AMERICAN MOTORS 4-CYL. COMPUTERIZED EMISSION CONTROLS

All Models
Auto. Trans. – Nationwide
Man. Trans. – Calif. Only

NOTE – *Some of the above listed models which were manufactured early in the production year, may be equipped with the C-4 system rather than the CEC system. If vehicle is equipped with the C-4 system, see appropriate article in this section.*

DESCRIPTION

The Computerized Emission Control (CEC) system is an electronically controlled system that closely controls air/fuel ratio. This close control of the air/fuel ratio is needed to lower exhaust emissions while maintaining good fuel economy and controlling the air injection system. The primary objective of the CEC system is to maintain the ideal air/fuel mixture ratio of 14.7:1 under all operating conditions. When the ideal air/fuel ratio is maintained, the catalytic converter can effectively control nitrogen oxides (NOx), hydrocarbons (HC) and carbon monoxide (CO).

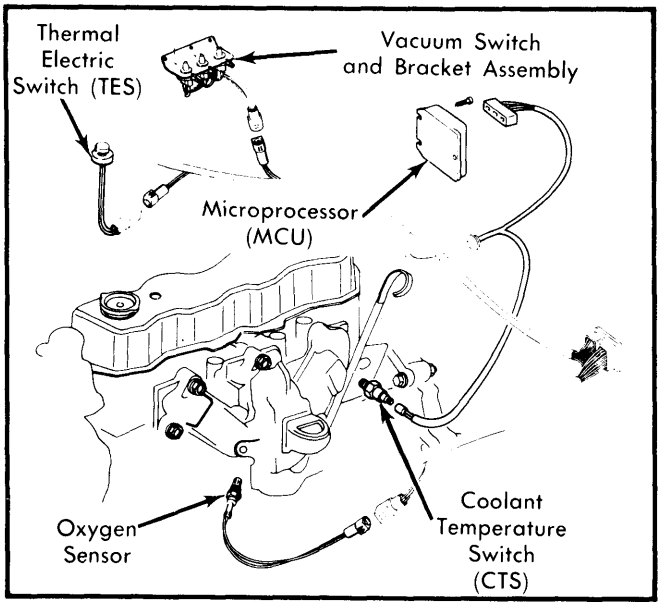

Fig. 1 American Motors 4-Cyl. CEC System

OPERATION

The CEC system consists of 4 sub-systems: Fuel control, data sensors, Micro Computer Unit (MCU) and catalytic converter.

FUEL CONTROL

All models are equipped with a feedback carburetor which contains an electro-mechanically operated mixture control (M/C) solenoid. The M/C solenoid regulates the air/fuel mixture according to the commands from the MCU. One terminal of the M/C solenoid is connected to battery voltage (12 volts) and the other terminal is connected to the MCU. The MCU functions as a switch that either provides a ground for current flow to energize the M/C solenoid or an open circuit to deengerize the M/C solenoid. The MCU switches the M/C solenoid on and off 10 times per second.

When the M/C solenoid is energized, the needle is inserted into the jet resulting in a lean air/fuel mixture. When the solenoid is deenergized, the needle is withdrawn from the jet resulting in a rich air/fuel mixture.

DATA SENSORS

Oxygen Sensor – The oxygen sensor, located in the exhaust manifold, is used by the MCU to determine oxygen content of exhaust gases. The sensor sends a voltage signal to the MCU that is proportional to the oxygen content of exhaust gases. When higher amounts of oxygen are detected in the exhaust gases (lean mixture indicated), the electrical signal generated by the sensor drops in voltage. A lower oxygen content (rich mixture indicated) causes an increase in voltage signal output.

Adaptive Vacuum Switch (AVS) – This switch is mounted on a bracket, with 2 other switches, which is attached to the right inner fender panel. The AVS is closed during engine idle and partial throttle operation. The AVS opens when manifold vacuum decreases to 9 in. Hg (auto. trans.) or 13 in. Hg (man. trans.).

Wide Open Throttle Switch (WOT) – The WOT switch is used to sense a full throttle condition. The full throttle condition is detected by the WOT switch when manifold vacuum drops below 5 in. Hg (cold engine) or 3 in. Hg (warm engine) thus closing the switch. This results in the M/C solenoid being regulated to provide a rich air/fuel mixture.

Enrichment Coolant Temperature Switch (ECTS) – The ECTS operates in conjunction with the WOT switch when the engine is warm. When the ECTS temperature is above 135°F and engine is at full throttle operation, the M/C solenoid provides a rich air/fuel mixture necessary for the increased air flow during warm engine wide open throttle operation.

Coolant Temperature Switch (CTS) – The CTS is open when engine is warm, below 95°F. When CTS temperature is below 95°F, the MCU does not accept oxygen sensor signals and a predetermined air/fuel mixture is maintained.

NOTE – *Both coolant temperature switches are contained in a single housing.*

Thermal Electric Switch (TES) – The TES is attached to the inside of the air cleaner. This sensor provides either a ground circuit for the MCU (for cold weather start-up; below 55°F) or an open circuit to indicate normal start-up (temperature above 65°F).

Engine RPM Voltage – This voltage signal is supplied to the MCU from the tach terminal on the distributor. The M/C solenoid is deenergized until a voltage, equivalent to a predetermined RPM, is received by the MCU. This causes the system to remain in the open loop mode of operation. The result is a rich air/fuel mixture for engine starting.

NOTE – *All switching temperatures and vacuum levels are average values. The actual switching temperature or vacuum level will vary slightly from unit to unit.*

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MICRO COMPUTER UNIT (MCU)

The MCU is a microprocessor that monitors oxygen sensor voltage and, based on the mode of engine operation, generates an output control signal for the M/C solenoid.

Open Loop – When the engine is in the open loop mode of operation, the air/fuel mixture ratio will be based on a predetermined value that is dependant on several engine operating factors.

- **Cold Weather Start-Up & Operation** – If the air cleaner air temperature is below the calibrated value of the TES (55°F), the air/fuel mixture is rich. Lean air/fuel mixtures are not permitted for a preset time after cold weather start-up.
- **At or Near WOT Operation (Cold Engine)** – Whenever the temperature of the CTS is below 95°F and the WOT switch is closed, because of the decrease in manifold vacuum, the M/C solenoid provides a rich mixture for cold engine operation at wide open throttle.
- **At or Near WOT Operation (Warm Engine)** – Whenever the temperature of the ECTS is above 135°F and the WOT switch is closed, because of a decrease in engine vacuum (less than 3 in. Hg), the M/C solenoid provides a rich mixture for warm engine operation at wide open throttle.
- **Adaptive Mode of Operation** – This mode of operation occurs when engine is either at idle speed, accelerating from idle speed or decelerating to idle speed. During this mode of operation a check of all sensors is made by the MCU. If the operating values of the sensors do not agree with one another, the MCU uses a predetermined value to maintain proper engine operation. During the adaptive mode of operation, the M/C solenoid provides a predetermined air/fuel mixture.

Closed Loop – This mode of operation occurs whenever none of the open loop engine operating conditions exist. The MCU causes the M/C solenoid to adjust air/fuel mixture according to voltage signals from the oxygen sensor. Closed loop operation is characterized by constant variation of the air/fuel mixture. This is because the MCU is forced to constantly make small changes in order to maintain an optimum air/fuel mixture ratio.

CATALYTIC CONVERTER

All models utilize a 3-way catalytic converter to reduce exhaust emissions. 3-Way means it has the ability to convert the following gases:

- Hydrocarbons (HC) to water vapor and carbon dioxide (CO_2).
- Carbon monoxide (CO) to carbon dioxide (CO_2) and oxygen.
- Nitrogen oxide (NOx) and carbon monoxide (CO) to nitrogen (N_2) and carbon dioxide (CO_2).

EMISSION MAINTENANCE LAMP

The emission maintenance lamp will come on after 1,000 hours of engine operation. This is to indicate required service of the oxygen sensor. After performing required service on the oxygen sensor, the emission maintenance E-Cell timer must be replaced. The timer is located in the passenger compartment within the wiring harness leading to the MCU.

DIAGNOSIS & TESTING

The CEC system should be considered as a possible source of trouble for engine performance, fuel economy and exhaust emission problems only after normal tests and inspections are performed. Normal tests and inspections are one's that would apply to a vehicle without the CEC system (ignition system, carburetor, etc.).

The steps listed in the following charts will provide a systematic evaluation of each component that could cause a malfunction. After completing a repair, repeat the test to ensure that the malfunction has been corrected.

Test Equipment – The following tools will be needed to perform the diagnostic tests: Dwell meter, digital volt-ohmmeter, tachometer, vacuum gauge and jumper wire.

NOTE – *The "System Operational Test" should also be performed after all repairs on the CEC system have been completed.*

TEST CHARTS

Chart No.	Test
No. 1	System Operational Test
No. 2	Coolant Temperature Switch Circuit Test
No. 3	Vacuum Switch Circuit Test
No. 4	Thermal Electric Switch Circuit Test
No. 5	Engine RPM (TACH) Voltage Test
No. 6	Mixture Control Solenoid Test

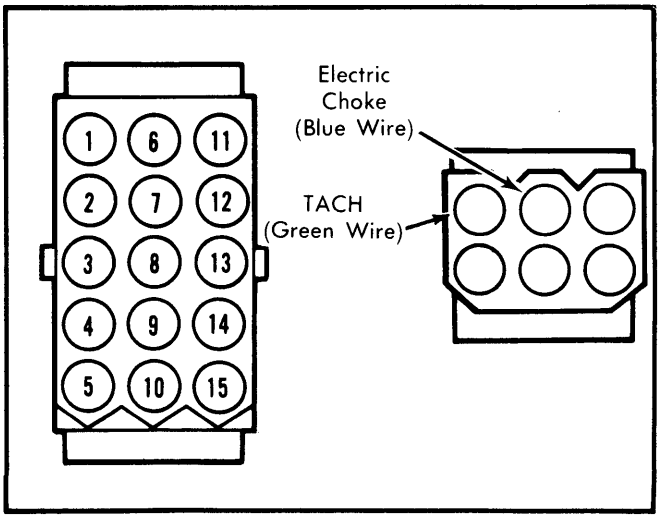
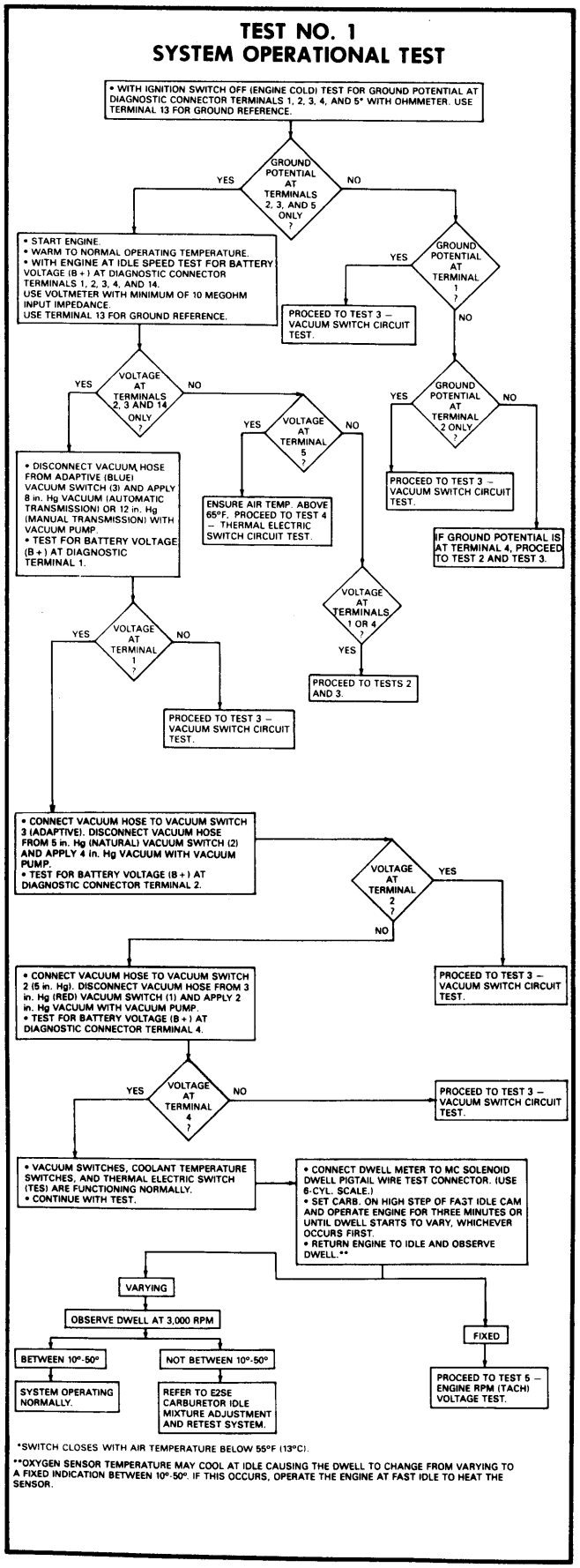


Fig. 2 View of Diagnostic Connector Showing Pin Number Location

AMERICAN MOTORS 4-CYL. COMPUTERIZED EMISSION CONTROLS (Cont.)

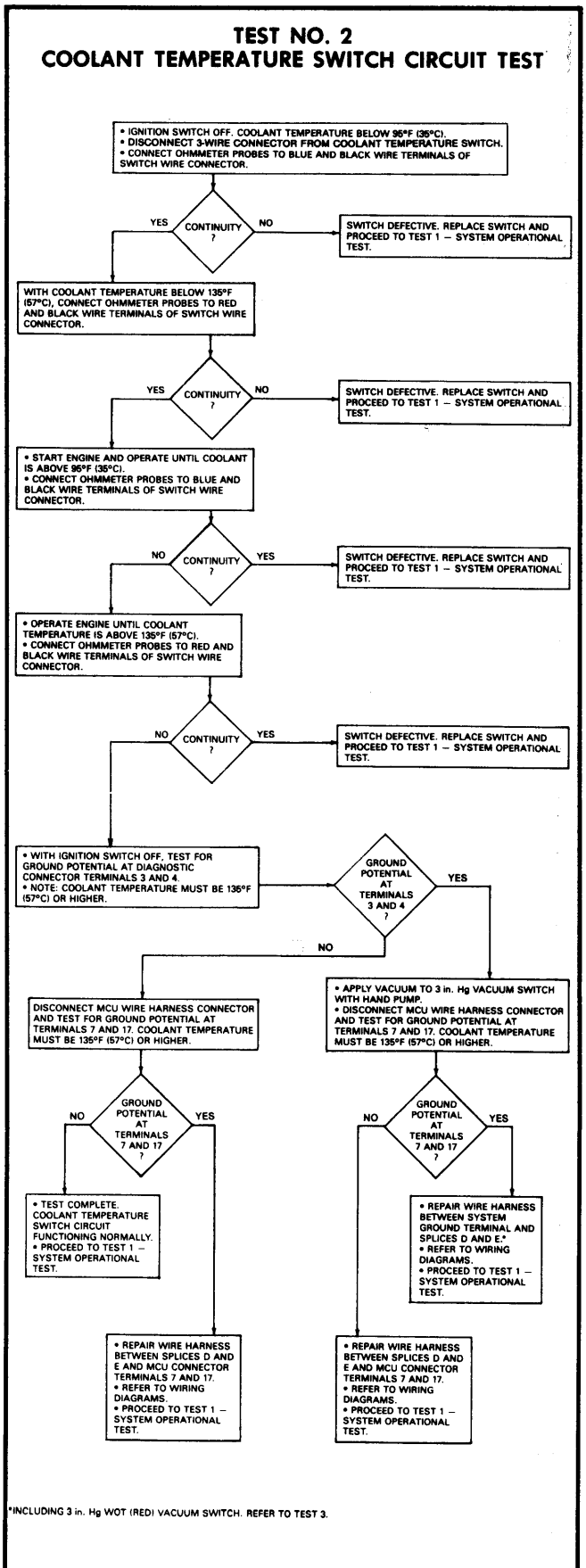
TEST NO. 1
SYSTEM OPERATIONAL TEST



*SWITCH CLOSES WITH AIR TEMPERATURE BELOW 55°F (13°C).

**OXYGEN SENSOR TEMPERATURE MAY COOL AT IDLE CAUSING THE DWELL TO CHANGE FROM VARYING TO A FIXED INDICATION BETWEEN 10°-50°. IF THIS OCCURS, OPERATE THE ENGINE AT FAST IDLE TO HEAT THE SENSOR.

TEST NO. 2
COOLANT TEMPERATURE SWITCH CIRCUIT TEST



*INCLUDING 3 in. Hg WOT (RED) VACUUM SWITCH. REFER TO TEST 3.

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TEST NO. 3
VACUUM SWITCH CIRCUIT TEST

- IGNITION SWITCH OFF.
- DISCONNECT WIRE CONNECTOR FROM VACUUM SWITCH ASSEMBLY.
- CONNECT OHMMETER PROBES TO BOTH RED WIRE TERMINALS OF VACUUM SWITCH CONNECTOR.

CONTINUITY ? — NO / YES

YES → SWITCH DEFECTIVE. REPLACE VACUUM SWITCH ASSEMBLY AND PROCEED TO TEST 1 – SYSTEM OPERATIONAL TEST.

NO →
- DISCONNECT VACUUM HOSE FROM 3 in. Hg (RED) VACUUM SWITCH AND APPLY 4 in. Hg OF VACUUM TO SWITCH WITH VACUUM PUMP.
- CONNECT OHMMETER PROBES TO BOTH RED WIRE TERMINALS OF VACUUM SWITCH CONNECTOR.

CONTINUITY ? — YES / NO

NO → SWITCH DEFECTIVE. REPLACE VACUUM SWITCH ASSEMBLY AND PROCEED TO TEST 1 – SYSTEM OPERATIONAL TEST.

YES →
- DISCONNECT VACUUM PUMP AND CONNECT VACUUM HOSE TO SWITCH.
- CONNECT OHMMETER PROBES TO BOTH CENTER TERMINALS (LIGHT GREEN AND BLACK WIRES) OF VACUUM SWITCH CONNECTOR.

CONTINUITY ? — YES / NO

NO → SWITCH DEFECTIVE. REPLACE VACUUM SWITCH ASSEMBLY AND PROCEED TO TEST 1 – SYSTEM OPERATIONAL TEST.

YES →
- DISCONNECT VACUUM HOSE FROM 6 in. Hg (NATURAL) VACUUM SWITCH AND APPLY 6 in. Hg OF VACUUM TO SWITCH WITH VACUUM PUMP.
- CONNECT OHMMETER PROBLES TO BOTH CENTER TERMINALS (LIGHT GREEN AND BLACK WIRES) OF VACUUM SWITCH CONNECTOR.

CONTINUITY ? — NO / YES

YES → SWITCH DEFECTIVE. REPLACE VACUUM SWITCH ASSEMBLY AND PROCEED TO TEST 1 – SYSTEM OPERATIONAL TEST.

NO →
- DISCONNECT VACUUM PUMP AND CONNECT VACUUM HOSE TO SWITCH.
- CONNECT OHMMETER PROBES TO BOTH RIGHT SIDE OUTBOARD TERMINALS (GREEN W/TRACER AND BLACK WIRES) OF VACUUM SWITCH CONNECTOR.

CONTINUITY ? — NO / YES

NO → SWITCH DEFECTIVE. REPLACE VACUUM SWITCH ASSEMBLY AND PROCEED TO TEST 1 – SYSTEM OPERATIONAL TEST.

YES →
- DISCONNECT VACUUM HOSE FROM ADAPTIVE (BLACK: AUTOMATIC TRANSMISSION, BLUE: MANUAL TRANSMISSION) VACUUM SWITCH AND APPLY 10 in. Hg (AUTOMATIC TRANSMISSION) OR 14 in. Hg (MANUAL TRANSMISSION) TO SWITCH WITH VACUUM PUMP.
- CONNECT OHMMETER PROBES TO BOTH RIGHT SIDE OUTBOARD TERMINALS (GREEN W/TRACER AND BLACK WIRES) OF VACUUM SWITCH CONNECTOR.

CONTINUITY ? — YES / NO

NO → SWITCH DEFECTIVE. REPLACE VACUUM SWITCH ASSEMBLY AND PROCEED TO TEST 1 – SYSTEM OPERATIONAL TEST.

YES →
- DISCONNECT VACUUM PUMP AND CONNECT VACUUM HOSE TO SWITCH.
- WITH IGNITION SWITCH OFF, TEST FOR GROUND POTENTIAL AT DIAGNOSTIC CONNECTOR TERMINALS 1, 2, AND 4.

GROUND POTENTIAL AT TERMINAL 2 ONLY ? — YES / NO

YES → Continued Next Column

NO → GROUND POTENTIAL AT TERMINAL 4 ? — YES / NO

YES → • PROCEED TO TEST 2*
• REPAIR SHORT CIRCUIT IN VACUUM SWITCH WIRE HARNESS.
• CONTINUE WITH TEST.

NO → GROUND POTENTIAL AT TERMINAL 1 ? — YES / NO

YES → • REPAIR SHORT CIRCUIT IN VACUUM SWITCH WIRE HARNESS.
• CONTINUE WITH TEST.

NO → • VACUUM SWITCH CIRCUIT IS FUNCTIONING NORMALLY.
• CONNECT MCU CONNECTOR AND DISCONNECT VACUUM GAUGE.
• PROCEED TO TEST 1 – SYSTEM OPERATIONAL TEST.

*ENSURE COOLANT TEMPERATURE IS BELOW 135°F (57°C).

TEST NO. 3 (Cont.)

- START ENGINE AND OPERATE UNTIL COOLANT TEMPERATURE EXCEEDS 135°F (57°C).
- CONNECT VACUUM GAUGE TO MANIFOLD VACUUM SOURCE. DISCONNECT MCU WIRE HARNESS CONNECTOR.
- TEST FOR OPEN CIRCUIT AT MCU WIRE HARNESS CONNECTOR TERMINAL 5 WHILE ACCELERATING ENGINE AND DECREASING MANIFOLD VACUUM TO LESS THAN 9 in. Hg (AUTOMATIC TRANSMISSION) OR LESS THAN 13 in. Hg (MANUAL TRANSMISSION).
- TEST FOR GROUND POTENTIAL AT MCU WIRE HARNESS CONNECTOR TERMINAL 6 WHILE ACCELERATING ENGINE AND DECREASING MANIFOLD VACUUM TO LESS THAN 5 in. Hg.
- TEST FOR OPEN CIRCUIT AT MCU WIRE HARNESS CONNECTOR TERMINAL 17 WHILE ACCELERATING ENGINE AND DECREASING MANIFOLD VACUUM TO LESS THAN 3 in. Hg.

GROUND POTENTIAL AT TERMINAL 6, OPEN CIRCUITS AT TERMINALS 7 AND 17 ? — YES / NO

YES → • VACUUM SWITCH CIRCUIT IS FUNCTIONING NORMALLY.
• CONNECT MCU CONNECTOR AND DISCONNECT VACUUM GAUGE.
• PROCEED TO TEST 1 – SYSTEM OPERATIONAL TEST.

NO → • ENSURE COOLANT TEMPERATURE IS ABOVE 135°F (57°C).
• REFER TO TEST 2.
• INSPECT VACUUM HOSES AND FITTINGS. REPAIR AS NECESSARY.
• REPAIR WIRE HARNESS BETWEEN SPLICES B, C, AND E, AND MCU CONNECTOR. REFER TO WIRING DIAGRAMS.
• RETEST VACUUM SWITCH CIRCUIT.

TEST NO. 4
THERMAL ELECTRIC SWITCH CIRCUIT TEST

- IGNITION SWITCH OFF.
- DISCONNECT THERMAL ELECTRIC SWITCH WIRE HARNESS CONNECTOR.
- CONNECT OHMMETER TEST PROBES TO SWITCH CONNECTOR TERMINALS.
- WITH AIR CLEANER TEMPERATURE BELOW 55°F (13°C)*, CONTINUITY SHOULD BE INDICATED BY OHMMETER.
- WITH AIR CLEANER TEMPERATURE ABOVE 65°F (18°C)*, OPEN CIRCUIT SHOULD BE INDICATED BY OHMMETER.

SWITCH OK ? — YES / NO

NO → REPLACE SWITCH AND PROCEED TO TEST 1 – SYSTEM OPERATIONAL TEST.

YES →
- CONNECT THERMAL ELECTRIC SWITCH WIRE HARNESS CONNECTOR.
- WITH AIR CLEANER AIR TEMPERATURE BELOW 55°F (13°C), TEST FOR GROUND POTENTIAL AT DIAGNOSTIC CONNECTOR TERMINAL 5.

GROUND POTENTIAL AT TERMINAL 5 ? — YES / NO

NO → • REPAIR WIRE HARNESS BETWEEN SYSTEM GROUND AND DIAGNOSTIC CONNECTOR TERMINAL 5. REFER TO WIRING DIAGRAMS.
• PROCEED TO TEST 1 – SYSTEM OPERATIONAL TEST.

YES →
- WITH AIR CLEANER AIR TEMPERATURE BELOW 55°F (13°C), TEST FOR GROUND POTENTIAL AT MCU WIRE HARNESS CONNECTOR TERMINAL 18.

GROUND POTENTIAL AT TERMINAL 18 ? — YES / NO

NO → • REPAIR WIRE HARNESS BETWEEN SPLICE F AND MCU CONNECTOR. REFER TO WIRING DIAGRAMS.
• PROCEED TO TEST 1 – SYSTEM OPERATIONAL TEST.

YES →
- THERMAL ELECTRIC SWITCH (TES) CIRCUIT IS FUNTIONING NORMALLY.
- CONNECT MCU CONNECTOR.
- PROCEED TO TEST 1 – SYSTEM OPERATIONAL TEST.

*WITH DECREASING AIR TEMPERATURE, SWITCH CLOSES AT 55°F (13°C). WITH INCREASING AIR TEMPERATURE, SWITCH OPENS AT 65°F (18°C).

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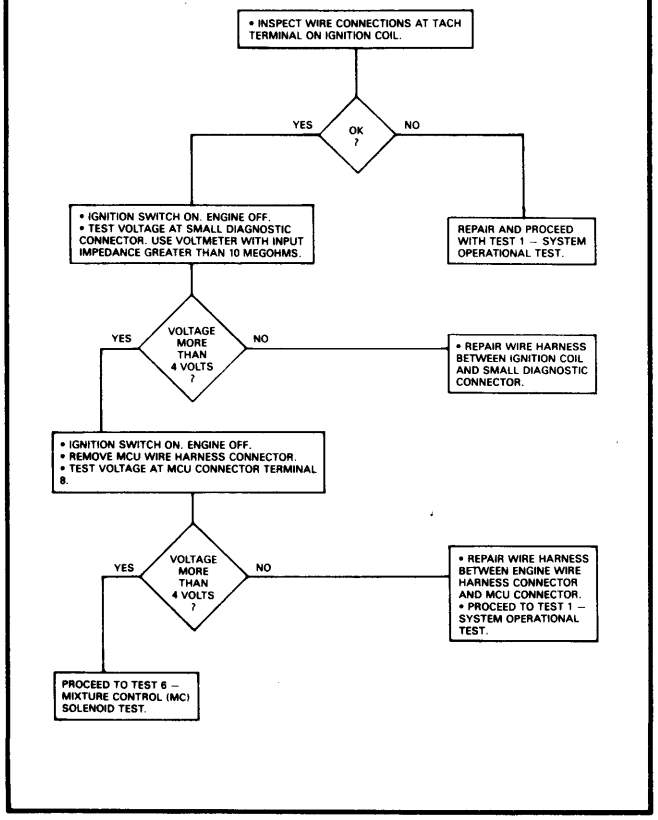
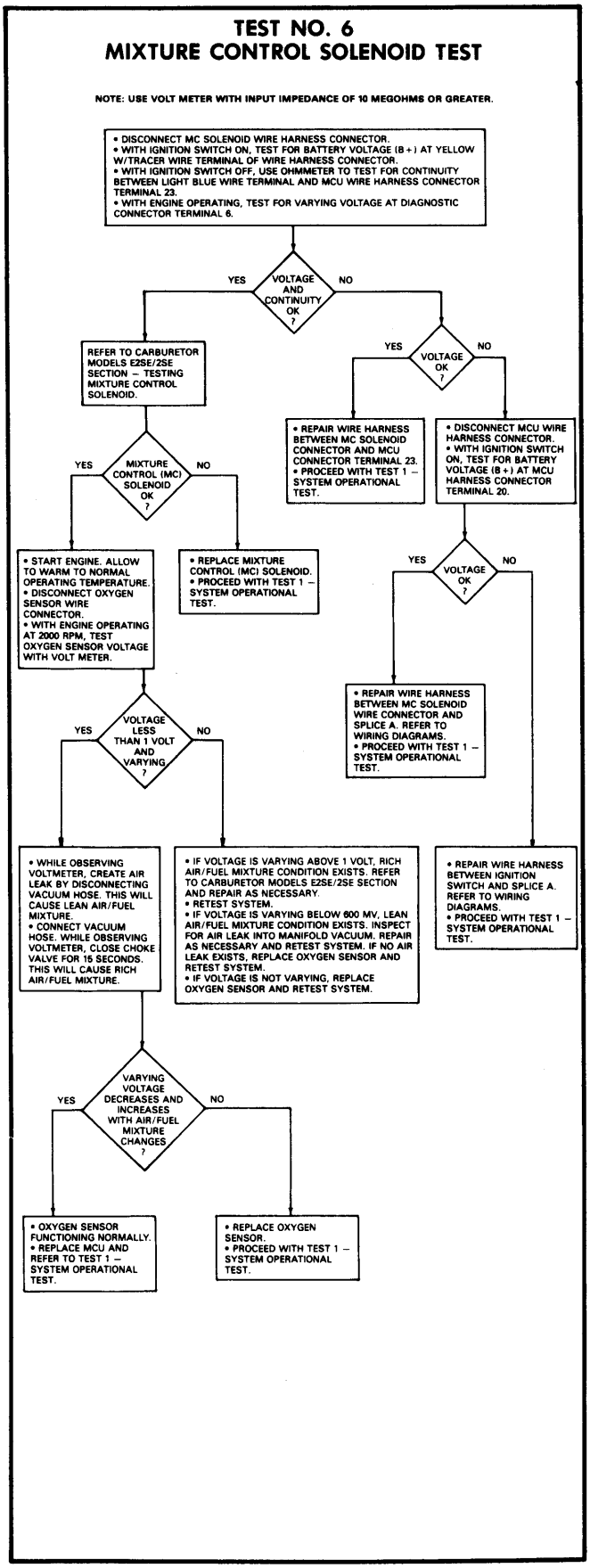
TEST NO. 5
ENGINE RPM (TACH) VOLTAGE TEST



TEST NO. 6
MIXTURE CONTROL SOLENOID TEST



AMERICAN MOTORS 4-CYL. COMPUTERIZED EMISSION CONTROLS (Cont.)

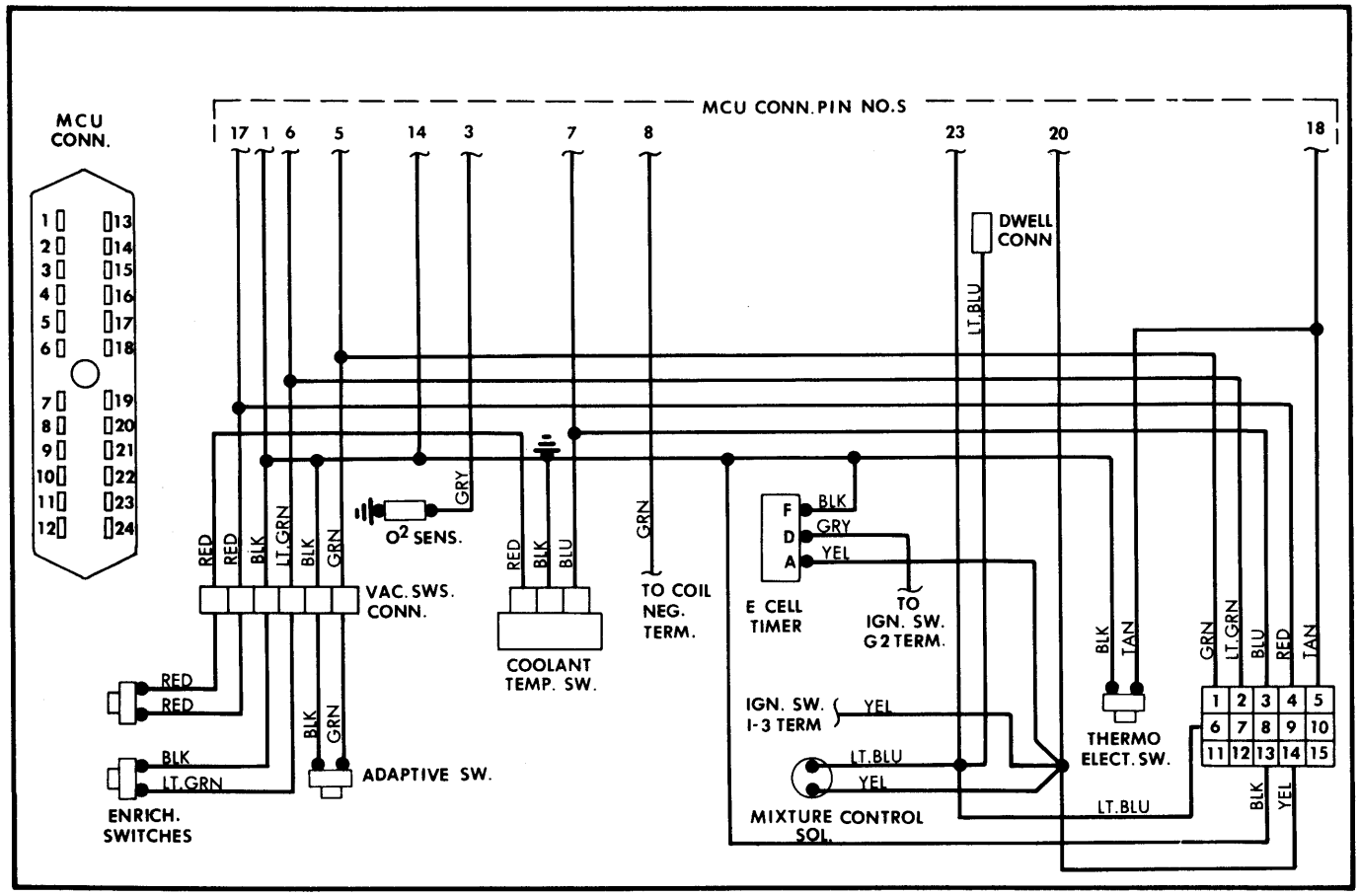


Fig. 3 American Motors 4-Cyl. CEC System Wiring Diagram