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SECTION 1

INTRODUCTION

This PPN Manual describes the gasoline engine emission controls currently in use on GM medium duty trucks. It describes how each system works, how malfunctions can cause performance and driveability problems, and how to test them. For service and repair procedures, refer to the GMC Medium Duty Service Manual.

These systems are designed to work together to meet emission control standards without sacrificing fuel economy or performance. Thus, calibrations are critical in such areas as ignition timing and carburetion. Variations in exhaust back pressure, intake air temperature, choke time, fuel delivery, etc., are far less tolerable now than they were before emission standards went into effect.

HEAT SHIELDS

The significant changes required to meet emission standards have resulted in higher underhood operating temperatures. This has necessitated the use of heat shields in various locations (Fig. 1-1). Be sure these heat shields are in position and kept in good condition. If they are removed or knocked out of position, components could malfunction or be damaged. Also, vapor lock could occur if excessive heat reaches the fuel pump.

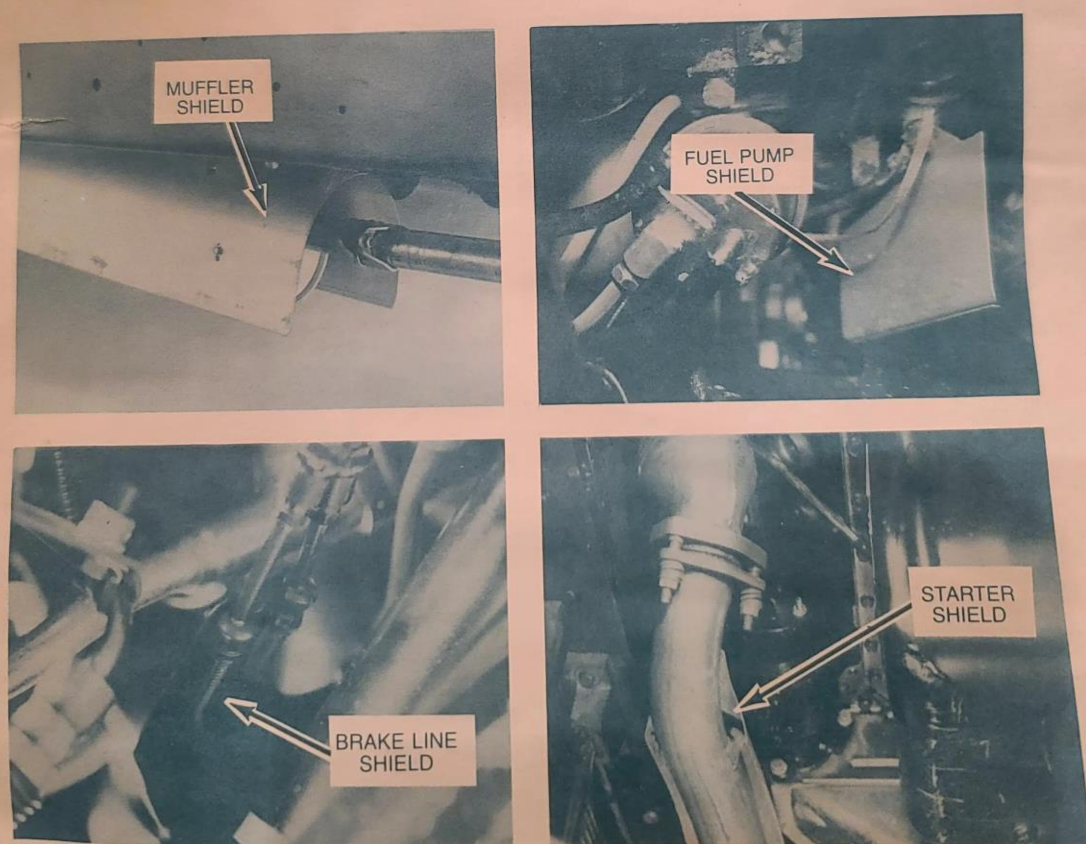


Figure 1-1. Typical Heat Shields

KINDS OF EMISSION CONTROLS

Every gasoline engine emits some quantity of these three compounds in normal operation:

HC—Unburned Hydrocarbons: Raw fuel vapors that pass through the exhaust when combustion is not complete. They can also be emitted by vaporization in the carburetor fuel bowl and fuel tank.

CO—Carbon Monoxide: Another product of incomplete combustion. Carbon is part of gasoline. If it burns fully, it becomes carbon dioxide (CO_2), which is harmless. CO is poisonous.

NO_x—Oxides of Nitrogen or "nox": Air contains nitrogen as well as oxygen, and we can't keep the nitrogen out of the combustion chamber. In all that heat, some of the nitrogen "burns" or combines with oxygen in various proportions. The resulting oxides of nitrogen are considered harmful in large quantity.

The Federal Government and the State of California have placed specific limits on how much of each of these can be emitted. Emission control is the way to meet those limits. The specific systems for the control on medium duty gas engines are:

1. Thermostatically Controlled Air Cleaner (THERMAC)
2. Early Fuel Evaporation (EFE)
3. Positive Crankcase Ventilation (PCV)
4. Evaporation Control System (ECS)
5. Throttle Return Control (TRC)
6. Air Injection Reactor (AIR)
7. Exhaust Gas Recirculation (EGR)
8. Carburetor Calibration
9. Distributor Calibration and Spark Advance Control

The most common causes of excess exhaust emissions related to these systems are shown in Fig. 1-2.

Execssive Emission	Common Cause	Excessive Emission	Common Cause
CO	Improper idle mixture.	HC, CO	Choke sticking.
CO	Incorrect idle speed.	HC, CO	Air Injection Pump inoperative or disconnected (if equipped).
HC	Retarded timing.	HC, NO,	Advanced ignition timing.
HC	Vacuum leaks.	HC, NO,	Wrong spark plugs (too hot).
HC	Throttle control device not functioning.	HC, NO,	Improper vacuum advance, (if so equipped).
Very High HC	Ignition miss, fouled spark plugs, improper plug gap, disconnected plug wire.	HC, CO, NO,	Improper grade of fuel.
HC, CO	Dirty air cleaner.	HC, CO, NO,	Sticking air cleaner damper door (with Thermostatically Controlled Air Cleaner) (if so equipped).
HC, CO	Improper positive crankcase ventilation valve.	Fuel Odor	External fuel leaks or damaged Evaporation Control System (if so equipped).
HC, CO	High float level, defective power valve, incorrect power valve, incorrect metering.		

Figure 1-2. Most Common Causes of Excessive Emissions

SECTION 2

THERMOSTATICALLY CONTROLLED AIR CLEANER (THERMAC) AND EARLY FUEL EVAPORATION (EFE) SYSTEMS

There are two systems used on gasoline engines to heat the induction air for better combustion and emission control.

- The **Thermostatically Controlled Air Cleaner (THERMAC)** system is used on all engines. It heats the **induction air before it enters the air cleaner.**
- The **Early Fuel Evaporation (EFE)** system heats the **air/fuel mixture at the intake manifold** during cold driveaway (4.8L engine only).

THERMAC SYSTEM

The THERMAC system (Fig. 2-1) is designed to provide a steady **temperature** of the inlet air. If the ambient air is cold, it will heat it. This improves combustion, reduces HC and CO emissions, and prevents icing of the throttle plates. It also allows the carburetor and choke to be calibrated leaner.

The air cleaner has two air inlets:

- Fresh air through the snorkel.
- Manifold heated air from a "heat stove" built around the exhaust manifold.

The airflow is controlled by the positioning of a damper door between the two openings. The damper door is controlled by a vacuum motor. Manifold vacuum is applied to the motor through a bi-metal sensor, with a built-in bleed valve.

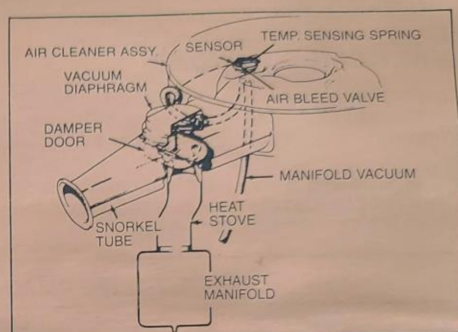


Figure 2-1. THERMAC System Components

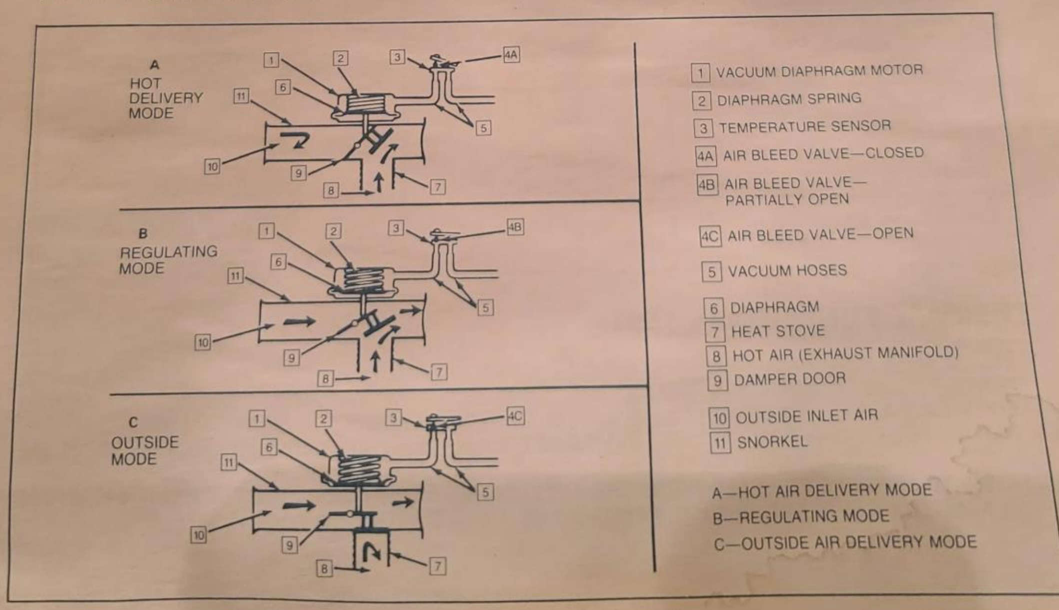


Figure 2-2. THERMAC System Operation

THERMAC OPERATING MODES

The fuel system is calibrated to operate best with the inlet air warmed to somewhere above 86° F. The THERMAC system should operate in one of three modes to maintain the temperature in the 77-123° range (Fig. 2-2).

1. **Hot Delivery Mode**—When the air cleaner is cold, the sensor allows full vacuum to be applied to the diaphragm of the vacuum motor. The damper door is pulled up fully. This blocks off fresh air and lets only heated air go to the air cleaner. This mode of operation is up to about 77° F.
2. **Regulating Mode**—Between 85-105° F. (approximately), the air door splits the airflow. The air bleed valve on the sensor is partly open, so some of the vacuum bleeds off. The diaphragm assumes an intermediate position to mix fresh air with heated air.
3. **Outside Mode**—When the air cleaner is hot (above 123° F.), the air bleed valve is fully open. All the vacuum bleeds off from the diaphragm and the air damper door goes fully down. This closes off the heated air and lets only fresh air enter the air cleaner.

WHAT CAN GO WRONG

Table 2-1 below summarizes the THERMAC system conditions that can cause driveability problems. Since vacuum system conditions usually cause the THERMAC to go to full fresh air, most problems are on cold driveability. (They can continue even in a warm engine when the ambient air is cold.)

Also,air leaks anywhere in the system can bypass the heated air and defeat the system's purpose. Occasionally,the damper door may stick up; or the sensor may fail to bleed off when it is hot. That causes hot-engine performance problems.

TABLE 2-1. THERMAC DIAGNOSIS SUMMARY

CONDITION	RESULT	TYPICAL SYMPTOMS
Heat stove tube disconnected. Vacuum diaphragm motor inoperative (open to snorkel). No manifold vacuum. Damper door stuck open.	No heated air available.	Hesitation during warm-ups. Sag or stumble in cold operation. Poor fuel economy.
Missing air cleaner to carburetor seal. Missing air cleaner cover seal or loose cover. Loose air cleaner.	Cold air leaks past system.	
Damper door stuck closed. Sensor doesn't bleed off.	Too much heated air.	Poor performance; spongy, hot engine.

THERMAC FUNCTIONAL TEST

1. Inspect the system to be sure all hoses and the heat stove tube are connected. Check for kinked, plugged or deteriorated hoses.
2. Check for presence and condition of air cleaner to carburetor gasket and cover seal.
3. With the air cleaner assembly installed and the engine off, the damper door should be open to outside air.

NOTE: TO PREPARE FOR STEP FOUR, THE AIR CLEANER MUST BE COLD. IF THE ENGINE IS WARM OR AMBIENT AIR IS ABOVE 70° F., REMOVE THE AIR CLEANER AND COOL IT.

4. Start the engine. Watch the damper door in the air cleaner snorkel. When a cold engine is first started, the damper door should move and close off the outside air.
   As the air cleaner warms up, the damper door should open slowly to outside air.
5. If the air cleaner fails to operate as described above, perform the vacuum motor check. If it operates, the door may not be moving at the right temperature. If the driveability problem is during warm-up, make the temperature sensor check.

VACUUM MOTOR FUNCTIONAL CHECK

1. With the engine off, disconnect the vacuum hose at the vacuum diaphragm motor. Attach a hand vacuum pump to the motor (Fig. 2-3).
2. Apply at least 7 inches of vacuum to the vacuum diaphragm motor. The damper should completely close to outside air when vacuum is applied. If not, check to see if the linkage is hooked up correctly.
3. With the vacuum still applied, trap vacuum in the vacuum diaphragm motor by bending the hose. The damper door should remain closed. If not, replace the vacuum diaphragm motor assembly.
   (Failure of the vacuum diaphragm motor assembly is more likely to be caused from binding linkage or a corroded snorkel than from a failed diaphragm. This should be checked first, before replacing the diaphragm.)
4. If the vacuum motor checks OK, check the vacuum hoses and connections. If they are OK, replace the temperature sensor.

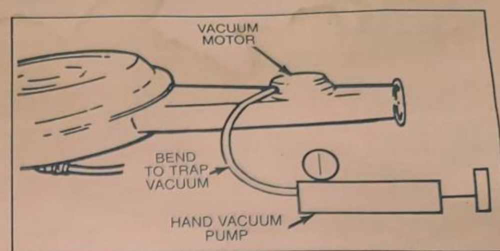


Figure 2-3. Vacuum Motor Test

TEMPERATURE SENSOR FUNCTIONAL CHECK

1. Start the test with the air cleaner temperature below 30° C. (86° F.). If the engine has been run recently, remove the air cleaner cover and place a thermometer as close as possible to the sensor. Let the air cleaner cool until the thermometer reads below 86° F. (about 5 to 10 minutes). Reinstall the air cleaner and continue to Step 2.
   (**NOTE:** Do not let the air cleaner get hot or it will have to be cooled off again.)
2. Start and idle the engine. The damper door should move to close off outside air immediately, if the engine is cool enough. When the damper door starts to open the snorkel passage (in a few minutes), remove the air cleaner cover and read the thermometer. It must read about 120° F.
3. If the damper door is not open to outside air at the temperature indicated, the temperature sensor is malfunctioning and must be replaced.

EARLY FUEL EVAPORATION (EFE) SYSTEM (4.8L ENGINE ONLY)

Early Fuel Evaporation (EFE) provides a quick source of heat to the induction system after a cold-engine start. This improves vaporization of the mixture and allows a leaner choke calibration. The result is reduced HC and CO emissions, as well as faster warm-up and better performance.

The EFE valve replaces the manifold heat control valve, which was controlled by a thermostat. Instead of the thermostat, it is controlled by an EFE actuator (vacuum diaphragm) and a thermal vacuum switch (Fig. 2-4).

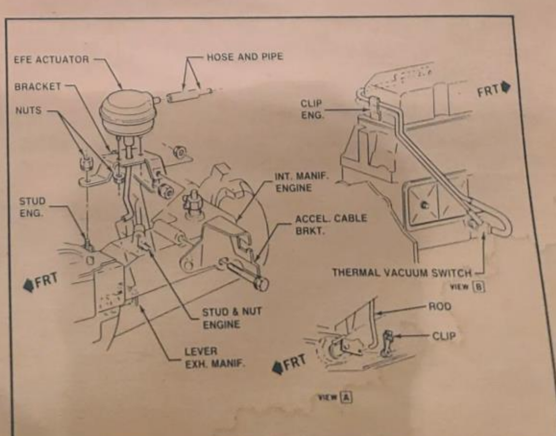


Figure 2-4. EFE System Installation

COOLANT TEMPERATURE CONTROL OF EFE VALVE

The vacuum-operated EFE valve uses a thermal vacuum switch (TVS) to control vacuum to the actuator diaphragm (Fig. 2-5). The TVS senses coolant temperature and is open until the temperature reaches 105° F.

- When the TVS is open on a cold engine, it allows vacuum to go to the actuator.
- The actuator then closes a damper valve in the exhaust pipe. This causes exhaust gas to flow through a part of the exhaust manifold, where it will heat part of the intake manifold below the carburetor.

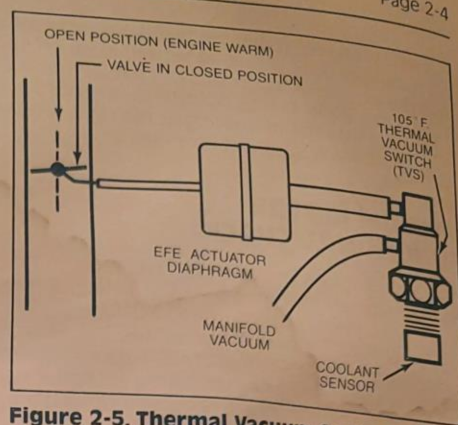


Figure 2-5. Thermal Vacuum Switch Control

- When the coolant warms and the TVS closes, vacuum is cut off to the diaphragm. The damper valve is opened and all the exhaust gas flows directly to the exhaust pipe.

WHAT CAN GO WRONG

- If the EFE valve sticks open, or if the TVS fails closed, the intake doesn't get heated. The engine may stumble or stall on cold start-up. Also, the warm-up time will be longer. The choke may get warm and go off before the engine is warm enough.
- If the damper valve sticks closed, the manifold continues to be heated after the engine warms. This can cause poor performance, lack of power and, possibly, overheating. Detonation is also a possibility.

FUNCTIONAL TEST

1. Locate the EFE valve and check the position of the actuator arm. The valve should be closed when the engine is off; warm or cold.
2. Move the actuator arm to check for free movement of the valve and diaphragm. Lubricate the valve with heat valve lubricant 1050422, or equivalent, if it is sticking.
3. Start the engine cold. The valve should stay closed.
4. Check the valve position after the coolant warms. It should be open.
5. If the valve doesn't open, apply 10 inches of vacuum from a hand vacuum pump to the actuator diaphragm. If it still doesn't open, replace the valve assembly.
6. To test the TVS, blow through it or try to apply vacuum to the lower port. It should trap vacuum warm and release it (or pass air) cold. If it doesn't, replace it.

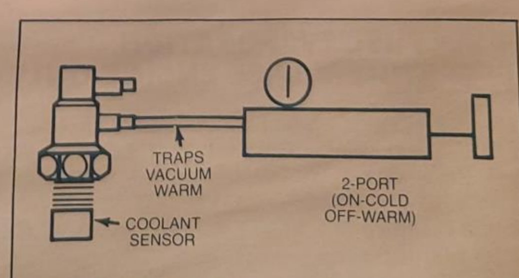


Figure 2-6. TVS Test

SECTION 3

POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM

Positive Crankcase Ventilation (PCV) system prevents the release of blowby vapors from the crankcase to the atmosphere. These vapors, which "blow by" the pistons during compression and combustion, include HC, CO and NO_x compounds.

The PCV system (Figures 3-1, 3-2, 3-3) has two main jobs:

1. It prevents the emission of HC and CO in gases that "blow by" the pistons into the crankcase by recirculating them to the engine intake instead of venting to the outside air.
2. It provides a more complete scavenging of the crankcase by positive venting, using fresh air from the air cleaner to mix with the blowby gases and flow to the intake manifold. Better scavenging prevents contamination of the oil, and thus leads to longer engine life.

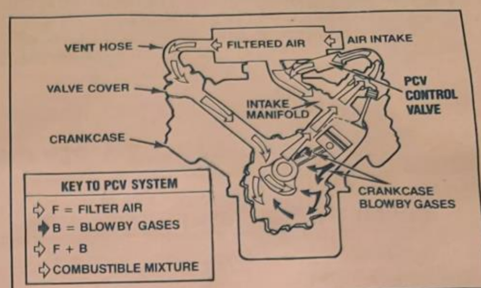


Figure 3-1. PCV System Flow—Typical

OPERATION

As shown in Fig. 3-1, the crankcase vent hose connects the air cleaner to the valve cover of the engine allowing fresh airflow to the crankcase. The return flow (for scavenging) is through the PCV valve and PCV hose to the intake manifold. The fumes then are burned in the engine.

The PCV valve meters the flow at a rate that depends on engine manifold vacuum:

- When manifold vacuum is high (closed throttle), the PCV valve restricts the flow to maintain idle quality.
- In conditions of high amounts of blowby gas (wide-open throttle, for instance), the PCV valve is wide open. However, the system will allow any abnormal amount of gases to "back flow" into the air cleaner and to the carburetor.

After a hot engine shutdown, the fumes will also move up into the air cleaner. Thus, none of them are emitted into the atmosphere.

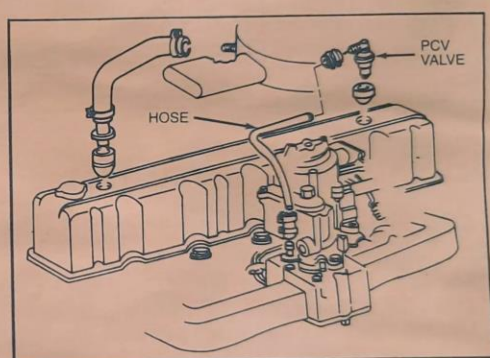


Figure 3-2. PCV System (6-Cylinder Engine)

IDLE CALIBRATION

The engine idle is maintained by a combination of air/fuel through the idle system and air with fumes from the crankcase (which are drawn into the manifold). The crankcase is actually kept at a slight vacuum through the PCV valve. The valve is spring-loaded open and allows very high PCV flow when vacuum is high at idle.

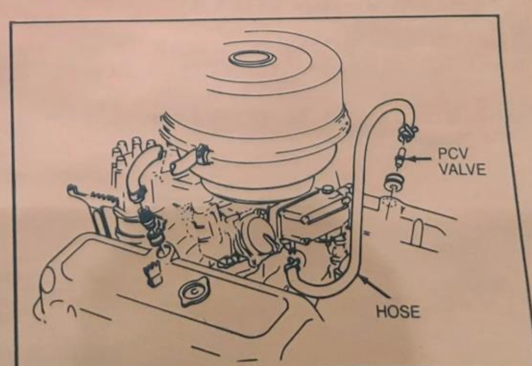


Figure 3-3. PCV System (V8 Engine)

WHAT CAN GO WRONG

Since engine idle is calibrated for proper PCV function, any malfunction can cause rough idle or even stalling. Also, if the system doesn't scavenge properly, it can cause oil leaks from pressure buildup and oil in the air cleaner.

The PCV valve must be replaced periodically; it can get corroded or contaminated with long use and no longer regulate flow properly.

A leak in the closed system becomes, in effect, a vacuum leak. The valve cover and oil pan gasket are thus part of the closed system—as well as the oil fill cap and the PCV valve grommet in the valve cover. If air enters any leak, it upsets the calibration. Also, a dirty air filter or PCV filter will cause an excessive vacuum buildup in the crankcase. This can cause oil to be pulled past the PCV valve into the intake. The engine will then burn oil and have a blue exhaust.

Table 3-1 summarizes the PCV conditions that can cause engine performance problems.

TABLE 3-1. PCV DIAGNOSIS SUMMARY

CONDITION	TYPICAL SYMPTOM/PROBLEM	CONDITION	TYPICAL SYMPTOM/PROBLEM
Plugged hose. Stuck valve (closed).	Rough idle. Stalling. Slow idle speed.	Dirty filter pad (vent hose to air cleaner). Dirty air filter element.	Slow, unstable idle or stalling. Oil leak (pressure). Oil in air cleaner; blue exhaust smoke. Sludge in engine (prolonged failure to scavenge).
Stuck valve (open). Leaking valve or hose.	Rough idle. Stalling. High idle speed.		

PCV VALVE FUNCTIONAL TEST

If an engine is idling rough, check for a clogged PCV valve or plugged hose. Use the following procedure:

1. Remove the PCV valve from the rocker arm cover or intake manifold.
2. Run the engine at idle.
3. Place your thumb over the end of the valve to check for vacuum. If there is no vacuum at the valve, check for plugged hoses or manifold port or PCV valve. Replace plugged or deteriorated hoses.
4. Remove the PCV valve. Shake the valve and listen for the rattle of the check needle inside the valve. If the valve does not rattle, replace it.

TESTER QUICK CHECK

If one is available, a PCV diagnostic tester can be used to quick-check the system, provided the PCV valve is installed in line or in a grommet. It cannot be used if the PCV valve is in the oil filler cap.

The tester is placed over the oil fill opening with the cap off, and the engine run at idle. An indicator on the tester tells whether the system is OK or needs to be serviced.

SECTION 4

EVAPORATION CONTROL SYSTEM (ECS)

All GM medium duty vehicles with gasoline engines are equipped with an Evaporation Control System (ECS), which prevents raw fuel vapors (HC) from escaping into the atmosphere. Vapor created by the evaporation of fuel from tank(s) is transferred to a 2500cc. carbon canister. Vapor from the carburetor float bowl is also transferred to a smaller (1500cc) canister. The carbon absorbs the vapor and stores it. During engine operation, vapor is purged from the canisters to the engine intake system, where it is consumed. A charcoal element in the air cleaner of V8 engines also collects and stores vapor from the fuel induction system. These vapors are drawn into the carburetor on engine start-up.

The current system uses electronic controls for the purge function. On earlier systems, purging was accomplished by vacuum-controlled valves on the canisters. Canisters are purged into a port on the intake manifold.

Special fuel tank(s), filler cap(s), carbon canister(s), purge control valves and switches, and carburetor modifications are included in the system. Excessive fuel tank pressure can cause fuel tank deformation and/or gasoline spray when the filler cap is removed. To prevent excessive tank pressure or vacuum, a pressure/vacuum relief valve is used on each tank. It's located on the frame rail near each tank and connected to it by a length of hose. The fuel tank(s) use special screw-on type filler cap(s). **Always use a GM replacement cap for service to avoid malfunctions or damage to the system.**

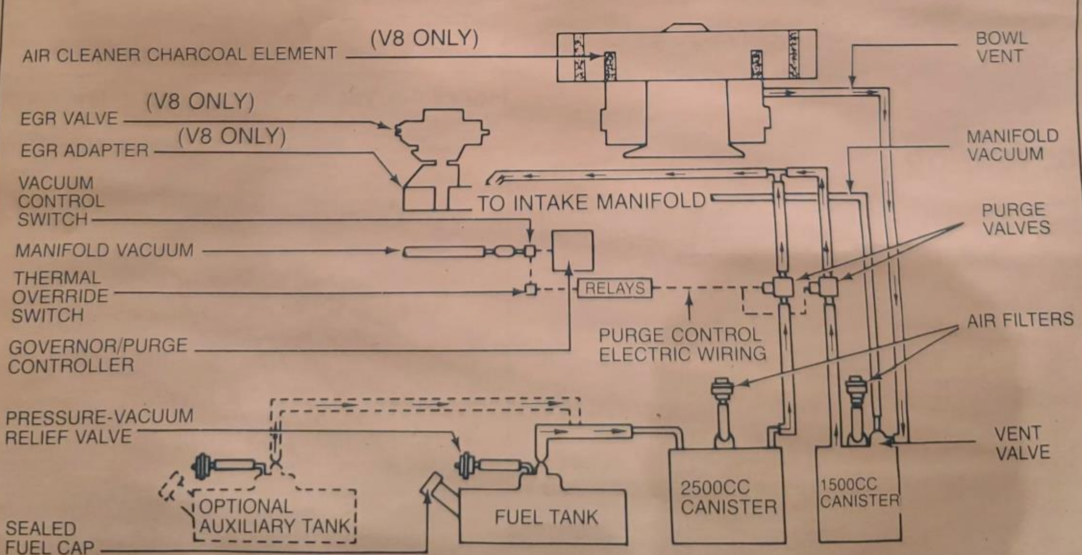


Figure 4-1. ECS Schematic

HOW THE ELECTRONIC PURGE CONTROL SYSTEM WORKS

The purge control system controls the release of vapors from the canisters according to engine speed, engine temperature and intake manifold vacuum. Two purge control solenoid valves (Fig. 4-2) are open when the relays (Fig. 4-3) are energized by a signal from the governor (Fig. 4-4). A vacuum control switch and a thermal override switch must **both** be closed to get the "signal" to the relay coil.

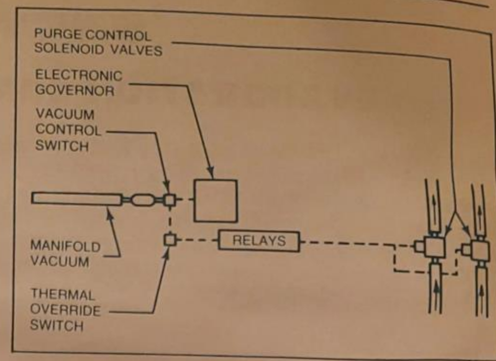


Figure 4-2. Purge Control Schematic

VACUUM SWITCH

The vacuum switch is mounted on the right front side of the cowl (Fig. 4-3). It is controlled by manifold vacuum so that it closes with the engine running.

THERMAL OVERRIDE SWITCH

This switch is mounted on the thermostat housing with the sensor in the coolant. It is open with the engine cold and closes when the temperature is 60° F. or higher.

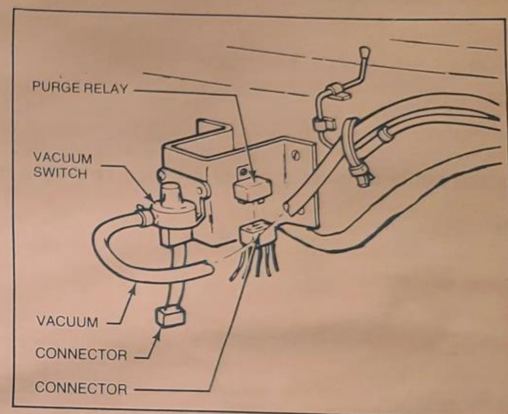


Figure 4-3. Vacuum Switch and Relay

RELAYS

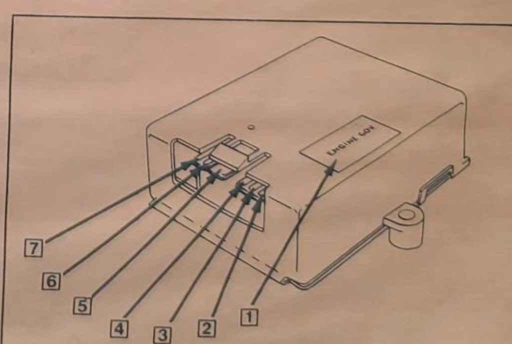
The relays are mounted next to the vacuum switch (Fig. 4-3). Their coils are connected through the two switches to the governor. When they are energized, they power the purge control valve solenoids.

GOVERNOR

The engine governor/purge controller (Fig. 4-4) is a solid state electronic control. It uses the "tachometer" signal (7) from the HEI ignition to measure engine speed.

- On initial start-up, the governor sends a 12-volt signal to the purge relay coils (3) when the engine speed gets up to 2250 RPM.
- From then on, the signal is on whenever the speed reaches 1825 RPM.
- If speed goes below 1700 RPM, the signal at pin 3 goes to zero volts to de-energize the relay and prevent purging.

If both the vacuum switch and thermal override switch are closed, the voltage at pin 3 will get to the relays. If either switch is open (no vacuum or cold engine), the relays will not be energized and vapors will not be purged.



1 – Engine Governor/Purge Controller
2 – 12 Volts (+)
3 – Purge Relay
4 – Governor Solenoid (Engine Governor Only)
5 – Engine Overspeed Warning Light (Engine Governor Only)
6 – Ground (–)
7 – Engine Speed Signal Input (Tachometer)

Figure 4-4. Governor/Purge Controller Module

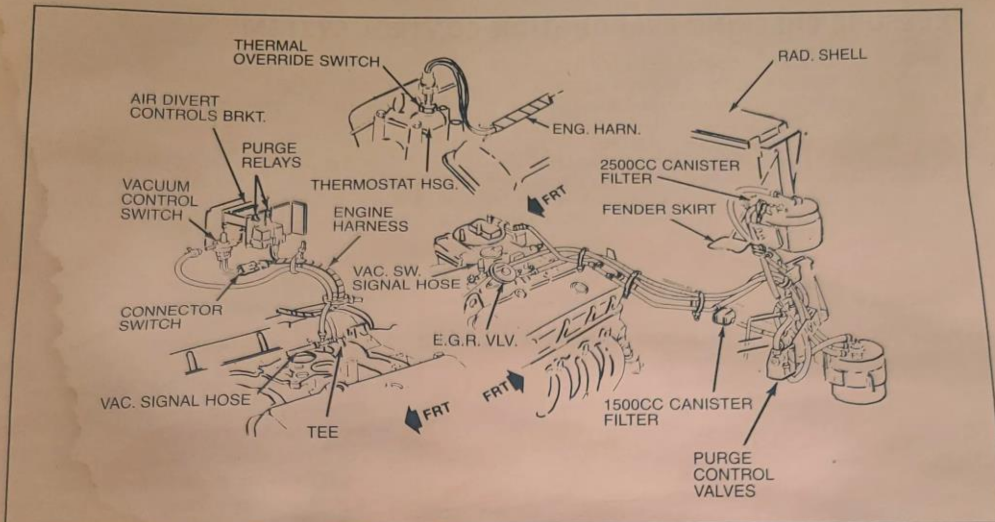


Figure 4-5. Evaporation and Purge Control Component Locations (V8 typical)

DIAGNOSIS

Broken or disconnected lines let vapors escape and can cause gasoline odor or gasoline condensing on the tank. If a pressure-vacuum relief valve fails closed, it can cause fuel starvation. If the small canister doesn't get a vacuum signal, fuel bowl vapors can back up under pressure and cause start-up enrichment, backfire or rough idle.

Failure to purge with the engine running can be caused by a failure of the governor or any component or wire in the purge control circuit. Use the diagnosis procedures in the following chart (Fig. 4-6) depending on the symptoms.

GOVERNOR/PURGE CONTROLLER TEST

Refer to Fig. 4-4 for terminal locations.

1. Disconnect the wiring harness connector from the electronic controller.
2. Using an ohmmeter, measure the resistance between the ground terminal (6) in the harness connector and chassis ground. Resistance should be less than 3 ohms. If the circuit is open or reads a very high resistance, look for a defective ground wire or terminal. Correct any defects before proceeding to Step 3.
3. Turn the ignition switch to the "ON" position but do not start the engine. Using a voltmeter, check for battery voltage at the wiring harness connector terminals (3) and (2). The terminals should be at battery potential with respect to the ground terminal (6). If these terminals are not at battery potential, check for broken connectors and terminals.
4. To check the tachometer signal, turn the ignition switch off and, using an ohmmeter, check the signal input wire (7) for continuity between the distributor (tachometer connector) and the electronic controller harness connector.
5. If after checking the wiring harness, tubing, electrical fuse, purge control relay—or relays, on V8s—purge control valve and purge cut-off switches, and the purge system still does not operate, replace the electronic controller.

PRESSURE CHECKING EVAPORATION CONTROL SYSTEM

1. Stabilize the vehicle by operating it until it is warmed up.
2. Remove the tank line at the canister and check for liquid in the line.
3. Apply 3.5 kPa (1/2 psi) air pressure (the equivalent of 3.5 kPa [14 in. H_2O pressure]) to the fuel vapor line:
   a. Check for excessive loss of pressure.
   b. If negligible pressure loss occurs, check for fuel vapor smell or fuel loss at connection points.
   c. Remove the fuel filler cap(s) and check for pressure in tank(s).
4. Remove the fuel cap (LH on dual tank units) and blow on vent line to check for obstructions. (Install LH cap on dual tank units and remove RH cap. Repeat above.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
No Purge	1. Loose, broken, or incorrect wiring connections.	1. Check all wiring connections.
	2. Inoperative relay.	2. Turn the ignition switch to "ON" position, but do not start the engine. Apply ground to the control side of the relay coil. Relay contacts should close. Using a voltmeter, check for battery voltage at the purge control valve. If no voltage is read, replace the relay.
	3. Inoperative purge control valve.	3. Remove the purge hoses. Apply 12 volts and ground to the terminals. Solenoid should click open. Blow compressed air into "CAN" port and check airflow out of "ENG" port. If plugged, replace the purge control valve.
	4. Inoperative purge cut-off temperature switch.	4. Disconnect wiring harness connector from the component. Using an ohmmeter, measure the resistance between component's terminals. If engine temperature is above 15.5°C.(60°F.), resistance should be less than 1 ohm. If engine temperature is below 10°C.(50°F.), resistance should be infinity. Replace the switch as necessary.
	5. Inoperative purge cut-off vacuum switch.	5. Disconnect wiring harness connector from the component. Using an ohmmeter, measure the resistance between component's terminals. If no vacuum is present, resistance should be less than 1 ohm. If vacuum is greater than 64 kPa (19 in. Hg.), resistance should be infinity.
	6. Inoperative engine governor/purge controller.	6. See "Governor/Purge Controller Test" on Page 4-3.
	7. No RPM signal to engine governor/purge controller.	7. See "Governor/Purge Controller Test" on Page 4-3.

Figure 4-6. Diagnosis of Evaporation Control System (Partial)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Gasoline Odor	1. Purge lines not connected, improperly routed, plugged or pinched. 2. Disconnected pressure-vacuum relief valve hose. 3. Damaged or missing filler cap gasket. 4. Plugged air breather assembly. 5. Plugged tank vent restrictor in sending unit. 6. Plugged or leaking canister. 7. Inoperative control valve-carburetor canister.	1. Check, connect and open lines as required. 2. Check and connect hose as required. 3. Replace gasket. 4. Replace assembly. 5. Remove sending unit. Apply vacuum and pressure to the canister port. Check if roll-over valve ball moves freely. Replace sending unit if not corrected. 6. Check and replace if damaged. 7. Disconnect signal vacuum hose and blow compressed air 68 kPa max. (10 psi max.) into the carburetor bowl port. If plugged, replace the canister.
Liquid Gasoline On Fuel Tank	1. Damaged or missing filler cap gasket. 2. Damaged or missing sending unit seal.	1. Replace gasket. 2. Replace seal.
Exhaust After-Fire	1. No vacuum to the purge cut-off vacuum switch. 2. Loose, broken or incorrect wiring connections to the purge cut-off vacuum switch. 3. Inoperative purge cut-off vacuum switch.	1. Check for disconnected vacuum hose and for vacuum leaks. Correct as required. 2. Check and correct as required. 3. Disconnect wiring harness connector from component. Using an ohmmeter, measure the resistance between component's terminals. If no vacuum is present, resistance should be less than 1 ohm. If vacuum is greater than 64 kPa (19 in. Hg.), resistance should be infinity. Replace the switch as necessary.
Rough Idle	1. No vacuum to carburetor canister control valve. 2. Loose, broken or incorrect wiring connections to the relay or purge control valve. 3. Inoperative relay. 4. Inoperative purge control valve. 5. Inoperative engine governor/purge controller.	1. Check for disconnected vacuum hose and for vacuum leaks. 2. Check and correct as required. 3. Turn ignition switch to "ON" position but do not start the engine. Apply ground to the control side of the relay coil. Relay contacts should close. Using a voltmeter, check for battery voltage at the purge control valve. If no voltage is read, replace the relay. 4. Remove the purge hoses. Apply 12 volts and ground to the terminals. Solenoid should click open. Blow compressed air into "CAN" port and check airflow out of "ENG" port. If plugged, replace the purge control valve. 5. See "Governor/Pure Controller Test" on Page 4-3.

Figure 4-6. Diagnosis of Evaporation Control System (Cont'd.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Rough Engine At Cruise	1. No vacuum to carburetor canister control valve.	1. Check for disconnected vacuum hose and for vacuum leaks.
	2. Plugged air breather assembly.	2. Replace assembly.
	3. Inoperative pressure-vacuum relief valve.	3. Remove valve from the vehicle. To clean the valve, apply vacuum and pressure. Check if valve works and replace if necessary.
	4. Loose, broken or incorrect wiring connections to the relay or purge control valve.	4. Check and correct as required.
	5. Inoperative relay.	5. Turn ignition switch to "ON" position, but do not start engine. Apply ground to the control side of the relay coil. Relay contacts should close. Using a voltmeter, check for battery voltage at the purge control valve. If no voltage is read, replace the relay.
	6. Inoperative carburetor canister control valve.	6. Disconnect the signal vacuum hose and blow compressed air 68 kPa max. (10 psi max.) into the carburetor bowl port. If plugged, replace the canister.
	7. Inoperative purge control valve.	7. Remove purge hoses. Apply 12 volts and ground to terminals. Solenoid should click open. Blow compressed air into "CAN" port and check airflow out of "ENG" port. If plugged, replace the purge control valve.
	8. Inoperative engine governor/purge controller.	8. See "Governor/Purge Controller Test" on Page 4-3.
Engine Stalls At Idle	1. Purge control valve stuck open.	1. Replace the purge control valve.
Fuel Starvation	1. Inoperative pressure-vacuum relief valve.	1. Remove valve from the vehicle. To clean the valve, apply vacuum and pressure. Check if valve works and replace if necessary.
	2. Plugged tank vent restrictor in the sending unit.	2. Remove sending unit. Apply vacuum and pressure to the canister port. Check if the roll-over valve ball moves freely. Replace sending unit if not corrected.
High Idle Speed On Cold Starts	1. Loose, broken or incorrect wiring connections to the purge cut-off temperature switch.	1. Check and correct as required.
	2. Inoperative purge cut-off temperature switch.	2. Replace purge cut-off temperature switch.

Figure 4-6. Diagnosis of Evaporation Control System (Cont'd.)

SECTION 5

AIR INJECTION REACTOR (AIR) SYSTEM

The Air Injection Reactor (AIR) system is used to provide extra air to the exhaust to reduce HC and CO emissions. In the hot exhaust, the oxygen in the fresh air combines with HC and CO to chemically change them to water vapor (H_2O) and carbon dioxide (CO_2).

AIR COMPONENTS AND FUNCTIONS

The AIR system (Figures 5-1, 5-2 and 5-3) consists of an air injection pump (or pumps), air injection tubes for each cylinder, a diverter valve (for each pump), and air check valves.

The air pumps are belt-driven and supply constant airflow to the air diverter valves with the engine running. In normal driving, the air diverter valve directs the air to the exhaust through a check valve. The check valve prevents back-flow of exhaust gas in case of a pump or control failure.

When the exhaust is rich (and backfire could occur during deceleration), the diverter valve directs the air to the silencer or air cleaner. On 1985 and later engines, the diverter valve is electronic (ECM) controlled.

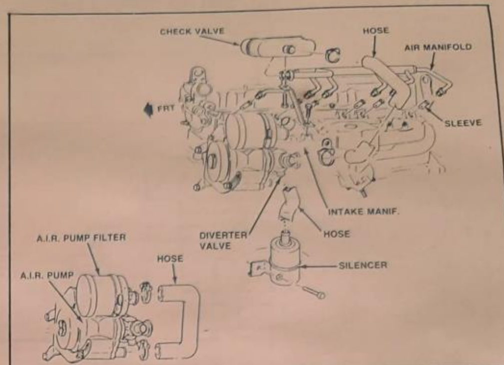


Figure 5-1. AIR System on 292 Engine

AIR SUPPLY

Prior to 1985, air was taken into the pump directly through a plastic, centrifugal air filter on the pump. On 1985 and later engines, it is drawn through an inlet hose and filter assembly.

CHECK ENGINE LIGHT

With electronic control of the diverter valve, there is an amber warning light on the dash. On school buses it reads "CHECK ENGINE"; on trucks, it reads "SERVICE ENGINE SOON."

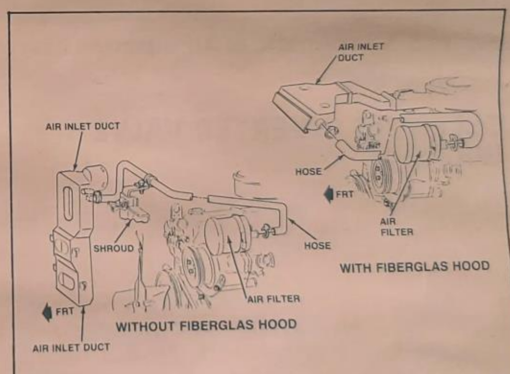


Figure 5-2. Fresh Air Supply to Pump (292)

The light comes on to check the bulb when the key is on and before the engine starts. After starting, it goes out after a few seconds. The electronic module turns the light on if there is a malfunction in the electronic control, the wiring harness or the diverter valve solenoid(s). At the same time, it de-energizes the solenoid(s).

When the "CHECK ENGINE" light comes on, it indicates an electrical problem that could be caused by inoperative air pumps. Use the diagnosis chart in this section to isolate the condition and repair the system.

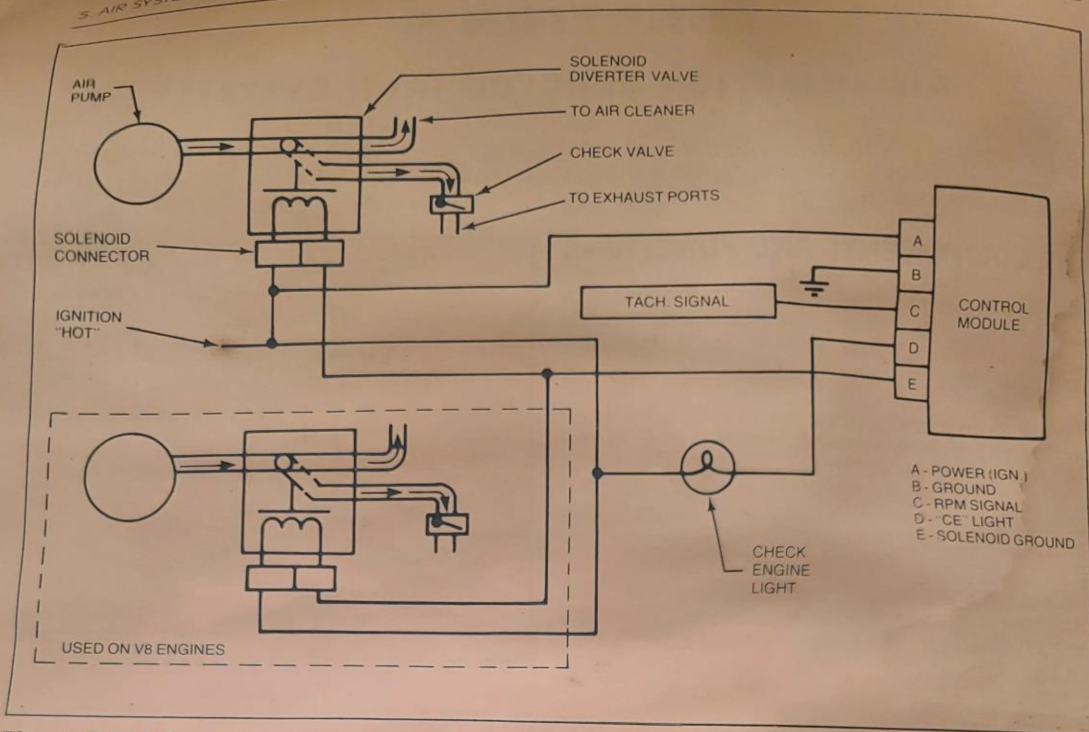


Figure 5-3. Schematic of Air Injection Reactor (AIR) System

SOLENOID DIVERTER VALVE (FIG. 5-4)

The diverter valve has an electric solenoid to add electronic control of the airflow to the normal diverter valve functions.

- With the ignition on, the control module energizes the solenoid. Air control is the same as with a standard diverter valve: to the exhaust except in deceleration. In deceleration, a high vacuum signal causes the air to be diverted momentarily to the air cleaner or silencer. (This prevents excess heat or backfire.)
- If there is high engine RPM (above 2850 RPM for over 90 seconds), the control module de-energizes the solenoid. The decel timing chamber is vented and the valve diverts the air to the air cleaner or silencer.
- The module will also de-energize the solenoid if there is a malfunction in the electrical circuit.

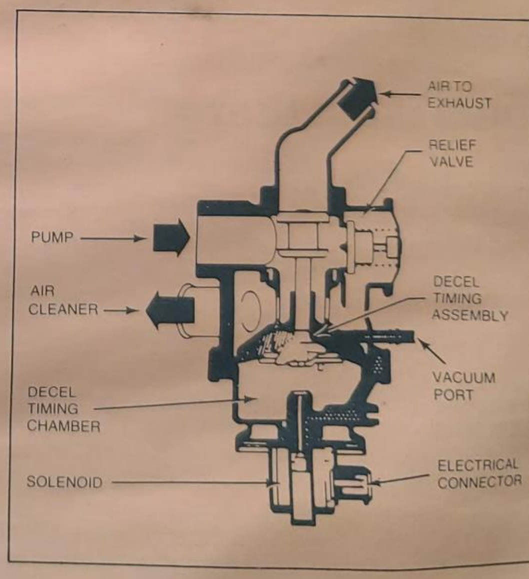


Figure 5-4. Solenoid Diverter Valve

DECELERATION (GULP) VALVE

A deceleration (or "gulp") valve is used on all medium duty gas engines with AIR systems. It prevents backfiring during deceleration, when the exhaust is normally very rich.

HOW IT WORKS

The valve ports (Fig. 5-5) are connected to the air cleaner and to the intake manifold. The diaphragm port is connected to manifold vacuum.

- In normal operation, the valve is closed by spring force and does not affect the air/fuel mixture.
- During deceleration, manifold vacuum becomes strong. The diaphragm is pulled down and overcomes spring force. The valve opens (as shown in Fig. 5-5) and bleeds air into the intake manifold.

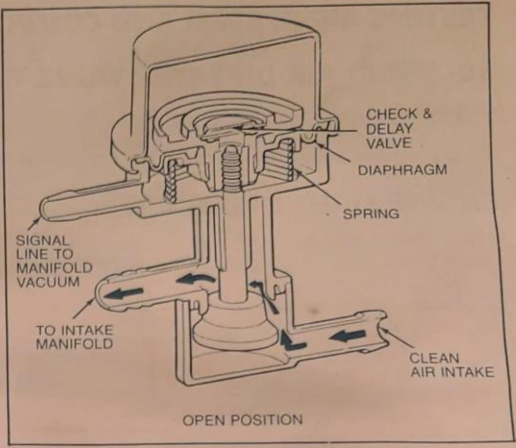


Figure 5-5. Deceleration Valve Cutaway

- If deceleration is prolonged, air trapped in the chamber above the vacuum diaphragm bleeds through the delay valve portion of the integral "check and delay valve." This reduces the "signal" vacuum. The valve then closes, at a calibrated rate, to shut off the airflow.

WHAT CAN GO WRONG WITH AIR SYSTEMS

The AIR system does **not** (except for the gulp valve) affect the engine breathing or air/fuel ratio in any way. Therefore, it is **not** a factor in performance or driveability problems. Some of the problems that can occur are:

- **Excess HC and CO in exhaust**—Caused by loss of pump delivery or diverter valve malfunction such that air doesn't get into the exhaust.
- **Backfire**—Caused by lost vacuum to the gulp valve or a gulp valve failure to operate. Also can be caused by a diverter valve sticking in the open position or by a check valve that allows airflow in both directions.
- **Noise**—Caused by malfunction of the AIR pump or drive belt. Also can be caused by a system leak or a diverter valve stuck closed.
- **Vacuum leak**—Caused by leak in signal line to deceleration valve; or in control vacuum to the diverter valve on 1984 and earlier engines. A vacuum leak often causes rough hot idle and hesitation off idle.
- **CE light on**—Caused by malfunction of diverter valve solenoid or control circuit.

TESTING AIR SYSTEM AND COMPONENTS

SOLENOID AIR DIVERTER VALVE TEST

1. Disconnect the solenoid and start the engine. Air should go to the air cleaner or silencer.
2. Connect the solenoid and open the throttle. Air should go to the exhaust manifold check valve.

ENGINE LIGHT DIAGNOSIS

If the engine light stays on, refer to Fig. 5-6 for diagnosis of the control module. The control module is located on a bracket on the right side of the cowl.

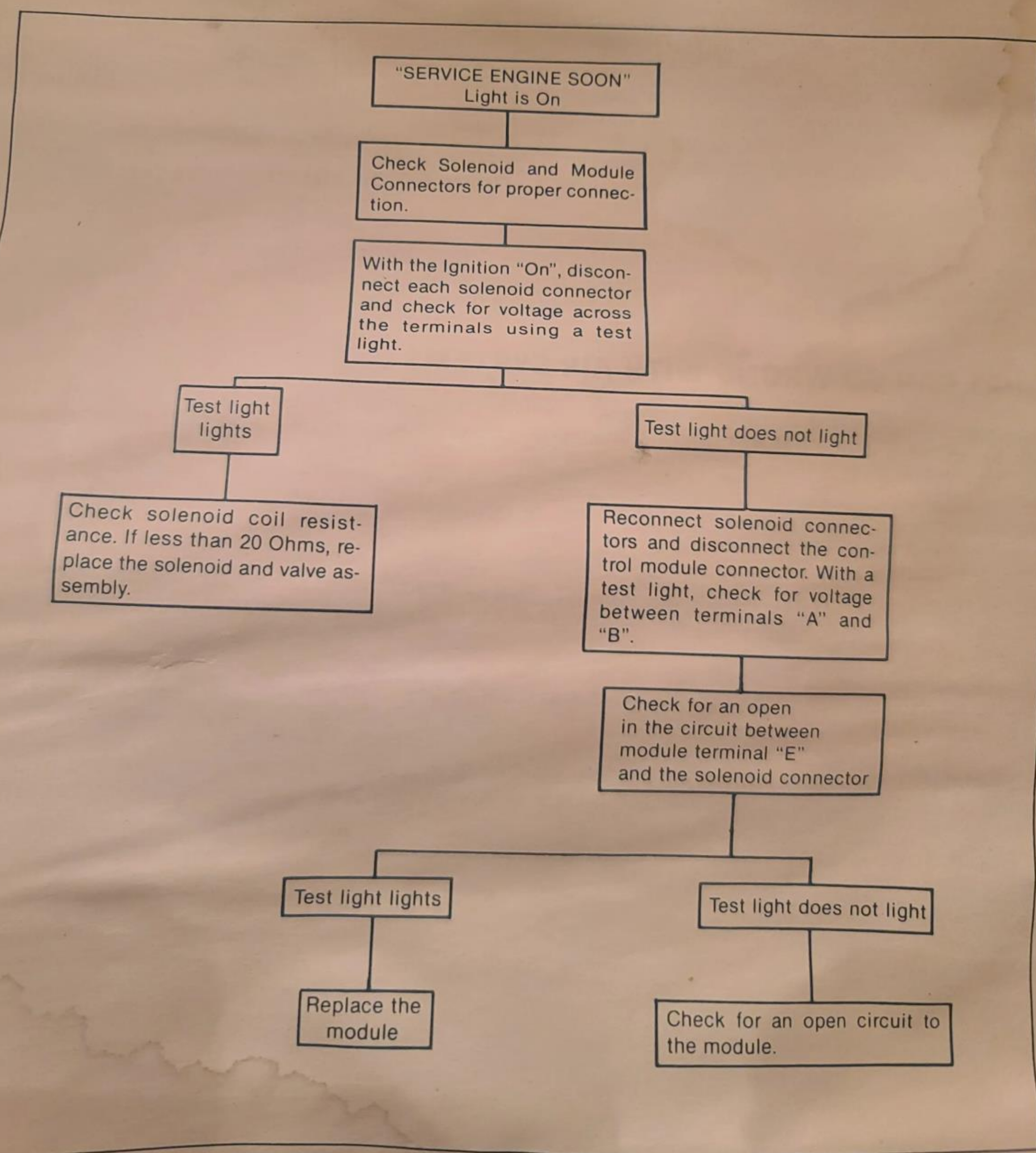


Figure 5-6. Diagnosis of "SERVICE ENGINE SOON" Light

DECELERATION VALVE FUNCTION TEST

A loss of signal vacuum or internal failure of the deceleration valve can cause popping in the air cleaner to backfire during deceleration. Test the valve function as follows:

1. Remove the air cleaner, plug the air cleaner vacuum source, and connect the tachometer to the engine.
2. With the engine running at specified idle speed, remove the small deceleration valve signal hose from the manifold vacuum source.
3. Reconnect the signal hose and listen for airflow through the ventilation pipe and into the deceleration valve. There should also be a noticeable speed drop when the signal hose is reconnected.
4. If the airflow does not continue for at least one second, or the engine speed does not drop noticeably, check the deceleration valve hoses for restrictions or leaks.
5. If no restrictions or leaks are found, replace the deceleration valve.

AIR PUMP DIAGNOSIS

The AIR system can have certain pump noises, such as chirping, rumbling or knocking, that are objectionable and could seem to the owner to be engine problems. They are caused by pump malfunctions or by leaks in the air delivery system. Remember that some AIR pump noise is normal.

To isolate noise or vibration to the AIR system, remove the pump drive belt and run up the engine. If the noise goes away, diagnose the AIR system as follows:

1. **Check for proper drive-belt tension.**
2. **Check for a leaky pressure relief valve, which is incorporated in the diverter valve. Air may be heard leaking with the pump running.**
3. **Check for seized Air Injection Pump.**
4. **Check hoses, tubes, and all connections for leaks and proper routing.**

Do not oil air pump; this pump is permanently lubricated and requires no periodic maintenance.

5. **Check the diverter valve.**
6. **Check the Air Injection Pump for proper mounting.**
7. **Repair irregularities in these components as necessary.**
8. **If no irregularities exist and the Air Injection Pump noise is still excessive, replace the pump.**

PUMP DRIVE BELT

Inspection:

1. Inspect the drive belt for wear, cracks or deterioration. Replace if required.
2. Inspect the belt tension and adjust if below 311 N (70 pounds) using Belt Tension Gage J-23600-B.

Adjustment:

NOTICE: Do not pry on the pump housing. Distortion of the housing will result in extensive damage to the Air Injection Pump.

Loosen the pump mounting bolt and the pump adjustment bracket bolt. Move the pump until the belt is properly tensioned, then tighten the adjustment bracket bolt and the mounting bolt.

New belt tension should be adjusted to 400-445 N (90-100 pounds). Used belt tension should be adjusted to 356-400 N (80-90 pounds). Use Belt Tension Gage J-23600-B placed at the center of the greatest span.

After a belt has been in operation approximately 5 minutes, it is considered used; and when belt tension is rechecked, it is to the used belt specification.

SECTION 6

EXHAUST GAS RECIRCULATION (EGR) SYSTEM

The Exhaust Gas Recirculation (EGR) system is used to reduce exhaust emissions of oxides of nitrogen (NO_x). It does this by recirculating a small volume of exhaust gases to the intake to lower the temperature of the combustion chamber. EGR is used on V8 engines only. Six-cylinder (292) engines do not have EGR.

EGR VALVE

The EGR valve (Fig. 6-1) is mounted on an adapter on the intake manifold. Exhaust gas is piped to the area below the valve seat.

- When vacuum is applied to the valve diaphragm, it compresses the spring and pulls the valve off the seat. This allows exhaust gas to flow into the intake manifold.
- The amount of valve opening—and, therefore, the amount of exhaust gas flow—depends on the strength of the vacuum signal. It is greatest at high vacuum (off idle) and least at wide-open throttle.

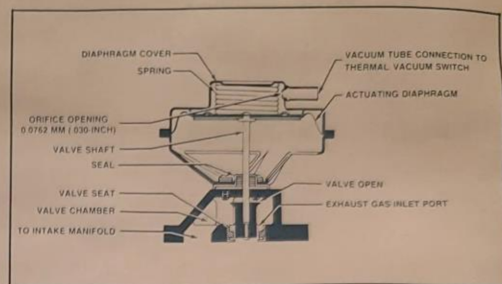


Figure 6-1. Ported EGR Valve

- *Vacuum is applied through an orifice in the diaphragm port. This prevents rapid opening or closing of the valve as the throttle position changes. This prevents spitback or backfire during gear shifting or range shifting.*

TYPES OF EGR VALVES

Medium duty trucks use only the **ported**-type valve. A ported valve is controlled strictly by vacuum strength and spring force.

Back-pressure valves (identified by a "P" or "N" stamped on the top side of the valve after the part number) must not be used. Always use the correct part number valve for replacement.

THERMAL VACUUM SWITCH (TVS) AND PORTED VACUUM CONTROL

The Vacuum source (Fig. 6-2) is ported vacuum from a port in the carburetor above the closed throttle plate. Thus, there is **no** EGR flow at closed throttle because no vacuum is available. Vacuum is applied through an 85-degree thermal vacuum switch (TVS). This control shuts off the vacuum when the engine is cold, so there is no EGR gas flow. This improves cold driveaway performance and prevents cold stalling.

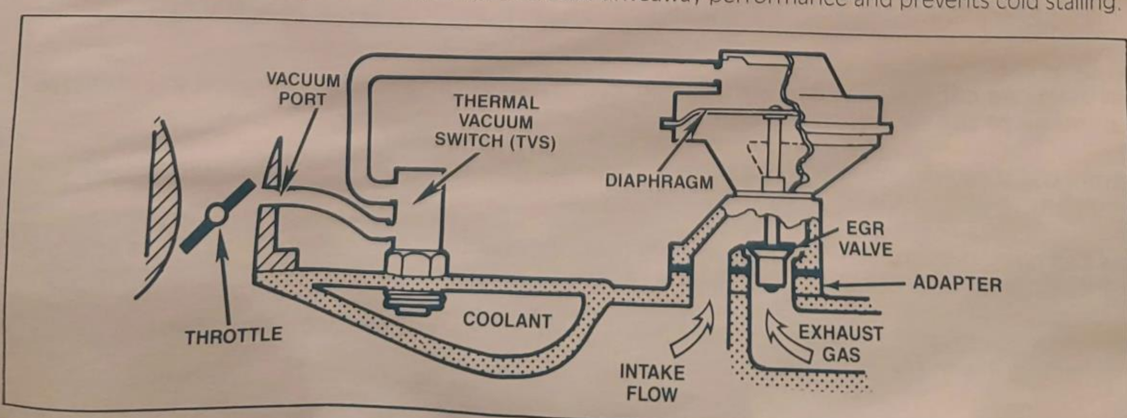


Figure 6-2. EGR Valve with TVS Control for Cold-Engine Lockout

EGR SYSTEM DIAGNOSIS

The EGR gas flow is very critical to the air/fuel intake calibration. If too much exhaust gas gets in, sometimes the engine won't keep firing and will stall. Or it may idle very rough if the valve is stuck open. On the other hand, if it fails to open when it should, the engine may detonate (ping).

If the TVS sticks open, a cold engine can perform poorly because the EGR comes in before it is warm enough. Table 6-1 summarizes the EGR conditions that can cause driveability problems.

TABLE 6-1. EGR SYSTEM DIAGNOSIS SUMMARY

CONDITION	RESULT	TYPICAL SYMPTOMS
Vacuum leak or loss. *TVS fails "closed."* *Valve sticks closed.* Leaking EGR valve gasket.	Valve doesn't open (or opens too little). Low or no exhaust gas flow.	Detonation (spark knock). Engine overheat. Fails emission NO_x test.
Valve stuck open at idle. Vacuum misrouted to manifold vacuum source.	Too much exhaust gas flow at idle.	Poor (rough) idle. Stalling at idle.
Open too far; sticking open. TVS fails "open."	Too much exhaust gas flow.	Engine stops after cold start. Engine stops at idle after deceleration. Vehicle surges during cruise. Rough idle. Sluggish, poor performance.

FUNCTIONAL TESTS

Ported Valve and Diaphragm Test

1. Check the hose routing (refer to the Vehicle Emission Control Information Label).
2. Check the EGR valve signal tube orifice for obstructions.
3. Hook up vacuum gage between the EGR valve and carburetor and check the vacuum—engine must be at operating temperature approximately 91° C. (195° F.). With the engine running at approximately 3000 RPM, there should be at least 5 inches of vacuum.
4. Depress the valve diaphragm.
5. With the diaphragm still depressed, hold a finger over the source tube and release the diaphragm.
6. Check the diaphragm and seat for movement. The valve is good if it takes over 20 seconds for the diaphragm to move to the seated position (valve closed).
7. *Replace the EGR valve if it takes less than 20 seconds to move to the seated position.*
8. *If the EGR valve is OK, check TVS for correct operation. Blow through the valve or attempt to apply vacuum (Fig. 2-6). It should trap vacuum warm and release it cold (or pass air cold but not warm). If it fails, replace it.*

Gas Flow Test

It is possible for the valve to function OK but for EGR gas flow to be reduced by obstructions around the seat or in flow passages or piping. To check for gas flow:

1. Run the engine at hot curb idle.
2. Gradually apply vacuum with a hand vacuum pump to the EGR valve diaphragm. As the opening increases, the engine will start to idle rough, lose RPM and/ or stall. If this happens, the gas flow is OK. If not, something is obstructed. Remove the valve and locate the obstruction.

SECTION 7

CARBURETION AND THROTTLE RETURN CONTROL (TRC)

CARBURETOR CALIBRATION

While the carburetor's main function is to provide the engine with a combustible air/fuel mixture, the carburetor calibration is critical to maintaining proper emission levels. The carburetor's idle, off idle, main metering, power enrichment, and accelerating pump systems are calibrated to provide the best possible combination of engine performance, fuel economy and exhaust emission control. Carburetor adjustments and service must be performed using the recommended procedures to insure engine exhaust emission levels remain within legislated limits. Refer to the GMC Service Manual, Fuel System, Section 6C, for carburetor adjustment specifications and recommended service procedures.

THROTTLE RETURN CONTROL (TRC) SYSTEM

The Throttle Return Control (TRC) system is used on all medium duty gasoline engines with federal or California emission certification. It reduces hydrocarbon (HC) emissions during deceleration by controlling the rate of throttle closing, causing a more complete burning. The system consists of three major components: throttle lever actuator, solenoid vacuum control valve and an electronic speed sensor control.

OPERATION

The electronic control is the speed sensor on ungoverned engines or the electronic governor control unit on governed engines. It receives an engine RPM signal from the HEI distributor tach input (Fig. 7-2).

- At 1825 RPM (±65 RPM), the electronic control energizes the TRC solenoid.
- The solenoid (Fig. 7-1) opens and directs vacuum to the throttle lever actuator. The actuator extends a plunger that will limit the return of the throttle lever in deceleration.
- When the driver releases the accelerator, the plunger stays extended until the RPM drops to at least 10 RPM below the actuating speed; or 1700 RPM minimum.
- Then the electronic control de-energizes the solenoid. The solenoid blocks the vacuum source and **bleeds off** the vacuum at the actuator. This causes the throttle to close slowly.
- Slow throttle return causes a leaner burn during deceleration to reduce HC emissions.

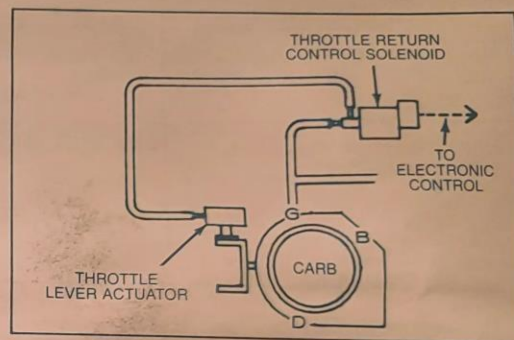


Figure 7-1. TRC System Vacuum Schematic (6-cylinder shown)

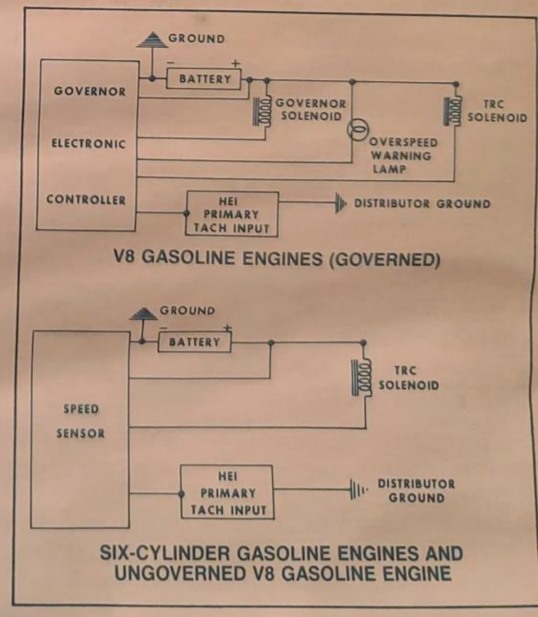


Figure 7-2. Electronic Control for TRC Solenoid

TRC THROTTLE LEVER ACTUATOR

The throttle lever actuator (Fig. 7-3 and 7-4) is part of the carburetor assembly. When vacuum is applied to its diaphragm, a plunger is extended (pushed out) toward the throttle lever. The plunger will keep the throttle from returning to curb idle until the vacuum is released.

TRC SOLENOID VALVE

The TRC solenoid valve (Fig. 7-4 and 7-5) is mounted separately from the carburetor. It has ports for engine vacuum and throttle lever actuator connections. The actuator port contains a restrictor to slow the release of vacuum when the solenoid de-energizes and closes off vacuum.

The TRC solenoid receives 12 volts directly from the battery (Fig. 7-2). It is energized to open the vacuum circuit when the electronic module completes the circuit to ground.

HOW TO CHECK OUT THE TRC SYSTEM

1. Connect an accurate tachometer to the distributor "TACH" terminal.
2. Start the engine and, with the transmission in "Neutral," advance the throttle to the indicated 1890 RPM (TRC system activation value is 1825 RPM ± 65 RPM). The throttle lever actuator (Fig. 7-3) should be **extended** at this speed.
3. Reduce the throttle opening to 1700 RPM (TRC system minimum deactivation value). The throttle lever actuator should be **retracted** at this speed.
4. If the throttle lever actuator operates outside of the 1700 to 1890 RPM limits, the electronic speed sensor is out of calibration and should be replaced.

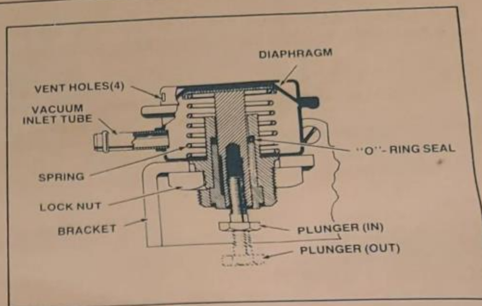


Figure 7-3. Throttle Lever Actuator (4.8L and 5.7L Gasoline Engines)

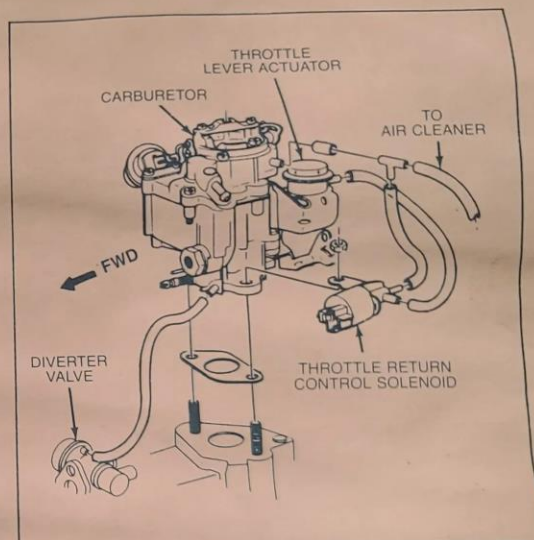


Figure 7-4. Throttle Return Control Solenoid Valve Location (4.8L Gasoline Engine)

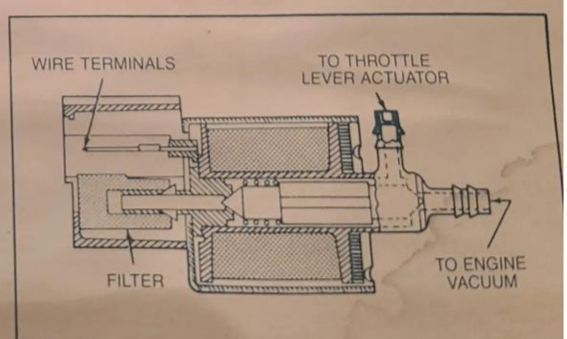


Figure 7-5. Throttle Return Control Soleno Vacuum Control Valve

5. If the actuator does not operate at any speed, proceed as follows (with the engine running):

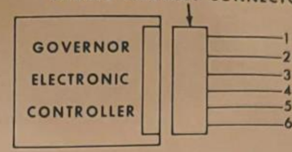
   a. With a voltmeter, check for voltage at the solenoid vacuum control valve and electronic speed sensor. This can be done by connecting the negative probe of a voltmeter to the engine "ground" and inserting the positive probe in the connector cavity of the voltage source wire (Fig. 7-6).

      A voltage of 12-14 volts should be measured at this terminal on both the solenoid control valve and the electronic speed sensor. When making this measurement, it is not necessary to unplug the connector from its component. The voltmeter probe can be inserted in the connector body on the wire side of the connector to contact the metal terminal.

   b. If voltage is present at the speed sensor but not at the solenoid control valve, repair the engine wiring harness as required.

   c. If voltage is not present at either device, check the engine harness connections at the distributor and/or bulkhead connector. Repair as required.

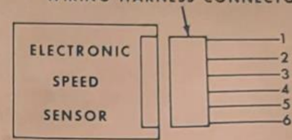
WIRING HARNESS CONNECTOR



1 BRN SIGNAL INPUT (TACH)
2 BLK GROUND
3 BLU ENG OVERSPEED WARNING LAMP
4 YEL GOVERNOR SOLENOID
5 GRN TRC SOLENOID
6 PINK 12 VOLT POSITIVE (+) INPUT

V8 ENGINES (GOVERNED)

WIRING HARNESS CONNECTOR



1 BRN SIGNAL INPUT (TACH)
2 BLK GROUND
3 BLU NOT USED
4 YEL NOT USED
5 GRN TRC SOLENOID
6 PINK 12 VOLT POSITIVE (+) INPUT

V8 & 6-CYLINDER ENGINES (UNGOVERNED)

Figure 7-6. Identification of Electronic Terminals

   d. If the proper voltage exists at each device, check for proper solenoid valve operation by "grounding" the solenoid control valve-to-speed sensor connector using a jumper wire. The throttle lever actuator should extend (engine running).

   e. If the actuator does not extend, remove the actuator vacuum hose from the solenoid side port. Visually check the orifice in this port for plugging. Clear the orifice as required. If not plugged, replace the solenoid control valve.

   f. If the actuator extends in Step "d", ground the solenoid control valve-to-speed sensor wire terminal at the speed sensor. If the actuator does not extend, repair the wire connecting the speed sensor and solenoid vacuum control valve. If the actuator does extend, check the speed sensor ground wire for "ground" at the speed sensor with a voltmeter (engine running)—the voltmeter should read zero (0) volts. If voltage exists at this point, the sensor to ground circuit is open.

6. If the actuator remains extended at all speeds, proceed as outlined:

   a. Remove the wiring connector from the solenoid vacuum control valve.

   b. If the actuator remains extended, check the orifice in the solenoid side port for plugging. If plugged, clear and reconnect system and recheck. If the actuator again remains extended, remove the solenoid wiring connector. If the actuator does not retract, replace the vacuum solenoid control valve.

   c. If the actuator retracts with the solenoid wiring connector removed, reconnect and then remove the speed sensor wiring connector. If the actuator retracts, replace the speed sensor. If the actuator does not retract, the solenoid-to-sensor wire is shorted to ground in the wiring harness. Repair as required.

SECTION 8

IGNITION AND SPARK ADVANCE SYSTEMS

Medium duty gasoline engines use the HEI (High Energy Ignition) distributor (Fig. 8-1). HEI distributors combine all ignition components, including the coil, in one unit.

DISTRIBUTOR CALIBRATION

The distributor calibration is an important part of exhaust emission control. The ignition timing, centrifugal advance and vacuum advance (when used) are calibrated to provide the best engine performance and fuel economy at varying speeds and loads while remaining within exhaust emission limits. Be sure to set everything to exact specifications.

IGNITION TIMING

Timing specifications are on the tune-up decal on the air cleaner. When using a timing light, connect an adapter between the No. 1 spark plug and the No. 1 spark plug wire, or use an inductive-type pickup. **Do not pierce the plug lead.**

SECONDARY WIRING

The spark plug wiring used with the HEI system is a carbon-impregnated cord conductor encased in an 8mm (5/16-inch) diameter silicone rubber jacket. The silicone wiring will withstand very high temperatures and also provides an excellent insulator for the higher voltage of the HEI system. The silicone spark plug boots form a tight seal on the plug. **The boot must be twisted one-half turn before removing it. Do not pull on the wire to remove it. Use a tool designed for this purpose.**

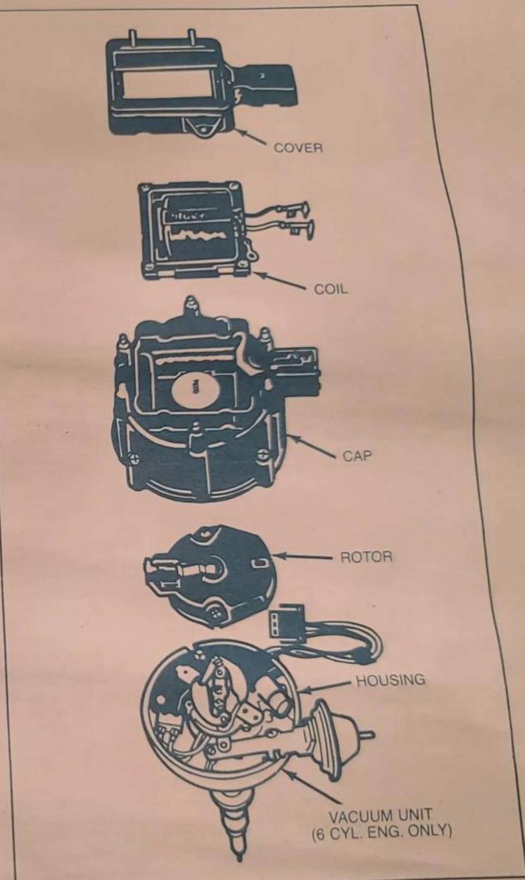


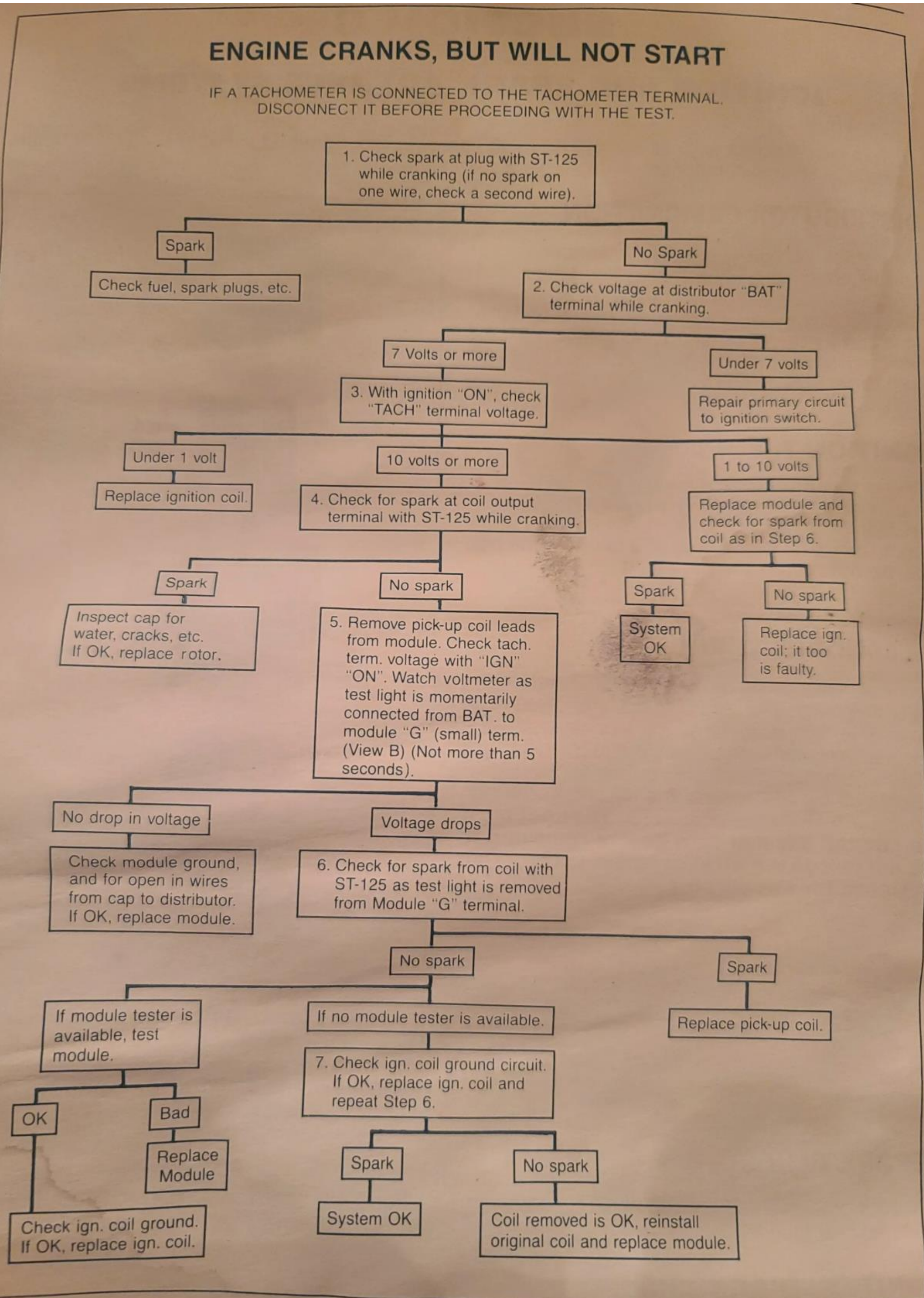
Figure 8-1. HEI Distributor Components

SPARK PLUGS

Resistor-type, tapered seat spark plugs are used on all gasoline engines. No gasket is used on these tapered seat plugs.

IGNITION DIAGNOSIS

See Figures 8-2 and 8-3 for diagnosis of no start or miss operation.



ure 8-2. HEI Diagnosis (Part 1)

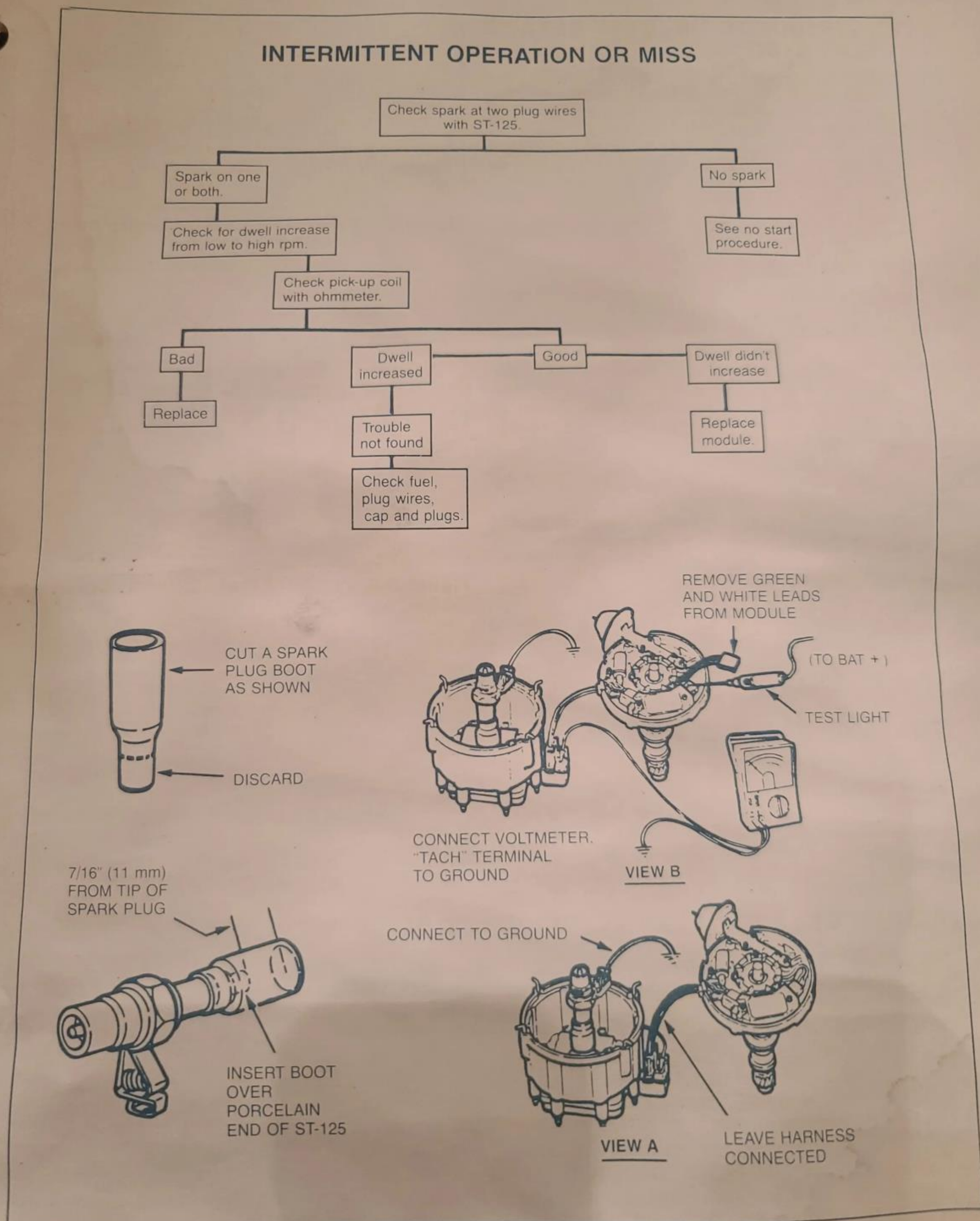


Figure 8-3. HEI Diagnosis (Part 2)

DISTRIBUTOR VACUUM RETARD DELAY SYSTEM

A Distributor Vacuum Retard Delay System (Fig. 8-4) is used on all 4.8L (292 cu. in.) six-cylinder gasoline engines. It is used to momentarily trap the distributor advance vacuum and prevent an instant retard when the throttle is opened for acceleration on a cold engine. Delaying the retard speeds warm-up, reduces HC-CO emissions, and improves performance. It consists of a vacuum retard delay valve (Fig. 8-5), with a warm engine bypass through a thermal vacuum switch (TVS).

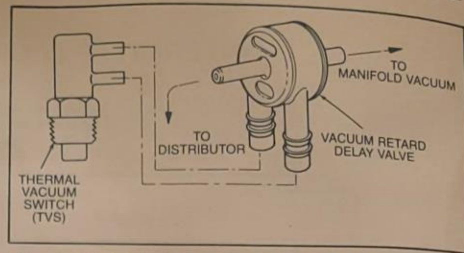


Figure 8-4. Distributor Vacuum Retard Delay System Schematic

OPERATION

When the engine coolant is cold, the vacuum from the vacuum source is routed to the distributor through the check valve in the vacuum retard delay valve. When the vacuum drops during vehicle acceleration or after an engine stall, the check valve closes. Vacuum trapped in the distributor vacuum advance unit bleeds through the sintered iron air bleed. The vacuum advance stays on until the bleed down is complete.

When the engine coolant temperature is warm, the thermal vacuum switch opens the vacuum bypass. This routes the vacuum from the vacuum source directly to the distributor, with the delay valve functioning only as a connector.

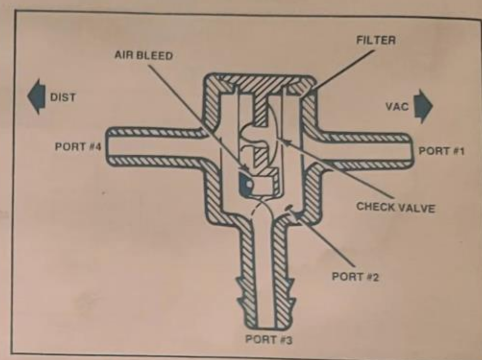


Figure 8-5. Vacuum Retard Delay Valve

WHAT CAN GO WRONG

- If the thermal vacuum switch sticks open, there is instant retard on acceleration. When cold, engine may stall. A leaking check valve in the retard delay valve can also cause this.
- If the check valve sticks closed, advance comes on slow, which could cause cold stalling.

THERMAL VACUUM SWITCH TEST

1. Inspect hoses for proper routing and loose, pinched, kinked or deteriorated conditions. Repair or replace as necessary.
2. With a cold engine—coolant at about 21° C. (70° F.)—the TVS must be closed. Check the switch by applying vacuum from the engine or external source to the inlet port on the switch—or by blowing through it. If it won't trap vacuum or passes air, replace it.
3. Check that the switch opens to release vacuum (or passes air) when the coolant is warm.

VACUUM RETARD DELAY VALVE CHECK-OUT

1. Disconnect hoses from the valve and remove the valve from the vehicle.
2. Using a Hand Vacuum Pump J-23738 (or equivalent) equipped with a vacuum gage, apply -68 kPa (20 in. Hg.) vacuum to the "VAC" port while sealing the other three ports with fingers:
   a. Vacuum gage reading should hold steady; if vacuum drops off, the valve is leaking and must be replaced.
   b. Unsealing any of the other three ports should cause the vacuum to immediately drop to zero. Check each of the three ports in turn, applying vacuum, unsealing a port, and watching for an immediate drop in vacuum. If the vacuum drops slowly—or not at all—check the port for an obstruction. If the obstruction can't be cleared away, replace the valve.
3. Next, apply -68 kPa (20 in. Hg.) vacuum to the "DIST" port while sealing the other three ports with fingers. Unsealing the "VAC" port should cause the vacuum gage reading to decrease slowly, from −68 kPa (20 in. Hg.) vacuum to −17 kPa (5 in. Hg.) vacuum in approximately 2 to 8 seconds. If the time is outside of this range, replace the valve.