ENGINE PERFORMANCE

1992 General Motors System & Component Testing

INTRODUCTION

Before testing separate components or systems, perform all procedures listed in F - BASIC TESTING article in this section. Since many computer-controlled and monitored components will set a trouble code if they malfunction, it is also recommended that self-diagnosis be performed. See appropriate G - TESTS W/ CODES article in this section.

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests with a Digital Volt-Ohmmeter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

NOTE: The following table provides the location of commonly used diagnostic information. These former "A" and "C" charts are now written in text and inserted into the appropriate location in the new Engine Performance workflow. To familiarize yourself with the Engine Performance workflow, see the HOW TO USE THE ENGINE PERFORMANCE SECTION article in this section.

COMPUTERIZED ENGINE CONTROLS

CONTROL UNIT

Ground Circuits

1. Using an ohmmeter, check for continuity to ground on control unit ground terminals. Use appropriate wiring diagram at the end of this article to determine ECM ground terminals. Resistance to ground should be zero ohms. If reading is other than zero ohms, repair open to circuit ground.
2. Using a DVOM, touch negative lead of voltmeter to a good ground. Touch positive lead of voltmeter to each ground terminal. With vehicle running, voltmeter should indicate less than one volt. If voltmeter reading is one volt or more, check for open, corroded or loose connection on ground lead.

Power Circuits

1. Using a voltmeter, check for battery voltage between control unit constant battery power terminals and ground. If battery voltage is not present, check control unit power supply fuse. If fuse is okay, check for open in power supply or control unit wiring.
2. Turn ignition switch to the ON position. Using a voltmeter, check for battery voltage between control unit ignition power terminals and ground. If battery

voltage is not present, check power supply fuse(s). If fuse is okay, check for an open in wiring between fuse and control unit, or check for a defective ignition switch.

3. Connect voltmeter between ground and control unit start (crank) signal terminal. Turn ignition switch to the START position. Battery voltage should be present between control unit start terminal and ground ONLY when ignition switch is in the START position.
4. If voltage is not present, check fuse(s). If fuse is okay, check for an open in wiring between fuse and control unit, or check for a defective ignition switch.

ENGINE SENSORS & SWITCHES

NOTE: For additional sensor testing specifications, see K - SENSOR RANGE CHARTS article in this section.

A/C ON (A/C Request) Switch Test

1. Start engine and allow to idle. If a "Scan" tester is available, scan A/C request parameter. Move A/C mode selector back and forth between ON and OFF positions. Scan status should change.
2. If "Scan" tester is not available or scan status does not change, measure voltage between ground and ECM A/C request terminal. For wiring schematics, see mini-schematics in **A/C CLUTCH** under MISCELLANEOUS CONTROLS.
3. With A/C mode selector in the ON position, 12 volts should be present. If 12 volts are not present, check for open between A/C mode select switch and ECM A/C request terminal, low A/C refrigerant level causing low pressure switch to open, bad A/C fuse or bad A/C mode select switch.

A/C Pressure Sensor

A malfunction in A/C pressure sensor circuit will set a related trouble code. For testing procedures, see appropriate G - TESTS W/ CODES article in this section. For wiring schematics, see mini-schematics in **A/C CLUTCH** under MISCELLANEOUS ECM CONTROLS.

A/C Pressure Switch

1. Connect A/C pressure gauges to system and start engine. Note high and low pressure readings. If pressures are normal, go to step 2). If pressures are less than normal, check system for leaks. Evacuate and recharge as necessary. If pressures are high, check for system overcharge, overheating or mechanical failure in freon delivery system.
2. Disconnect high and low pressure switches. Jumper across each switch harness connector to allow A/C system to function normally. Using an ohmmeter, check continuity between pressure switch terminals.

3. Continuity should be present on both high and low switches (if equipped). If continuity is not present, replace A/C pressure switch. For wiring schematics, see mini-schematics in **A/C CLUTCH** under MISCELLANEOUS CONTROLS.

Brake Switch

Disconnect brake switch harness connector. Using an ohmmeter, check continuity between brake switch terminals. Continuity should be present. Depress brake pedal to activate brake switch, continuity should not be present.

Coolant Temperature Sensor (CTS)

If a coolant sensor-related code is present, see appropriate G - TESTS W/ CODES article in this section. An out-of-calibration sensor may not set a trouble code. Use following procedure to test sensor calibration. Disconnect coolant temperature sensor connector. Measure resistance between sensor terminals. Resistance should be high when engine is cold and drop as engine warms. See **CTS RESISTANCE VALUES** .

CTS RESISTANCE VALUES

°F (°C)	Ohms
210 (100)	185
160 (70)	450
100 (38)	1800
70 (20)	3400
20 (-7)	13,500
0 (-18)	25,000
-40 (-40)	100,700

Crankshaft Position Sensor (DIS)

1. If a "Scan" tester is available, scan RPM parameter while cranking engine. If RPM is indicated, crankshaft position sensor is operating properly.
2. If "Scan" tester is not available, disconnect crankshaft sensor harness connector. Set ohmmeter to 2-k/ohm position, measure resistance across sensor terminals. Resistance should be 900-1200 ohms.
3. Set voltmeter on the 2-volt AC scale. Crank engine and measure voltage across sensor terminals. Voltmeter reading should be .1 volt or greater. If resistance reading is not as specified or sensor does not produce a voltage reading, repair faulty wiring or crank sensor.

Crankshaft Position Sensor (IDI)

1. If a "Scan" tester is available, scan RPM parameter while cranking engine. If RPM is indicated, crankshaft position sensor is operating properly.

2. If "Scan" tester is not available, disconnect crankshaft sensor connector, located above oil filter. Set ohmmeter to 2-k/ohm position, measure resistance across sensor terminals. Resistance should be 500-900 ohms.
3. Set voltmeter on the 2-volt AC scale. Crank engine and measure voltage across sensor terminals. Voltmeter reading should be .1 volt or greater. If resistance reading is not as specified or sensor does not produce a voltage reading, replace faulty crankshaft sensor. Also, check if sensor is still magnetized. Replace as necessary.

Intake Air Temperature Sensor

A malfunction in the intake air temperature sensor will set a related trouble code. For testing procedures, see appropriate G - TESTS W/ CODES article in this section.

Knock Sensor

Disconnect knock sensor harness connector. Using an ohmmeter, measure knock sensor resistance between sensor terminal and engine block. Resistance should be 3300-4500 ohms. Connect DVOM between sensor terminal and ground. Set voltmeter to 2-volt AC scale. Start and idle engine. Tap on engine block near sensor. A signal should be indicated on voltmeter. If no signal is indicated, replace knock sensor. Also, see **TIMING CONTROL SYSTEMS** under IGNITION SYSTEM. Also see Code 43 in appropriate G - TESTS W/ CODES article in this section.

Manifold Absolute Pressure (MAP) Sensor (C-1)

1. A malfunction in the MAP sensor circuit should set a related trouble code in ECM memory. If a code is present, see appropriate G - TESTS W/ CODES article in this section. An out-of-calibration sensor may not set a trouble code. Use following procedure to test sensor calibration. If driveability problems exist, MAP sensor failure is suspected and no MAP code is present, disconnect MAP sensor connector. See **Fig. 1** . If driveability condition improves, replace MAP sensor.
2. With ignition on and engine off, check MAP sensor parameter using a "Scan" tester connected to the ALDL connector. Voltage should be as specified in **MAP SENSOR VOLTAGE RANGE** . If MAP sensor voltage is as specified, go to step 3). If voltage is not as specified, check for 5-volt reference supplied to sensor. Check harness integrity. If no problems are evident, replace MAP sensor.
3. Using a hand-held vacuum pump, apply 10 in. Hg to MAP sensor, and note voltage change. Voltage should drop about 1.2-2.3 volts less than as specified in table. If voltage is not as specified or voltage reading does not immediately follow vacuum change, MAP sensor is faulty.

Fig. 1: Typical MAP Sensor Circuit
Courtesy of GENERAL MOTORS CORP.

MAP SENSOR VOLTAGE RANGE

Altitude (Ft.)	Volts
Below 1000	3.8-5.5
1000-2000	3.6-5.3
2000-3000	3.5-5.1
3000-4000	3.3-5.0
4000-5000	3.2-4.8
5000-6000	3.0-4.6
6000-7000	2.9-4.5
7000-8000	2.8-4.3
8000-9000	2.6-4.2
9000-10,000	2.5-4.0

Manifold Air Temperature (MAT) Sensor

On some models, MAT sensor may also be referred to as a Intake Air Temperature (IAT) sensor. If a MAT sensor related code is present, see appropriate G - TESTS W/ CODES article in this section. An out-of-calibration sensor may not set a trouble code. Use following procedure to test calibration. Disconnect MAT sensor harness connector. Connect ohmmeter between sensor terminals. Sensor resistance should be as specified. See **MAT SENSOR RESISTANCE** . After vehicle has sat overnight, MAT sensor and coolant sensor should have close to the same resistance reading.

MAT SENSOR RESISTANCE

°F (°C)	Ohms
210 (100)	185
160 (70)	450
100 (38)	1800
70 (20)	3400
40 (4)	7500
20 (-7)	13,500
0 (-18)	25,000
-40 (-40)	100,700

Oxygen (O2) Sensor

1. Start engine and warm to operating temperature. Disconnect oxygen sensor. Connect a DVOM between lead of oxygen sensor and ground. Place meter on the 2-volt scale. Voltmeter reading should increase to greater than .8 volt.

2. Using another DVOM on the 20-volt scale. Connect voltmeter in series between the O2 wire from the ECM and the positive post of battery. Reading on voltmeter connected to oxygen sensor should decrease to a low voltage (less than .3 volt).
3. If a second DVOM is not available, install short jumper in O2 wire from the ECM. Hold jumper in one hand and touch positive post of battery with other hand. This should cause oxygen sensor to produce less than .3 volt. For additional testing procedures, see appropriate G - TESTS W/ CODES article in this section.

Park/Neutral (P/N) Switch (C-1)

1. Disconnect P/N switch harness connector. Connect ohmmeter between the P/N switch terminals. See **Fig. 2** . Continuity should be present only when gear shift selector is in Park or Neutral. If continuity is not present, check P/N switch adjustment or replace defective P/N switch.
2. With park/neutral switch connector disconnected, turn ignition on. Check for 12 volts on the Orange/Black wire of park/neutral switch harness. If 12 volts are not present, check for open or short to ground between switch harness connector and ECM.

Fig. 2: Park/Neutral (P/N) Switch Circuit (Typical)
Courtesy of GENERAL MOTORS CORP.

Power Steering (P/S) Pressure Switch (C-1)

1. If "Scan" tester is available, scan power steering pressure switch status. Note status with engine running and wheels in straight-ahead position. Turn steering wheel to full left or right position and again note status. If status changed, power steering pressure switch is okay. If status did not change or "Scan" tester is not available, go to next step.
2. Turn ignition off. Disconnect P/S pressure switch harness connector. Connect ohmmeter between P/S pressure switch terminals. Start engine. With no-load on power steering, continuity should not be present. Turn steering wheel to full left or right position. Continuity should now be present. If readings are not as specified, replace P/S pressure switch.
3. With P/S pressure switch connector disconnected and ignition on, check for 12 volts on switch harness from ECM. If 12 volts are not present, check for open or short to ground in harness between switch connector and ECM.

Throttle Position Sensor (TPS)

Install jumper wires to enable connection of a DVOM in parallel between TPS harness connectors. Connect DVOM positive lead to Dark Blue TPS signal wire terminal. Connect negative lead to Black sensor ground wire terminal. See **Fig. 3** . Turn ignition on, engine off. Signal voltage 6should gradually change from less than one volt at closed

throttle to about 5.0 volts at wide open throttle position. If reading is not as specified, adjust or replace TPS. See D - ADJUSTMENTS article in this section.

A malfunction in the TPS circuit should set a related trouble code. For further information, see appropriate G - TESTS W/ CODES article in this section.

Fig. 3: Throttle Position Sensor Circuit (Typical)
Courtesy of GENERAL MOTORS CORP.

Vehicle Speed Sensor (PM Generator Type)

Disconnect vehicle speed sensor harness connector (located in transaxle). Place gear selector in Neutral. Raise vehicle drive wheels off the ground. Turn drive wheels by hand (greater than 3 MPH). Measure AC signal voltage between sensor terminals. Voltage reading should be vary from 0.1-0.5 volt AC as the wheel is turned. If reading is not as specified, replace vehicle speed sensor.

Vehicle Speed Sensor (LED Type)

A speed sensor or buffer malfunction should set a related code in ECM memory. If a code is set, refer to appropriate G - TESTS W/ CODES article in this section for diagnosis.

MOTORS, RELAYS & SOLENOIDS

MOTORS

Idle Air Control (IAC) Motor & Idle Speed Control (ISC) Motor

See **IDLE CONTROL SYSTEM** .

RELAYS

A/C Clutch Relays

See **MISCELLANEOUS CONTROLS** .

Fuel Pump Relay

See **FUEL SYSTEM** .

SOLENOIDS

NOTE: **All ECM-controlled solenoids should have at least 20 ohms of resistance when checked with positive ohmmeter lead**

connected to power supply terminal of solenoid and negative ohmmeter lead connected to ground terminal of solenoid. Some solenoids are equipped with internal diodes. On these solenoids, resistance values will differ if ohmmeter test leads are reversed.

Air Injection Solenoids

See **EMISSION SYSTEMS & SUB-SYSTEMS** .

Canister Purge Solenoid

See **EMISSION SYSTEMS & SUB-SYSTEMS** .

EGR Solenoid

See **EMISSION SYSTEMS & SUB-SYSTEMS** .

FUEL SYSTEM

FUEL DELIVERY

NOTE: For fuel system pressure testing, see F - BASIC TESTING article in this section.

Fuel Pressure Regulator (PFI)

1. Install fuel pressure gauge to fuel rail fuel pressure test fitting. Remove vacuum hose from fuel pressure regulator. Turn ignition on and note fuel pressure on gauge.
2. Start engine. Check for manifold vacuum at pressure regulator vacuum hose. Repair as necessary. Reconnect vacuum hose to pressure regulator and note fuel pressure on gauge. Compare first and second reading. Fuel pressure reading should be 4-7 psi (.28-.49 kg/cm^2) less with vacuum hose installed. Fuel pressure should decrease as vacuum increases. If results are not as specified, replace fuel pressure regulator.

Fuel Pressure Regulator (TBI)

Fuel pressure regulator is mechanically controlled by internal spring pressure. Regulator is adjusted at factory and is not serviceable. If fuel pressure is too low, check fuel filter, fuel pump pressure and volume. If fuel pressure is too high, check for restricted fuel tank return line. If no faults are found and pressure is too high or too low, replace fuel pressure regulator.

Fuel Pump Relay (A-5)

1. Disconnect fuel pump relay connector. Refer to COMPONENT LOCATIONS at the end of this article to locate fuel pump relay. Apply battery voltage and ground to fuel pump relay winding terminals. To identify fuel pump relay terminals, see appropriate wiring diagram at the end of this article.
2. Using an ohmmeter, check for continuity between fuel pump relay power supply terminal and fuel pump drive terminal. Continuity should exist ONLY with relay energized. If relay does not test as indicated, replace relay.
3. To by-pass fuel pump relay (to test fuel pump and wiring when fuel pump is not energizing), see FUEL PUMP RELAY BY-PASS PROCEDURE below.

Fuel Pump Relay By-Pass Procedure

1. If fuel pump will not energize, relay may be by-passed to test fuel pump and related wiring. See **Fig. 4** . Turn ignition off. Disconnect fuel pump relay connector. Using a fused jumper wire, apply battery voltage to fuel pump test connector (located in engine compartment). For fuel pump test connector location, refer to **COMPONENT LOCATIONS** at end of this article. See **Fig. 25** - **Fig. 28** .
2. If fuel pump runs and relay tests okay, check for faulty connections at relay. If fuel pump does not run, check for faulty wiring between relay and fuel pump or replace defective fuel pump.

Fig. 4: Typical Fuel Pump Relay Schematic
Courtesy of GENERAL MOTORS CORP.

Oil Pressure Switch Fuel Pump Back-Up

With engine idling, disconnect fuel pump relay. Engine should continue to run through oil pressure switch back-up circuit. If engine stalls, check oil pressure switch and related wiring.

FUEL CONTROL

Fuel Injector(s)

Disconnect fuel injector harness connector. Measure resistance across injector terminals at each injector. Resistance should be as specified. See **INJECTOR RESISTANCE SPECIFICATIONS** .

INJECTOR RESISTANCE SPECIFICATIONS (Injector resistance specification is at 140°F (60°C))

Application	Ohms
3.1L (VIN T)	11.8-12.6

5.0L (VIN E)	1.2
5.0L (VIN F)	10.0
5.7L (VIN 8)	10.0

NOTE: **If injectors are dirty, they should be cleaned using approved injector cleaning procedure before performing PFI INJECTOR BALANCE TEST.**

PFI Injector Balance Test (C-2)

The injector balance test is used to pulse the injector for a precise amount of time, spraying a measured amount of fuel in the intake manifold. As each injector is pulsed, a drop in fuel rail pressure occurs. This pressure drop can be recorded and compared to other injectors. An injector with a pressure drop of 1.5 psi (.11 kg/cm^2) or more, greater than or less than other injectors, should be considered faulty.

NOTE: **Allow engine to cool down to avoid irregular readings due to "hot soak" fuel boiling. To prevent flooding, the PFI INJECTOR BALANCE TEST should not be repeated more than once without starting and running engine.**

CAUTION: **To avoid possible vehicle fire, wrap a shop towel around fitting to avoid fuel spillage.**

1. With ignition off, connect Fuel Pressure Gauge (J-34730-1) to pressure tap. Unplug harness connector at all injectors. Connect Injector Tester (J-34730-3) to one of the injectors.
2. Follow manufacturer's instructions when installing adapter harness. Ignition should be turned off at least 10 seconds to complete ECM shutdown cycle.
3. Turn ignition on. Fuel pump should run at least 2 seconds after ignition is turned on. Bleed air from gauge and hose to ensure accurate gauge reading. Repeat this procedure until all air is bled from system. Turn ignition off for at least 10 seconds.
4. Turn ignition on again to bring fuel pressure to maximum. Record initial pressure reading. Energize tester one time and note pressure drop at lowest point.
5. Disregard any slight pressure drop after low point is reached. Subtracting second pressure reading from initial reading indicates amount of injector pressure drop.
6. Repeat step 4) on each injector and compare pressure drop. Recheck injectors not within pressure drop range. Replace injector(s) failing second check.
7. If injectors are all okay, plug in harness connectors and review SYMPTOMS in H - TESTS W/O CODES article in this section.

Oxygen Sensor

See **ENGINE SENSORS & SWITCHES** .

IDLE CONTROL SYSTEM (C-2)

Idle Air Control (IAC) Motor

1. Disconnect harness connector to motor. Check resistance across IAC coil terminals "A" and "B" (coil "B") and "C" and "D" (coil "A"). See **Fig. 5** . Resistance should be 40-80 ohms. If resistance is as specified, go to next step. If resistance is not as specified, replace IAC motor.
2. Check resistance between IAC terminals "B" to "C" and "A" to "D". Resistance should be infinite. If resistance is not as specified, replace IAC motor.

NOTE: Additional testing of Idle Air Control (IAC) motor requires an IAC motor actuator and node light, or a "Scan" tester capable of cycling ECM output devices (General Motors Tech 1).

Fig. 5: Typical IAC Motor Circuit
Courtesy of GENERAL MOTORS CORP.

Idle Speed Control (ISC) Motor (Cadillac Except Brougham)

A malfunction in the ISC circuit will set a trouble code. For testing procedures, see appropriate G - TESTS W/ CODES article in this section. Also, see ISC minimum and maximum adjustment procedures in D - ADJUSTMENTS article in this section.

IGNITION SYSTEM

NOTE: For basic ignition system checks, see F - BASIC TESTING article in this section.

TIMING CONTROL SYSTEMS

Electronic Spark Timing (EST) Advance System

1. A malfunction in the EST circuit should set a related trouble code. Start engine and warm to operating temperature. On vehicles equipped with a manual transmission, increase engine speed to about 2000 RPM. On vehicle equipped with an automatic transmission, slightly increase idle speed.
2. On all vehicles, ground "test" terminal "B" of ALDL. A noticeable change in engine speed should occur. If no change occurs, see DIAGNOSTIC CIRCUIT CHECK in F - BASIC TESTING article in this section.

Electronic Spark Control (ESC) System W/O ESC Controller (C-5)

1. An open or short circuit on the ESC wire to the ECM will set a related trouble code. A false detonation signal will not cause ECM to set a code.

2. If a "Scan" tester is available, connect it to the ALDL connector. Tap on engine next to knock sensor and note "knock" parameter. Knock should be indicated on "Scan" tester.
3. If a "Scan" tester is not available, connect tachometer to engine. Start engine and hold RPM above idle. Using a metal object, tap on engine close to knock sensor. A noticeable decrease in engine RPM should occur. If no RPM decrease occurred, check knock sensor-to-ECM circuit.
4. On vehicles equipped with automatic transmission, it may be necessary to place transmission in Drive for timing change to occur. Also, see KNOCK SENSOR in **ENGINE SENSORS & SWITCHES** .

Electronic Spark Control (ESC) Sys W/ESC Controller (C-5)

1. An open or short circuit on the ESC wire to the ECM will cause a loss of the 12-volt ESC controller signal. This will cause the ECM to fully retard ignition timing.
2. If a "Scan" tester is available, connect it to the ALDL connector. Tap on engine next to knock sensor and note "knock" parameter. Knock should be indicated on "Scan" tester.
3. If a "Scan" tester is not available, connect a DVOM to the ECM ESC signal terminal. With engine idling, 12 volts should be present at this terminal. Using a metal object, tap on engine close to knock sensor. Voltage signal at ECM terminal should drop to zero volts, and return when knock signal ceases.
4. If signal does not respond as described, check knock sensor signal to ESC controller. On vehicles equipped with automatic transmission, it may be necessary to place transmission in Drive for timing change to occur. Also, see KNOCK SENSOR in **ENGINE SENSORS & SWITCHES** .

EMISSION SYSTEMS & SUB-SYSTEMS

AIR INJECTION (C-6)

Air Pump (Belt-Driven)

Accelerate engine to approximately 1500 RPM and observe airflow from hoses. If airflow increases as engine is accelerated, pump is working properly. If airflow does not increase, check hoses, pump belt tension, leaky valves or defective air injection pump.

Check Valve

Detach check valve and blow through valve in direction of check valve flow (to cylinder head). Attempt to suck air back. Replace valve if airflow is allowed against the direction of flow.

Deceleration Valve (3.1L "F" Body)

1. Remove air cleaner. Remove and plug vacuum hose to air cleaner. Connect tachometer to engine. With engine at idle, remove deceleration valve signal hose from vacuum port.
2. Reconnect signal hose to deceleration valve while listening for airflow through ventilation pipe into deceleration valve. Engine speed should drop when hose is reconnected.
3. If airflow lasts less than one second or engine speed does not drop, check for defective hose(s) or deceleration valve.

Air Management System - Pressure Operated Electric Divert/Electric Switching (V8 "F" Body)

1. When engine is cold, port solenoid should be energized, allowing airflow to exhaust ports.
2. When engine is warmed up, port solenoid is de-energized (off) and converter solenoid should be energized, forcing airflow past the converter valve to the catalytic converter.
3. In the divert mode, both solenoids are de-energized, which opens the converter valve, allowing air out to divert/relief tube to atmosphere. If valves are not operating as specified, check circuit to solenoids. Repair or replace components as necessary.

EXHAUST GAS RECIRCULATION (C-7)

There are 3 types of EGR systems used: pulse width modulated backpressure EGR (positive and negative) with a control solenoid, pulse width modulated backpressure (positive and negative) EGR without a control solenoid, and digital EGR. To determine EGR system usage, see **EGR SYSTEM IDENTIFICATION** .

EGR SYSTEM IDENTIFICATION

Application	System Type	Solenoid Type
3.1	Digital	N/A
5.0L & 5.7L ("F" Body)	BP/EGR	Normally Open

System Test (Vacuum Operated)

Start and run engine to normal operating temperature. With engine at idle, push up on underside of EGR diaphragm. RPM should drop as EGR valve is opened. If RPM does not drop, remove EGR valve and check for blocked EGR passages. If RPM drops as diaphragm is lifted and EGR vacuum supply is regulated by an ECM-controlled solenoid, verify vacuum is available to solenoid at 2000 RPM and check solenoid using appropriate procedure. See appropriate EGR CONTROL SOLENOID procedure below.

CAUTION: Wear gloves if handling EGR valve when it is hot.

EGR Control Solenoid (Normally Open)

1. Disconnect solenoid harness connector. Install vacuum pump to vacuum source side of solenoid. Apply vacuum to solenoid. Vacuum should pass through when solenoid connector is disconnected.
2. Apply battery voltage and ground to solenoid terminals. With solenoid energized, apply vacuum to solenoid. Vacuum should not pass through solenoid. If results are not as specified, check EGR solenoid resistance. Solenoid should have at least 20 ohms of resistance.

Digital EGR Valve (3.1L)

1. If an EGR-related code is set, go to appropriate G - TESTS W/ CODES article in this section for diagnosis. Start and allow engine to idle. With engine at normal operating temperature, disconnect digital EGR valve solenoid harness connector.
2. Using a 12-volt power source and a fused jumper wire, very quickly energize EGR solenoid No. 1 Blue wire terminal on EGR valve. See **Fig. 6** RPM should drop slightly. Next, energize EGR solenoid No. 2 Brown wire terminal on EGR valve. RPM should drop slightly more than step 1). Energize EGR solenoid No. 3 Red wire terminal on EGR valve.
3. RPM should drop more than step 1) or 2). If RPM drops as indicated, EGR is okay. If RPM drop is not as indicated, check for plugged EGR passages or defective digital EGR valve. Check EGR solenoid resistance. See **DIGITAL EGR SOLENOID RESISTANCE** .

NOTE: **For additional testing procedures, see appropriate G - TESTS W/ CODES article in this section.**

Fig. 6: Typical Digital EGR Solenoid Circuit (3.1L)
Courtesy of GENERAL MOTORS CORP.

DIGITAL EGR SOLENOID RESISTANCE

Terminals	Ohms
A-D	20-30
B-D	20-30
C-D	10-17

Positive Backpressure EGR Valve

1. Place transmission in Park or Neutral. Set parking brake and block drive wheels. Connect tachometer. With engine running at normal operating temperature, run engine at 2000 RPM.

2. Disconnect vacuum hose from EGR valve and plug hose. EGR valve diaphragm should move down and engine RPM should increase.

   NOTE: On some engines with ECM-controlled solenoid, EGR vacuum is locked out in Park/Neutral and solenoid must be by-passed with vacuum supply hose.

3. Reconnect vacuum hose. EGR diaphragm should move up and engine RPM should decrease. A slight vibration of diaphragm plate may be noticed in backpressure EGR valves.
4. If engine RPM did not change and EGR diaphragm moved, the EGR valve is functioning properly. If engine RPM did not change and diaphragm did not move, remove EGR valve and apply 10 in. Hg to EGR vacuum signal port. EGR valve should not open.
5. If EGR valve opens, replace EGR valve. With vacuum still applied, direct a stream of air (15 psi maximum) into valve seat. EGR valve should open completely.
6. If air is not available, connect a short piece of hose over EGR valve seat. Connect vacuum pump to signal port. With thumb plugging intake port of EGR valve, operate vacuum pump while alternately blowing and pausing through hose.
7. With vacuum present at signal port, EGR valve should open while pressure is applied and should close when no vacuum is present.

Negative Backpressure EGR Valve

With engine off, disconnect vacuum hose to EGR valve. Connect vacuum pump to EGR and apply 10 in. Hg. EGR diaphragm should move up and stay up for 20 seconds. If valve does not operate as indicated, replace EGR valve.

FUEL EVAPORATION CONTROL (C-3)

CANISTER PURGE SOLENOID IDENTIFICATION

Application	Solenoid Type
3.1	Normally Open
5.0L & 5.7L	Normally Open

Canister Purge Solenoid (Normally Open)

1. Disconnect canister purge solenoid harness connector and vacuum hose. Apply vacuum to ported intake manifold vacuum side of solenoid valve. If vacuum holds, go to next step. If vacuum does not hold, replace canister purge solenoid.
2. Using a 12-volt power source, energize canister purge solenoid. Vacuum should release. If vacuum does not release, replace canister purge solenoid. Solenoid resistance should be at least 20 ohms.

Fuel Tank Pressure Control Valve

Apply approximately 15 in. Hg to fuel tank pressure control valve. The diaphragm should hold vacuum for at least 20 seconds. If fuel tank pressure control valve does not hold vacuum, replace tank pressure control valve.

POSITIVE CRANKCASE VENTILATION (PCV)

Required Service

The PCV system may require service for obstructions if any of the following conditions exist:

- Rough idle.
- Stalling or slow idle speed.
- Oil leaks.
- Oil in air cleaner.
- Sludge in engine.

A leaking PCV valve or hose could cause:

- Rough idle.
- Stalling.
- High idle speed.

If engine idles roughly, check for clogged PCV valve or plugged or broken hoses BEFORE adjusting idle. Check PCV valve application to ensure the correct valve is fitted. Replace PCV valve if required.

Checking PCV Valve Function

1. Remove PCV valve from rocker cover. Run engine at idle. Place thumb over open end of valve to check for vacuum. If there is no vacuum at valve, check for obstruction in manifold port, hoses or PCV valve. Repair or replace as necessary.
2. Turn engine off. Remove PCV valve. Shake valve and listen for rattle of check valve inside. If a clear rattle is not heard, replace PCV valve.
3. Visually inspect valve for varnish or deposits which may make PCV valve operation sticky or restricted, or cause incomplete seating of valve. Replace if necessary.
4. An engine must be sealed for the PCV system to function as designed. If leakage, sludging or dilution of oil is noted and the PCV system is functioning properly, check engine for cause and repair as required to ensure PCV system will continue to function properly.

5. An engine operating without any crankcase ventilation can be damaged, so it is important to replace PCV valve and air cleaner breather at regular intervals (at least every 30,000 miles). Check all hoses and clamps for failure or deterioration.

THERMOSTATIC AIR CLEANER

Temperature Sensor (Vacuum Motor Type)

1. Air cleaner temperature should be less than 86°F (30°C). Place thermometer as close as possible to sensor inside air cleaner. Start and idle engine. Damper door should close off outside air immediately.
2. When damper door starts to open snorkel passage, remove air cleaner cover and read thermometer temperature. Thermometer should read about 131°F (55°C).
3. If damper door does not open to outside air at the specified temperature, replace defective thermostatic air cleaner temperature sensor.

Vacuum Motor Diaphragm

1. Turn engine off. Disconnect vacuum hose to vacuum motor. Apply 7 in. Hg to vacuum motor. Damper door should close. If door does not close, check if linkage is properly hooked up.
2. With vacuum still applied, trap vacuum in vacuum diaphragm motor by bending hose. Damper door should remain closed. If damper door does not remain closed, replace vacuum diaphragm motor assembly.

MISCELLANEOUS CONTROLS

NOTE: Although some of the controlled devices listed here are not technically engine performance components, they can affect driveability if they malfunction.

HOT LIGHT OR COOLANT TEMPERATURE LIGHT

NOTE: These checks assume vehicle is not overheating. Verify proper operation of cooling system prior to diagnosing hot light. The coolant temperature sensor, in rare cases, may fail to indicate the correct coolant temperature without setting a malfunction code (Code 14 or 15). This could result in turning on the hot light without having an overheating condition. It could also result in engine overheating without turning on the hot light. Check coolant sensor temperature-to-resistance values in K - SENSOR RANGE CHARTS article in this section.

Hot light is powered by the 10-amp INDIC or GAGES fuse. Light will turn on when ECM provides a ground for the circuit. If circuit grounds between light and ECM, light will illuminate any time the ignition is turned on.

1. Turn ignition on with engine off (bulb test position). If hot light illuminates, go to step 3). If hot light does not illuminate, check the following:
    - 10-amp INDIC OR GAGES fuse.
    - Faulty instrument cluster bulb.
    - Open circuit between fuse and hot light.
2. Backprobe ECM hot light driver terminal with a test light to battery voltage. Turn ignition on. If test light does not illuminate, ECM terminal connection is bad or ECM is faulty. If test light illuminates, turn ignition off. Disconnect ECM connectors. Jumper ECM hot light driver harness terminal to ground. Turn ignition on. If hot light does not illuminate, check for open circuit between hot light and ECM. If light does not illuminate and all circuits are intact and power is available to light, instrument cluster must be replaced.
3. Start engine. If test light goes off, no problem is evident. If test light is on, turn ignition off. Disconnect ECM connector. Probe ECM hot light driver harness terminal with a test light to battery voltage. If light is off, replace ECM. If light is on, repair short to ground in hot light driver circuit. If no short is present, replace instrument cluster.

TRANSMISSION (C-8)

NOTE: ECM transmission controls are also covered in greater detail in appropriate TRANSMISSION article in the TRANSMISSION SERVICING Section for domestic vehicles.

Converter Clutch Solenoid

Disconnect harness connector to TCC solenoid. Measure resistance between TCC solenoid terminals "A" and "D". Solenoid resistance should be greater than 20 ohms. See **Fig. 7** - **Fig. 9** .

NOTE: Some solenoids have an internal pressure switch in series with the solenoid winding and will not show continuity until that pressure switch is applied by transmission hydraulic pressure. See Fig. 7 - Fig. 9 .

Converter Lock-Up Signal At Transmission

1. Warm engine to operating temperature. Raise vehicle and support drive wheels. Support suspension where necessary to prevent damage to drive axles.
2. Disconnect converter clutch connector at transmission. Connect a test light across terminals "A" and "D" of converter clutch harness. Start engine and place transmission in Drive. Accelerate vehicle to 45 MPH and note test light.
3. If test light is not on, check solenoid power supply wire of harness for open or short to ground. Check ground circuit for open between harness connector and

ECM. If harness is okay, see CONVERTER LOCK-UP SIGNAL FROM ECM below.

Converter Lock-Up Signal From ECM

1. Warm engine to operating temperature. Raise vehicle and support drive wheels. Support suspension where necessary to prevent damage to drive axles.
2. Connect a test light to battery voltage. Touch TCC control driver terminal with test light. On some vehicles this is terminal "F" of the ALDL connector. See **Fig. 7** - **Fig. 9** . Accelerate vehicle to 45 MPH and note test light. If test light does not illuminate, problem is a faulty ECM connector or ECM.

Fig. 7: Converter Clutch Schematic (3.1L "F" Body)
Courtesy of GENERAL MOTORS CORP.

Fig. 8: Converter Clutch Schematic (5.0L VIN E - "F" Body)
Courtesy of GENERAL MOTORS CORP.

Fig. 9: Converter Clutch Schematic (5.0L & 5.7L PFI - "F" Body)
Courtesy of GENERAL MOTORS CORP.

Shift Light (Man. Trans.)

1. These tests assume a shift light problem exists. Use this procedure only if the light will not illuminate, or illuminates all of the time.
2. Turn ignition on, with engine off. Note shift light. Shift light should not be on. If light is on, check for a short to ground between the bulb and the ECM, or a bad ECM. See **Fig. 10** .
3. With ignition on and engine off, ground test terminal of ALDL connector. SERVICE ENGINE SOON light should start to flash and shift light should come on. If light comes on, go to next step. If SERVICE ENGINE SOON light does not flash, perform DIAGNOSTIC CIRCUIT CHECK in F - BASIC TESTING article in this section.
4. If shift light does not come on, ground Tan/Black wire at appropriate ECM terminal using a jumper wire. See **SHIFT LIGHT CIRCUIT IDENTIFICATION** . If light still does not come on, check for blown GAUGES fuse, blown bulb or open circuit between fuse and ECM. If light comes on when grounding terminal with a jumper wire, problem is a bad ECM connection or bad ECM.

SHIFT LIGHT CIRCUIT IDENTIFICATION

Application	ECM Terminal
Camaro & Firebird	B7F

Fig. 10: Shift Light Schematic
Courtesy of GENERAL MOTORS CORP.

A/C CLUTCH (C-10) & ELECTRIC COOLING FAN (C-12)

NOTE: For additional information on electric cooling fans, see ELECTRIC COOLING FANS article in the ENGINE COOLING Section.

A/C Clutch Relay

1. Disconnect A/C clutch relay harness connector. Using proper mini-schematic and an ohmmeter, check continuity between A/C clutch relay winding terminals. Continuity should exist. Check continuity between clutch drive circuit terminals of relay. Continuity should not exist.
2. Using jumper wires, apply ground and battery voltage to relay winding of relay. Continuity should now exist between clutch drive circuit terminals of relay. Replace A/C clutch relay if readings are not as specified.

Cooling Fan System & Quad-Driver Check

1. Connect a test light to battery voltage. Touch test light probe to the cooling fan control driver terminal of the ECM. See **Fig. 11** - **Fig. 24** . Disconnect coolant temperature sensor. This should set a code, causing ECM to engage cooling fan through relay. On some models it may be necessary to jumper the coolant temperature sensor harness connectors. On some models, grounding the ALDL with the ignition on and engine off will cause the ECM to activate the cooling fan control driver (ground circuit).
2. If test light illuminates and cooling fan does not come on, check cooling fan relay, power circuits, cooling fan motor, and relay and fan motor ground circuits. If test light does not illuminate, problem is a faulty ECM connector or ECM. Clear trouble code(s) from ECM memory after testing.
3. If cooling fan functions normally during testing but fails to operate under normal conditions, check ECM monitored inputs which affect cooling fan operation. These include the following: coolant temperature sensor, A/C request signal from A/C control switch and A/C pressure sensor or pressure/temperature switch signals (if equipped).

Cooling Fan Relay

1. Disconnect cooling fan relay harness connector. Using an ohmmeter, check continuity of relay winding. See **Fig. 11** - **Fig. 24** . Continuity should exist. Check continuity across power delivery terminals of relay. With relay not energized, no continuity should exist.
2. With ohmmeter still attached to power delivery terminals of relay, apply battery voltage and ground to energize relay winding. Continuity should now be present between cooling fan relay power delivery terminals. Replace cooling fan relay if readings are not as specified.

Cooling Fan Motor

Disconnect cooling fan motor harness connector. Apply battery voltage to one of the fan motor terminals and jumper the other terminal to ground. Fan motor should activate. If fan motor does not activate, replace faulty fan motor.

NOTE: For a more specific system testing, refer to the following C-10 or C-12 diagnostic charts. If any chart other than a C-10 or C-12 chart is referenced, see appropriate G - TESTS W/ CODES article in this section.

CHART C-12, 3.1L (1 OF 2), COOLING FAN CKT DIAGNOSIS

Cooling fan is ECM controlled based on inputs from coolant temperature sensor, A/C fan control switch and Vehicle Speed Sensor (VSS). ECM grounds circuit No. 335, energizing cooling fan relay and turning on cooling fan. ECM grounds circuit No. 335 when coolant temperature is more than 228°F (109°C) or when A/C has been requested, and fan control switch opens with high A/C pressure, about 240 psi (16.9 kg/cm^2). When cooling fan is turned on, ECM will keep fan energized at least 30 seconds or until vehicle speed exceeds 70 MPH. Also, if Code 14 or Code 15 is set or ECM is in fuel back-up mode, fan will run continuously. On vehicles not equipped with A/C, circuit No. 732 is jumpered to ground so fan does not run continuously.

NOTE: Test numbers refer to test numbers on diagnostic charts.

1. With diagnostic terminal grounded, cooling fan control driver will close, which should energize cooling fan relay.
2. If A/C fan control switch or circuit is open, fan would run whenever engine is running.
3. With A/C clutch engaged, A/C fan control switch should open whenA/C high pressure exceeds approximately 200 psi (14.1 kg/cm^2). This signal should cause ECM to energize cooling fan relay.

Diagnostic Aids

If an overheating condition is suspected, verify if it is due to an actualboilover. If gauge or light indicates an overheat condition and boilover is not evident, inspect gauge circuit for malfunction.

If vehicle is overheating and gauge or light indicates so but cooling fan is not coming on, check coolant sensor temperature using a Tech 1 scan tester. Sensor may have shifted out of calibration and should be replaced. If engine is overheating and cooling fan is on, check cooling system.

Fig. 11: Cooling Fan, Schematic (1 of 2), 3.1L
Courtesy of GENERAL MOTORS CORP.

Fig. 12: Cooling Fan, Flow Chart (1 of 2), 3.1L
Courtesy of GENERAL MOTORS CORP.

CHART C-12, 3.1L "F" (2 OF 2), BODY COOLING FAN CKT DIAGNOSIS

NOTE: Test numbers refer to test numbers on diagnostic charts.

1. B+ should be available to terminals "D" and "E" when ignition is on.
2. Checks ability of ECM to ground circuit No. 335. SERVICE ENGINE SOON light should also be flashing at this point. If SERVICE ENGINE SOON light is not flashing, see DIAGNOSTIC CIRCUIT CHECK in F - BASIC TESTING article in this section.
3. Jumpering terminals "A" and "E" together by-passes relay. Cooling fan motor should run.

Fig. 13: Cooling Fan, Schematic (2 of 2), 3.1L
Courtesy of GENERAL MOTORS CORP.

Fig. 14: Cooling Fan, Flow Chart (2 of 2), 3.1L
Courtesy of GENERAL MOTORS CORP.

CHART C-10, 3.1L, A/C CLUTCH CTRL CKT DIAGNOSIS

A/C relay is ECM controlled to delay A/C clutch engagement .4 second after A/C is turned on. This allows IAC motor to adjust engine RPM before A/C clutch engages.

ECM also causes relay to disengage A/C clutch during WOT operation. A/C relay is energized when ECM provides ground to circuit No. 459.

NOTE: Test numbers refer to test numbers on diagnostic charts.

1. ECM will only energize relay when engine is running. This test will determine if relay or circuit No. 459 is faulty.
2. To engage compressor clutch, the pressure cycling switch must be closed to provide 12 volts to the relay, and the high pressure switch must be closed, so that A/C request (12 volts) will be present at ECM.
3. Determines if signal is reaching ECM on circuit No. 366 from A/C control panel. Signal should only be present when A/C or defrost mode has been selected.
4. This step checks for a short to ground in any part of the A/C request circuit, circuit No. 67 to relay, circuit No. 59 to A/C clutch, or a shorted A/C clutch unit.
5. If ECM sees a high power steering pressure signal, ECM will disengage A/C clutch.
6. With engine idling and A/C on, ECM should be grounding circuit No. 459, which should cause test light to illuminate.

Diagnostic Aids

If complaint is insufficient cooling, problem may be an inoperative cooling fan or A/C pressure fan switch. The cooling fan should engage when A/C pressure exceeds a value to open switch, which causes ECM to energize cooling fan relay. See CHART C-12 for cooling fan diagnosis. If fan operates correctly, check for a basic A/C problem.

Fig. 15: A/C Clutch Control, Schematic, 3.1L
Courtesy of GENERAL MOTORS CORP.

Fig. 16: A/C Clutch Control, Flow Chart, 3.1L
Courtesy of GENERAL MOTORS CORP.

CHART C-10, A/C CLUTCH CTRL CKT DIAGNOSIS, 5.0L (VIN E)

When A/C selector switch is turned to ON position, ignition voltage is applied to A/C pressure cycling switch through the control head. If there is sufficient A/C charge, the pressure cycling switch will be closed to complete circuit to ECM and to A/C high pressure switch. If A/C head pressure is not too high, circuit would be completed to A/C clutch coil.

NOTE: Test numbers refer to test numbers on diagnostic charts.

1. Checks for short to ground in circuits No. 59, No. 66 or No. 67, if fuse was open. Check for shorted compressor clutch coil. Check A/C system for further diagnosis of power feed circuit to the control head.
2. Check to determine if ECM is capable of detecting A/C status.
3. If A/C clutch engaged, check for 12 volt supply at ECM terminal B8. If voltage is present, a faulty connection exists at ECM or a faulty ECM.
4. Before replacing control head, perform thorough A/C system diagnosis.

Fig. 17: Cooling Fan, Schematic, 5.0L (VIN E)
Courtesy of GENERAL MOTORS CORP.

Fig. 18: Cooling Fan, Flow Chart, 5.0L (VIN E)
Courtesy of GENERAL MOTORS CORP.

CHART C-12, 5.0L (VIN F) & 5.7L (VIN 8) (1 OF 2), COOLING FAN CKT DIAGNOSIS

This system uses 2 cooling fans. Primary cooling fan is ECM controlled and secondary cooling fan is activated by A/C pressure and/or coolant temperature. Primary cooling fan is ECM controlled based on inputs from coolant temperature sensor and fan control switch. Fan should run if coolant temperature is greater than 223°F (106°C). Battery voltage is supplied to fan relay on terminal "E" and voltage through ignition switch is supplied to fan relay terminal "D". Grounding circuit No. 335 (relay terminal "F") will energize relay and supply battery voltage to fan motor. Once fan relay is energized, ECM will keep relay on at least 15 seconds. ECM will remove ground on circuit No. 335 if vehicle speed is more than 40 MPH, unless engine is overheating.

A/C cooling fan pressure switch, mounted in A/C high pressure line, will close when head pressure exceeds 233 psi (16.4 kg/cm^2), energizing secondary cooling fan relay and turning on secondary cooling fan. Secondary cooling fan will also energize if secondary cooling fan temperature switch closes. ECM will turn on primary cooling fan if Code 14 or 15 sets or if ECM is operating in fuel back-up mode.

Diagnostic Aids

If an overheating condition is suspected, verify if it is due to an actual boilover. If gauge or light indicates an overheat condition and boilover is not evident, inspect gauge circuit for malfunction.

If vehicle is overheating and gauge or light indicates so but cooling fan is not coming on, check coolant sensor temperature using a "Scan" tester. Sensor may have shifted out of calibration and should be replaced. If engine is overheating and cooling fan is on, check cooling system.

Fig. 19: Cooling Fan, Schematic (1 of 2), 5.0L VIN F & 5.7L VIN 8
Courtesy of GENERAL MOTORS CORP.

Fig. 20: Cooling Fan, Flow Chart (1 of 2), 5.0L VIN F & 5.7L VIN 8
Courtesy of GENERAL MOTORS CORP.

CHART C-12, 5.0L (VIN F) & 5.7L (VIN 8) (2 OF 2), COOLING FAN CKT DIAGNOSIS

Diagnostic Aids

If an overheating condition is suspected, verify if it is due to an actual boilover. If gauge or light indicates an overheat condition and boilover is not evident, inspect gauge circuit for malfunction.

If vehicle is overheating and gauge or light indicates so but cooling fan is not coming on, check coolant sensor temperature using a "Scan" tester. Sensor may have shifted out of calibration and should be replaced. If engine is overheating and cooling fan is on, check cooling system.

Fig. 21: Cooling Fan, Schematic (2 of 2), 5.0L VIN F & 5.7L VIN 8
Courtesy of GENERAL MOTORS CORP.

Fig. 22: Cooling Fan, Flow Chart (2 of 2), 5.0L VIN F & 5.7L VIN 8
Courtesy of GENERAL MOTORS CORP.

CHART C-10, 5.0L (VIN F) & 5.7L (VIN 8), A/C CLUTCH CTRL CKT DIAGNOSIS

When A/C selector switch is turned on, ignition voltage is applied to the A/C pressure cycling switch through the control head. If there is sufficient A/C charge, the pressure cycling switch will be closed to complete circuit to the ECM and to the A/C high pressure switch. If A/C head pressure is not too high, the circuit would be completed to the A/C clutch coil.

NOTE: Test numbers refer to test numbers on diagnostic charts.

1. Checks for short to ground in circuits No. 59, No. 66 or No. 67, if fuse was open. Check for shorted compressor clutch coil. Check A/C system for further diagnosis of power feed circuit to the control head.
2. Check to determine if ECM is capable of detecting A/C status.

3. If A/C clutch engaged, check for 12 volt supply at ECM terminal B8. If voltage is present, a faulty connection exists at the ECM or ECM is faulty.
4. Before replacing control head, perform thorough A/C system diagnosis.