Fuel Evaporative Control Systems

What Are Evaporative Emissions?

Evaporative emissions are raw gasoline vapors that can escape from a vehicle under several different circumstances. Evaporative emissions are in addition to those released from the tail pipe. Gasoline fuel molecules are large and heavy and stay close to the ground. They contribute significantly to urban smog. The whole idea of evaporative emissions controls is to trap these fuel vapors before they can escape to the atmosphere.

Types of evaporative emissions

- Running Loss - vapors that escape from the vehicle's fuel system while it is being driven
- Hot Soak - fuel vapors that escape immediately after the vehicle has been shut off due to the high under-hood and fuel tank temperatures
- Diurnal Emissions - vapors that escape due to the ambient temperature increases during the day, especially on hot days.
- Refueling Emissions - occur when vapors inside the fuel tank are displaced into the atmosphere as the tank is refilled.

Early Systems

Early evaporative emissions control systems (evap) were fairly simple. They consisted of a charcoal canister with vent lines running to the fuel tank and the carburetor float bowl. Charcoal has a large capacity to absorb and trap gasoline molecules. When the vehicle warmed up, a thermal vacuum switch opened and allowed engine vacuum to draw fresh air across the charcoal. The gasoline vapors trapped in the charcoal were then drawn into the engine and burned.
Today the principle is still the same – a charcoal canister is used to temporarily store the gasoline vapors. However, over the years, and particularly since the introduction of OBD II regulations in the mid 1990s, many additional controls and sensors have been added. OBD II regulations require that the evap system is continuously checked for leaks and function. Following is a list and brief description of typical evaporative emissions controls components and their operation.

- **The Charcoal Canister (Fuel Vapor Canister)** - This is where the gasoline vapors are trapped and stored temporarily until they can be drawn into the engine and burned. When the vehicle is off, the gas tank is vented to the canister. Any fuel vapors that evaporate from the tank are trapped in the canister. Once the engine is up and running, engine vacuum is used to draw fresh air through the canister to purge the stored vapors from the canister and draw them into the engine. Raw fuel vapors from the fuel delivery system accumulate until a valve is opened, allowing the vapors to be pulled into the engine for combustion. Canisters must be replaced if they become plugged, cracked, or saturated with fuel.

- **The Canister Purge Valve** - This valve controls the flow of the trapped vapors from the charcoal canister as they are drawn into the engine and burned. Most early valves were vacuum operated. Later ones are usually vacuum solenoids controlled by the computer. The purge valve is closed when the engine is off and opens at idle and at cruise to allow the vapors to be drawn into the engine when it is running. Both the older all vacuum and the later electrical vacuum solenoid types of valves are fairly common failure items.

- **The Vent Solenoid Valve** - This valve is located on the canister vent line. It is normally open to allow air to pass into and out of the canister. The PCM closes the valve temporarily to seal the canister and then draws a slight vacuum on the system to check for leaks. Vent solenoids are often mounted low the vehicle next to the purge canister. As a result, they fail frequently due to contamination, corrosion, and clogging.
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*Canister Purge Valves*

- **The Fuel Tank Pressure Sensor** - This was introduced on OBD II vehicles. The computer uses the sensor to monitor fuel tank pressure and determine if the system is leaking. The sensor outputs a voltage signal to the PCM proportional to the pressure (or vacuum) in the tank. Depending on the year and manufacturer, several strategies may be used to determine if the system is leaking. The computer may draw a small vacuum on the system and check that the vacuum holds. Other systems monitor natural vacuum and pressure changes that occur in the system in response to ambient temperature changes.

- **Bowl Vent Solenoid or Valve** - These valves are only found on carbureted vehicles. The carburetor float bowl is a source of evaporative emission. When the vehicle is off, the bowl is vented to the canister. The bowl vent valve seals the bowl when the engine is running. Early valves were all vacuum operated, but later ones are an electrical solenoid controlled by the computer.

- **Thermal Vacuum Switch (TVS)** - This is used on older systems. It allows vacuum to pass to the purge valve to purge the canister after the engine is warmed up. The TVS may have multiple functions. See the section on miscellaneous components for more detail.

- **Fuel Separators** - These are used to prevent liquid fuel from entering the charcoal canister.