1975-79 COMPUTERIZED ENGINE CONTROLS
Chrysler Corp. Electronic Feedback Carb.

1979 Chrysler Corp.

DESCRIPTION

The Electronic Feedback Carburetor (EFC) system is used on Aspen and Volare models with 225" 1-barrel California engines. In addition to Electronic Spark Control (ESC) components, the Electronic Feedback Carburetor (EFC) system uses a specially calibrated feedback carburetor, a regulator valve, an oxygen sensor, and a 3-way catalytic converter. *See Figs. 1 and 2.*

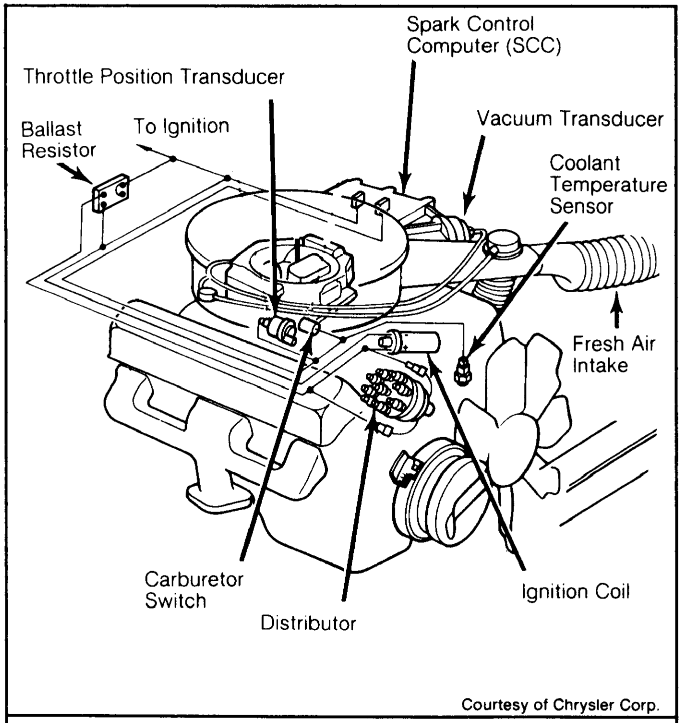


Fig. 1: Electronic Spark Control (ESC) System

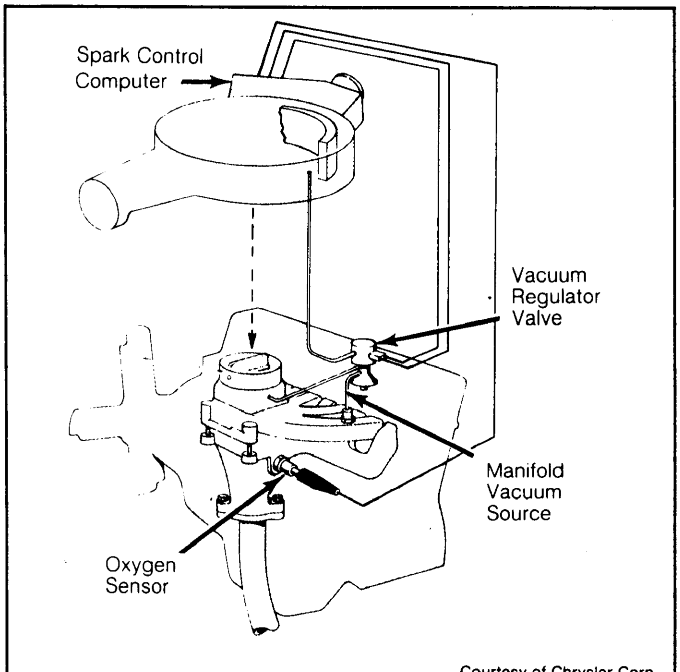


Fig. 2: Electronic Feedback Carburetor (EFC) System

SPARK CONTROL COMPUTER

The Spark Control Computer (SCC) is the heart of the EFC system. It gives the EFC/ESC system the capability of igniting a lean air/fuel mixture according to different modes of engine operation by delivering an infinite amount of variable advance curves. There are 2 slightly different computers depending upon application.

The SCC determines the exact instant when ignition is required, then feeds the ignition coil to produce electrical impulses which fire the spark plugs. The SCC consists of 2 electronic circuit boards, which receive signals from system sensors and instantly makes any necessary correction to engine advance or retard to maintain maximum efficiency.

The SCC provides optimum engine operating characteristics for ignition timing and carburetor operation. The SCC monitors voltage generated by the oxygen sensor and receives input signals from the sensors of the ESC system. The SCC interprets the various inputs and then transmits the proper output signal to the solenoid-operated vacuum regulator valve, which in turn forwards a vacuum signal to the feedback carburetor.

PICK-UP COIL

Located in the distributor, this unit supplies the Spark Control Computer (SCC) with information concerning engine speed and crankshaft location. The SCC is able to supply proper maximum advance for any given engine condition through this signal.

COOLANT TEMPERATURE SENSOR

Located on the water pump housing or intake manifold, it signals the Spark Control Computer (SCC) when engine coolant temperature is below 150°F.

THROTTLE POSITION TRANSDUCER

This unit is located on the carburetor and signals the Spark Control Computer (SCC) the position and rate of change of the throttle plates. Additional spark advance will be given by the SCC when the throttle plates start to open, and in every position to full throttle.

CARBURETOR SWITCH SENSOR

Located on the idle stop solenoid or on the air conditioning solenoid, this switch tells the Spark Control Computer (SCC) if the engine is at idle or off idle.

VACUUM TRANSDUCER

The vacuum transducer provides an intake manifold vacuum signal to the Spark Control Computer (SCC). The higher the vacuum, the more spark advance that is given. To obtain the greatest amount of advance for any inch of vacuum, the carburetor switch sensor must be open for a specified time. The advance at this time happens slowly.

If the carburetor switch closes, the advance is cancelled, but the SCC puts the last point of advance in memory; then the advance slowly drops to zero. If the carburetor switch is opened before the advance drops to zero, the advance at point of memory, is restored. If zero advance is reached, the advance must start from zero.

OXYGEN SENSOR

Located in exhaust manifold, the oxygen sensor detects changes in air/fuel ratio. When heated by exhaust gases, oxygen sensor generates a voltage signal which varies with amount of oxygen sensed.

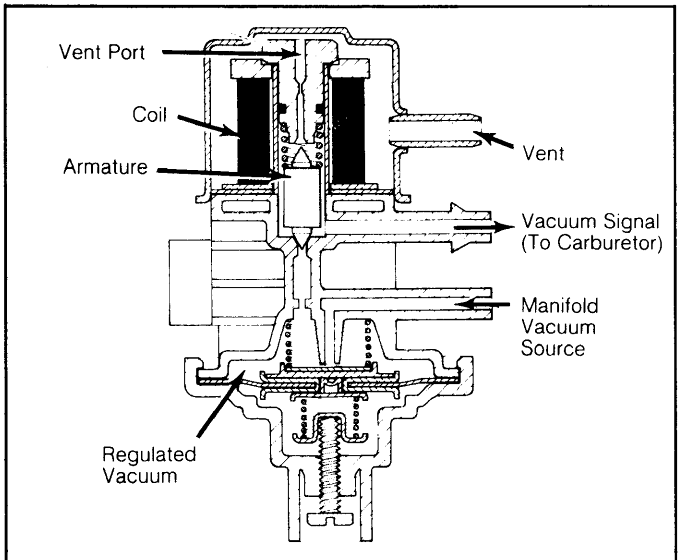
At high oxygen content (lean mixture), the voltage signal is low (.2 volts). With low oxygen (rich mixture), the voltage signal is high (.8 volts). These voltage signals are used by the Spark Control Computer (SCC) to calculate and adjust air/fuel mixture (through regulator valve) to its proper ratio.

To ensure proper function, oxygen sensor must be replaced every 15,000 miles. A mileage counter is in-line with speedometer cable and activates a maintenance reminder light every 15,000 miles. A reset screw turns off light and resets counter.

VACUUM REGULATOR VALVE

A solenoid-operated vacuum regulator valve converts electrical signals from SCC to vacuum signals for controlling air/fuel ratio and maintaining it at 14.7:1. Intake manifold vacuum is supplied to a control diaphragm within the regulator through which a vacuum signal of 0-5 in. Hg is generated.

Solenoid portion of valve contains an armature which acts as an on-off switch. When energized, solenoid pulls armature up so vacuum from the regulator can pass to the carburetor. *See Fig. 3*. When de-energized, armature is down, no vacuum passes to carburetor. Vacuum signal within regulator is vented to atmosphere. Solenoid is energized and de-energized rapidly by SCC which responds to signals from the oxygen sensor. The rapid up and down movement of the armature determines average vacuum signal supplied to carburetor vacuum channel port. Control of the on or off time is determined by the Spark Control Computer through an electrical signal to the solenoid. This signal operates in a range of about 10 cycles per second.



Courtesy of Chrysler Corp.

Fig. 3: Vacuum Regulator Valve

FEEDBACK CARBURETOR

A specially calibrated carburetor is used to maintain an air/fuel mixture within limits required for efficient emission control by the 3-way catalytic converter. The Holley 6145 carburetor contains 2 special diaphragms, one for controlling idle system and one for main metering system. *See Fig. 6*.

A "lean" command from Spark Control Computer to the vacuum regulator valve will result in an increasing vacuum level to the carburetor. This causes idle diaphragm to move its idle air bleed rod upward, resulting in increased idle air bleed. At the same time, main metering diaphragm moves its rod so reduced fuel flow results. A "rich" command from the computer causes the opposite result.

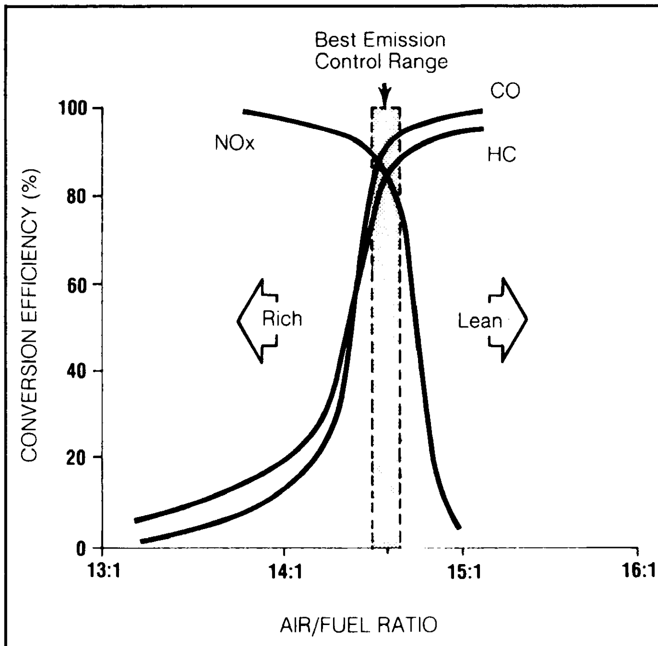
The carburetor is calibrated so that the desired nominal flow is obtained with a vacuum signal of 2.5 in. Hg. This vacuum signal can be monitored with a vacuum gauge at carburetor. *See Fig. 6*. If the air/fuel mixture is forced to "lean" by creating a large vacuum leak at the carburetor, the computer should send a "rich" command to the vacuum regulator valve and should show up on the vacuum gauge as low vacuum (about 1/2 to 3/4 in. Hg). If the air/fuel mixture is forced "rich" by closing off air inlet or by safely adding a small amount of propane at the carburetor, the computer should send a "lean" command to the vacuum regulator valve and should show up on the vacuum gauge as high vacuum (about 5 in. Hg).

NOTE: For additional information see Holley 6145 Single Barrel carburetor article in FUEL SYSTEMS section.

CATALYTIC CONVERTERS

Two types of catalytic converters are used with the EFC system, an oxidation catalyst for controlling HC and CO and a 3-way catalyst for controlling all 3 emissions (HC, CO and NOx). The 3-way catalytic converter is specially coated with Rhodium, which gives it the ability to convert NOx into nitrogen and oxygen.

In the following graph, it can be seen that proper air/fuel ratio is essential for control of all 3 emissions by the 3-way catalytic converter. Also, the effect of a too-rich or too-lean mixture can be seen. *See Fig. 4*.



Courtesy of Chrysler Corp.

Fig. 4: Air/Fuel Ratio to Emissions Output Graph

OPERATION

ELECTRONIC SPARK CONTROL

The Electronic Spark Control ignition system functions in 2 modes, the start mode and the run mode. During engine cranking the start mode is in operation. A fixed advance is established in the ignition system during this mode. The pick-up coil tells the computer that the engine is in the cranking/start mode.

When the engine is started, the run mode takes over. The pickup coil signals the computer during the run mode; however, the amount of advance will be determined by the signals received from all system sensors.

Should the run mode fail, the start mode will take over. At this point, the fixed amount of advance will again be supplied and engine operation will continue but will be below standard.

If the computer should fail, the system will switch to the "limp-in" mode. This will enable the engine to continue running, but poor performance will be experienced. Should the pick-up coil or start mode of the computer fail, the engine will not start.

ELECTRONIC FEEDBACK CARBURETOR SYSTEM

The Electronic Feedback Carburetor (EFC) system operates in 2 modes, open loop mode and closed loop mode. During the open loop mode, system operates in response to pre-programmed electronic commands and signals other than those from the oxygen sensor. In the closed loop mode, system is responsive to oxygen levels in the exhaust as picked up by the oxygen sensor.

Open Loop Mode - This mode occurs when any of the following conditions are present: coolant temperature below 150°F, oxygen sensor temperature below 660°F, low manifold vacuum, oxygen sensor inoperative, or during hot engine start-up.
During start-up and acceleration, the SCC disregards any oxygen sensor signals and operates on a fixed value of 2.5 volts. This results in temporarily richer mixtures for better performance.
During warm-up, the air injection system supplies air to the exhaust manifold (ahead of both catalytic converters). This additional air allows complete oxidation of HC and CO in the main converter during this rich mixture period (NOx is not a factor since low temperatures do not create this emission). This "burning" helps quickly raise exhaust system temperatures, allowing the oxygen sensor and 3-way catalytic conveter to warm-up faster.
At normal operating temperatures, the air switching valve in the air injection system directs additional air from the exhaust ports to the exhaust pipe, just ahead of the oxidation catalyst. The closed loop mode comes into operation.

Closed Loop Mode - During this mode, the Spark Control Computer is operational and continuously corrects the air/fuel mixture toward 14.7:1 air/fuel ratio. When the computer receives voltage signals from the oxygen sensor, it combines this signal with others from the ESC system to energize or de-energize the solenoid on the vacuum regulator to control the vacuum signal to the carburetor.
In addition, during the closed loop mode, this system offers the built-in ability to maintain a constant air/fuel mixture regardless of altitude, because of its oxygen-sensing operation.

ELECTRONIC SPARK CONTROL SYSTEM TESTS

IGNITION SYSTEM STARTING TEST

1) Remove coil wire from distributor cap. Hold end of wire about 1/4" away from a good engine ground. Have an assistant crank engine while you look for a bright Blue spark at coil wire.
2) If there is no spark, go to FAILURE TO START TEST. If spark is constant and bright Blue, continue to crank engine while moving coil wire away from ground and look for arcing at coil tower (between coil terminals). If arcing occurs, replace coil.
3) If spark is good and there is no arcing at coil tower, ignition system is producing necessary high secondary voltage. Make sure this spark is getting to plugs by checking distributor rotor, cap, spark plugs, and plug wires.
4) If ignition system checks out okay, but engine still will not start, the ignition system is not the problem. It will be necessary to check fuel system and engine mechanical items.

FAILURE TO START TEST

NOTE: Perform IGNITION SYSTEM STARTING TEST first. Failure to do so may lead to unnecessary diagnosis time and incorrect results.

1) Use a voltmeter to measure battery voltage. Note and record this reading. Battery specific gravity must be at least 1.220 (temperature corrected) in order to deliver proper voltage to the cranking (ignition) system.
2) Disconnect coolant sensor lead, insert a piece of paper between idle adjustment screw and carburetor switch to ensure screw does not contact switch. Connect a voltmeter negative lead to ground.
3) Turn ignition on and measure voltage at carburetor switch terminal. If voltage is greater than 5 volts but less than 10 volts, go to step **10)**.
4) If voltage in step **3)** is more than 10 volts, ensure there is continuity between terminal No. 10 of 10-pin connector and engine ground.
5) If voltage in step **3)** is less than 5 volts, turn ignition off and detach 10-pin connector from bottom of Spark Control Computer.
6) Turn ignition back on and measure voltage at terminal No. 2. Voltage should be within 1 volt of noted battery voltage.
7) If voltage is correct, go to next step. If not, check wiring between terminal No. 2 of 10-pin connector and ignition switch for opens, shorts or poor connections.
8) Turn ignition off. Disconnect 10-pin connector from bottom of computer. Check for continuity between terminal No. 7 of 10-pin connector and carburetor switch terminal. If there is no continuity, check for opens, shorts or poor connections.
9) If continuity exists between carburetor switch and 10-pin connector, test for continuity between terminal No. 10 of 10-pin connector and ground. If continuity exists, replace Spark Control Computer. If no continuity exists, check wire for opens or poor connections.

NOTE: Proceed with remainder of this test only if engine fails to start.

10) Turn ignition on. Check voltage between ground and terminal No. 1 of 10-pin connector. Voltage should be within 1 volt of noted battery voltage. If voltage is correct, go to next step. If not, check wiring and connections between terminal No. 1 and ignition switch.
11) Turn ignition off and measure resistance between terminals No. 5 and 9. If resistance is between 150-900 ohms, go to step **13)**. If not, disconnect pick-up coil leads from distributor.
12) Measure resistance at lead going into distributor. If resistance is in 150-900 ohms range, there is an open, shorted or poor connection between distributor and terminals No. 5 and 9 of 10-pin connector. If resistance is still out of specifications, pick-up coil is bad.
13) Connect one lead of ohmmeter to engine ground, and with other lead check for continuity at each terminal of lead going into distributor. There should be no continuity. Reconnect distributor lead. If there is continuity, replace pick-up coil.
14) Remove distributor cap and check pick-up coil air gap, adjust gap if necessary. Install distributor cap, reconnect all wiring and try to start engine. If engine fails to start, replace Spark Control Computer.
15) If, after installing new computer, engine still fails to start, install original computer and repeat test sequence (one of the steps was probably improperly performed or false readings were obtained).

POOR PERFORMANCE TESTS

NOTE: Be sure initial timing and curb idle are set before beginning the following tests.

Start Timer Advance Timing Test - 1) Connect adjustable timing light to engine so total timing advance can be checked at crankshaft. Connect a jumper wire between carburetor switch and a known good ground. Start engine.
2) Continue to observe timing for one minute while adjusting timing light to maintain initial timing. Advance should slowly decrease to initial timing in about one minute.
3) If timing did not increase and/or decrease to initial timing, replace Spark Control Computer. If timing performed satisfactorily, go to Speed Advance Schedule Test. Do not remove timing light or jumper wire (if used).

Speed Advance Schedule Test - 1) Connect a jumper wire between carburetor switch terminal and a good ground. Disconnect wiring harness connector from throttle position transducer.
2) Start and run engine for 2 minutes. Raise RPM to specifications. Adjust timing light so that initial timing is seen at timing plate. Additional advance seen on timing light meter should be as specified. If not, replace computer and repeat test. If within specifications, ensure throttle position transducer is adjusted properly and go to Throttle Advance Schedule Test.

Throttle Advance Schedule Test - 1) Turn ignition off. Disconnect 10-pin connector from Spark Control Computer. With ohmmeter, measure resistance between terminals No. 8 and 9 of 10-pin connector. If reading is 50-90 ohms, reconnect computer and go to step **3)**.
2) If reading is incorrect, remove connector from throttle position transducer and measure resistance at transducer terminals. If transducer resistance is 50-90 ohms, an open, short or poor connection exists between terminals No. 8 and 9 and transducer. If resistance is incorrect, replace transducer and go to next step.
3) Reconnect all wiring and turn ignition on. Connect voltmeter negative lead to ground and touch positive lead to each transducer terminal. Fully open and then close throttle. A 2 volt change should occur with throttle action.
4) Position throttle linkage on fast idle cam and ground carburetor switch with jumper wire. Disconnect wiring harness from throttle position transducer and connect it to a known good transducer (for testing purposes).
5) Move transducer core in until fully bottomed. Start engine, wait 90 seconds, then pull transducer core slowly out to about 1 inch. *See Fig. 5.*
6) Adjust timing light so initial timing is seen at timing plate. Meter on timing light should show additional amount of advance as indicated under specifications.
7) If within specifications, move core back into transducer and timing should return to initial setting. If timing returns to initial setting, go to next step. If timing did not react as indicated, replace Spark Control Computer. Repeat test starting at step **3)**. If vehicle fails test, replace throttle position transducer.
8) Return timing light advance meter to zero. Observe timing marks while having an assistant rapidly move core of test throttle position transducer in and out 1 inch (5-6 times).
9) Timing should advance as specified for about 1 second, then return to zero. If advance is not as specified, replace Spark Control Computer. Repeat test starting at step **3)**, using original transducer. If test fails, replace original transducer.

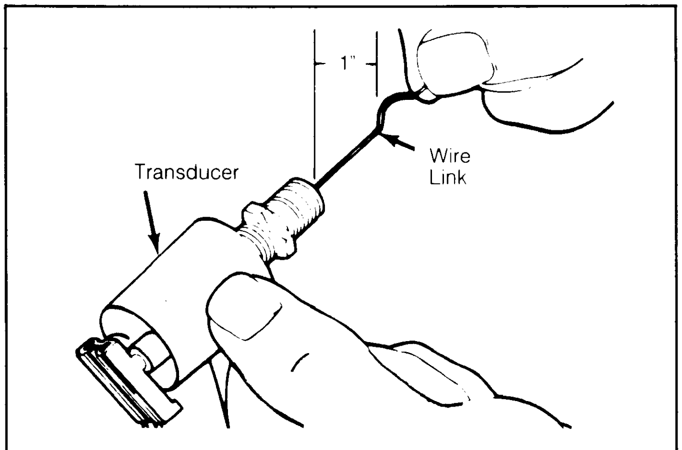


Fig. 5: Actuating Throttle Position Transducer

POOR FUEL ECONOMY & UNUSUALLY HIGH IDLE SPEED TESTS

Coolant Sensor Tests - Connect ohmmeter to ground and touch terminal of sensor with other ohmmeter lead. With engine cold, Black/Red wire should have continuity. At normal operating temperature, no continuity should exist.

Vacuum Advance Schedule Test - 1) While proceeding through following test, be sure to check each specification when indicated. See appropriate table in DISTRIBUTOR & IGNITION SYSTEMS section of this manual.
2) Connect magnetic timing probe or adjustable timing light and tachometer to engine. Start engine and warm to normal operating temperature. If already at operating temperature, wait at least 1 minute for start-up advance to return to basic timing. Place transmission in Neutral and apply parking brake.
3) Check basic timing and adjust if not to specification. Remove and plug vacuum line at vacuum transducer. Using a jumper wire, ground carburetor switch and (if equipped) remove connector from throttle position transducer. Set engine speed to 1100 RPM.
4) Check speed advance timing. Be sure it is at specifications. With engine at 1100 RPM, remove carburetor switch ground and reconnect vacuum line to vacuum transducer.

CAUTION: Use of a rubber exhaust tube for ventilation may result in fire due to high temperature experienced during this test. Only use a metal exhaust tube.

5) Check zero time offset. It should be at specification. Allow accumulator in computer to "clock up." Check specified time.
6) With accumulator clocked up and engine at 1100 RPM, check vacuum advance. It should be to specification. Disconnect and plug vacuum line at vacuum transducer and increase engine speed to 1500 (3000 RPM on Omni and Horizon). Note speed advance timing.
7) Reconnect vacuum line to vacuum transducer. Check vacuum advance. It should be as specified. Return to curb idle, connect carburetor switch ground wire and (if equipped) install connector to throttle position transducer.
Coolant Switch Test - 1) Remove connector from coolant switch and ground carburetor switch. If timing advances, hot idle function of valve is okay. If not, go to next step.
2) Ground Black wire of coolant switch connector. If timing retards, coolant switch is bad and must be replaced. If not, go to next step.
3) Check wire between coolant switch connector for opens, shorts or poor connections. If okay, replace defective SCC. If not, repair wire, reset basic timing and curb idle; then repeat test.

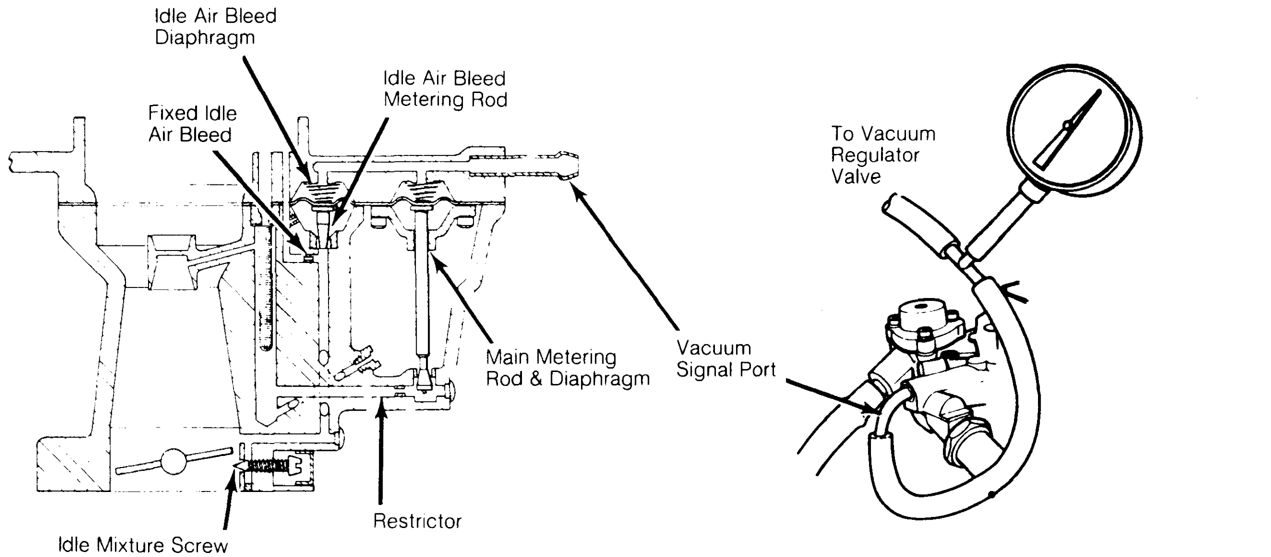
NOTE: Coolant switch has two functions: not to allow additional spark advance from transducer until coolant temperature is above 150°F and to give additional advance above basic timing at hot idle (above 235°F).

ELECTRONIC FEEDBACK CARBURETOR TESTS

PRELIMINARY TEST

An EFC malfunction may result in engine surge, hesitation, rough idle and/or poor fuel economy. Before making any tests, check all vacuum and electrical wiring for proper routing and connections, and check for exhaust and intake manifold leaks. If these are in order, testing may begin.

1) With vehicle at normal operating temperature, "T" a 0-5 in. Hg vacuum gauge into source vacuum signal port at carburetor (from vacuum regulator). *See Fig. 6.* Start engine and idle while watching



Courtesy of Chrysler Corp.

Fig. 6: Monitoring Vacuum Signal At Holley 6145 Feedback Carburetor

gauge. It should be steady at 2.5 in. Hg for about 100 seconds after starting, then drop to zero, and then rise slowly to 1-4 in. Hg.

2) If vacuum is not as indicated, raise engine speed to 2000 RPM. If reading is now 1-4 in. Hg, return to idle. If reading is still not 1-4 in. Hg, oxygen sensor may not have reached 660°F yet.

3) If vacuum is 1-4 in. Hg at 2000 RPM, but not at idle, idle mixture is out of adjustment and carburetor must be replaced. If control vacuum was above 4 in. Hg or below 1 in. Hg at idle, perform the following diagnostic tests.

NOTE: Most system malfunctions will probably indicate 0 in. Hg or 5 in. Hg.

CONTROL VACUUM ABOVE 4 IN. HG TEST

If preliminary test shows vacuum constantly above 4 in. Hg, the SCC is trying to lean mixture. One of the following may be the problem: carburetor, carburetor heat shield, vacuum regulator valve, oxygen sensor, or Spark Control Computer.

1) With transmission in Neutral, start engine and place throttle on next to lowest step of fast idle cam. High control vacuum indicates system is trying to correct for rich mixture. The following steps will check for this.

2) Remove PCV hose from valve and cover end with thumb. Slowly uncover end of hose until engine begins running roughly (indicates very lean mixture).

3) If control vacuum falls as more of PCV hose is uncovered, carburetor is too rich and should be replaced. Before replacing carburetor, check heat shield for possible interference at power enrichment valve actuating lever (rear of carburetor). If interference exists, it could cause richened mixture.

NOTE: A service replacement heat shield is available which provides additional clearance to avoid interference.

4) To check vacuum regulator valve solenoid, disconnect electrical lead from solenoid. Control vacuum should drop to zero. If not, replace vacuum regulator assembly. Reconnect solenoid electrical lead.

5) To determine if Spark Control Computer is faulty, disconnect oxygen sensor wire. Hold computer end of oxygen sensor wire in one hand and touch battery negative terminal with other hand to send a false voltage signal to the computer. DO NOT connect oxygen sensor directly to battery or ground.

6) Control vacuum should gradually lower to zero, in about 15 seconds. If not, replace computer. If it does, replace oxygen sensor. Before replacing computer or oxygen sensor, carefully check wiring between these items.

CONTROL VACUUM BELOW 1 IN. HG TEST

If preliminary test showed vacuum constantly low, SCC is trying to richen mixture. Problem maybe in one of the following areas: lack of vacuum to vacuum transducer, carburetor, air switching system, vacuum regulator solenoid, wiring harness, oxygen sensor, or Spark Control Computer.

1) To determine if vacuum transducer is lacking vacuum, place transmission in Neutral, start and idle engine. Disconnect vacuum hose at transducer and connect hose to a 0-30 in. Hg vacuum gauge. Gauge should read manifold vacuum (more than 12 in. Hg). If not, follow hose to source and properly connect it to a good manifold vacuum source.

2) Be sure throttle is on next to lowest step of fast idle cam. Apply parking brake. To check carburetor for an overly lean mixture, remove air cleaner cover and slowly close choke blade until engine runs roughly (indicating a rich mixture).

3) If control vacuum to carburetor slowly rises to 5 in. Hg, carburetor was either too lean or air switching system is malfunctioning. Go to next step to find fault. If control vacuum remained low, go to step **6)**.

4) Detach air injection hose at metal tube leading to rear of cylinder head and plug tube. If control vacuum remains low, replace carburetor. If vacuum returns to proper range (1-4 in. Hg), reconnect air injection hose and detach 3/16" vacuum hose from air switching valve.

5) If control vacuum stays below 1 in. Hg, replace air switching valve. If it returns to proper range, check hose routings. If okay, replace vacuum coolant switch.

6) Check that bottom nipple of vacuum regulator assembly is connected to manifold vacuum. Detach electrical connector to solenoid. Connect jumper wire from positive terminal of battery to one terminal of solenoid lead. Connect other terminal of solenoid lead to ground. Control vacuum should go above 5 in. Hg. If not, replace solenoid. If it does, go to next step.

Chrysler Corp. Electronic Feedback Carb. (Cont.)

7) Disconnect 5-pin connector at SCC. Connect jumper wire from terminal No. 2 in harness to ground. Control vacuum should go to 5 in. Hg. If not, trace wire back to battery to determine where loss of voltage occurs.

8) If vacuum responds, disconnect oxygen sensor wire. Hold computer end of oxygen sensor wire in one hand and touch battery positive terminal with other hand to send a false voltage signal to the computer. DO NOT connect oxygen sensor directly to battery or to ground.

9) Control vacuum should rise to 5 in. Hg in about 15 seconds. If not, replace Spark Control Computer. If it does, replace oxygen sensor.

ADJUSTMENTS

THROTTLE POSITION TRANSDUCER

Disconnect wiring from throttle position transducer. Loosen lock nut. Place measuring device (C-4522) between outer portion of transducer and transducer mounting bracket. Adjust transducer by turning clockwise or counterclockwise until clearance fit is obtained. Tighten lock nut.

MAINTENANCE

OXYGEN SENSOR WARNING LIGHT

Every 15,000 miles, oxygen sensor requires replacement. A mainteneance reminder warning light will be activated. After replacing sensor (threaded into exhaust manifold), slide rubber shield off of mileage counter (in-line with speedometer cable) and turn reset screw to deactivate light and reset counter. *See Fig. 8*.

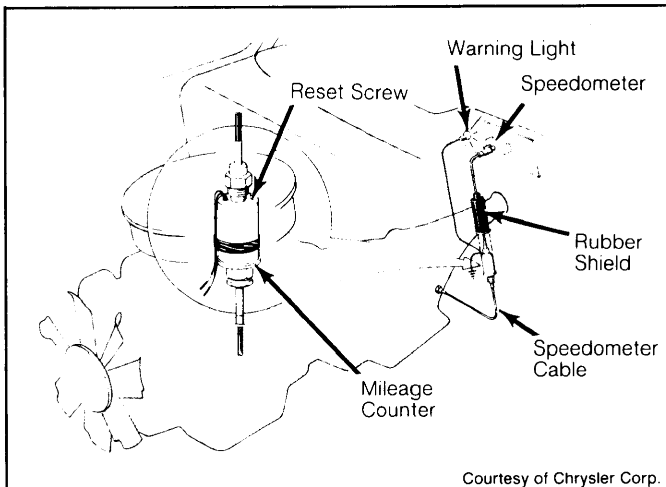


Fig. 8: Oxygen Sensor Mileage Counter Location

WIRING DIAGRAMS

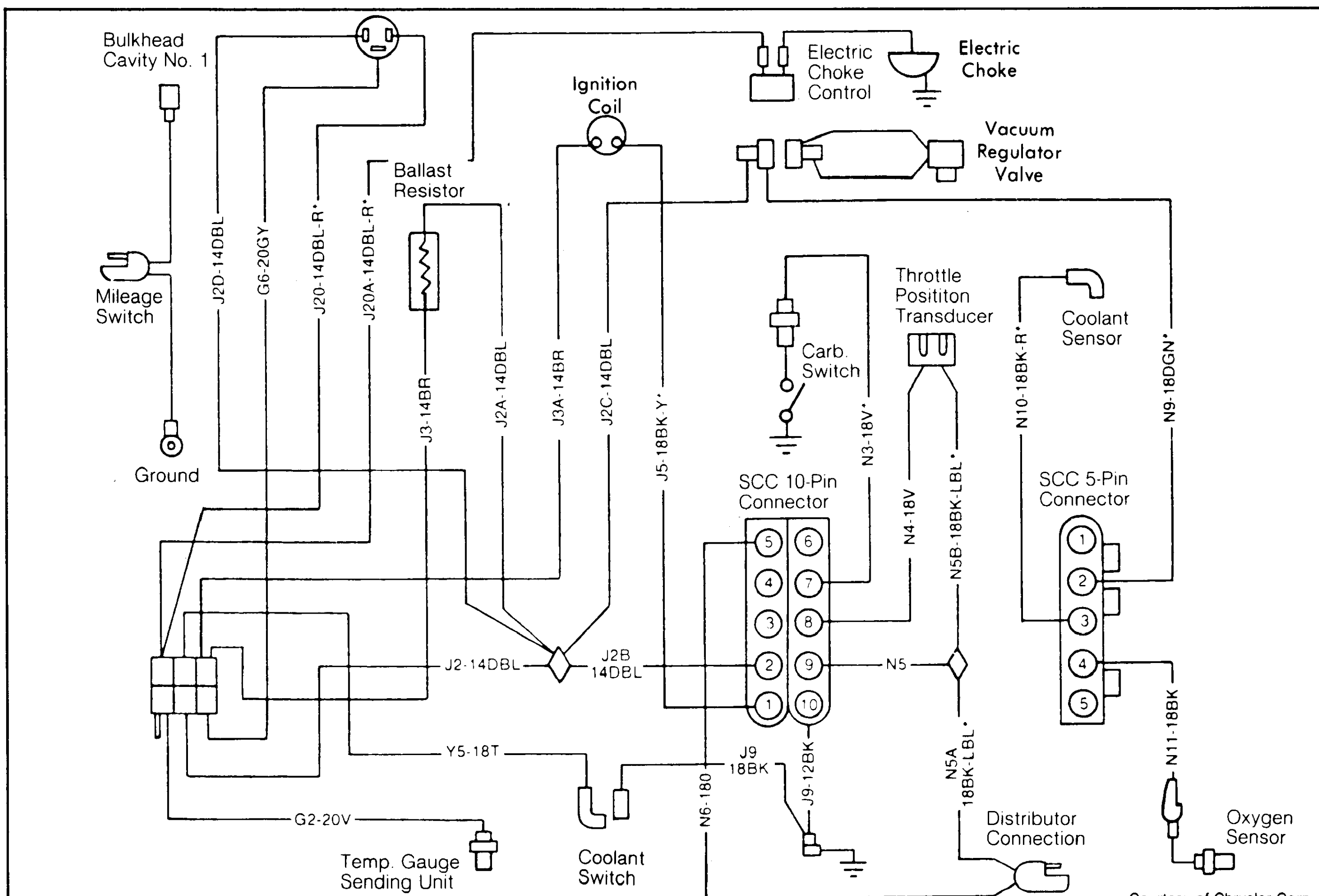


Fig. 7: 1979 Electronic Feedback Carburetor (FBC) System Wiring Diagram