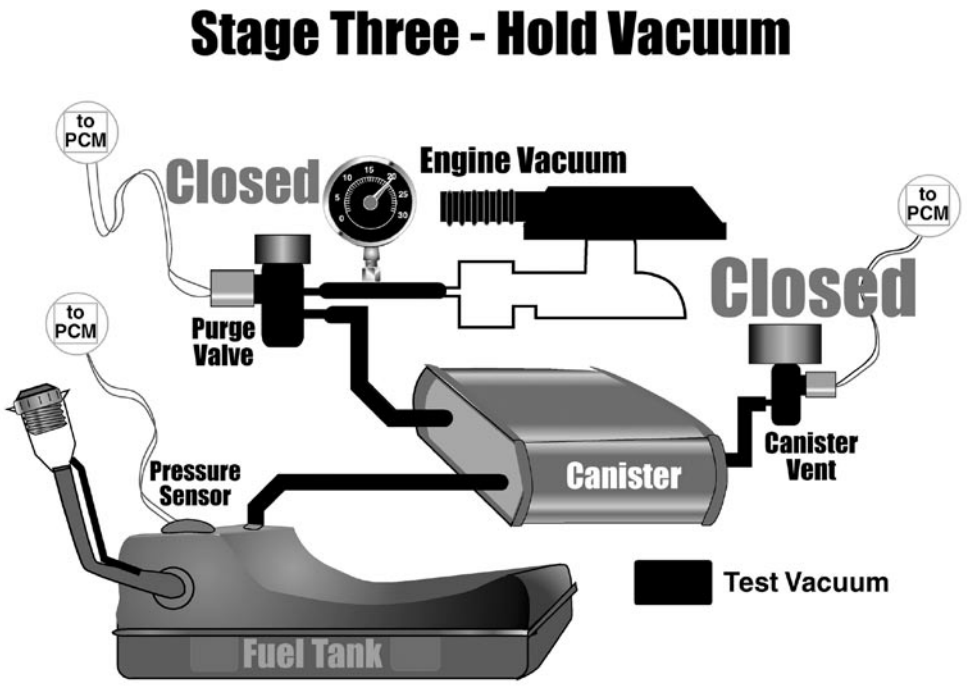
Vacuum Leak Detection Principles

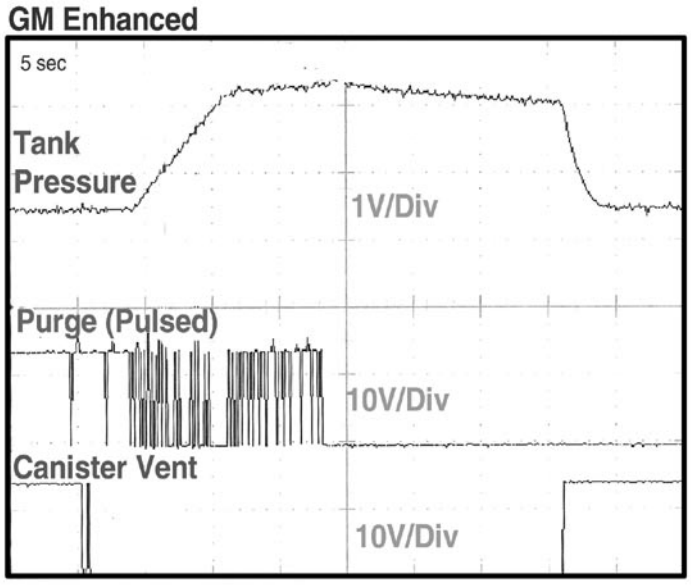
Step Three - Small Leak Test - Hold Vacuum

In Step Three, the Purge Valve is closed and the Canister Vent remains closed. If there are no leaks, the vacuum generated inside the EVAP system should hold steady (some small amount of decay is allowed, however, and may be caused by increased vapor pressure, not a leak). If the vacuum does not hold within an acceptable range, a fault is recorded by the EVAP monitor.



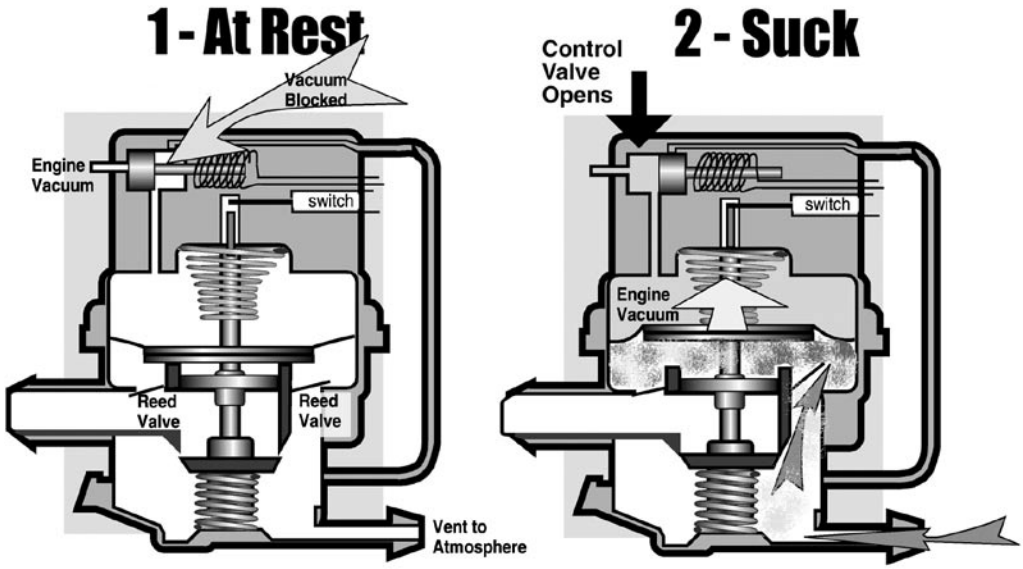
These waveforms show a GM Enhanced system as the EVAP monitor runs. Unlike the Ford system on the previous page, the pressure sensor voltage in this GM vehicle is only 1.3-1.7 volts at atmospheric pressure.

Another change? Opposite the Ford pressure sensor, this GM pressure sensor's voltage **increases** as pressure **decreases**.



Chrysler Leak Detection Pump Operation

For the LDP EVAP leak test to run, the vehicle must be cold, and the fuel level must be between 15 and 85%.

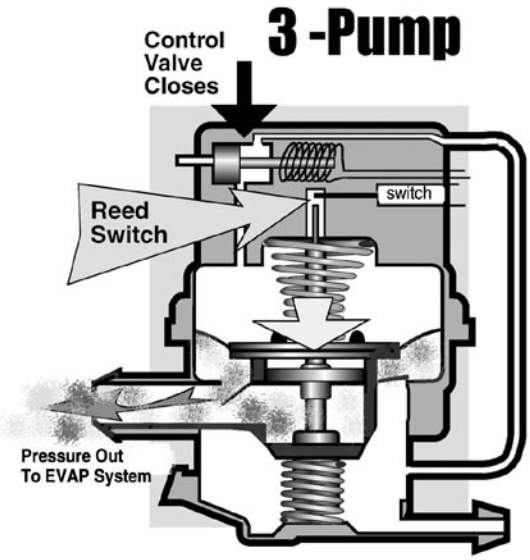


- **At Rest**. With the system at rest, the LDP solenoid blocks manifold vacuum from the running engine, preventing it from entering the LDP diaphragm upper chamber. The LDP vent is open to atmosphere.

- **Suck.** When the PCM grounds the vacuum control solenoid, manifold vacuum reaches the upper diaphragm chamber, pulling the diaphragm upward against a counter spring rated at 7.5 inH_2O. As the diaphragm rises, air from the vent port is drawn into the lower LDP diaphragm chamber through a reed valve. This is the LDP's suction stroke.

- **Pump.** When the LDP solenoid is de-energized by the PCM, suction in the upper chamber vents to atmosphere through a bypass hose. The counter spring pushes the LDP diaphragm downward, and the air that was previously drawn in on the suction stroke is exhausted to the EVAP system under pressure. This is the LDP's pressure stroke. The pumping continues until the EVAP pressure builds to a point where it is greater than the downward force of the counter spring. The pump diaphragm then remains in the up position and the electrical contact in the LDP sensing switch opens.

- **The LDP switch is the only LDP output signal to the PCM.** The PCM tests switch operation by applying vacuum to the diaphragm to raise it far enough to open the switch. Then it cycles the pump rapidly to create pressure in the system.



The LDP sense switch circuit is the only EVAP monitor input to the PCM. Since the switch is normally closed, look for battery voltage at the PCM switch pin KOEO. The switch circuit voltage drops to zero when vacuum pulls the pump diaphragm upwards far enough to open the switch.

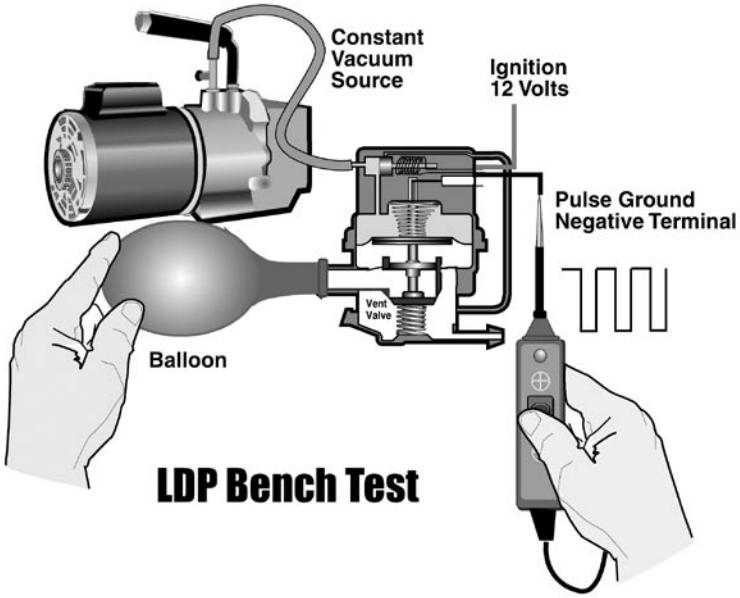
LDP Diagnostics

Once a pressure of 7.5 inH_2O is reached, the pressure in the system balances the force of the counter spring above the diaphragm, and the pump stops. The PCM knows when this happens because the LDP switch opens (goes from 12 to zero volts). The PCM monitors the pump time period to determine if there is a leak or obstruction.

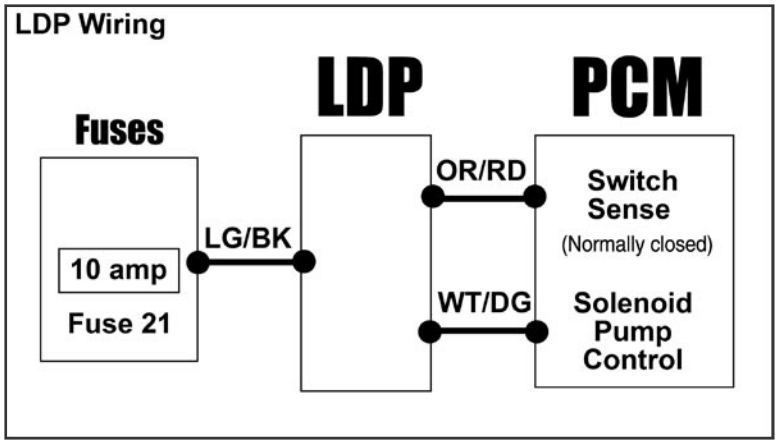
- If the pump **stops too soon**, the PCM assumes that there is an **obstruction** in the EVAP system (the pump did not have to fill the entire system to reach a pressure of 7.5 inH_2O).
- If the pump **runs too long** before stopping, it is assumed that the pump cannot create a maximum 7.5 inH_2O, due to a **large leak** in the system.
- If the pump runs, stops, and then restarts, the PCM calculates the size of the leak based on the interval between the time the pump stops and restarts. The longer the time, the smaller the leak. Large leaks cause pressure to drop quickly, and the pump restarts sooner.

When manually checking for leaks (e.g., using a smoke machine or other pressurized gas applied to the test port), the LDP vent valve must be closed. To close the vent valve, the LDP solenoid must be energized at the same time that a vacuum source is applied to the LDP solenoid. This lifts the LDP diaphragm all the way up, closing the vent valve.

The LDP can also be bench tested using a procedure similar to the one shown below. Connect the vacuum port to a constant vacuum source. (You might choose to connect the LDP to the vacuum port of a running engine if a vacuum pump isn't handy.) Then pulse the control valve open and closed using a Power Probe or similar switching device. This will create vacuum pulses in the upper chamber to operate the pump. If the pump is mechanically sound, it should inflate a balloon attached to the pump outlet and maintain the inflation without leaking down.



This schematic identifies LDP connector pin values. The LDP is supplied fused power through the ignition. The PCM controls the pump through a switch to ground. The Switch circuit is normally closed.



Ford Engine Off Natural Vacuum (EONV) Leak Detection

4) The canister vent closes again to reseal the system. The system is monitored for pressure or vacuum. If a large enough pressure change is measured, a passing grade is recorded for the test. The test times out in 45 minutes. If a pass is not recorded in this time, the test fails.

5) Test is complete. The canister vent is opened and all electrical loads are turned off to prevent continued battery drain. At the next start, test values and test results are sent to the main PCM processor.

To prevent false trouble codes, the results of **four key-off test cycles** are averaged to store the first fault. Since this is a two-trip code, about 8 key-off test cycles are needed to store a DTC and illuminate the MIL.