

G.M. COMPUTER CONTROLLED CATALYTIC CONVERTER SYSTEM C-4

NOTE — This system is used on some 1980 Federal and all 1980 California carbureted engines. It is also used on AMC models equipped with 151" 4-cylinder engines (California only).

DESCRIPTION

The Computer-Controlled Catalytic Converter (C-4) system closely controls air/fuel ratio through a feedback system from an oxygen sensor in the exhaust system. The major components of this system include an exhaust gas oxygen sensor, an electronic control module, a special electronically controlled air/fuel ratio carburetor and a three-way catalytic converter.

OPERATION

OXYGEN SENSOR

This unit is positioned in the exhaust pipe so it can sense exhaust gas composition as it comes from the engine. The sensor detects oxygen content in order to relay a signal to the Electronic Control Module. A special construction allows this sensor to react to oxygen levels by generating a voltage signal which is inversely proportionate to the amount of oxygen. If the oxygen content of the exhaust gas is high, the voltage signal created by the sensor is low. If the oxygen content is low (indicating a rich mixture), the voltage signal to the ECM is high.

To ensure proper functioning of the oxygen sensor, it must be replaced at regular intervals. On all models, replacement is re-

quired every 30,000 miles. A warning "flag" in the speedometer face will be activated at the appropriate time.

ELECTRONIC CONTROL MODULE (ECM)

The Electronic Control Module (ECM) reads the voltage signal from the oxygen sensor. In response, it sends a proportionate signal to the carburetor solenoid, which creates either a lean or rich mixture, as required. A high voltage signal from the oxygen sensor causes the ECM to send a similar signal to the carburetor solenoid to energize it. A leaner mixture results. The signal which is sent from the ECM to the carburetor solenoid is also modified by inputs from other engine sensors, which include vacuum switches, an engine coolant sensor and a throttle position sensor.

The ECM also contains a "memory" system which stores an average set of operating conditions with the ideal air/fuel ratio for those conditions. If any settings change from these stored conditions (as determined by engine sensors), the ECM will make necessary adjustments to bring engine back to the "ideal" set of conditions.

Before the ECM can begin governing the air/fuel ratio, it is important to note that a minimum of 10 seconds must have elapsed after startup before any C-4 operation begins, engine coolant temperature must be above 90°F, and the oxygen sensor must be sufficiently warm and putting out sufficient voltage before the ECM can react. During cold engine startup, the ECM is off-line and a fixed carburetor condition is maintained until proper warmup occurs.

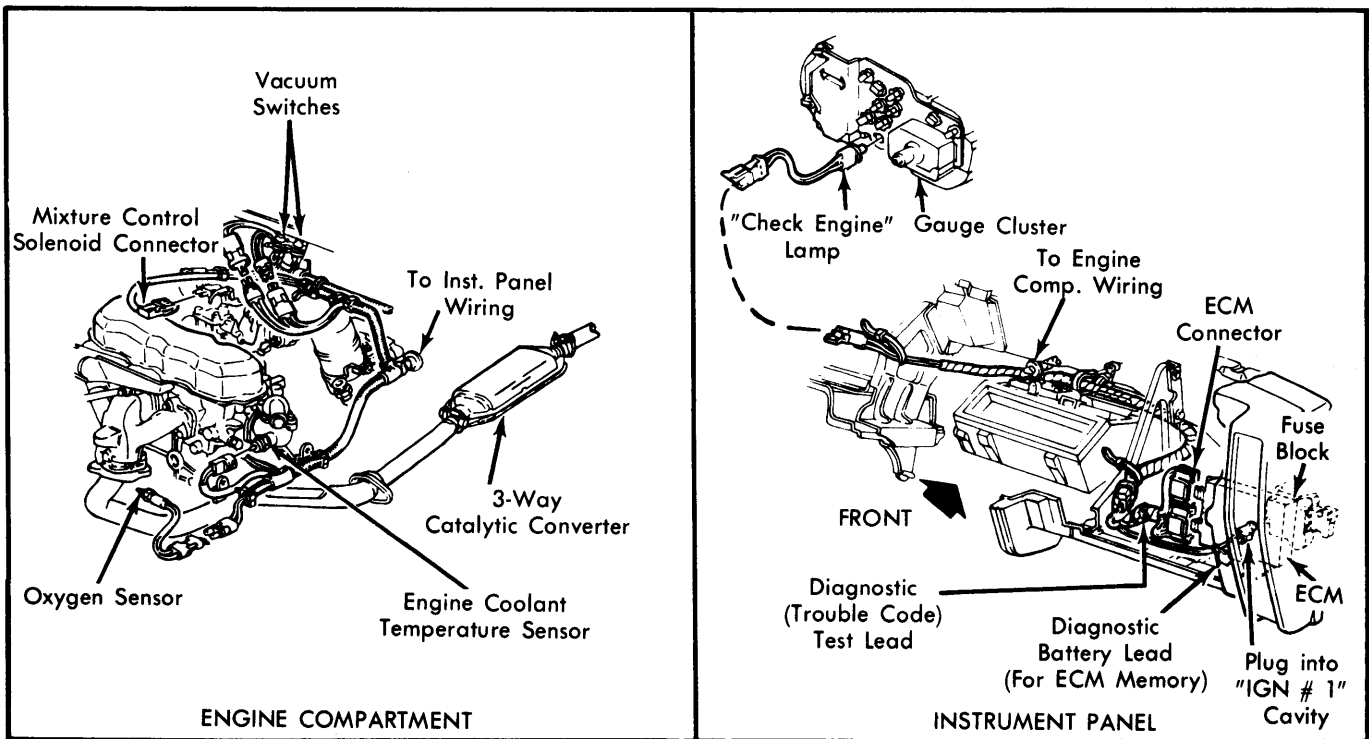


Fig. 1 Layout of Typical C-4 System Showing Engine and Instrument Panel Component Locations

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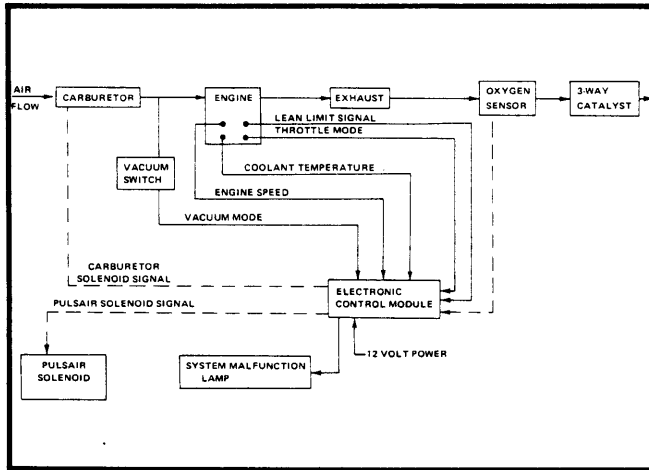


Fig. 2 Typical C-4 Flow Diagram Showing Operating Relationships

CARBURETORS

Carburetors used in conjunction with the C-4 system are designed with an electrically operated solenoid in the fuel bowl. In the Rochester E2ME, E4ME and E4MC carburetors this solenoid controls position of metering rods in main fuel jets. In the Rochester E2SE carburetor this solenoid provides a controlled restriction to the main metering system. This solenoid responds to impulses (cycles) generated from the ECM to make the mixture leaner or richer, as determined by the system of engine sensors and switches.

NOTE — For additional information, including adjustments and specifications, see appropriate carburetor article in FUEL SYSTEMS section of this manual.

CATALYTIC CONVERTER

Proper emission control is accomplished with the special catalytic converter used with this system. It is a 3-way converter; that is, it converts all three major pollutants (HC, CO and NO_x). In order for this catalytic converter to be effective, precise control of the oxygen content of gases entering the converter is necessary, thus the need for the oxygen sensor, ECM and special carburetor.

ENGINE SENSORS & SWITCHES

NOTE — Sensors and switches listed are not used on all engines. Refer to "Emission Control Application" section for exact usage.

Barometric Pressure Sensor (BARO) — The BARO sensor is mounted beneath instrument panel. This unit senses ambient or barometric pressures and signals the ECM on pressure changes due to altitude and weather.

Manifold Absolute Pressure Sensor (MAP) — The MAP sensor, mounted in engine compartment above right wheel well, monitors intake manifold pressure. It senses intake manifold pressure and sends signals to ECM which allows adjustment of system operation according to engine operating conditions.

Coolant Temperature Sensor (CTS) — The CTS senses engine coolant temperature and sends a proportionate signal to the ECM. It does not allow C-4 system operation (closed loop) while coolant temperature is below 90° F.

Lean Authority Switch (LAS) — The LAS monitors heated inlet air through the air cleaner thermal vacuum switch to prevent a too lean mixture during cold engine operation.

Throttle Position Sensor (TPS) — The TPS is used to signal ECM of throttle position changes as they occur. When throttle position changes, a tang on accelerator pump lever moves TPS plunger. This signals ECM to hold last known air/fuel ratio to aid in throttle response. It also signals ECM of various part throttle positions and of idle position.

Wide Open Throttle Switch (WOT) — This switch is used to detect full throttle condition. When activated, a signal from the WOT to ECM sets a temporary full rich mixture until throttle moves off wide open position. At which time the C-4 system returns to pre-WOT operating conditions. This switch is closed at wide open throttle and opens with 5 in. Hg or more of ported vacuum.

Closed Throttle Switch (CTS) — This switch detects closed or part throttle conditions and sends appropriate signal to ECM. This switch is used in conjunction with WOT in most cases. This switch is normally closed until 12 in. Hg or more manifold vacuum is present.

NOTE — In some cases the BARO and MAP sensors are used to perform the functions of the CTS and WOT switches.

MAINTENANCE

OXYGEN SENSOR REPLACEMENT

Every 30,000 miles (15,000 miles for Cadillac), a maintenance reminder "flag" appears in the speedometer face, indicating need for oxygen sensor replacement. Replace sensor as follows:

Removal — Disconnect sensor electrical connector and spray sensor threads with suitable heat riser valve lube. Allow to soak at least 5 minutes, then carefully back out oxygen sensor.

Installation — Coat threads of new oxygen sensor with anti-seize compound and carefully install. Tighten to 30 ft. lbs. Reconnect electrical lead. Reset flag.

MAINTENANCE REMINDER FLAG RESET

Cadillac — Remove lower steering column cover. Sensor reset cable is located to the left of speedometer cluster. Pull cable lightly (maximum 2 lbs. force). Reinstall lower steering column cover.

All Except Cadillac — Remove instrument panel trim plate. Remove instrument cluster lens. Using pointed tool apply light downward pressure on notches of flag until it is reset. An alignment mark will appear in left center of odometer window when flag is reset.

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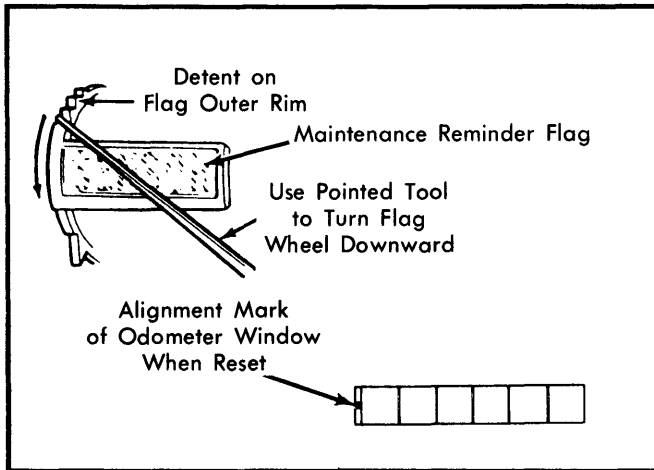


Fig. 3 Resetting Maintenance Reminder Flag (All Except Cadillac)

TESTING & DIAGNOSIS

C-4 DIAGNOSTICS

The C-4 system may be suspected when engine performance, fuel economy or exhaust emissions are improper. A built-in diagnostic system is likely to activate if a problem occurs in the system (however, there is the possibility of this not happening). If the C-4 system contains a problem, a "CHECK ENGINE" warning light will be activated on the instrument panel. If, however, the warning light is not activated, the following items should be checked before inspecting the C-4 system further:

- Ignition system (dist., timing, plugs, etc.)
- Air cleaner system
- Fuel evaporation system
- Early fuel evaporation system
- PCV system
- EGR valve
- Engine compression
- Intake manifold
- Vacuum hoses
- Carburetor mounting bolts

WARNING LIGHT CHECK

1) To test warning light and be sure the diagnostic system is operating, turn off the ignition switch, leave engine stopped and ground trouble code test lead located beneath dash (black/white wire with green connector, attached to ECM harness).

2) If the system is operating properly, the "CHECK ENGINE" light will flash a code "12", which indicates proper operation. The "12" will be flashed as follows: one flash, followed by a pause, and then two more flashes. After a longer pause, the code will repeat two more times.

NOTE — If fault is intermittent, "CHECK ENGINE" light may come on and then go out; however, fault problem will be stored in ECM memory so diagnosis can be performed.

C-4 SYSTEM DIAGNOSTIC TROUBLE CODES

Trouble Code	Explanation
12	No tach or reference signal to ECM.
13	Oxygen sensor circuit.
13 & 14	At same time, refer to code 43
14	Shorted coolant sensor circuit.
15	Open coolant sensor circuit.
21	Shorted wide open throttle circuit (if used). Throttle position sensor circuit.
22	Grounded closed throttle or wide open throttle switch circuit.
21 & 22	At same time, grounded wide open throttle circuit switch.
23	Open or grounded carburetor solenoid circuit.
32	Barometric pressure sensor output low.
32 & 55	At same time, grounded +8V, V (REF) or faulty ECM.
34	Manifold absolute pressure sensor output high.
43	Throttle position sensor adjustment.
44	Lean oxygen sensor.
45	Rich oxygen sensor.
44 & 45	At same time, faulty oxygen sensor or open sensor.
51	Faulty calibration (PROM) unit or improper PROM installation.
52 & 53	"CHECK ENGINE" light off — intermittent ECM problem, "CHECK ENGINE" light on — faulty ECM.
54	Faulty carburetor solenoid and/or ECM.
55	Faulty oxygen sensor, open manifold absolute pressure sensor or ECM (3.8L V6), faulty ECM or throttle position sensor (exc. 3.8L V6).

TROUBLE CODES

C-4 diagnostic system is programmed to flash a series of codes through the "CHECK ENGINE" light. After light becomes activated by the system, it is necessary to ground a Trouble Code test lead, with engine running, so system can flash proper Trouble Code. See Fig. 5 for location of Trouble Code test leads.

When "CHECK ENGINE" light comes on, trouble in C-4 system is indicated. A series of codes are programmed to assist in diagnosis and correction of the problem. See "C-4 System Diagnostic Trouble Codes" table for explanation of codes.

Codes are flashed by "CHECK ENGINE" light after the trouble code test lead is grounded. Codes will be flashed as follows: light will flash 1, 2, 4 or 5 times to indicate first number of code; then, it will flash (after a short pause) 1, 2, 3, 4 or 5 more times to indicate second number of code. After a long pause, signal will repeat itself two more times.

FOR EXAMPLE — With Trouble Code lead grounded and engine running, if problem is a Shorted Coolant Sensor Circuit, Code 14, light will flash one time, pause, then flash four times. A long pause, then repeat one-and-four flashes, a long pause and repeat again.

If more than one trouble spot is detected, one code series will flash, then the other code series will flash.

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SYSTEM PERFORMANCE CHECK

Since it is not possible to store a code for every possible problem, one may develop in which the "CHECK ENGINE" light does NOT come on. If C-4 system is suspected, make a System Performance Check, using a dwell meter, ohmmeter, test light, voltmeter, tachometer, vacuum gauge and jumper wires. Refer to "System Performance Check" chart later in this article.

Connecting Dwell Meter – Set "6 Cylinder" position and connect meter to a lead from the mixture control solenoid. On normally operating engine, dwell at both idle and part throttle will fluctuate between 10-50°. This is the "closed loop" system, meaning the dwell is varying due to reaction from the oxygen sensor through the ECM. At wide open throttle or cold engine, dwell will be fixed (needle steady). This is the "open loop", since oxygen sensor has no effect on the dwell.

CAUTION – When attaching dwell meter, do not allow lead to touch ground. This includes hoses, since they are conductive.

DIAGNOSTIC MEMORY

C-4 system is designed with a short-term memory. It will store a trouble code as long as the ignition switch is on. When it is turned off, the memory will be erased. To remember intermittent problems, and because some trouble codes do not register for 5-18 minutes after engine warmup, a long-term memory is sometimes needed. To create a long-term memory, connect the orange terminal lead "S" ("R" on 3.8L V6) of the ECM to fuse block cavity marked "GAUGES".

NOTE – Some 1980 vehicles are equipped with a full-time long term memory. To erase memory on these, after repairs are completed, disconnect ECM terminal "S" ("R" on 3.8L V6) and reconnect to briefly interrupt power supply to memory.

DIAGNOSTIC PROCEDURES

Follow the sequence given in the following "Diagnostic Charts" until proper problem identification and correction can be made. Refer to appropriate wiring diagrams in this article and other illustrations to assist in diagnosis.

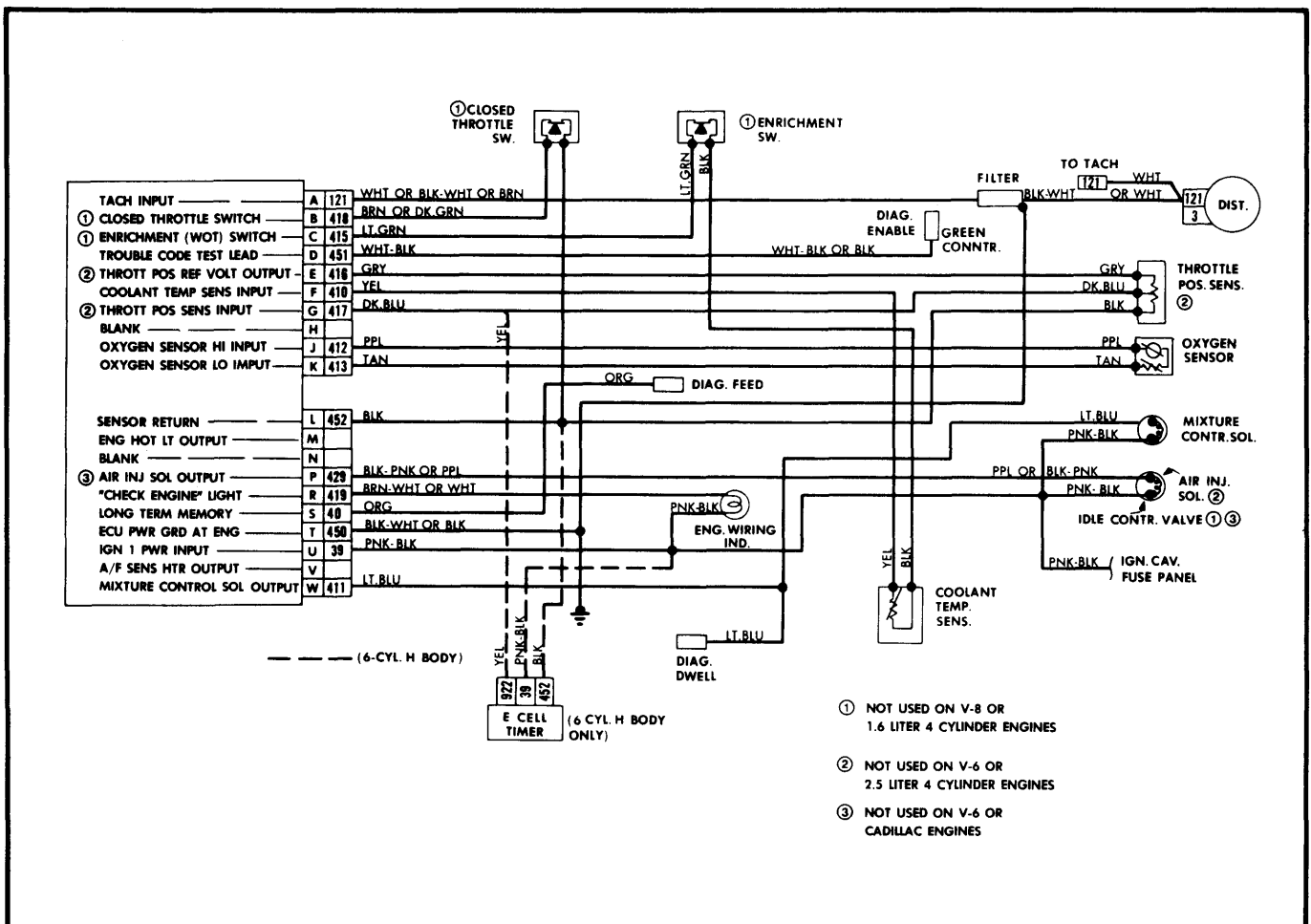


Fig. 4 C-4 Wiring Diagram for 1980 4-Cyl., V-6 ("H" Body) and V8 Models

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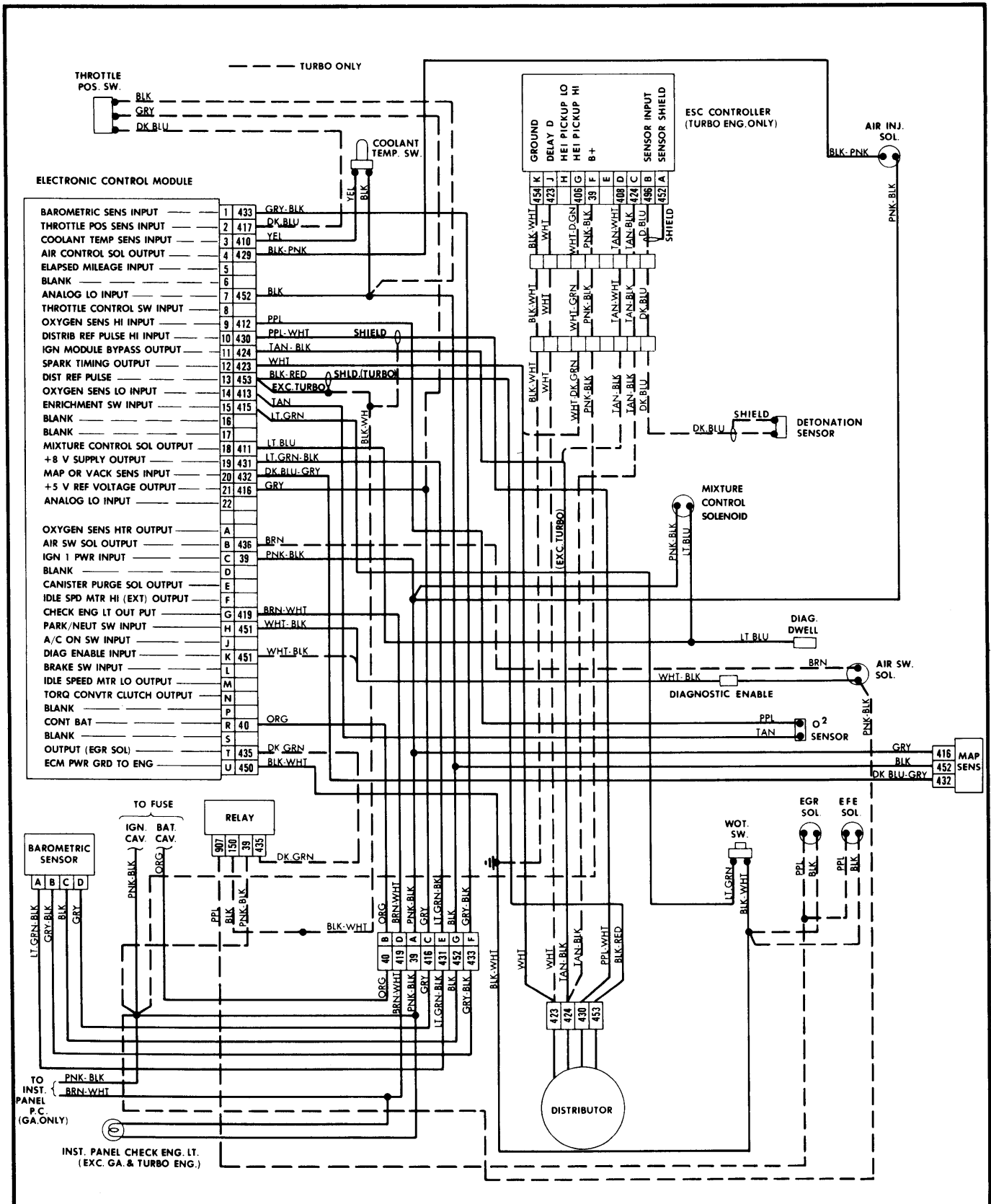
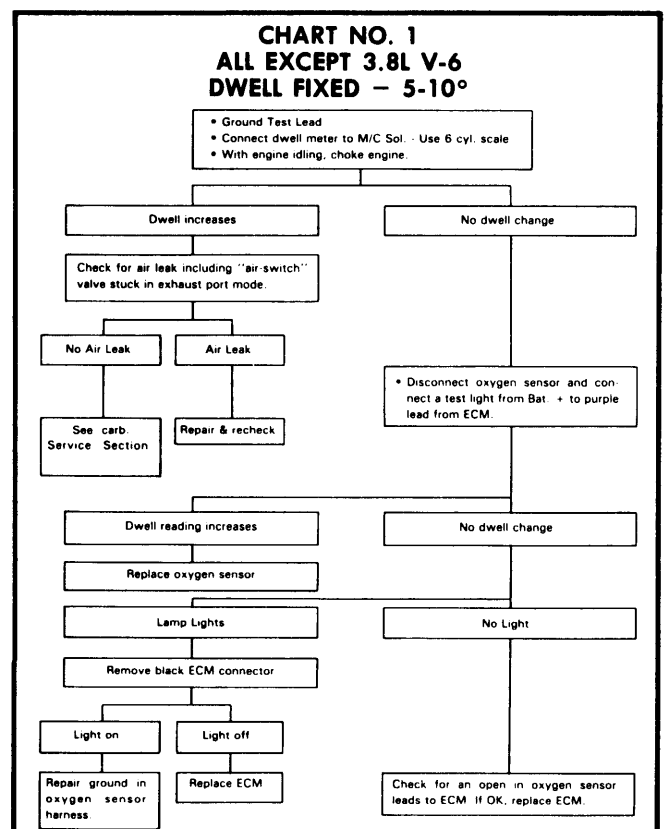
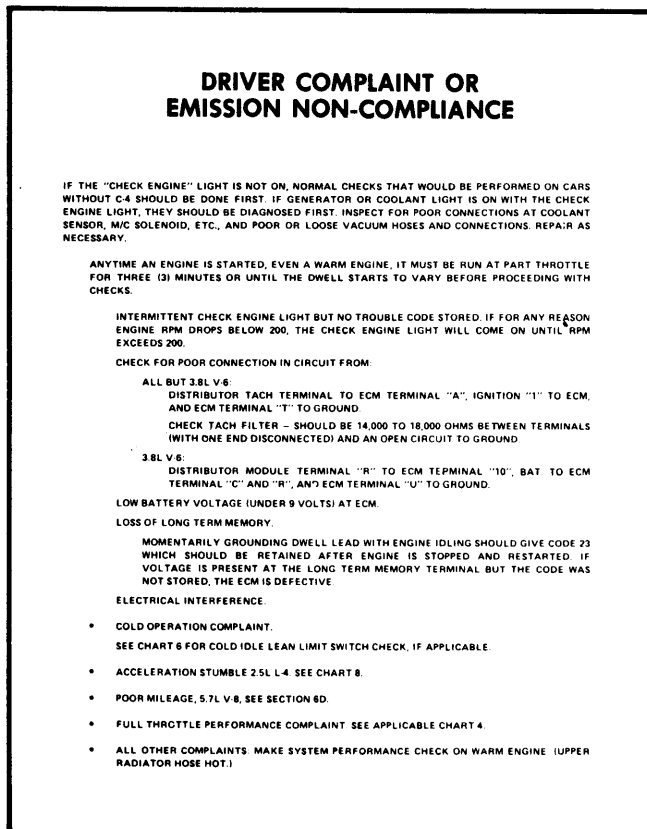
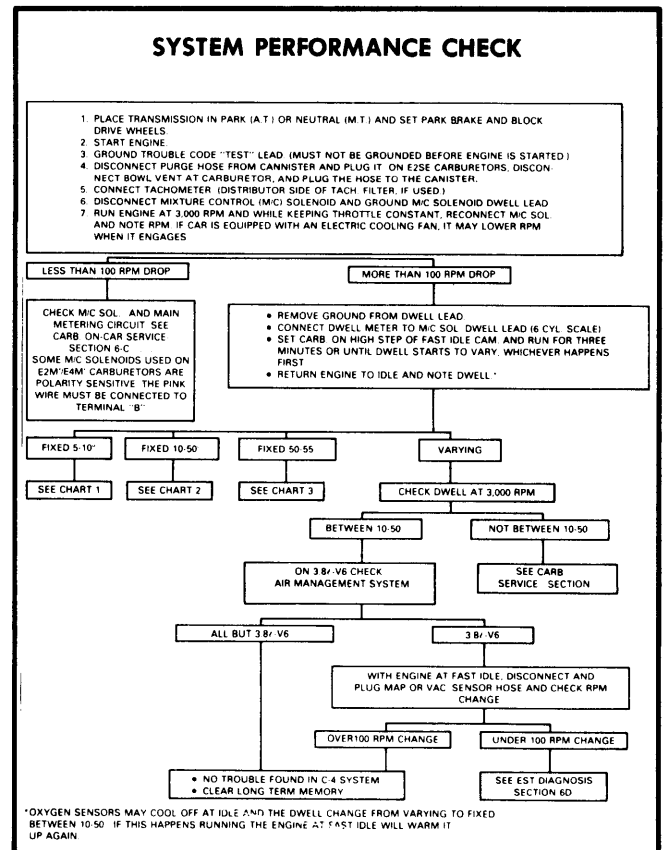
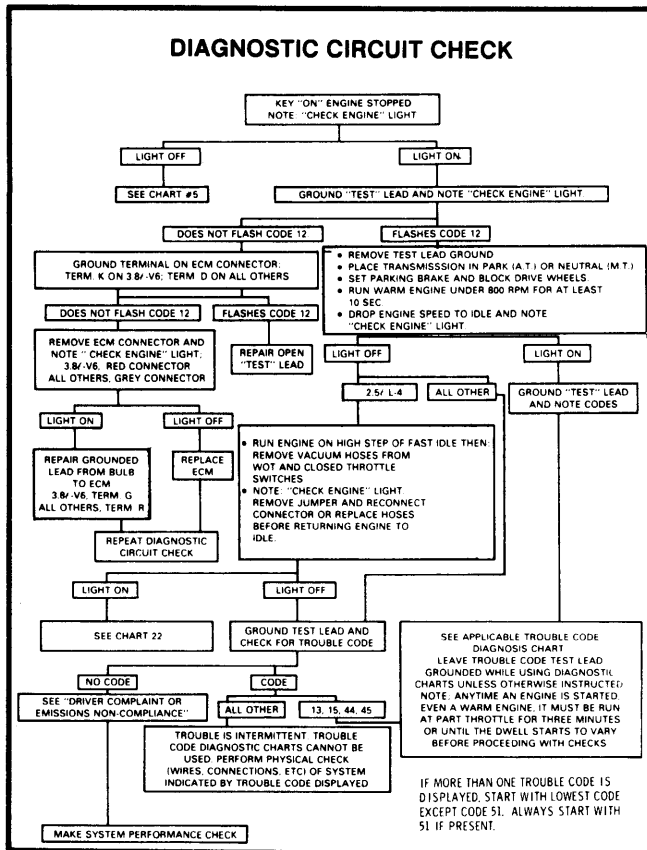
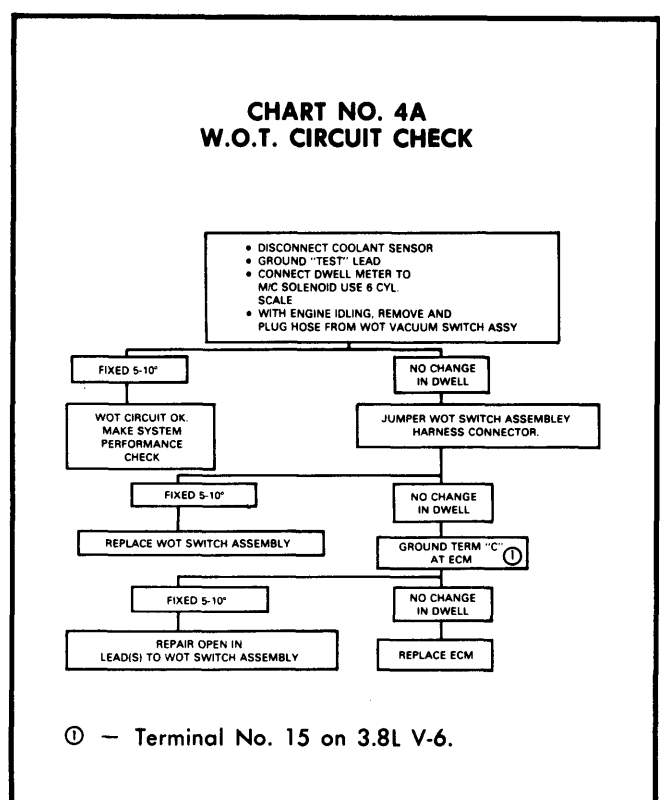
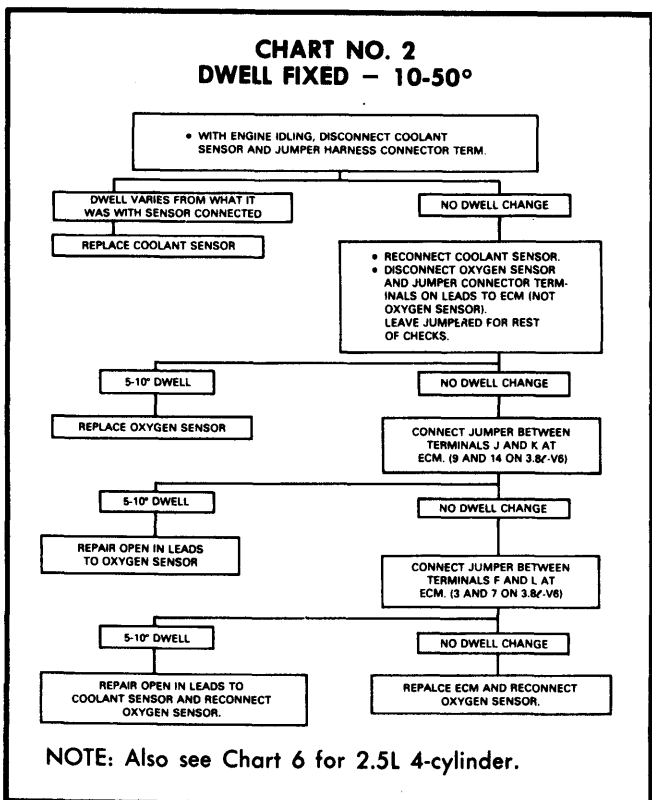
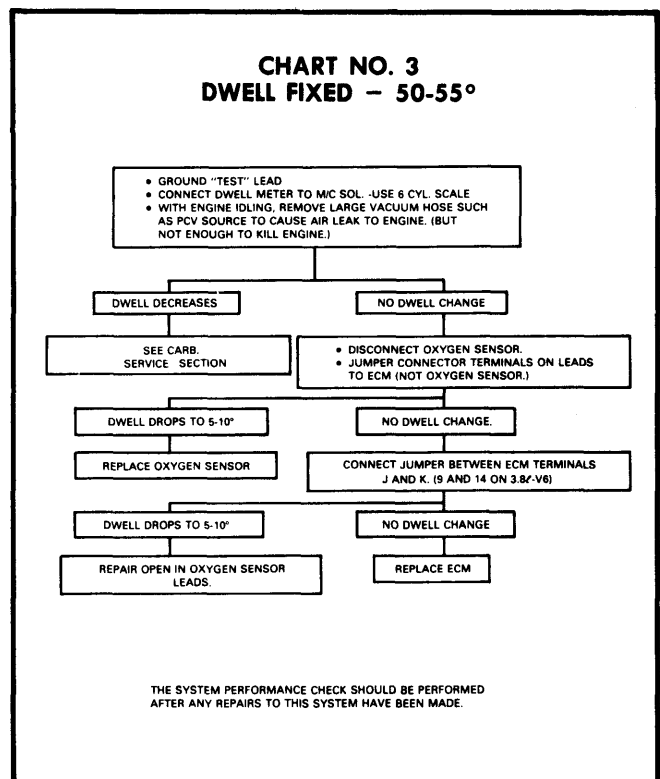
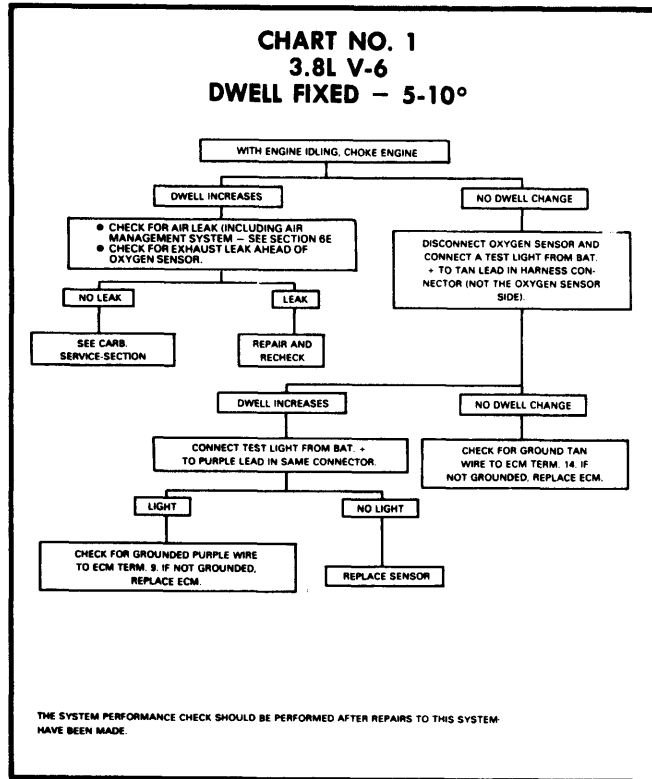


Fig. 5 C-4 Wiring Diagram for 1980 V-6 Models - Except "H" Body

G.M. COMPUTER CONTROLLED CATALYTIC CONVERTER SYSTEM C-4 (Cont.)

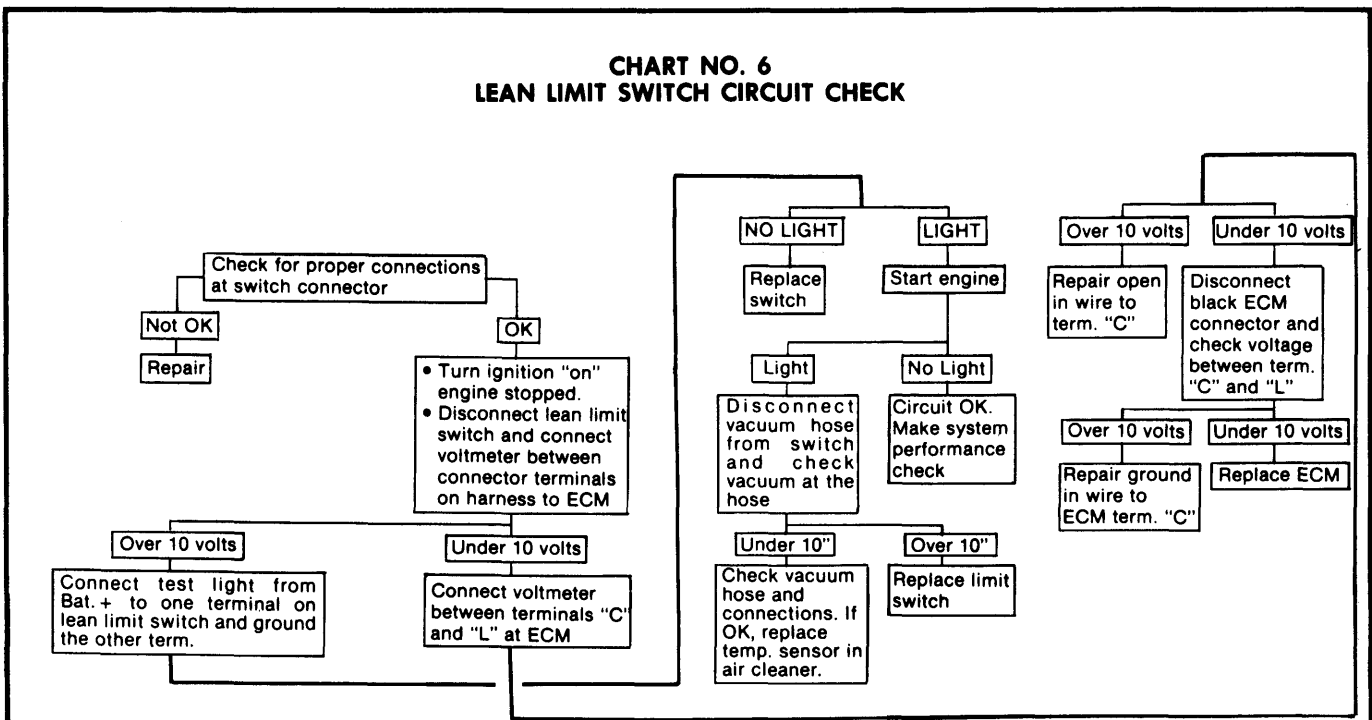
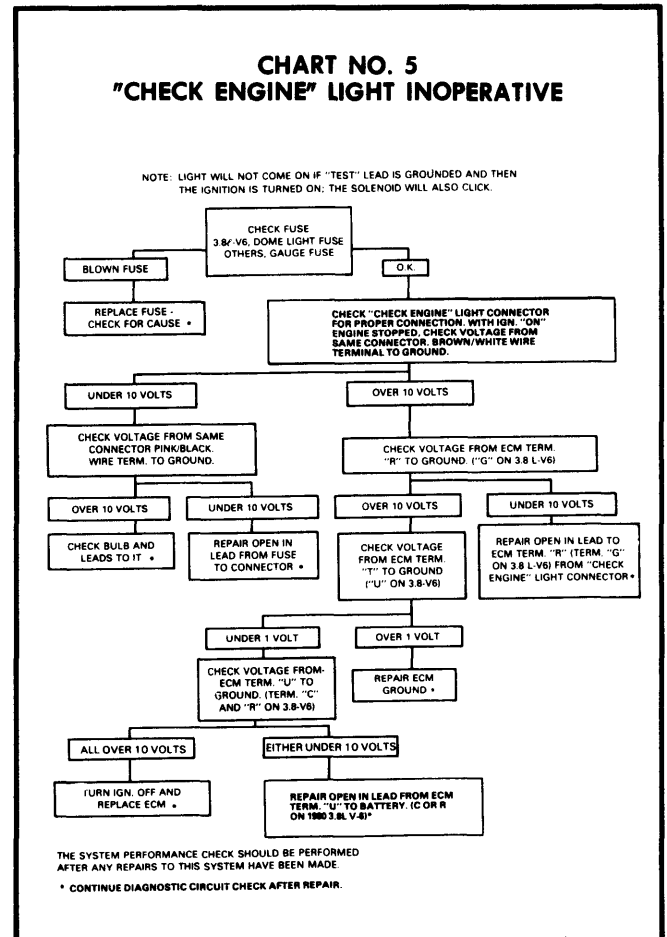
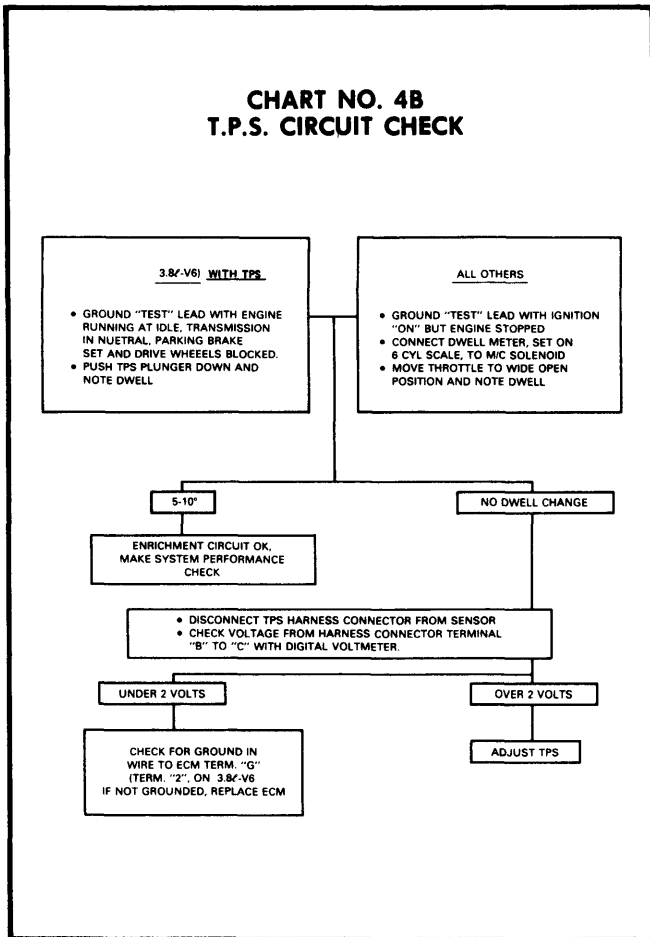


G.M. COMPUTER CONTROLLED CATALYTIC CONVERTER SYSTEM C-4 (Cont.)

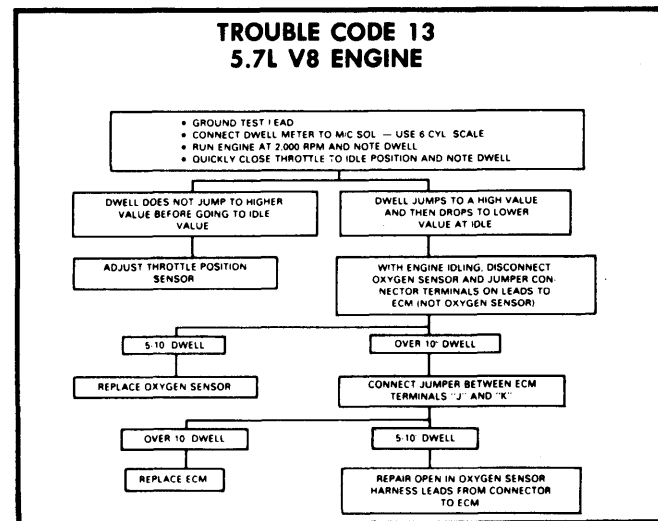
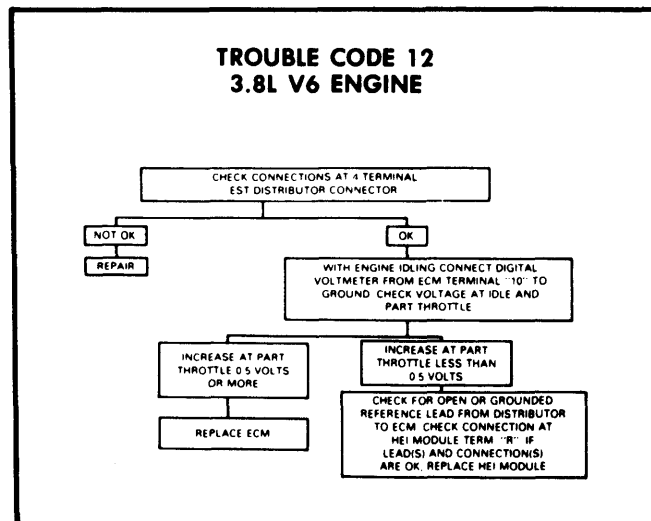
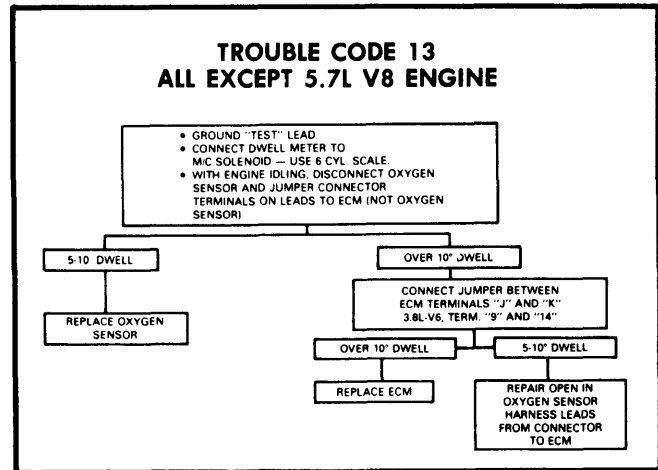
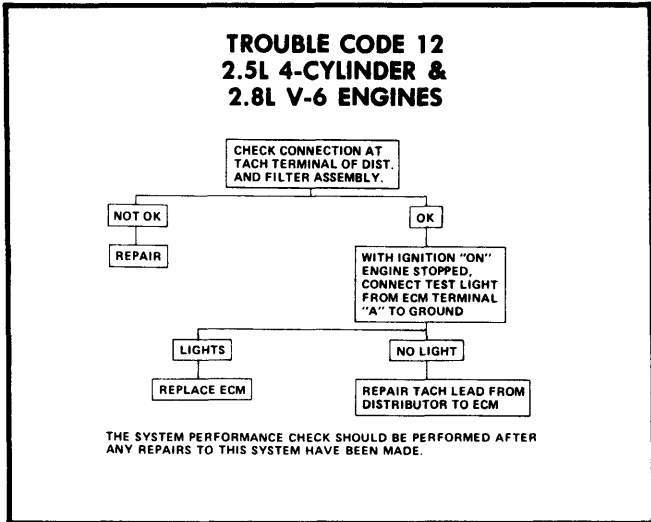
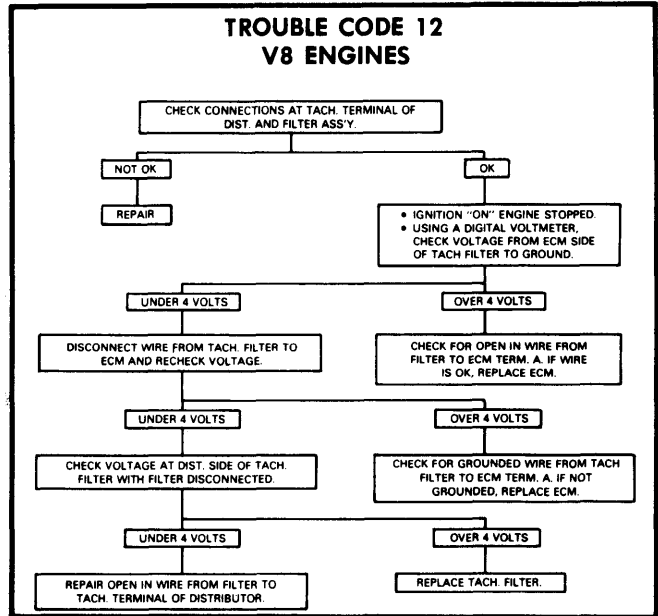
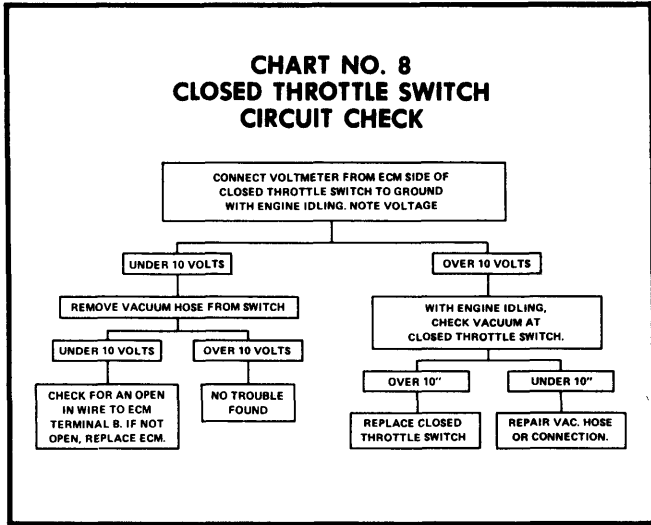


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G.M. COMPUTER CONTROLLED CATALYTIC CONVERTER SYSTEM C-4 (Cont.)



G.M. COMPUTER CONTROLLED CATALYTIC CONVERTER SYSTEM C-4 (Cont.)



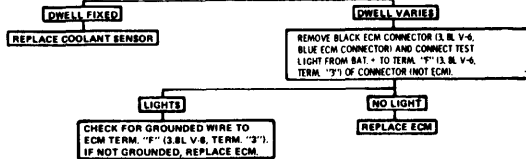
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G.M. COMPUTER CONTROLLED CATALYTIC CONVERTER SYSTEM C-4 (Cont.)

TROUBLE CODE 14

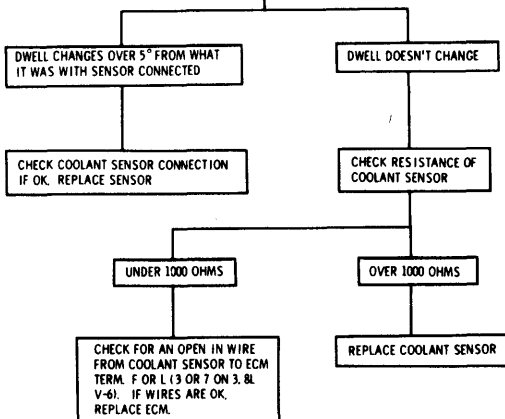
IF THE ENGINE HOT LIGHT IS "ON", CHECK FOR OVERHEATING CONDITION BEFORE MAKING FOLLOWING TEST.

- GROUND "TEST" LEAD.
- CONNECT DWELL METER TO M/C SOLENOID.
- RUN ENGINE AT PART THROTTLE UNTIL DWELL STARTS TO VARY.
- WITH ENGINE IDLING, REMOVE CONNECTOR FROM COOLANT SENSOR.



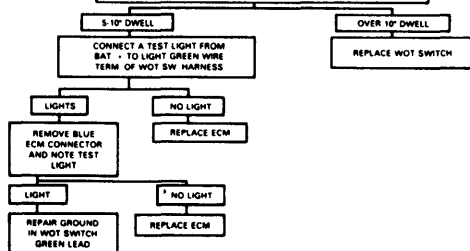
TROUBLE CODE 15

GROUND "TEST" LEAD. CONNECT DWELL METER TO M/C SOLENOID (6 CYL. SCALE). STOP ENGINE (IF RUNNING) AND RESTART IT. RUN AT PART THROTTLE FOR 3 MINUTES. WITH ENGINE IDLING, NOTE DWELL. REMOVE CONNECTOR FROM COOLANT SENSOR AND JUMPER CONNECTOR TERMINALS.



TROUBLE CODE 21 3.8L V6 ENGINE

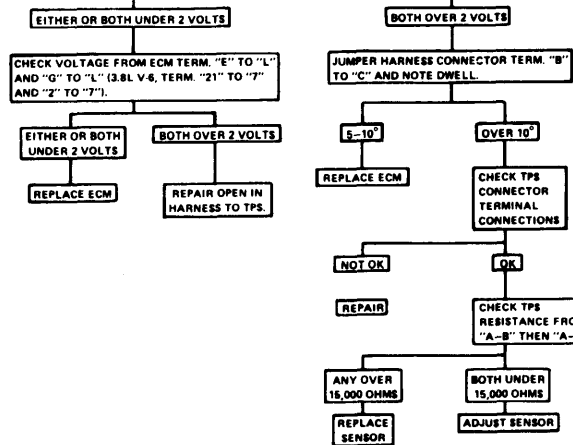
- GROUND "TEST" LEAD
- CONNECT DWELL METER TO M/C SOLENOID - USE 6 CYL. SCALE
- WITH ENGINE IDLING, DISCONNECT WOT SWITCH



TROUBLE CODE 21 ENGINES EQUIPPED WITH THROTTLE POSITION SENSOR ONLY

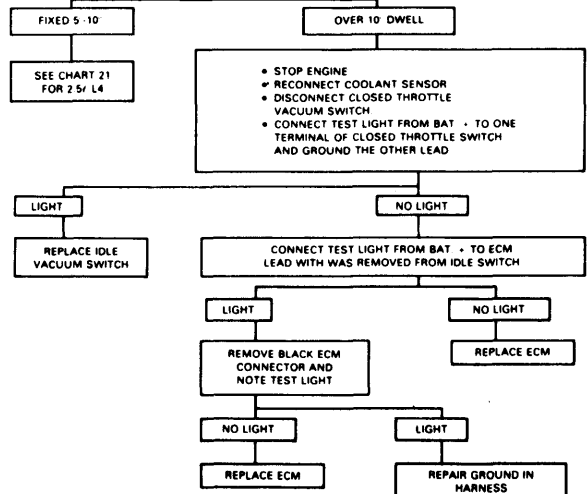
CHECK FOR STUCK TPS PLUNGER; REPAIR AS NECESSARY. IF OK, PROCEED BELOW:

- GROUND "TEST" LEAD.
- CONNECT DWELL METER TO M/C SOLENOID - USE 6-CYL. SCALE.
- DISCONNECT TPS HARNESS CONNECTOR FROM SENSOR.
- CHECK VOLTAGE FROM HARNESS CONNECTOR TERM. "A" TO "C" THEN "B-C" WITH A DIGITAL VOLTMETER AND IGN. "ON", ENGINE STOPPED.



TROUBLE CODE 22 2.5L 4-CYL. ENGINE

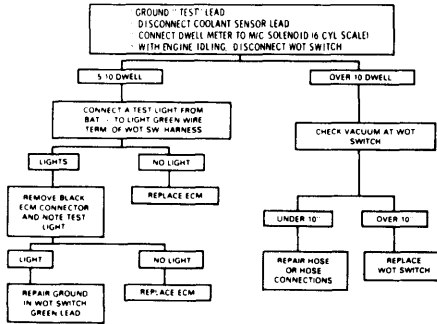
- DISCONNECT COOLANT SENSOR
- GROUND "TEST" LEAD
- CONNECT DWELL METER TO M/C SOLENOID - USE 6 CYL. SCALE
- WITH ENGINE IDLING, NOTE DWELL



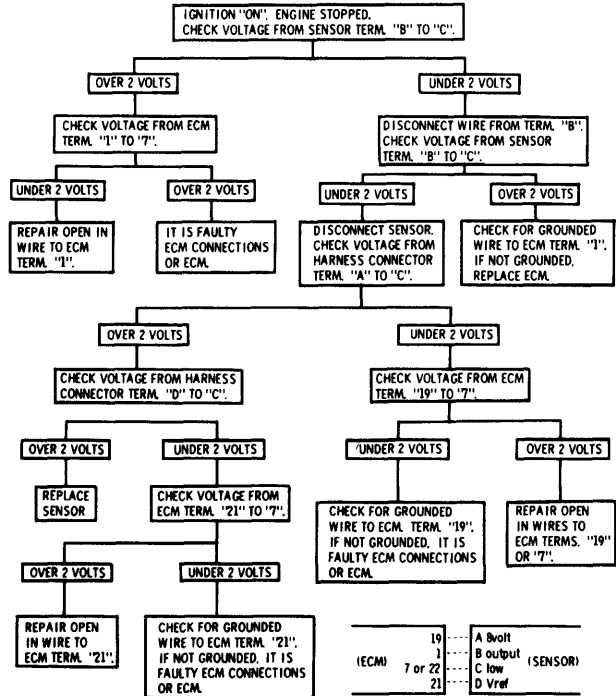
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TROUBLE CODE 21 & 22 TOGETHER 2.5L 4-CYL. ENGINE

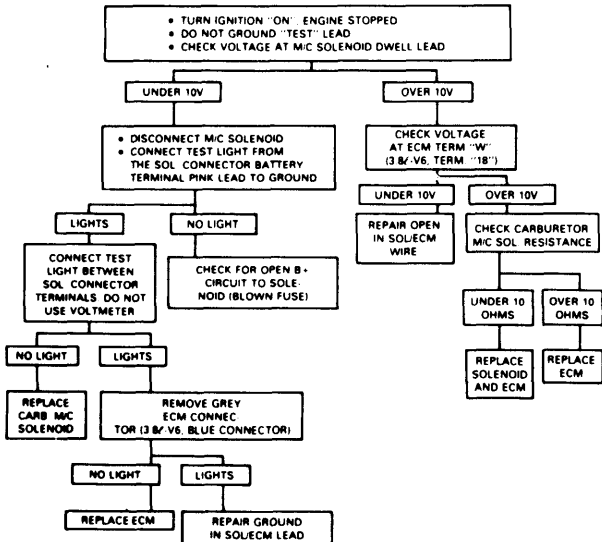


TROUBLE CODE 32 OR 32 & 55 TOGETHER EXCEPT 3.8L V-6 ENGINE 4-TERM BARO SENSOR

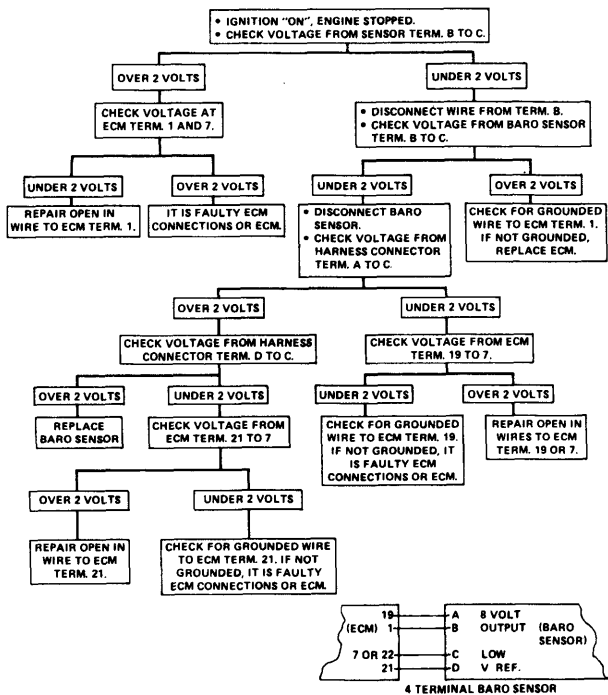


TROUBLE CODE 23

CHECK CONNECTIONS AT MIC SOLENOID IF O.K.

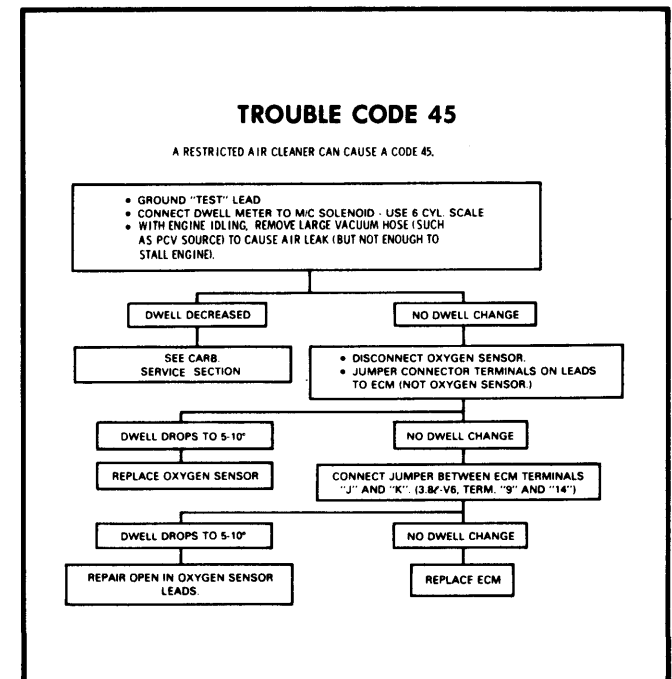
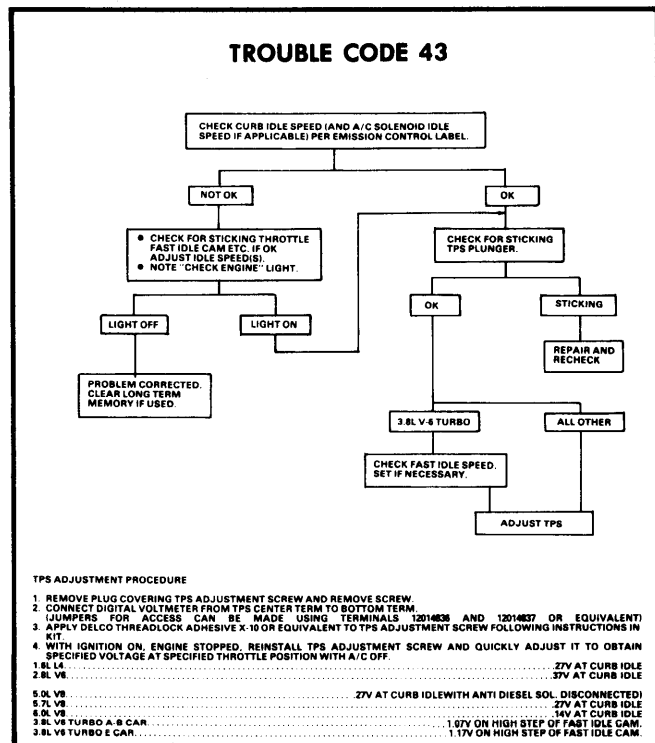
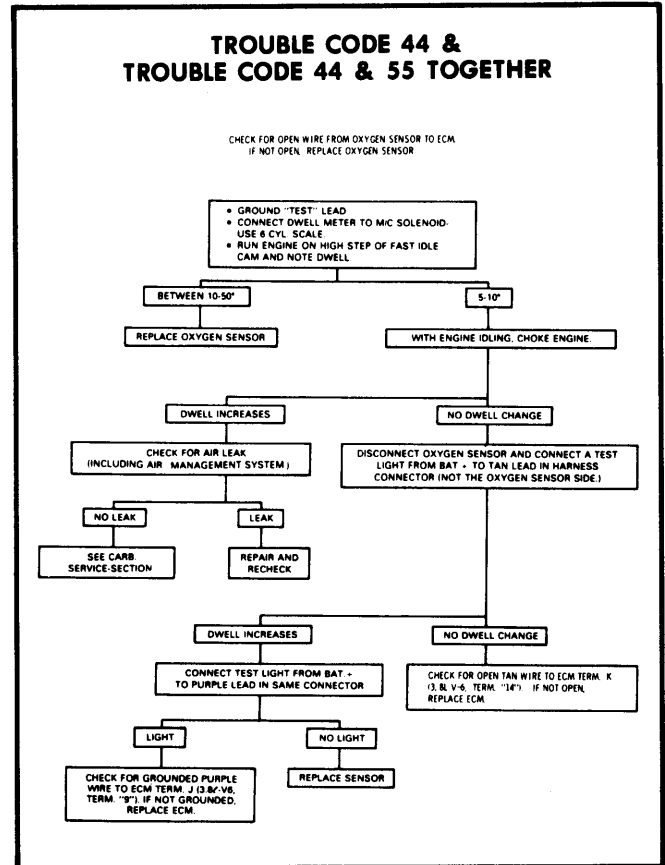
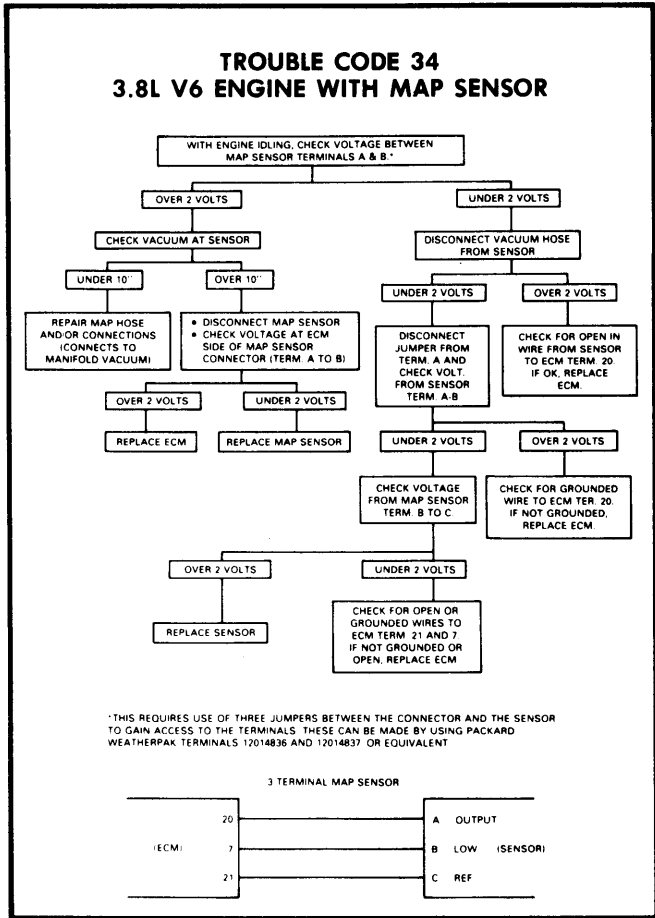


TROUBLE CODE 32 OR 32 & 55 TOGETHER 3.8L V-6 ENGINES 4-TERM BARO SENSOR



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G.M. COMPUTER CONTROLLED CATALYTIC CONVERTER SYSTEM C-4 (Cont.)

