# AVOIDING FUEL CONTAMINATION

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FUEL CONTAMINATION HAS always been a major concern of pilots. If you take the time and effort to avoid fuel contamination, you will probably live to tell the grandkids about the "good old days of aviation". Cavalierly ignore that stuff in your fuel tanks and chances are that you will wind up a one paragraph accident statistic in a half dozen aviation magazines.

The subject of fuel contamination has received more attention lately. Some of this concern is a result of the thousands of U. S. aircraft owners who are switching to auto fuel. However, reports indicate that pilots using mogas are the least likely to be affected by fuel contamination problems. Nevertheless, fuel contamination **is possible** in **any** aircraft using **any** fuel. Whether it is 100LL purchased from an FBO or mogas transported in a 5 gallon can we need to be prudent in examining its quality. As Pilot in Command it is **your** responsibility to ensure that your aircraft has been fueled with the proper fuel and that it is free from contamination.

### What Is Fuel Contamination?

Fuel is contaminated when it contains any material that was not provided under the fuel specification. In other words, if it's not gasoline it doesn't belong in your fuel tanks. Contamination can be water, rust, sand, dust, microbial growth, or certain additives that are not compatible with the fuel, fuel system materials and engine. These contaminating additives include alcohol. Another form of contamination can result from topping the tanks off with the wrong fuel. We are all familiar with the horror stories involving line men who inadvertently fuel aircraft equipped with piston engines with jet fuel. Once again, as Pilot in Command it is your responsibility to ensure that your aircraft is properly fueled.

### Water Is The Most Usual Fuel Contaminant

Water can get into your fuel in a variety of ways. All aviation fuels absorb moisture from the air and contain water in both suspended particle and liquid form. Water may find its way into an FBO's underground fuel tank, through improper housekeeping methods or through condensation. At dealers with a low turnover rate, water sometimes condenses in the partially-filled underground fuel tanks as it does in your aircraft.

Storing the aircraft with partially-filled fuel tanks encourages condensation and water contamination of the fuel. The next time you perform an early morning preflight inspection of your aircraft notice the dew or moisture on the wings, cowling and windshield. This same type of moisture can form on the inside walls of your partially-filled fuel tanks. Filling your tanks at the end of the flight and before parking or storing the aircraft will tend to minimize the problem. The fuel system sumps and screens must be drained prior to flight to ensure that any water that may have entered the system through condensation or fuel cap seal leaks is removed.

### Checking For Fuel Contamination

FAA's pamphlet "Safety Guide for Private Aircraft Owners" (FAA Document FAA-P-8740-4A) concisely outlines the steps necessary to check for fuel contamination. According to the pamphlet, "The importance of proper servicing of the fuel system during preflight inspection cannot be over-emphasized. Drain a generous sample of fuel (several ounces or more — not just a trickle) into a transparent container. Examine the sample of fuel from each sump for water, dirt, sand, rust, etc. Water will not mix with gasoline and, if present, will collect at the bottom of the transparent container and will be easily detected. If water or other contaminants appear, continue to drain the fuel from that sump until you are sure that the system is clear.

"If your aircraft is not equipped with wing tank "quick-drain" valves, the shop where your inspection and maintenance are performed can advise you about such installations. It is also wise to periodically inspect and clean the fuel tank outlet finger strainer; inspect and clean the carburetor inlet screen; and flush the carburetor bowl."

FAA has performed a series of field tests to determine how much fuel must be drained from the sump in order to ensure that water is not present. In one test 3 gallons of water were added to a half-full fuel tank of a popular high-wing monoplane. After several minutes, the fuel strainer (gascolator) was checked for water. It was necessary to drain **10 liquid ounces** of fuel before any water appeared. This is considerably more than most pilots drain when checking fuel for water contamination. In another test, simulating a tricycle-geared model, one gallon of water was added to a half-full fuel tank. It was necessary to drain more than a **quart** of fuel before any water appeared. In both of these tests, about 9 ounces of water remained in the fuel tanks after the belly drain and the fuel strainer (gascolator) had ceased to show any trace of water. This residual water could only be removed by draining the tank sumps.


**If the fuel truck is grimy, dirty and rusty, what is the condition of its contents? Although the truck is marked aviation fuel the type or grade of fuel is not indicated. Note the rusty disintegrating cylinder on the back bumper. That's a fire extinguisher!**

The fuel sample, in your transparent container, should be visually free of undissolved water, sediment and suspended matter and should be clear and bright at the ambient temperature or at 21° C (70° F) whichever is higher. This description applies to both avgas and mogas.

If you discover water in your fuel sample, continue to drain the sumps to remove the water. It is practically impossible to drain all water from the tanks through the fuel lines, so it becomes necessary to regularly drain the fuel sumps in order to remove all water from the system. It may be necessary to gently rock the wings of some aircraft while draining the sumps to completely drain all the water. On certain tail-wheel-type aircraft, raising the tail to level flight attitude may result in additional flow of water to the gascolator or main fuel strainer.

### A Word About Alcohol

Yes, alcohol is a fuel contaminant. A concentration of 5% to 10% of alcohol can play havoc with your fuel system and engine materials. Alcohol, whether methanol or ethanol, can cause the deterioration of synthetic rubber seals and fittings. Deterioration of these parts can lead to the blockage of fuel filters and lines and a general degradation of the fuel system. There have been some reports of problems caused by alcohol-tainted fuel in gascolators. The cement bond between the rubber tip and the steel rod within the gascolator is deteriorated by fuel containing alcohol. As a result, the gascolator does not separate water from fuel as it should. Unchecked, the gascolator may suffer a total malfunction.

Users of mogas should be particularly careful of alcohol contamination. Some independent autogas dealers have intentionally added alcohol to their fuel tanks without notifying the buyer. That is one of the reasons that mogas users are encouraged to buy fuel only from high volume, reputable dealers of major refineries.

Alcohol contamination of fuel does not result from the use of FAA approved deicing fluid, which contains less than 1% of alcohol.

If you suspect alcohol contamination there is one relatively crude check you can make on the fuel. In a transparent container mix 9 equal parts of fuel with 1 equal part of water. While a graduated beaker is helpful it is not necessary. You may, for instance, measure the parts with a cocktail jigger. If there is no alcohol in the fuel, the water will settle to the bottom of the container. It should be clearly identifiable as the same amount of water you added in the first place. If the water collects at some point above the bottom of the container, the liquid between the base of the water level and the bottom of the container is approximately proportional to the amount of alcohol in the fuel. If you discover alcohol in your fuel system you are advised to drain the entire system.

### Out Of The Can, Into The Wing

Depending on your point of view, refueling your aircraft from 5 gallon cans or 55 gallon drums can either be a time-honored tradition or a hazardous enterprise. Generally, refueling your aicraft from small containers is not recommended by the FAA or EAA. However, if you follow the proper procedures, refueling an airplane from containers can be just as safe and sure as refueling it from an underground tank . . . sometimes even better. It's better because you, personally, have complete control over the type of fuel you introduce into the fuel system and complete control (and responsibility for) of its purity. How often have you landed at a strange airport and taxied up to an FBO only to discover a fuel truck in a horrible state of disrepair. If a fuel truck is grimy and rusty, what are we to assume of its contents?

Necessity often results in mogas users refueling their aircraft from containers. EAA is currently aware of approximately 200 FBOs across the country which provide autofuel for their customers. Obviously, not all mogas users are within flying range of these FBOs. On the brighter side of the coin, it is equally obvious that more and more FBOs are beginning to stock autogas. They are reacting to the economic impact of about 11,000 aircraft now legally flying around the country on auto fuel and more every day. As more of us switch to auto fuel we can be sure that the FBOs will follow suit. Until that time, many of us will resort to lugging autogas in 5 gallon containers.

Refueling an aircraft from a container is no more hazardous than refueling a boat, lawnmower or snowmobile. The same precautions apply. Mogas users are urged to add a single step to their refueling practices. The EAA Aviation Foundation's Kermit Weeks Flight Research Center highly recommends filtering the auto fuel through a 100 mesh screen and a chamois as it is being introduced into the fuel system. If you purchase auto fuel produced to ASTM specification D-439, from a high volume, reputable dealership of a major refinery you should have no problem. However, the very act of transporting fuel from the service station to the airport may, in some way contaminate it. It will ease your mind and ensure contaminant-free fuel if you filter it before putting it in your airplane.

We have heard from some EAA members who have run into opposition from airport managers or FBOs when they attempt to refuel their own aircraft from containers. It is your **right** to refuel your own aircaft from a container. According to FAA Advisory Circular 150/5190-2A (4 April, 1972), "Any unreasonable restriction imposed on the owners and operators of aircraft regarding the servicing of their own aircraft and equipment may be considered a violation of agency policy. The owner of an aircraft should be permitted to fuel, wash, repair, paint and otherwise take care of his own aircraft, provided there is no attempt to perform such services for others. Restrictions which have the effect of diverting activity of this nature to a commercial enterprise amount to an exclusive right contrary to law."

One more point should be made about a contamination problem that has arisen in some older aircraft through the use of uncontaminated high-aromatic fuels. Some older airplanes utilize varnished cork floats in the fuel tank. High-aromatic fuels such as 100LL or mogas may attack the old varnish. The varnish can come loose and lodge in critical areas of the fuel system. If you are using 100LL or mogas in an older airplane, check the floats. You can avoid problems with cork floats by refinishing them with a modern urethane varnish.

There it is. Follow a few simple rules and you can avoid fuel contamination. Just don't tell the grandkids how easily it's done.

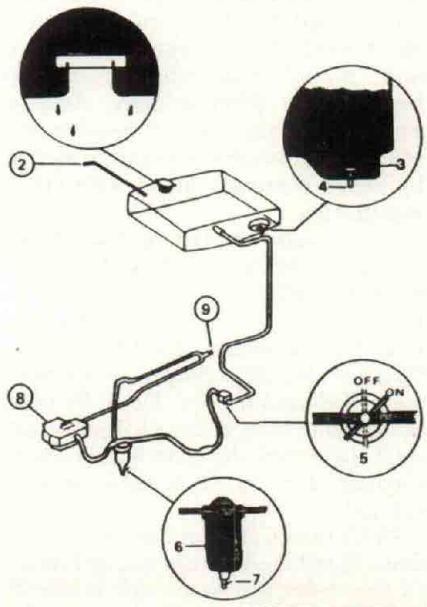
*References: FAA Pamphlets FAA-P-8740-35A, FAA-P-8740-4A, FAA Advisory Circulars 20 - 43C and 150/5190-2A, FAA Great Lakes Region Pamphlet 8000-3.6 (1-77) and ASTM Specification D-439.*

## SUMMARY

**(Courtesy Department of Transportation, Federal Aviation Administration, Great Lakes Region GL form 80003.6 (1-77).)**

**ILLUSTRATION #1**

1. Fuel Filler Cap
2. Fuel Vent
3. Sump
4. Sump Drain (Use of Quick Drain Recomended)
5. Fuel Selector
6. Fuel Screen
7. Fuel Drain Valve (Usually Quick Drain Valve)
8. Carburetor
9. Primer




**SIMPLIFIED GRAVITY FEED HIGH WING FUEL SYSTEM. LOW WING FUEL SYSTEMS REQUIRE ENGINE DRIVEN FUEL PUMP AND AN AUXILLILARY FUEL PUMP. (USUALLY ELECTRICALLY OPERATED)**