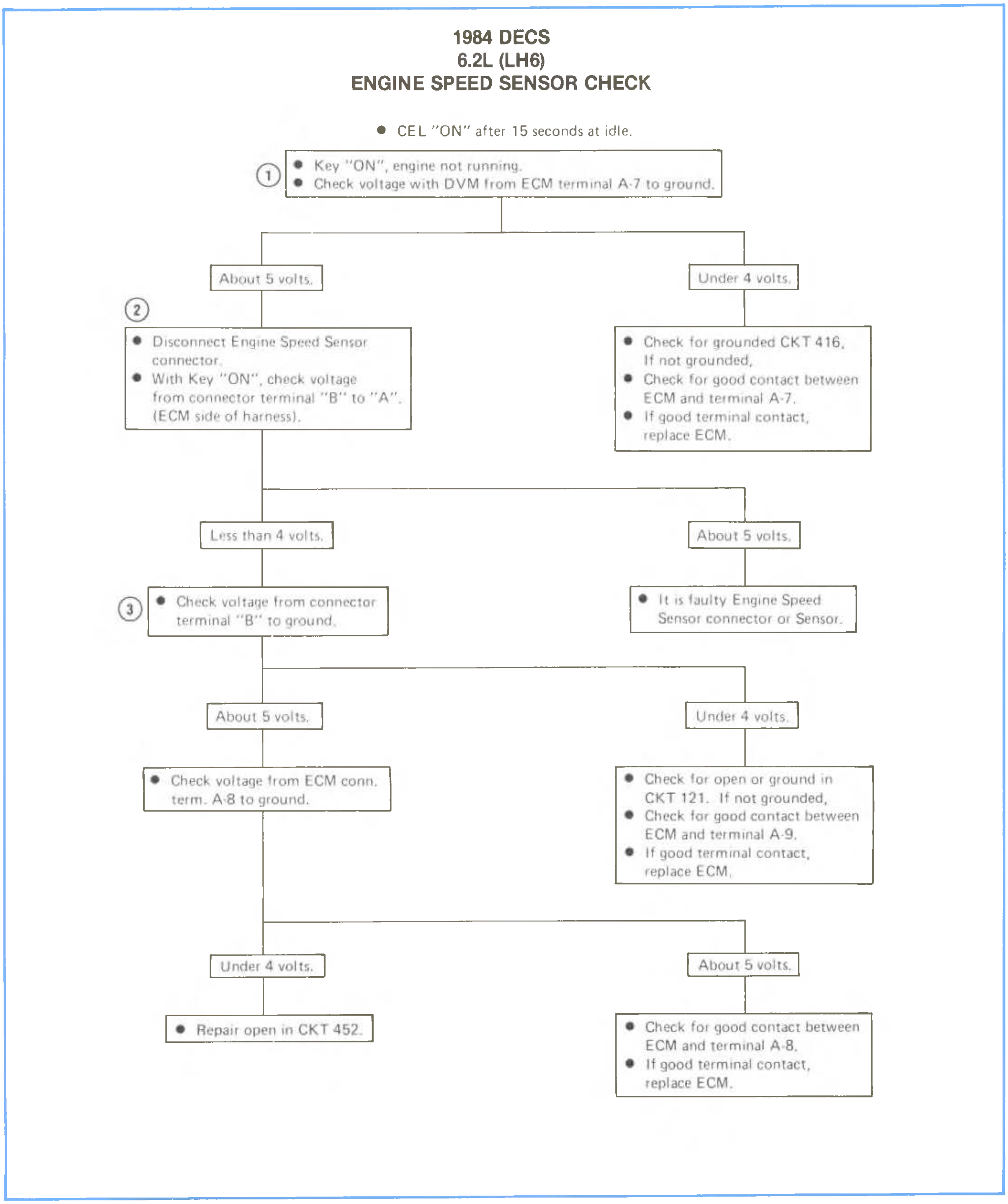


Figure 5-42, 1984 Engine Speed Sensor Chart.

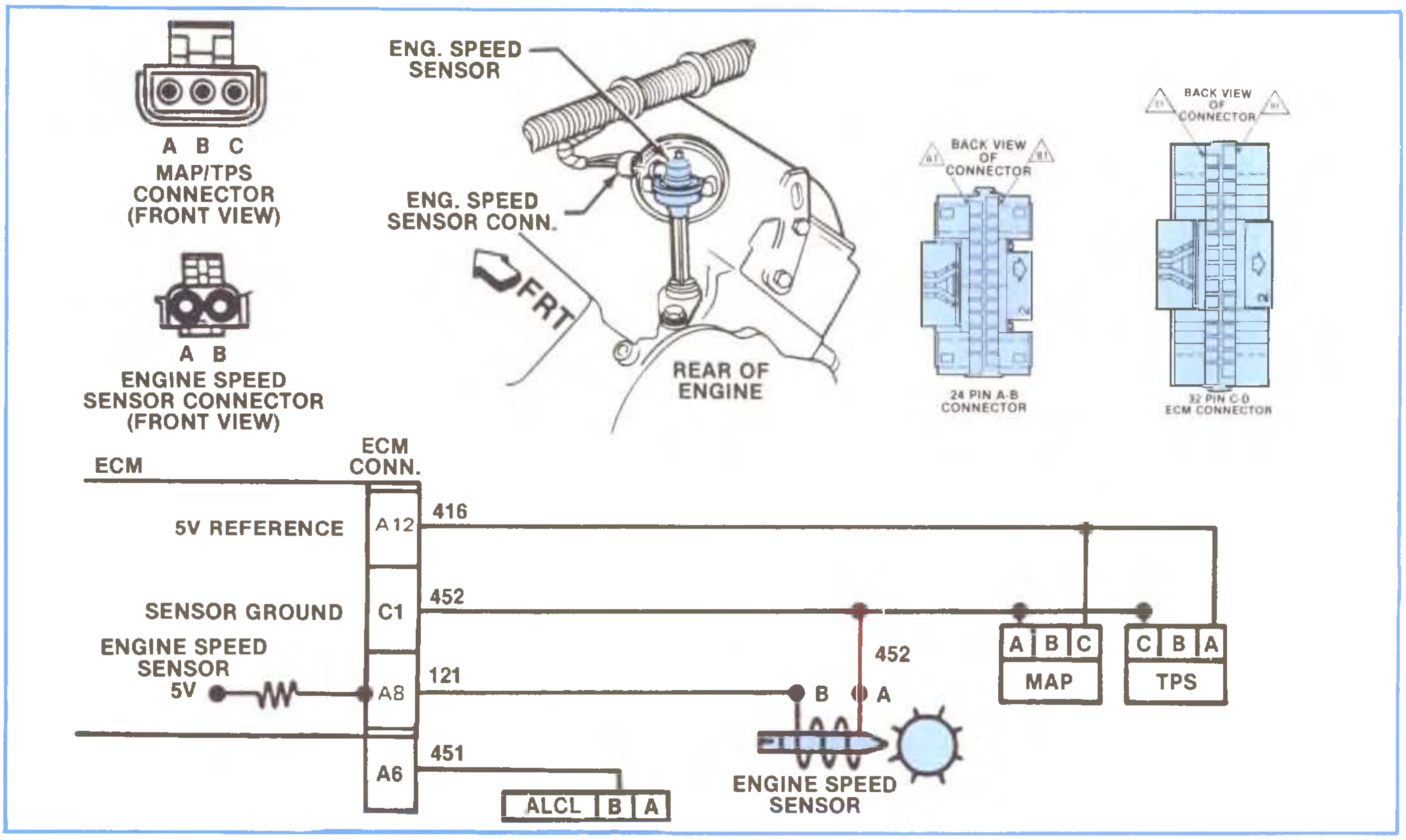


Figure 5-43, 1985 Engine Speed Sensor Schematic.

CODE 12, NO REF PULSE

Malf Code 12 is detected when the ECM detects an "engine not running" condition.

Code is not to be stored in nonvolatile memory. Operation is the same as the gas controller.

Pin Condition	Terminal Name	CEL/CODE	Vacuum Condition	Codes
A6 GND	Diag. Term.	Yes — 12	10″/Full (Flutters)	Code 12 at all times
A8 OPN	RPM	Solid CEL — 12	NO/NO	Code 12 immediate
A8 GND	RPM	Solid CEL — 12	NO/NO	Code 12 immediate
C1 OPN	Sensor GND	Solid CEL — 12	NO/NO	
Engine Speed Sensor	—	Immed. CEL — 12	None/None	

CODE 12
NO REFERENCE PULSE
6.2L (LH6) DIESEL (CALIF)

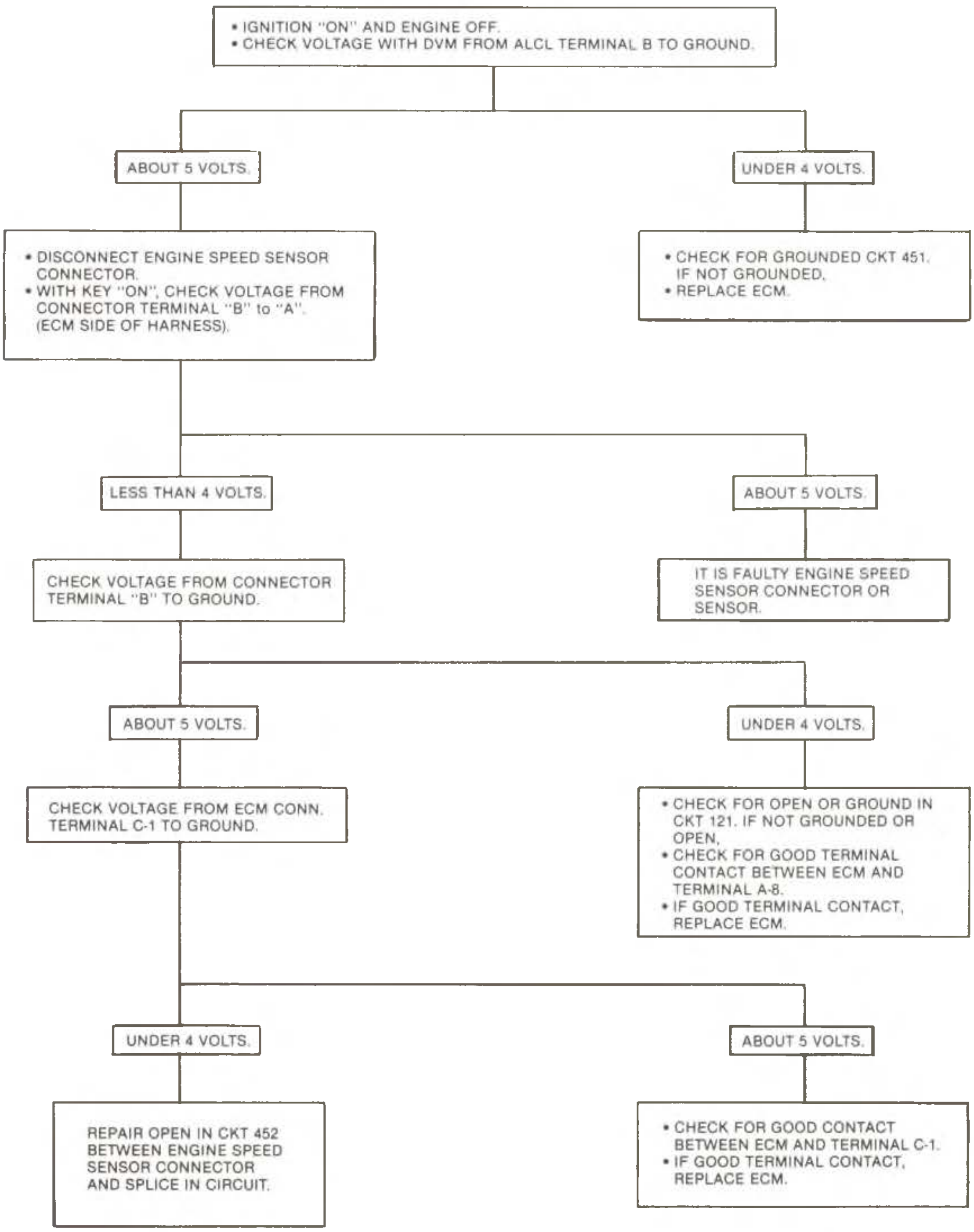


Figure 5-43A, Code 12.

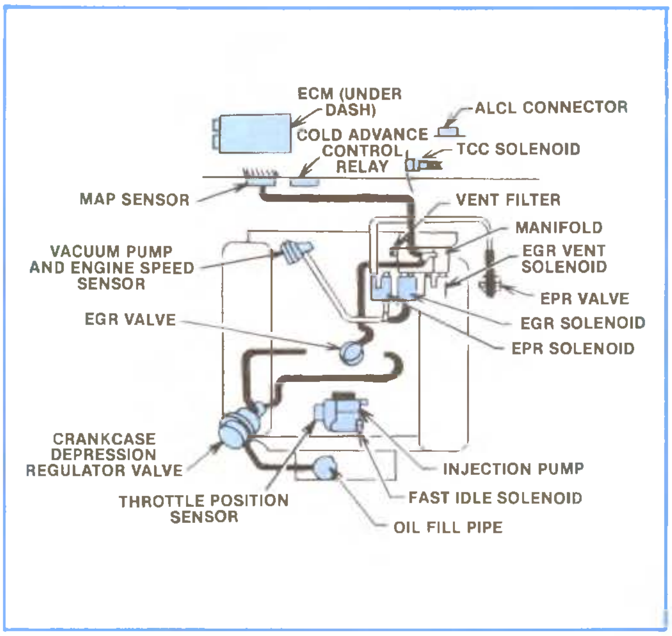


Figure 5-44, Emission Systems — California CK (LH6 Engine).

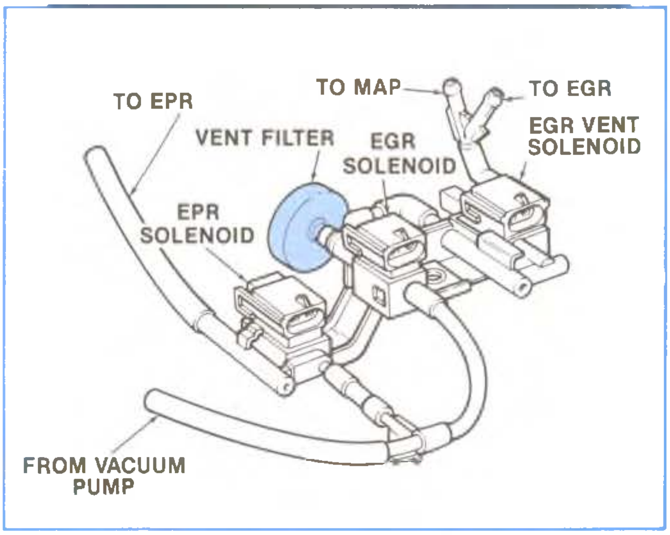


Figure 5-45, EGR, EPR, Vent Solenoid Assembly.

Exhaust Gas Recirculation Control (EGR)

See Figure 5-44.

The exhaust gas recirculation system provides a means to direct exhaust gases from the exhaust manifold to the intake manifold.

This is accomplished using a vacuum powered EGR valve. The opening of this valve, and therefore the amount of exhaust gas flow, is increased as the amount of vacuum routed to the EGR valve is increased. The amount of vacuum regulated to the EGR valve is controlled by an electrically operated solenoid valve which is supplied with a relatively constant amount of vacuum. The solenoid valve then controls the amount of vacuum to the EGR valve by means of oscilating on and off at a frequency of 25 Hz, with a variable pulse width, controlled by the ECM. The EGR MAP sensor monitors the regulated vacuum to the EGR valve as the feedback parameter of the control function.

PULSE WIDTH MODULATED EGR VACUUM CONTROL SOLENOID — 6.2L (CALIFORNIA) DIESEL

See Figure 5-45.

A pulse width modulated solenoid (pulsed solenoid) controls the vacuum signal to the EGR valve in the electronic vacuum modulated EGR system. This vacuum control is via an electronic pneumatic servo loop based primarily on load (throttle angle) engine RPM inputs and vehicle speed.

Vacuum is supplied at #8 from the vacuum pump and the vacuum is modulated between #2 (vent to atmosphere) and #4 (vacuum output to EGR valve) as a result of a pulsed electrical signal from the controller.

At 0% duty cycle, the output vacuum signal is 0″ hg. At 100% duty cycle, the output vacuum signal is equal to the input vacuum from the supply pump.

In 1984 the solenoid is grounded at ECM Pin B2 on Circuit 538. In 1985 it is grounded at ECM Pin C10 on Circuit 435.

The duration (time) of the pulses (pulses per second) of the duty cycle (0-100%) for the EGR solenoid is determined by engine parameters such as RPM and the Throttle Position Sensor.

- **DUTY CYCLE IS DETERMINED BY:**

$$\text{DUTY CYCLE} = \frac{\text{t-time on}}{\text{T-time off}}$$

$$\text{D.C.} = \frac{\text{10 m sec.}}{\text{40 m sec.}} = 25\%$$

It would only be on 25% of the time.

Frequency 25Hz (25 × @ sec.) 25-40 m sec. time periods.

OUTPUT VACUUM SIGNAL		
ABS. PRESS kPa	ABS. PRESS IN HG.	VAC. IN HG.
0	0	29.92
5	1.48	28.44
10	2.96	26.96
15	4.44	25.48
20	5.92	24.00
25	7.40	22.52
30	8.88	21.04
35	10.36	19.56
40	11.84	18.08
45	13.32	16.60
50	14.80	15.12
55	16.28	13.64
60	17.76	12.16
65	19.25	10.67
70	20.72	9.20
75	22.20	7.72
80	23.68	6.24
85	25.16	4.76
90	26.65	3.27
95	28.12	1.80
100	29.61	.31
101	29.92	—
105	30.09	—

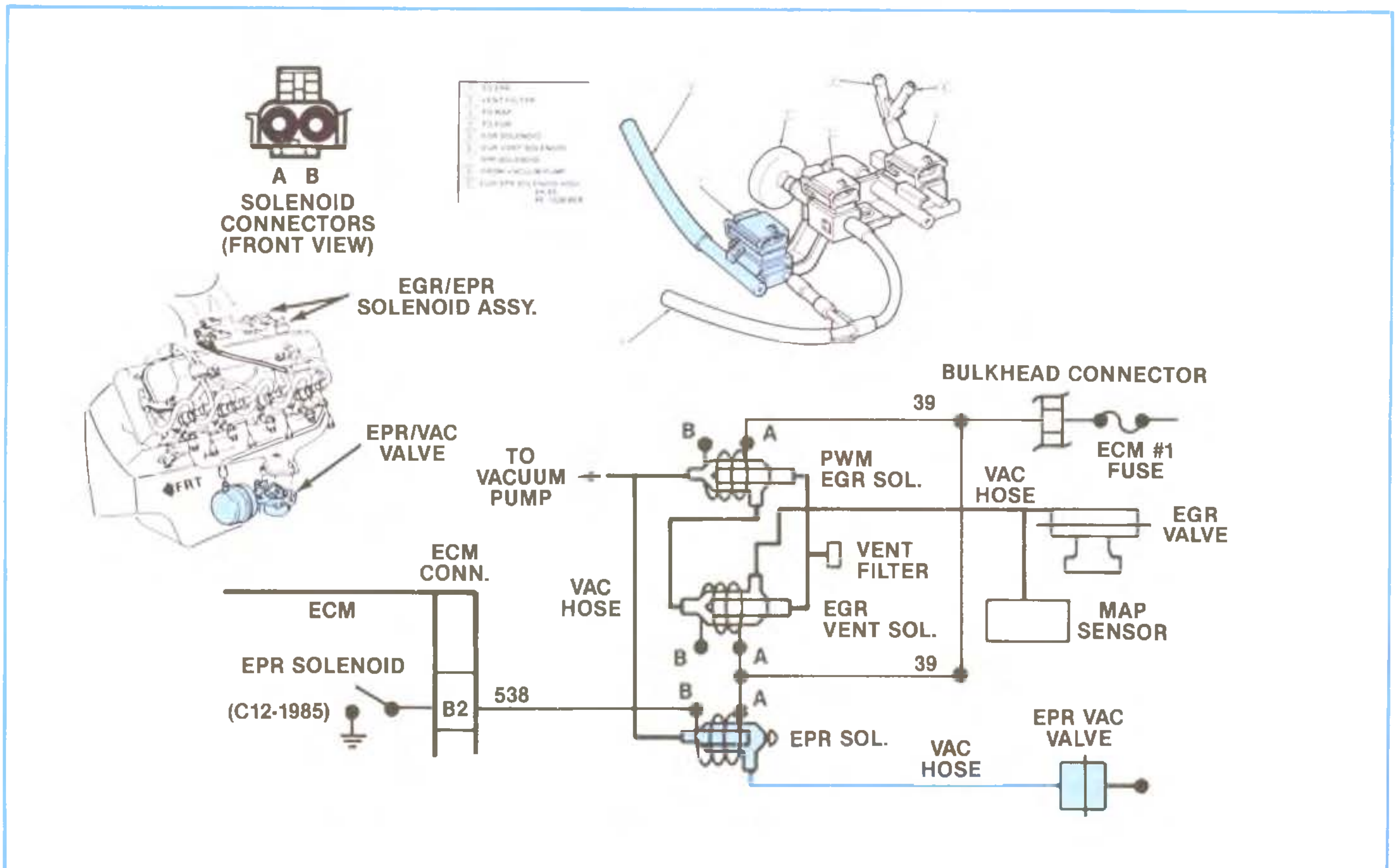


Figure 5-46, **EPR Valve Circuit (1984 & 1985).**

EPR Valve

The system also incorporates an exhaust pressure regulator (EPR) valve, which is closed by control of the ECM whenever the ECM control logic determines that the EGR valve is open. (Figure 5-46).

When the EPR valve is closed, it simply makes a restriction in the exhaust system which causes the pressure inside of the exhaust manifold to rise, thereby increasing the exhaust gas flow through the EGR valve. The EPR valve is also a vacuum actuated valve, which is either supplied vacuum or not, as directed by the EPR solenoid, which is energized or de-energized by the ECM.

An EGR vent solenoid valve is also used in the system. This solenoid valve is controlled by the ECM and upon request of the EGR vent control logic, the vent solenoid valve allows the regulated vacuum supply to the EGR valve to be vented to barometric pressure. This very fast rise in EGR pressure allows the EGR valve to close much more quickly than is attainable with the normal EGR feedback control.

Desired EGR Pressure Calculation

The amount of controlled EGR flow is determined by the calculated value of the desired EGR valve pressure. The desired EGR pressure is calculated in the following manner:

The desired EGR pressure is calculated by summing the required amount of EGR pressure value obtained from one of the desired kPa ECM memory tables, altitude compensated pressure value is obtained from the Table for EGR Altitude Compensation and vehicle speed modification value, unless one of the following conditions exist:

- If the ECM is in either the Diagnostic Mode or the ALCL 1 Mode, the desired EGR pressure value is calculated to be the difference of the barometric pressure value minus the calibration constant value of 10 in. Hg.
- If the initialization routine is forcing the barometric pressure value to be updated, the desired EGR pressure value is set equal to the calibration parameter.
- If the successive calculated values of desired EGR pressure have been increasing and the value is presently greater than the EPR switchpoint value obtained from table, the desired EGR pressure value is set equal to the calibration constant.
- If the calculated values of desired EGR pressure have been decreasing and this value is presently greater than or equal to the EPR switchpoint value minus the calibration constant, the desired EGR pressure value is set equal to the calibration value.

— NOTE —

The EGR vacuum (low pressure kPa) look-up tables are in the read only memory (ROM) of the E PROM. They are for designated EGR pressure (vacuum to EGR), and are based upon known engine RPM and throttle position values.

The 1st table is used to determine the required amount of EGR when engine RPM is between 551 and 1349 RPM.

The 2nd kPa table is used to determine the required amount of EGR when the engine speed is between 1350 and 2650 RPM.

If the engine speed is less than or equal to 550 RPM and greater than or equal to the "Low RPM threshold for no EGR", the required EGR is set equal to a table value corresponding to the minimum RPM value (550 RPM).

If the RPM is less than the "Low RPM for no EGR", the required EGR is set equal to a calibrated value, which will fully close the EGR valve.

When the engine speed is greater than 2650 RPM, the required amount of desired EGR pressure is set equal to the value in the table corresponding to the maximum RPM value (2650 RPM).

ALTITUDE COMPENSATION

There is a look-up table for Altitude Compensation which is based upon barometric pressure values.

VEHICLE SPEED MODIFICATION

The EGR amount is modified with respect to vehicle speed. The EGR amount will be reduced upon reaching a calibrated vehicle speed.

EPR VALVE CONTROL

This portion of the EGR logic determines whether the EPR valve should be open or closed as controlled by the ECM.

EGR SWITCHPOINT TABLE

This is a two dimensional table used for determining what pressure value is to be used for the EPR switchpoint, based upon the present atmospheric pressure value. This table contains 12 look-up values.

EPR OUTPUT DETERMINATION

The EPR solenoid will be de-energized (EPR valve open) if the desired EGR pressure value exceeds the EPR switchpoint value obtained from the table.

If the desired EGR pressure value is less than or equal to the EPR switchpoint value, then the EPR solenoid will be energized (EPR valve closed).

EGR VENT CONTROL

This portion of the EGR logic determines if the EGR vent solenoid should be controlled to allow the EGR pressure to quickly reach a maximum value, equal to atmospheric pressure.

EGR VENT DETERMINATION

The EGR vent function will be enabled, (vent valve open) if the desired EGR pressure value exceeds the EPR switchpoint value obtained from the table.

EGR PULSE WIDTH MODIFICATIONS

Two terms are calculated and used to modify the EGR output pulse width, which controls the EGR solenoid duty cycle. One term is called the integral gain and the other term is called the proportional gain. These values are used to calculate an EGR pressure error, which is the difference between desired EGR pressure, minus the actual EGR pressure.

In 1984 a 4th gear switch is located in the 700-R4 4th gear pressure circuit, and a mechanical switch on the shifter linkage of manual transmissions. When these switches close, this input to the ECM cuts off EGR at all throttle angles.

NOTES

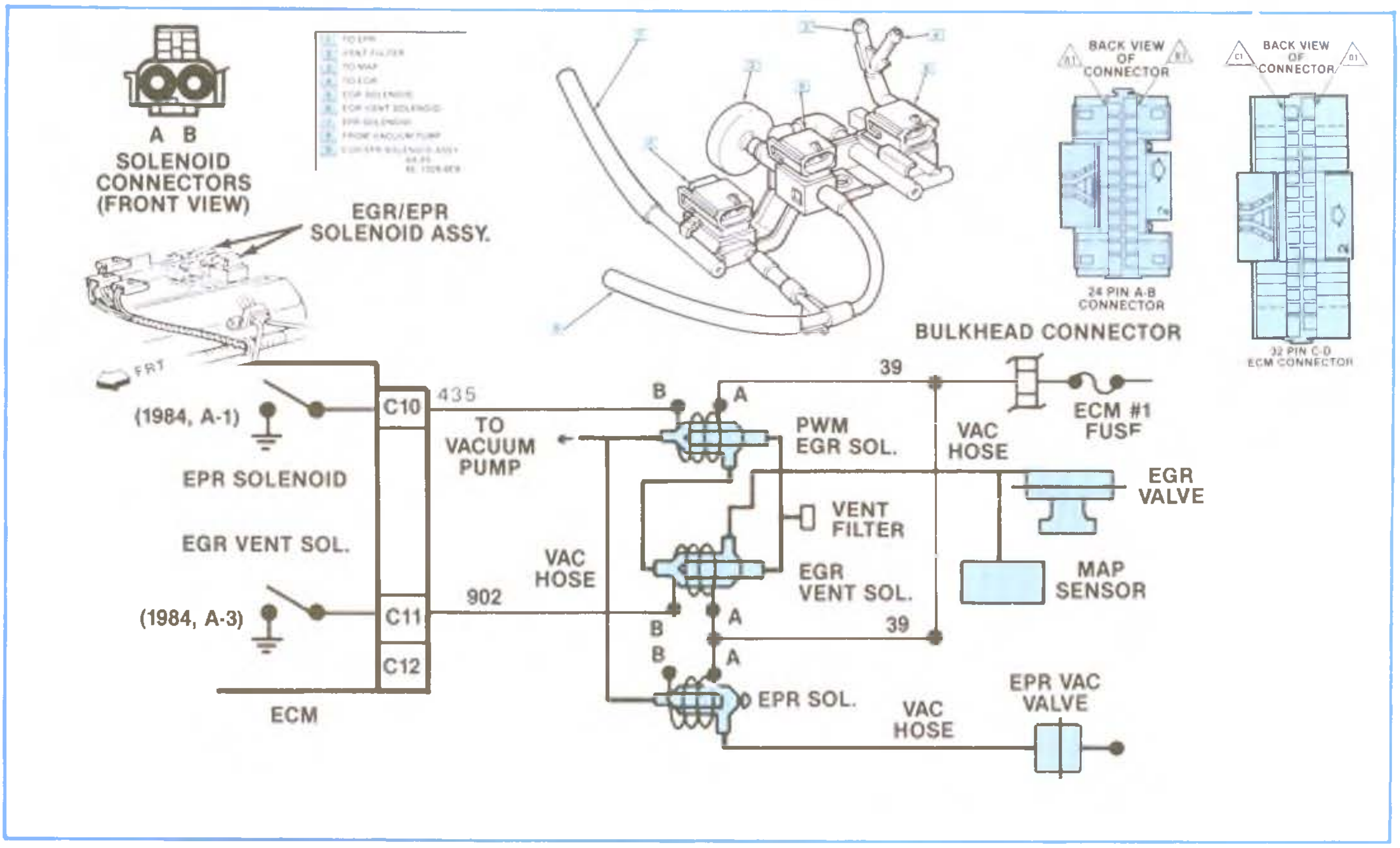


Figure 5-47, EGR/EGR Vent Schematic (1984 & 1985).

EGR/EGR VENT CHECK (1984 & 1985)

The EGR solenoid controls the amount of vacuum to the EGR valve. The signal from the ECM is Pulse Width Modulated (PWM) which varies the cycle ("ON" time) from 0% to 100%.

As the EGR solenoid cycles, vacuum to the EGR valve is controlled. When the EGR solenoid is "ON", there is no EGR vacuum.

The EGR Vent Solenoid operates to allow rapid venting of EGR vacuum to improve driveability and performance when the ECM recognizes the operating range for no EGR. When the solenoid is "ON", EGR vacuum is vented.

Both solenoids operate on 12 volts supplied by ignition. The ECM supplies the ground to turn the solenoids "ON". See Figure 5-47.

- Checks for EGR vacuum at idle. Normally, there should be full EGR vacuum at idle (above 68 kPa/20″ vacuum).
- Checks for a ground in the circuit that would energize either solenoid. At idle, neither solenoid should be "ON". A test light "ON" indicates a faulty ground in the circuit.
- Checks for complete circuits to both solenoids. The test light should be "ON" normally.
- Using the DDC tool in the 3.9k mode should turn the vacuum "OFF" to the EGR valve by ECM activation of the EGR vent solenoid. If vacuum is present, the ECM was not able to energize the EGR vent solenoid.

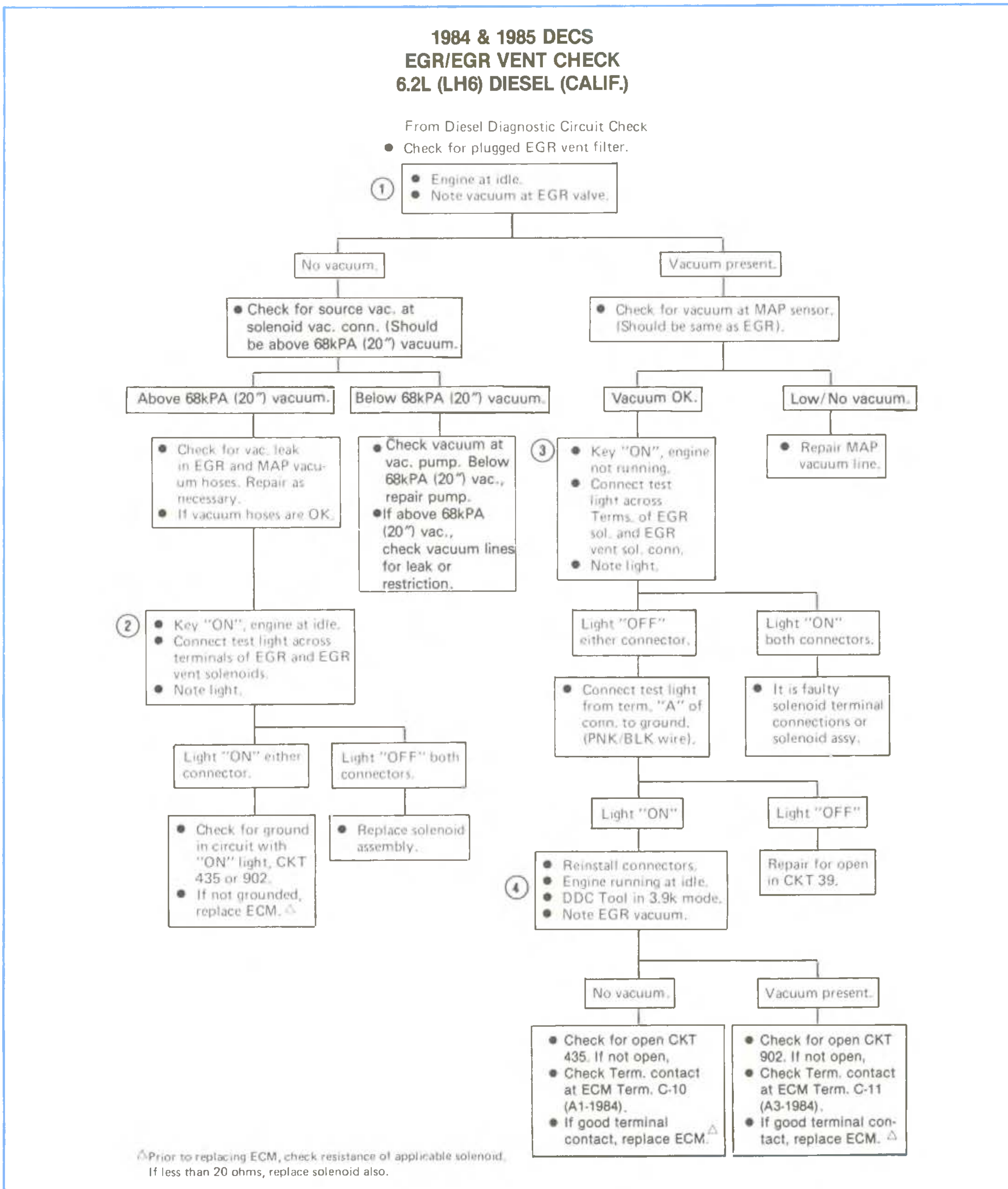


Figure 5-48, EGR/EGR Vent Check, 1984-1985.

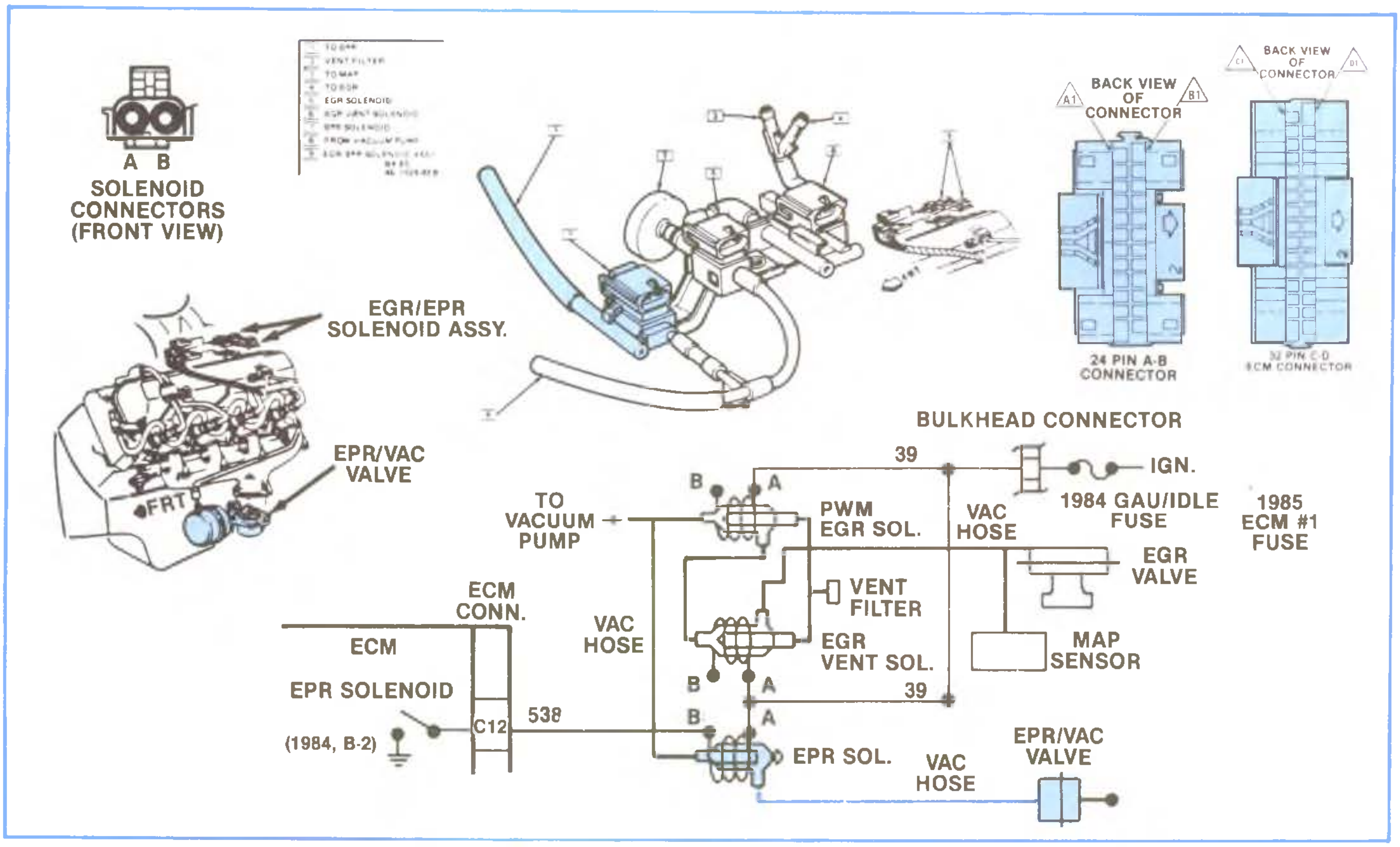


Figure 5-49, EPR Solenoid Schematic (1984 & 1985).

EPR Solenoid Electrical Check (1984 & 1985)

The EPR solenoid controls vacuum to the EPR valve. The EPR solenoid, when energized, allows vacuum pump vacuum to close the EPR valve and increase exhaust back pressure for proper EGR operation. The solenoid is supplied 12 volts by the ignition and the ECM completes the ground to energize the solenoid and turn EPR "ON". See Figure 5-49.

- Checks for a short to ground or a faulty ECM signal to EPR solenoid. Test light should normally be "OFF".
- Checks for signal to energize EPR solenoid with engine at idle. If the test light is "ON", electrical circuits to the solenoid are OK.

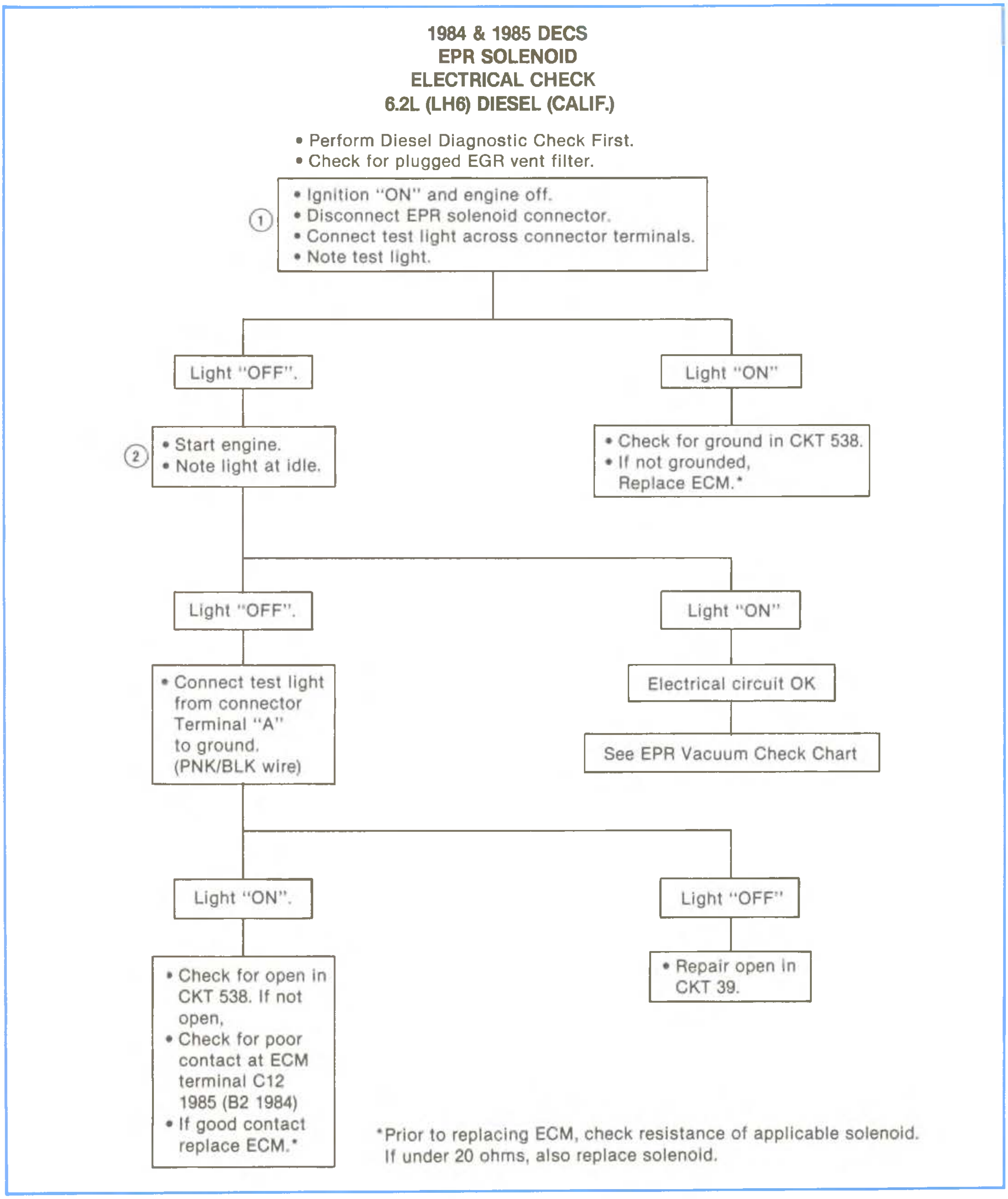


Figure 5-50, EPR Solenoid Electrical Check (1984 & 1985).

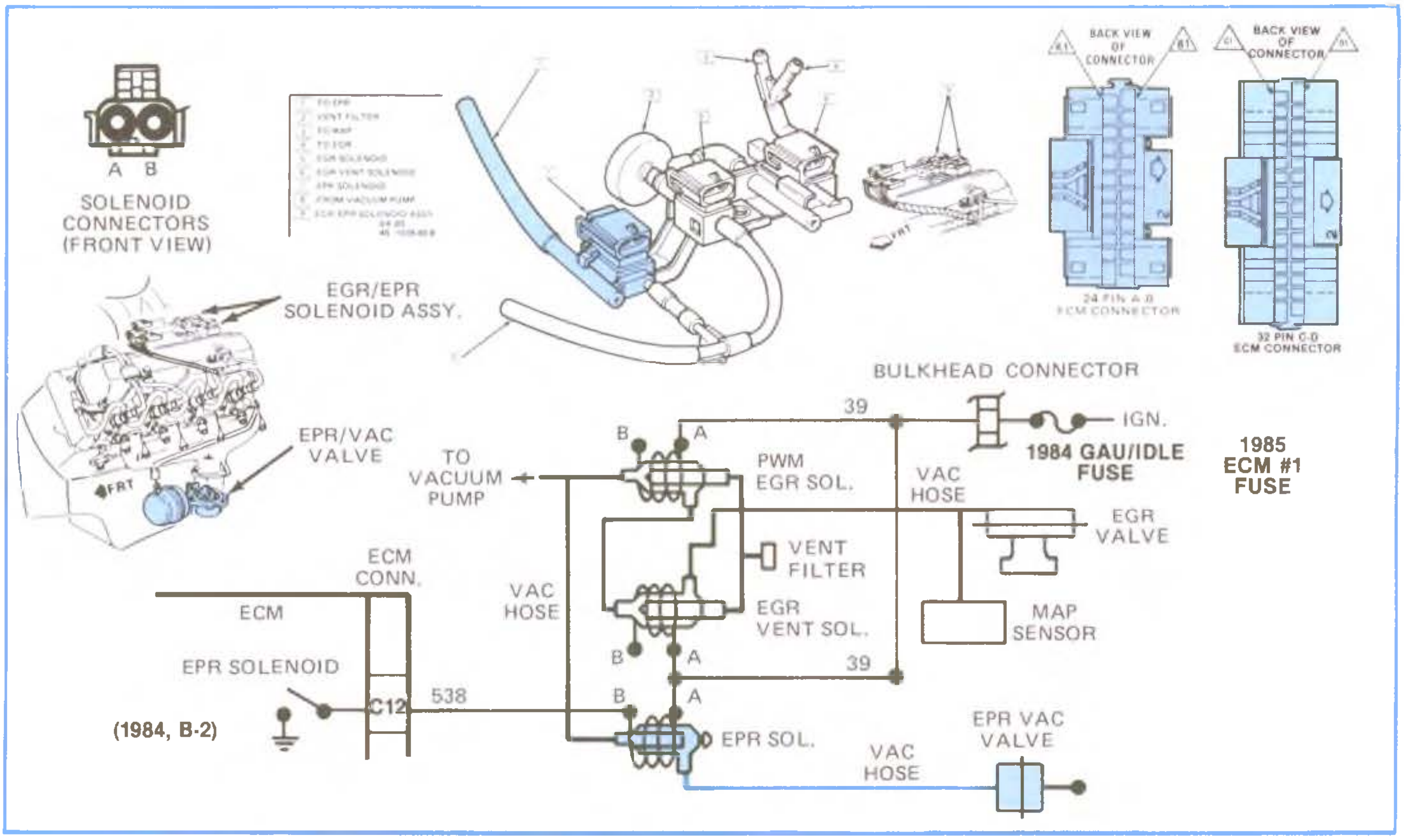


Figure 5-51, **EPR Solenoid Schematic (1984 & 1985).**

EPR Vacuum Check (1984 & 1985)

The EPR Solenoid controls vacuum to the EPR valve. The EPR solenoid, when energized, allows vacuum pump vacuum to close the EPR valve and increase exhaust back pressure for proper EGR operation. The EPR valve is a combination vacuum, actuator and exhaust restrictor plate. When vacuum is applied to the actuator, the restrictor plate closes to increase exhaust system back pressure to allow the EGR valve to function more efficiently. See Figure 5-51.

- Checks for normal EPR vacuum at idle. Since electrical circuit was verified as OK on prior chart, if no vacuum is present, it is due to no source vacuum (vacuum pump) or a restriction or leak in vacuum lines to valve including the solenoid.
- Checks to see if solenoid will respond to ECM command. In 3.9k mode, EPR solenoid is de-energized, so no vacuum should be present if the solenoid did close.
- Checks for normal operation of EPR valve. When vacuum is applied to vacuum, valve actuator should move and hold.

1984 & 1985 DECS
6.2L (LH6)
EPR VACUUM CHECK

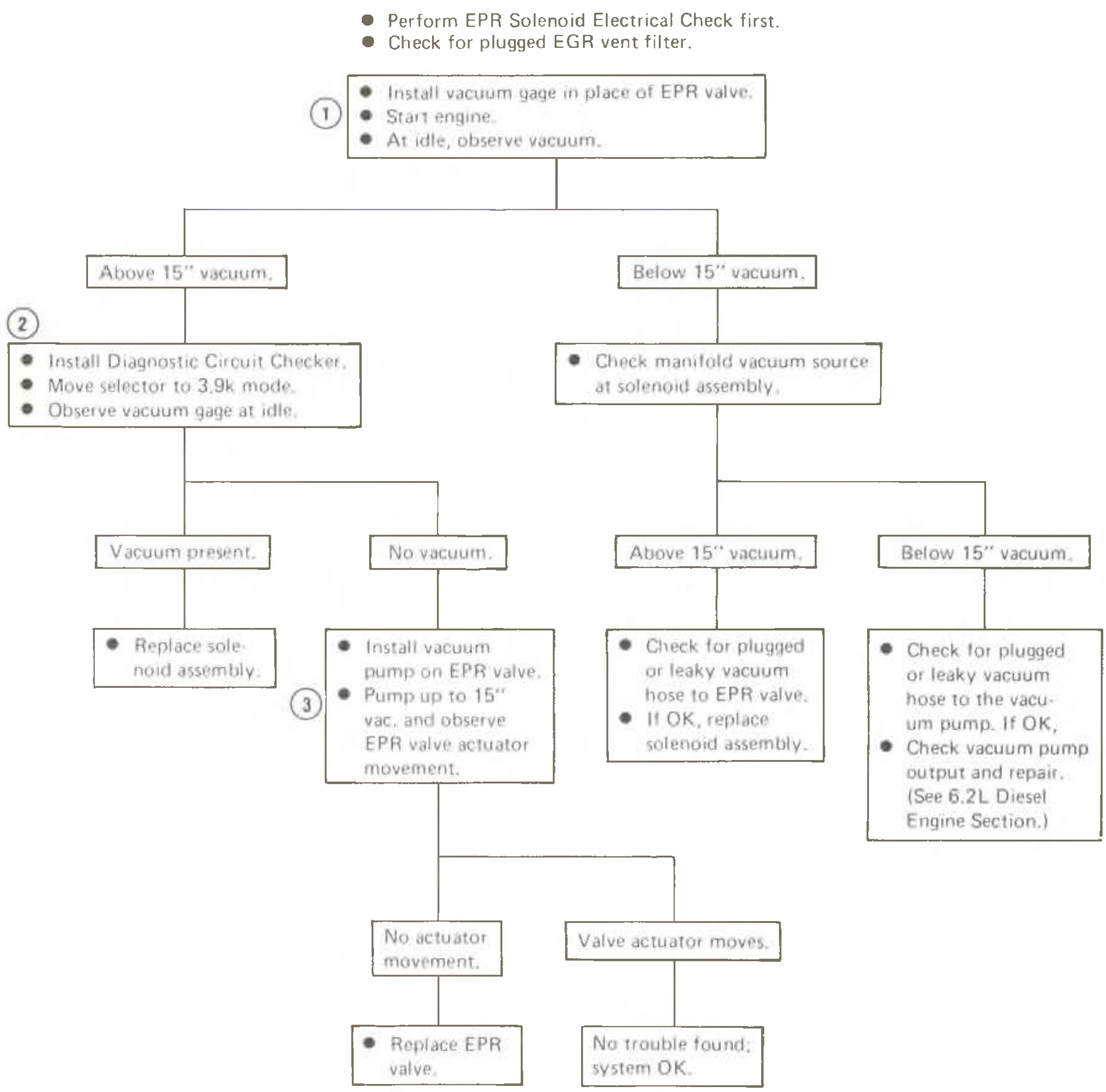


Figure 5-52, **EPR Vacuum Check (1984 & 1985).**

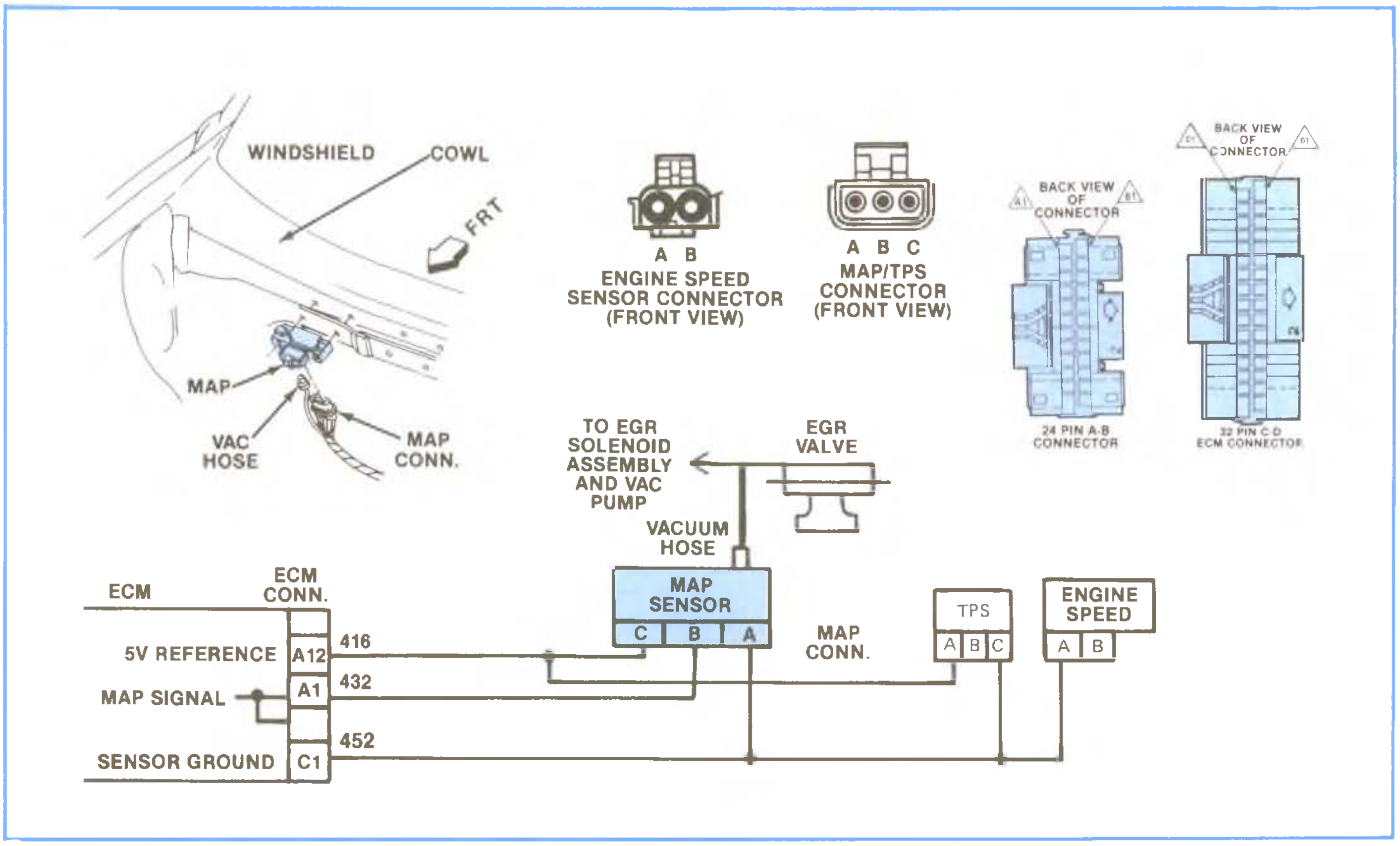


Figure 5-53, 1985 MAP Sensor Schematic.

1985 CODE 32 EGR LOOP ERROR

Malf Code 32 is detected when the engine is running and all of the following are true:

*1. If the difference between calibrated vacuum and actual vacuum is greater than 2 kPa.
2. If the calibrated vacuum is less than the EPR switch point (in ECM memory).
3. If the calibrated vacuum is greater than 25 kPa.
4. If Code 31 is not set.
5. If Code 33 is not set.
6. If Code 51 is not set.
7. If Code 52 is not set.
8. If Code 53 is not set.
9. If Code 54 is not set.
10. Ignition is on.
11. In normal mode of operation.
12. If all the above conditions have been present for a period of time greater than 10 seconds.

* = Major Condition.

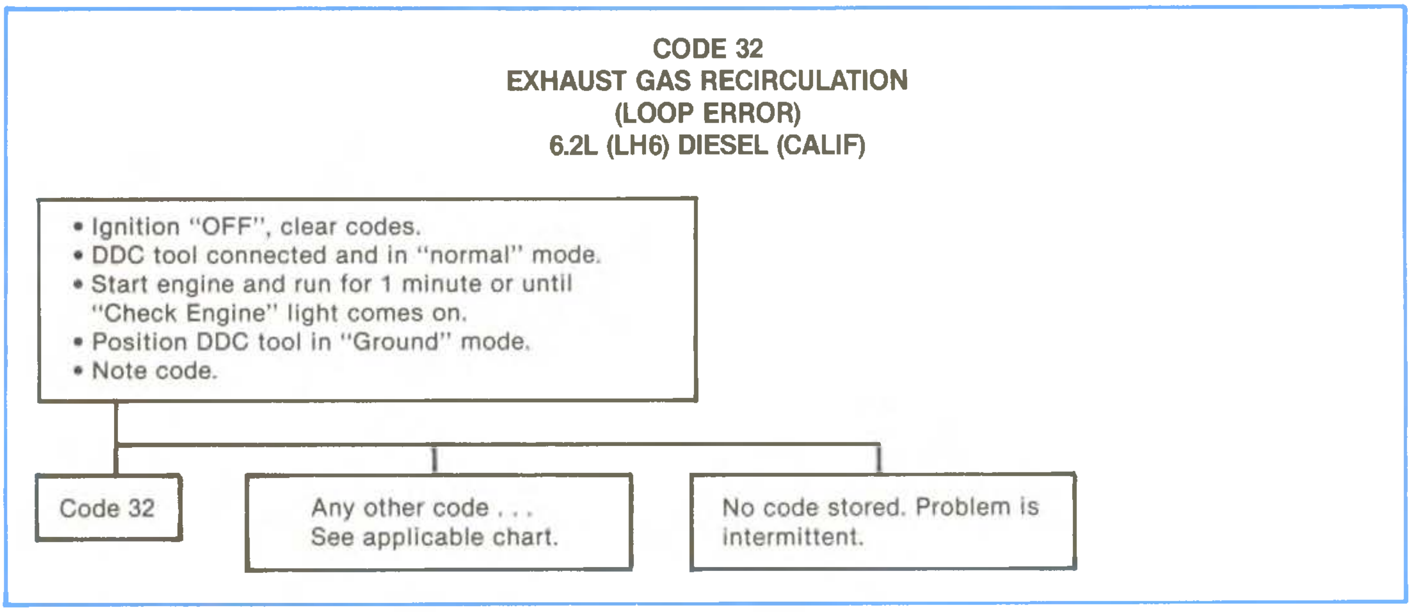


Figure 5-53A, Code 32.

NOTES

Strain Gage MAP Sensor

The 6.2L DEC System uses a strain gage type MAP sensor. This sensor uses a silicone chip which is approximately 3 millimeters square. Along the outer edges, the chip is approximately 250 micrometers (1 micrometer = 1 millionth of a meter) thick but the center area is only 25 micrometers thick to form a diaphragm. The edge of the chip is sealed to a pyrex plate under vacuum thereby forming a vacuum chamber between the plate and the center area of the silicone chip.

A set of sensing resistors are formed around the edge of this chamber. The resistors are formed by diffusing a "doping impurity" into the silicon. External connections to these resistors are made through wires connected to the metal bonding pads.

This entire assembly is placed in a sealed housing which is connected to the vacuum system by a small diameter tube. Pressure applied to the diaphragm causes it to deflect. The resistance of the sensing resistors changes in proportion to the applied manifold pressure by a phenomenon which is known as piezo-resistivity. Piezo-resistivity occurs in certain semiconductors so that the actual resistivity (a property of the material) changes in proportion to the strain (fractional change in length).

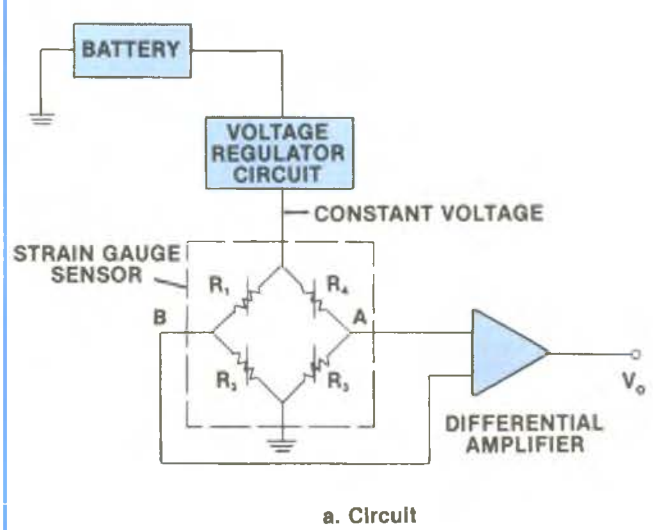


Figure 5-54A, **Wheatstone Bridge Set-up.**

An electrical signal which is proportional to the pressure is obtained by connecting the resistors in a circuit called a "Wheatstone bridge" as shown in the schematic diagram of Figure 5-54a. The voltage regulator holds a constant dc voltage across the bridge. The resistors diffused into the diaphragm are denoted R_1, R_2, R_3 and R_4 in Figure 5-54a. When there is no strain on the diaphragm, all four resistances are equal, the bridge is balanced, and the voltage between points A and B is zero. When manifold pressure changes, it causes these resistances to change in such a way that R_1 and R_3 increase by an amount which is proportional to pressure and, at the same time, R_2 and R_4 decrease by an identical amount. This unbalances the bridge and a net difference voltage is present between points A and B. The differential amplifier generates an output voltage proportional to the difference between the two input voltages.

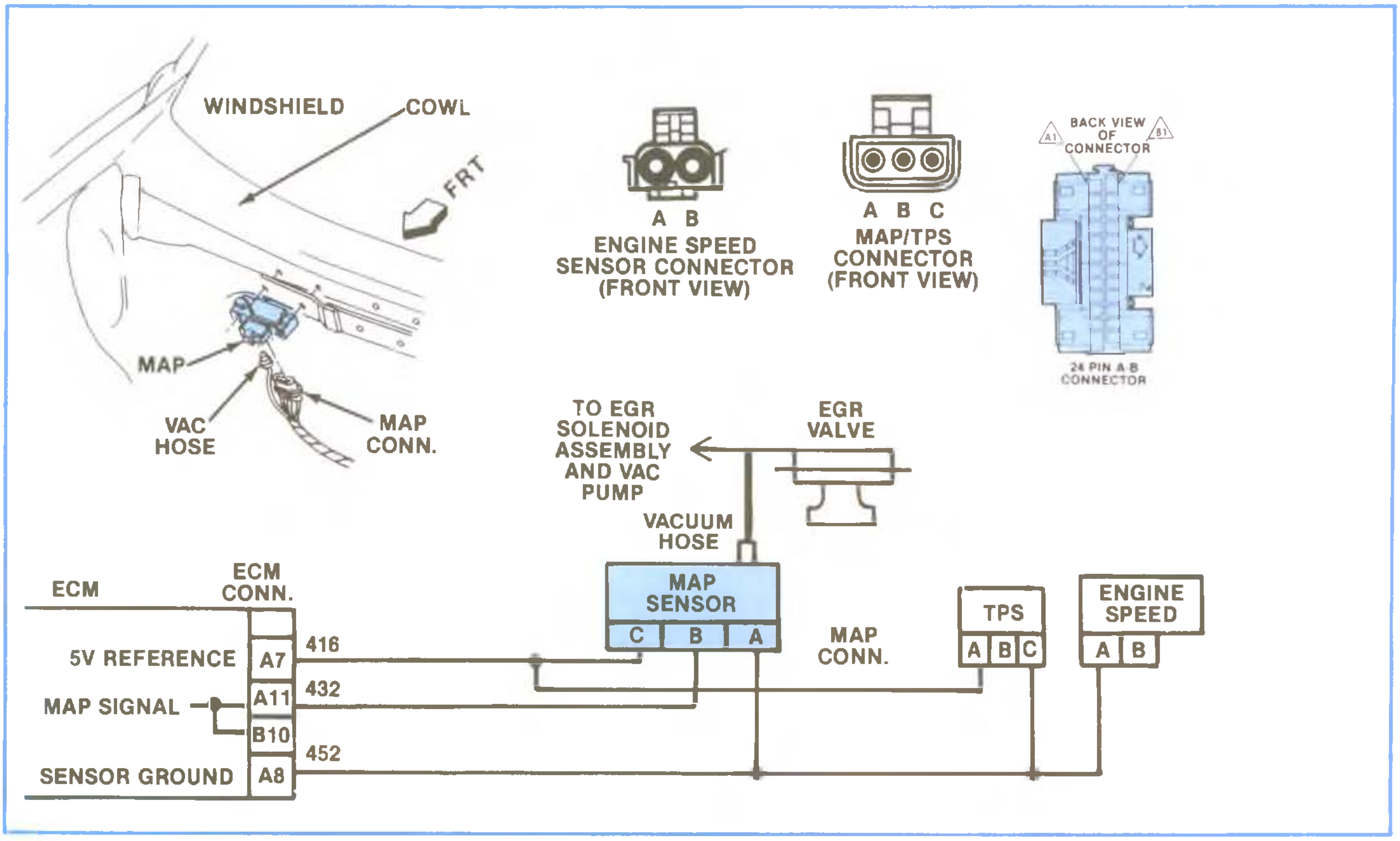


Figure 5-54, 1984 (Only) MAP Sensor Check Schematic.

MAP Sensor

A Manifold Absolute Pressure Sensor is used to monitor the amount of vacuum in the EGR circuit. It senses the actual vacuum in the EGR vacuum line and sends a signal back to the ECM. The signal is compared to the EGR duty cycle calculated by the ECM. If there is a difference in the ECM command and what is at the EGR valve sensed by the MAP, the ECM makes minor adjustments to connect.

The system can sense a high or low vacuum error, indicating a vacuum leak or faulty electrical component in the vacuum control system. Once a gross vacuum error is sensed, like a disconnected vacuum hose, the ECM de-energizes EGR solenoid. This causes full EGR and excessive smoking.

1984 MAP SENSOR CHECK

See Figure 5-54.

- Check for 5-volt reference signal to MAP Sensor. Normally, about 5 volts should be present with the key "ON" at Terminal "C".
- Check for a complete circuit from MAP sensor back through the sensor ground wire. As in Step 1, this should be about 5 volts.
- Check for normal response from the MAP to an external vacuum signal. There should be an immediate voltage as vacuum is applied.

1984 DECS
6.2L (LH6)

MAP SENSOR CHECK

From Diesel Diagnostic Circuit Check

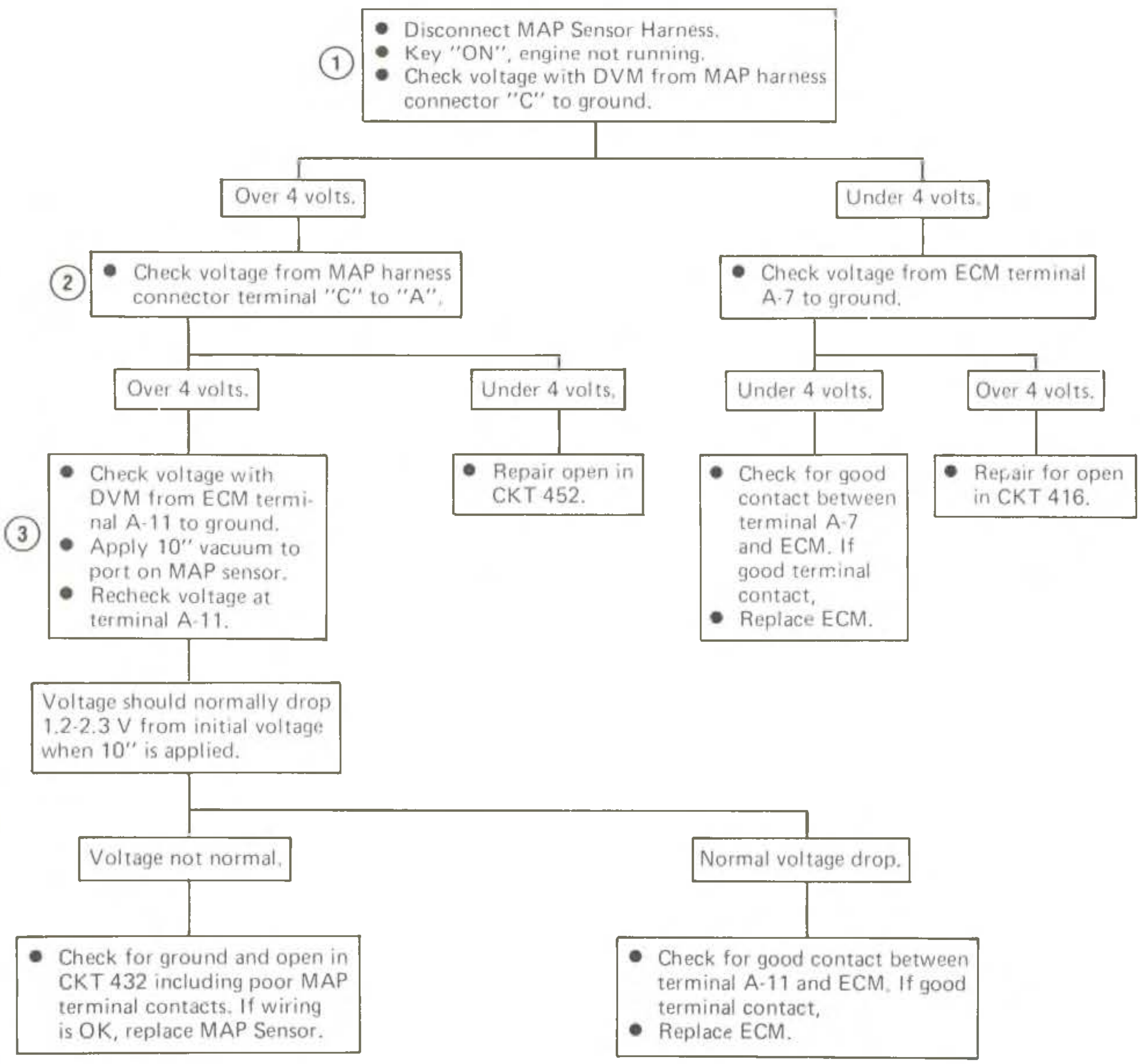


Figure 5-55, MAP Sensor Check.

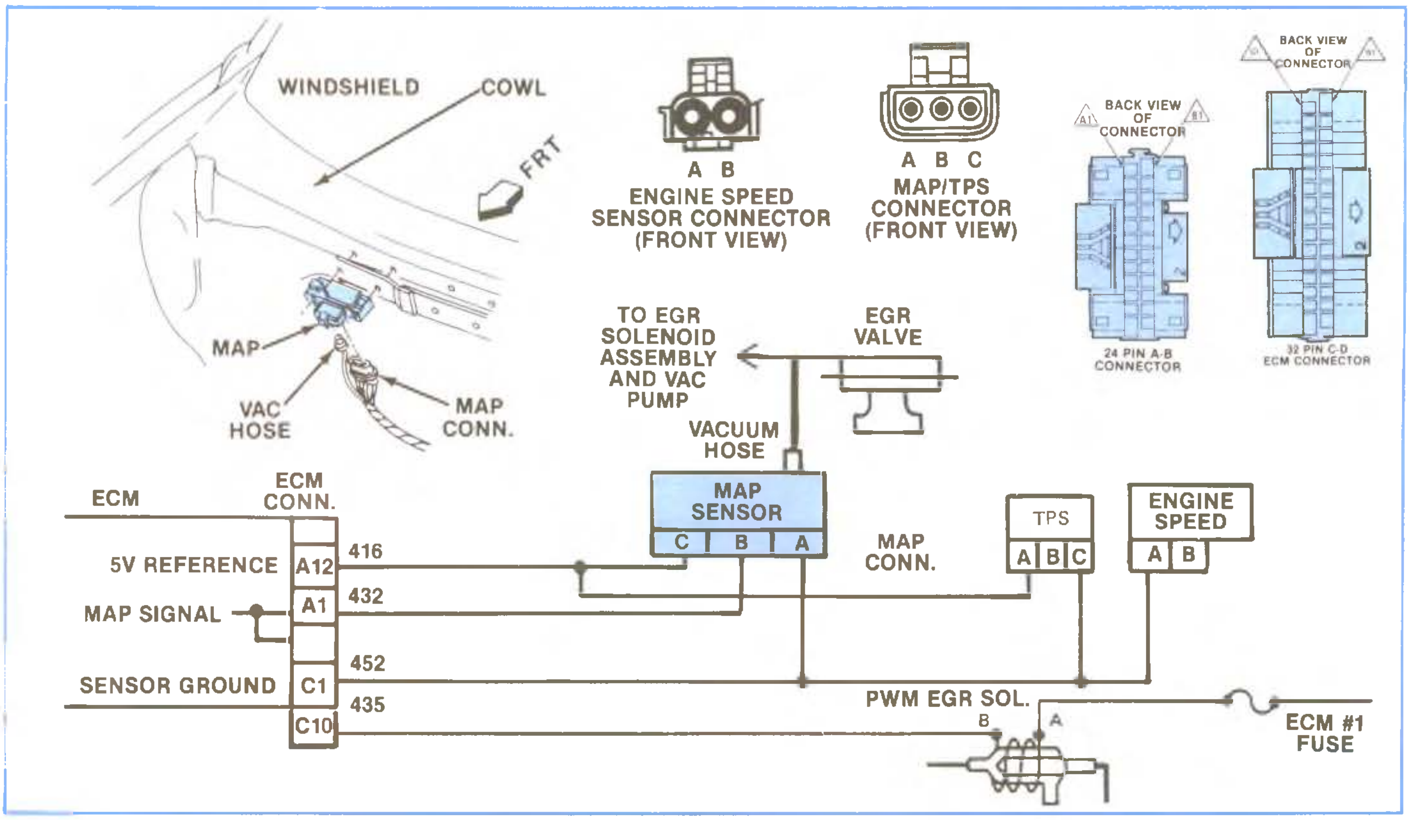


Figure 5-56, 1985 MAP Sensor Schematic (Code 31).

CODE 31 MAP SENSOR TOO LOW

Malf Code 31 is detected when the engine is running and all of the following are true:

*1. MAP voltage is less than ½ volt (voltage low = vacuum high).
2. If Code 51 is not set.
3. If Code 52 is not set.
4. If Code 53 is not set.
5. Ignition is on.
6. In normal mode of operation.
7. Conditions 1 thru 4 has to be present for a period of time greater than 10 seconds.

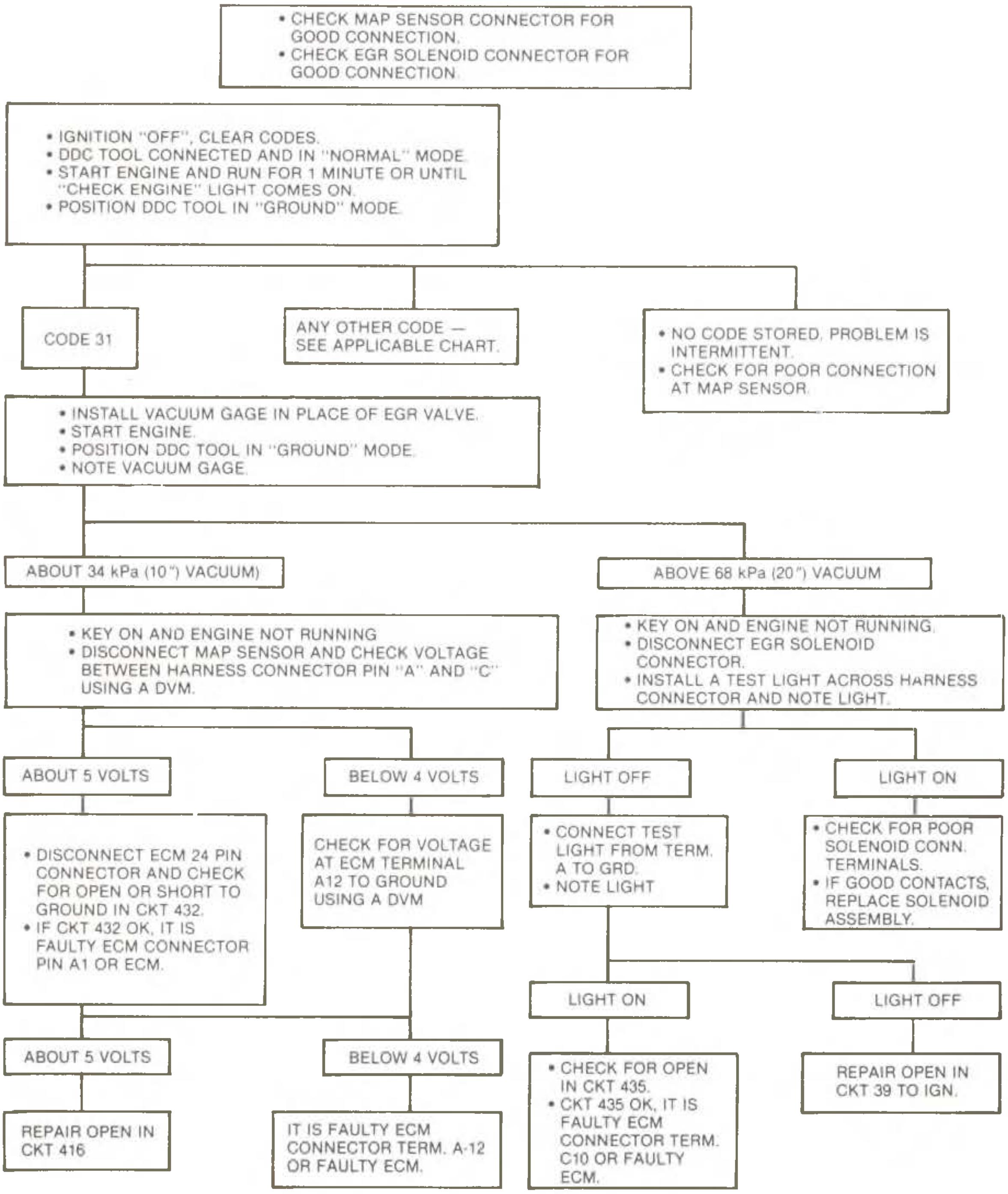
* = Major Condition.

The engine must run at idle for 10 seconds before code will set.

— NOTE —

If Code 31 is detected the EGR duty cycle should be assigned to 0% (off = full vacuum), the EPR value should be turned off and the dump solenoid should be turned off. Also the baro term should be forced to 100 kPa.

CODE 31
MAP SENSOR
(SIGNAL VOLTAGE TOO LOW)
6.2L (LH6) DIESEL (CALIF)



CLEAR CODES AND CONFIRM NO "CEL" WITH ENGINE RUNNING

Figure 5-57, Code 31.

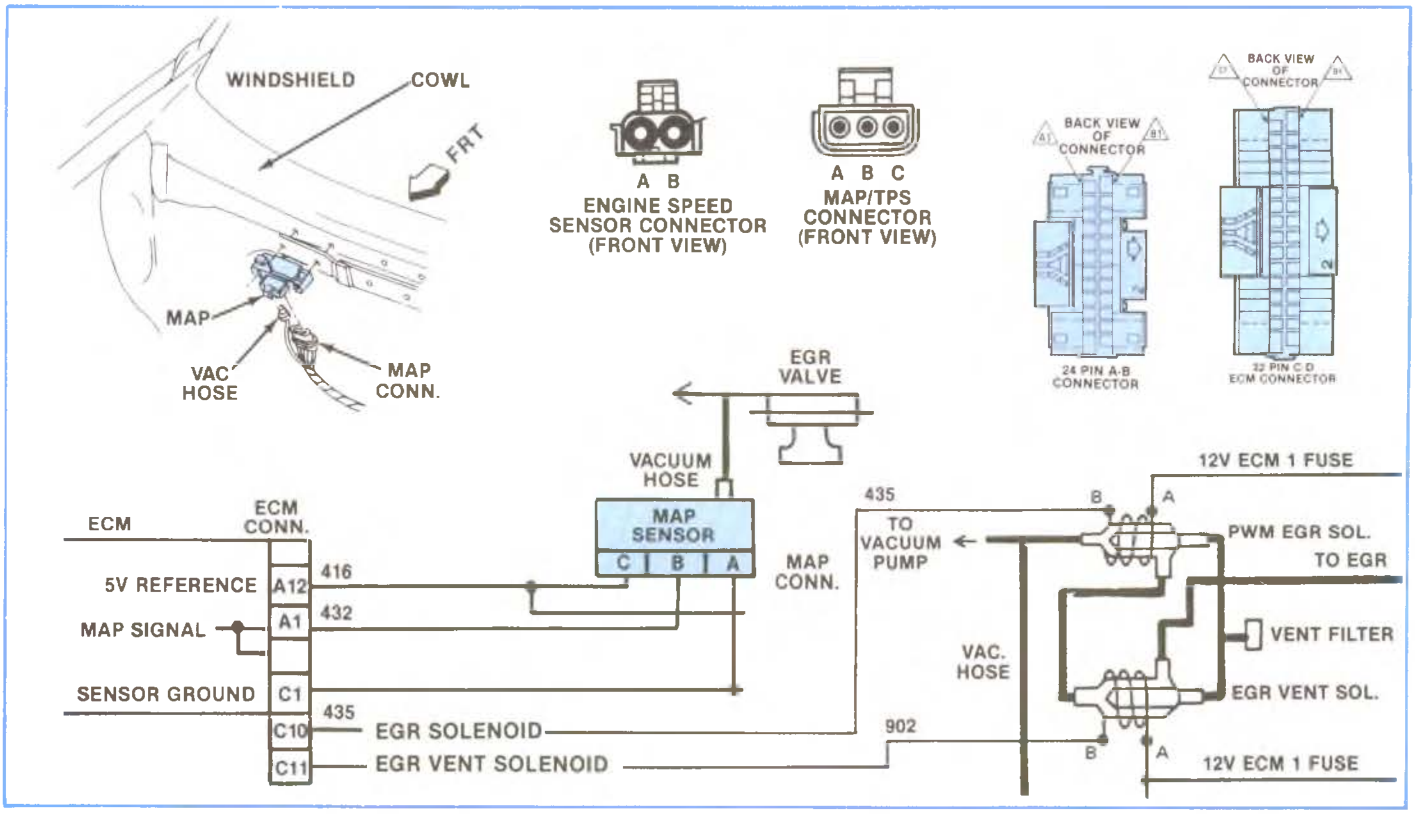


Figure 5-58, **MAP Sensor Schematic (Code 33).**

CODE 33 MAP SENSOR TOO HIGH

Malfunction Code 33 is detected when the engine is running (**REFPER** less than **KRUNPER**) and all of the following are true:

*1. If the actual vacuum is greater than EPR switch point.
2. If the calibrated vacuum is less than EPR switch point.
3. If Code 51 is not set.
4. If Code 52 is not set.
5. If Code 53 is not set.
6. If Code 54 is not set.
7. Ignition is on.
8. In normal mode of operation.
9. If all of the above conditions have been present for a period of time greater than 10 seconds.

* = Major Condition.

Pin/Condition	Pin Name	CEL/Code	Vacuum/Condition	Remarks
C10 GND	EGR solenoid	CEL - 33 after 10 sec.	No/to Full	Not throttle sensitive
MAP Vacuum off		10 sec. CEL - 33	½/Flutters	
MAP hose pinched		10 sec. CEL -33	Full	

NOTE: A grounded Pin C11 CKT902 EGR vent solenoid may set a Code 33.

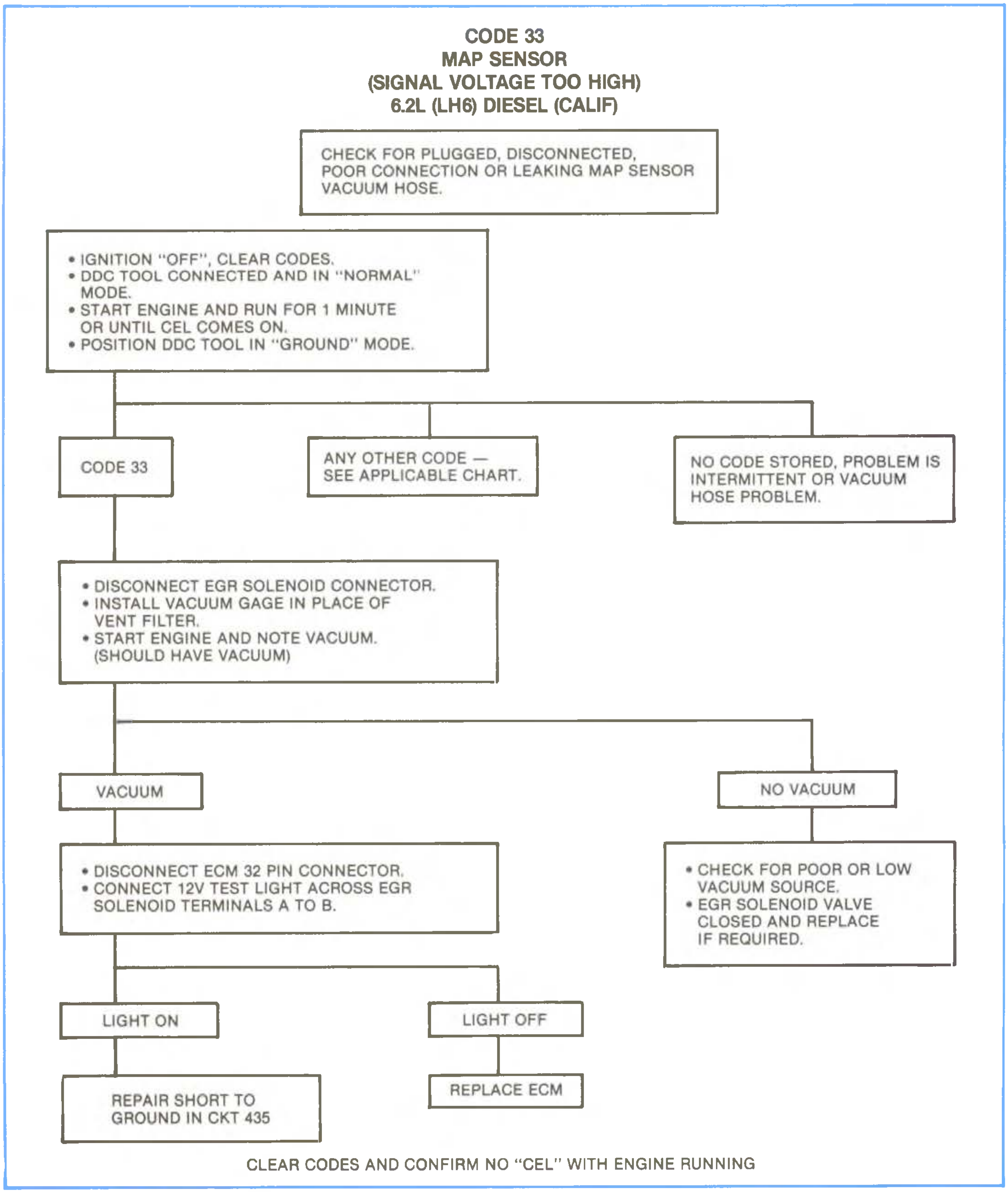


Figure 5-58A, Code 33.

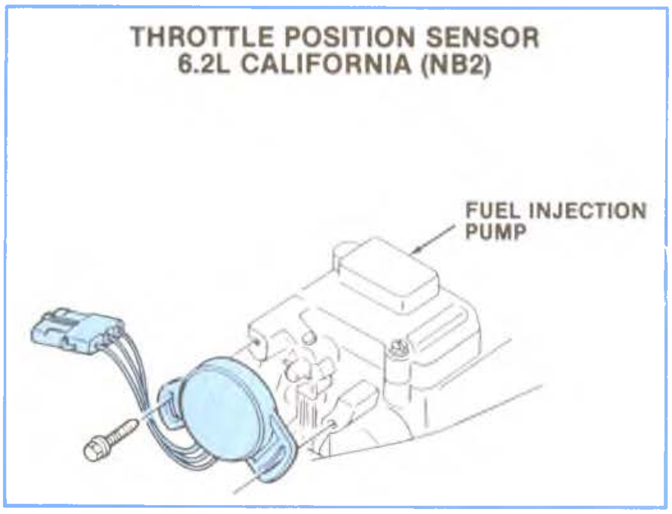


Figure 5-59, Throttle Position Sensor.

Throttle Position Sensor, TPS

A throttle position sensor is used to indicate throttle position, in calculating EGR pressure amount and T.C.C. engagement. (See Figure 5-60).

- The TPS is a 4000 to 6000 ohm (4k to 6k potentiometer) variable resistor. It signals the ECM, the degree of throttle opening.
- The TPS is connected to a 5-volt reference and has its highest resistance at closed throttle (idle). At wide open throttle (WOT), the resistance is lowest and the output will be near 5 volts.
- The TPS is ratio-metric which means it measures the quotient of two quantities. It operates by the balancing of electromagnetic forces which are a function of the moving element.

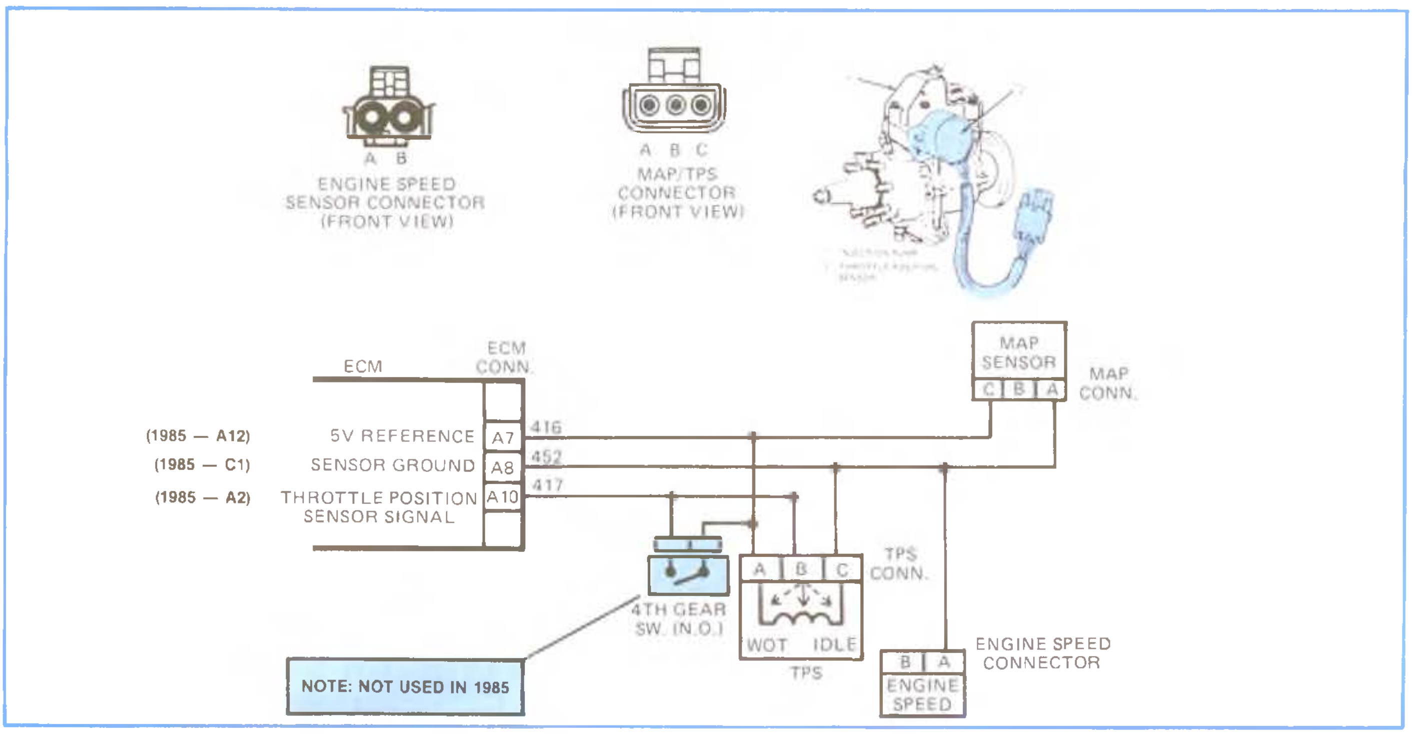


Figure 5-60, TPS Check (1984 & 1985).

1984 & 1985 TPS Check

See Figure 5-61:

- Check for complete 5-volt reference circuit. If the circuit is complete from V-ref and back to sensor ground in ECM, DVM will read about 5 volts.
- Check for a shorted or stuck 4th gear switch. When the transmission shifts to 4th gear, this switch will close and signal the ECM to turn "OFF" EGR. If the 4th gear switch is not faulty, there could be a short to V-ref or a faulty TPS adjustment or switch.
- Check for normal response at ECM from TPS. Voltage should be normally less than 1 volt at closed throttle and go to about 5 volts at WOT. If voltage change is OK, circuit is complete.

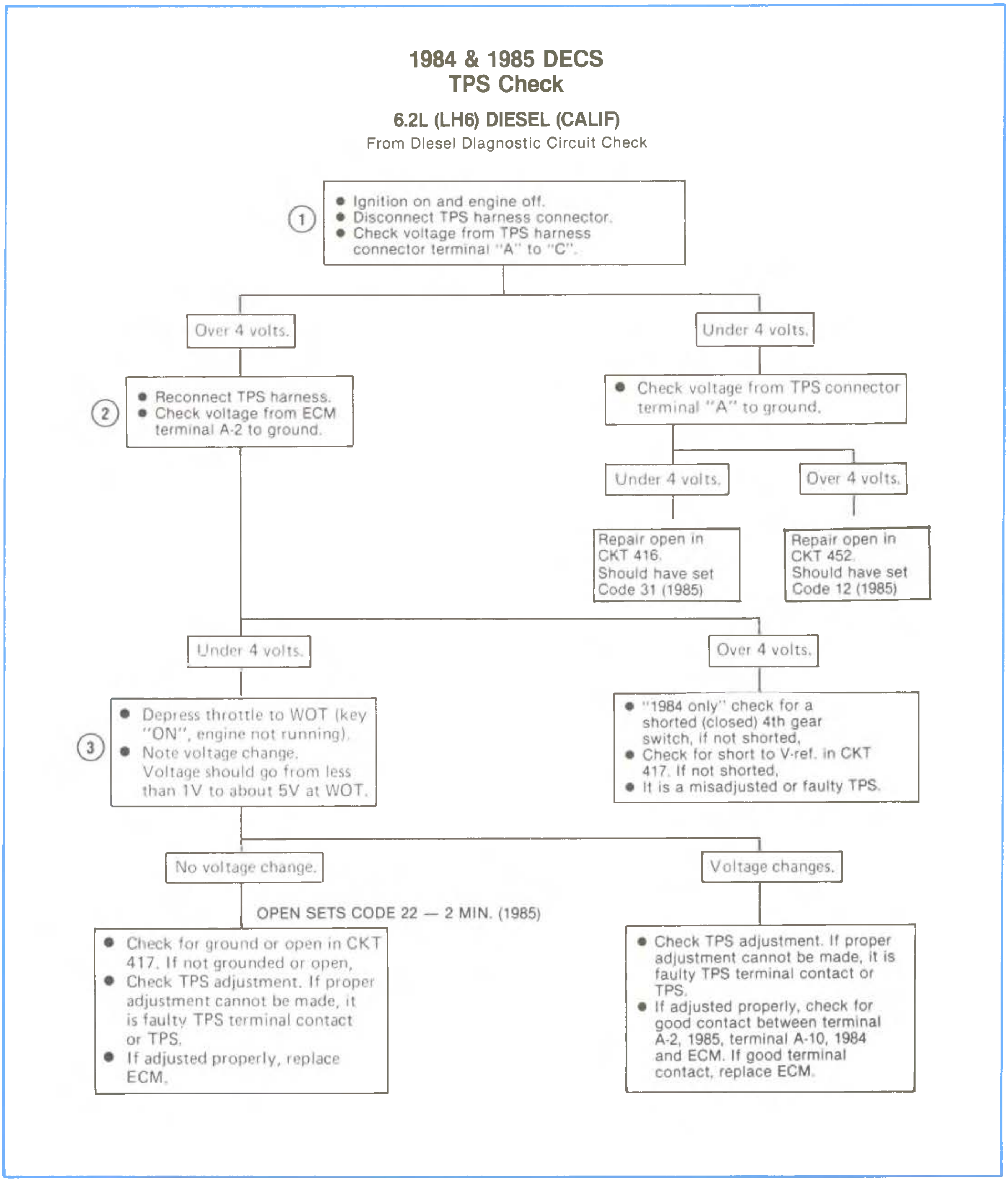


Figure 5-61, **TPS Check, 1984-1985.**

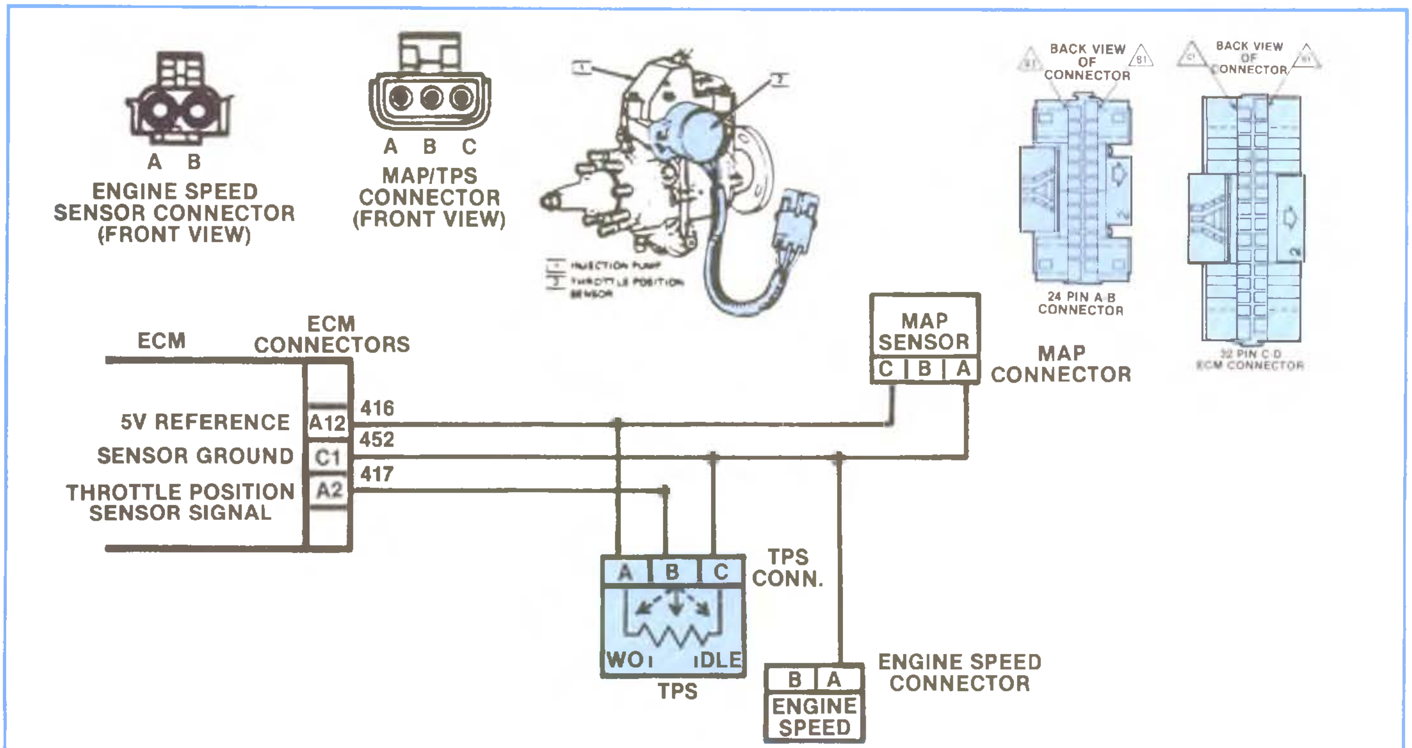


Figure 5-62, 1985 TPS Schematic.

TPS	Conn. off	No EGR, No EPR for 2 min.	After 2 min. CEL-22 code	Full/None	Vacuum
A2	OPN	TPS	Yes - 22	Full/off	Pull up resistor — 2 min. code

CODE 21 TPS TOO HIGH

Malf Code 22 is selected when the ECM detects an "engine running" condition (**REFPER** less than **KRUNPER**) and all of the following are true:

1. If the throttle angle is greater than 70%
2. Engine speed less than 1120 RPM
3. Vehicle speed greater than 0 mph
4. If Code 51 is not set
5. If Code 52 is not set
6. If Code 53 is not set
7. Conditions 1 thru 6 have been present for a period of time greater than 2 minutes.

— NOTE —

If Code 22 exists then the control algorithm is to use the throttle percent of 15 for all throttle variables. This can cause the controller to deliver full EGR. Also EPR is to be turned off.

HARDWARE

A pull-up resistor should be used on the TPS input so that an open sensor will be a Code 21.

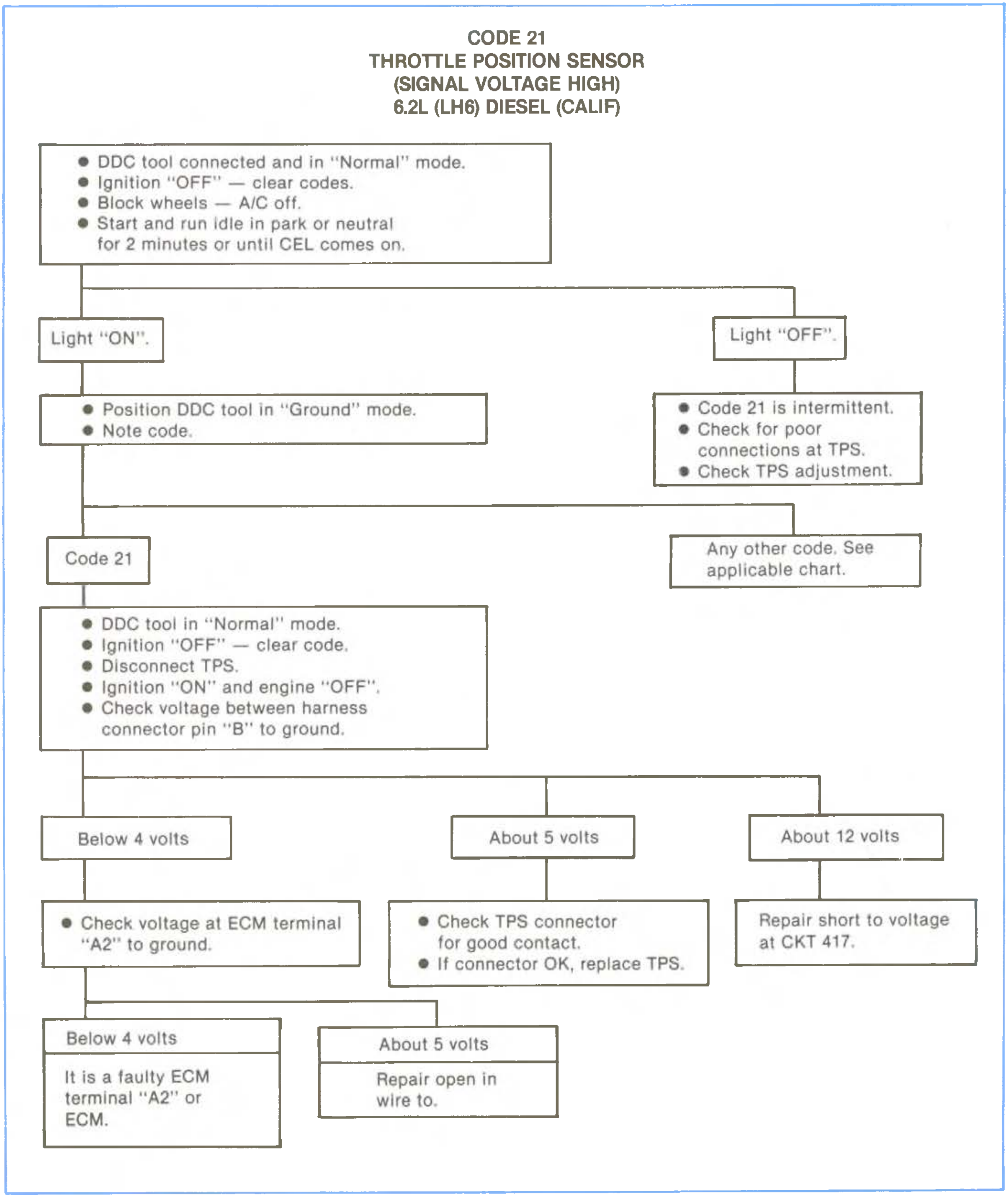


Figure 5-62A, Code 21.

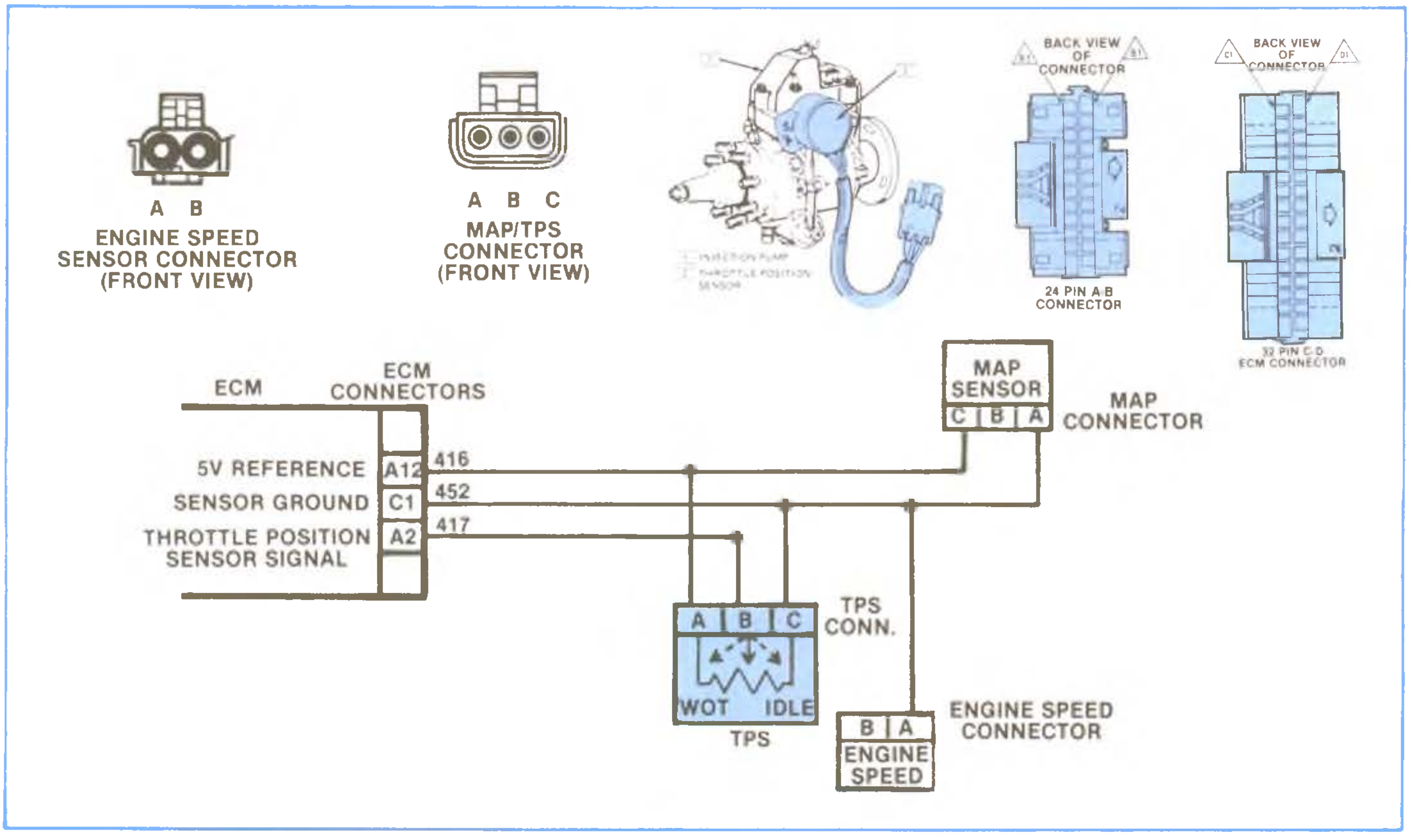


Figure 5-63, **1985 TPS Schematic.**

CODE 22 TPS TOO LOW

Malf Code 21 is detected when the engine is running at 375 RPM or more, and all of the below conditions are met:

1. The throttle angle is less than 40%.
2. Engine speed greater than 1250 RPM
3. If Code 51 is not set
4. If Code 52 is not set
5. If Code 53 is not set
6. Conditions 1 thru 5 have existed for greater than **KKTAT21** time

If Code 22 exists then EPR is to be turned off.

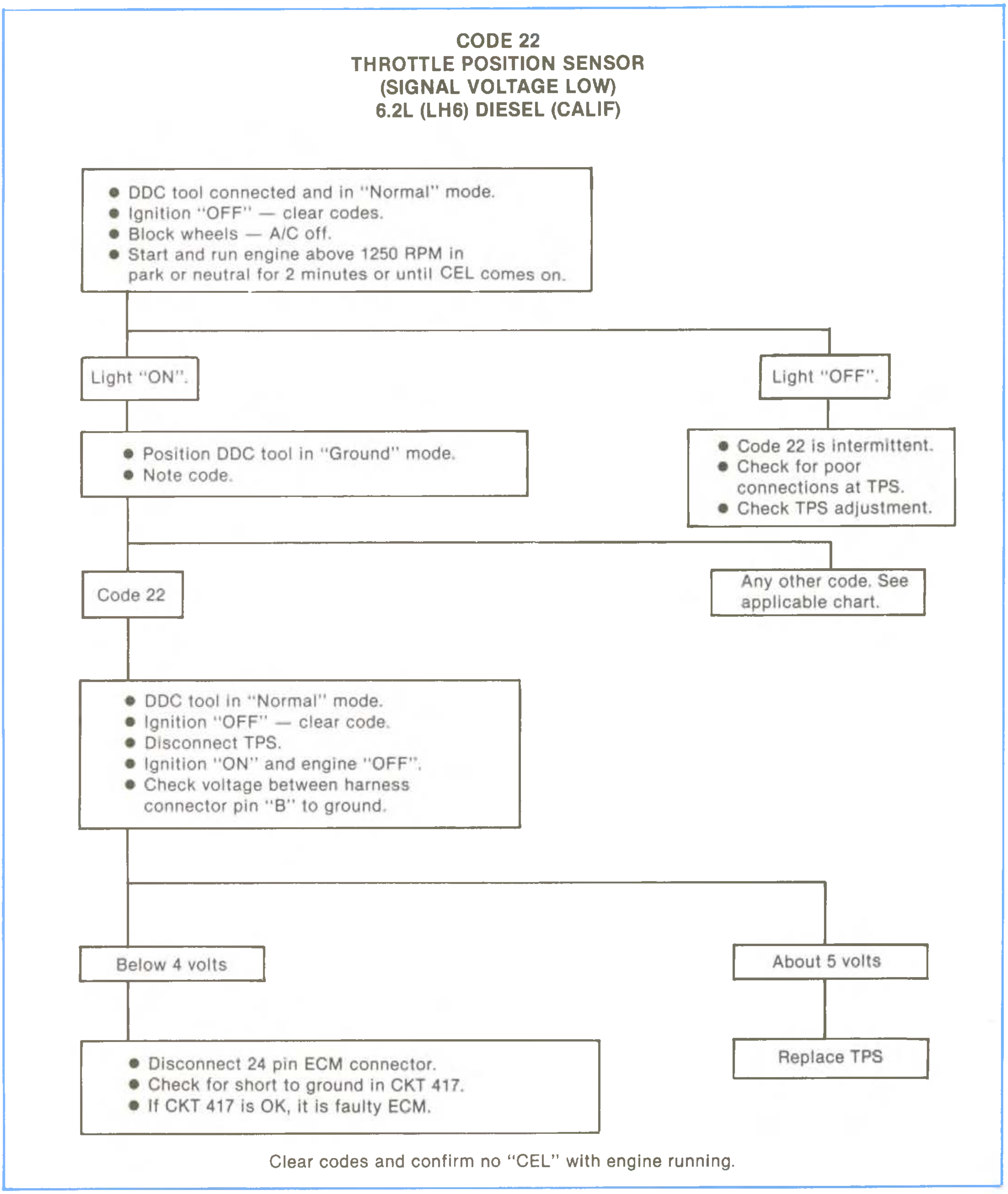


Figure 5-63A, Code 22.

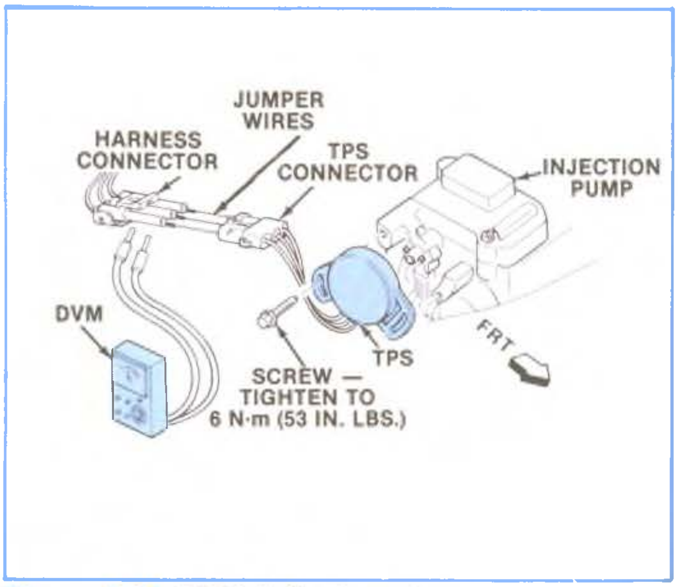


Figure 5-64, TPS Adjustment.

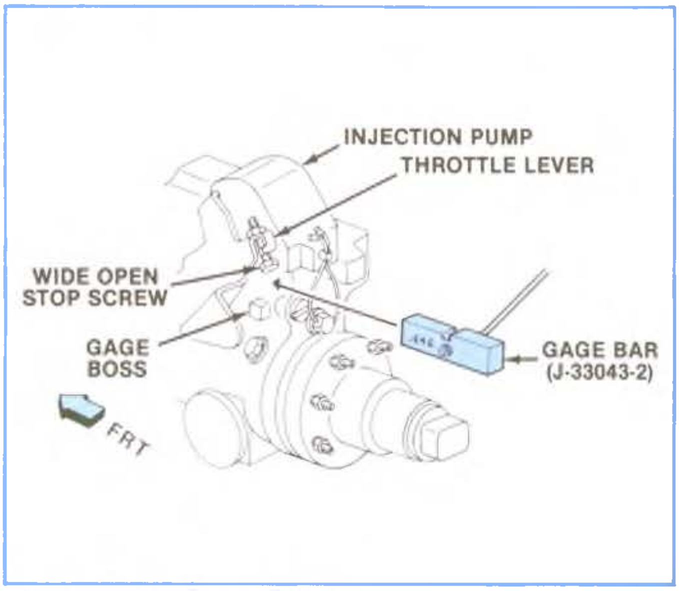


Figure 5-65, Gage Block.

Throttle Position Sensor, TPS Adjustment

1. Remove Air Cleaner Assembly and related hoses.
2. Disconnect TPS connector. Install jumper wires between TPS and harness. Jumpers can be made using terminals P/N 12014836 and 12014837. Three jumpers or their equivalent will be necessary (Figure 5-67).
3. Key "ON", engine not running.
4. Install TPS/VRV gage block to J-33043-2 or equivalent using the .646 side of the block. Position tool between gage boss on injection pump and the wide open stop screw on throttle shaft (Figure 5-68).
5. Rotate the throttle lever and hold the wide open stop screw against the gage block.
6. Using a DVM J-29124 or equivalent, measure voltage from TPS connector terminals "A" to "C". This is V-ref. Record the voltage reading (Figure 5-66).
7. Now measure and record voltage between terminals "B" to "C". This is the TPS voltage (Figure 5-66).
8. Compare the voltage recorded in Step 7 under the corresponding V-ref. recorded in Step 6 against the data in TPS table (Figure 5-66).

   The TPS voltage should be within ±1% of voltage shown. Example: A V-reference of 4.6 — the TPS voltage may be 2.87 to 2.93 volts and be within tolerance.
9. If no adjustment is necessary, proceed to Step 12.
10. To adjust TPS, loosen the two attaching screws and rotate TPS until the correct TPS voltage is obtained as per TPS Table (Figure 5-66).
11. When the correct TPS value is obtained, tighten the TPS attaching screws to 6 N·m (53 in. lbs.).
12. Check TPS voltage by releasing the throttle lever allowing it to return to the idle stop position measuring voltage from terminals "B" to "C".

Return lever against gage block. Voltage should be about 1 volt at closed throttle and return to TPS voltage within ±1% of the adjusted voltage when throttle is again opened against gage block. If voltage does not return to TPS voltage, repeat Steps 10, 11 and 12. If at closed throttle, voltage is not less than 1 volt or adjustment cannot be made, replace TPS.

V-REFERENCE →	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.3	5.4	5.5
TPS VOLTAGE → (with gage tool installed)	2.84	2.90	2.96	3.02	3.09	3.15	3.21	3.28	3.34	3.40	3.47

Figure 5-66, TPS Voltage Table.

13. Remove gage block tool.
14. Turn ignition "OFF".
15. Remove jumper wires and reconnect TPS harness connector.
16. Reinstall Air Cleaner Assembly and related hoses.

• REMOVE OR DISCONNECT

1. Air cleaner and related hoses.
2. TPS connector.
3. TPS attaching screws.
4. TPS

• CONNECT OR INSTALL

1. TPS and attaching screws.
2. Adjust TPS voltage following procedure above.
3. TPS connector.
4. Air cleaner and related hoses.

MAP SENSOR

Refer diagnosis that checks MAP sensor circuit and replace sensor as required.

EGR/EGR SOLENOID ASSEMBLY

The EGR solenoid, EGR vent solenoid and EPR solenoid are replaced as an assembly. The vent filter can be replaced as required. If diagnosis has determined that any solenoid does not operate, replace with complete assembly.

PARTS INFORMATION

PART NAME	GROUP
Controller, ECM	3.670
Calibrator, PROM	3.670
Sensor, MAP	3.682
Sensor, Throttle Position	3.440
Sensor, Vehicle Speed	3.682

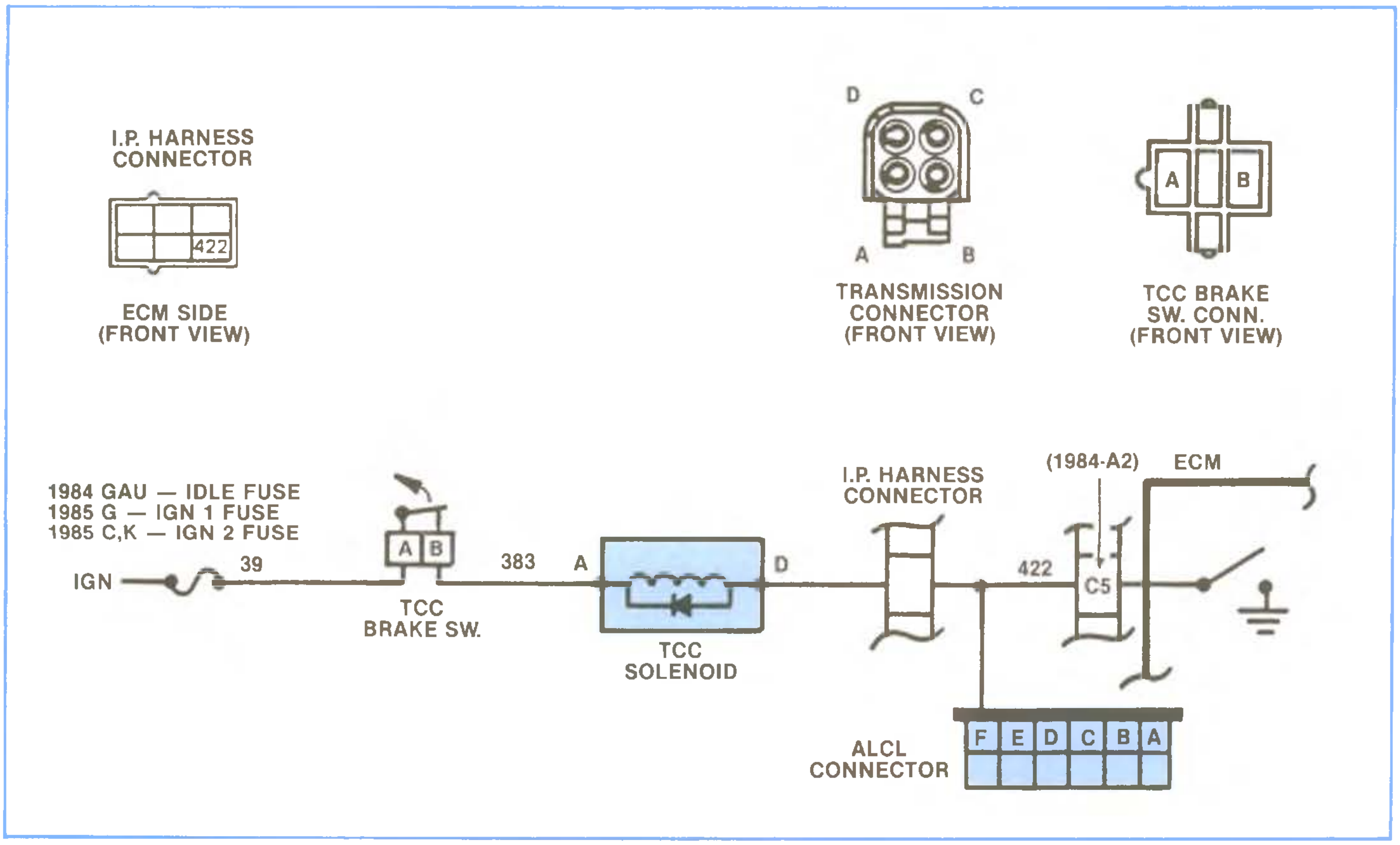


Figure 5-67, Torque Converter Clutch, TCC Circuit.

Torque Converter Clutch Control

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 (Figure 5-67). This allows the convenience of the automatic transmission and the fuel economy of a manual transmission. The heart of the system is a solenoid located inside the automatic transmission which is controlled by the ECM.

The solenoid is configured mechanically such that when the coil is activated (ON) the torque convertor clutch is applied which results in straight through mechanical coupling from the engine to transmission output.

Ignition power feed to the solenoid passes through a brake switch which opens when the brake is applied. The ECM completes the ground to activate the TCC solenoid for clutch engagement.

The ECM completes the circuit whenever the TPS exceeds a calibrated valve for throttle opening.

When the transmission solenoid is de-activated, the torque converter clutch is released which allows the torque converter to operate in the conventional manner (fluidic coupling between engine and transmission).

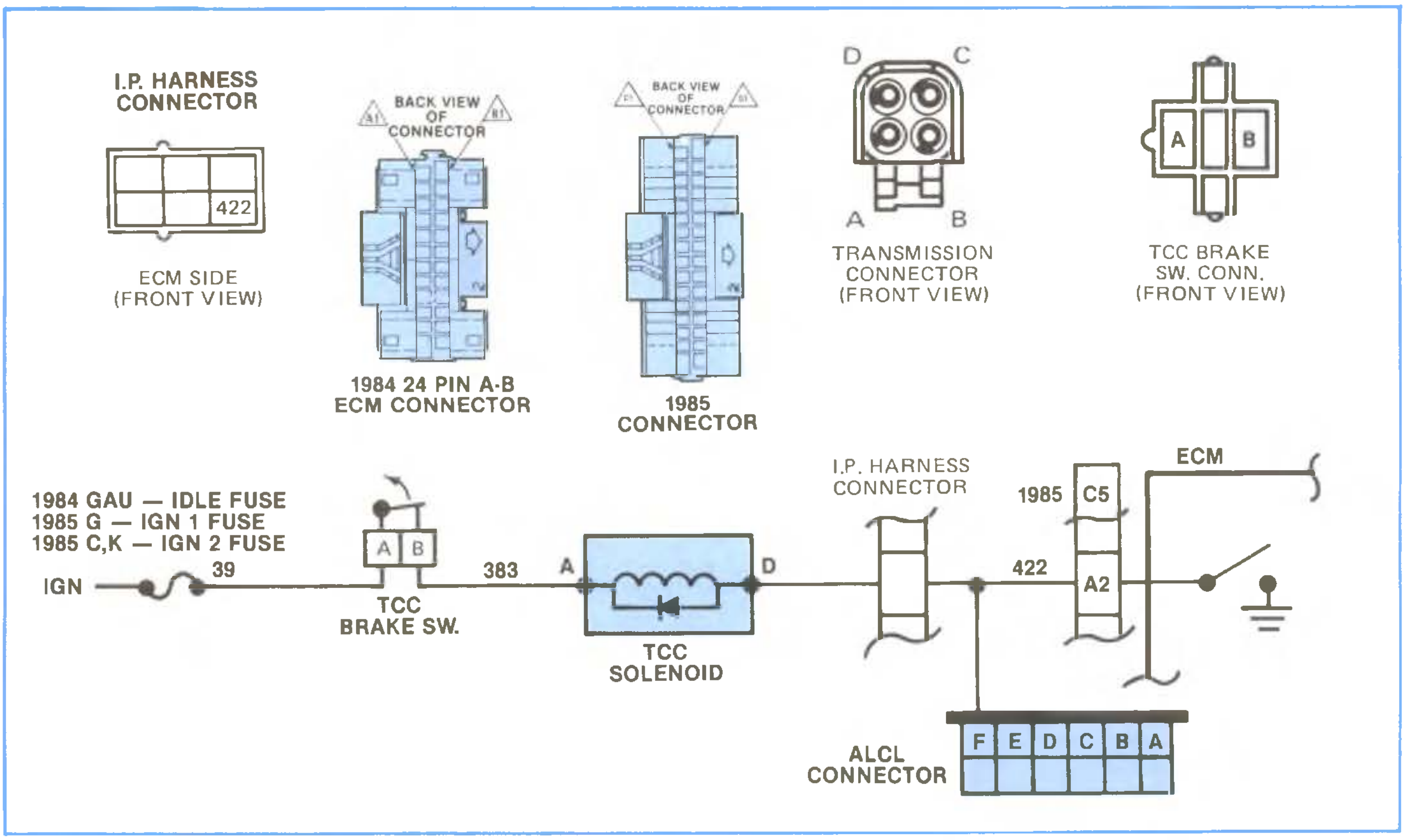


Figure 5-68, 1984 and 1985 TCC Check.

1984 AND 1985 TCC CHECK

The ECM completes the circuit whenever the TPS exceeds a calibrated valve for throttle opening. (See Figure 5-68).

- Checks for complete circuit from ignition through solenoid up to test point. Test light should be "ON" normally since ECM has not completed circuit yet.
- Checks for ECM to complete circuit to ground to energize TCC solenoid and engage TCC. Test light should normally go out when ECM completes circuit.
- Checks for TPS signal. If signal to ECM is correct, fault is in ECM connection or ECM. If TPS signal to ECM is incorrect (voltage) proper operation will not occur.
- Checks for ground in circuit to ECM Terminal A-2. Normally, light should be "OFF".
- Checks for ignition voltage to Terminal "A" of TCC connection. Light should normally be "ON".
- Checks for complete circuit from ignition to ground via TCC test terminal in ALCL. Normally, light should go "ON" if harness is good.

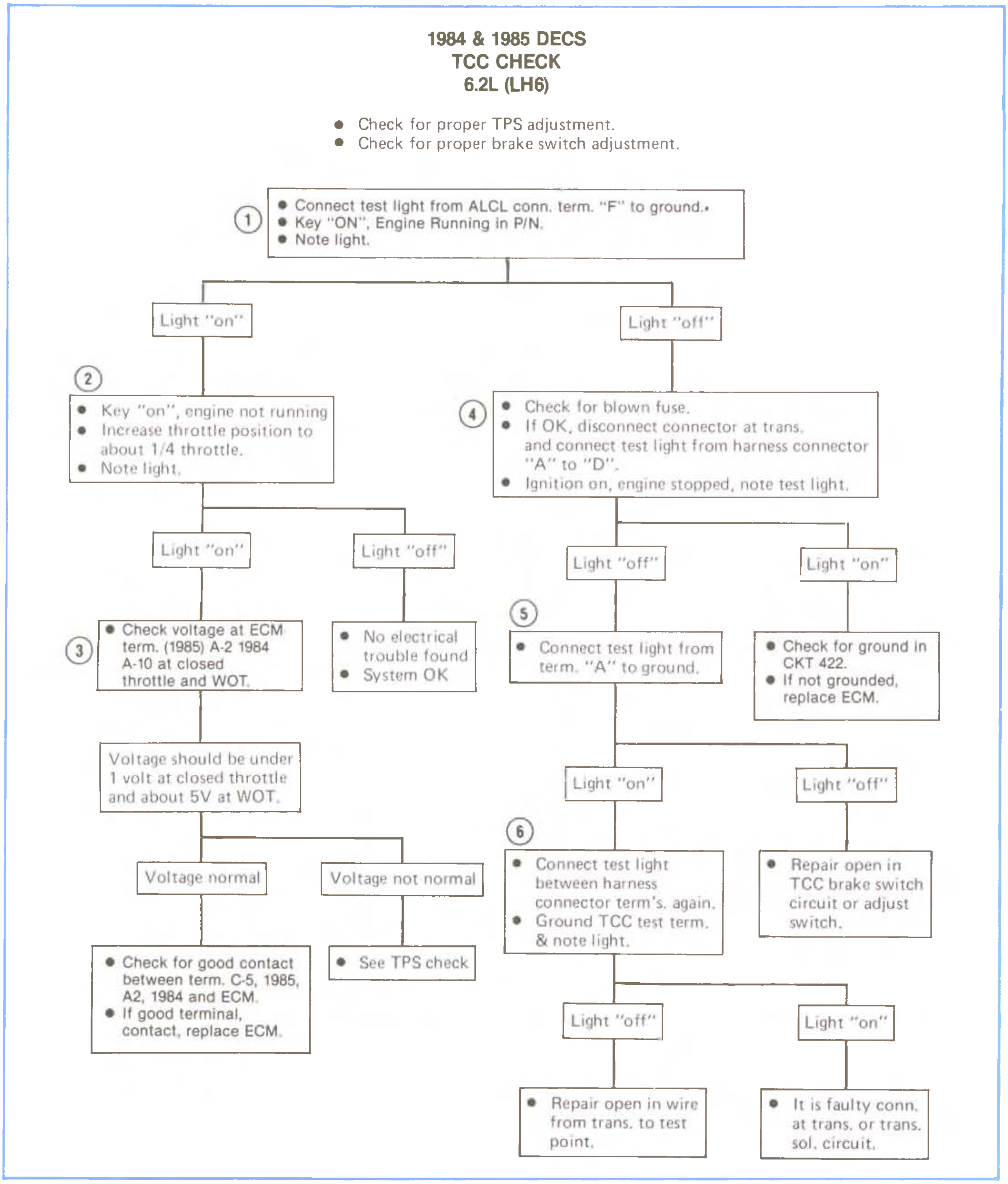


Figure 5-69, TCC Check (1984 & 1985).

TCC SOLENOID OPERATION

The TCC solenoid is actuated (clutch applied) by up to two separate control devices in series. These devices consist of:

- Vehicle brake switch.
- Electronic driver in ECM.

TCC OPERATION MODES

1. **RESET.** When the ECM is reset, the ECM shall activate the TCC solenoid driver clutch ON.
2. **ALCL 1 MODE OR ALCL 2 MODE/ENGINE NOT RUNNING.** The ECM driver is de-activated (clutch OFF) if either ALCL Mode is selected and the engine not running.
3. **ALCL 1 MODE/ENGINE AT IDLE-ALCL LEAD GROUNDED WITH 10K OHMS.** The ECM driver is activated (clutch ON) if the ALCL 1 Mode is selected and the engine is at idle.
4. **ALCL 2 MODE/ENGINE AT IDLE-ALCL LEAD GROUNDED WITH 3.9K OHMS.** The ECM driver is de-activated (clutch OFF) if the ALCL 2 Mode is selected and the engine is at idle.
5. **DIAGNOSTIC MODE — ALCL LEAD GROUNDED.** The ECM driver is activated (clutch ON) whenever the Diagnostic Mode is selected.

TORQUE CONVERTER CLUTCH CONTROL

Provided the ECM is not in any of the 5 special ALCL cases, the TCC control is determined by TCC control ECM programming.

If the solenoid driver is not activated (TCC released), the ECM will control the solenoid driver to activate the TCC solenoid (clutch ON) when the throttle position is at position greater than the minimum throttle position for clutch engagement (12 degrees ±2 degrees).

If the solenoid driver is activated (TCC ON), the ECM will control the solenoid driver to de-activate the TCC solenoid (clutch released) when the throttle position is less than the maximum throttle position for clutch release. However, the solenoid will remain activated as long as the throttle position remains greater than, or equal to, the **"Maximum Throttle Position for Clutch Release".**

VEHICLE SPEED SENSOR, VSS

In 1985 a vehicle speed sensor (VSS) is used, so the operation of TCC changes slightly with vehicle speed. If the vehicle speed is below the calibration value, the TCC operates as previously described.

If vehicle speed is above this value, the apply and release is also the same as described with one exception. The release of the TCC will be delayed by 3 seconds. Re-apply will occur as soon as throttle position requirements are met.

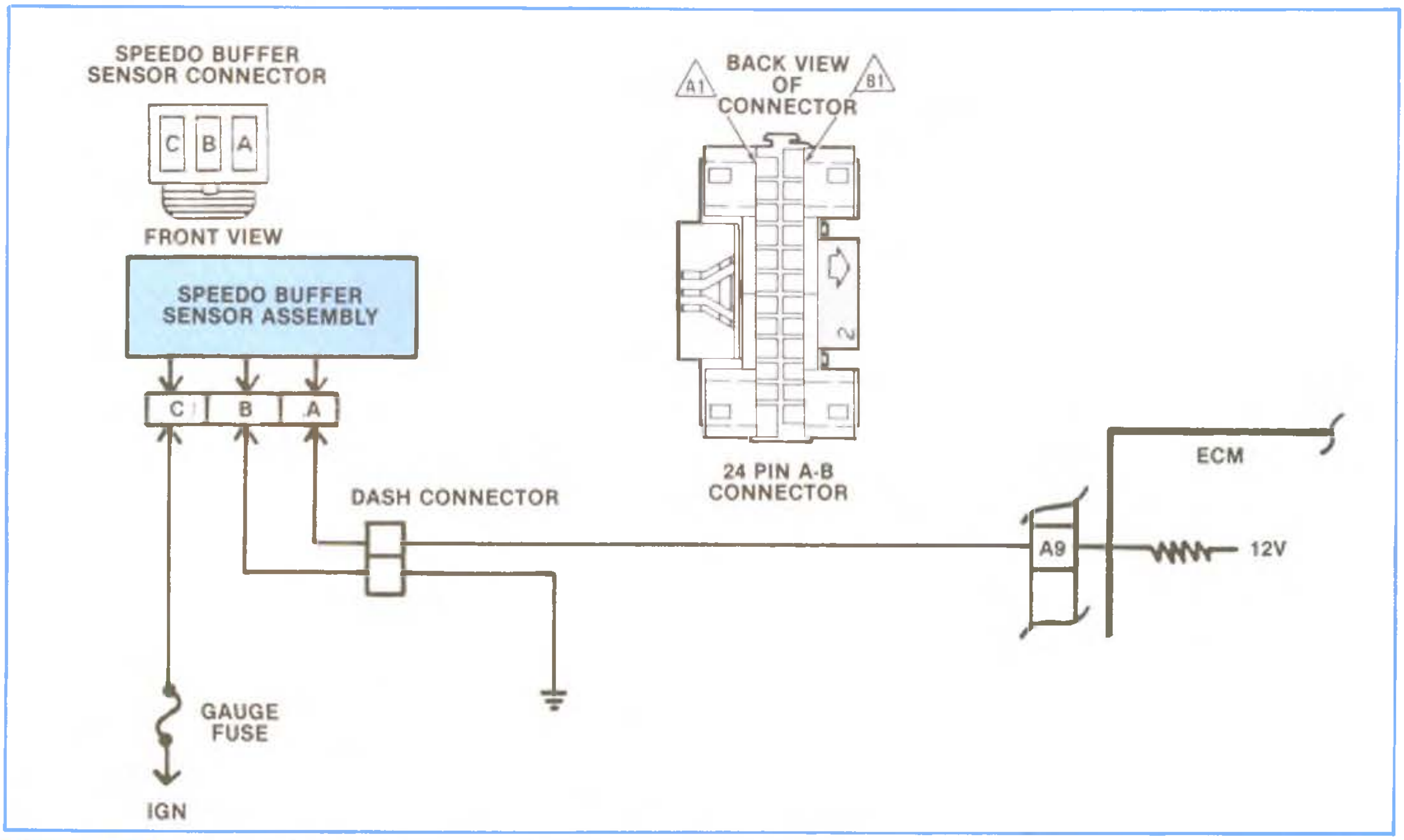


Figure 5-70, VSS Wiring Diagram — Code 24 (1985 only).

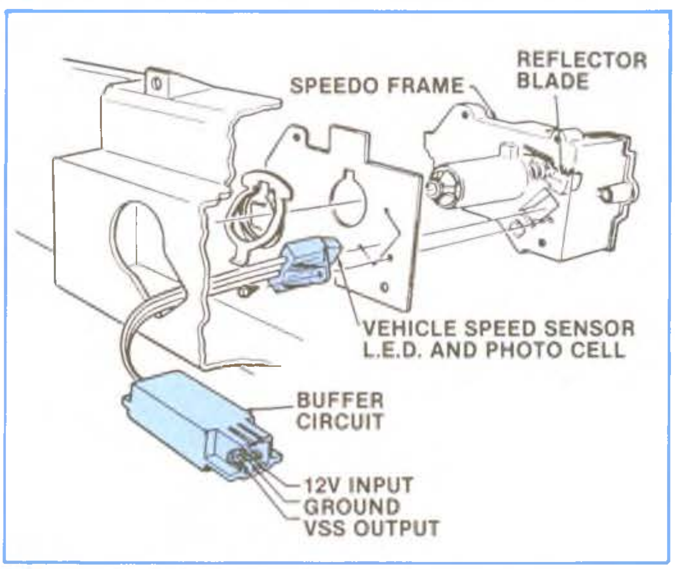


Figure 5-71, Vehicle Speed Sensor.

The speed of the vehicle is sensed by the speed sensor. The speed sensor consists of a light emitting diode and a phototransistor both of which are enclosed in one connector. This connector is located in the back of the speedometer cluster next to the speedometer cable. A wiring harness connects the sensor to the ECM (Figure 5-70).

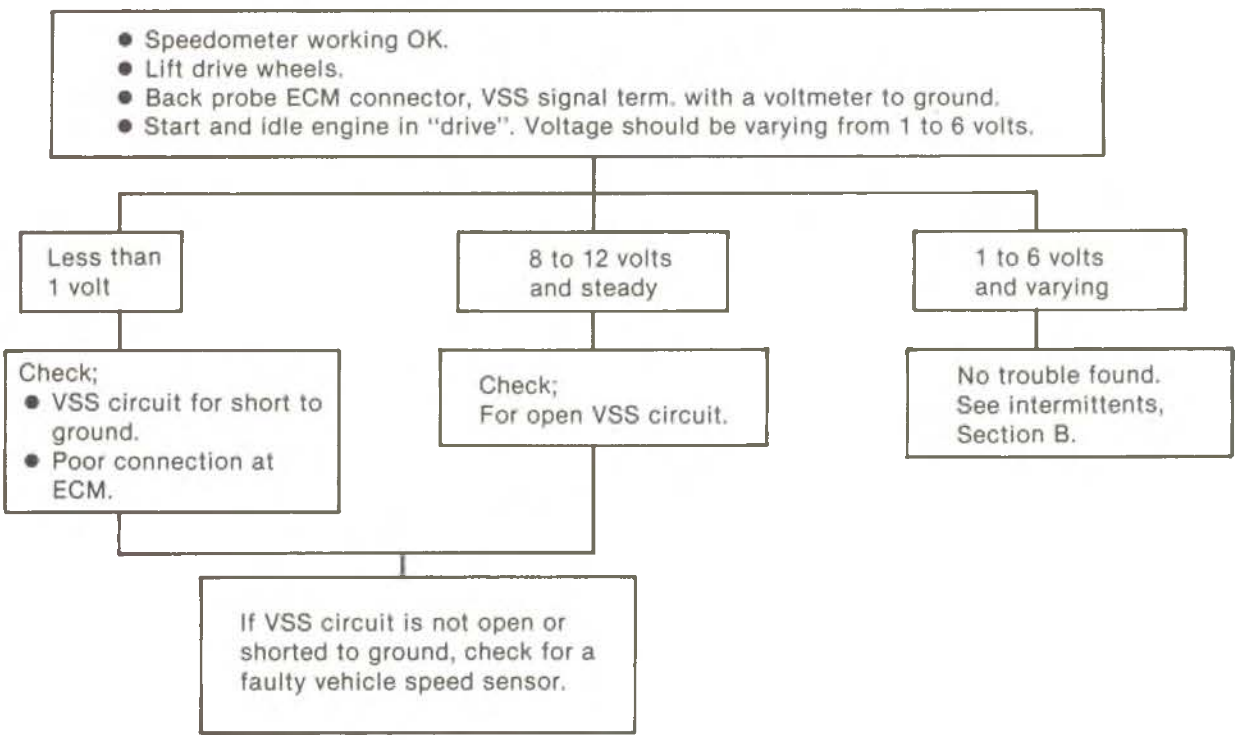
The light emitting diode is lit any time the ignition is turned on. The light given off is in the infrared area of the light spectrum and is not visible to the human eye. The diode directs its light toward the back of the speedometer cup which is painted black, and the shiny drive magnet which is part of the speedometer rotating parts.

As each bar of the drive magnet passes the light beam of the diode, the light beam is reflected back to the photo transistor. The photo transistor generates an electrical signal to the ECM. This signal is representative of vehicle speed.

See Figure 5-71. The speed sensor is supplied with 12 volts. When a voltmeter is hooked from terminal A9 of the ECM to ground and the speedometer cable turned, the voltage will swing between 8 volts and something under 1 volt rather than going up to 12 volts.

DRIVEABILITY AND EMISSIONS — DECS
CODE 24
VEHICLE SPEED SENSOR (VSS)

NOTICE; TO PREVENT MISDIAGNOSIS, THE TECHNICIAN SHOULD REVIEW ELECTRICAL SECTION 8A OR THE ELECTRICAL TROUBLESHOOTING MANUAL AND IDENTIFY THE TYPE OF VEHICLE SPEED SENSOR USED PRIOR TO USING THIS CHART. DISREGARD CODE 24 SET WHEN DRIVE WHEELS ARE NOT TURNING.



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

Figure 5-72, Code 24.

CODE 24 VEHICLE SPEED SENSOR

Malf Code 24 is detected when the engine is running at 375 RPM or more, and all of the following are true:

1. The vehicle speed is less than 5 mph.
2. The engine speed is above 2000 RPM.
3. The throttle angle is greater than 60%.
4. If Code 51 is not set.
5. Ignition is on.
6. Conditions 1, 2, and 3 have been present for a period of time greater than 10 seconds.

— NOTE —

This code could be tricked on a "K" truck by putting the transfer case in neutral and running a load with the PTO pad.

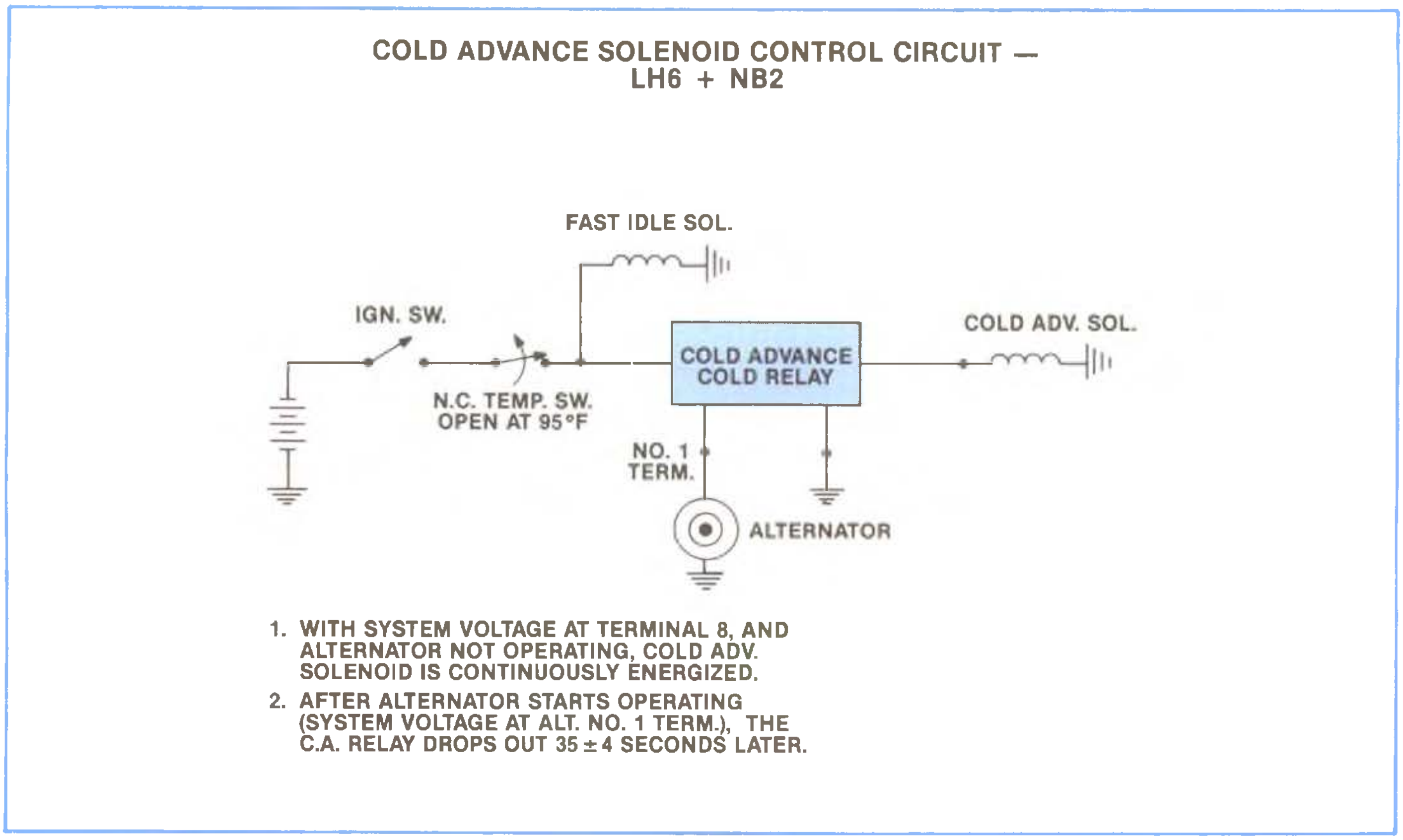


Figure 5-73, **Cold Advance Solenoid Control Circuit.**

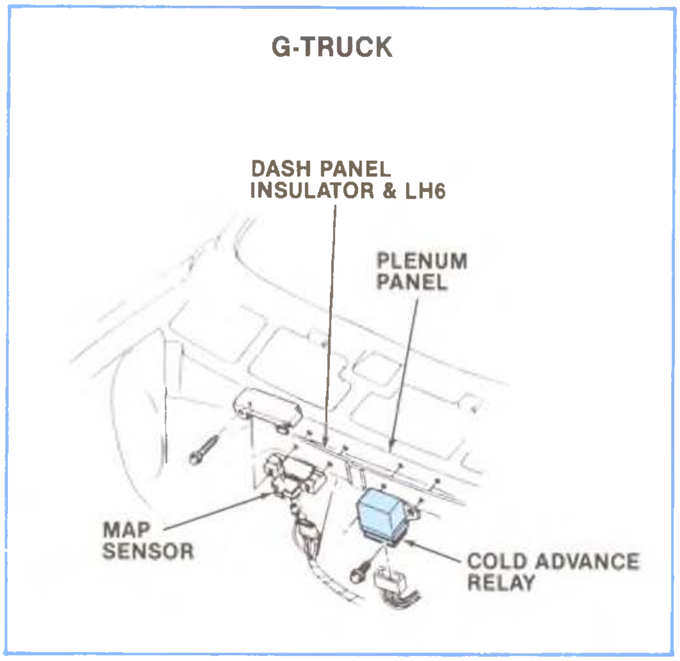


Figure 5-74.

Cold Advance Circuit, CAC

The 1984 California LH6 6.2 Diesel uses a cold advance circuit (CAC) to terminate housing pressure cold advance (H.P.C.A.) before the temperature switch does (Figures 5-73 and 5-74). It uses a cold advance control relay, which is activated by generator output.

CAC OPERATION

When the generator is not operating, and the voltage at relay terminal 8 is system voltage, the H.P.C.A. is energized.

The generator starts charging and system voltage (12-14 volts) appears at generator Terminal 1. In 35 ± 4 seconds the CAC relay will disengage the H.P.C.A.

1984-85 DECS
6.2L (LH6) CALIFORNIA ONLY
COLD ADVANCE CONTROL (CAC) CHECK

Check for blown fuse, repair for short if blown.
Engine coolant temperature below 95°F.

- Key "ON", engine not running.
- Connect test light from Cold Advance Solenoid conn. to ground. (leave harness connected to solenoid).
- Note light.

Light "ON"

- Start engine.
- Light should remain "ON" for approx. 35 sec. then go "OFF" with a drop in engine RPM.

OK

No trouble found.

Not OK

Light goes "OFF". No drop in RPM.

- It is faulty CAC solenoid.

Light remains "ON" or not "ON" for 35 sec.

- Remove CAC relay conn.
- Connect test light across Terms. "A and G".
- Start engine and note light.

Light "OFF"

- Check for open to ground in CKT 150 or open to generator in CKT 25. (CKT 25 will have system voltage only while generator is operating).

Light "ON"

- It is faulty relay connections or relay.

Light "OFF"

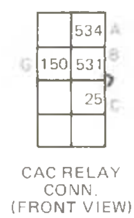
- Remove and jumper Cold Advance Coolant temperature switch connector.
- Note test light at relay Terminal "A".

Light "OFF"

- Repair open in CKT 39 to ign. or CKT 534 to CAC relay.

Light "ON"

- It is a faulty temperature switch connection or temperature switch. (Switch should be closed below 95°F).



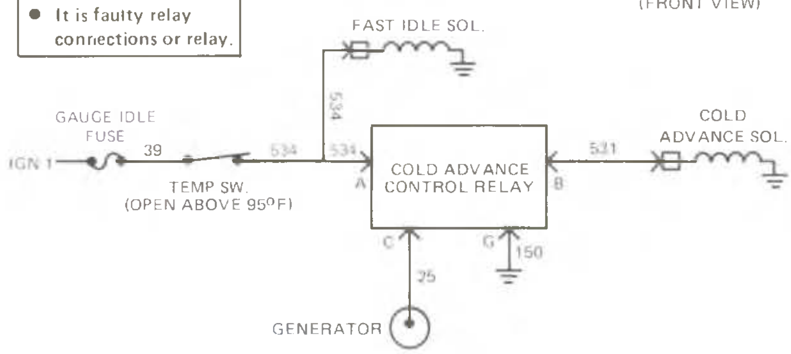


Figure 5-75.

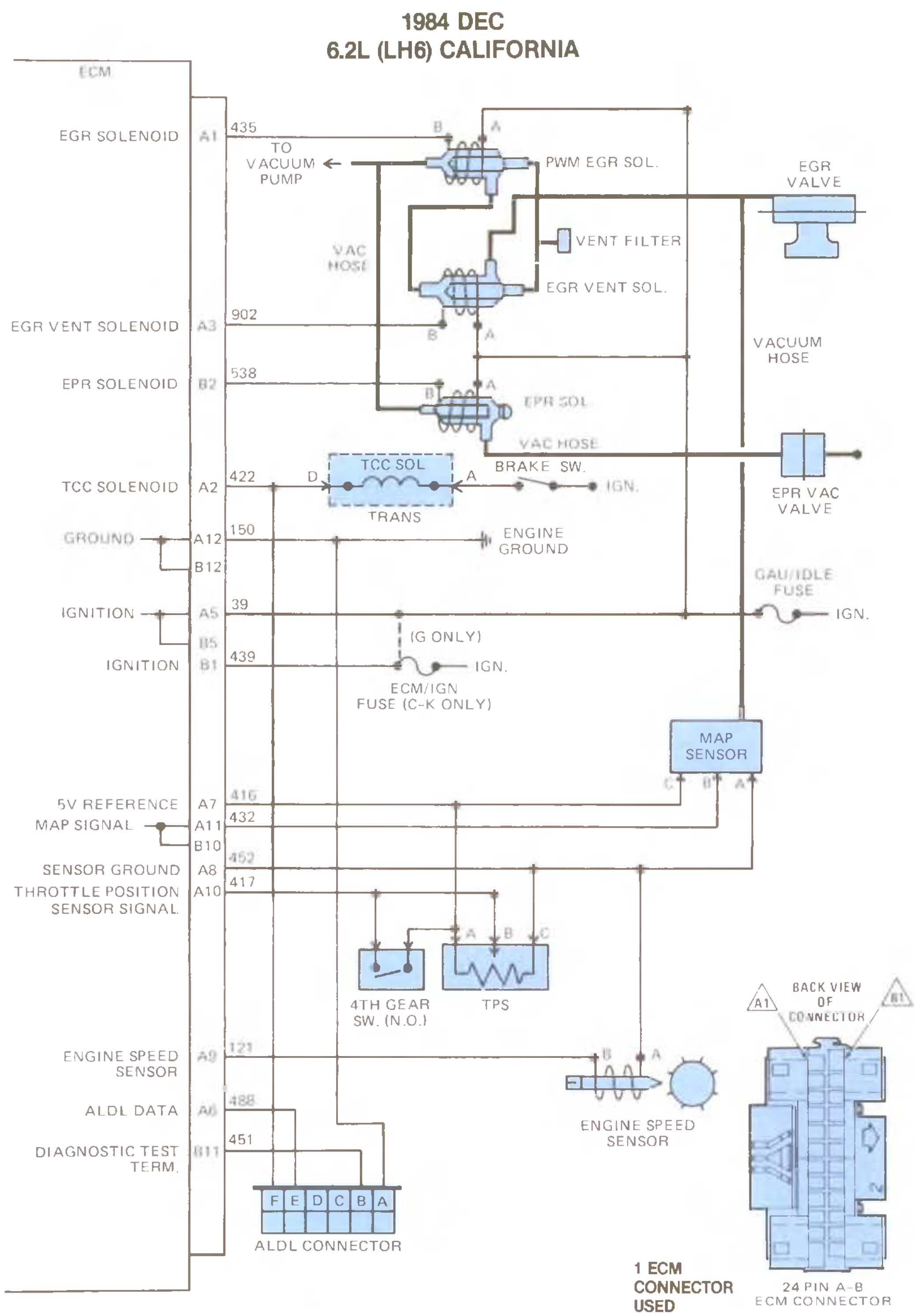


Figure 5-76, 1984 Calif. (DECS) Diesel Electronic Control System Wiring Schematic.

1984 DECS ECM TERMINAL VOLTAGE

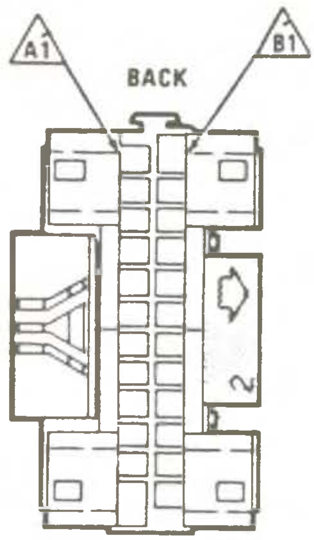
6.2L DIESEL (LH6) CALIFORNIA

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
- BATTERIES FULLY CHARGED AND GLOW PLUGS NOT CYCLING
- TEST TERMINAL NOT GROUNDED
- DDC TOOL NOT INSTALLED

VOLTAGE KEY "ON"	VOLTAGE ENG. RUN	VOLTAGE OPEN CRT.	CIRCUIT	PIN
*1.0	14	*.5	EGR SOLENOID	A1
12	14	*.5	TCC SOLENOID	A2
*1.0	14	*.5	EGR VENT SOLENOID	A3
—	—	—	NOT USED	A4
12	14	*.5	IGNITION	A5
12	*.5	*.5	ALCL DATA	A6
5.01	5.01	5.01	5V REFERENCE	A7
*.5	*.5	*.5	SENSOR GROUND	A8
*.5	.22 var.	*.5	† ENGINE SPEED SENSOR	A9
.57 var.	.57 var.	*.5	TPS SIGNAL	A10
4.83 var.	.45	3.0	MAP SIGNAL	A11
*.5	*.5	—	GROUND	A12



24 PIN A-B CONNECTOR

PIN	CIRCUIT	VOLTAGE KEY "ON"	VOLTAGE ENG. RUN	VOLTAGE OPEN CRT.
B1	IGNITION	12	14	*.5
B2	EPR SOLENOID	12	*1.0	*.5
B3	NOT USED	—	—	—
B4	NOT USED	—	—	—
B5	NOT USED	—	—	—
B6	NOT USED	—	—	—
B7	NOT USED	—	—	—
B8	NOT USED	—	—	—
B9	NOT USED	—	—	—
B10	NOT USED	—	—	—
B11	DIAGNOSTIC TEST TERMINAL	5.01	5.01	5.01
B12	NOT USED	—	—	—

† — AC VOLT SCALE READING
* — VOLTAGE LESS THAN THAT VALUE
var. — VARIES WITH ENGINE SPEED, THROTTLE POSITION, OR ALTITUDE

Figure 5-77, 1984 Calif. (DECS) ECM Terminal Voltage.

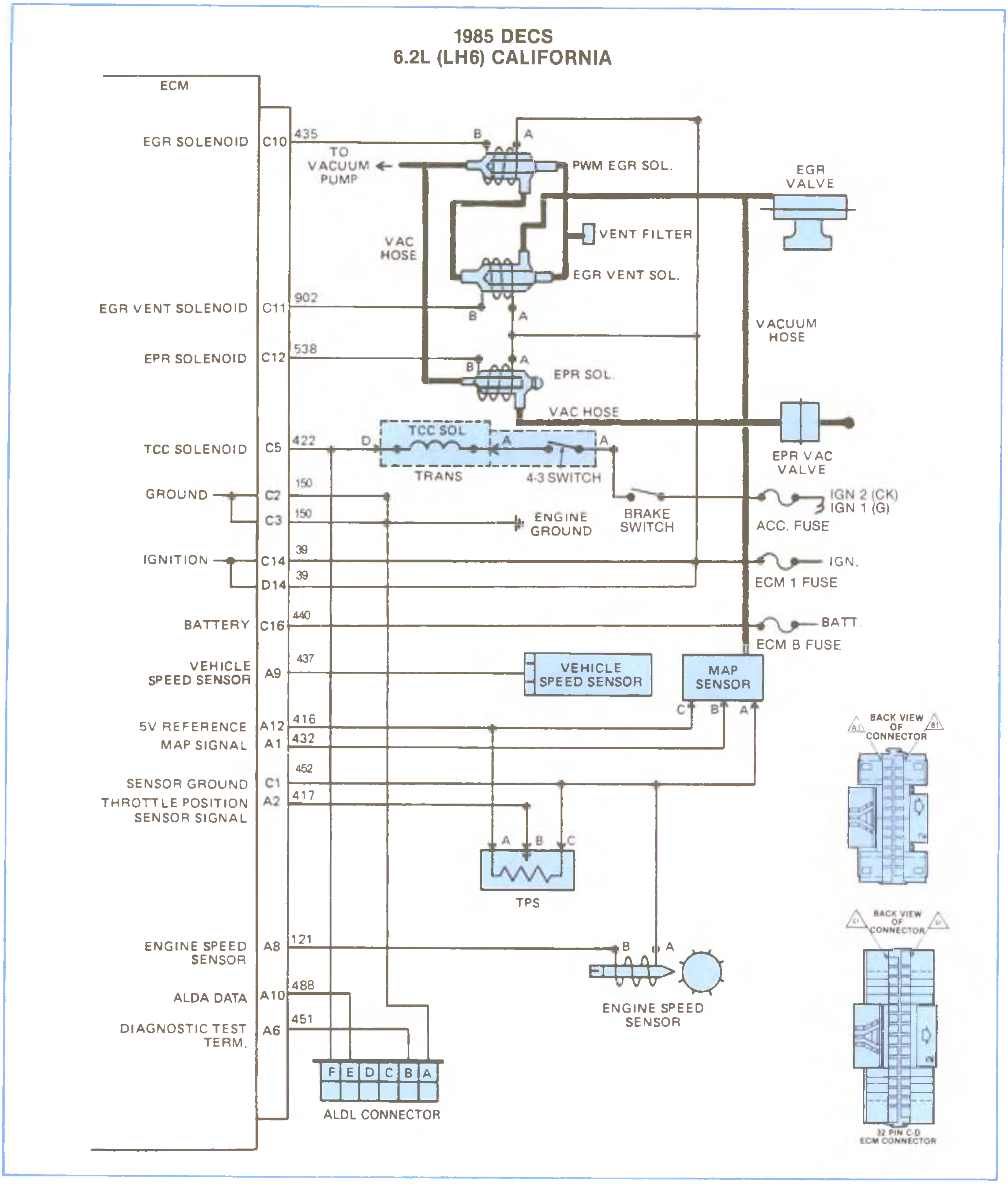


Figure 5-79, 1985 California (DECS) Diesel ECS Wiring Schematic.

1985 6.2L (LH6) CALIFORNIA (DECS)

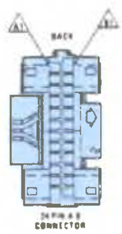
ECM CONNECTOR IDENTIFICATION

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:

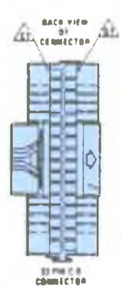
• ENGINE AT OPERATING TEMPERATURE • BATTERIES FULLY CHARGED AND GLOW PLUGS NOT CYCLING •
• TEST TERMINAL NOT GROUNDED • ALCL TOOL NOT INSTALLED •

	VOLTAGE KEY "ON"	VOLTAGE ENG. RUN	VOLTAGE OPEN CRT.	CIRCUIT	PIN	WIRE COLOR
(4)	4.64	.70	432	MAP SIGNAL	A1	LT GRN
	1.01	1.01	417	TPS SIGNAL	A2	BLU
				NOT USED	A3	
				NOT USED	A4	
				NOT USED	A5	
	5.0	5.0	451	DIAGNOSTIC TEST TERMINAL	A6	YEL
				NOT USED	A7	
	.01	.02	121	ENGINE SPEED SENSOR	A8	WHT
	10.72	12.32	437	VEHICLE SPEED SENSOR	A9	PPL
(1)	12.41	.03	488	ALCL DATA	A10	TAN
				NOT USED	A11	
	5.0	5.0	416	5V REFERENCE	A12	BRN



WIRE COLOR	PIN	CIRCUIT	VOLTAGE KEY "ON"	VOLTAGE ENG. RUN	VOLTAGE OPEN CRT.
	B1	NOT USED			
	B2	NOT USED			
	B3	NOT USED			
	B4	NOT USED			
	B5	NOT USED			
	B6	NOT USED			
	B7	NOT USED			
	B8	NOT USED			
	B9	NOT USED			
	B10	NOT USED			
	B11	NOT USED			
	B12	NOT USED			

	VOLTAGE KEY "ON"	VOLTAGE ENG. RUN	VOLTAGE OPEN CRT.	CIRCUIT	PIN	WIRE COLOR
	0	0	452	SENSOR GROUND	C1	BLK
	0	0	150	GROUND	C2	TAN/BLK
	0	0	150	GROUND	C3	TAN/BLK
				NOT USED	C4	
	8.88	10.40	422	TCC SOLENOID	C5	YEL
				NOT USED	C6	
				NOT USED	C7	
				NOT USED	C8	
				NOT USED	C9	
(2)	.94	14.47	435	EGR SOLENOID	C10	PINK
	1.88	14.47	902	EGR VENT SOLENOID	C11	LT BLU
	12.40	.87	538	EPR SOLENOID	C12	GRN
				NOT USED	C13	
	12.40	14.52	39	IGN.–ECM FUSE	C14	PNK/BLK
				NOT USED	C15	
	12.35	14.32	440	BATT. 12 VOLTS	C16	RED



WIRE COLOR	PIN	CIRCUIT	VOLTAGE KEY "ON"	VOLTAGE ENG. RUN	VOLTAGE OPEN CRT.	
	D1	NOT USED				
	D2	NOT USED				
	D3	NOT USED				
	D4	NOT USED				
	D5	NOT USED				
	D6	NOT USED				
	D7	NOT USED				(3)
	D8	NOT USED				
	D9	NOT USED				
	D10	NOT USED				
	D11	NOT USED				
	D12	NOT USED				
	D13	NOT USED				
PNK/BLK	D14	IGN.–ECM FUSE	12.40	14.32	39	
	D15	NOT USED				
	D16	NOT USED				

Figure 5-80, 1985 ECM Connector Identification.

NOTES

6. Electrical System

Starting System

Components of these systems are described here. Figure 6-1 shows the 27MT starter used in the 6.2L. Starting procedures are covered in detail in Section 1.

Starter Motor

Due to the high compression ratios in the diesel engine, a high torque starter motor is required for starting.

A heavy duty starter with a center armature bearing is used on the diesel. This is needed to handle the higher compression ratios and to produce the minimum cranking speeds needed for starting of 100 rpm when the engine is cold and 180-200 rpm on a warm engine.

The diesel engine is fitted with a heavy-duty 12-volt cranking motor with increased strength pinion and ring gear teeth. Power is supplied by two 12-volt batteries connected in parallel.

This cranking package provided all-weather starting capability.

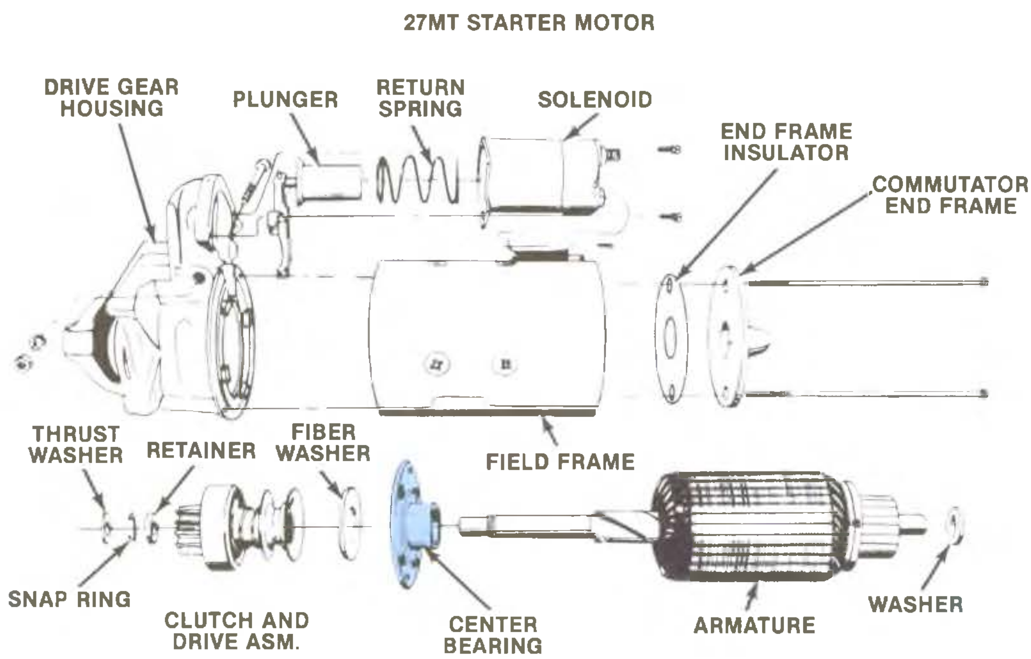


Figure 6-1, 6.2L - 27MT Starting Motor Exploded View.

STARTER MOTOR NOISE DIAGNOSIS

PROBLEM	CAUSE
1. HIGH PITCHED WHINE DURING CRANKING (BEFORE ENGINE FIRES) BUT ENGINE CRANKS AND FIRES OKAY.	DISTANCE TOO GREAT BETWEEN STARTER PINION AND FLYWHEEL'
2. HIGH PITCHED "WHINE" AFTER ENGINE FIRES, AS KEY IS BEING RELEASED. ENGINE CRANKS AND FIRES OKAY. THIS INTERMITTENT COMPLAINT IS OFTEN DIAGNOSED AS "STARTER HANG-IN" OR "SOLENOID WEAK."	DISTANCE TOO SMALL BETWEEN STARTER PINION AND FLYWHEEL. FLYWHEEL RUNOUT CONTRIBUTES TO THE INTERMITTENT NATURE.
3. A LOUD "WHOOP" AFTER THE ENGINE FIRES BUT WHILE THE STARTER IS STILL HELD ENGAGED' SOUNDS LIKE A SIREN IF THE ENGINE IS REVVED WHILE STARTER IS ENGAGED.	MOST PROBABLE CAUSE IS A DEFECTIVE CLUTCH. A NEW CLUTCH WILL OFTEN CORRECT THIS PROBLEM.
4. A "RUMBLE", "GROWL" OR (IN SEVERE CASES) A A "KNOCK" AS THE STARTER IS COASTING DOWN TO A STOP AFTER STARTING THE ENGINE.	MOST PROBABLE CAUSE IS A BENT OR UNBALANCED STARTER ARMATURE. A NEW ARMATURE WILL OFTEN CORRECT THIS PROBLEM.

Figure 6-2, Starter Motor Noise Diagnosis.

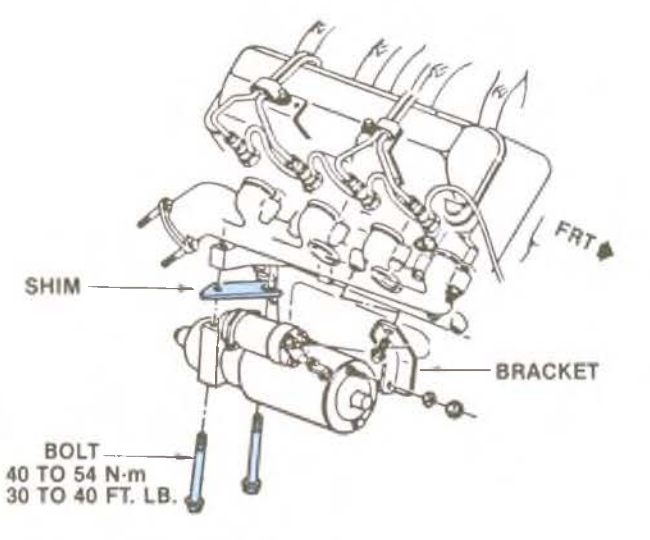


Figure 6-3, Starter Shims.

STARTER NOISE/NO-START CONDITION 1982-83 C-K-P-G WITH 6.2L DIESEL

Starter noise or a no-start condition may result from inadequate flywheel ring gear to starter pinion clearance, due to insufficient shimming.

To correct these conditions, proper starter shimming procedures should be followed:

1. Disconnect both battery ground wires.
2. Remove flywheel inspection cover.
3. Inspect for damage to flywheel teeth. Replace flywheel if teeth are damaged. (The 6.2L engine will normally stop in one of four positions approximately 90 degrees apart where, due to repeated starter pinion gear engagements, the teeth will be more worn than others. Do not fail to check these four locations for excessive damage.)
4. Loosen both starter bolts. Remove the outboard bolt. Remove the shim(s).
5. Check the shim(s) for thickness. Regardless of the total shim thickness present, add more shim(s) to bring the total thickness to 3.0 mm. If the shim thickness is 3.0 mm, add a 1.0 mm shim. Do not exceed 4.0 mm. 1.0 mm shim is P·n 14028933. (Figure 6-3).
6. Position shim(s) and insert outboard bolt.

— NOTE —

1982-1983 Starter Motor Noise Repair Procedure

Noise during cranking...reduce shim thickness by removing one 2mm or one 1mm shim or by leaving both shims out.

Noise after engine fires...remove existing 1mm shim and install a 2mm shim (total 4.0mm) do not exceed 4.0mm.

— NOTE —

1984 only

Install one 2mm shim on every job. Additional shimming or shim removal is a repair procedure.

Starter Motor Noise Repair Procedure

Noise during cranking...reduce shim thickness by removing existing shim and using one 1mm shim or by leaving shim out.

Noise after engine fires...add one 1mm or 2mm as required up to a maximum total shim stack (original shim plus corrective) of 4.0mm. DO NOT EXCEED 4.0mm.

PINION TO FLYWHEEL CLEARANCE

Pinion to flywheel clearance can be checked, using a wire gage of .508mm (.020 in.) minimum thickness. Center the pinion tooth between the flywheel teeth and gage, and not in the corners, where a misleading larger dimension may be observed.

7. Torque bolts to 40 to 54 N·m (30 to 40 ft. lbs.). Torque is very important. Do not overtorque. Overtorque will cause the starter housing to crush. Undertorque can cause the bolts to loosen.
8. If the starter and/or the starter pinion gear has to be repaired or replaced, remove the bracket bolt from the front of the starter. Disconnect wires. Remove both bolts and shims. Be sure to replace the front bracket bolt on reassembly. Replace shims as in Step 5.
9. Reinstall inspection plate.
10. Connect battery wires.

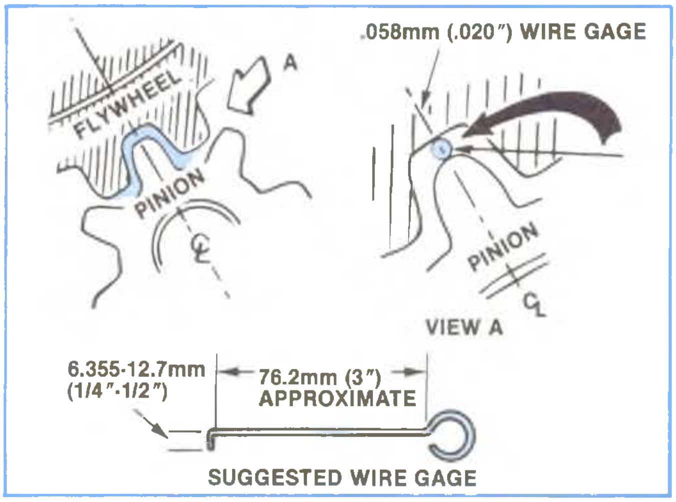


Figure 6-4, Measure Pinion To Flywheel Clearance

Batteries

The 6.2L diesel engine uses two 12 volt batteries. This doubles the amperage output and eliminates the need for a special double size battery to meet the high amperage requirements of the starter motor and glow plug circuits.

— IMPORTANT —

The batteries are connected in parallel to provide 12 volts and must never be hooked up in series. This could produce over 24 volts in the system and cause damage to the electrical circuits and equipment in the car.

Block Heater

To help assist the diesel with cold weather starts, a block heater comes as optional equipment with this engine. The heater is built into the right center block core freeze plug and operates off of normal 110 volt house current.

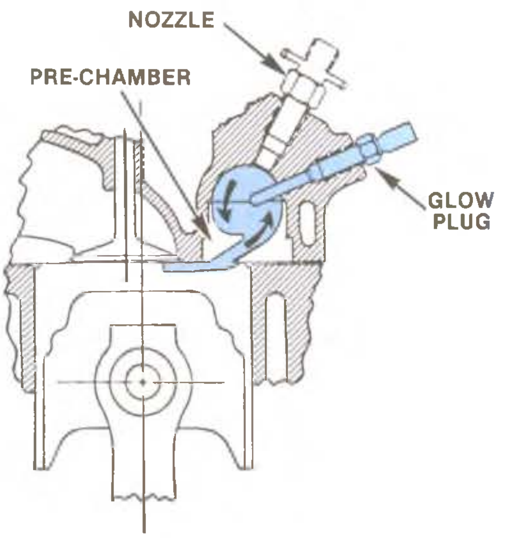


Figure 6-5, Diesel Engine Glow Plug Location.

Glow Plugs

On initial or cold start-up, glow plugs (Figure 6-5) preheat the air in the diesel engine prechambers. This along with the heat created by compression, makes the air hot enough to vaporize diesel fuel being sprayed into the prechambers by the nozzles. Once the engine starts, the glow plugs cycle to keep the engine running smoothly until warm-up time is complete. When the engine obtains proper temperature, the glow plugs turn off.

Glow plug systems include a network of electrical components which coordinate the operations of the plugs themselves with various sensors and controllers.

The glow plug is energized prior to cranking the engine for a period of time called "pre-glow". The pre-glow time period is dependent upon engine coolant temperature. Figure 6-5 shows that when the engine coolant temperature reaches 140°F (60°C), pre-glow is not required. At temperatures of 0°F (–18°C) and below, maximum pre-glow is necessary.

When operating, the glow plugs remain on for up to 60 seconds after the engine starts. This maintains ignition in all cylinders, improves throttle response and reduces exhaust smoke. This glow plug operating period is called "after glow".

Two types of glow plugs are used.

- Fast glow 6 volt plug max pre-glow is approximately 8 ± 2 seconds.
- Positive temperature coefficient (PTC) 6 volt glow plugs, max pre-glow is approximately 15 seconds (CUCV military).

The maximum operating temperature of the glow plug is 1800 °F (982 °C).

G.M. DIESEL GLOW PLUG COMPARISON

STAMPED	ENGINE	YEAR	SYSTEM	VOLT	AMP	OHM	TANG WIDTH
7G	5.7L (4.3L V-8)	78-79	Slow Glow	12	7.5	1.8	1/4″
8G	5.7L (4.3L V-6)	79-83	Fast Glow	6	15	.7-.8	5/16″
9G	6.2L	82-85	Fast Glow	6	15	.7-.8	1/4″
12G	5.7L (4.3L V-6)	84-85	PTC Fast Glow	6	10	.7	1/4″
13G	CVCV 6.2L	84-85	PTC Fast Glow	6	9	.7	3/16″

— IMPORTANT —

Be sure to use the proper replacement glow plug(s) for the system you are working on. If 12 volt glow plugs are used in the "second type" 6 volt pulsing system, the plugs will never get hot enough. If 6 volt glow plugs are used in the "first type" system, steady current will cause the glow plugs to quickly burn out and the tip may break off and drop into the prechamber. (Figure 6-7).

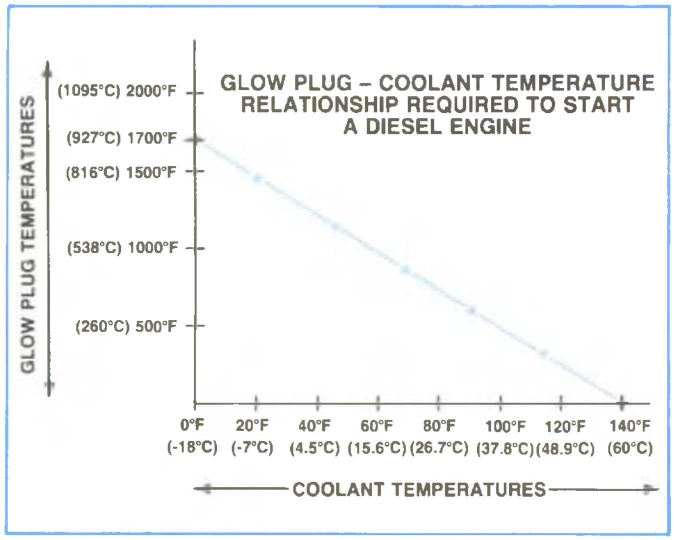


Figure 6-6, Glow Plug Temperature Required for Engine Start.

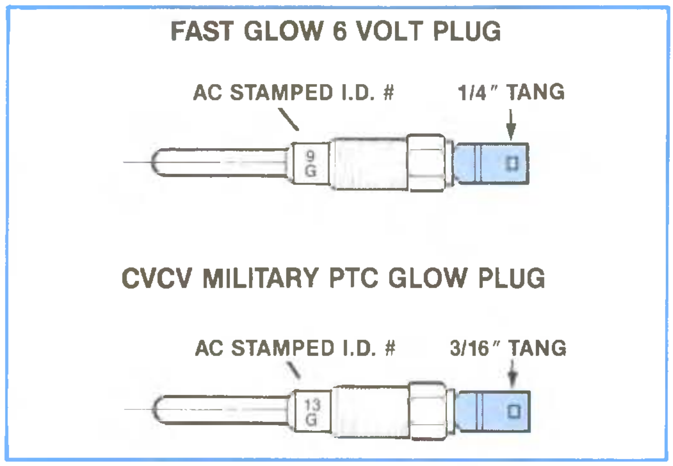


Figure 6-7, Glow Plug Comparison.

COMMERCIAL UTILITY CARGO VEHICLE (CUCV) MILITARY 6.2L APPLICATION (D-TRUCK)

See Figure 6-7.

Glow plugs from the "D" (military) truck are AC 13G glow plugs. They will fit into any 6.2L head but have a thinner electrical connection than the normal 6.2L glow plug, AC 9G. Therefore, they could be installed in a non-military 6.2L diesel, but they would not heat up correctly and a hard start condition would occur. The wider electrical tab on the AC 9G will not allow them to be hooked up in a military unit.

Glow Plug Design Considerations

Figure 6-8 is a typical AC diesel engine glow plug. The Heater Coil Element is a resistance wire centrally positioned in the sheath. The Heater Coil Element is welded to the Center Terminal Conductor and to the Sheath. The Heater Coil Element and the Center Terminal Conductor are supported and electrically insulated from the Sheath by Magnesium Oxide. The entire assembly is joined to a Threaded Shell which has a tapered seat and a Hex Section. Above the Hex Section are an Insulator and Electrical Terminal Blade.

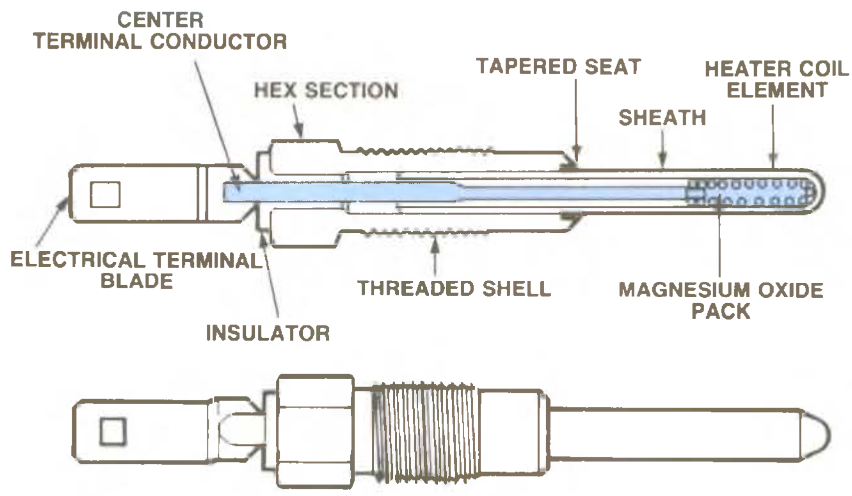


Figure 6-8, Typical AC Diesel Engine Glow Plug.

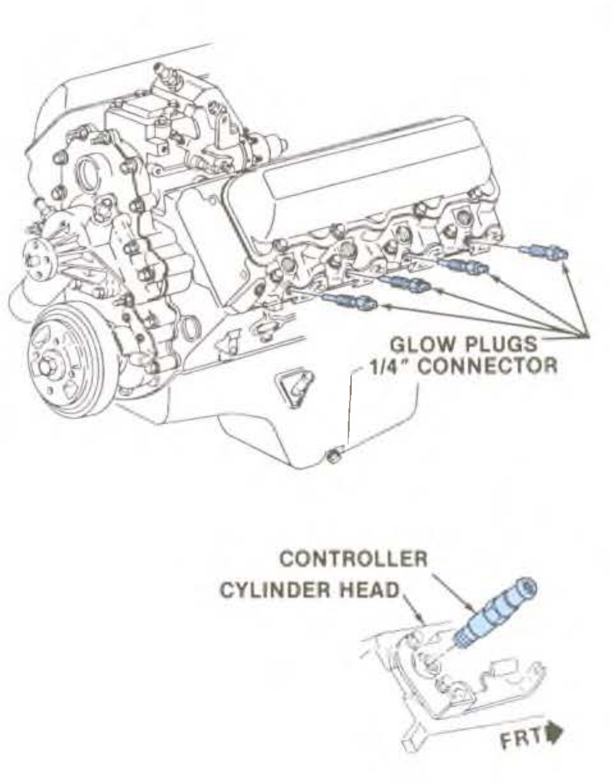


Figure 6-9, Glow Plug Location.

See Figure 6-9. The glow plug is assembled to the cylinder head and into the pre-chamber. It has only one purpose and this is to aid the engine in starting in cold weather.

When the ignition of the vehicle is turned on, the glow plugs are immediately energized. They rapidly heat up the air in the pre-chamber to approximately 1400°F. In 0°F weather the glow plug can pre-heat the pre-chamber in only 8 seconds. The engine will then start much easier. After the engine starts, the function of the glow plugs is complete, except for afterglow.

PTC GLOW PLUGS

> **— NOTE —**
> **Used in the "D" truck military application, commercial utility cargo vehicle (CUCV).**

The CUCV diesel engines will incorporate glow plugs that are, temperature self-regulating. These new glow plugs have PTC (positive temperature coefficient) characteristics (low resistance at low temperature — high resistance at high temperature) that provide the self-regulating feature.

The PTC plugs offer rapid temperature rise similar to the present fixed resistance plugs, but do not require the critical shuf-off timing and cycling, and can therefore be operated by a simpler and less costly control. However, the PTC plugs do require protection from voltages above 13.7 volts.

The glow plugs are self-regulating at 11.5 volts.

PTC GLOW PLUG SPECIFICATIONS

	BODY	TIP
Length (mm)	16.5	6.35
Cold Resistance (Ohms)	.30	.70
Power (Watts)	40	93
	(133w Total)	
Hot Resistance (Ohms)	1.3	.70
Power (Watts)	43	23
	(66w Total)	

The PTC (Figure 6-10) is a dual coil plug. It is used to aid cold weather starting of the diesel engine. In a typical installation, the heated sheath of the glow plug extends into the pre-combustion chamber of the engine near the injection nozzle.

The glow plug is energized prior to cranking the engine for a period of time called "pre-glow". The pre-glow time period is dependent upon battery voltage and underhood air temperature. For temperatures above 131 degrees F (55 degrees C) pre-glow is not required. At temperatures of 0 degrees F (– 18 degrees C) and below, maximum pre-glow (10-13 seconds) is necessary.

The PTC duel coil glow plug is so named because it consists of two coils in series. The tip consists of a steady resistance element. This tip coil is controlled by the body coil. This occurs because the body coil consists of a positive temperature coefficient (PTC) wire which increases in resistance with an increase in temperature. As voltage is applied to the plug, the body coil resistance is very low allowing high current to pass through the tip coil. As the body coil heats up, its resistance increases 400% to reduce the current through the tip. This allows the tip to heat up quickly while self-regulating itself for various voltage levels less than 14 volts.

The self-regulating nature makes the plug more forgiving of voltage levels which allows a simpler, less expensive controller to be used. In addition, this new plug continues to heat during cranking, thus improving cold starts. (The earlier quick heat glow plug cooled down during cranking after being superheated to its maximum possible temperature.)

The dual coil remains on after engine start-up for up to ninety seconds. This maintains ignition in all cylinders, improves throttle response and reduces exhaust smoke. This glow plug operating period is called "after-glow".

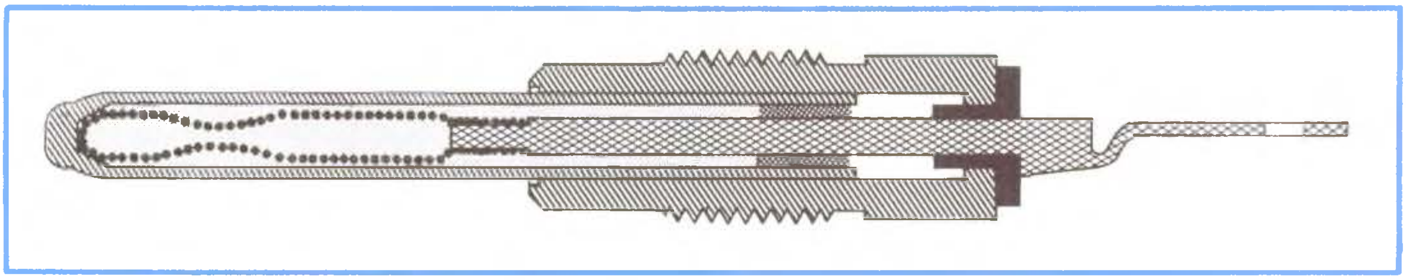


Figure 6-10, PTC Glow Plug.

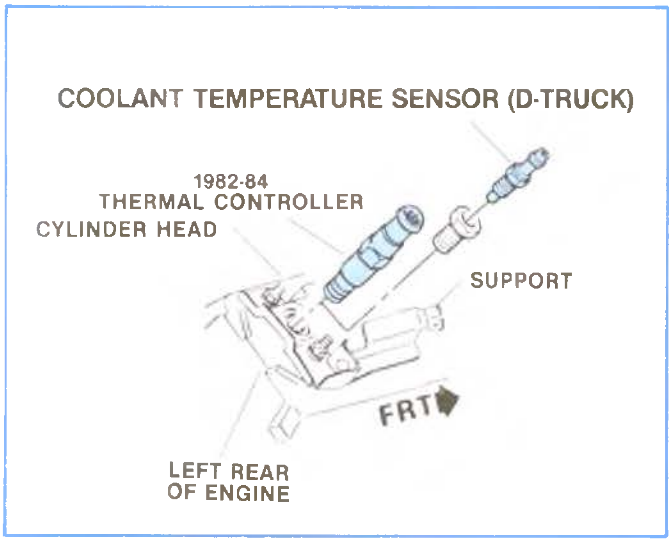


Figure 6-11, Thermal Controller.

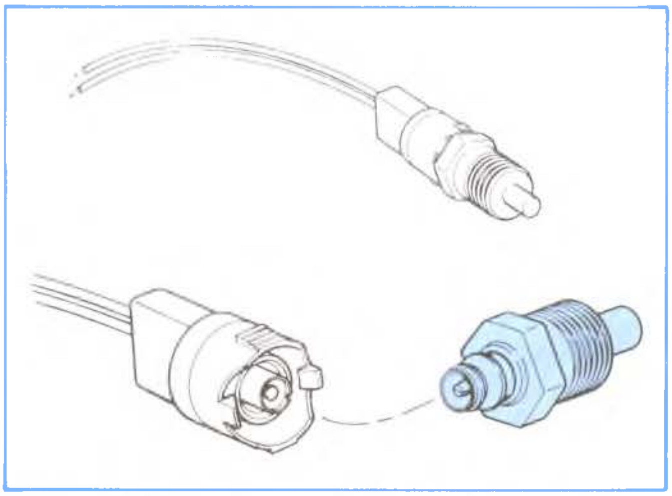


Figure 6-12, Coolant Temperature Sensor.

Electro-Mechanical Thermal Controller

The electro-mechanical thermal controller controls glow plug temperature, pre-glow time, and after-glow time. It signals the "wait" and "start" lamp relay. See Figure 6-11.

It senses ambient temperature and glow plug voltage to control system operation. The glow plug relay is pulsed on and off by the thermal controller to control current to the glow plugs and maintain glow plug temperature without overheating.

COOLANT TEMPERATURE SENSOR

See Figure 6-12. This sensor is used on the military CUCV (D-truck) application only. This sensor provides engine temperature information to the electronic module glow plug controller.

The sensor is a two-wire thermister type that lowers its resistance with coolant temperature increase. The resistance raises as temperature goes down.

Measuring resistance of this sensor, while in the engine will indicate engine temperature condition.

ENGINE COLD	– 40 °C – 40 °F	Approximate 100,000 OHMS
	0 °F	3200 OHMS
	130 °C 266 °F	70 OHMS

The resistance of the coolant sensor changes approximately 300 OHMS per degree of water temperature.

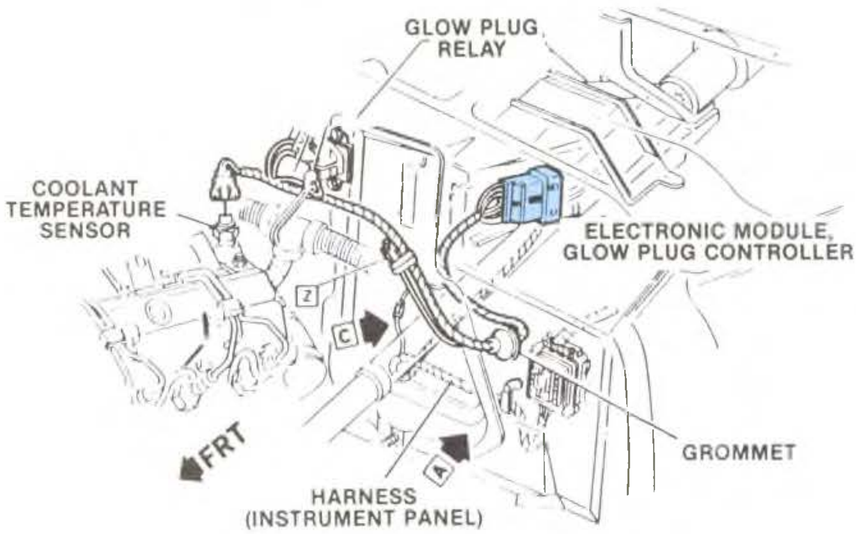


Figure 6-13, Electronic Module Glow Plug Controller (D-Truck).

Electronic Module Glow Plug Controller

With the ignition switch in "run", the Electronics Module sends constant voltage to the glow plug relay to maintain proper glow plug temperature (Figure 6-13). It receives feedback signals from the control sensor to control glow plug and "wait" lamp operation. The module also contains circuits which monitor the system for failures, and keep the "wait"lamp on to indicate a problem in the system.

The "D" truck (CUCV) military application also uses a cowl mounted glow plug relay (Figure 6-13). This relay is turned on and off by the Electronic Module Glow Plug Controller.

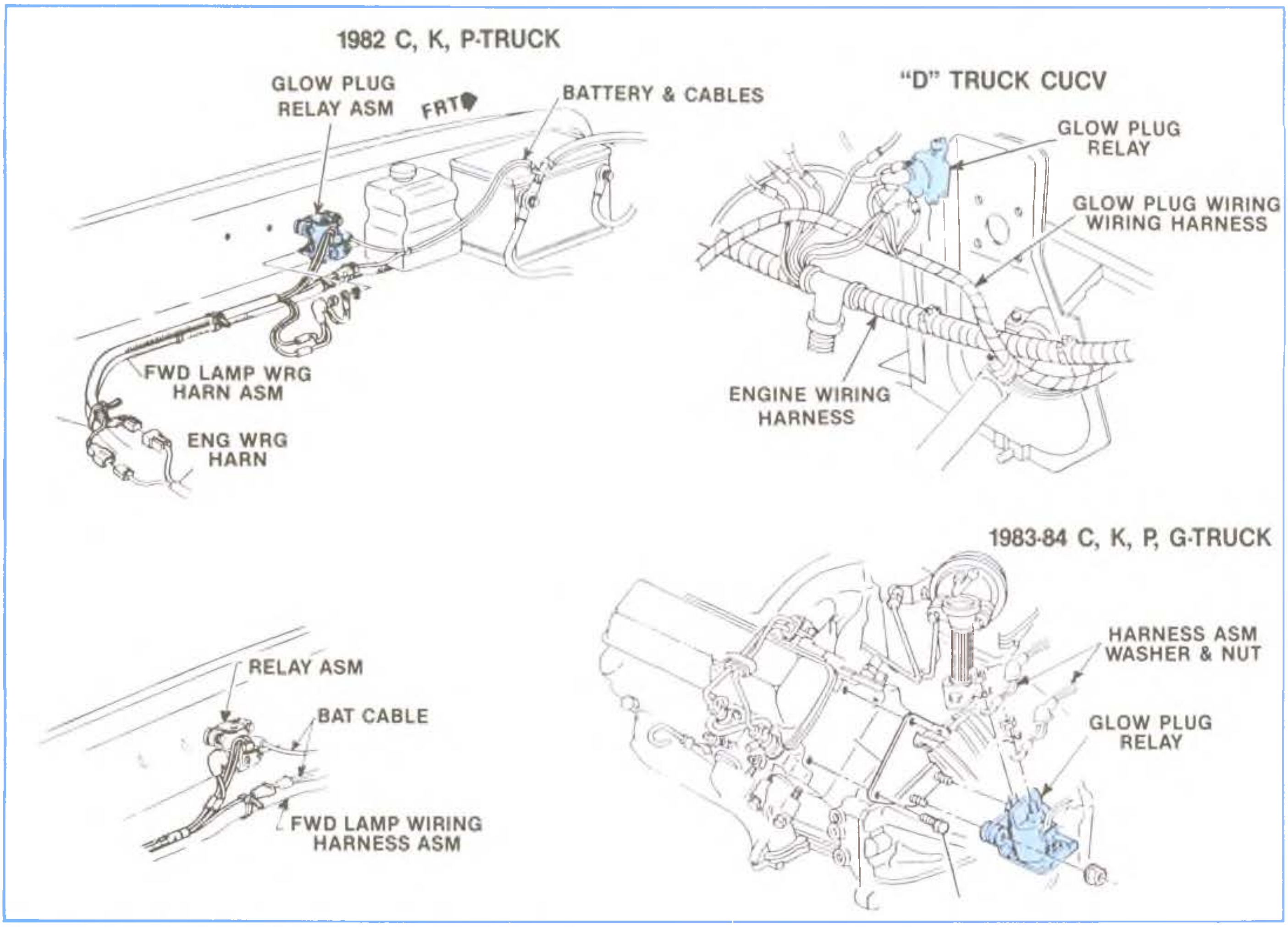


Figure 6-14, Glow Plug Relay Locations.

GLOW PLUG RELAY

The glow plug relay is pulsed on and off by the controller to control current to the glow plugs and maintain glow plug temperature to prevent overheating (Figure 6-14).

— NOTE —

The "D" truck (CUCV) military application relay does not pulse, it is "ON" or "OFF".

— NOTE —

1985 and later C, K, P, G trucks use a combined electronic module controller and relay in one unit.

GLOW PLUG TEMPERATURE INHIBIT SWITCH

The non-military glow plug system in 1984 and later uses a temperature switch in the wire between the glow plug relay and Pin 3 of the controller (Figure 6-15). It opens above 125 degrees F and terminates all glow plug operation. This helps glow plug life, by reducing needless glow plug cycles. It is located in the rear of the right cylinder head, across from the glow plug controller.

Figure 6-16 illustrates the Temperature Inhibit Switch Circuit.

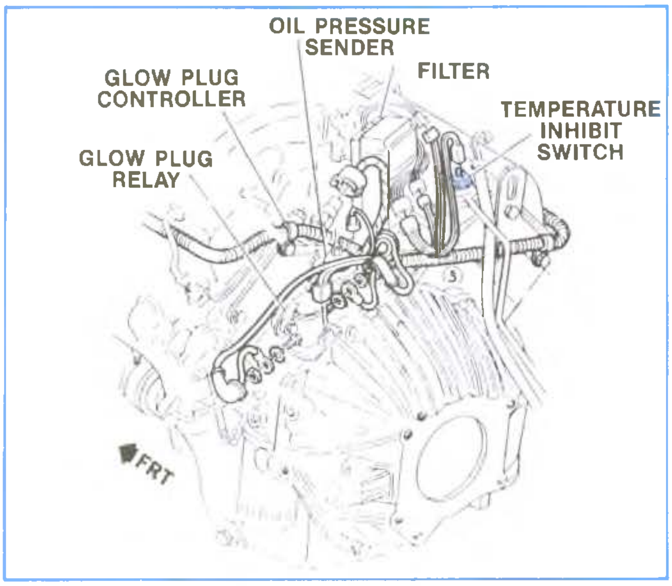


Figure 6-15, Temperature Inhibit Switch.

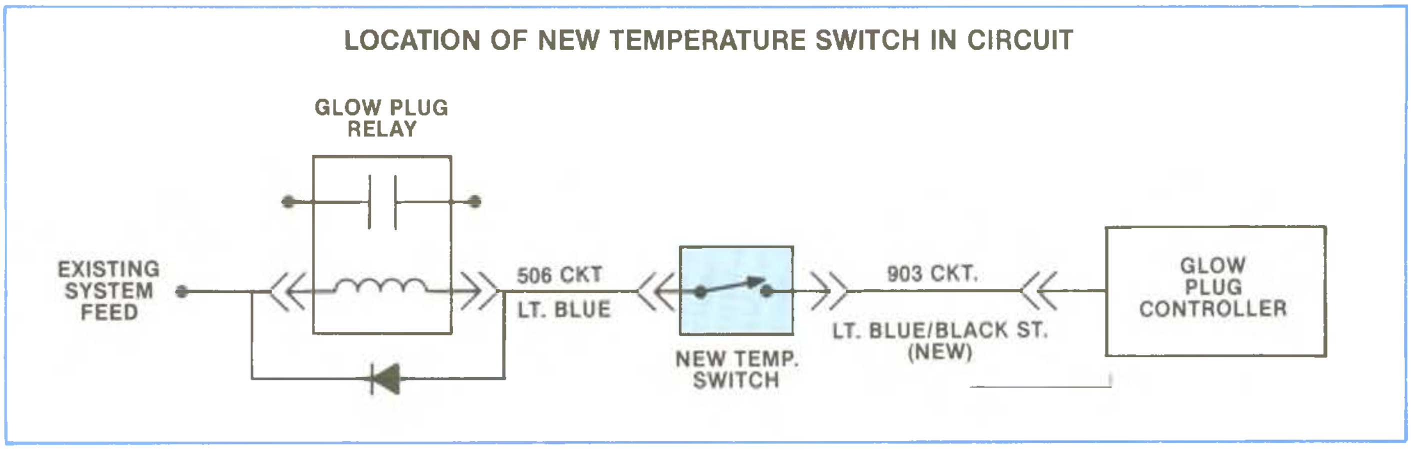


Figure 6-16, Temperature Inhibit Switch Circuit.

— NOTE —

This switch can be fitted to all past models. The procedure is in this section.

CONTROLLER (THERMAL SWITCH) DESCRIPTION

A controller is an electro-thermal device that threads into the engine water jacket to sense engine coolant pressure and contains small electric heaters to operate three bi-metal switches. There are four electrical heaters that alternately heat and cool causing the bi-metal switches to open and close the glow plug relay circuit. Typical circuit schematics are shown in Figure 6-17.

The circuit for heater H-1 is fed by the glow plug side of the glow plug Relay, and gets hot when the glow plugs get hot. The heater has 300 OHMs resistance. This causes switch S-1 to open (at 180°F) and close to pulse the glow plug Relay coii and the glow plugs. Heater H-2 is energized by generator output and gets hot when the engine runs. This heater has a 115 OHMs resistance. It opens switch S-3 (at 160°F) and keeps the glow plug Relay de-energized when the glow plugs are no longer needed. Switch S-2 is acted on by heat from heaters H-3 and H-4. The resistance of H-3 is 45 OHMs, and H-4 is 32 OHMs.

The operating temperature of switch S-2 is about 300°F. Heater H-3 is a low heat unit and heater H-4 only supplies heat when switch S-2 is open. Switch S-2 is also effected by engine coolant temperature so that at engine operating temperature in combination with heat from heater H-3 and water temperature will open switch S-2. This will cause heater H-4 to warm up and maintain switch S-2 in the open position.

System Operation, (Engine Cold-Pre-Glow)

When the ignition switch is turned to the "ON" position, current flows through; gau-idle fuse, 3Ω glow plug relay coil, closed temperature switch, and closed controller switches S-2, 1 and 3 to ground. This energizes the glow plug relay, which connects battery to the 8 glow plugs. The "glow plugs" light is wired in parallel with the glow plugs, so when they are "ON", the glow plugs "LIGHT". It will cycle "ON" and "OFF" with the glow plugs.

When H1 heater of the controller reaches 180°F, S-1 will open. This de-energizes the glow plug relay, and turns "OFF" the glow plugs. As this heater cools off, if the engine is not started, S-1 will close again and turn "ON" the glow plugs. The glow plugs and light will cycle "ON" and "OFF" in a controlled heating mode before the engine is started.

AFTER-GLOW

When the engine is running, the glow plugs light may pulse on for a time period determined by generator output. The total after-glow time period is controlled by a signal from the alternator to the control system.

Current from generator output entering the controller at Pin 1, will cause heater 2 to get hot and open S-3 at 160°F. This ends the after-glow period.

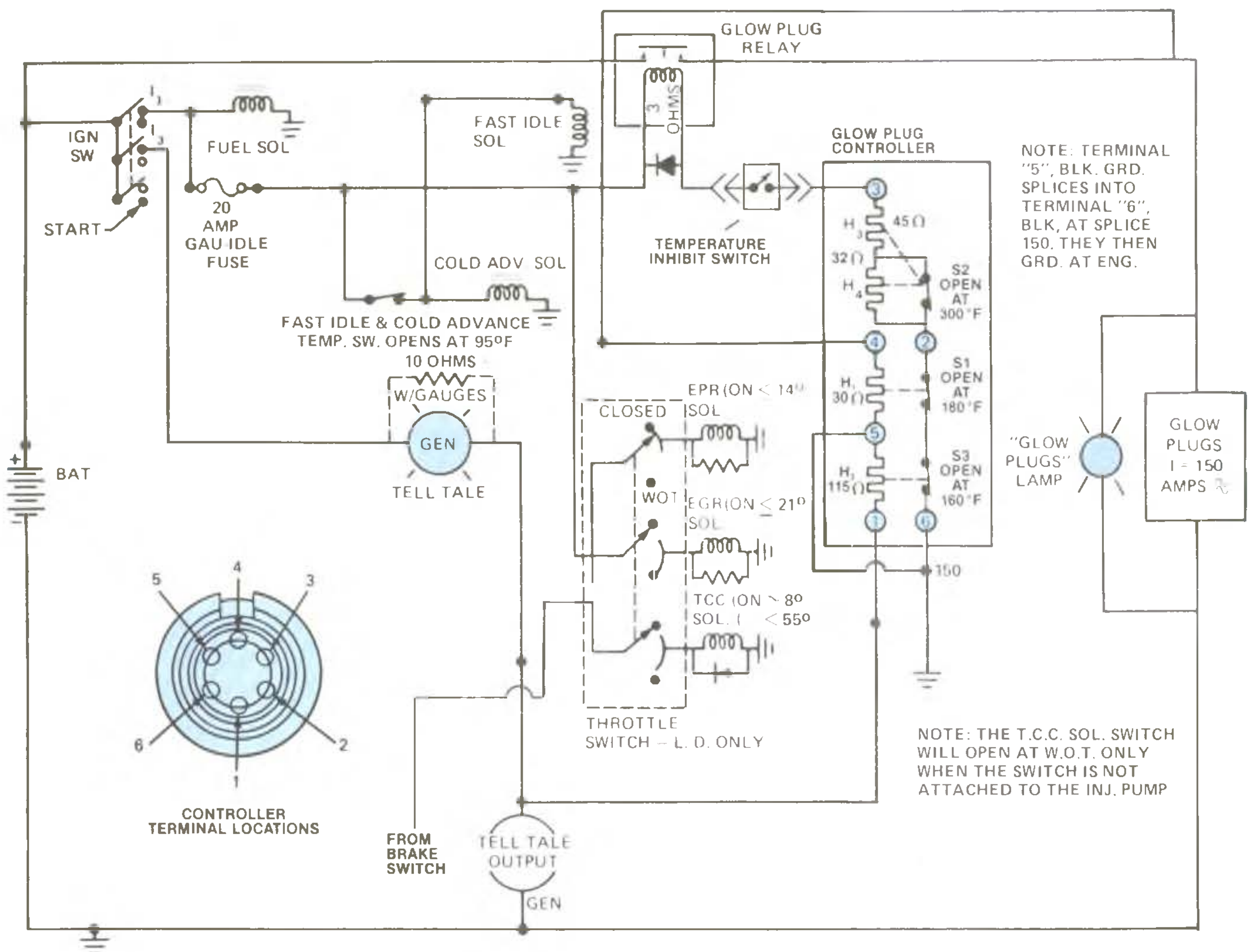


Figure 6-17, Glow Plug Schematic.

General Glow Plug System Diagnosis

Tools for Diagnosis

Successful diagnosis of any condition depends on having the proper tools. This section tells you what tools are needed and how they must be used.

- **DIGITAL MULTIMETER — (TOOL J-29125)**
  The multimeter has become an essential tool for the glow plug system because it measures extremely low voltages, without burning out the delicate circuits in the electronic module.
- **SELF POWERED TEST LIGHT**
  Necessary for checking glow plug continuity and opens and grounds in circuit checks where no voltage can be applied.
- **12 VOLT TEST LIGHT**
  Used to check for opens and grounds in circuit checks requiring 12 volts or more for proper diagnosis.
- **VOLT AMPERE TESTER (VAT-40) OR EQUIVALENT (INDUCTION PICK-UP TYPE)**
  Measures current flow (amps). Used in conjunction with Diesel Glow Plug Systems to measure amperage draw between right and left glow plug banks.

(When using any of these tools, be sure to follow the manufacturer's instructions for proper use.)

Preliminary Checks

Make the following preliminary checks before proceeding to diagnosis:

- Check wait light operation D-Truck (CUCV) military application — the wait light will remain on if there is a problem in the glow plug system. Usually the engine can still be started, but the glow plug control system must be repaired.
- Check glow plug light operation — non-military with the key in the "RUN" position, glow plug light should come "ON", and should stay "ON" 8 to10 seconds. When it goes out, start the engine. The light should then cycle a few times and go out. If the system doesn't cycle or continues to cycle, the glow plug system needs repair.

— NOTE —

1984 and later non-military trucks have a temperature inhibit switch which prevents glow plug operation above a coolant temperature of approximately 125°F.

- Check all the glow plugs to see that they are working properly — Refer to the preliminary diagnosis flow charts at the end of this section.
  — If the glow plugs are working properly refer to the appropriate Chassis Service Manual for further diagnosis.
  — If the glow plugs are not working properly refer to the appropriate flow charts for diagnosis.
- Check all fuses, bulbs and grounds before replacing any components.
- Make sure that all connections are clean, dry and that no wires are exposed.
- Perform ammeter test (next page) to isolate condition to glow plug system.

Glow Plug Controller and Advanced Engine Timing

The glow plug controller has three internal circuits, a pre-glow timer, an after-glow timer and a circuit breaker. Failure of the pre-glow timer will cause the circuit breaker to operate. The fact that the circuit breaker is controlling the glow plugs can be determined on a cold start by observing the glow plug light on the instrument panel. If the pre-glow timer **is** working, the glow plug light will continue to cycle "ON" and "OFF" with the ignition key "ON" and the engine "OFF". If the pre-glow timer **is not** working, the glow plug light will only cycle once with the ignition key "ON" and the engine "OFF".

If it is found that the circuit breaker is controlling the glow plugs, the glow plug controller should be replaced. Extended operation of the glow plugs with the circuit breaker can cause premature failure of the glow plugs.

— NOTE —

Be sure A, 6.2L diesel controller is IN THE ENGINE, not a 5.7L diesel. The 6.2L controller has a light gray connector and a silver label. The 5.7L (4.3L V-6) diesel controller has a black connector, and a gold label. Because of different resistance values between the two controllers, do not interchange them.

— NOTE —

Advanced fuel injection pump timing will cause glow plug failures due to higher than normal cylinder temperatures. When an advanced timing condition exists, several glow plugs may not operate; however, usually not all eight.

A normal looking glow plug, which is electrically open, or that has a small blister could probably be due to a glow plug or system fault. Glow plugs however, that have burned off tips are more likely a result of advanced engine pump timing.

Preliminary Diagnosis With Ammeter

The following procedure (Figure 6-18) provides a fast way to determine whether the glow plug system is functioning correctly or if you have another condition to contend with. It is suggested that this procedure be performed whenever there is doubt about correct system operation. Then refer to the diagnosis charts that follow to pinpoint the condition.

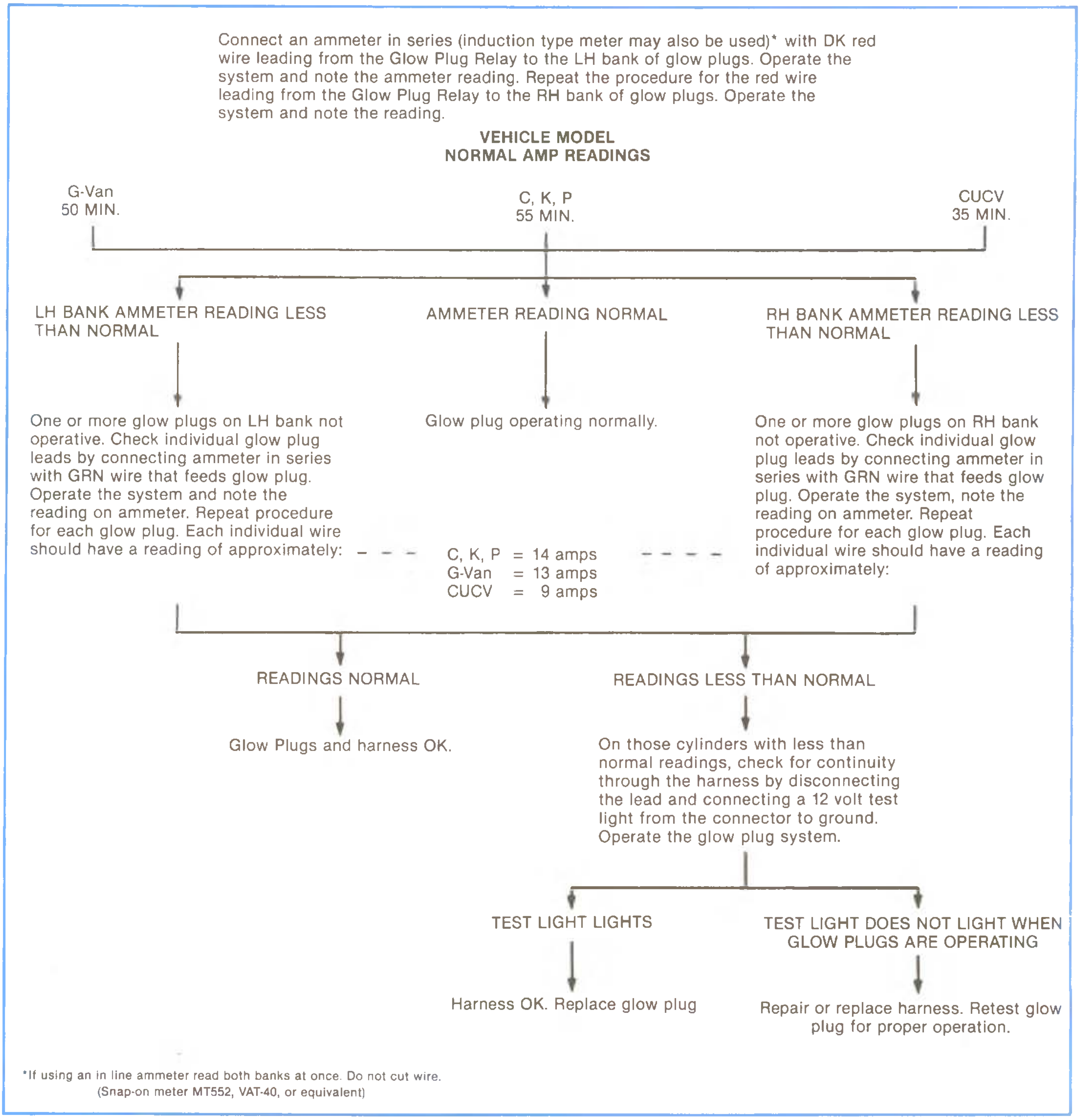


Figure 6-18, Preliminary Ammeter Diagnosis.

1982-1984 6.2L Diesel Glow Plug System Diagnosis

1982 C/K/P AND 1983 C/K/P/G 1500 THRU 3500 SERIES TRUCK WITH LH6 (6.2L DIESEL L.D. EMISSIONS) OR LL4 (6.2L DIESEL H.D. EMISSIONS)

GLOW PLUG CONTROLLER CONNECTOR CIRCUIT CHECKS

PIN 1: (Brown Wire) Should have continuity (0 Ohms resistance) to the brown wire at the alternator with the engine off or alternator voltage with the engine running. If there is battery voltage at this pin with the ignition key off, the alternator has failed a diode (see below).

PIN 2: There is no connection to this pin on 1982 vehicles. On 1983-84 vehicles, there may be a white tube or a wire to this pin, it is only to seal the position in the connector. It is hooked to the wiring harness. DO NOT GROUND THIS PIN FOR ANY REASON, IT WILL PROHIBIT NORMAL OPERATION OF THE CONTROLLER AND CAN DAMAGE GLOW PLUGS.

PIN 3: (Blue Wire) Should have battery voltage with the vehicle ignition key on.

PIN 4: (Orange Wire 82MY, Dark Green Wire 83,84MY) Should have continuity (0 Ohms resistance) to the double red wire terminal on the glow plug relay.

PIN 5: (Black Wire) Should have continuity (0 Ohms resistance) to Pin 6 (Black Wire) and to ground.

PIN 6: (Black Wire) Same as Pin 5.

— NOTE —

Complaint of a "no-start — due to no glow plugs heating" where the no-start problem was a result of a failed delcotron positive diode.

When the diode fails in the delcotron, battery voltage can be supplied to the glow plug controller with the key off and the engine stopped. This battery voltage is normally supplied to pin #1 in the glow plug controller from the delcotron after the engine starts. This voltage, in effect, tells the controller that the engine has started and shuts off the glow plug heating cycle.

When a "no glow plug heating" problem is received, a quick check should be made to see if a diode failure is the cause.

Follow this procedure:

1. With the key off and the engine stopped, check for voltage in the brown wire that goes from the delcotron to the glow plug controller.
2. If a voltage is present, disconnect the wire from the delcotron. Again, check for voltage in the brown wire. There should be none. (If the key is "ON", a low voltage — approximately 3 volts — will be present in a properly operating system.)
3. Wait for a minimum of 15 minutes, or sufficient time for the controller to cool off.
4. Turn the key on. If the glow plugs heat, the problem was with the delcotron.

— NOTE —

The only time battery voltage should be present in the brown wire is when the engine is running. With the key on, and the engine not running, a low voltage (approximately 3 volts) will be present in the brown wire. This is normal.

GLOW PLUG CONTROLLER CHECK FOR PROPER FUNCTION

ENGINE COLD, IGNITION SWITCH OFF

1. First connect a VOM between the negative side (Blue Wire) of the power relay coil and ground.

— CAUTION —
Do not short the positive terminal to any metal object.

2. Monitor the VOM when the ignition switch is turned on. Turn the ignition switch on.
3. The VOM should read about 2 VDC for approximately 4 to 10 seconds depending on the engine coolant temperature. NOTE: If the engine is hot, you may get a continuous voltage reading of about 12 VDC, (the battery voltage).
4. The VOM will then repeat an on-off cycle, about 12 VDC then 2 VDC. NOTE: The power relay should also be heard turning on and off.
5. If this occurs, the controller is functioning properly. Remove the positive lead of the VOM from the power relay coil and connect to the relay output.
6. With the ignition switch still on, the VOM should continue to repeat the on-off cycle of 3 above.
7. If this is occurring, the proper voltage is being applied to the wiring harness connected to the glow plugs.

ASEMBLY PLANT CHECKOUT OF 1983 G-VAN 6.2L DIESEL GLOW PLUG SYSTEM

NORMAL OPERATION

With cold engine (below approximately 100°F), and good batteries (green eye visible):

1. Ignition switch on.
2. Glow plugs light "ON" for 10 seconds maximum (engine below 20°F), "ON" for 7 seconds maximum with engine at room temperature.
3. Glow plug light then cycles on-off.
4. Start engine.
5. Glow plug light continues to cycle on-off for up to one minute with cold engine (below 20°F), less time if engine is warmer.
6. Light remains off as long as engine is running.

VISUAL CHECK

If glow plug light does not operate as above, check the following:

1. Check connections on glow plug lamp jumper harness in I.P. area.
   a. "Ground" at bus bar ground terminal.
   b. Fuse block.
   Two wire connections to bulkhead connector (Orn/Dbl. Blk. stripe and Yel/Dbl. Blk. stripe).
2. Check connections in engine compartment.
   a. "Ground" at stud — power steering brace.
   b. Glow plug relay 2-way connector and connections at studs.
   c. Glow plug controller.
   d. 2-way connector on delcotron.

If all connections are intact, but glow plug system is not operating as stated, proceed with normal diagnostic procedure. **Do not bypass or manually operate the glow plug relay.**

GLOW PLUG CONTROLLER CONTAMINATION

On early 1982 production vehicles, the engine wiring harness connector at the glow plug controller has an open hole at the No. 2 pin connection. Moisture and/or dirt entering this hole can cause deterioration of the pin connections and result in a controller malfunction (Figure No. 6-19).

If a comment such as poor starting, burned glow plugs, etc. is received, remove the connector from the controller. Check for moisture and dirt. Clean the pin area on the controller and the connector. Reinstall the connector.

Apply a small amount of R.T.V. 1052734 or similar silicone sealant over the No. 2 pin hole to prevent water from entering.

If the controller cycles normally, replacement is not necessary. However, if corrosion of the pins was excessive and/or the controller does not cycle correctly, it should be changed.

The two (2) wires from No. 5 and No. 6 pin position are ground wires. The ground connection is at the rear of the right hand head on a stud which also grounds the body ground strap. (The stud is on the opposite side of the engine from the controller.) Make sure the ground connection is secure (Figure 6-19).

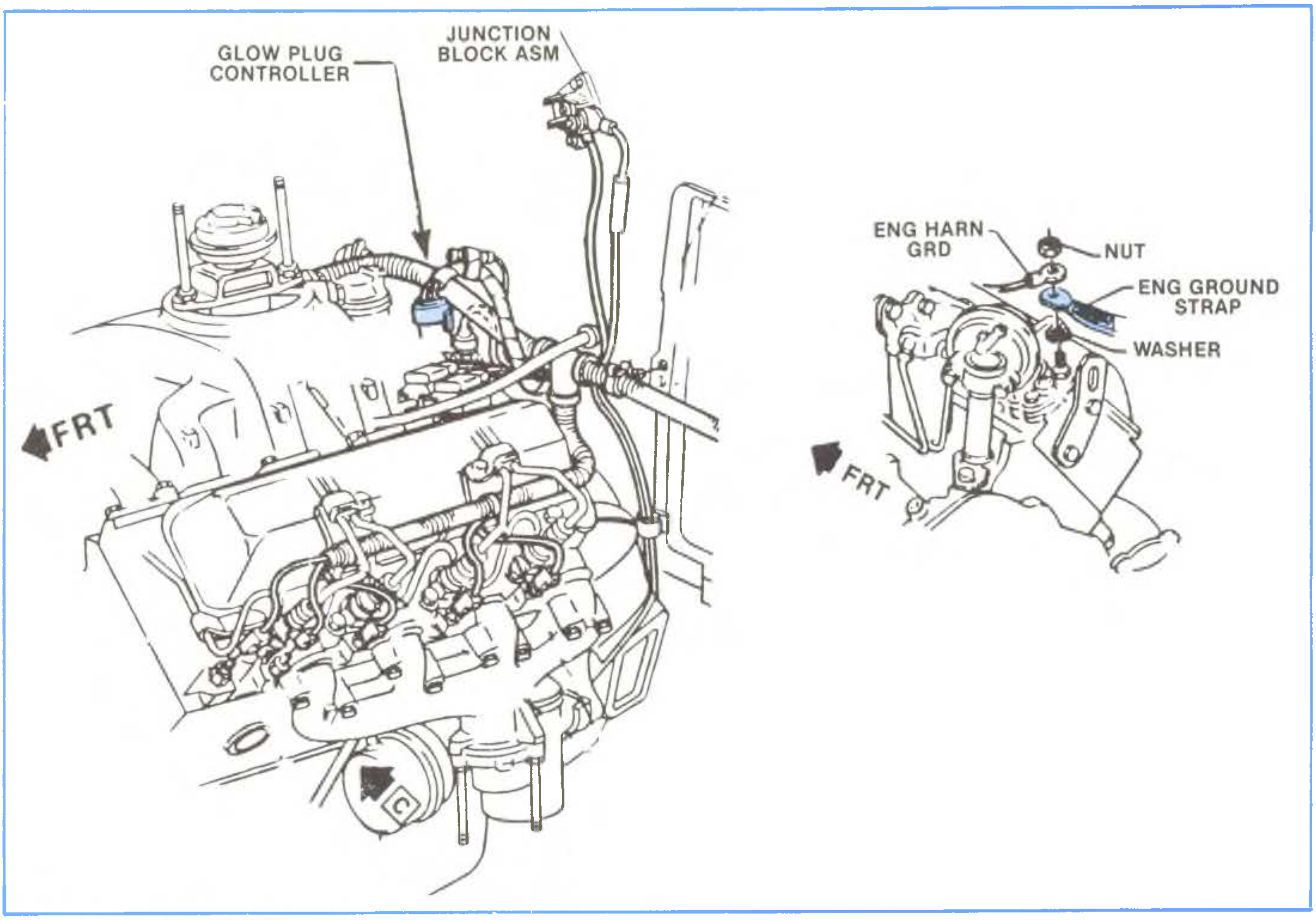


Figure 6-19, **Glow Plug Controller Contamination.**

THERMAL CONTROLLER CHECK

This should be used when diagnosing the glow plug system on all 1982-84 model trucks with the 6.2L diesel engine, excluding the military (CUCV) vehicles.

With the connector removed from the glow plug controller, the controller bimetal heaters may be tested using a high impedance digital Ohm meter on the 200 Ohm scale. See Figure 6-20.

CHECK	READING
Pins 2 to 3	0.40 to 0.75 Ohms
Pins 4 to 5	24 to 30 Ohms
Pins 1 to 5	117 to 143 Ohms
Pins 2 to 6	Continuity ("0" Ohms)

If the controller does not measure within all the above values, the controller should be replaced.

If the controller checks good to the above measurements, the harness connector should be put back on and insure that the controller cycles on and off more than once with the ignition key on (engine not running). If the controller cycles more than once and the measurements are correct, the controller is good. If the controller cycles only once, the controller is bad or a harness problem exists. Refer to the Glow Plug Electrical System Diagnosis Chart for testing for a harness problem.

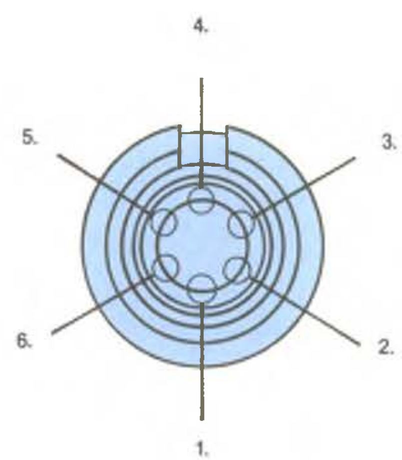


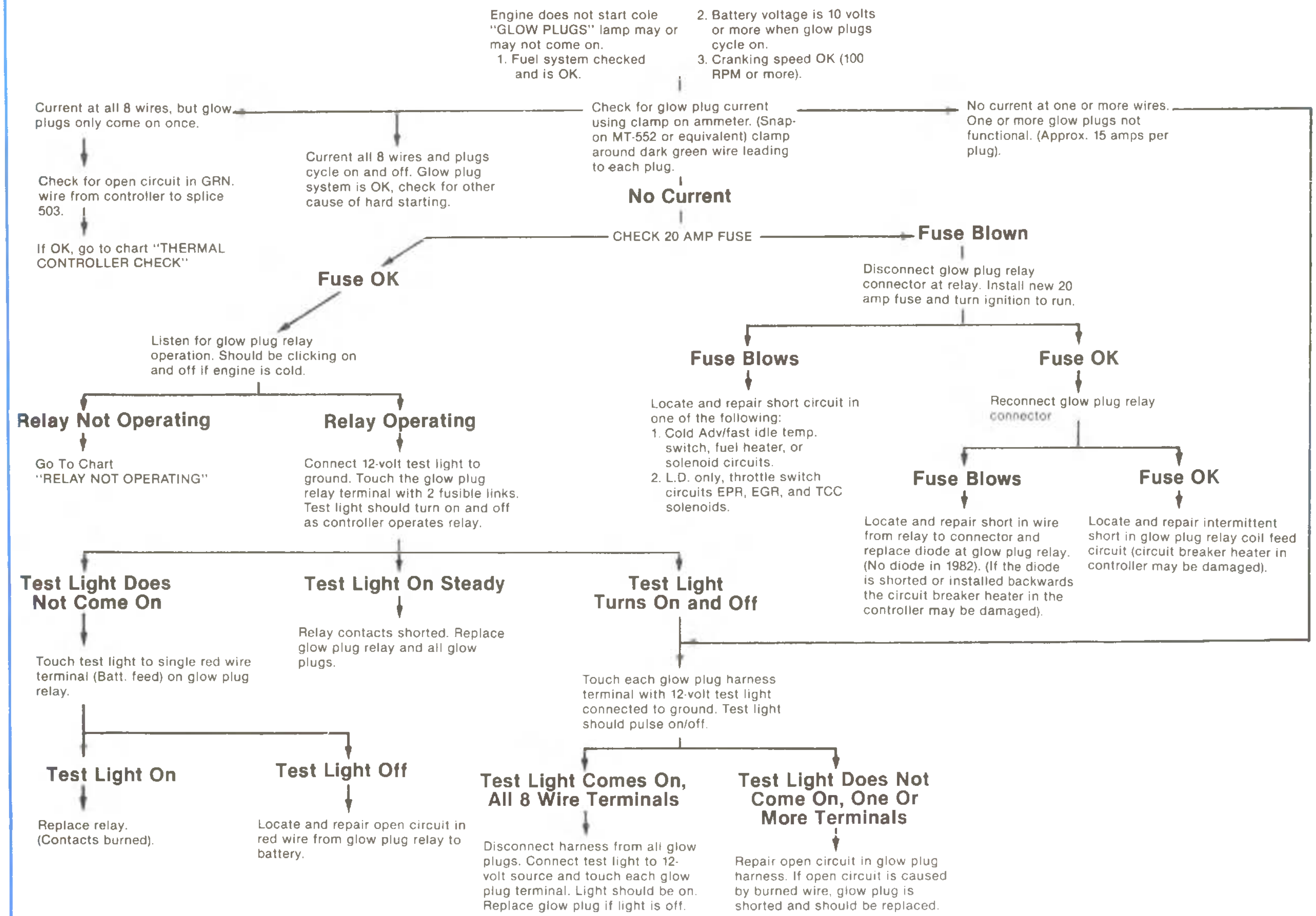
Figure 6-20, Controller Pin-Outs.

DIAGNOSTIC PROCEDURE CHARTS

Figure 6-21 is Chart #1, 6.2L Diesel Glow Plug Electrical System Diagnosis. Figure 6-22 describes the relay not operating diagnostic procedure.

Figure 6-21, Glow Plug System Diagnosis.

Chart #1 — 6.2 L DIESEL GLOW PLUG ELECTRICAL SYSTEM DIAGNOSIS



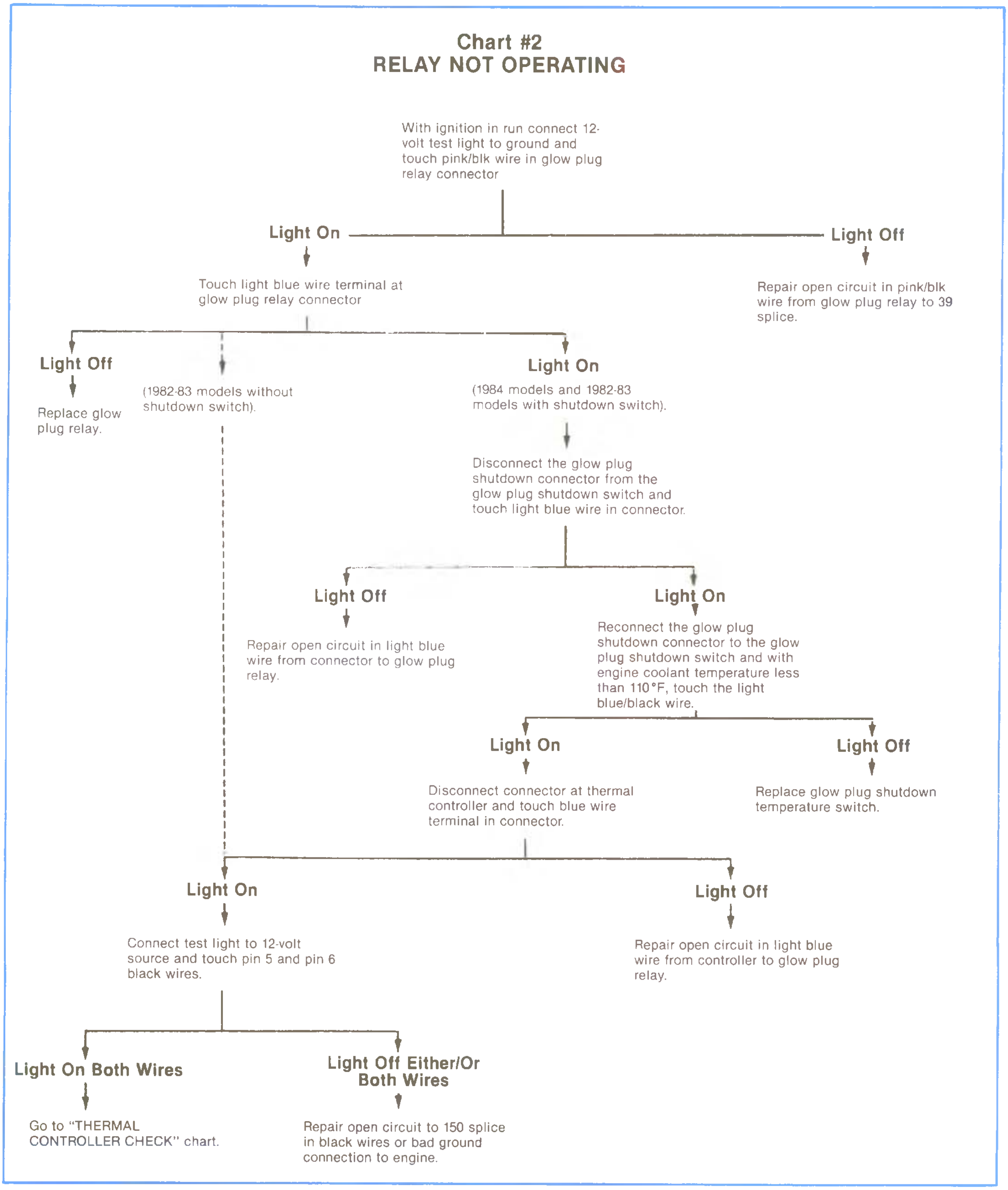


Figure 6-22, Glow Plug System Diagnosis.

Installation of Glow Plug System Inhibit Switch

1982-83 C/K/G/P TRUCK WITH 6.2L DIESEL — RPO LH6 — L.D. EMISSIONS
RPO LL4 — H. D. EMISSIONS

Many times a 6.2L diesel will not require glow plugs to start, such as a warm engine or warm climate.

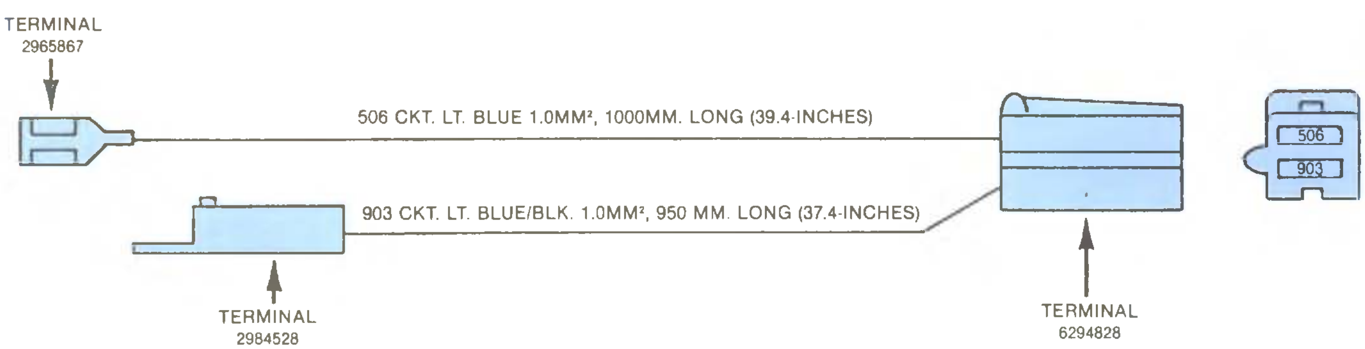
To inhibit glow plug system function when engine coolant temperature is above 125°F and lower glow plug usage, the following parts can be installed.

Inhibit wire assembly; should be assembled per attached drawing (Figure 6-23).

GLOW PLUG INHIBIT TEMPERATURE SWITCH INSTALLATION

1. Disconnect batteries.
2. Replace cover on R.H. rear head (Figure 6-24A) with cover 14028949 (same as on L.H. head) (Figure 6-24B). Use new gasket 14028951. Drain coolant as required.
3. Install new temperature switch 15599010 using appropriate pipe thread sealer. Tighten to 19-27 N·m (13-20 ft. lb.). Replace any lost coolant.
4. Connect glow plug inhibit wire assembly to switch with the light blue (without the stripe) wire terminal mating with the switch terminal.
5. Route the wire assembly toward the left side of the vehicle, strap to the engine harness as required.
6. Disconnect the 4-way engine harness connector from its mate on the glow plug relay extension harness 12031493 (Figure 6-25).
7. Remove the light blue wire female terminal from the engine harness 4-way connector and install connector body 2977253 on this terminal. Plug mating connector on new jumper wire assembly (light blue/black stripe) to 2977253.
8. Insert female terminal of jumper wire assembly into empty cavity of 4-way connector. Reconnect 4-way connectors.
9. Reconnect batteries.

GLOW PLUG INHIBIT WIRE ASSEMBLY



Use with Temperature Switch #15599010 in 6.2L Diesel Engine. Connector Body #2977253 also required.

Figure 6-23, **Glow Plug Inhibit Wire Assembly.**

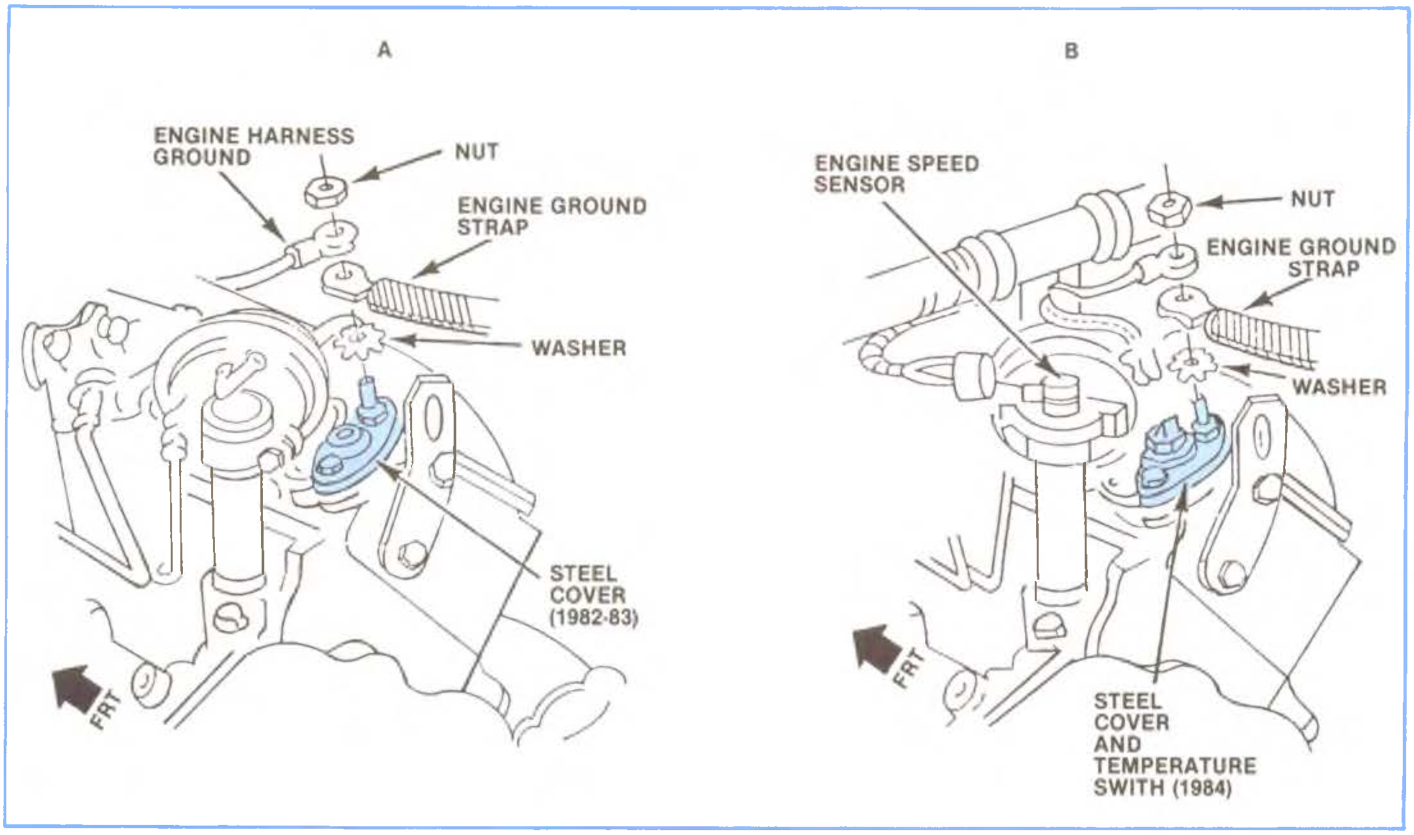


Figure 6-24 A and B, **Installation of Temperature Inhibit Switch.**

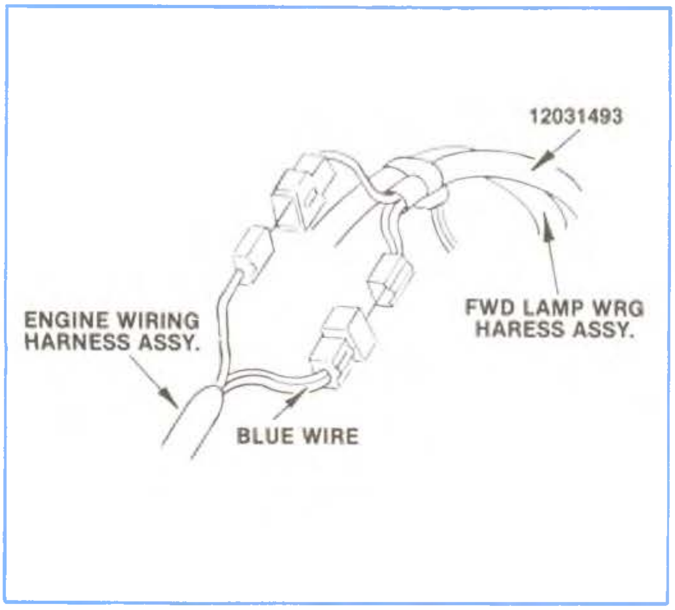


Figure 6-25, **Harness Connection.**

D-Truck (CUCV) Military 6.2L (LL4) PTC Glow Plug System

The D-Truck (CUCV) System is Composed of:

- 2 Reducing Resistors
- Electronic Module Controller
- Wait Lamp
- Reducing Resistors
- 8 PTC Glow Plugs

REDUCING RESISTORS

See Figure 6-26. Two 300 watt (.280 Ohm) reducing resistors are hooked in a parallel circuit to reduce the 24 volts (used for starting) to 12 volts nominal. This was done to provide voltage to the glow plug system when using the 24 volt slave (jump) start socket.

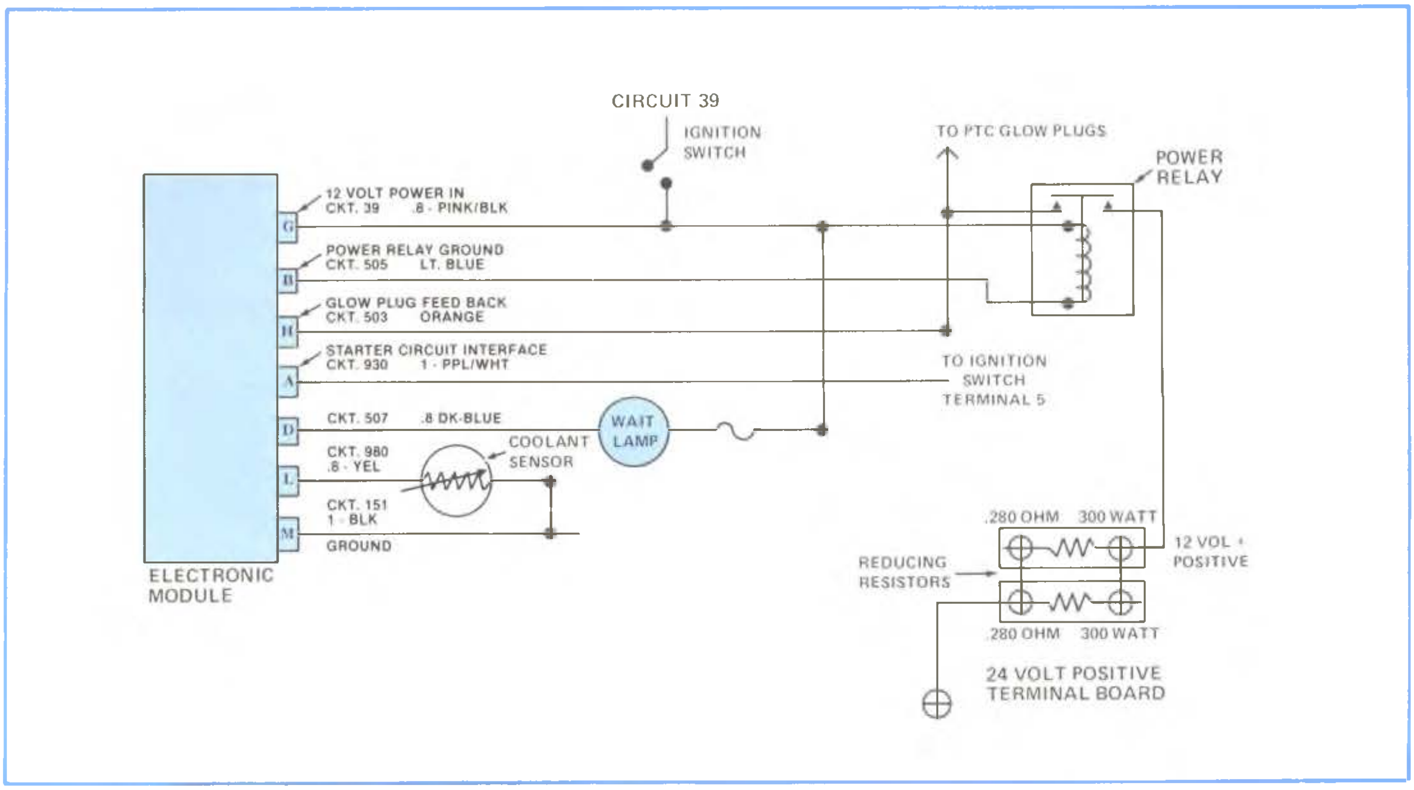


Figure 6-26, **D-Truck Glow Plug System.**

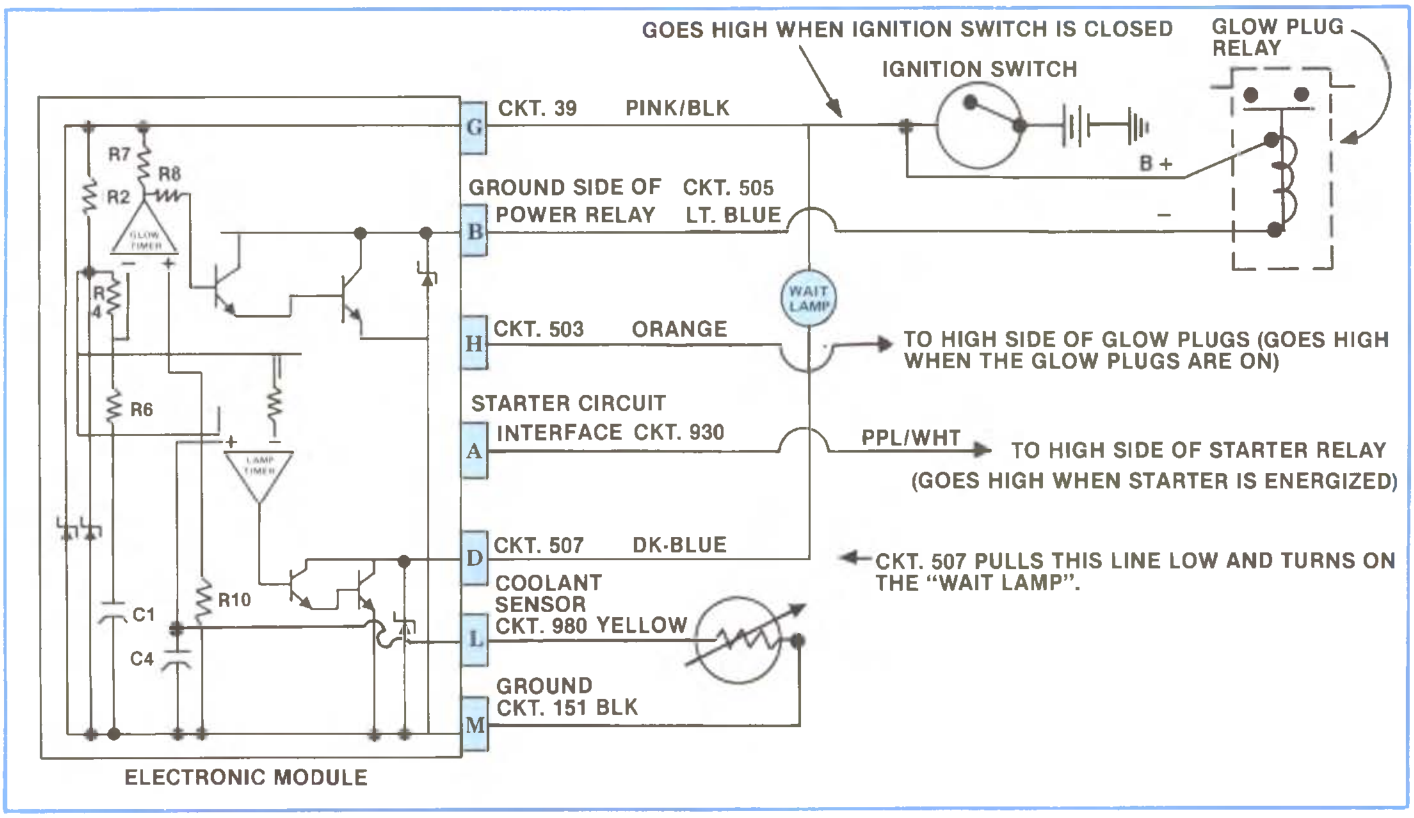


Figure 6-27, **D-Truck Electronic Module Controller.**

System Operation, D-Truck

Refer to Figure 6-27. When turning "ON" the ignition, the following occurs:

WAIT LAMP INDICATION

12 volts B+ flows from the Ignition Switch Circuit 39 to the top pin of the electronic module. This energizes the Darlington Compound Q1 and turns "ON" the second transistor. This transistor grounds the wait lamp and turns it "ON".

POWER RELAY ACTIVATION

12 volts flow from Ignition Circuit 39 to Darlington Compound Q2. This turns "ON" the second transistor, which provides a ground for the power relay.

— NOTE —

This system is regulated by voltage and coolant temperature rise.

When the power relay is energized, 12 volts flow to the glow plugs.

The Power Relay and the wait lamp will both turn "OFF" at the same time.

The system "On-Time" is about 14.5 seconds. The "On-Time" is regulated by:

- Coolant temperature
- Battery voltage
- Battery temperature
- Combustion chamber temperature
- Glow plug counter voltage

When the pre-chamber temperature is about 1650°F, which is determined by glow plug counter voltage, the glow plug timer in the module goes low and turns off Q2 transistor which removes the power relay ground. This turns "OFF" the glow plugs. At the same time, the module lamp turns "OFF" Q1 transistor which ungrounds the wait lamp.

The plugs will be "OFF" for 4.5 seconds. Then they turn "ON" for an "after glow" period. The "after glow" is controlled by generator output voltage, which changes the voltage into the module. The wait lamp will not turn on during after glow.

If the coolant temperature is above 48°C (118°F), the wait lamp will not turn "ON".

Anytime the starter is energized, it will maintain glow plug operation, engine cold, or energize them if the engine is hot.

Glow Plug System Troubleshooting Procedure, D-Truck

1. SYSTEM DEFINITION

For troubleshooting purposes, the glow plug system is divided into two subsystems; the power system and the control system. The power system is shown in Figure 6-28. It consists of the glow plugs, the contacts of the control relay, the series voltage dropping resistor assembly, and associated wiring. The control system is shown in Figure 6-29. It consists of the electronic controller module, the "wait" lamp, the coolant temperature sensor, and associated wiring.

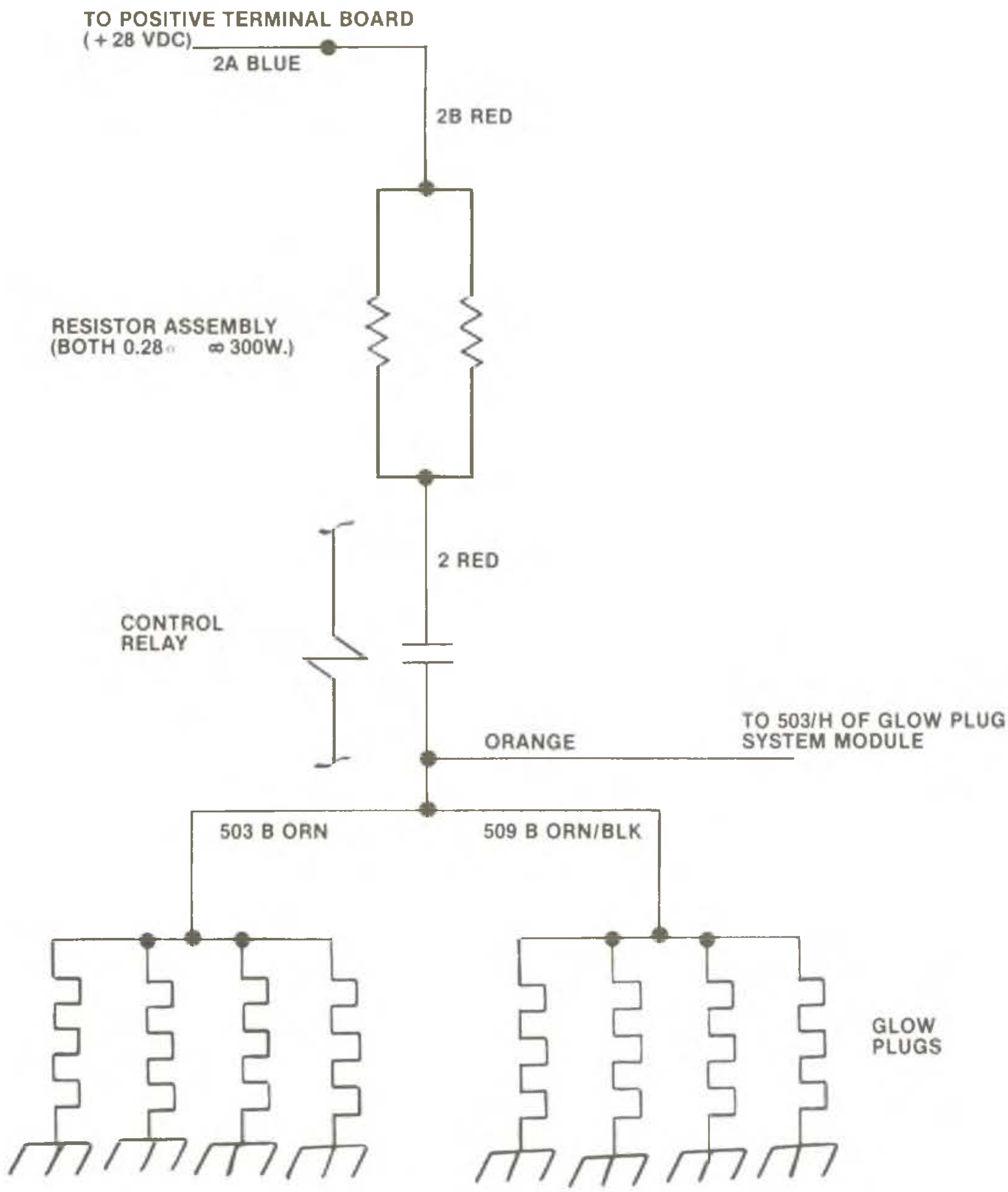


Figure 6-28, Glow Plug Power System, D-Truck.

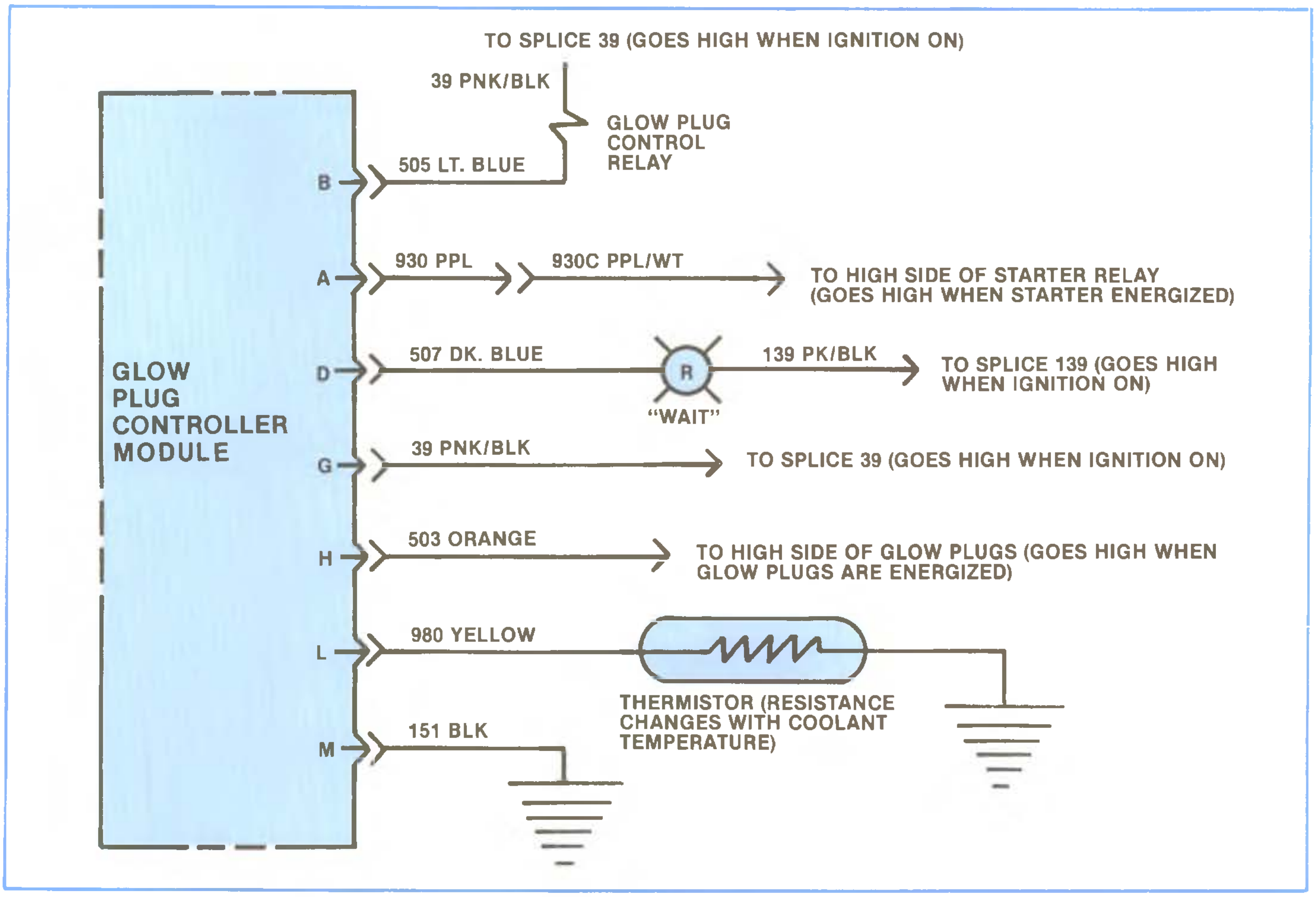


Figure 6-29, Glow Plug Control System, D-Truck.

2. TROUBLESHOOTING THE POWER SYSTEM, D-TRUCK

This procedure is illustrated in flow chart form in Figure 6-30. In this procedure, the low side of the control relay coil is disconnected from its harness. This is done to prevent the controller from turning the circuit "ON" and "OFF" during the test. A DC voltmeter is connected across the resistor assembly, and the control relay is briefly turned "ON" by grounding the disconnected terminal. The voltage across the resistors can be quite useful for isolating faults in the system. For example:

- **OV WITH RELAY "OFF" . . .**
  10-15V with relay "ON". Expected values; relay OK, resistors OK, harness and plugs probably OK (maybe one or two open).
- **OV WITH RELAY "OFF" . . .**
  22-28V with relay "ON". Open resistors.
- **10-15V WITH RELAY "ON" OR "OFF" . . .**
  Stuck relay contacts.
- **22-28V WITH RELAY "ON" OR "OFF" . . .**
  Stuck relay contacts and open resistors (since the resistors are operated at a power level considerably higher than their rating, continuous duty could cause them to burn open).
- **OV WITH RELAY "ON" OR "OFF" . . .**
  No current flow. Defective relay or open circuit (possibly all plugs open).

Depending on the findings in this step, the technician is directed to a fault path in the flow chart which will isolate the problem to a particular component.

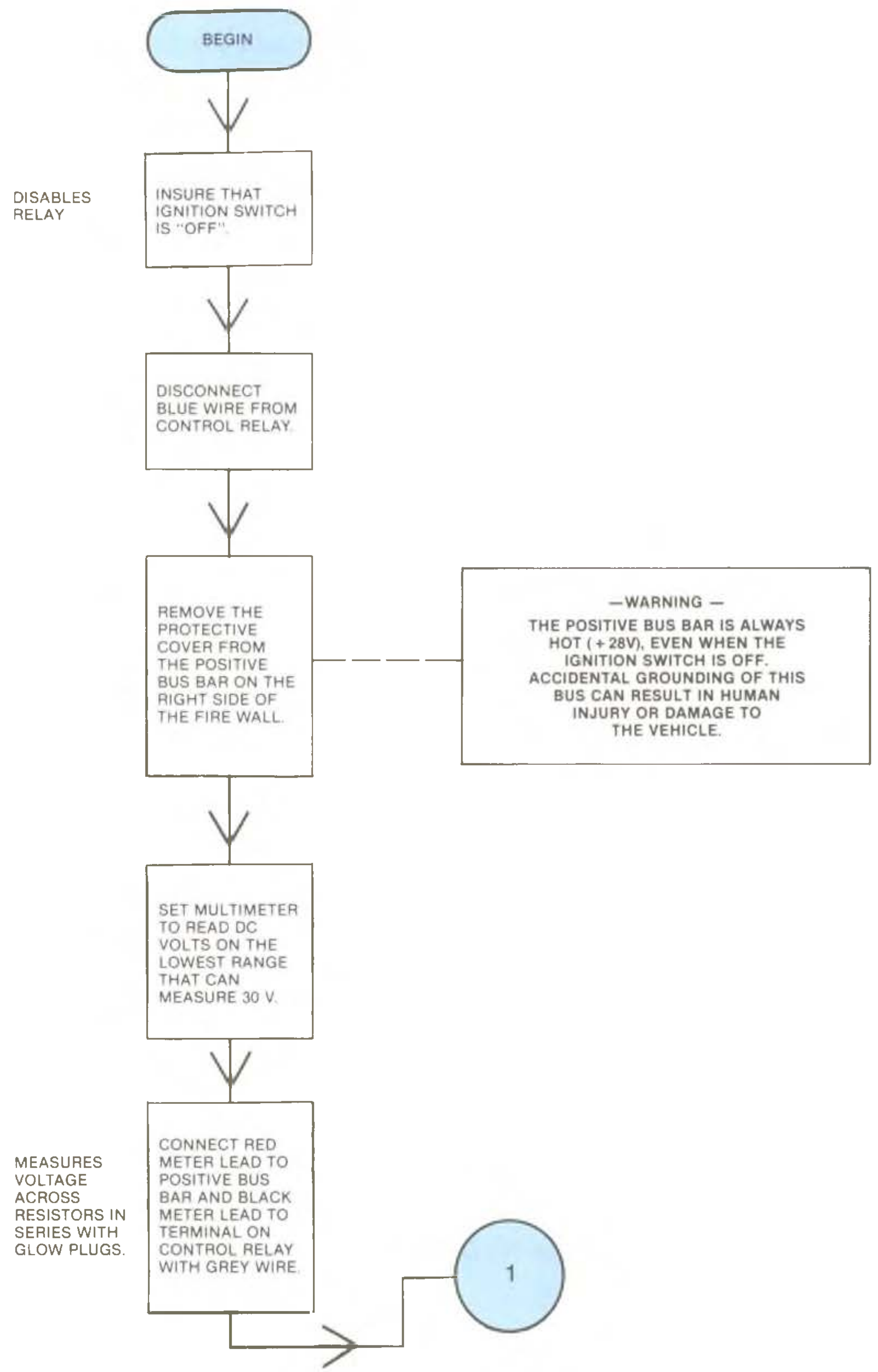


Figure 6-30, Troubleshoot Glow Plug Power Circuit, D-Truck.

3. TROUBLESHOOTING THE CONTROL SYSTEM

Before testing the control system, the power system will be tested and, if necessary, repaired.

Due to the near-nonaccessability of the controller module, no direct measurements will be taken. Instead, the following procedure will be used:

1. Connect a DC voltmeter between ground and the orange wire connector on the relay.
2. Disconnect the pink wire from the fuel shut-off solenoid on the injector pump to keep the engine from starting.
3. Turn "ON" the ignition switch. Plugs and "WAIT" lamp should turn "ON" and "OFF" at irregular intervals lasting several seconds (10-15V displayed on the voltmeter indicates that the plugs are "ON").
4. When plugs and "WAIT" lamp are "OFF", crank engine. Plugs should come "ON" and stay on for duration of cranking. "WAIT" lamp should be "OFF".
5. Plugs should remain "ON" for several seconds after cranking. "WAIT" lamp should be "OFF".

If the plugs and lamp act as described during this sequence, the system can be assumed to be OK. Any major deviation can be assumed to be the fault of the controller module or wiring harness (unless the "WAIT" lamp never comes "ON", whereupon the light bulb is suspect).

The technician should first replace the controller module. If this does not solve the problem, the wiring harness should be replaced. A controller module input-output line description (Figure 6-31) so that, if desired, the technician can trace continuity or voltage levels on specific lines.

PIN NO.	CIRCUIT NO.	WIRE COLOR	I/O	DESCRIPTION
G	39	Pink/Black	I	From splice 39. Goes high when ignition "ON". Serves 3 functions: 1) Provides power to module. 2) When it first goes high, the module starts the glow plug sequence. 3) Allows the module to monitor system voltage level. This value is one of the factors used to determine the duration of "WAIT" light display and "AFTERGLOW".
A	930	Purple	I	From high side of starter relay. Goes high when starter is energized. When this line is high, the glow plugs are "ON" unconditionally.
H	503	Orange	I	From high side of glow plugs. The voltage on this line varies with glow plug resistance, which varies with pre-combustion chamber temperature. Used to determine "ON-time".
L	980	Yellow	I	From thermistor in cooling system. Measures coolant temperature. Used to determine duration of "WAIT" light display.
B	505	Light Blue	O	Normally high. Goes low to turn "ON" glow plug control relay.
D	507	Dark Blue	O	Normally high. Goes low to turn "ON" "WAIT" lamp.
M	151	Black	—	System ground.

Figure 6-31, Glow Plug Controller Module I/O Description, D-Truck.

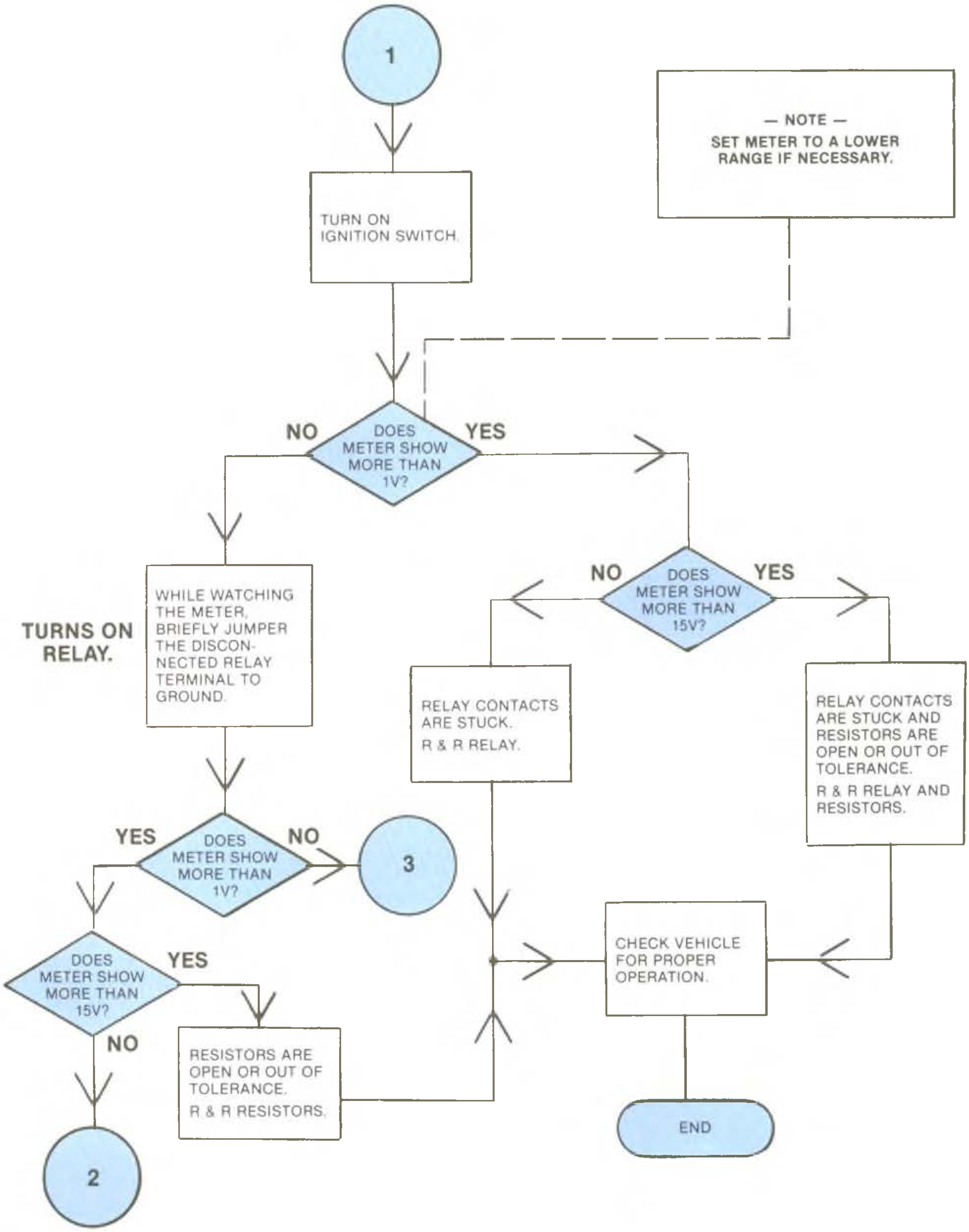


Chart #1, Glow Plug Trouble Shooting Procedure, D-Truck.

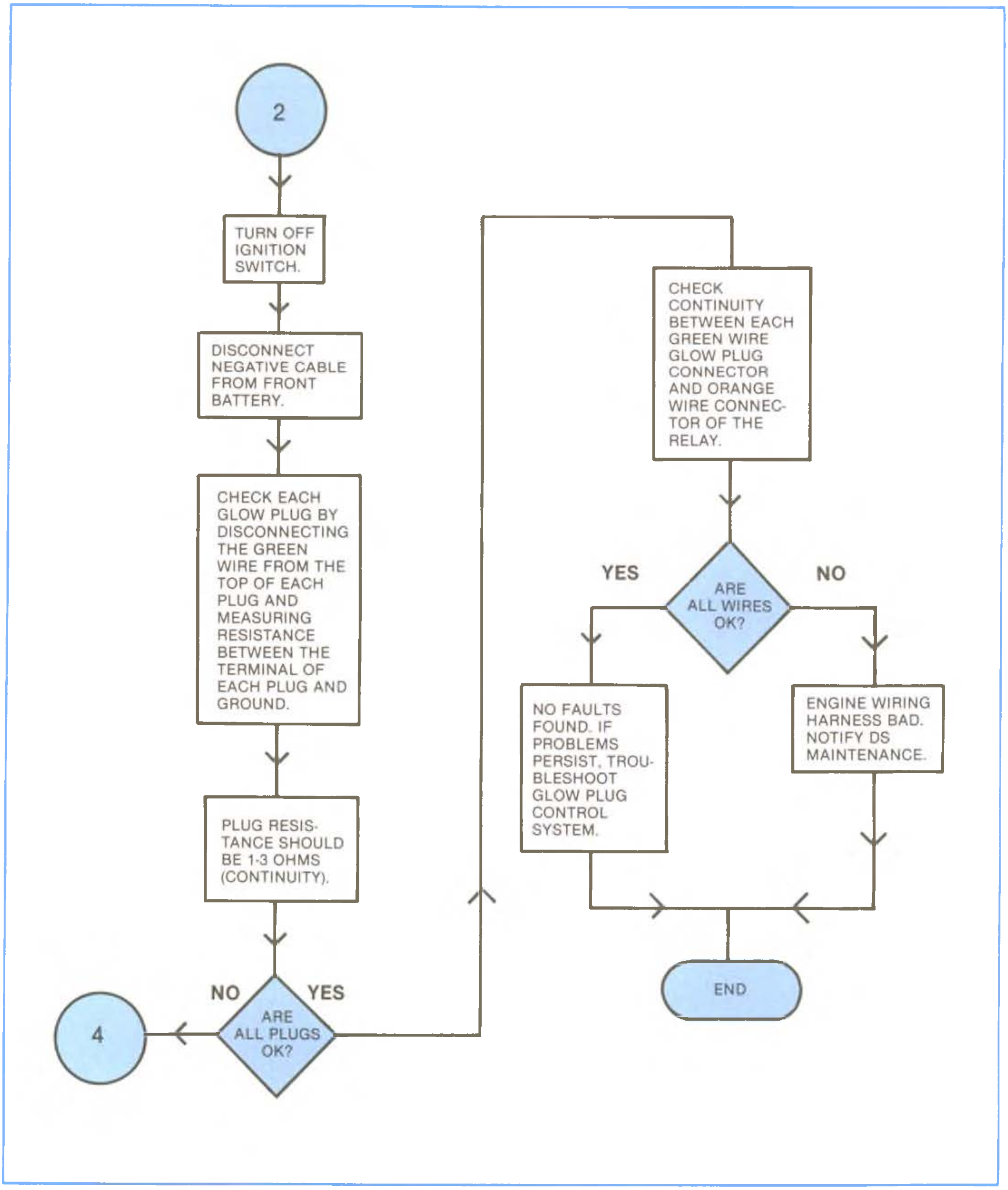


Chart #2, Glow Plug Trouble Shooting Procedure, D-Truck.

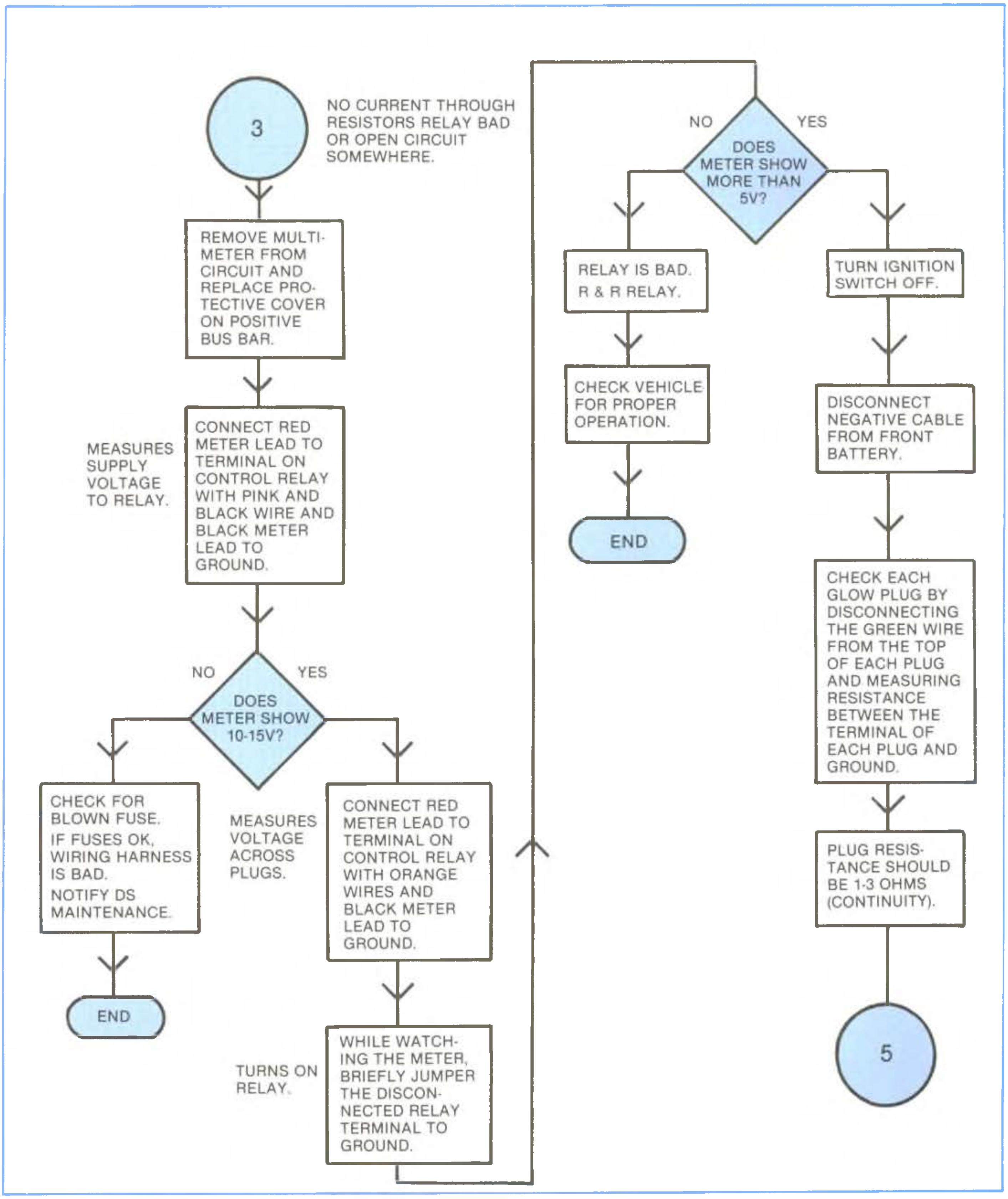


Chart #3, **Glow Plug Trouble Shooting Procedure, D-Truck.**

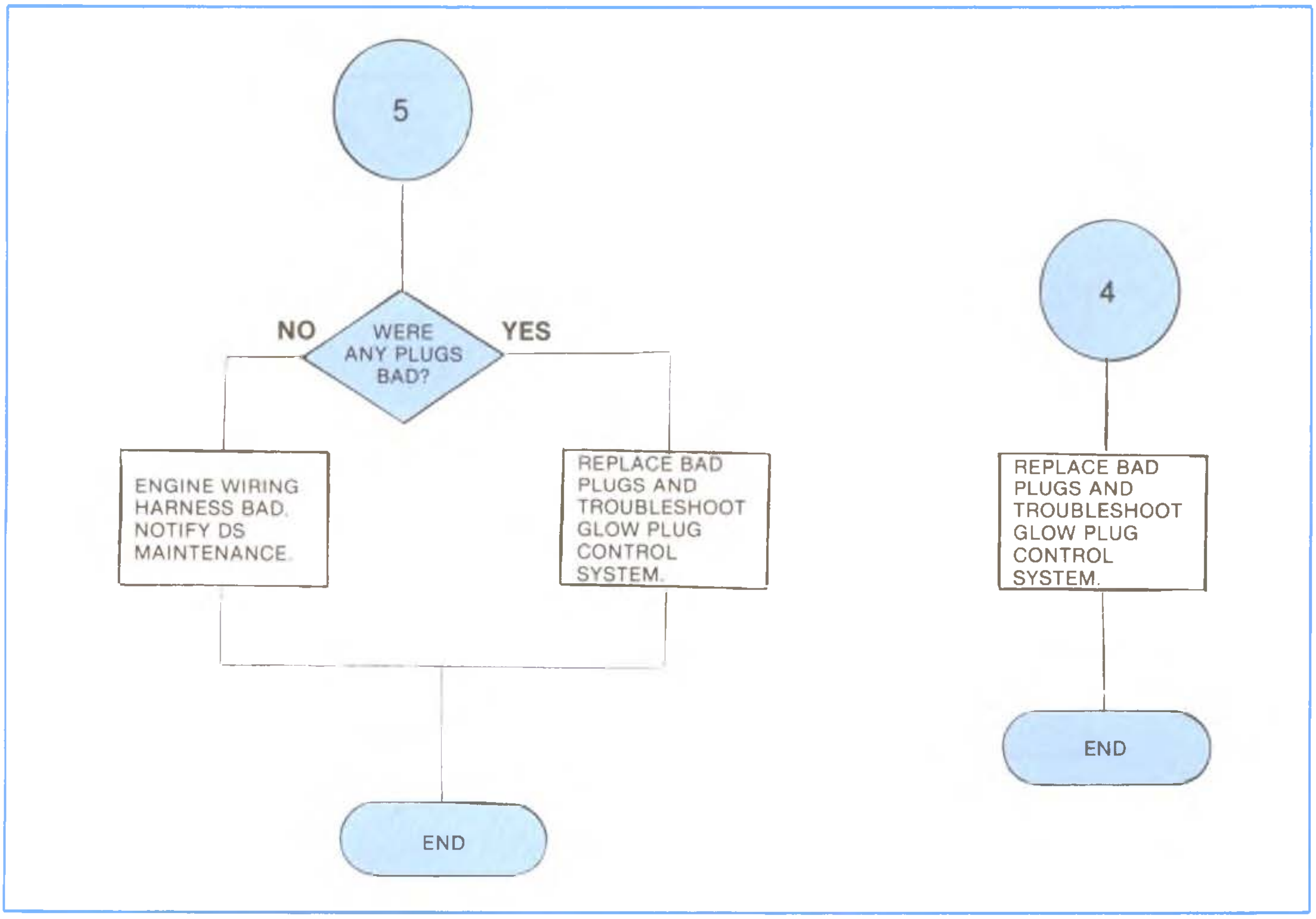


Chart #4-5, Glow Plug Trouble Shooting Procedure, D-Truck.

1985 6.2L (LH6/LL4) Glow Plug Control System, CKGP-Truck

A new glow plug controller is used in the 1985 CK/G, & P trucks with the 6.2L Diesel engine (Figure 6-32). This new controller is electronic and contains an integral glow plug relay. This single unit installs to two 10mm studs at the rear of the left hand head.

The glow plugs are the same as in 1984 and the operation of the "Glow Plug" light remains basically unchanged — that is, it is on wherever the glow plugs are energized.

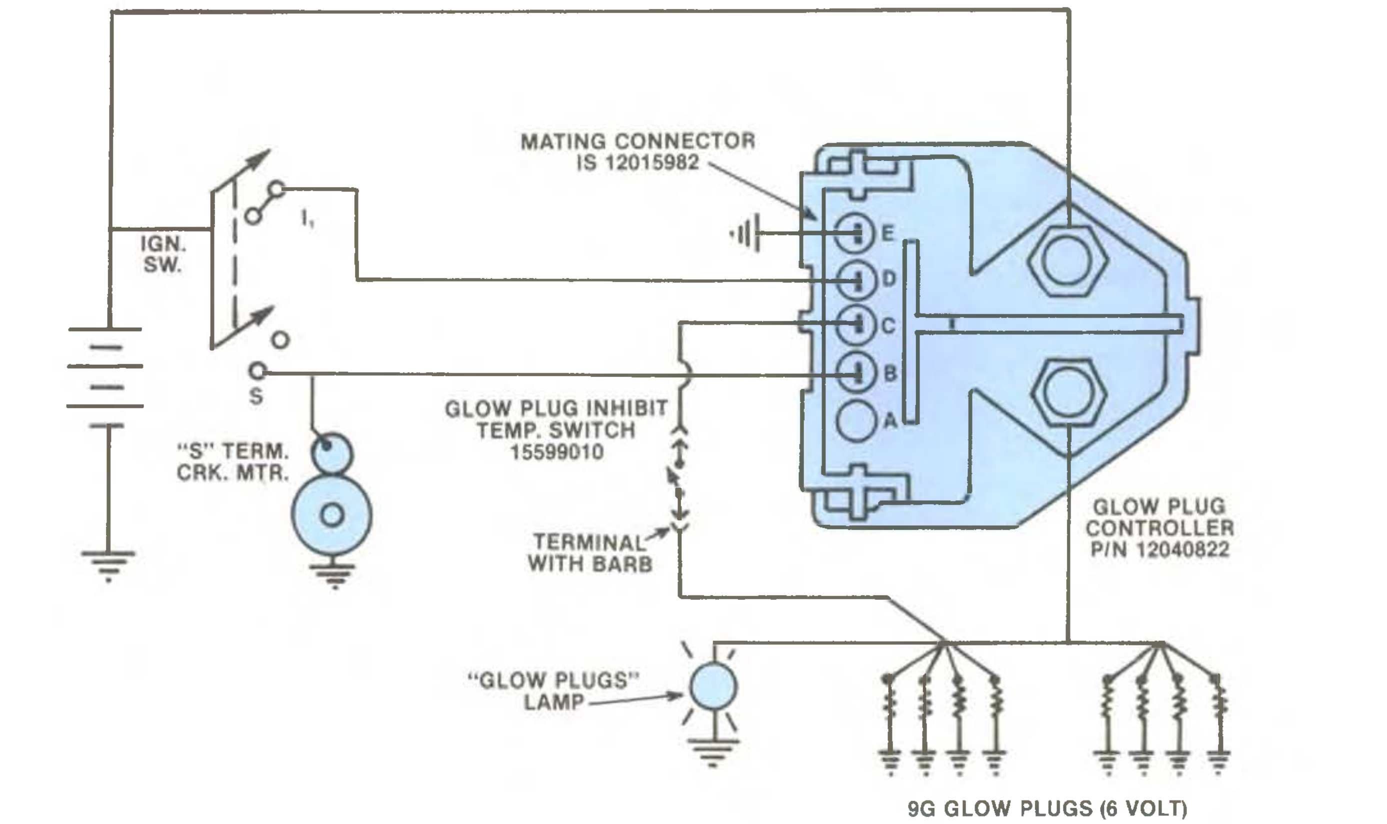


Figure 6-32, Electronic Glow Plug Control System.

A normal functioning system (Green eye in batteries) operates as follows:

- **KEY "ON" — ENGINE NOT RUNNING — VEHICLE AT ROOM TEMPERATURE**
  1. Glow plugs "ON" for 4 to 6 seconds, then "OFF" for approximately 4.5 seconds,
  2. Then cycle; "ON" for approximately 1.5 seconds, "OFF" for approximately 4.5 seconds, and continue to cycle 1.5 "ON"/4.5 "OFF", for a total duration (including the initial 4-6 seconds) of about 25 seconds.
- If the engine is cranked during or after the above sequence, the glow plugs will cycle "ON/OFF" for a total duration of 25 seconds **after** the ignition switch is returned from the crank position, whether the engine starts or not. The engine does not have to be running to terminate the glow plug cycling. All the "times" shown above are approximate because they vary with initial engine temperature.

The initial "ON" time and cycling "ON/OFF" times vary also with system voltage. That is, longer "ON" times are produced by lower voltage and/or temperature. Longer duration of cycling is produced by lower temperature only. The temperature switch in the upper rear of the R.H. head is calibrated to 125°F and above this temperature the glow plugs are not energized.

If the system does not operate as described, check all connectors to ensure they are fully seated. As in the 1982-84 6.2L diesels, the engine harness ground connection to the engine is critical . . . make sure the nut is tightened to specifications and the ground ring terminal is tight.

- **THE OTHER CONNECTIONS TO CHECK IN THE ENGINE COMPARTMENT ARE:**

1. Four-wire connector on controller. If this connector isn't fully seated and latched, the glow plugs may not function.
2. Both stud nuts on controller. Tighten to 4-5 N·m (35-45 lb.-in.). Do not overtorque.
3. Temperature switch connector at top rear of R.H. Head. If this connection is not made, the glow plugs will not energize (Engine temperature must be below 110°F for glow plugs to operate).

If the glow plugs function normally, but the "Glow Plugs" light does not, check all the connections and bulb in the jumper harness in the IP area.

If all connections are intact, but the glow plug system does not operate as stated, proceed with normal electrical diagnostic procedures (Figure 6-33).

— CAUTION —

Do not manually bypass relay in the glow plug controller. Do not jump start with more than 12 Volt System.

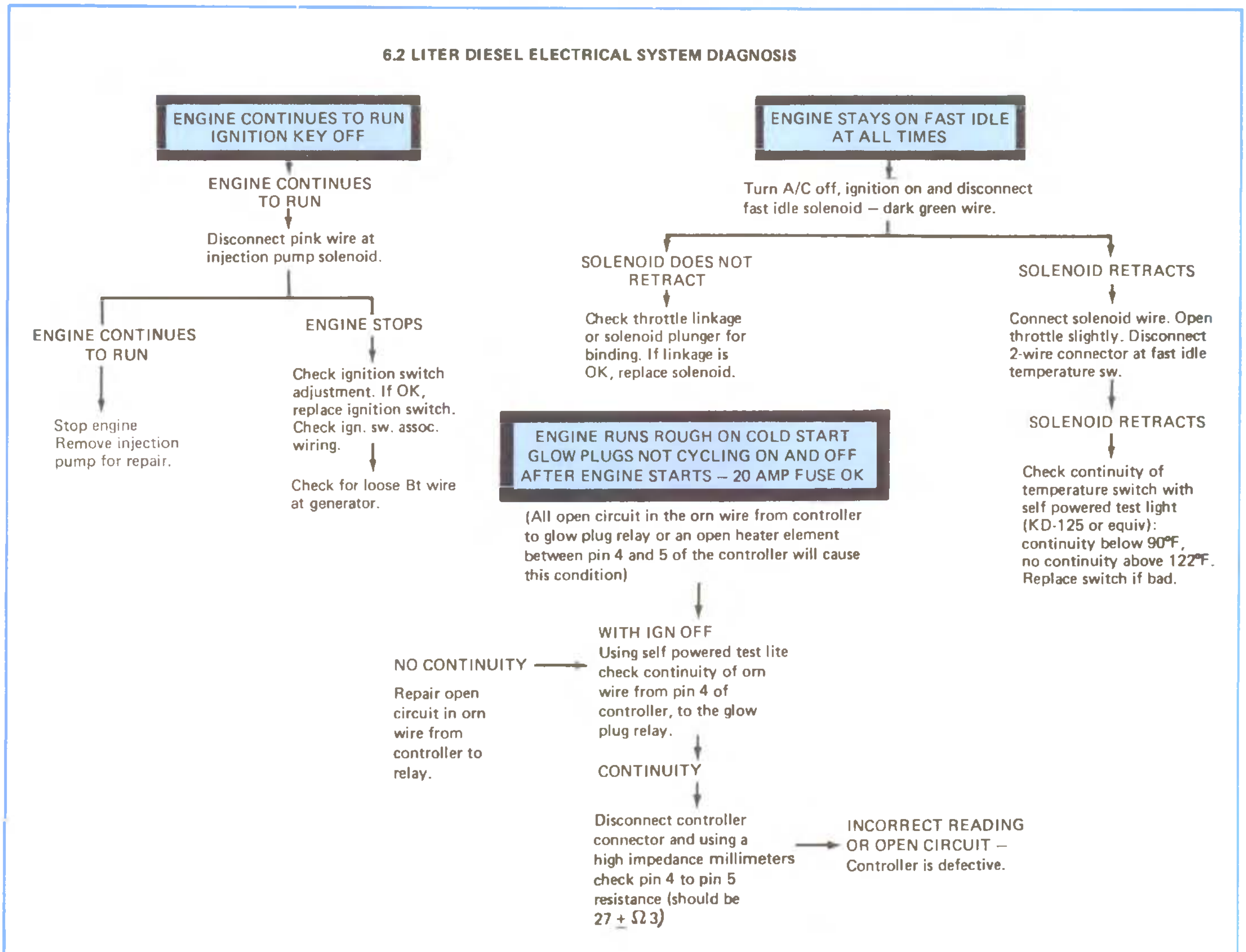


Figure 6-33, General Electrical Diagnosis

1983 Diesel G-Truck Engine Run-On, 6.2L Diesel with Base Engine Warning Lights

A condition exists whereby an electrical feedback signal from the alternator can caust the engine to continue running with the key in the "OFF" position.

The feedback signal prevents the injection pump solenoid from shutting off the fuel supply. This is only in 1983 "G" Truck vehicles equipped with the 6.2L Diesel and base warning light system (tell-tale lights).

To correct an affected vehicle, install jumper wire harness P/N 12038051 (Figure 6-34). This wire incorporates a diode which prevents a feedback signal. This harness assembly is installed in production vehicles starting approximately March, 1983.

USE THE FOLLOWING PROCEDURE TO INSTALL THIS WIRE ON AFFECTED VEHICLES:

1. Disconnect the negative battery cable from both batteries.
2. Remove the engine harness bulkhead connector.
3. Looking into the terminal end of the bulkhead connector, locate the #25 circuit (brown wire) and remove.
4. Insert the end of the jumper harness into the bulkhead connector.
5. Using the supplied terminal, connect the other end of the #25 circuit (brown wire) to the jumper harness.
6. Attach the bulkhead connector.
7. Re-connect both negative battery cables.

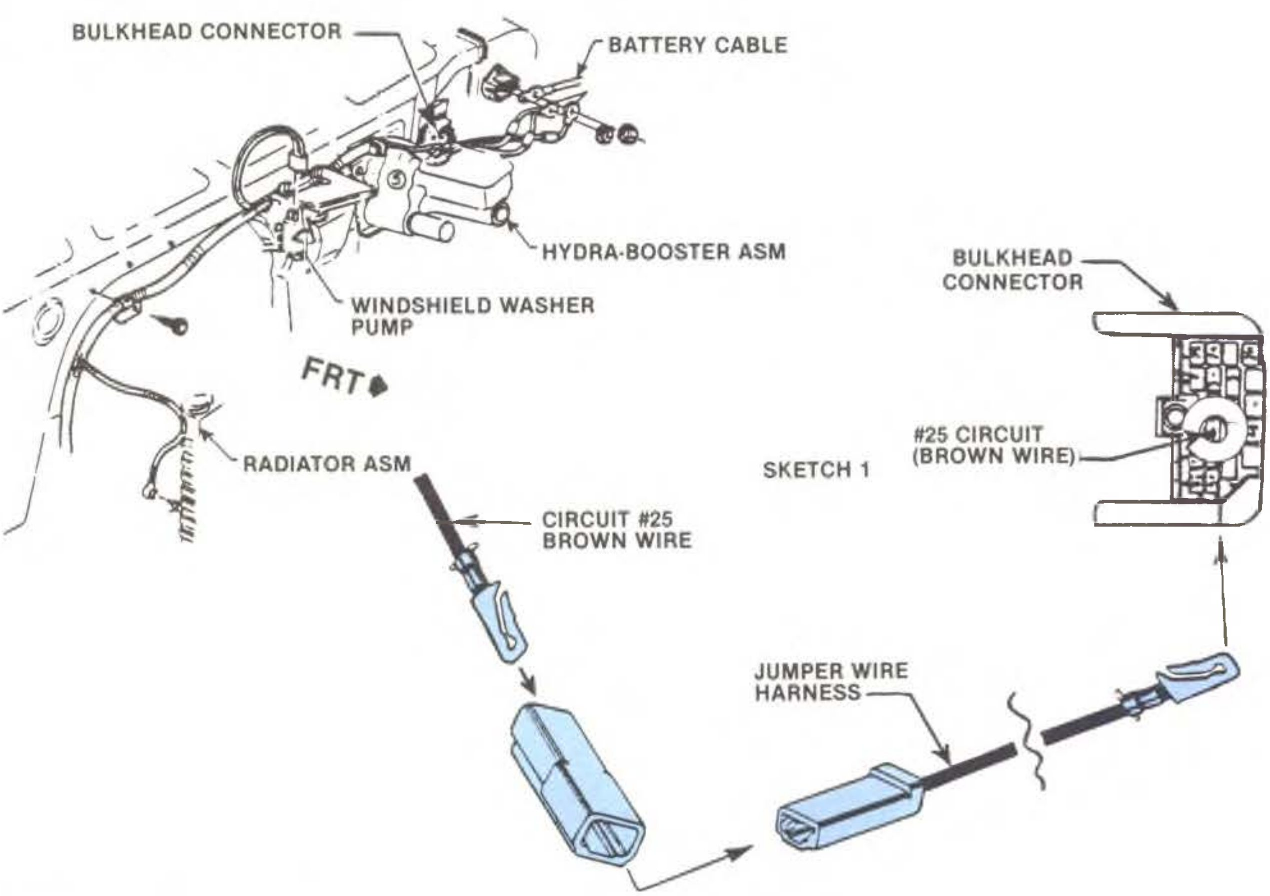


Figure 6-34, Jumper Wire Harness Installation.

6.2L Diesel Drive Belts, 1982-1984 C/K/P/G Truck With 6.2L Diesel Engine

BELT USAGE	RECOMMENDED BELT
Alternator	14050449
A/C Belt	14033869
P.S. Belt	14050459

Pre-delivery retensioning of drive belts in 6.2L diesel engines is **MANDATORY** to maintain proper adjustment throughout the life of the belt.

A high percentage of belt tension is lost during the first 15 minutes that the engine is run. This occurs when the initial stretching of the belt fibers relaxes as the belt seats itself in the pulleys. Vibrations unique to diesel engines, especially at idle, continue to stretch belt fibers throughout the life of the belt, although a majority of this occurs during the first 15 minutes of running time. Once a belt has accumulated 15 minutes running time, it is considered a used belt, and the parameters of belt tension change accordingly.

During the dealer pre-delivery inspection, the belt tension **MUST** be checked. If the tension is below 350 N (80 pounds), the tension must be reset to 445 N (100 pounds).

It is recommended that when a vehicle is in for service and a **NEW** belt is installed that the belt be tensioned to the new belt specification (See attached chart). The engine should then be run for a minimum of 15 minutes at idle and the tension rechecked. If below 350 N (80 pounds), retention the belt to 445 N (100 pounds).

A used belt should never be tensioned to more than 445 N (100 pounds). When checking used belt tension, it will be necessary to run the engine 5 to 15 minutes to assure the belts are hot. Check the belt tension. If under 275 N (60 pounds) **HOT**, the belt must be retentioned to 445 N (100 pounds) **COLD.**

— CAUTION —

Avoid over- or under- tightening belts. Loose belts result in slippage which can lead to belt and pulley "glazing" and inefficient component operation. Once a belt has become "glazed", it will be necessary to replace the belt. Loose belts can also place high impact loads on driven component bearings due to the whipping action of a loose belt. Over tightened belts can lead to bearing damage and early belt failure.

When adjusting drive belts, use belt tension gage J-23600-B.

BELT TENSION (ALL BELTS)		
	IF BELOW: Newton (Pounds)	RETENSION TO: Newton (Pounds)
DEALER (Pre-delivery inspection)	350 (80)	445 (100)
SERVICE (New Belt)	Set Tension to 775 N (175 lbs.)	
SERVICE (New belt after minimum of 15 minutes running time)	350 (80)	445 (100)
SERVICE (Used belt — any mileage over 50 miles)	275-HOT* (60-HOT*)	445-COLD** (100-COLD**)

*HOT = Belt feels hot to the touch. Engine may have to be run 5 to 15 minutes to warm the belt.

**COLD = Belt feels only warm to the touch, or cooler.

— NOTE —

The alternator/vacuum pump belt for 1984 G and P models is #14071081. This is a cog type belt, 49″ x 3/8″.

7. Diagnosis

THIS DIAGNOSIS SECTION IS DIVIDED INTO THE FOLLOWING:

- General/Mechanical Diagnosis
- Smoke Diagnosis
- Idle and Performance Diagnosis
- MPG Diagnosis
- Fuel and Air System Diagnosis
- Brake Diagnosis
- Engine Oil Leak Diagnosis
- Checking For Air Leaks
- Testing Fuel System Pressures

General/Mechanical Diagnosis

Diesel Engine Mechanical Diagnosis such as noisy lifters, rod bearings, main bearings, valves, rings and pistons is the same as for a gasoline engine. This diagnosis covers only those conditions that are different for the diesel engine.

General Diagnosis Charts

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Will Not Crank	a. Loose or Corroded Battery Cables	Check connection at batteries, engine block and starter solenoid.
	b. Discharged Batteries	Check generator output and generator belt adjustment.
	c. Starter Inoperative	Check voltage to starter and starter solenoid. If OK, remove starter for repair.
Engine Cranks (Slowly) But Will Not Start or is Hard to Start — Hot or Cold (Minimum Cranking Speed is 100 RPM Cold, 180 RPM Hot.	1. Low Cranking Speed Due to:	
	a) Loose or Corroded Battery Connections	Clean and/or tighten terminals.
	b) Partially Discharged Batteries	Charge batteries and check charging system including belt tension and battery terminals.
	c) Wrong Engine Oil	Use correct viscosity oil.
	d) Defective Cranking Motor	Repair or replace as necessary.

● LIKELIEST CAUSES

• POSSIBLE CAUSES

	CONDITION	WILL NOT START	HARD STARTING	STARTS - THEN STOPS	ROUGH IDLE	MISSES	DILUTION OF OIL	KNOCKS	LOW POWER	BLACK SMOKE AT IDLE	BLACK SMOKE AT LOAD	WHITE SMOKE	FUEL CONSUMPTION EXCESSIVE	NO HEAT FROM HEATER
AIR SYSTEM	RESTRICTED AIR INTAKE		•	•					•	•	•		•	
	HIGH EXHAUST BACK PRESSURE			•					•		•		•	
FUEL SYSTEM	OUT OF FUEL	●		•										
	RESTRICTED FUEL RETURN LINE			•	•	•			•			•	●	
	AIR LEAKS IN SUCTION LINES	•	•	•	•	•			•			•		
	RESTRICTED FUEL LINE OR FILTER	•	•	•		•			•	•	•	•	•	
	EXTERNAL FUEL LEAKS		•	•	•	•			•				•	
	NOZZLES		•		●	●		●	●	•	●		●	
	FAST IDLE INOPERATIVE			•	•									
	FAULTY FUEL SUPPLY PUMP	•	•	●	•	•	•						•	
	INCORRECT FUEL (GASOLINE)	•	•			•		•	•		•		•	
	PARAFFIN DEPOSIT IN FILTER	•	•	•					•					
	IDLE SPEED TOO LOW			●	•									
	INJECTION PUMP	•	•	•	•	•	•	•	•		•	•	•	
OIL	WRONG GRADE FOR AMBIENT	●	•									•		
MECHANICAL	HEAD GASKET LEAKS								•				•	●
	BROKEN OR WORN PISTON RINGS				•		•	•	•	•			•	
	VALVE LEAKAGE				•	•			•				•	
	INCORRECT BEARING CLEARANCE							•						
	DAMAGED BEARINGS							•						
	LOW COMPRESSION	•	•		•	•					•		•	
	LOOSE TIMING CHAIN				•	•			•			•	•	
	TIMING ADVANCED		•		•			•	•	●	●		•	
	TIMING RETARDED		•		•				•			●	•	
	CAMSHAFT WORN		•		•	•			•		•		•	
	STUCK OPEN EGR										●			
ELECTRICAL	BATTERIES NOT CHARGED	●												
	GLOW PLUGS INOPERATIVE	●	●									•		

Figure 7-1, Summary of Major Diagnosis Conditions.

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Cranks Normally — Will Not Start	a. Incorrect Starting Procedure	Use recommended starting procedure.
	b. Glow Plugs Inoperative	Refer to Section 6.
	c. Glow Plug Control System Inoperative	Refer to Section 6.
	d. No Fuel Into Cylinders	Remove any one glow plug. Depress the throttle part way and crank the engine for 5 seconds. If no fuel vapors come out of the glow plug hole, go to step e. If fuel vapors are noticed remove the remainder of the glow plugs and see if fuel vapors come out of each hole when the engine is cranked. If fuel comes out of one glow plug hole only clean and test the injection nozzle in that cylinder. Crank the engine and check to see that fuel vapors are coming out of all glow plug holes. If fuel is coming from each cylinder, go to step k.
	e. Plugged Fuel Return System	Disconnect fuel return line at injection pump and route hose to a metal container. Connect a hose to the injection pump connection, route it to the metal container. Crank the engine. If it starts and runs, correct restriction in fuel return lines. If it does not start, remove the top of the injection pump and make sure that it is not plugged. NOTE: If fitting is plugged and/or small black particles are visible in the pump, a governor weight retaier flex ring may be needed (See Section 4B).
	f. No Fuel to Injection Pump	Loosen the line coming out of the filter. Crank the engine, the fuel should spray out of the fitting, use care to direct fuel away from sources of ignition. If fuel sprays from the fitting go to step j. **NOTE: Perform fuel supply system checks at the end of this section.**
	g. Restricted Fuel Filter	Loosen the line going to the filter. If fuel sprays from the fitting, the filter is plugged and should be replaced. Use care to direct the fuel away from sources of ignition.

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Cranks Normally — Will Not Start (Cont'd)	h. Fuel Pump Inoperative	Remove inlet hose to fuel pump. Connect a hose to the pump from a separate container that contains fuel. Loosen the line going to the filter. If fuel does not spray from the fitting, replace the pump. Use care to direct the fuel away from source of ignition.
	i. Restricted Fuel Tank Filter	Remove fuel tank and check filter. (Filter for diesel fuel is blue.)
	j. No Voltage to Fuel Solenoid	1. Connect a voltmeter to the wire at the injection pump solenoid and ground. The voltage should be a minimum of 9 volts. If there is inadequate voltage, refer to the ELECTRICAL DIAGNOSIS in Service Manual for more information. 2. Disconnect pink lead from terminal on top of injection pump. Turn key to "ON" position. Touch lead to and remove — audible clicking sound should be heard from within pump. If no sound is heard, turn key off and remove governor cover. Check solenoid arm and plunger for freedom of movement. Repair or replace solenoid as necessary. *NOTE: Occasionally, plunger solenoid stickiness may be caused by an accumulation of metallic debris in the mechanism. Before replacing inoperative solenoids, blow off the debris with compressed air and recheck for proper operation by applying a minimum of 12 volts to the terminal and grounding the cover.*
	k. Incorrect or Contaminated Fuel	Flush fuel system and install correct fuel. Replace with correct fuel. To verify suspected poor quality fuel, connect a hose to the inlet of the fuel supply pump and route to a container of known good quality fuel. If engine starts and runs, drain and flush poor fuel from vehicle.

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Cranks Normally — Will Not Start (Cont'd)	l. Pump Timing Incorrect	Make certain that pump timing mark is aligned with mark on adapter or front cover. Check timing with timing meter (if available or applicable)
	m. Low Compression	Check compression to determine cause. Repair as necessary. The 6.2L Diesel should have compression in each cylinder of at least 380 psi, and the lowest cylinder reading should not be less than 80% of the highest cylinder reading.
	n. Bent Upper Compression Ring	Replace rings.
	o. Injection Pump Malfunction	With pump on engine, check transfer pressure during cranking. Housing pressure should be a minimum of 2 psi **less** than transfer pressure which should be at least 10 psi. Also check the transfer pump pressure at idle, should be approximately 30 psi. If incorrect, remove pump from engine and have the calibration checked by an authorized repair agency. Particular attention should be paid to cranking delivery and transfer pressure at cranking speed.
	p. Nozzle Malfunction	Remove nozzles from engine and check on nozzle tester according to manufacturers' instructions.
	q. Air In Fuel Supply Lines	Connect a known good hose to a container of known good fuel, if engine starts, locate source of air leak in supply lines. See "checking for air leaks", page 7-38).
Instrument Panel Oil Warning Lamp "ON" at Idle	a. Oil Cooler or Oil or Cooler Line Restricted	Remove restrictions in cooler or cooler line.
	b. Oil Pump Pressure Low	See oil pump repair procedures in the Service Manual.

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Will Not Shut Off With Key	a. Injection Pump Fuel Solenoid Does Not Return Metering Valve to "OFF" Position	Refer to ELECTRICAL DIAGNOSIS in the Service Manual.
NOTE: With Engine at Idle, Pinch the Fuel Return Line at the Flexible Hose to Shut Off Engine.	b. Disconnect Pink Wire at Solenoid, if Engine Now Shuts Off	Refer to ELECTRICAL DIAGNOSIS in the Service Manual.
	c. An Electrical Feedback Signal From the Generator.	1. 1983 G-Van without gages use a jumper wire pin 12038051. This wire incorporates a diode which prevents feedback. 2. Disconnect the negative battery cable from both batteries. 3. Remove the engine harness bulkhead connector. 4. Looking into the terminal end of the bulkhead connector, locate the #25 circuit (brown wire) and remove it. 5. Insert the end of the jumper harness into the bulkhead connector. 6. Using the supplied connector, connect the other end of the #25 circuit (brown wire) to the jumper harness. 7. Attach the bulkhead connector. 8. Reconnect both negative battery cables.
	d. If the Engine Still Does Not Shut Off	Remove injection pump for repair.
Engine Starts But Will Not Continue to Run at Idle and Stalls	a. Slow Idle Incorrectly Adjusted	Adjust idle screw to specification.
	b. Fast Idle Solenoid Inoperative	With engine cold, start engine; solenoid should move to hold injection pump lever in "fast idle position". If solenoid does not move, refer to ELECTRICAL DIAGNOSIS in the Service Manual.

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Starts But Will Not Continue to Run at Idle and Stalls (Cont'd)	c. Restricted Fuel Return System	Disconnect fuel return line at injection pump and route hose to a metal container. Connect a hose to the injection pump connection; route it to the metal container. Crank the engine and allow it to idle. If engine idles normally, correct restriction in fuel return lines. If engine does not idle normally, remove the return line check valve fitting from the top of the pump and make sure it is not plugged.
		NOTE: If the fitting is plugged and/or small black particles are visible in the pump, a governor weight retainer flex may be at fault. See Section 4B
	d. Glow Plugs Turn Off Too Soon	Refer to Section 6.
	e. Pump Timing Incorrect	Make certain that timing mark on injection pump is aligned with mark on adapter or front cover.
	f. Limited Fuel to Injection Pump (Fuel Supply)	Test the engine fuel pump; check fuel lines. Replace or repair as necessary.
	g. Incorrect or Contaminated Fuel	Flush fuel system and install correct fuel.
	h. Low Compression	Check compression to determine cause.
	i. Fuel Solenoid Closes in Run Position	Ignition switch out of adjustment. If OK, refer to ELECTRONIC DIAGNOSIS in Service Manual.
	j. Injection Pump Malfunction	Remove injection pump for repair.
	k. Incorrect or Poor Quality Fuel	Replace with correct fuel. To verify suspected poor quality fuel, connect a hose to the inlet of the fuel supply pump and route to a container filled with known good quality fuel. Start and run engine. If performance of engine improves, drain and flush system of poor fuel and replace with correct fuel.

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Starts But Will Not Continue to Run at Idle and Stalls (Cont'd)	I. Air in Fuel	Check for presence of air by disconnecting fuel return line from top of pump and connecting a clear hose to return fitting. Route hose to a metal container. Start engine and allow to idle. Watch return fuel for air bubbles. If bubbles are present, locate source of air leak in fuel supply system and correct. If stalling occurs *only* on cold engine start up, check for fuel leaking backwards, or air leaking into the fuel supply lines. See page 7-38 for "Checking for Air Leaks". Pin hole in tank sending unit.
Engine Stalls Under Deceleration or Heavy Braking	a. Idle Speed Too Low	Adjust to specification and also check and adjust fast idle solenoid.
	b. Governor Weight Retainer Ring Fault.	Remove governor cover and check for small black particles. If they are present, a governor weight retainer flex ring may be at fault.
	c. Binding Condition Between Min-Max Block and Throttle Shaft	To check for binding between min-max block and throttle shaft, remove governor cover, place throttle in low idle position and slide min-max governor back and forth on guide stud. Assembly should move freely without binding.
	d. Sticky Metering Valve or Linkage in Injection Pump	Remove pump from engine, mount on test bench and check calibration paying particular attention to low idle settings and action of governor around low idle speed. Repair or replace metering valve or other governor components as necessary (See appendix 5).
Excessive Surge at Light Throttle, Under Load **NOTE:** If Engine Has a Rough Idle	a. Torque Converter Clutch Engages Too Soon	See Section 7A, of the Service Manual "Torque Converter Clutch Diagnosis".
	b. Timing Retarded	Be sure timing mark on injection pump is aligned with mark on adapter or front cover.

CONDITION	POSSIBLE CAUSE	CORRECTION
Excessive Surge at Light Throttle, Under Load (Cont'd)	c. Clogged Fuel Filter	Check fuel pump pressure on inlet and outlet sides of filter, 5.5-6.5 psi.
	d. Injection Pump Housing Pressure Too High	1. Repair return line restriction. 2. Replace back leak connector.
	e. Injection Line Volume Too Low	Replace affected line(s).
	f. Low Opening Pressure Nozzle	Replace nozzle.
Engine Starts, Idles Rough, WITHOUT Abnormal Noise or Smoke (Fully Warmed Up Engine)	a. Slow Idle Incorrectly Adjusted	Adjust slow idle screw to specification.
	b. Injection Line Leaks	Wipe off injection lines and connections. Run engine and check for leaks. Correct leaks.
	c. Restricted Fuel Return Systems	Disconnect fuel return line at injection pump and route hose to a metal container. Connect a hose to the injection pump connection; route it to the metal container. Start the engine and allow it to idle; if engine idles normally, correct restriction to fuel return lines. If engine does not idle normally, remove the return line check valve fitting from the top of the pump and make sure it is not plugged.
	d. Air in System	Install a section of clear plastic tubing on the fuel return fitting from the engine. Evidence of bubbles in fuel when cranking or running indicates the presence of an air leak in the suction fuel line. Locate and correct. If foam or bubbles are present, proceed as follows: 1. Raise vehicle and disconnect both fuel lines at the tank unit. 2. Plug the smaller disconnected return line. 3. Attach a low pressure (preferably hand operated pump) air pressure source to the larger 3/8 fuel hose and apply 8-12 psi. 4. Observe the pressure pump reading of 8-10 psi. A decrease in pressure will push fuel out at the leak point indicating the location of the leak.

CONDITION	POSSIBLE CAUSE	CORRECTION
Fully Warmed Up Engine Idles Rough in Neutral and/or Drive (Cont'd)	d. Air in System (Cont'd)	5. Repair as necessary. In checking for air comments, the proper size clamps on all hoses should be checked. Also, a burr on the edge of a pipe could rip the inside of a line and create air ingestion. Particular attention should be given to improper installation or defective auxiliary filters or water separators.
	e. Incorrect or Contaminated Fuel	Flush fuel system and install correct fuel.
	f. Nozzle(s) Malfunction	Perform glow plug resistance test (in this section), or crack open the nozzle inlet fitting, to locate the missing cylinder.
	g. Incorrect Timing **NOTE: Retarded timing will cause white smoke. Advanced timing will cause black smoke.**	1. Check housing pressure and supply pressure. If housing pressure is higher than 12 psi or supply pressure is lower than 5 psi, the injection pump advance mechanism may be too far retarded. Replace fuel filters, supply pump, or clear return line restriction as necessary to correct. 2. Check timing. 3. If pump is equipped with mechanical light load advance, check for sticky or stuck advance mechanism (internal timing) by depressing the rocker level on the side of the injection pump while the engine is idling. If the engine sound does not change, the pump should be removed and sent to an authorized agency for repairs.
	h. Governor Weight Retainer Flex Ring Fault	Remove governor cover and check for small black particles. If they are present a governor weight retainer flex ring may be at fault. See Section 4B.
	i. Low or Uneven Engine Compression	Check compression according to engine manual. GM diesel engines should have compression in each cylinder of at least 380 psi, and the lowest cylinder reading should not be less than 80% of the highest cylinder reading.

CONDITION	POSSIBLE CAUSE	CORRECTION
Fully Warmed Up Engine Idles Rough in Neutral and/or Drive (Cont'd)	j. Internal Injection Pump Fault	Remove pump from engine and have calibration checked by an authorized agency.
Cold Engine Idles Rough After Start-up But Smooths Out as it Warms Up. (This Problem is Often Accompanied by White Exhaust Smoke)	a. Incorrect Starting Procedure	See section 1 or owners manual for starting procedure.
	b. Fast Idle Solenoid Inoperative or Set Incorrectly	Test and re-set according to engine manual or vehicle emissions sticker.
	c. Air in Fuel	See page 7-38 "Checking For Air Leaks".
	d. One or More Glow Plugs Inoperative	Perform glow plug system diagnosis, Section 6.
	e. Injection pump timing to engine.	Check alignment of timing mark on pump with the engine front cover.
	f. Insufficient engine break-in time.	Break-in engine 2,000 or more miles.
	g. Incorrect Internal Timing	1. *Automatic Advance Fault* The pump is equipped with mechanical light load advance, check for stuck or sticky advance mechanism by depressing the rocker lever on the side of the pump while the engine is idling. If the engine sound doesn't change, the pump should be removed and sent to an authorized agency for repairs. 2. *Housing Pressure Cold Advance Malfunction* Check pump housing pressure. Pressure should be 0-1 psi when the engine is cold and 8-12 psi when the engine is fully warmed up.
	h. Nozzle Valve(s) Sticking Open (Usually Accompanied by Knocking Sound)	Remove nozzles from engine and repair or replace as necessary.

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Misfires Above Idle or Runs Rough While Driving But Idles OK ("Chuggle" in Vehicles Equipped with a Transmission Converter Clutch (TCC).	a. Incorrect Pump to Engine Timing	Check and adjust timing to specifications.
	b. Air in Fuel	Check for presence of air by disconnecting fuel return line from top of pump and connecting a clear hose to return fitting. Route hose to a metal container. Start engine and allow to idle. Watch return fuel for air bubbles. If bubbles are present, locate source of air leak in fuel supply system and correct.
	c. Fuel Return System Restricted	Measure pump housing pressure at idle speed. Pressure should be 12 psi maximum. If pressure is greater than 12 psi, correct restriction in fuel return system.
	d. Fuel Supply Restriction	Test fuel supply pump and check fuel filter for plugged condition.
	e. Incorrect or Contaminated Fuel	Flush fuel system and install correct fuel.
Poor Fuel Economy	a. See page 7-24	See page 7-24
Noticeable Loss of Power	a. Restricted Air Intake	Check air cleaner element.
	b. Timing Set to Specifications	Be sure timing mark on injection pump is aligned with mark on adapter or front cover.
	c. EGR or EPR Malfunction	Refer to Emissions Diagnosis, Section 5.
	d. Restricted or Damaged Exhaust System	Check system and replace as necessary.
	e. Plugged Fuel Filter	Replace filter.
	f. Plugged Fuel Tank Vacuum Vent in Fuel Cap	Remove fuel cap. If loud "hissing" noise is heard, vacuum vent in fuel cap is plugged. Replace cap (Slight hissing sound is normal).

CONDITION	POSSIBLE CAUSE	CORRECTION
Noticeable Loss of Power (Cont'd)	g. Restricted Fuel Supply From Fuel Tank to Injection Pump	Examine fuel supply system to determine cause of restriction. Repair as required.
	h. Restricted Fuel Tank Filter	Remove fuel tank and check filter. (Filter for diesel fuel is blue.)
	i. Pinched or Otherwise Restricted Return System	Examine system for restriction and correct as required.
	j. Incorrect or Contaminated Fuel	Flush fuel system and install correct fuel.
	k. External Compression Leaks	Check for compression leaks at all nozzles and glow plugs, using "Leak-Tec" or equivalent. If leak is found, tighten nozzle or glow plug.
	l. Plugged Nozzle(s)	Remove nozzles. Have them checked for plugging and repair, replace or clean (where applicable) as necessary.
	m. Low Compression	Check compression to determine cause
	n. Transmission Fault	See Section 7A of the Service Manual.
Engine Stalls on Deceleration or Stalls at Idle	a. Sticking Metering Valve	Remove metering valve. Clean with 400 or 500 sandpaper. Wet sandpaper with diesel fuel and turn the metering valve in the wet paper no more than 5-6 turns.
Engine Will Not Return to Idle	a. External Linkage Binding or Misadjusted	Free up linkage. Adjust or replace as required.
	b. Fast Idle Malfunction	Check fast idle adjustment.
	c. Internal Injection Pump Malfunction	Remove injection pump for repair.
Fuel Leaks on Ground—No Engine Malfunction	a. Loose or Broken Fuel Line or Connection	Examine complete fuel system, including tank, lines, and injection lines. Determine source and cause of leak and repair.
	b. Injection Pump Internal Seal Leak	Remove injection pump for repair.

CONDITION	POSSIBLE CAUSE	CORRECTION
Noise—"Rap" From One or More Cylinders (Sounds Like Rod Bearing Knock)	a. Nozzle(s) Sticking Open or With Very Low Nozzle Opening Pressure	Remove nozzle for test and replace or clean (where applicable) as necessary.
	b. Mechanical Problem	Refer to Mechanical Diagnosis.
	c. Piston Hitting Cylinder Head	Replace malfunctioning parts. Be sure timing mark on injection pump is aligned with mark on front housing. Break in engine 2000 miles.
Noise—Objectionable	a. Timing Not Set to Specification	Make certain that timing mark on injection pump is aligned with mark on front housing.
Noise Over Normal Noise Level High Excessive Black Smoke	a. EGR Malfunction	Refer to the Emission Section 5.
	b. Injection Pump Housing Pressure Out of Specifications	Check housing pressure as described in this section.
	c. Injection Pump Internal Problem	Remove injection pump for repair.
Engine Noise Internal or External	a. Engine Fuel Pump, Generator, Water Pump, Valve Train, Vacuum Pump, Bearings, Etc.	Repair or replace as necessary. If noise is internal, see Diagnosis For Noise — Rap From One or More Cylinders and Engine Starts and Idles Rough With Excessive Noise and/or Smoke.
Engine Overheats	a. Coolant System Leak, Oil Cooler System Leak or Coolant Recovery System Not Operating	Check for leaks and correct as required. Check coolant recover jar, hose and radiator cap.
	b. Belt Slipping or Damaged	Replace or adjust as required.
	c. Thermostat Stuck Closed	Check and replace if required.
	d. Head Gasket Leaking	Check and repair as required.
Poor Performance Extended Hot Crank Time No W.O.T. Upshift	a. King in the Fuel Supply Hose Between the Fuel Tank and Body	Shorten the fuel supply hose at the kinked area.
Excessive Engine Blowby	a. Bent Upper Compression Ring	Check compression. If about 100 psi low, change the piston rings.

General Diagnosis Conditions

DIESEL STARTING

It must be remembered that diesels need three ingredients to start — air, fuel, and heat. If the valves open, the engine should have air. The best method to check for fuel is to pull a glow plug, crank the engine and look for fuel vapors. Heat is furnished by the glow plugs and the heat of compression by cranking.

DIESEL COMPRESSION LEAK

Some diesel engine equipped vehicles may exhibit an inadequate amount of passenger compartment heat. If you experience inadequate heat at idle, the cause may be a compression leak to the cooling system. Examine the coolant recovery tank to see if bubbles are evident with the engine running. If bubbles are evident, the cause may be a head gasket leak. To determine which head gasket is leaking, remove the water pump belts and the water outlet and thermostat. Run the engine and observe which side of the engine bubbles are coming from.

DIESEL ENGINE KNOCK

Diesel engine knock may be caused by a piston. The piston knock sounds very similar to combustion knock.

To assist in the diagnosis, with the engine off, retard the injection pump timing as far as the slot in the pump flange will allow. This will quiet down a combustion knock. If the knocking is not substantially reduced, the noise is most likely a mechanical problem. Crank the fuel injection lines one by one to identify the cylinder with the knock. The knock tone will change when the line is cracked feeding the cylinder with the problem.

Smoke Diagnosis Principles

Three different types of smoke will be reviewed in this section. Black, white and blue.

BLACK SMOKE

Black smoke is the most common smoking complaint. Diesels are usually rated according to the maximum horsepower developed at the "smoke limit." At a certain speed, a definite amount of air enters the cylinder. This amount of air is sufficient to produce complete combustion of a given quantity of fuel. If more fuel is injected, overloading the engine beyond the rated horsepower, there will not be sufficient air for complete combustion and black smoke will result. Under these conditions, the black smoke contains a large quantity of unburned carbon (soot) formed by thermal decomposition of the fuel in the over-rich mixture in the cylinder.

The injection pump is incapable of delivering rich or lean mixtures. Therefore any variable that increases fuel or reduces the amount of air taken into the cylinder will increase the tendency to produce black exhaust smoke.

Some sources of black smoke directly related to improper burning of fuel are:

- Air into injection pump
- Fuel return restricted (both of the above will change automatic advance; EPR 1981 only)
- Pump timing advanced (usually will be accompanied by excess combustion noise)
- Wrong fuel
- Excess fuel delivery from nozzles due to low opening pressure or stuck nozzle
- Less than 5½ lbs of fuel pump pressure

Although not directly fuel related some indirectly related sources of black smoke are:

- EGR stuck open (at w.o.t. only)
- Restricted exhaust
- Low compression
- Clogged air inlet
- Missing prechamber (causes black smoke when hot and white smoke when cold)

Presence of prechamber can be checked externally. To check, remove glow plug and insert a probe into the prechamber. If more than 3⅜"-2¾" of the probe can be inserted, prechamber is missing.

The fuel variables that can affect black smoke are gravity (an indirect measure of heating value); viscosity, and cetane number. An engine may smoke when a fuel of lower gravity is used. This is an overfueling problem that occurs because injectors meter fuel on a volume basis and low gravity fuels have more Btu's per gallon, and therefore, less fuel is required for equal power, equal air utilization, and equal smoke.

Increasing viscosity can also cause overfueling by reducing the leakage in the injection pump, thus allowing more fuel to be injected into the cylinder.

In engines which are sensitive to cetane number, the tendency toward black smoke is greater as cetane number increases. The short delay period of a high cetane number fuel assures that some raw fuel is sprayed into an established flame where the atmosphere is too lean for complete combustion.

WHITE SMOKE

At light loads, the average temperature in the combustion chamber may drop 500 degrees due to the decreased amount of fuel being burned. As a result of the lower temperature, the fuel ignites so late that combustion is incomplete at the time the exhaust valve opens and fuel goes into the exhaust in an unburned or partially burned condition producing the white smoke. Under these conditions, a higher cetane fuel or a more volatile fuel will tend to promote better combustion and reduce smoke. Any operating variable (jacket temperature, inlet air temperature, etc.) that increases compression temperature or reduces ignition delay will improve the white smoke problem. White smoke is considered normal when the car is first started but should stop as the car warms up. A continuing white smoke condition could indicate a loss of compression. Retarded timing and plugged fuel return can cause white smoke.

BLUE SMOKE

Blue smoke indicates that engine oil is burning in the cylinders and may be accompanied by excessive oil consumption.

Some mechanical conditions which should be considered are:

- Stuck piston rings
- Worn piston rings
- Failed valve seals
- Faulty crankcase vent valve

Some non-mechanical checks would include:

- Lube oil level too high
- Fuel oil in crankcase
- Wrong dipstick

Black Smoke Diagnosis Chart

CONDITION	POSSIBLE CAUSE	CORRECTION
Excessive Black Smoke	a. Air Inlet Restriction	Replace air filter element.
	b. EGR or EPR Valve Malfunction	Refer to Section 5 for diagnosis.
	c. Advanced Timing	Check timing marks and correct as necessary.
	d. Nozzle Malfunction	Check function of injection nozzles on nozzle tester according to manufacturers' instructions.
	e. Engine Mechanical Problem Resulting in Air Inlet Restriction or Low Compression	Check for carbon buildup in intake manifold or valve train wear which would cause air inlet restriction. Check engine compression. The 6.2L diesel engine should have compression in each cylinder of at least 380 psi, and the lowest cylinder reading should not be less than 80% of the highest cylinder reading.

White Smoke Diagnosis Chart

CONDITION	POSSIBLE CAUSE	CORRECTION
White Smoke During Cold Weather Starting	a. Increased Operating Noise and Light White Smoke	This is normal.
	b. Incorrect Starting Procedure, Pumping the Accelerator	Consult Owners Manual, for correct starting procedure.
	c. Glow Plugs Not On Long Enough	Check Glow Plug Diagnosis in Section 6.
	d. H.P.C.A. Inoperative	1. Check for current at the H.P.C.A. terminal on the right side of the injection pump, when engine temperature is less than 115°F (1982) 95°F on 1983's and later. If there is no current, determine the cause and correct. 2. If current is available at the H.P.C.A. terminal, remove the governor cover and connect a feed wire to H.P.C.A. terminal and ground governor cover, the H.P.C.A. solenoid should activate. If it does not, replace H.P.C.A. solenoid.
	e. Timing Incorrect	Time engine to specification, (see Section 4).
White Smoke on Start Up	a. Sticking Advance Piston	1. Hook up a dynamic timing meter. Push in on the bottom of the face cam rocker lever on the right side of the pump. This will retard the timing and cause the engine to run rough, if the advance piston is free. 2. If there is no change, the piston is sticking, polish the piston to correct.
	b. Low Compression	Check compression, repair as necessary. The 6.2L diesel engine should have compression in each cylinder of at least 380 psi, and the lowest cylinder reading should not be less than 80% of the highest cylinder reading.
	c. Retarded Pump to Engine Timing	Time engine to specifications, see Section 4.

Rough Idle Diagnosis

Rough idle is caused by variable power output between cylinders as they fire in sequence. The following can cause variable fuel flow to each cylinder and, therefore, its relative power output.

- Air in fuel system
- Nozzle opening pressure
- Nozzle tip leakage (seat tightness)
- Injection line volume and internal diameter
- Line fitting leakage — normally this engine uses approximately .3 gal per hour at idle, and considering one wet nozzle out of eight cylinders, the amount of fuel being consumed is so small that even a damp, not yet dripping nozzle fitting can cause that cylinder not to fire
- Injection pump output
- Injection pump low speed governor sensitivity

1982-83 6.2L DIESEL

A rough idle condition may be caused by a damaged injection pump drive shaft retaining ring.

If the ring is bent rearward, the governor arm can contact the ring. This affects governor control of fueling at idle, causing a rough idle.

The retaining ring can be damaged during manufacture or repair. It is used to retain the pump drive shaft.

If a vehicle is received with a rough, idle condition, use the following steps:

STEP 1 Request the date condition first appeared.

A. If since new, the retaining ring may be the cause.

B. If after pump removal or repair, the ring may be the cause.

C. If neither A nor B, then the ring is not likely the cause of rough idle.

STEP 2 If 1A or 1B does apply, and the condition is only a rough idle, with smooth operation above a 1,000 RPM, proceed to Step 3.

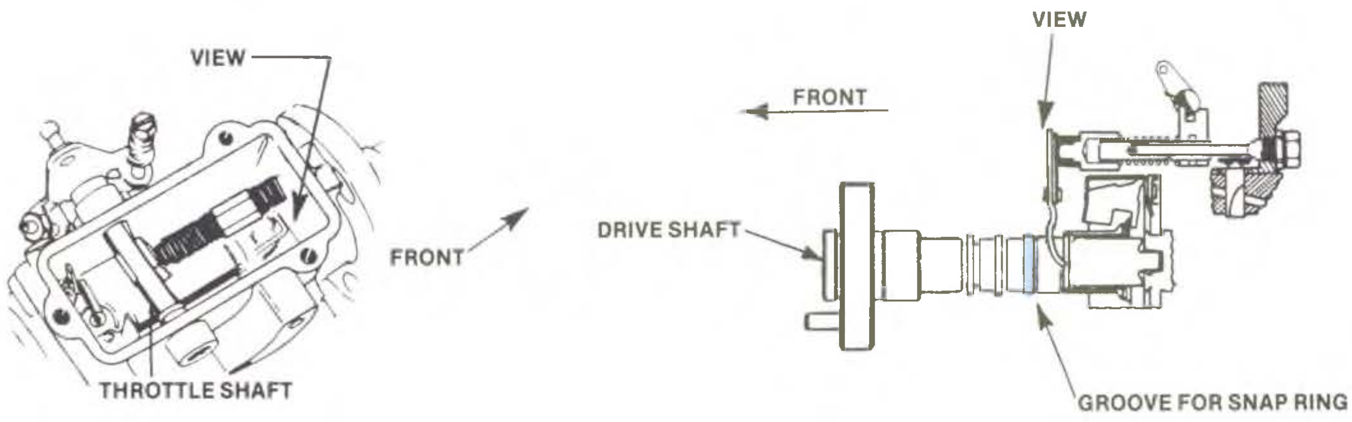
STEP 3 Remove the injection pump governor cover.

STEP 4 Using a flashlight, look between the forward edge of the housing and the governor. The main shaft will be visible below the governor. Where the main shaft enters the forward edge of the housing, a snap-ring should be visible. The use of a mirror may help to get a better view. Refer to Figure 7-2.

STEP 5 If the snap ring appears to be bent out of the shaft groove rearwards towards the governor, the ring must be replaced.

STEP 6 To replace the snap ring the injection pump must be removed and should be repaired at an authorized pump repair facility.

STEP 7 If the ring is not bent, the rough idle is due to some other cause such as a fuel line air leak, timing, etc.



TOP VIEW OF PUMP WITH HOUSING COVER REMOVED

CROSS SECTION VIEW OF INJECTION PUMP

Figure 7-2, Diesel Injection Pump.

DIAGNOSIS PROCEDURE, ROUGH IDLE

See Figure 7-3.

DIESEL ENGINE IDLE ROUGHNESS DIAGNOSIS PROCEDURE

CONDITION

IDLE ROUGHNESS

Idle roughness is defined as an uneven shaking of the engine in comparison to others with the same number of cylinders and in the same body style.

A rough idle condition may be caused by a difference in the output between cylinders on diesel engines. By selection of parts it is possible to alter the output between cylinders, and smooth out the idle quality.

CORRECTION

Follow the diesel engine idle roughness diagnosis procedure. Make all necessary adjustments and corrections. The idle roughness procedure must be followed step by step prior to performing the glow plug resistance check. The glow plug resistance check will only be successful after the idle roughness procedure is performed and corrections made.

CONDITION

COAST DOWN ROUGHNESS

A condition may exist where a roughness is observed on coast down at 50 mph or less with a closed throttle.

CORRECTION

Confirm that this condition is engine roughness rather than a tire waddle or a bent wheel by coasting down through the roughness period in neutral with the engine at 1500 to 2000 RPM. If roughness still exists, during the coast down, the condition is not caused by engine roughness. If the roughness condition is gone, follow the idle roughness diagnosis procedure. If not corrected prior to the glow plug resistance procedure, correct the roughness using the glow plug resistance procedures.

Diesel engine roughness at idle

On new vehicles — vehicle should have ¼ tank fuel and it may be necessary to run engine at high rpm to purge air from system

Remove air cleaner, install intake or crossover cover

Install Mag-Tach J-26925 — check idle speed (slow and fast)

Idle speeds OK | Idle speed incorrect → Set idle to specification

Make certain that timing mark on injection pump is aligned with mark on front cover. (if available or applicable)

Timing OK | Timing off → Reset timing

Continue on next page

Figure 7-3, Diesel Engine Idle Roughness Diagnosis Procedure.

Disconnect vacuum hose from vacuum pump — check idle quality

No improvement

Idle improves

Reinstall vacuum hose to pump. Loosen vacuum pump hold down clamp. Rotate pump in engine. If idle improves, clamp in that position. If idle does not improve, remove vacuum pump and reinstall with drive gear in different relationship to camshaft.

Examine nozzles for leaks at nozzle body or at fuel line connection (engine running)

No leaks

Leaks

Correct

Check for leak at injection pump to high pressure lines

No leaks

Leaks

Correct

Check for fuel pressure by cracking line at fitting between fuel filter and injection pump

Pressure evident

No pressure evident

Determine cause of lack of/or low pressure

Remove fuel return line from top of pump. Install short pieces of clear plastic tube between return line and check for presence of bubbles or foam in tube

No bubbles or foam

Bubbles evident

Find cause in fuel supply

*Loosen the line at the nozzles to bleed a small amount of fuel from the line. If solid fuel appears, go on to the next nozzle. If foam appears, shut the engine off and disconnect the line from the nozzle. Move the line so the inlet to the nozzle can be observed. Remove the pink wire to the pump and crank the engine and observe the nozzle inlet for bubbles. If bubbles are evident, replace the nozzle. Squirt some oil or fuel in the new nozzle inlet and recheck for bubbles. If bubbles are not evident, reconnect the line and pink wire, and go on to the next nozzle and repeat the process. Check the removed nozzle on a tester to determine if it is inoperative or if it is incompatible with the cylinder head.

If an objectionable rough idle condition still exists, proceed using glow plug resistance check to correct rough idle

Figure 7-3, (Cont'd.) Diesel Engine Roughness Diagnosis Procedure.

Glow Plug Resistance Procedure

To determine glow plug resistance, use the following steps:

STEP 1 Use the Kent-Moore High Impedence Digital Multimeter (Essential Tool J-29125A, J-34520 or J-34029) for measurements.

If another ohmmeter is used, different values will result. This does not mean that another ohmmeter is not accurate for measuring resistors or solenoids. Glow plugs can be individually probed, or a Cylinder Balance Tester (J-34116) can be used with the Digital Multimeter to select cylinders.

STEP 2 Select scales as follows: On K-M Tool J-29125A, LH Switch to "OHMS," RH Switch to full counter-clockwise, "200 Ohms," Slide Center Switch to the left "DC.LO." On J-34520 or J-34029, select 200 "OHS."

STEP 3 Start engine, turn on heater and allow engine to warm up. REMOVE all the feed wires from the glow plugs.

STEP 4 Disconnect the generator two lead connector.

STEP 5 Using a tachometer, adjust engine speed by turning the idle speed screw on the side of the injection pump to the worst engine idle roughness, but do not exceed 900 rpm.

STEP 6 Allow engine to run at worse idle speed for at least one minute. The thermostat must be open and the upper radiator hose hot.

STEP 7 Attach an alligator clip to the **black** test lead of the multimeter. THIS CLIP MUST BE GROUNDED TO THE FAST IDLE SOLENOID. It must remain grounded to this point until all tests are complete.

STEP 8 On a separate sheet of plain writing paper, write down the engine firing order. The 6.2L engine's firing order is 1-8-7-2-6-5-4-3.

STEP 9 With engine still idling, probe each glow plug terminal and record the resistance values on each cylinder in firing sequence. Most readings will be between 1.9 and 3.9 Ohms. If these readings are not obtained, turn engine "OFF" for several minutes and recheck the glow plugs. The resistance should be .5 to 1.6 Ohms. (Ohm readings depend on method used to check glow plug resistance.) If this reading is not obtained, check meter for correct settings, check for low or incorrect battery in meter, and check the meter ground wire to the engine.

If the vehicle is equipped with an electric cooling fan, record the resistance values with the cooling fan not running. Do not disconnect the cooling fan electrically.

The resistance values are dependent on the temperature in each cylinder, and therefore indicate the output of each cylinder.

STEP 10 If an Ohm reading on any cylinder is between .5 and 1.6 Ohms (Ohm readings obtained depend on the method used to check glow plug resistance), check to see if there is an engine mechanical problem. Make a compression check of the low reading cylinder and the cylinders which fire before and after the low cylinder reading. Correct the cause of the low compression before proceeding to the fuel system.

STEP 11 If the engine misfires erratically, install the glow plug luminosity probe that is included with the Diesel Timing Meter (J33300-100, J33075, or equivalent) into the cylinder with the lowest resistance reading. Observe the combustion light flashes. They will be erratic in time with the misfire that is felt. If it is not, move the probe to the next highest reading cylinder until the malfunctioning cylinder is found.

STEP 12 Examine the results of all cylinder glow plug resistance readings, looking for differences between cylinders. Normally, rough engines will have a difference of .4 Ohms or more between cylinders in firing order. It will be necessary to raise or lower the reading on one or more of these cylinders by selection of nozzles.

A nozzle with a tip leak can allow more fuel than normal into the cylinder, which will raise the glow plug Ohm reading. This will rob fuel from the next nozzle in the firing sequence and will result in that glow plug having a low Ohm reading. If this is encountered, it is advisable to remove and check the nozzle with a high reading. If it is leaking, it could be causing the rough idle. Plugged nozzle(s) will be indicated by low glow plug resistance readings.

Some glow plugs have been found which do not increase in resistance with heat. If you experience low readings on a glow plug and it does not change with nozzle change, then switch glow plugs between a good and bad cylinder. If the reading of each cylinder is not the same as before the switch, then the glow plug cannot be used for rough idle diagnosis, although it will function for starting the vehicle.

STEP 13 Remove the nozzles from the cylinders in which you wish to raise or lower the Ohm reading. Determine the pop off pressure of the nozzles as well as checking the nozzle for leakage and chatter. (Refer to Testing of Nozzles Section of Service Manual.)

- Install nozzles with a high pop off pressure to lower the Ohm reading, and nozzles with lower pop off pressure to raise an Ohm reading. Normally, a change of about 30 psi in pressure will change the reading by about .1 Ohm. Nozzles normally will drop off in pop off pressure with miles. Use nozzles from parts stock or a new vehicle. Use broken-in nozzles on a vehicle with 1500 or more miles, if possible.
- Whenever a nozzle is cleaned or replaced, before installing the injection pipe, crank the engine and watch for air bubbles at the nozzle inlet. If bubbles are present, clean or replace the nozzle.
- Install the injection pipe, restart engine, and check idle quality. If idle is still not acceptable, recheck glow plug resistance of each cylinder in firing order sequence. Record readings.
- Examine all glow plug resistance readings looking for differences of .4 Ohms or more between cylinders. It will be necessary to raise or lower the reading on one or more of these cylinders as previously done.
- After making additional nozzle changes again check idle quality. Normally, after completing two series of resistance checks and nozzle changes, idle quality can be restored to an acceptable level.

STEP 14 An injection pump change may be necessary if the following occurs:

A. If the problem cylinder moves from cylinder to cylinder as changes in nozzles are made.

B. If cylinder Ohm readings do not change when nozzles are changed.

— NOTE —

It is important to always recheck the cylinders at the same RPM. Sometimes the cylinder readings do not indicate that an improvement has been made although the engine may in fact idle better.

Rough Idle/Performance Diagnosis Conditions

— NOTE —

An intermittent miss at idle may not show up on the glow plug resistance test. To correct, first find the cylinder that is not firing by moving the timing meter glow plug probe cylinder to cylinder and observing the flash (wear safety glasses when watching the probe.) When the miss is located, remove the nozzle in that cylinder and the prior cylinder in the firing order. Use a lower opening pressure nozzle in the cylinder with the miss and/or a higher opening nozzle in the other cylinder. This will increase the fuel flow to the cylinder that has the miss.

M.P.G. Diagnosis Principles

The diesel, like any engine, is affected by driving habits. Speed is more critical on a diesel than a gas engine. On the highway, in the 50-75 mph range, the fuel economy will go down about 3 mpg for each 10 mph increase in speed. A gasoline engine will lose about 1½ mpg for each 10 mph increase in speed. This condition is perhaps the most significant factor in obtaining good fuel economy. Fuel economy may vary as much as 5 mpg in a given vehicle with different drivers. M.P.G. will increase with use of a steady foot, easy acceleration and light braking. Most drivers are unaware of their "jerky" driving habits. If the owner either traded in or still has a higher performance vehicle, it may be a case of driving the diesel excessively hard trying to match this performance, but at the same time reducing fuel economy.

The type and condition of a trade-in, if there was one, could be a clue to the owner's driving habits. Another indication which would be revealing would be a road test with the owner driving. Since most owners are unaware of their habits, it may be valuable to observe if the accelerator pedal is "pumped" excessively. Stop and go driving uses more fuel and hilly terrain will call for more accelerations, using more fuel.

Mechanical conditions of the vehicle, both engine related and non-engine related, also affect mpg. In diagnosing poor fuel economy complaints, first determine if other conditions such as excessive smoke or poor performance or unusual noises are also present.

NON-ENGINE RELATED CONDITIONS

Some non-engine related items which play an important part in the fuel economy process are:

- Tires and inflation pressure — snow tires, radial types included, will drop fuel mileage by nearly two miles per gallon. Standard inch size tires used in place of metric size tires can generate as high as a 6% error in speedometer readings.
- Speedometer error
- Axle ratio
- Transmission malfunctions
- Weather — cold weather and increased viscosity of all lubricants in the power train (especially wheel bearing grease), stiffer tires, and driving through snow, slush, and ice require more power with a corresponding decrease in mileage.

ENGINE-RELATED CONDITIONS

Some engine related items which should be understood are:

- Check pump timing.
- Engine compression — heat of compression is essential.
- Missing or improperly installed prechambers can result in poor combustion.
- Non-functioning glow plugs will result in poor combustion during engine warm-up.
- A plugged air cleaner element or restrictions in the air intake system will cause a richer running condition.
- Plugged exhaust.
- Worn camshaft or lifter will impair engine breathing.
- Thermostatic fan — If the viscous drive in the thermostatic fan fails or locks up, the fan will be forced to operate at constant engine speed and will produce a very significant drop in mileage. Malfunction is easily recognized by continuous roar from the engine cooling fan.

FUEL SYSTEM RELATED CONDITIONS

Some fuel related items are:

- Fuel type and quality — The heating value of No. 1 Diesel fuel is about 5% less than No. 2 diesel fuel. Gasoline mixed with diesel fuel will also reduce the heating value of the fuel and reduce fuel economy. Winterized blends usually fall somewhere between No. 1 and No. 2, depending on the blend, and consumption decreases commensurately.
- Fuel line leaks.
- Restricted fuel return line retards advance mechanism.
- Restricted fuel filter.
- Pump timing — During factory calibration the pump dynamic timing mark is placed within one quarter degree electronically. Retarding the pump will result in quieter operation with less smoke. Advancing the pump will be noisier with some increase in smoke. "Right on" timing is best for maximum economy.
- Automatic advance malfunction usually demonstrates poor idle or poor part load performance with smoke and low power at higher speeds.
- Nozzle fault — (many possibilities here) opening pressure below spec., valve lift incorrect, excessive seat leakage, sticking or stuck-open valve.

Fuel System Diagnosis

SYMPTOM	PUMP CONDITION – POSSIBLE CAUSE: No fuel delivery	Low fuel delivery	Excess fuel delivery	Erratic fuel delivery	Incorrect timing	Sticking advance piston
Engine cranks but will not start – cold	•	•			•	
Engine cranks but will not start – hot	•	•			•	
Engine starts but then stalls				•	•	
Rough operation at idle				•		•
Rough operation at all speeds				•		•
Low power and smoke		•		•		•
Low mileage						•
Engine speed fluctuates				•		
Engine knock				•	•	
Engine stalls	•					•
Engine stalls in panic stop					•	
Engine fails to shut off				•		
Smoke – white					•	•
Smoke – black			•			•

PUMP CONDITION	POSSIBLE CAUSE: Plugged return fitting	Cam ring in backwards	Pump seizure	Low housing pressure	High housing pressure	Advanced timing	Faulty advance mechanism	Failed fuel shutoff solenoid	Governor linkage stuck	Governor weight retainer ring	Advance piston sticking
No fuel delivery	•		•		•			•	•		
Low fuel delivery					•			•	•		•
Excess fuel/no shutoff								•	•		
Erratic fuel delivery		•				•			•	•	
Incorrect timing		•		•	•	•	•				•

Figure 7-4, General Diagnosis of Fuel System.

SYMPTOM	FUEL SYSTEM – POSSIBLE CAUSE: No fuel or wrong fuel	Fuel leak	Air leak	Faulty fuel pump	High fuel viscosity	Plugged return line	Clogged fuel filter	Clogged fuel tank strainer	Throttle linkage adjustment
Engine cranks but does not start – cold	•	•	•	•	•	•	•	•	
Engine cranks but does not start – hot	•	•	•	•	•	•	•	•	
Engine starts but then stalls	•			•	•	•	•	•	
Rough operation at idle			•	•		•			•
Rough operation at all speeds	•								
Low power and smoke	•								
Poor acceleration			•			•	•	•	
Low mileage		•							
Engine speed fluctuates			•						
Engine knock	•		•						
Engine stalls			•	•		•			
Engine stalls in panic stop									
Engine fails to shut off									
Smoke – black	•		•	•	•	•			

Figure 7-4A, Pump Diagnosis.

SYMPTOM \ POSSIBLE CAUSE (NOZZLE CONDITION)	No fuel delivery	Low fuel delivery	Excess fuel delivery	Erratic fuel delivery
Engine cranks but will not start – cold	●	●		
Engine cranks but will not start – hot	●	●		
Engine starts but then stalls				●
Rough operation at idle				●
Rough operation at all speeds				●
Low power and smoke		●		●
Low mileage			●	●
Smoke – black			●	

NOZZLE CONDITION \ POSSIBLE CAUSE (SYMPTOM)	Excess return fuel	Nozzle valve hanging up	Low opening pressure	High opening pressure	Clogged nozzle tip
No fuel delivery					●
Low fuel delivery	●			●	●
Excess fuel delivery		●	●		
Erratic fuel delivery		●			

Figure 7-4B, **Nozzle Diagnosis.**

Diagnosis of Fuel System Conditions

DIESEL ENGINE INTERMITTENT START

An intermittent no-start condition on some diesel engines could be due to an inoperative check valve in the engine fuel delivery (lift) pump. This condition could occur after the engine has been running, then stopped for a short time. Fuel could drain past the inoperative check valve back into the fuel tank. To correct this condition, replace the fuel delivery (lift) pump.

PLUGGED DIESEL FUEL FILTERS — ALL DIESELS

Condition: Plugged fuel filters. Stanadyne checks a percentage of fuel filters with a light petroleum product before leaving the factory. As a result, air will not pass through a wet filter element as easily as one that is dry. Therefore, blowing through the filter element with your mouth cannot be used as a criteria to determine if the element is plugged. Installation on the engine, or regulated air pressure of 2-3 PSI is the only way to determine if the filter is plugged.

HARD START IN COLD WEATHER — ALL DIESELS

A condition of hard start in cold weather can be caused by SAE 30 weight oil in a diesel engine. Change the oil using SAE 10W30 SF/CD.

— NOTE —

Do not use 10W40 oil.

6.2L DIESEL — HARD STARTING

Poor starting (good cranking speed but limited ignition) and excessive smoke after start up can be the result of a restricted fuel supply. This can be misdiagnosed as a glow plug system condition. This restriction most likely will be from a plugged fuel filter but can also be caused by a pinched or kinked fuel line. After the engine warms up, it generally will run satisfactorily. If the restriction gets progressively worse, top speed and performance will be affected also.

Even though the filters may have relatively few miles, purchase of dirty fuel can plug the filters in a short time. A check of the fuel lines for restrictions should also be made.

6.2L DIESEL INJECTION NOZZLE RETURN HOSE — 1982 C/K/P AND 1983 C/K/P/G WITH 6.2L DIESEL

Conditions may arise where the fuel return hose or nipple is disconnected from the fuel injection nozzle.

The purpose of the fuel hose is to return the fuel which leaks past the pintle in the injector nozzle, back to the fuel tank. This is a relatively small amount of fuel. Starting with the end cylinders on each side of the engine, the fuel passes through each succeeding nozzle. If a blockage occurs in this flow path, pressure will build up and result in a small fuel leak or the cap or hose becoming disconnected.

One cause of blockage is the leak-off nipple on the nozzle being plugged on the bottom end. During assembly of the nipple into the nozzle body, the epoxy sealant may have flowed over the hole in the nipple on the bottom end. If this happens, the return flow of fuel is restricted (Figure No. 7-5).

To determine if the hose or nipple fall off was caused by a blocked nozzle passage:

1. Remove the hoses from all nozzle nipples on the side of the engine involved.
2. Using a vacuum source, attach it to one nipple on a nozzle. If the nozzle nipple end is plugged, a vacuum reading will result. Check each nozzle.
3. Those nozzles that indicate a plugged or partially plugged opening will generate some reading on the vacuum scale.
4. To unplug a suspected plugged nipple insert a small drill bit into the nozzle nipple and turn by hand to break the epoxy covering.
5. Recheck with vacuum. If unable to break the epoxy barrier, the nozzle should be replaced.
6. Replace hoses and nipple.

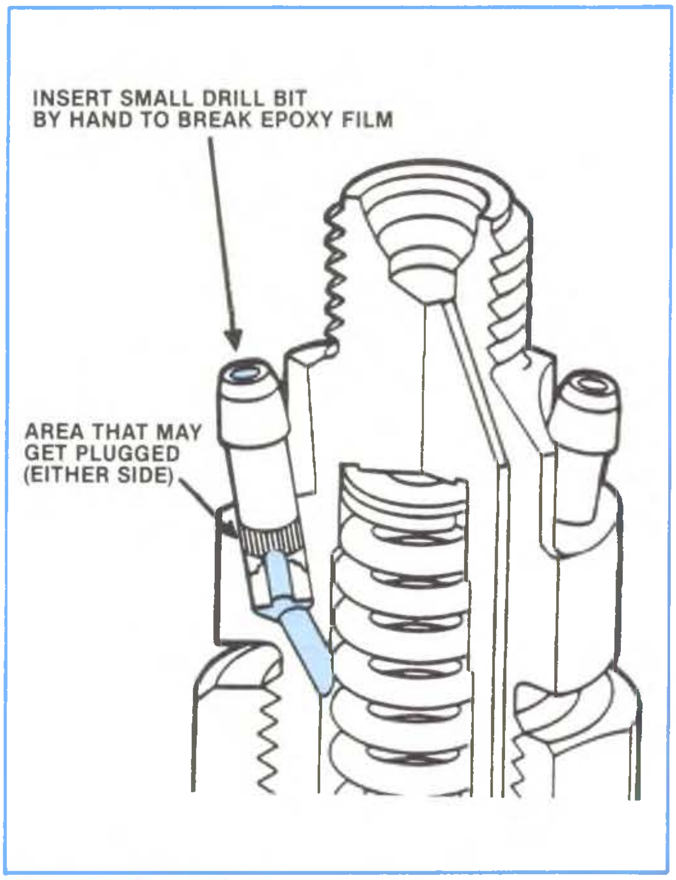


Figure 7-5, **Fuel Injection Nozzle.**

Brakes Diagnosis — Diesel Vehicles

NO POWER STEERING OR POWER BRAKES ON DIESEL ENGINE COLD STARTS

Diesel equipped trucks use the Hydro-Boost Brake System. In this system, the power steering pump provides the hydraulic fluid pressure to operate both the power brake booster and power steering gear. If hard steering and a lack of brake assist immediately after a cold start occur, make sure that the correct starting procedure is followed by the owner (starting procedure on sun visor above driver.) The fast idle solenoid must be extended prior to starting by depressing and releasing the accelerator pedal to obtain engine fast idle speed. This allows the power steering pump to build up the necessary fluid pressure to operate the power steering and brake systems immediately after start up. If you verify that the solenoid has extended and is holding the throttle open and the condition persists, check the fast idle speed as per the emission label. If this is correct, and the power steering pump belt is tight and not damaged, the cause may be in the power steering pump.

BRAKE ROUGHNESS FEEL — DIESEL VEHICLES

On cars equipped with a diesel engine, a brake roughness feel may be experienced, just before the car comes to a complete stop. This condition could be caused by a rough engine idle transmitting a pulsation through the transmission. To determine whether the rough idle is the cause of the complaint, shift the transmission into neutral while braking. If there is no brake roughness feel, refer to the Service Manual for procedures to correct the rough engine idle.

Diesel Engine Oil Leak Diagnosis

This section tells how to locate an oil leak, how to repair the leak and what sealer should be used.

The removal and installation procedures will not be covered in detail. Refer to the Service Manual for these procedures.

The only equipment needed to help locate any leaks is a spray can of foot powder.

The RTV sealer referred to in the book is room temperature vulcanizing sealer GE 1673 (22521437 or 1052915).

VENTILATION SYSTEM-CAUSED OIL LEAKS

The diesel engine is more subject to oil leaks than the gasoline engine because of no intake manifold vacuum in the diesel engine. With no vacuum, the crankcase pressure is higher in the diesel engine than in the gasoline engine.

The CDR valve in the ventilation system helps to reduce some of the pressure. It is very important that the ventilation system be free from any restriction.

OIL LEAKS FROM FRONT OF ENGINE

Wipe the front of the engine clean and spray foot powder over the entire area.

With the engine at operating temperature, let it idle for about 10 to 15 minutes or until a leak is evident.

OIL PAN

If leak is coming from the rear oil pan seal, remove the pan and install a new rear seal as shown in Figure 7-6.

- Examine the front cover for damage and correct as required.
- Apply GE1673 RTV sealer on top and bottom of seal and also to each end of seal where it contacts the cylinder block.
- Examine the side rails for damage. File off any spot weld dimples at the reinforcement at the end of the pan.
- Torque oil pan bolts, as follows:

  6mm = 6-14 N·m
  8mm = 18-27 N·m

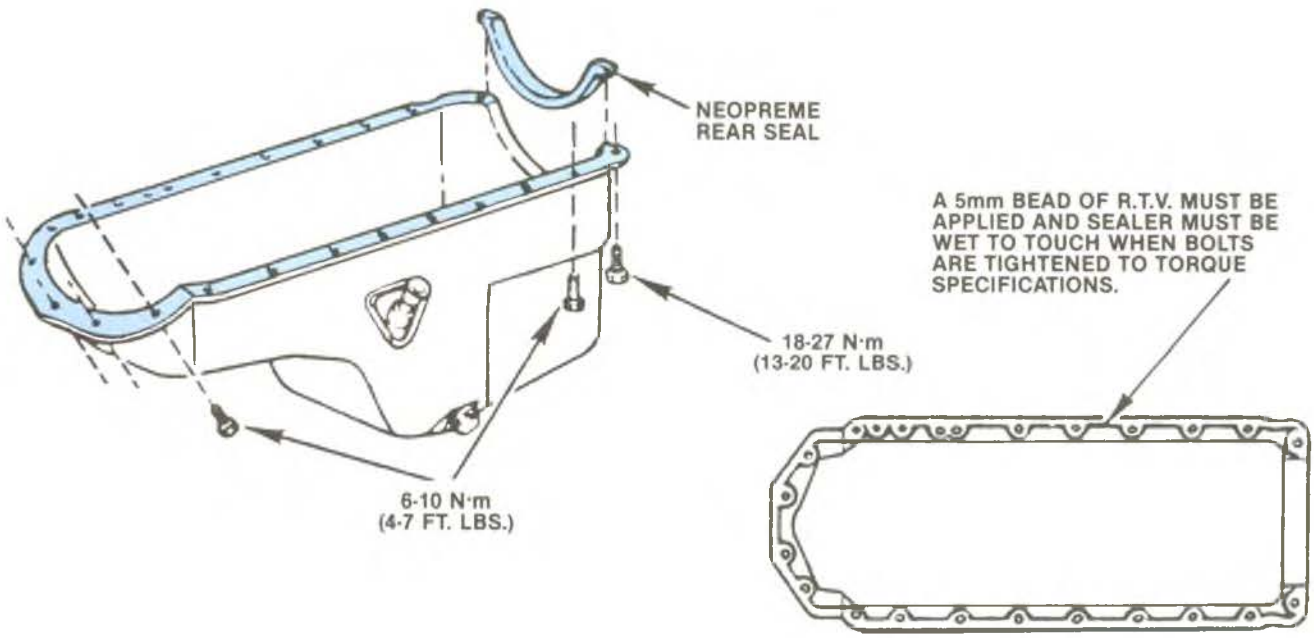


Figure 7-6, **Oil Pan Assembly.**

RTV Sealer And Gasket Eliminator

There are two (2) sealers used to seal the 6.2L engine. The first is RTV (Room Temperature Vulcanizing) which is used where a non-rigid part is assembled to a cast or rigid part such as rocker covers, oil pans, etc. The second is gasket eliminator, an anaerobic material (cures in the absence of air) which is used where two (2) rigid parts are assembled together, such as the front covers. When two (2) rigid parts are disassembled and no gasket or sealer is readily noticeable it is sealed with gasket eliminator.

When assembling parts, use the preferred material. Don't use RTV to seal together two rigid parts and don't use gasket eliminator on stamped parts such as rocker covers.

• **DIRECTIONS FOR USE OF RTV:**

1. When separating components sealed with RTV, use a rubber mallet and "bump" the part sideways to shear the RTV seal. "Bumping" should be done at bends or reinforced areas to prevent distortion of parts. RTV is weaker in shear (lateral) strength than in tensile (vertical) strength.

   Attempting to pry or pull components apart may result in damage to the part.
2. Surfaces to be resealed must be clean and dry. Remove all traces of oil and RTV. Clean with a chlorinated solvent such as carburetor spray cleaner. Don't use petroleum cleaners such as mineral spirits; they leave a film onto which RTV won't stick.
3. Cut the tube opening to approximately 1/8″ diameter.
4. Apply RTV to one of the clean surfaces. Circle all bolt holes. Use a 5mm bead.
5. Assemble while RTV is still wet (within 3 minutes). Don't wait for RTV to skin over.
6. Torque bolts to specs. Don't over torque.
7. RTV will skin over in 15 minutes sufficiently to allow for testing and limited operation of vehicle. Stop engine and allow RTV to cure for approximately 1 hour before placing vehicle in service.

Don't use RTV when extreme temperatures are expected, e.g. exhaust manifold, head gasket or where gasket eliminator is specified.

7. Diagnosis

— NOTE —

Higher temperature resistant compounds are visually red due to the addition of iron oxide.

- **DIRECTIONS FOR USE OF GASKET ELIMINATOR:**

1. Clean surfaces to be resealed with a chlorinated solvent to remove all oil, grease and old material.
2. Apply a continuous bead of gasket eliminator to one flange.
3. Spread bead evenly with your finger to get a uniform coating on the complete flange.
4. Assemble parts in the normal manner and torque to specs.
5. Vehicle can be operated after completion of assembly. No need to wait for gasket eliminator to cure.

— NOTE —

The useful shelf life of most RTV and gasket eliminator products is one (1) year.

Don't use gasket eliminator where RTV is recommended. The key to satisfaction with RTV and gasket eliminators is following the directions and using where specified.Don't cut the procedure short or a leak may result.

RTV's differ in performance.

For best results, use GM RTV or gasket eliminator from the following table:

GM RTV AND GASKET ELIMINATOR			
SEALANT TYPE	**WDDGM P/N**	**COLOR**	**SIZE AND CONTAINER TYPE**
RTV	1052734	Red	10 Ounce Cartridge
RTV	1052915	Black	10 Ounce Cartridge
RTV	1052751	Red	3 Ounce Tube
Gasket Eliminator (Anaerobic)	1052357	Orange	6 ml. Tube
Gasket Eliminator (Anaerobic)	1052756	Grape	6 ml. Tube

7. Diagnosis

Explanation of Abbreviations

A/T	Automatic Transmission
EGR	Exhaust Gas Recirculation (Valve)
EPR	Exhaust Pressure Regulation (Valve)
VRV	Vacuum Regulator Valve
TCC	Torque Converter Clutch
H.P.C.A.	Housing Pressure Cold Advance
TV	Throttle Valve

Procedure 1. Checking Cranking Speed

Cranking speed is extremely critical for a diesel to start, either hot or cold. Some tachometers are not accurate at cranking speed. An alternate method of checking cranking speed or determining the accuracy of a tachometer is to perform the following procedure:

1. Install a compression gauge into any cylinder. (One such gauge is Kent-Moore P/N J-26999-10.)
2. Disconnect the injection pump fuel shut off solenoid lead on the top of the injection pump or at the harness connector.
3. Install the digital tachometer to be checked.
4. Depress the pressure release valve on the compression gauge.
5. With the aid of an assistant, crank the engine for 2 or 3 seconds to allow the starter to reach full speed, then without stopping, count the number of "puffs" at the compression gauge that occur in the next 10 seconds. Multiply the number of "puffs" in the 10 second period by 12 and the resulting number will be the cranking speed in revolutions per minute (RPM).

   Example: 10 seconds = 1/6 of a minute
   1 puff = 2 RPM
   RPM = No. of puffs × 2 × 6 or
   RPM = No. of puffs × 12

Minimum cranking speed on the 6.2L diesel engine is 100 RPM cold and 180 RPM hot. The actual cranking speed needed will vary depending on the condition of the engine (compression) and nozzles.

Procedure 2.
Checking for Adequate Supply of Fuel to Injection Pump

• Open fold-out page, Figure 7-7, Gage Connections for Diagnosis Procedure.

STEP 1 CHECKING SUPPLY PRESSURE:

A. From fuel supply lift pump and fuel filter.

B. From fuel filter to injection pump.

A. Install a pressure, such as gage "**B**" or equivalent, between the lift pump and the fuel filter inlet. NOTE: This would be the secondary filter for 1982-83 models.

1. The pressure should be 5.5 to 6.5 PSI, if less go to step #2.

B. Install pressure gage "**B**" in series between the filter outlet and the fuel injection pump. NOTE: You will be checking the lift pump pressure drop across the filter. This tells if there is a filter restriction.

1. The pressure at idle should be a 2 PSI minimum and not drop below 1 PSI. If less go to step #2.

STEP 2 CHECK FOR RESTRICTION IN FUEL SUPPLY LINE (USING GAGE "C"):

A. Install pressure/vacuum gage in fuel supply line before supply pump as shown in using gage "**C**". On 1982-83 it can be installed at the primary filter outlet.

If engine is operable, start and check for a maximum vacuum in fuel supply line of 3 inches Hg at idle speed. If engine is not operable, disconnect fuel line from filter inlet, add an extension hose, and route to a metal container. Crank engine and check for a maximum vacuum in supply line of 3 inches Hg. Vacuum greater than 3 inches Hg. indicates a restriction such as a plugged fuel strainer in the fuel tank. If vacuum is less than 3 inches Hg., replace fuel filter element(s) and recheck supply pressure after fuel filter (Step 1). If pressure is still less than 2 PSI, go to Step #3.

STEP 3 PERFORM SUPPLY PUMP VOLUME CHECK:

Disconnect fuel line from filter inlet, add an extension hose and route to a graduated container that can hold at least one pint. Disconnect lead from electric shut off solenoid on top of pump and crank engine (or turn key to "**ON**" position if equipped with an electric supply pump) for 15 seconds. Fuel pump should supply a minimum of ½ pint. If less, replace supply pump and go back to Step #1.

Procedure 3.
Measuring Housing Pressure and Transfer Pressure

STEP 1 CHECKING HOUSING PRESSURE:

Remove the return line connector from the top of the pump (both the blackened and brass fittings). Examine the lower end of the regulator fitting where the glass ball seats for evidence of debris. If present, blow through the fitting with compressed air to eliminate the debris or replace the fitting.

Before reinstalling the fittings to the cover, turn the ignition key to the "ON" position and connect a jumper wire between the electric shut off solenoid terminal and the H.P.C.A. terminal. Make and break the connection to the H.RC.A. terminal and observe the H.P.C.A. solenoid plunger through the return fitting opening. It should move up and down as the current is applied and removed. If it does not function. repair or replace the solenoid as necessary.

STEP 2 MEASURE THE VOLTAGE AVAILABLE AT THE H.P.C.A. TERMINAL:

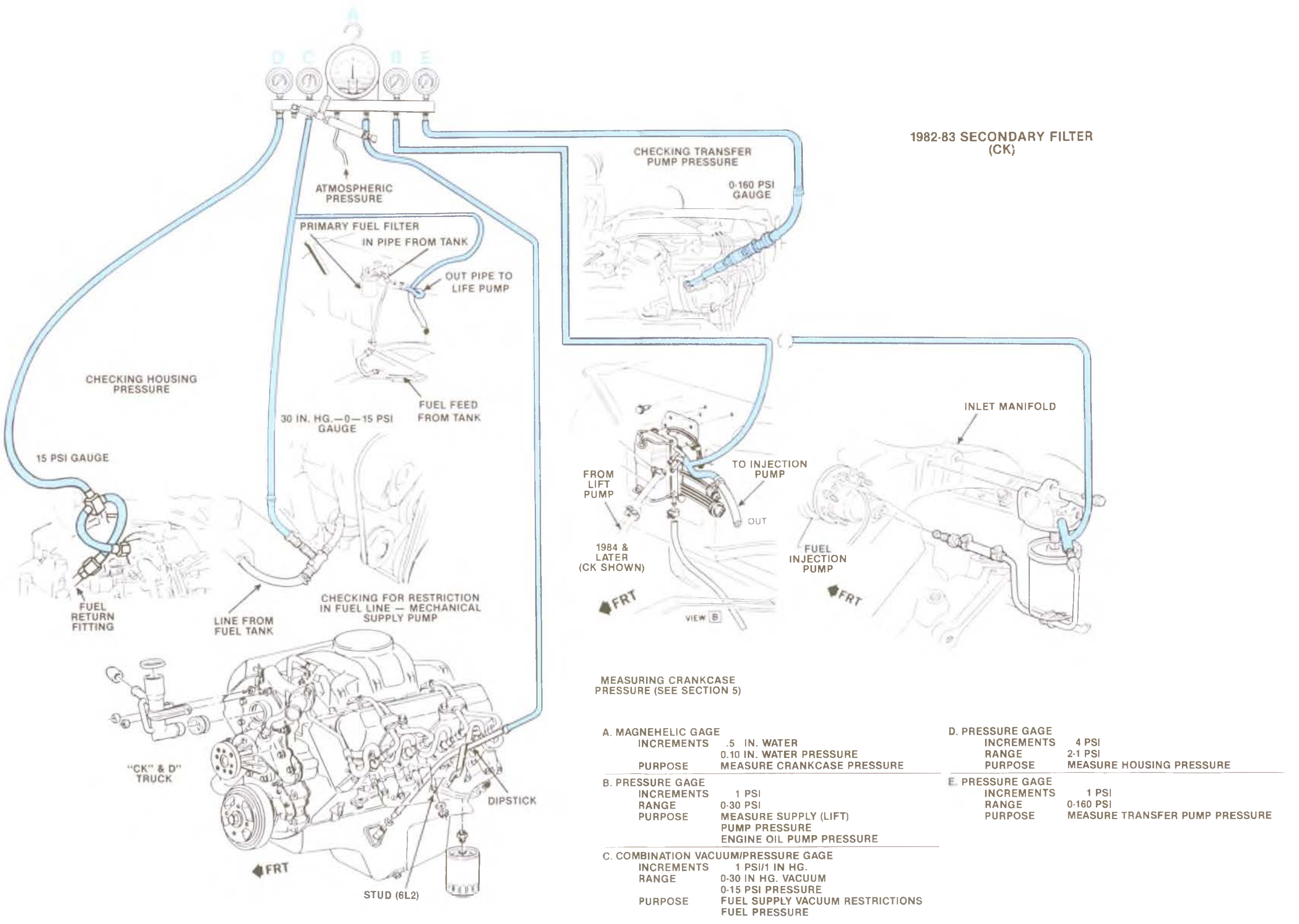
A. When the engine is cold <95°F, there should be 9 volts minimum at the H.P.C.A. terminal. If voltage is low check battery and charging system condition. If there is no voltage at terminal, check operation of temperature sensor located on right rear head. (See chassis service manual).

B. Install housing pressure gage adapter as shown using gage "**D**" or J34151. Reinstall return line connector and fuel return line, then connect pressure gage.

C. Start the engine, the housing pressure should be 8-12 PSI, WHH no more than 2 PSI fluctuation. If pressure is high check for restriction in fuel return system. If pressure is low or fluctuates excessively, replace return line connector fitting.

STEP 3 CHECKING TRANSFER PRESSURE:

Connect adapter and pressure gage as shown above. At cranking speed, transfer pump pressure should be 10 PSI minimum and housing pressure should be at least 2 PSI less than transfer pressure. At idle speed, transfer pressure should be 30 PSI minimum.



A. MAGNEHELIC GAGE

INCREMENTS	.5 IN. WATER
RANGE	0-10 IN. WATER PRESSURE
PURPOSE	MEASURE CRANKCASE PRESSURE

B. PRESSURE GAGE

INCREMENTS	1 PSI
RANGE	0-30 PSI
PURPOSE	MEASURE SUPPLY (LIFT) PUMP PRESSURE ENGINE OIL PUMP PRESSURE

C. COMBINATION VACUUM/PRESSURE GAGE

INCREMENTS	1 PSI/1 IN HG.
RANGE	0-30 IN HG. VACUUM 0-15 PSI PRESSURE
PURPOSE	FUEL SUPPLY VACUUM RESTRICTIONS FUEL PRESSURE

D. PRESSURE GAGE

INCREMENTS	4 PSI
RANGE	2-1 PSI
PURPOSE	MEASURE HOUSING PRESSURE

E. PRESSURE GAGE

INCREMENTS	1 PSI
RANGE	0-160 PSI
PURPOSE	MEASURE TRANSFER PUMP PRESSURE

Figure 7-7, Gage Connections for Diagnosis Procedure.

Procedure 4. Checking for Air Leaks

If stalling or rough operation only occurs after cold startup, check for fuel leaking backwards or air leaking into the fuel supply lines. Fuel leaking backwards may be caused by faulty check valves in supply pump. To check for this condition, remove return line connector fitting (ball check) from the top of pump and install a plain fitting in its place. Connect a section of clear hose approximately 3 feet long to the fitting and route to a container. Start engine and allow to idle. Stop engine. Suspend clear hose from hood of vehicle and mark fuel level in hose.

— NOTE —

Allow sufficient room in hose for level of fuel to rise due to thermal expansion. If level drops over a period of several hours (or sooner), a leak back condition is indicated.

Occasionally a very small air leak will only let enough air into the system to cause a stalling problem or rough running condition after the vehicle is shut down for many hours (such as overnight). Double check all fittings, clamps and fuel lines and do not overlook components after the supply pump such as the fuel filter element or base. There have been cases where tiny holes in the filter base casting or in the sealant used in the manufacture of the filter element have allowed air to enter but no external fuel leakage to occur.

Air Leak Diagnosis

AIR LEAK ON THE SUCTION SIDE

The housing vent wire may allow minute quantities of air to pass harmlessly out of the pump. However, at some point there will be more air than can go out the vent and the air will go into the charging circuit. This air will compress and upset fuel flow in the lines which will create a rough running engine. A plastic line placed on the fuel return fitting will show up this condition. To isolate the air leak, it may be necessary to feed the system out of a container and hook it up at various places to bypass certain sections of the fuel system.

AIR LEAK ON SUCTION OR RETURN SIDE

An air leak in either the suction or return side can cause starting problems. Air entering the system will allow fuel to drain back towards the tank. If an air leak occurring at some point like the filter, the fuel will drain back then the fuel on the return side will be heavier and it will pull fuel out of the filter through the pump and back towards the tank. Because there is no fuel in the filter or pump, the engine will not start. When it finally does, surging will be very evident.

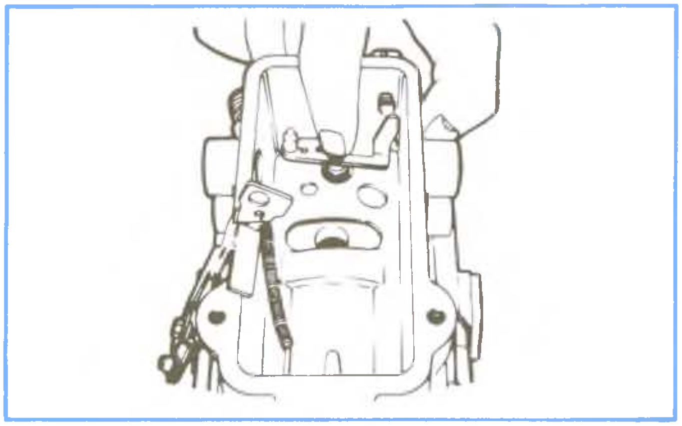


Figure 7-8

Procedure 5. Causes of Underrun or Stalling

1. Sticky Metering Valve Or Linkage

a. Check metering valve for freedom of rotational movement (Figure 7-8).

b. Check for twisted linkage hook spring.

c. Check for burrs on the metering valve arm in the area where the linkage hook rides.

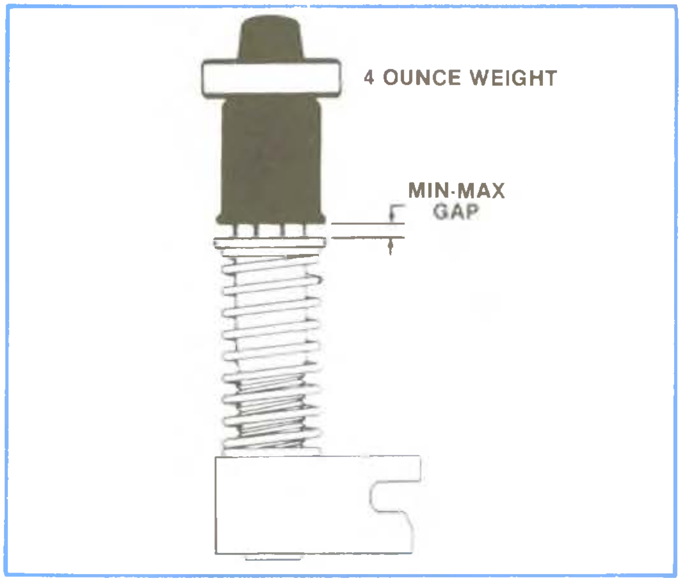


Figure 7-9

d. Check for excessive min-max gap on pumps equipped with internal low idle springs. (See Figure 7-9).

e. Check for binding condition between min-max governor block and throttle shaft by placing throttle lever in low idle position and moving governor block back and forth on guide stud. Governor assembly should move (jiggle) freely on guide stud.

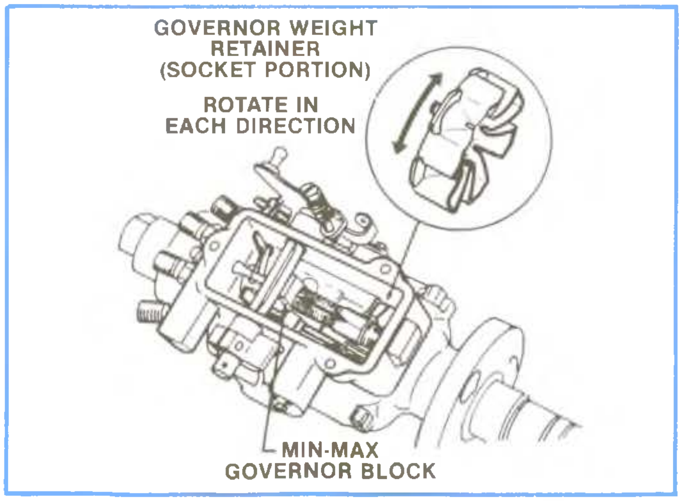
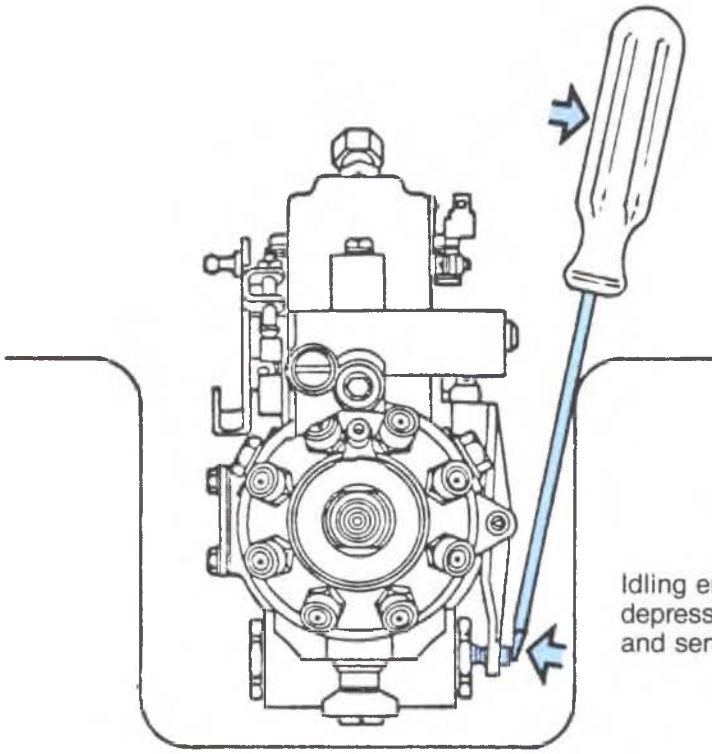


Figure 7-10

f. Check for failed flex ring by attempting to rotate the socket portion of the retainer by hand or with a screwdriver blade (Figure 7-10). If the retainer can be rotated more than 1/16th of an inch in either direction and doesn't return when pressure is released, then a failed flex ring is indicated. See Oldsmobile Dealer Technical Bulletin 80-T16 for instructions regarding flex ring replacement.

Procedure 6.
Checking For Sticky or Stuck Advance Mechanism
(Pumps equipped with mechanical light load advance)



Idling engine sound should change when lever is depressed. If it does not, pump should be removed and sent to an authorized agency for repairs.

Figure 1.

8. Glossary

ANALOG – Continuously variable electrical signal.

ATMOSPHERIC PRESSURE – The air pressure at sea level 14.696 or 14.7 P.S.I.

ATOMIZATION – The breaking up of the fuel into fine particles, so that it can be mixed with air.

BDC – Bottom Dead Center is the point of lowest piston travel in a stroke.

CAFE – Abbreviation for Corporate Average Fuel Economy. Part of the Energy Policy and Conservation Act of 1975. This law mandates GM's fleet mileage at 22 mpg for 1981. By 1985, it will climb to 27.5 mpg.

CALIBRATION –

1. **Balancing** – The setting of the delivery of several elements of an injection system or the setting of the rack pointer on a single unit pump in relation to predetermined positions of a quantity control member.
2. **Adjustment** – Fixing fuel delivery and speed adjustments to specified engine requirements.

CENTRIFUGAL FORCE – The inertial reaction by which a body tends to move away from the center about which it revolved.

CENTRIPETAL FORCE – A constant force acting continuously at right angles to the motion of a particle (body) which causes it to move in a circle at a constant speed.

CETON FILTER – A sock-type filter in the fuel tank capable of wicking diesel fuel but not water. This keeps water from the rest of the fuel system until the sock is 90% submerged in water.

CLOUD POINT – Temperature at which paraffin crystals in diesel fuel separate out of solution and solidify.

COMPRESSION IGNITION ENGINE – Internal combustion engine where the heat of compression ignites the fuel mixture. Diesels are, by definition, compression ignition engines.

CRACKING – Oil refining technique where heavier fractions of crude are subjected to heat and pressure and transformed into lighter fractions.

DELAY PERIOD – Initial phase of diesel combustion. It lasts from about 15° to about 5° before top dead center and is where the injected fuel warms up and begins to burn.

DI – Direct Injection diesel engine.

DIESEL – Engine that is powered by compressed fuel injection.

DIFFUSION – The mixing by thermal agitation of the molecules of two gases.

DISPERSANT – The act of dispersing or to scatter in various directions. A state of matter in which finely divided particles of one substance (the disperse phase) are suspended in another (the dispersion medium) substance.

DRIBBLE – Insufficiently atomized fuel issuing from the nozzle at or immediately following the end of main injection.

DURATION – The period of time during which anything lasts.

EGR – Exhaust Gas Recirculation system. First used in 1980 diesels to control the output of nitrous oxides. The 1980 system was an external type with exhaust being transmitted through hoses outside the engine. The 1981 system is an internal type with exhaust passages cast in the cylinder head and an air crossover comparable to a gas engine's EGR system. In the external type, the system operates at all times except during maximum speed. The internal type is regulated by degrees from full-on at idle to fully closed at maximum speed.

EMULSION –

1. A liquid mixture in which a fatty or resinous substance is suspended in minute globules.
2. The particles of one liquid finely dispersed in another.

FLAMMABILITY – The ability of a substance to catch fire or be combustible.

FLASH POINT – Of a liquid fuel is the temperature at which the fuel gives off sufficient flammable vapor to be ignited in the presence of a flame.

FRACTIONS – Lighter and heavier elements in crude oil. Lighter fractions, such as gas and liquefied gas, have relatively few carbon atoms in each molecule. Heavier fractions, such as wax and asphalt, have many carbon atoms on each molecule.

FUEL ADVANCE SYSTEM – Standard in 1981, this system advances fuel delivery during cold starts. It consists of a thermal-sensitive solenoid on the intake manifold which sends a signal to the HPCA terminal that opens a ball-check valve on top of the injection pump housing. With pump housing pressure reduced, the timing mechanism has less resistance to overcome and so operates earlier to advance fuel delivery 3°.

FUEL DISTRIBUTION – Section of injection pump that feeds fuel to each cylinder at the proper time.

FUEL INJECTION PUMPS (COMPONENTS)

INJECTION PUMP – The device which meters the fuel and delivers it under pressure to the nozzle and holder assembly.

UNIT PUMP – An injection pump containing no actuating mechanism to operate the pumping element or elements. It can be classified as "in-line", "distributor", "submerged", etc.

CAMSHAFT PUMP – An injection pump containing a camshaft to operate the pumping element or elements. It can be classified as "in-line", "distributor", "submerged", etc.

IN-LINE PUMP – An injection pump with two or more pumping elements arranged in line, each pumping element serving one engine cylinder only.

NOTE: A pump which has the elements arranged in line and in more than one bank, for instance, in two banks forming a "V", is a specific case of an in-line pump.

DISTRIBUTOR PUMP – An injection pump where each metered delivery is directed to the appropriate engine cylinder by a distributing device.

SUBMERGED PUMP – A pump with the mounting flange raised to limit pump projection above the mounting face.

CAMSHAFT PUMP MOUNTINGS –

1. **BASE MOUNTED** – A pump mounted on a surface of the engine which is parallel to the axis of the pump camshaft.
2. **CRADLE MOUNTED** – A special form of a "base mount" in which the base is contoured to permit rotation of the pump around the axis of the pump camshaft.
3. **FLANGE MOUNTED** – A pump mounted on a surface of the engine which is at a right angle to the axis of the pump camshaft.

INJECTION PUMP ASSEMBLY – A complete assembly consisting of the fuel pump proper, together with additional units such as governor, fuel supply pump, and additional optional devices, when these are assembled with the fuel injection pump to form a unit.

1. **RIGHT-HAND MOUNTED** – When the pump is mounted on the right-hand side of the engine commonly viewed from the engine flywheel end.
2. **LEFT-HAND MOUNTED** – When the pump is mounted on the left-hand side of the engine commonly viewed from the engine flywheel end.

PUMP ROTATION –

1. **CLOCKWISE** – The rotation of the pump camshaft or driveshaft is clockwise when viewed from the pump drive end.
2. **COUNTERCLOCKWISE** – The rotation of the pump camshaft or driveshaft is counterclockwise when viewed from the pump drive end.

PUMPING ELEMENT – The combination of parts in an injection pump by means of which the fuel is pressurized for injection.

PLUNGER AND BARREL ASSEMBLY (OR PLUNGER AND BUSHING ASSEMBLY) – The combination of a pump plunger and its barrel constituting a pumping element. The plunger and barrel assembly may also perform the additional functions of timing and metering.

PORT AND HELIX METERING – A system of metering fuel delivery by means of one or more helical cuts in the plunger and one or more ports in the barrel. Axial rotation of the plunger alters the effective portion of the stroke by changing the points at which the helices close and/or open the port or ports.

INLET METERING – A system of metering fuel delivery by controlling the amount of fuel entering the pumping chamber during the filling or charging portion of the pump's cycle.

SLEEVE METERING – A system of metering fuel delivery by incorporating a movable sleeve with which port opening and/or port closing is controlled.

PORT CLOSING – A term referring to the fuel injection pump of the port and helix or sleeve metering type in which timing is determined by the point of the closing of the port by the metering member, corresponding to the nominal start of pump delivery.

PORT OPENING – A term referring to a fuel injection pump of the port and helix or sleeve metering type in which timing is determined by the point of the opening of the port by the metering member, corresponding to the nominal end of pump delivery.

HYDRAULIC HEAD ASSEMBLY – The assembly containing the pumping, metering, and distributing elements (and may include the delivery valve) for distributor type pumps.

SPILL VALVE – A valve used to terminate injection at a controllable point on the pumping stroke by allowing fuel to escape from the pumping chamber.

INLET VALVE – A valve used to admit fuel to the pump barrel.

DELIVERY VALVE ASSEMBLY – A valve installed in a pump, interposed between the pumping chamber and outlet, to control residual line pressures and which may or may not have an unloading or retraction function.

DELIVERY VALVE HOLDER – A device which retains the delivery valve assembly within the pump.

FUEL PUMP HOUSING – The main casing into or to which are assembled all the components of the injection pump and it may accommodate the camshaft in the case of camshaft pumps; or the camshaft, or driveshaft in the case of distributor type pumps.

CONTROL RACK (CONTROL ROD) – The rack or rod by means of which the fuel delivery is regulated.

CONTROL PINION (CONTROL SLEEVE) – A collar engaging the plunger and having a segment of gear teeth, integral or attached, which mesh with the control rack. By this means, linear motion of the control rack is transformed into rotary movement of the plunger to regulate the amount of fuel delivered by the pump.

PLUNGER CONTROL ARM – A lever attached to a collar or sleeve engaging the plunger, or attached directly to the plunger, its other end engaging possibly adjustable fittings on the control rod. This transforms linear motion of the control rod to rotary motion of the plunger to regulate the amount of fuel delivered by the pump.

FUEL INJECTION TUBING – The tube connecting the injection pump to the nozzle holder assembly.

FUEL INJECTORS

FUEL INJECTOR – An assembly which receives a metered charge of fuel from another source at a relatively low pressure, then is actuated by an engine mechanism to inject the charge of fuel to the combustion chamber at high pressure and at the proper time.

UNIT FUEL INJECTOR – An assembly which receives fuel under supply pressure and is then actuated by an engine mechanism to meter and inject the charge of fuel to the combustion chamber at high pressure and at the proper time.

DELIVERY VALVE – A spring loaded valve which opens at some predetermined pressure to permit fuel flow from the injector plunger and bushing to the spray tip.

FUEL SOLENOID – Energizes the fuel metering valve whenever the ignition is switched "on".

GLOW PLUG – Used to heat pre-chamber before cold weather starting.

GOVERNORS (TYPES AND COMPONENTS)

MECHANICAL GOVERNOR – A speed sensitive device of the centrifugal type, which controls the injection pump delivery solely by mechanical means.

HYDRAULIC GOVERNOR – A mechanical governor having a hydraulic servo-booster to increase output force.

PNEUMATIC GOVERNOR –

1. **VACUUM OR SUCTION GOVERNOR** – One operated by a change in pressure created by the air actually consumed by the engine.
2. **AIR GOVERNOR** – One operated by air displaced by a device provided for this particular purpose and driven by the engine.

LOAD-SENSING GOVERNOR – An engine speed control device for use on engine-generator sets to control engine fuel settings as a function of electrical load to anticipate resulting changes in engine speed. It may or may not incorporate a mechanical speed-sensing device as well.

VARIABLE SPEED GOVERNOR – One of any of the above varieties which controls injection pump delivery throughout the speed range.

MAXIMUM-MINIMUM GOVERNOR – Any one of the above varieties which exerts control only at the upper and lower limits of the designed engine speed range, intermediate speeds being controlled by the operator setting the fuel delivery directly by throttle action.

OVERSPEED GOVERNOR – A mechanical speed-sensitive device that through mechanical or electrical action (operation of a switch) acts to shut down the engine and limit the speed by cutting off fuel and/or air supply should the engine speed exceed a preset maximum.

TAILSHAFT GOVERNOR – A mechanical speed-sensitive device commonly mounted on an engine driven torque converter to monitor its tailshaft speed. It is mechanically connected to the normal engine governor such that engine output will be governed to maintain a constant tailshaft speed regardless of torque load.

FULL LOAD STOP – A device which limits the maximum amount of fuel injected into the engine cylinders at the rated load and speed specified by the engine manufacturer.

TORQUE CONTROL – A device which modifies the maximum amount of fuel injected into the engine cylinders at speeds below rated speed to obtain the desired torque output.

EXCESS FUEL DEVICE – Any device provided for giving an increased fuel setting for starting only, generally designed to restore automatically action of the normal full load stop after starting.

ACCELERATION SMOKE LIMITER – A device which limits the smoke of a diesel engine during acceleration by temporarily limiting the amount of fuel injected into the engine cylinders during speed and/or load transients below the steady-state limit.

TIMING DEVICE – A device responsive to engine speed and/or load to control the timed relationship between injection cycle and engine cycle.

HELIX (SCROLL) – A term used to describe the control edge of a spill groove provided on the plunger, usually of helical form. The helices may be upper or lower or both and may be the same hand or opposite. They can also be duplicated on both sides of the plunger.

HELIX HAND – The hand of the helix in plungers is designated right or left, the same as a thread.

HELIX LEAD – The axial advance of the helix edge in one revolution.

HOMOGENEOUS – Having the same composition throughout the substance (well mixed).

HYDRO BOOST – Power brake system which operates on fluid from power brake pump.

HYDROCARBON – A complex mixture of hydrogen and carbon compounds.

IDI – Indirect Injection diesel engine.

IGNITION INJECTION – A small charge of fuel used to ignite the main gas charge in dual fuel engines.

IGNITION POINT (AUTO IGNITION) – This is a term applied to the event in which a combustible mixture under certain conditions of density, pressure and temperature ignites without a flame or spark.

INERTIA – A resistance to any change in the state of motion. It is Newton's First Law of Motion.

INJECTION – Method of forcing fuel into chamber when air is highly compressed by the piston.

INJECTION LAG – The time interval (usually expressed in degrees of crank angle) between the nominal start of injection pump delivery and the actual start of injection at the nozzle.

INJECTION NOZZLE (COMPONENTS)

NOZZLE AND HOLDER ASSEMBLY – The complete apparatus which injects the pressurized fuel into the combustion chamber.

NOZZLE – The assembly of parts employed to atomize and deliver fuel to the engine.

NOZZLE HOLDER ASSEMBLY – The assembly of all parts of the nozzle and holder assembly other than those comprised in the nozzle.

OPEN NOZZLE – A nozzle incorporating no valve.

CLOSED NOZZLE – A nozzle incorporating either a poppet valve or a needle valve, loaded in order to open at some predetermined pressure.

1. **POPPET NOZZLE** – A closed nozzle provided with an outward opening, spring-loaded, poppet valve.
2. **DIFFERENTIAL NOZZLE** – A closed nozzle provided with a spring-loaded needle valve.
3. **PINTLE NOZZLE** – A closed nozzle provided with a spring-loaded needle valve. The body of the nozzle has a single large orifice into which enters a projection from the lower end of the needle, this projection being so formed as to influence the rate and shape of the fuel spray.
4. **HOLE TYPE NOZZLE** – A closed nozzle provided with one or more orifices through which the fuel issues. Nozzles with more than one orifice are known as multihole nozzles.

NEEDLE VALVE (IN A CLOSED NOZZLE) – A needle valve has two diameters, the smaller at the valve seat. The fuel injection pressure acting on a portion of the total valve area lifts the valve at the predetermined pressure, then acts on the total area. The end opposite the valve seat is never subjected to injection pressure.

PINTLE VALVE (IN A CLOSED NOZZLE) – A special type of a "needle valve" wherein an integral projection from the lower end of the needle is so formed as to influence the rate and/or shape of the fuel spray during operation.

NOZZLE BODY – That part of the nozzle which serves as a guide for the valve and in which the actual spray openings may be formed. These two parts, the body and the valve, are considered as a unit for replacement purposes.

NOZZLE TIP – The extreme end of the nozzle body containing the spray holes (may be a separate part).

POPPET VALVE – An outwardly opening valve used with certain forms of closed nozzles.

NOZZLE HOLDER CAP – A cap nut or other type of closure which covers the outer end of the nozzle holder.

NOZZLE RETAINING NUT – The nozzle holder part which secures the nozzle or nozzle tip to the other nozzle holder parts.

SPINDLE – A spindle transmits the load from the spring to the valve.

PRESSURE ADJUSTING SCREW (SHIMS) – The screw (shims) by means of which the spring load on the nozzle valve is adjusted to obtain the prescribed opening pressures.

SPRING RETAINER – The spring retainer encloses the spring and carries the adjusting screw or shims.

NOZZLE HOLDER SHANK LENGTH – The distance from the top of the cylindrical shank to the seating face of the nozzle holder.

SEATING FACE – The face upon which the nozzle and holder assembly seats to make a gas tight seal with the cylinder head. Commonly, this face is on the nozzle retaining nut.

DIFFERENTIAL RATIO – The ratio between the guide diameter of the needle valve and the effective diameter of the needle valve seat.

SPRAY ORIFICE/ORIFICES – The opening or openings in the end of the nozzle or tip through which the fuel is sprayed into the cylinder.

SPRAY DISPERSAL ANGLE – The included angle of the cone of fuel leaving any single orifice in the nozzle or tip including pintle type.

SPRAY ANGLE – The included angle of the cone embracing the axes of the several spray holes of a multihole nozzle. In the case of nozzles for large engines, more than one spray angle may be needed to embrace all the sprays, for example, an inner and an outer spray angle.

SPRAY INCLINATION ANGLE – The angle which the axis of a cone of spray holes makes with the axis of the nozzle holder.

8. Glossary

SAC HOLE – The recess immediately within the nozzle tip and acting as a feeder to the spray hole(s) of a hole type nozzle.

DIFFERENTIAL ANGLE – The difference between the angles of the seat face of the valve and that of the seat in the body provided to insure its effective sealing.

LEAK-OFF – Fuel which escapes between the nozzle valve and its guide. (This term is also used to describe the leakage past the plunger of a fuel pump.)

NOZZLE OPENING PRESSURE – The pressure needed to unseat the nozzle valve.

PEAK INJECTION PRESSURE – The maximum fuel pressure attained during the injection period (not to be confused with opening pressure).

INJECTION TIMING – The matching of the pump timing mark, or the injector timing mechanism, to some index mark on an engine component, such that injection will occur at the proper time with reference to the engine cycle. Injection advance or retard is respectively an earlier, or later, injection pump delivery cycle in reference to the injection cycle.

IN-LINE FUEL HEATER – A 100-watt heater which is integral to the fuel line. This heat warms the fuel prior to the filter to keep paraffin crystals from stopping fuel flow. The heater warms the fuel by 20°.

INTERFACE – A surface forming the common boundary between two close spaces or substances.

LAMINAR FLAME SPEED – This is the speed at which a flame will burn through a quiet or still fuel-air mixture. A laminar flame burns as a flat flame sheet, as it moves through the mixture.

METERING – Method of controlling the amount of fuel injected on each power stroke.

MIN/MAX GOVERNOR – Controls idle speed and prevents overspeed.

MIN/MAX GOVERNOR KIT – A retro-fit assembly that desensitizes the governor to output variance between cylinders at idle.

MODULE – Electronic control unit that controls the glow plug system.

NOXES – Oxides of nitrogen (NO_X), a component of diesel exhaust.

NUMBER ONE DIESEL FUEL – Diesel fuel used in cold climates. Sometimes blended with #2 diesel fuel to increase #1's energy and #2's cold-weather performance.

NUMBER TWO DIESEL FUEL – Diesel fuel used in moderate climates.

ORIFICE – Restriction to control flow in a line (tube).

OXIDATION – The process of adding oxygen to a substance.

PARAFFIN –

1. A semi-transparent, waxy mixture of hydrocarbons, derived principally from the distillation of petroleum.
2. Any hydrocarbon of the methane series.

PARAFFIN HYDROCARBON – Petroleum-base fuels consist of hydrocarbons with varying molecular weights and atomic structure. The hydrocarbons represented in petroleum are, paraffins, olefins, diolefins, naphthene, and aromatics.

PARAFFINIC – Pertaining to or containing Paraffin.

PCV – Positive crankcase ventilation.

PEAK PRESSURE PERIOD – The phase of diesel combustion lasting from about 5° before top dead center to about 10° after top dead center. During this phase, the majority of diesel fuel burns.

PERPENDICULAR – A line which is at right angles to the horizontal plane.

PILOT INJECTION – A small initial charge of fuel delivered to the engine cylinder in advance of the main delivery of fuel.

POUR POINT – The temperature at which the fuel becomes too thick to flow or be pumped.

POUR POINT DEPRESSANT – Pour point depressants enable oil to flow or pour at low temperatures. Wax, present in all oils, forms a honey-comblike structure at low temperatures and restricts oil flow. Pour point depressants lower or depress the temperature at which this occurs and enable oil to pour more freely. They retard wax crystal growth.

PRECHAMBER – A precombustion chamber built into the cylinder head that creates turbulence in incoming air. Sometimes called a swirl chamber.

PROPAGATE – To spread through a mixture.

PUMPING LOSSES – Energy used as the engine creates a vacuum in the intake manifold.

RECIPROCATE – To move back and forth alternately, as in an engine piston.

RESIDUAL – Pertaining to what is left or remaining in a process, left over as a remainder.

RETRACTION VOLUME – The volume of fuel retracted from the high-pressure delivery line by action of the delivery valve's retraction piston in the process of the delivery valve returning to its seat following the end of injection.

RISING VOLUME PERIOD – The final combustion phase in diesels lasting from about 10° after top dead center to about 60° before bottom dead center. During this period, injection has stopped and the last few droplets of fuel burn.

ROTARY FUEL METERING VALVE – Regulates the flow of pressurized fuel into the charging chamber. It is directly controlled by the throttle linkage and is affected by the fuel solenoid and governor.

SECONDARY INJECTION – The fuel discharged from the nozzle as a result of a reopening of the nozzle valve after the main discharge.

SOCK – The fuel pickup strainer in the tank. It is made of saran, and water will not enter, until it becomes almost totally engulfed by water.

SPECIFIC HEAT – The capacity of any substance for absorbing heat.

SPONTANEOUS COMBUSTION – The oxidation of fuel rapidly enough, to generate sufficient internal heat to ignite it.

SPONTANEOUSLY – A self generated action resulting from something's own impulse.

STRATIFIED – To form or arrange in layers.

SUPPLY PUMP – A pump for transferring the fuel from the tank and delivering it to the injection pump.

T.D.C. – Top Dead Center is the point of highest piston travel in a stroke.

THERMAL EFFICIENCY – The thermal efficiency of a heat engine is that portion of the heat supplied to the engine which is turned into work.

THERMAL SWITCH – Bi-metal switch that contains four switches that control the glow plug system.

THERMODYNAMIC – The branch of physics dealing with heat, heat engines and other forms of energy.

TIMING ADVANCE CHAMBER – Part of the fuel injection pump; the timing advance chamber provides the proper timing of fuel injection for all operating conditions.

TRANSFER PUMP – Part of the fuel injection pump; boosts fuel pressure from 20 PSI to 130 PSI, depending on pump and engine speed.

VACUUM PUMP – Needed because vacuum can't be drawn from the unrestricted air manifold.

VISCOSITY – The viscosity of a liquid, is a measure of its internal resistance to flow or movement. It is a result of the molecular friction within the liquid. Thickness of oil; lower viscosity indicates a thinner oil.

NOTES

GM

Product Service Training

16015.05-1C

ASE CERTIFIED

WE SUPPORT
VOLUNTARY TECHNICIAN
CERTIFICATION THROUGH

National Institute for
AUTOMOTIVE
SERVICE
EXCELLENCE

JULY 198[illegible]
GENERAL MOTORS CORPORATION

LITHO IN USA