Phillip Lockwood et al.

Ethanol and Rotax Engines

What's its effect?

Q: What problems, if any, are associated with the use of E10 fuel in Rotax aircraft engines?

A: Fresh autogas without alcohol is the preferred fuel for all Rotax aircraft engines. However, in many parts of the United States and Canada, gasoline is blended with 10-percent ethanol to produce a product referred to as E10 fuel. Ethanol is an alcohol commonly made from corn or sugar cane. The added ethanol in E10 fuel offers advantages and disadvantages.

The Advantages:

• Ethanol acts as an oxygenate, which means it adds oxygen to the gasoline. Ethanol is 35 percent oxygen by weight and replaces methyl tertiary butyl ether (MTBE) to help the fuel burn more completely and cleanly, thus reducing smog-forming and ozone-eating emissions.

• Adding 10 percent ethanol increases a fuel's octane rating by two or three points.

• Widespread use of E10 fuels will significantly reduce our dependence on foreign oil.

• Because alcohol absorbs water, gasoline with added alcohol should help keep fuel systems free of water, so water should not be present when sumping the tanks and/or gascolator on an aircraft filled with E10 or any form of gasohol.

Officially, Rotax has approved the use of fuel with up to 5 percent alcohol content. Other than a slight increase in the exhaust gas temperatures (EGT), the engines seem to work fine operating on blends with up to 10 percent ethanol. Most autogas produced today has at least some alcohol mixed in to help reduce unwanted auto emissions.

The Disadvantages:

When using E10 or any fuel with alcohol in any aircraft application, potential problems exist. The greater the percentage of ethanol, the greater the chance you will experience problems, which can include the following:

• Damage to rubber gaskets and composite fuel tanks. E10 fuel is not as friendly as avgas or pure gasoline to these components. The aircraft fuel system must be compatible with E10 fuels to avoid this damage.

• Corrosion problems with metal tanks, electric fuel pumps, and other fuel system components. Ethanol, or any type of alcohol, readily absorbs water. It may even absorb significant amounts of water from the atmosphere in humid conditions. If too much water is absorbed, phase separation can occur, which results in the water and ethanol combining and falling to the bottom of the fuel tank. This combined water and ethanol can be quite corrosive to metal tanks and fuel system components, especially if the water and alcohol are allowed to remain in the bottom of the fuel tank for some length of time.

If properly equipped with fuel tank sump drains, the water/ethanol combination can be drained off leaving only the gasoline, but it will have a slightly reduced octane level—down by 2 to 3 points using the antiknock index (AKI) rating method. (The Rotax 912ULS, the turbocharged 914, and the two-stroke 618 engine all require 91 octane fuel using the AKI rating method. The 912UL (81-hp) and the two-stroke 447, 503, and 582 engines will run on 87 octane.)

Because of ethanol's propensity to absorb water:

• Use the freshest E10 fuel possible.

• Check your tanks for water before adding fresh fuel.

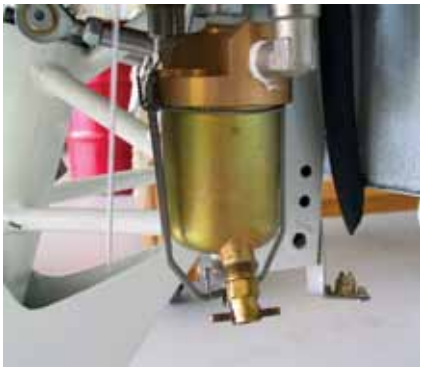
• Do not store E10 fuel in cans for more than a couple of weeks, unless you live in a dry climate.

• Buy your fuel when you plan to use it.

• Have fuel tank sump drains or add an aircraft-style gascolator that will act as a filter and a water collector.

If you find water when draining your gascolator, phase separation has probably occurred, and there is likely to be a significant amount of water/alcohol mix somewhere in your fuel system. Your engine will not run on this separated mix, so it shouldn't be allowed to make its way to the engine.

You must make a more complete investigation of your fuel system to look for water before attempting a takeoff. This holds true for gasoline with any percentage of alcohol mixed in.



Fuel system gascolators like this one act as a filter for both water and debris.

If your fuel tanks are not equipped with sump drains, and you've found water in your gascolator, you should consider draining a significant amount of fuel (several gallons) from each tank through the gascolator; then check the drained fuel for water contamination. Continue draining fuel until all the water has been removed.The gascolator should be the lowest point in the fuel system, and the aircraft must be level to keep any water in the fuel tanks at the fuel tank pickups. If the tanks don't have sump drains, then the point in the tank from which the fuel lines draw should be the lowest point; that is where the water will accumulate, assuming the airplane is level.

Fuel containing ethanol also suffers from an increased susceptibility to vapor lock, which occurs when fuel vaporizes in the fuel lines because of higher temperatures and/or reduced ambient pressure at higher altitudes. Some aircraft fuel systems designed to use autogas have special vapor bleed-back systems that help purge and return any vaporized fuel back to the fuel tank before it reaches the carburetors. If you live or fly in an area where conditions may be conducive to causing vapor lock and you use fuel containing ethanol, it's a good idea to include such a bleed-back system in your fuel lines. Vapor lock is more common in cowled, tractor-engine installations where the fuel lines are subjected to higher temperatures experienced within the engine compartment.