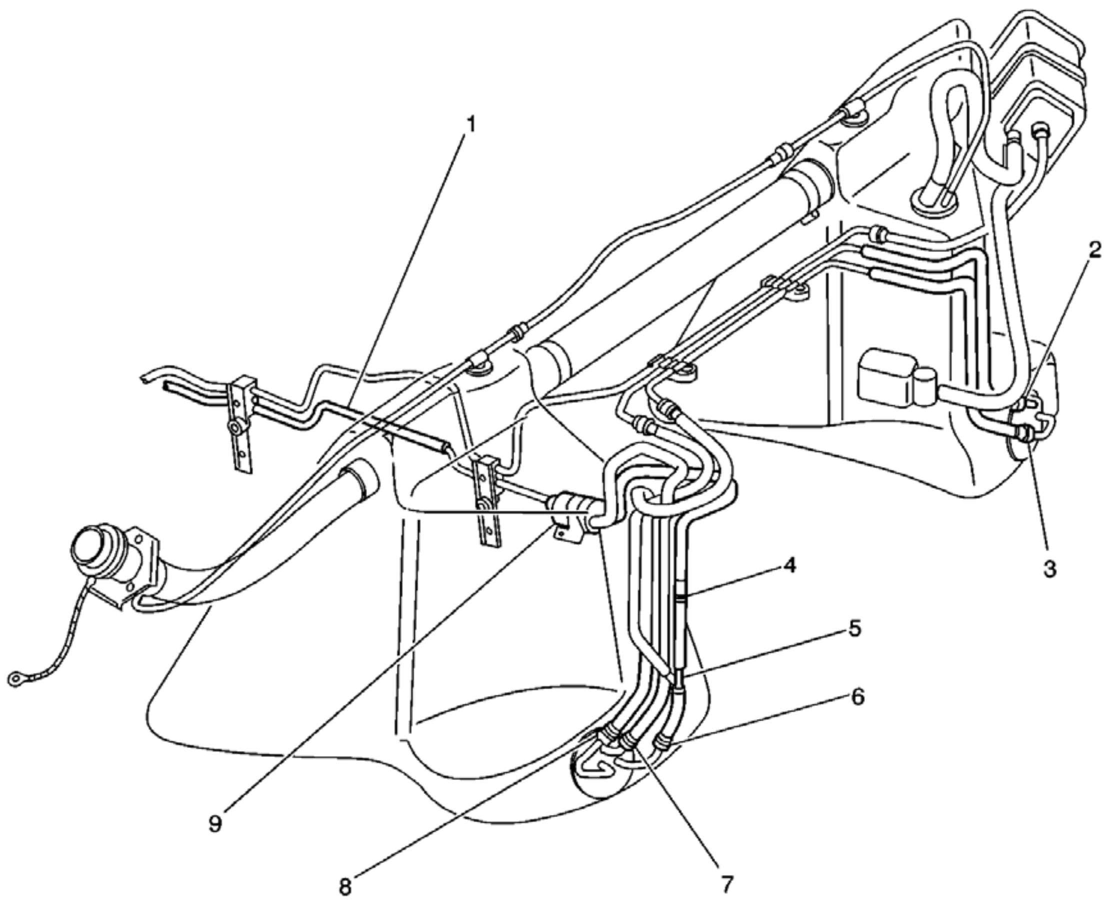
Fuel System Description

System Overview

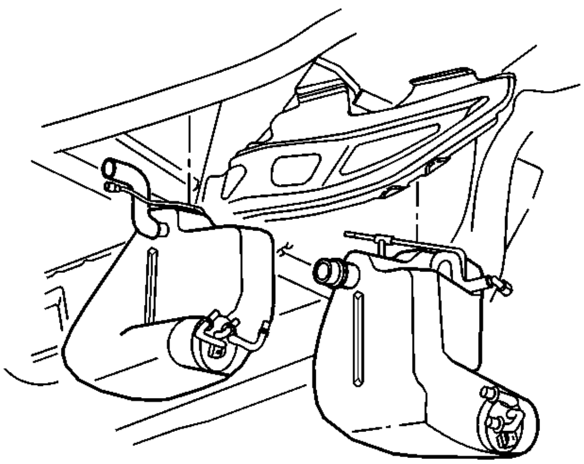


(1) Fuel Feed Pipe
(2) Auxiliary Fuel Feed Rear Pipe (left tank to jet pump)
(3) Auxiliary Fuel Return Rear Pipe (jet pump to left tank)
(4) Fuel Feed Pipe Check Valve
(5) Fuel Feed Pipe Tee with Orifice
(6) Fuel Feed Rear Pipe (to fuel filter/fuel pressure regulator and siphon jet pump)
(7) Fuel Return Rear Pipe
(8) Auxiliary Fuel Return Rear Pipe (jet pump to left tank)
(9) Fuel Filter/Fuel Pressure Regulator

2 fuel tanks store the fuel supply. An electric fuel pump attaches to the fuel sender assembly inside the

left fuel tank. The fuel pump pumps fuel through the fuel feed pipe (6) and an in-line fuel filter (9) to the fuel rail. The rear fuel feed pipe (6) has an integral check valve (4) in order to maintain the fuel system pressure in the feed pipe. The pump provides the fuel at a pressure greater than what is needed by the fuel injectors. The fuel pressure regulator, part of the fuel filter (9), keeps the fuel available to the injectors at a regulated pressure. A fuel return pipe (7) returns the unused fuel to the left fuel tank. The fuel pump also feeds the fuel through a tee (5) with an orifice in the fuel feed rear pipe (6) and through the auxiliary fuel feed rear pipe (2) in order to supply the siphon jet pump inside the right fuel tank. The siphon jet pump transfers the fuel from the right fuel tank to the left fuel tank through the auxiliary fuel return rear pipe (3, 8).

Fuel Tanks

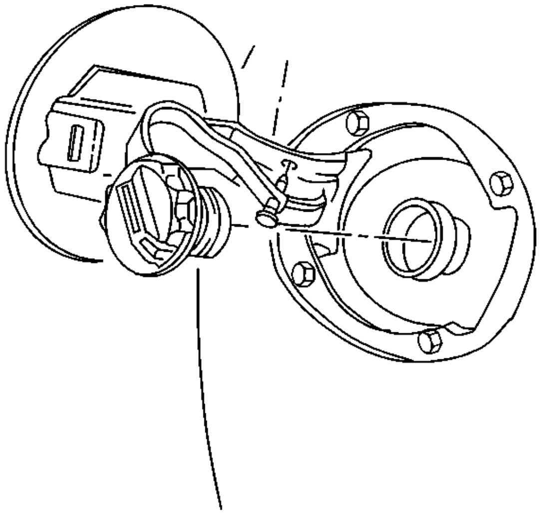


The fuel tanks store the fuel for the vehicle. The fuel tanks are located on the left and right side of the vehicle in front of the rear wheels. The fuel tanks are molded from high density polyethylene.

Fuel Tank Fill Pipe and Hose

The fuel tank fill pipe is positioned at the rear of the vehicle on the left side. A built in restrictor in the fuel tank fill pipe prevents refueling with leaded fuel. The fuel tank fill pipe connects to the left fuel tank with a rubber hose. Fuel transfers to the right fuel tank during fueling by a large rubber crossover hose which connects the left fuel tank to the right fuel tank.

Fuel Filler Cap

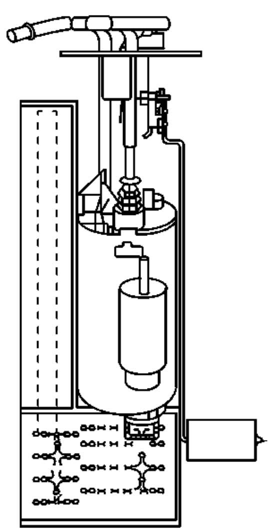


Notice

If a fuel tank filler cap requires replacement, use only a fuel tank filler cap with the same features. Failure to use the correct fuel tank filler cap can result in a serious malfunction of the fuel and EVAP system.

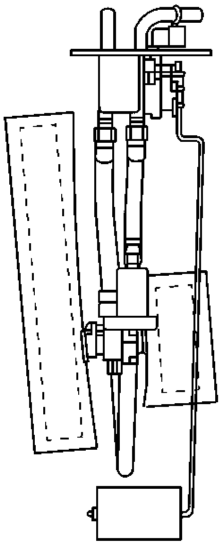
The fuel tank filler pipe has a tethered fuel tank filler cap. The fuel tank filler cap requires a quarter of a turn in order to be removed. A torque limiting device prevents the cap from being over tightened. To install the cap, turn the cap clockwise until the cap is fully seated.

Fuel Sender Assembly



A fuel sender assembly is located inside each fuel tank. The fuel sender assembly attaches to the lower side of each fuel tank. The left fuel sender assembly consists of the following major components:

- The fuel sender
- The fuel pump and reservoir assembly
- The fuel pump strainer



The right fuel sender assembly consists of the following major components:

- The fuel sender
- The siphon jet pump
- 2 fuel strainers

Fuel Sender

The fuel sender consists of a float, a wire float arm, and a fuel level sensor. The position of the float arm indicates the fuel level. The fuel level sensor contains a variable resistor, which changes the resistance corresponding to the amount of fuel in the fuel tank. The PCM uses inputs from both fuel senders in order to calculate the total fuel remaining in both fuel tanks. This information is sent via the serial data to the body control module (BCM) to be displayed on the fuel gauge.

Fuel Pump

An electric high pressure fuel pump attaches to the fuel sender assembly inside the left fuel tank. The fuel pump pumps fuel to the fuel rail assembly at a specified flow and pressure. Excess fuel from the fuel pressure regulator, a part of the fuel filter, returns to the left fuel tank through the return pipe. The fuel pump delivers a constant flow of fuel to the engine even during low fuel conditions and aggressive vehicle maneuvers. The PCM controls the electric fuel pump operation through a fuel pump relay.

The left tank fuel pump also supplies a small amount of pressurized fuel to the right fuel tank siphon jet pump through the fuel feed rear crossover pipe. The pressurized fuel creates a venturi action inside the siphon jet pump. The venturi action causes the fuel to be drawn out of the right fuel tank. Fuel is then transferred from the right fuel tank to the left fuel tank through the fuel sender fuel feed pipe.

Fuel Strainer

The fuel strainer is made of woven plastic. The functions of the fuel strainer are to filter the contaminants and to wick the fuel. The left fuel sender assembly has a large L-shaped strainer. The right fuel sender assembly has 2 strainers. The fuel strainer is self-cleaning and normally requires no maintenance. Fuel stoppage at this point indicates that the fuel tanks contain an abnormal amount of sediment or water. If a fuel strainer is plugged, refer to Fuel System Cleaning .

Fuel Filter/Fuel Pressure Regulator

The fuel filter/fuel pressure regulator is installed in the fuel feed pipe ahead of the fuel injection system. The paper filter element of the fuel filter traps particles in the fuel that may damage the fuel injection system. The fuel filter/fuel pressure regulator housing is made to withstand maximum fuel system pressure, exposure to fuel additives, and changes in temperature. There is no service interval for fuel filter replacement. Replace a restricted fuel filter.

The fuel pressure regulator is a diaphragm-operated relief valve. A software bias compensates the injector on-time because the fuel pressure regulator is not referenced to the manifold vacuum. The injector pulse width varies with the signal from the MAP sensor. With the ignition ON and the engine OFF, system fuel pressure at the pressure test connection should be 380-420 kPa (55-61 psi). If the pressure is too low, poor performance could result. If the pressure is too high, excessive odor and a DTC P0132, P0152, P0172, or P0175 may result. Refer to Fuel System Diagnosis for information on diagnosing fuel pressure conditions.

Fuel Feed and Return Pipes

The fuel feed pipe carries the fuel from the left fuel tank to the fuel rail assembly and to the right fuel tank siphon jet pump. The fuel return pipe carries the fuel from the fuel filter/fuel pressure regulator assembly back to the left fuel tank. The fuel feed and return pipes consist of 3 sections:

- The rear fuel pipes are located from the left fuel sender assembly to the fuel filter/pressure regulator assembly and from the left fuel sender assembly to the right fuel sender assembly. The rear fuel pipes connecting the fuel sender assemblies are constructed of sections of steel pipe and nylon pipe. The rear fuel pipes connecting the left fuel sender assembly to the fuel filter/pressure regulator assembly are constructed of nylon. The rear fuel feed pipe has an integral check valve in order to maintain the fuel system pressure in the feed pipe.
- The chassis fuel pipe is located under the vehicle on the left side of the tunnel. The chassis fuel pipe connects the rear fuel feed pipe from the left fuel sender assembly to the engine compartment connecting fuel pipe. This pipe is constructed of aluminum with a plastic coating.
- The engine compartment connecting fuel pipe connects the chassis fuel pipe to the fuel rail assembly. This pipe is constructed of Teflon® with a braided stainless steel covering.

Nylon Fuel Pipes

Caution

In order to reduce the risk of fire and personal injury observe the following items:

- **Replace all nylon fuel pipes that are nicked, scratched or damaged during installation, do not attempt to repair the sections of the nylon fuel pipes**
- **Do not hammer directly on the fuel harness body clips when installing new fuel pipes. Damage to the nylon pipes may result in a fuel leak.**
- **Always cover nylon vapor pipes with a wet towel before using a torch near them. Also, never expose the vehicle to temperatures higher than 115°C (239°F) for more than one hour, or more than 90°C (194°F) for any extended period.**
- **Apply a few drops of clean engine oil to the male pipe ends before connecting fuel pipe fittings. This will ensure proper reconnection and prevent a possible fuel leak. (During normal operation, the O-rings located in the female connector will swell and may prevent proper reconnection if not lubricated.)**

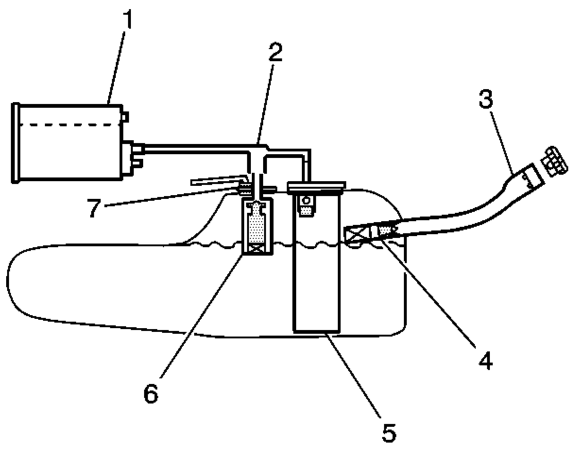
Nylon pipes are constructed to withstand maximum fuel system pressure, exposure to fuel additives, and changes in temperature. There are 2 sizes of nylon fuel pipes used. A 3/8 in ID pipe is used for the fuel feed pipe and the fuel sender fuel feed pipe (jet pump to left tank). A 5/16 in ID pipe is used for the fuel return pipe and the fuel feed rear crossover pipe (left tank to jet pump). Heat resistant rubber hose and/or corrugated plastic conduit protect the sections of the pipes that are exposed to chafing, high temperature or vibration.

Nylon fuel pipes are somewhat flexible and can be formed around gradual turns under the vehicle. However, if nylon fuel pipes are forced into sharp bends, the pipes will kink and restrict the fuel flow. Also, once exposed to the fuel, nylon pipes may become stiffer and are more likely to kink if bent too far. Take special care when working on a vehicle with nylon fuel pipes.

Quick-Connect Fittings

Quick-connect fittings provide a simplified means of installing and connecting fuel system components. The fittings consist of a unique female connector and a compatible male pipe end. O-rings located inside the female connector provide the fuel seal. Integral locking tabs located inside the female connector hold the fittings together.

On-Board Refueling Vapor Recovery System (ORVR)



The on-board refueling vapor recovery system (ORVR) is an on board vehicle system designed to recover fuel vapors during the vehicle refueling operation. The flow of liquid fuel down the fuel filler pipe provides a liquid seal which prevents vapor from leaving the fuel filler pipe. An EVAP pipe transports the fuel vapor to the EVAP canister for use by the engine. Listed below are the ORVR system components with a brief description of their operation:

- The EVAP canister (1)--the EVAP canister receives refueling vapor from the fuel system, stores the vapor and releases the vapor to the engine upon demand.
- The EVAP pipes (2)--transports fuel vapor from the fuel tank to the EVAP canister.
- The fuel filler pipe (3)--the pipe which carries fuel from the fuel nozzle to the fuel tank.
- The check valve (4)--the check valve limits fuel "spit back" from the fuel tank during the refueling operation by allowing fuel flow only into the fuel tank. This check valve is located at the bottom of the fuel filler pipe.
- The modular fuel sender assembly (5)--this assembly pumps fuel to the engine from the fuel tank.

- The fill limiter vent valve (FLVV) (6)--this valve acts as a shut off valve. The FLVV is located on the top of the right fuel tank. This valve is not serviced separately. The FLVV has the following functions:
    - Controls the fuel tank fill level by closing the primary vent from the fuel tank.
    - Prevents the fuel from exiting the fuel tank via the EVAP pipe to the canister.
    - Provides fuel-spillage protection in the event of a vehicle rollover by closing the vapor path from the fuel tank to the EVAP canister.

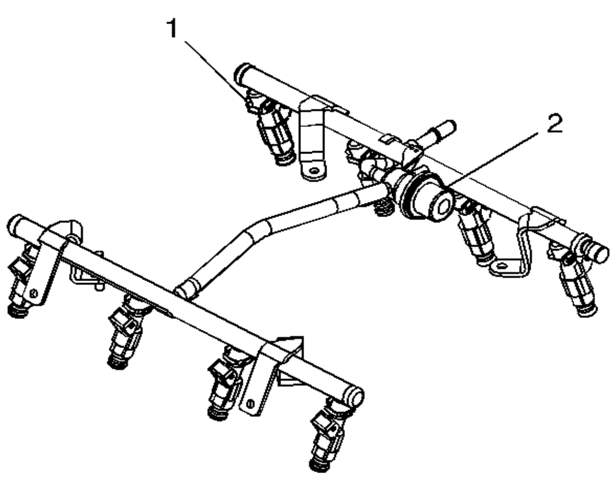
The fuel metering system consists of the following components:

- The fuel supply components, including:
    - 2 fuel tanks
    - A modular fuel pump and sender assembly
    - A siphon jet pump and sender assembly
    - A fuel filter/pressure regulator assembly
    - The fuel pipes and hoses
- The fuel pump electrical circuit
- The fuel rail assembly, including:
    - The fuel injectors
    - The fuel pulse dampener
- The throttle body assembly, including:
    - The throttle position (TP) sensor
    - The throttle actuator motor

Fuel Pump Electrical Circuit

When the ignition switch is in the ON position before engaging the starter, the PCM energizes the fuel pump relay for 2 seconds, causing the fuel pump to pressurize the fuel system. If the PCM does not receive the ignition, reference pulses with the engine cranking or running within 2 seconds, the PCM shuts OFF the fuel pump relay, causing the fuel pump to stop.

Fuel Rail Assembly



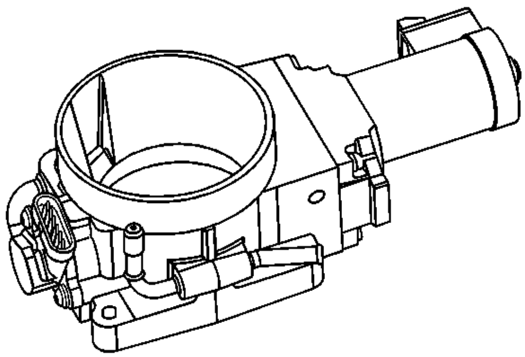
The fuel rail assembly attaches to the engine intake manifold. The fuel rail assembly performs the following functions:

- Positions the injectors (1) in the intake manifold
- Distributes the fuel evenly to the injectors
- Integrates the fuel pulse dampener (2) into the fuel metering system

Fuel Injectors

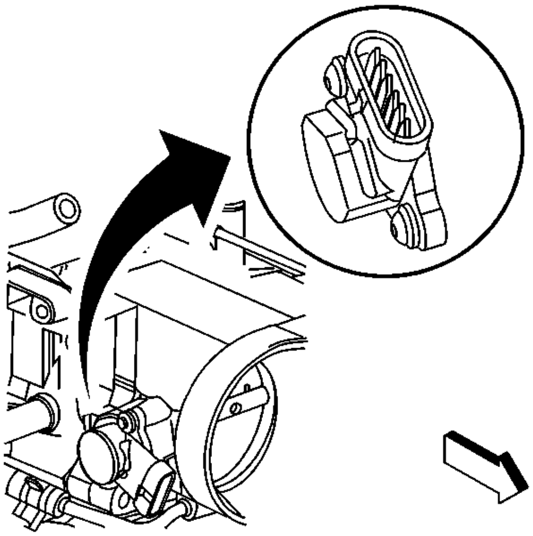
The top-feed fuel injector assembly is a solenoid device, controlled by the PCM, that meters pressurized fuel to a single engine cylinder. The PCM energizes the injector solenoid, which opens a ball valve, allowing the fuel to flow past the ball valve and through a recessed flow director plate. The director plate has multiple machined holes that control the fuel flow, generating a conical spray pattern of finely-atomized fuel at the injector tip. Fuel is directed at the intake valve, causing the fuel to become further atomized and vaporized before entering the combustion chamber. An injector stuck partly open can cause a loss of fuel pressure after engine shutdown. Consequently, long cranking times would be noticed on some engines.

Throttle Body Assembly



The throttle body assembly attaches to the intake manifold. The throttle body controls air flow into the engine, thereby controlling engine output. The throttle actuator motor mounted on the throttle body opens the throttle valve within the throttle body. Engine coolant flows through the coolant cavity on the bottom of the throttle body in order to prevent throttle valve icing during cold weather operation. The throttle body also provides the location for mounting the throttle position (TP) sensor.

Throttle Position (TP) Sensor



The TP sensor is mounted on the side of the throttle body opposite the air control valve. The TP sensor senses the throttle valve angle and relays that information to the PCM. Knowledge of the throttle angle is needed by the PCM in order to generate the required injector control signals, or pulses.

Fuel Metering Modes of Operation

The PCM monitors at voltages from several sensors in order to determine how much fuel to give the engine. The fuel is delivered under one of several conditions called modes. The PCM controls all modes.

Starting Mode

With the ignition switch in the ON position, before engaging the starter, the PCM energizes the fuel pump relay for 2 seconds allowing the fuel pump to build up pressure. The PCM first checks speed density, then switches to the mass air flow (MAF) sensor. The PCM also uses the engine coolant temperature (ECT), throttle position (TP), and manifold absolute pressure (MAP) sensors to determine the proper air/fuel ratio for starting. The PCM controls the amount of fuel delivered in the starting mode by changing the pulse width, or the On time, of the injectors.

Clear Flood Mode

If the engine floods, clear the engine by pushing the accelerator pedal down to the floor and then crank the engine. The PCM reduces the injector pulse width in order to increase the air/fuel ratio. The PCM holds this injector rate as long as the throttle stays wide open and the engine speed is below a predetermined RPM. If the throttle is not held wide open, the PCM returns to the starting mode.

Run Mode

The run mode has 2 conditions called Open Loop and Closed Loop. When the engine is first started, and engine speed is above a predetermined RPM, the system begins Open Loop operation. The PCM ignores the signal from the HO2S and calculates the air/fuel ratio based on inputs from the ECT, the MAF, the MAP, and the TP sensors. The system stays in Open Loop until meeting the following conditions are met:

- Both front HO2S have varying voltage output, showing that they are hot enough to operate properly. This depends upon the engine temperature.
- The ECT sensor is above a specified temperature.

- A specific amount of time has elapsed after starting the engine.

Specific values for the above conditions exist for each different engine, and are stored in the electrically erasable programmable read only memory (EEPROM). The system begins Closed Loop operation after reaching these values. In Closed Loop, the PCM calculates the air/fuel ratio (injector on-time) based on the signal from various sensors, but mainly from the HO2S. This allows the air/fuel ratio to stay very close to 14.7:1.

Acceleration Mode

When the driver pushes on the accelerator pedal, the air flow into the cylinders increases rapidly, while the fuel flow tends to lag behind. In order to prevent possible hesitation, the PCM increases the pulse width to the injectors in order to provide extra fuel during acceleration. The PCM determines the amount of fuel required based upon the throttle position, the coolant temperature, the manifold air pressure, the mass air flow, and the engine speed.

Deceleration Mode

When the driver releases the accelerator pedal, the air flow into the engine is reduced. The PCM senses the corresponding changes in throttle position, the manifold air pressure, and the mass air flow. The PCM shuts OFF fuel completely if the deceleration is very rapid, or for long periods, such as long closed throttle coast-down. The fuel shuts OFF in order to protect the catalytic converters.

Battery Voltage Correction Mode

When the battery voltage is low, the PCM compensates for the weak spark delivered by the ignition system in the following ways:

- Increasing the amount of fuel delivered
- Increasing the idle RPM
- Increasing the ignition dwell time

Fuel Cutoff Mode

The PCM cuts off fuel from the fuel injectors when certain conditions are met. This fuel shut off mode protects the powertrain from damage and improves driveability. The control module disables the injectors under the following conditions:

- The ignition is OFF (prevents engine run-on)
- The ignition is ON but there is no ignition reference signal (prevents flooding or backfiring)
- The engine speed is too high (above red line)
- The vehicle speed is too high (above rated tire speed)
- During an extended, high-speed, closed throttle coast down (reduces emissions and increases engine braking)

Short Term Fuel Trim

The short-term fuel trim (FT) is a PCM-erasable memory register. The neutral value for the short-term FT is 0 percent. Any deviation from 0 percent indicates that the short-term FT is changing the injector pulse width. The amount of pulse width change depends on how far the short-term fuel trim value is from 0 percent. The short-term FT is rich when the scan tool indicates a negative number. The short FT is lean when the scan tool indicates a number greater than 0. The short-term FT changes the injector pulse width by adding to or subtracting from the base pulse width equation. As the PCM monitors the oxygen sensors input, the PCM is constantly varying the short-term FT value. The value is updated very quickly. The short-term FT only corrects for short-term mixture trends. The correction of long-term mixture trends is the function of long-term FT.

When the PCM determines that the short-term FT is out of the operating range, 1 of the following DTCs will set:

- DTC P0171 FT System Lean Bank 1
- DTC P0172 FT System Rich Bank 1
- DTC P0174 FT System Lean Bank 2
- DTC P0175 FT System Rich Bank 2

Long Term Fuel Trim

The long-term fuel trim (FT) is a matrix of cells arranged by the RPM and the MAP. Each cell of the long-term FT is a register like the short-term FT. As the engine operating conditions change, the PCM will switch from cell to cell in order to determine what long-term FT factor to use in the base pulse width equation.

While in any given cell, the PCM also monitors the short-term FT. If the short-term FT is far enough from 0 percent, the PCM will change the long-term FT value. Once the long-term FT value is changed, the change should force the short-term FT back toward 0 percent. If the mixture is still not correct, as judged by the PCM, the short-term FT will continue to have a large deviation from the ideal 0 percent. In this case, the long-term FT value will continue to change until the short-term FT becomes balanced. Both the short-term FT and long-term FT have limits which vary by calibration. If the mixture is off enough so that long-term FT reaches the limit of its control and still cannot correct the condition, the short-term FT would also go to its limit of control in the same direction. If the mixture is still not corrected by both short-term FT and long-term FT at their extreme values, a FT DTC will likely result. When the PCM determines that the long-term FT is out of the operating range, the following DTCs will set:

- DTC P0171 FT System Lean Bank 1
- DTC P0172 FT System Rich Bank 1
- DTC P0174 FT System Lean Bank 2
- DTC P0175 FT System Rich Bank 2

Under the conditions of power enrichment, the PCM sets the short-term FT to 0 percent and freezes the FT there until the power enrichment is no longer in effect. This is done so the Closed Loop factor and the long-term FT will not try to correct for the commanded richness of power enrichment.

Speed Density

The speed density system is only needed when there is a mass air flow (MAF) sensor malfunction. If the PCM detects a malfunction with the MAF sensor circuit, the PCM will default to the speed density fuel management.

Three sensors provide the PCM with the basic information for the fuel management portion of its operation. That is, 3 specific signals to the PCM establish the engine speed and the air density factors. The engine speed signal comes from the ignition system. Air density is derived from the IAT and the MAP sensor inputs. The IAT sensor measures the air temperature that is entering the engine. The IAT signal works in conjunction with the MAP sensor to determine air density. As the intake manifold pressure increases, the air density in the intake manifold also increases and additional fuel is required. This information from the IAT and MAP sensors is used by the PCM to control injector pulse width.

Document ID# 672604
2001 Chevrolet/Geo Corvette