

Resources:

Renewable Fuels Association, Fuel Ethanol: Industry Guidelines, Specifications and Procedures, RFA Publication #960501, Revised December 2003. <http://www.ethanolrfa.org/Final960501.pdf>

US Department of Energy, National Renewable Energy Laboratory: Handbook for Handling, Storing, and Dispensing E85, April 2002 <http://www.eere.energy.gov/biomass/pdfs/30849.pdf>

Water Phase Separation in Oxygenated Gasoline by David Korotney, EPA, Chemical Engineer, Fuels Studies and Standards Branch. <http://www.epa.gov/otaq/regs/fuels/rfg/waterphs.pdf>

American Petroleum Institute, Storing and Handling Ethanol and Gasoline-Ethanol Blends at Distribution Terminals and Service Stations, API Recommended Practice 1626.

National Fire Protection Association (NFPA) 30, Flammable and Combustible Liquids Code, 2000 Edition; NFPA 30A Code for Motor Fuel Dispensing Facilities and Repair Garages.

Directory of vehicles manufactured with flexible fuel capability: <http://www.e85fuel.com/e85101/flexfuelvehicles.php>

Websites

Renewable Fuels Association
<http://www.ethanolrfa.org/>

National Ethanol Vehicle Coalition (NEVC)
<http://www.e85fuel.com/index.php>

American Coalition for Ethanol (ACE)
<http://www.ethanol.org/aboutace.html>

Center for Energy, Energy Efficiency and Renewable Energy
<http://www.ceere.org/>
http://www.eere.energy.gov/afdc/e85toolkit/converting_petroleum.html

National Renewable Energy Laboratory
<http://www.nrel.gov/>

U.S. Department of Energy – Alternative Fuels Data Center
<http://www.eere.energy.gov/afdc/about.html>

National Biodiesel Board
<http://biodiesel.org/>

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ENVIRONMENTAL & REGULATORY SERVICES
Bureau of Petroleum Products and Tanks
P. O. Box 7837
Madison, Wisconsin 53707-7837
Tel #: (608) 266-7874



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Compatibility

Flammable, combustible and hazardous substance storage rules (state and federal) and national standards require all components of the storage and dispensing system to be compatible with the product stored. Components and equipment used for storing/dispensing conventional motor fuels do not have adequate compatibility with many of the new motor fuels, such as gasoline-ethanol blends. Soft metals such as zinc, brass or aluminum, which are commonly found in conventional fuel storage and dispensing systems, are not compatible with ethanol, especially at the higher concentration found in E85 motor fuel. Steel, fiberglass (FRP) and plastic composite tanks and pipe must be certified by the manufacturer for ethanol compatibility. Some nonmetallic materials used in connections or components of the system may also degrade when materials, such as natural rubber, polyurethane, cork, adhesives (used in older fiberglass piping), pipe thread compounds, certain elastomers and polymers used in flex piping, bushings, gaskets, meters, and filters come in contact with ethanol. In order to store and dispense high percent ethanol, fiberglass and steel UST systems, system components must be listed by Underwriters Laboratories, Inc., or certified by the manufacturer for the concentration of ethanol that will be stored in the system. There are numerous variables associated with internal linings, ranging from what is or is not known about the lining material to existing cracks and abrasions in the lining wall that act as a conduit to expose ethanol to the surface of

the tank wall. Lined tanks will not be approved for E85 service.

Affinity for Water

Ethanol blends well with gasoline, but it also is completely miscible (mixable) in water. When water infiltrates a tank, (e.g., through sump covers and loose fittings at the top of the tank), the ethanol in the ethanol-gasoline blend will absorb the water, which, if enough is present, will overwhelm the ethanol's ability to remain blended with the gasoline.

Because it mixes easier with water than gasoline, the ethanol will be drawn from the gasoline into the water at the bottom, separating from the gasoline. The product in the tank is no longer a homogeneous blend of ethanol and gasoline, but two layers of product—a layer of gasoline on top and an ethanol layer on the bottom referred to as "phase separation." Phase separation can be a problem for vehicles' fuel lines and ignition system as the product is no longer an ethanol-gasoline blend.

Degradation and Conductivity

Ethanol can accelerate problems in UST systems by scouring or loosening deposits on the internal surfaces of tanks and piping. If a corrosion cell or rust plug exists, the ethanol may scour the corrosion cell or plug resulting in a leak. As mentioned above, ethanol is not compatible with soft metals such as zinc, brass, copper, lead, and aluminum. These metals will degrade or corrode in contact with ethanol and possibly contaminate a vehicle's fuel system. Tank leak detection equipment composed of polymers, elastomers and

certain metals (mentioned above), may not be compatible with ethanol. Because ethanol has a higher conductivity than gasoline, capacitance probes will not work in ethanol-blend fuels. Verify that the floats used in magnetostrictive probes are alcohol compatible and that the ATG system is properly calibrated for ethanol.

Process of Converting to Gasoline – Ethanol Blends greater than 10% Ethanol

Gasoline-ethanol blends with up to 10% ethanol are common in the current day market; however, the department has experienced motor fuel quality issues in numerous situations where the service station operator filled tanks with a blend for the first time. This program letter focuses on higher concentrations, but the first time transition to blends of up to 10% ethanol should not be assumed to be trouble free and the assessments and procedure below should be followed as well.



The conversion to high percent ethanol blend fuels requires time and effort to evaluate existing equipment, verify compatibility and order ethanol compatible equipment. Procedures to follow in converting existing conventional motor fuel storage/dispensing system to high percent ethanol blend:

1. Motor fuel dispensing systems must comply with Comm 10 – Flammable and Combustible Liquids Code and Comm 48 – Petroleum Products Code. Currently, neither Comm 10 nor Comm 48 requires specific plan submittal or Commerce notification when making a transition to ethanol fuels. However, it is prudent for a service station operator to consult with the Commerce Petroleum Inspector to discuss conversion requirements and dispenser labeling requirements before putting gasoline-ethanol blended fuel in your storage system.

The following equipment/components/materials must be compatible with the ethanol blend you intend to store and dispense:

- ◆ Fill Pipe
- ◆ Spill prevention
- ◆ Drop tube
- ◆ Overfill / Auto Shut-off
- ◆ Tank (Warranty, UL Listing, Manufacturer Certification)
- ◆ Gaskets
- ◆ Bushings
- ◆ Couplings
- ◆ Piping (Warranty, UL Listing, Manufacturer Certification)
- ◆ Pipe sealant / adhesive
- ◆ Flex connectors
- ◆ Sump
- ◆ Grommets / boots
- ◆ Submersible pump / Pump impeller
- ◆ Leak detection
 - * Probe
 - * Sensors
 - * Float
- ◆ Dispenser
 - * Gaskets
 - * Nozzle
 - * Filters
 - * Swivel
 - * Piping
 - * Pump/meter
 - * Hoses

For a listing of equipment approved to handle, store and dispense E85 see: <http://www.E85fuel.com> or http://www.eere.energy.gov/afdc/e85toolkit/equip_processes.html

2. You will need to verify that your dedicated fuel path is compatible with the percent of ethanol to be stored and dispensed. Contact your petroleum equipment supplier to discuss converting to a higher percent ethanol blend, assessing existing system components and purchasing the appropriate equipment.
3. No level of water is acceptable for ethanol blended fuel due to the phase separation problems. Make certain all fittings and connections at the top of the tank are tight (no vapors escape and no water enters) and that all

sump and spill containment covers prevent water from entering. Any water intrusion problems must be corrected.

4. A tank dedicated to storing ethanol or ethanol blends must be clean. After any water problems have been corrected, clean any tank used to store ethanol to remove all sludge from the bottom of the tank. Any sludge or particulate in the bottom of the tank will be suspended in the ethanol and cause problems with filters and fuel lines.
5. Many organizations recommend replacing the 10 micron dispenser filter with a 1 or 2 micron filter to capture smaller particulate before they enter a vehicle's fuel tank.
6. Fill pipe and access covers must be properly identified (API RP 1637 color code). You don't want the transport driver to mistakenly deliver E85 into another tank.
7. The tank storing E85 ethanol blended fuel must be registered with Commerce reflecting the correct product stored.
8. Dispensers must have a sign that prominently states "For Flexible Fuel Vehicles Only."

Ethanol Blended Motor Fuels - What are they?

E10: This is the most commonly used ethanol-blended fuel, containing 10% ethanol and 90% gasoline. All automobile manufacturers approve the use of E10 in vehicles sold in North America. Since 10% ethanol is a normal component of today's automotive fuel, it is accurate to refer to it as "gasoline." Any level above 10% ethanol can not be labeled as "gasoline."

E85: A blend of 85% ethanol with 15% gasoline. Fuel Flexible Vehicles (FFV) are able to run on E85 or plain unleaded gasoline, or any combination of the two.

E95: Ethanol in its pure form, as it comes from the ethanol production facility. E95 must be denatured to make it unfit for human consumption. Although some engines can run on E95, E95 is currently blended with unleaded gasoline for resale.

First Delivery and Ongoing Maintenance

- a. Follow normal delivery procedures for the first delivery of E85 blend. The Renewable Fuels Association (RFA) Renewable Fuels Association (RFA), Fuel Ethanol, Industry Guidelines, Specifications and Procedures, December 2003, (available at: <http://www.ethanolrfa.org/Final960501.pdf>) recommends filling the tank to 80 percent capacity and to keep the tank as full as possible for 7 to 10 days.
- b. As soon as product stabilizes, a tightness test (0.1 gph leak rate) is recommended using your ATG system to make sure your system is tight and the leak detection equipment is operating properly. Report any "Fail" results.
- c. You must test for water (use alcohol compatible paste if you stick your tanks) at the beginning of each shift for the first 48 hours after delivery. Checking for water regularly is a part of the ongoing maintenance with ethanol storage. Ethanol compatible water detect paste must stay in contact with the product for the time specified by the manufacturer. This is generally a period of 10 to 30 seconds.
- d. Dispenser fuel filters may have to be changed at more frequent intervals during the first few months of storage.

Financial Responsibility

Federally regulated USTs, which include almost every UST containing motor fuel, are required to have financial responsibility (FR). The most common mechanism for FR is pollution insurance. Insurance writers assess the FR coverage on product, type of system, age of tanks, overall risk, etc. Owners considering converting to ethanol blends above 10% ethanol should consult with their FR provider prior to committing to the actions and costs associated with preparing a tank for ethanol blended fuels.