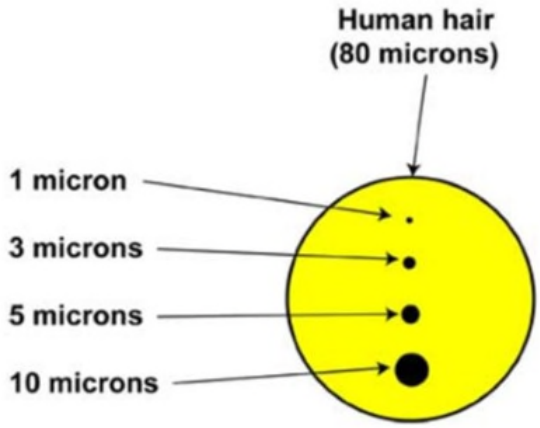
P.O. Box 1630, Missoula, MT 59806 Phone: 406-541-3246

Today's gas and diesel motors both require aircraft quality fuel. We will in the following pages discuss the issue and suggested remedies for poor fuel quality.

With regard to diesel fuels, Caterpillar and Cummins require fuel to meet or exceed ISO cleanliness levels of 18/16/13 with a water content of less than 0.05%.

ISO 4406 Definition of Particles

Fuel Status	ISO Code 4406	Partical Counts
Unacceptable Fuel Supply	22	Up to 40,000 particals > 4 micron
	20	Up to 10,000 particals > 6 micron
	18	Up to 2,500 particals > 14 micron
Recommended by engine manufacturers	18	Up to 2,500 particals > 4 micron
	16	Up to 640 particals > 6 micron
	13	Up to 80 particals > 14 microns
Fueltec Standards filtration for fuel storage tanks	17	Up to 2,500 particals > 4 microns
	15	Up to 320 particals > 6 microns
	12	Up to 40 particalc > 14 microns



Not too many years ago diesel engines were quite simple, not too efficient, smoked, and burned high sulfur fuel (as much as 5,000 parts per million). The older diesel injection systems only use about 1⁄2 the fuel pressure modern engines do, and older injectors send the fuel through much larger passages. If there was a little moisture in the storage tank, the high sulfur content killed most of the filter clogging bacteria and fungi. Today's diesel fuel is ultra-low sulfur (15 parts per million) which allows bacteria and fungi to grow rapidly if any moisture is in the fuel storage tank.

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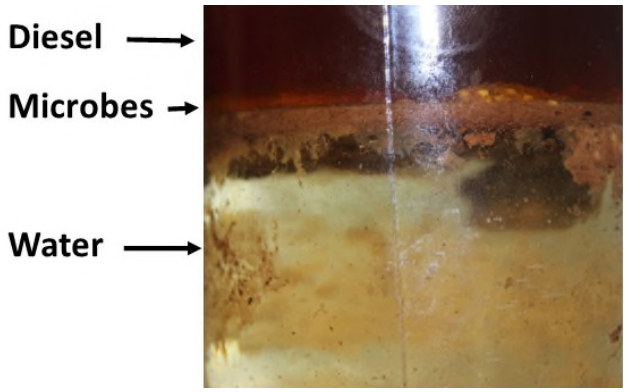
Today's diesel engines use high pressure, 27,000 to 35,000 psi fuel injectors with tiny fuel passages which are easily clogged with dirty fuel and damaged by water.



The ASTM D4814 is the governing document for Automotive Spark-Ignition Engine Fuel, i.e., gasoline and gasoline-ethanol blends.

In gasoline the loss of octane is a significant contributor to poor fuel quality and motor damage. The largest contributor to octane loss is water. In our newer blends of gasoline fuels containing ethanol higher percentages of water can be absorbed into the fuel. This water is introduced in to the fuel storage tank by a number of means such as misused or faulty spill buckets, condensation from ambient air or leaks in the tank risers or the tank itself. Once inside the tank the water accumulates to the point of causing issues. In extreme conditions we end up with phase separated fuel.

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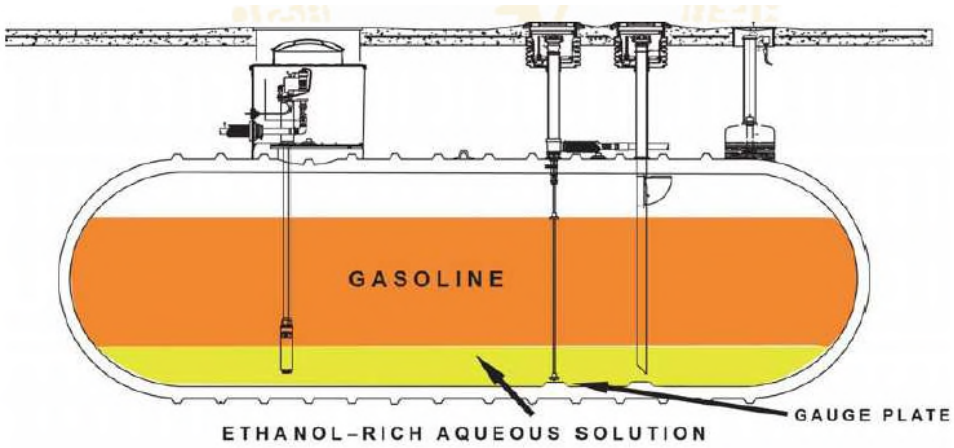

With E-10 fuel blends, E-10 can remain stable up to its saturation point with water; after that point is reached the water and ethanol will begin to separate from the fuel solution. The ability of the fuel to hold the disolved phase water is deminished when the temerature of the fuel descreases. The more drastic the temperature drop the faster the fuel mixture will enter the separated phase.

Because the serarated solition of water and ethanol is more dense than gasoline and is polar it will sink to the bottom of the tank.

Many state and Federal agencies such as the Tennessee Department of Agriculture have conducted studies into the best options in dealing with ethanol blended fuels. The below attachemnt are their recommendations for the prevention of phase sepparated fuels.

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TENNESSEE DEPARTMENT OF AGRICULTURE
Regulatory Services Division

Phase Separation Maintenance Steps

- ✓ Select maximum 10 micron filters. We suggest using Alcohol Monitor filtration that will slow down the dispenser when catastrophic phase separation is occurring.
- ✓ Periodically have tanks swept to remove any accumulated moisture. TN Rules allow up to 0.25" in an ethanol tank; however, we strongly recommend drying tanks when any moisture is present. The presence of any water may be contributing to our problems!
- ✓ Be sure that you are using water finding paste that is designed for ethanol blends.
- ✓ Inspect fill and vapor caps for damage and missing gaskets, replacing if necessary. They must be water tight. Seals and latches must be in excellent condition.

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Phase Separation Maintenance Steps

- ✓ Inspect tanks daily – always before and after fuel drop. If any water is present, have your employee contact QC officer and advise.
- ✓ Check vent pipes. They must have rain caps that allow ventilation yet prohibit rain water from entering the system. Do not overlook this item!
- ✓ Inspect product and spill containment buckets – if water is present, do not drain it into the tank but instead, remove and properly dispose of the water.
- ✓ Collect you own samples for visual inspection. Chill samples and look for any presence of water separation.

The most effective way of removing contaminantes from fuels is to develop a method of cleaning (polishing) the fuel to remove debris and unwatered water. The debris is removed via various micron size filters to meet any ISO standatrds. Coalescers with water separator filtration are the most common method of removing unwanted water for the fuel mixtures.

The process can be used to either polish fuel or clean debris and unwanted water and phase sepparated fuel from the tank bottoms. These are some examples of before and after samples taken from local tanks involved in a tank cleaning process.

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This photo is of a one micron filter bag on the initial run of a fule polishing process
Note the fine silt material most of which is not visable to the eye until it is accumulated in a larger mass.

This photo is of the same fuel from the same tank after the filtration prcess is complete

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There were thrity three filter bags used in this one tank cleaning and fuel polishing.
This tank and fuel was assumed in good conditon by the owner.
They noted a large reduction in fuel related calls to their facility after the polishing process.

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Bottom samples at the ATG riser on a nolead tank the jar to the right is the precleaning sample the jar to the left is the post cleaning sample.

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An example of pre and post polishing of phase separated fuels.
The water and water ethanol mixture has been removed and an additive to increas the octane to operation levels has been added. 7,800 gallons of fuel was saved and sold without further customer complaint of fuel quality.

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Before and after #2 diesel polished fuel