

Technical Notes — October '10' - Modern Corvette Fuel System



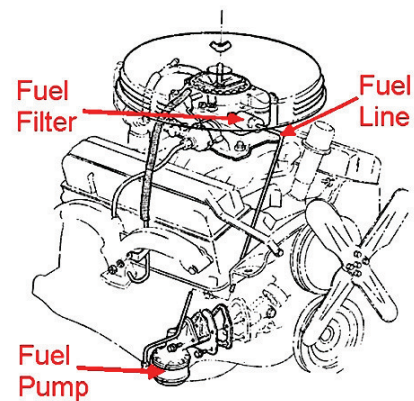
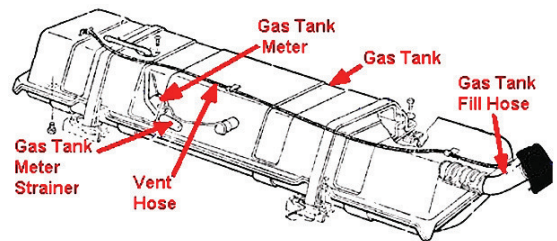
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The modern Corvette fuel system. In the early days, Corvette fuel systems were very rudimentary and for obvious reasons. First, the engines were generally carbureted, which required a lower fuel delivery pressure to the engine and second, the EPA didn't even exist until the 1970's. However, with the advent of the port fuel injected engine and the stringent air pollution standards, the fuel system has become a complicated and naturally, an expensive part of the modern sports car. Let's look at current design and some problems with the C5/C6 fuel systems.

Here is a diagram of the C1 fuel system. Basically, when you filled your tank at the gas station, the fuel flows into a fill hose connected directly to a single chamber tank. When the car was running the fuel passed through a strainer, went out the fuel feed line along the frame (not shown) to the fuel pump on the engine. The mechanical fuel pump ran off a rod from one lobe on the cam shaft. The rod pushed a lever on the fuel pump every time the high point on the lobe struck it. This action cycled a diaphragm within the fuel pump housing. Diaphragm cycling caused suction from the fuel tank and positive pressure up the fuel line to the carburetor. Depending on the carburetor model, the fuel filter either was in the line prior to the carburetor or in a small housing on the carburetor. A small vent hose was on the fuel tank top to vent any gasoline vapor to the atmosphere at all times, including when the vehicle was parked. (Uh oh! If the EPA ever heard that, I would be arrested for driving my '62 to Woody's!)



If you'll note, this system has the following characteristics. Most components such as fuel pump and fuel filter were readily exposed to allow for easy maintenance. The system polluted the environment because vapors were allowed to vent directly to the atmosphere. Finally, although not obvious, the fuel fill hose was a straight tube. This allowed fuel to be easily siphoned from the tank and did little to prevent fuel from splashing everywhere if the gas station attendant (yes, they existed in the 50s and 60s) had the feed nozzle at maximum flow.

This sort of system prevailed until the mid-70s when automakers were forced to deal with the air pollution issue. Many vapor recovery systems became prevalent and the efficiency of capturing of venting fuel vapor improved dramatically. However, the basic fuel system design remained: The fuel tank was a single metal can and the pump and filter were external. By the C4 era, fuel injection became the norm, so the fuel pump went to an electrically powered unit located within the tank, however the fuel filter was still located in the engine compartment. .

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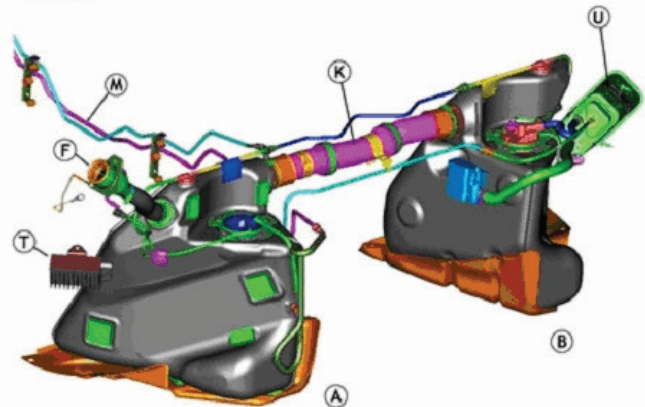
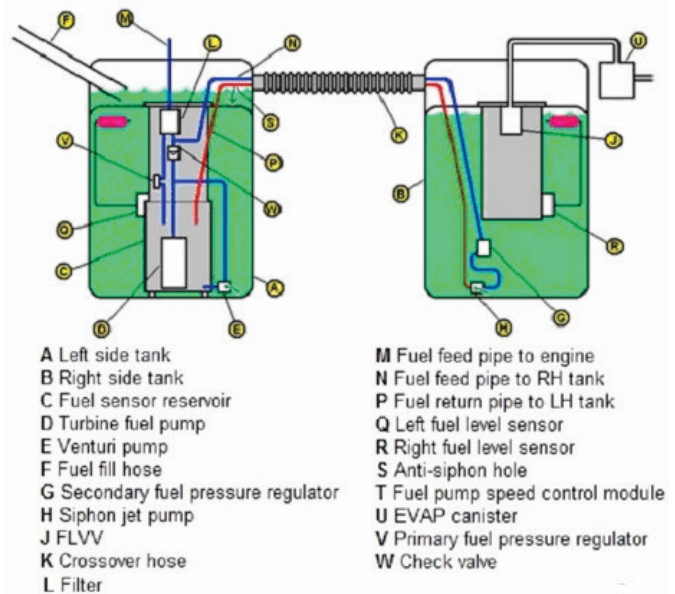
Even though the fuel pump was located within the fuel tank, it was relatively easy to change from the fuel filler door compartment.

With the advent of the C5 Corvette generation, the system became much more complex. First of all, dual (saddle) tanks behind the occupants replaced the single metal tank. The fuel pump was located within the left tank, but was very difficult to change because the tanks had to be removed. For most of the C5s, the fuel filter was no longer located in the engine compartment and now sat near the fuel tank on the body wall. Let's look at a C5 system.

If you look carefully, you'll see that the main fuel pump is located in the left tank. The right tank just as a jet pump which transfers its fuel into the left tank. So, only the left tank feeds the engine. The two tanks are connected through a crossover hose (K) and two pressurized lines, the line that powers the jet pump (N) and the fuel return from the right tank (P). The system works as follows:

1. **Fill:** As the fuel is pumped into the vehicle, it fills the left tank. Once the left tank is filled, fuel overflows into the crossover hose and fills the right tank. When the right tank is full, the FLVV (J) closes stopping the right tank from over filling into the vent system. The fuel backs up into the filling hose (F) eventually causing the gas pump nozzle to shut off.

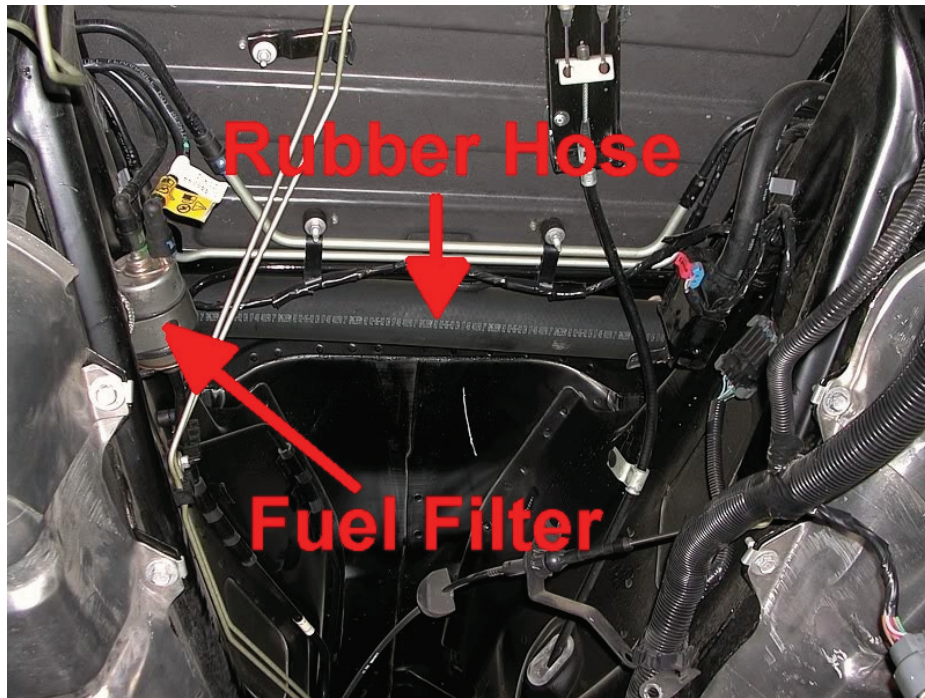
2. **Run:** When the car is running, the electrically powered, main turbine fuel pump creates more outflow than is required to feed the engine. Some fuel is diverted to the venturi pump which continuously scavenges fuel from the bottom of the left tank to insure every bit is used. Some fuel is sent through line (N) to the jet pump in the right tank. Through venturi effect in the jet pump (H), fuel is siphoned from the right tank to the left tank through line (P). As the fuel level decreases in the right tank, the left tank remains full. The main turbine fuel pump naturally feeds the engine through line (M). In most C5s, the fuel filter is located in line (M) just after the fuel leaves the left tank. You may note that when the fuel gage reads approximately half full, there is really no fuel in the right tank. At the half full point, all remaining fuel is essentially in the left tank.



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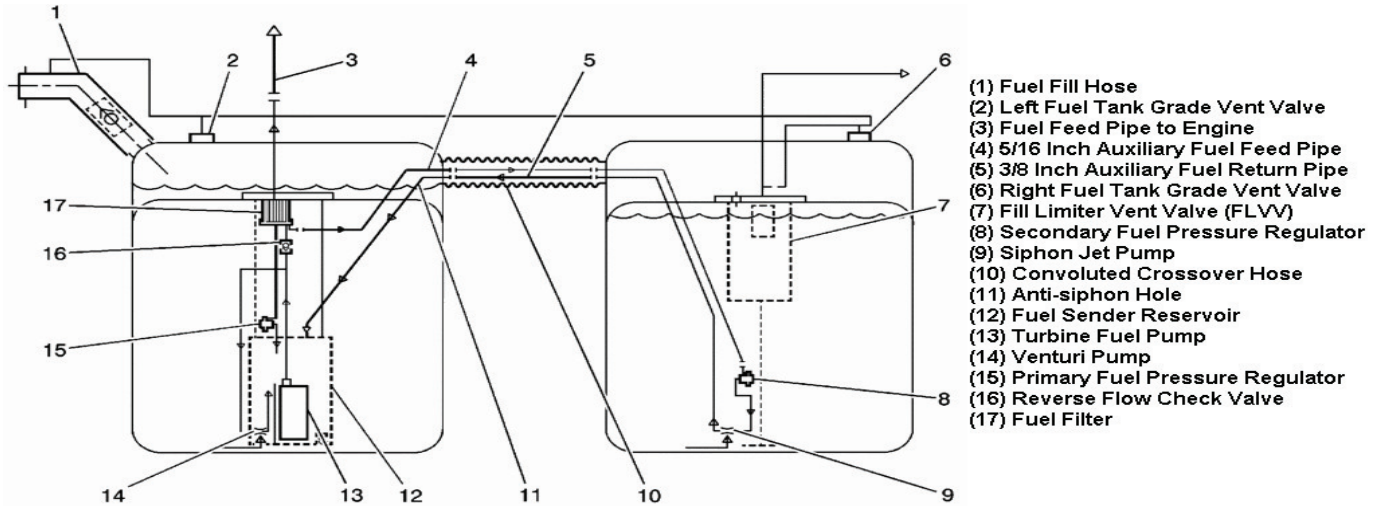
3. Some other features are notable. Through its internal design, fuel cannot be siphoned from the fuel tank through the fill hose. Although the pictured diagram shows the basic layout of a C5, it is technically for late 2003 and all 2004 Corvettes. The fuel system for the 1997 through early-2003 cars had some minor differences from the diagram. First, the fuel filter was mounted external to the tank and second, the crossover hose was smooth and straight. In late 2003 and 2004 cars, the diagram correctly shows the fuel filter within the left tank and the crossover hose (K) somewhat kinked. That's because late C5 crossover hoses were stainless steel. The C6 Corvette uses a very similar design to the late C5 cars. Let's look at a picture of the early C5 system. You can see the rubber crossover hose. The reason for the change to stainless steel in late 2003 was because of EPA emissions issues with the rubber hose. You can also see the fuel filter is located outside the tank.



As I said, the C6 system is basically identical to that of the late C5s. Here are the diagram of the system and a picture of what a complete system looks like. Note the internal fuel filter (17) in the diagram and stainless steel crossover hose in the picture.

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So, what issues do we have with this complex fuel feed system?

1. Let me remind you of the very first Tech Article I wrote. GM strongly recommends the use of Top Tier gasoline. Sulfur can build up on the two fuel sensors, (Q) and (R) shown in the first C5 fuel system diagram. This is a real problem that can cause erratic fuel readings. Using a Top Tier gasoline, or routinely using a good fuel system cleaner, can control this sensor contamination issue.
2. Replacing a fuel filter for early C5s is not difficult. Filters are about \$20 for the 1997/98 cars and about \$40 on later C5s, so they're expensive relative to early Corvettes (approximately \$5 for C1 cars). Fortunately, they are not a serviceable item on the maintenance schedule. Nevertheless, you will see articles suggesting a 50,000-mile replacement schedule.
3. Since the fuel filter sits within the fuel tank on late 2003 and subsequent vehicles, preventative maintenance replacement of this item would be an extremely expensive proposition. Remember, the entire fuel tank cluster must be removed to get to this filter. But again we are in luck since the filter is not a serviceable item and should last a lifetime.
4. Both the C5 and C6 systems can develop cracks in some of the tubing, pipes, etc. This will cause emissions control problems and may throw an OBD code. However, recently GM has issued a notable customer satisfaction notice for the 2004 Corvettes regarding a fuel leak in the crossover hose connectors. Here we are talking about a strong fuel odor during refueling, driving or after parking. It can even cause a fuel puddle under the vehicle. The dealer will repair this condition if it exists and Chevrolet is offering a 10-year, 100,000-mile warranty for this malfunction if the customer has not experienced the condition yet.



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Although the late 2003 Corvette is not included in this customer satisfaction notice, I would be aware of the condition. You could have the 2004-type system even in a 2003 car. The C6 system, although similar in design, does not have identical components and is not included in the customer satisfaction notice.

Now, the tech question of the month: During refueling you experience premature gas pump nozzle shutoff (i.e. nozzle shuts off before the tank is full). If you bring your car to the dealer, he undoubtedly will ask you if this happens at every gas station. That is because the C5 system is calibrated to accept only the “standard” refill-pumping rate for gas station fuel pump. If this condition only occurs at one station, that station’s pump may be defective and pumping gas too fast. Thus, the vehicle fuel system is not really faulty. So, here’s the question: What is the “standard” pumping rate for US service station pumps. Is it:

- (A) 6.5 gallons a minute
- (B) 10.0 gallons a minute
- (C) 14.45 gallons a minute
- (D) 20.0 gallons a minute

Naturally, all of you know the answer, because Corvette owners are purists and as such, are totally aware of everything that is happening during refueling. They would never be daydreaming, texting, or looking at the babe at the other pump. Yeah, right!