



## Ethanol's History

Ethanol's history in the automobile industry dates back to the 1880s when Henry Ford built one of his first automobiles and fueled it with ethanol. Today more than 30 percent of U.S. motor fuels contain ethanol, which is sold primarily as **E-10 (10 percent ethanol to 90 percent gasoline)**. Ethanol is a high octane, biodegradable alcohol produced from renewable resources such as grain or wood. Because ethanol contains 35 percent oxygen by weight, it reduces tail pipe emissions of carbon monoxide. Ethanol is blended with low octane fuel to produce a blend that is comparable to other fuels. Since the enactments of the Clean Air Act Amendments of 1990, oxygenates (compounds that contain oxygen like ethanol) have been required in RFG gasoline and have met the growing demand for ethanol blended fuel. To properly store and distribute ethanol-blended gasoline, precautionary measures must be taken to prevent product contamination.

## **Product Contamination**

Ethanol mixes with water in all proportions. Conventional gasoline does not have a high tolerance for water, which quickly separates to the tank bottom. In ethanol-blended gasoline, phase separation occurs when the water reaches a saturation point and the ethanol/water mix "falls out" of the gasoline.

## **Phase Separation**

The amount of water that causes phase separation will vary with temperature. At 60 degrees Fahrenheit (F), water can be absorbed by E10 up to 0.5 volume percent before phase separation occurs (about 3.8 teaspoons per gallon or 5 gallons per 1,000 gallons). Once phase separation occurs, the ethanol/water phase will fall to the bottom leaving the low octane blended gasoline at the top. The ethanol/water phase results in a leaner combustion mixture that will cause engine failure or damage if distributed to the consumer. If the ethanol/water phase is above the UST pump suction, this phase also will be dispensed to consumer vehicles where immediate engine failure will occur. Because of phase separation, tanks must be properly prepared for conversion and subsequently maintained



## Pre-Conversion

\_ Check the tank material for ethanol compatibility and determine if the tank has been internally lined. Most fiberglass tanks after 1970 are compatible with 10% ethanol blends but it should be confirmed by the tank supplier. Epoxy linings prior to 1980 are not suitable for gasoline/ethanol blends. Linings installed in 1980 or later may be satisfactory, but compatibility should be confirmed with the lining supplier. In addition, seals, gaskets, piping, meters, pumps, and hoses should be checked for ethanol compatibility.

\_ Apply water finding paste to a manual stick gauge and check for water at both ends of the Underground Storage Tank (UST). Note which direction the UST is tilting. Compare the water readings taken with the gauge stick to those from your automatic tank gauge and determine if the ATG probe needs servicing. Also, use a bacon bomb to check for particulate levels and for microbial activity at both ends of the UST. If microbes are found, treat with a biocide such as Kathon 1.5 and then remove water after the biocide has had time to work. If high levels of particulate and or microbial activity are discovered, the UST should be cleaned using a professional tank cleaning company. Also, review the history of the UST and insure prior causes of water infiltration have been corrected.

\_ Compare the water readings taken with the gauge stick to those from your automatic tank gauge (ATG), to determine if the ATG probe needs servicing.

\_ Remove water from UST (recommend using professional tank cleaning company)

\_ Inspect tank fill cap and gasket and replace as necessary.

\_ Inspect the spill bucket cover to ensure it fits properly over the spill bucket. **Note: This is the entry point for most water problems. This should be made as water tight as possible.**

\_ Check the fill's brass hookup adapter and replace as necessary.

\_ Clean spill bucket and inspect plunger to ensure proper operation and seating.

\_ Check the vapor recovery hookup and verify the spring and gasket are functioning properly.



\_ Check the STP sump for water and ensure water cannot penetrate the UST from the sump.

\_ Check for tilted tanks. In un-level tanks, water can collect in areas that are not detected by automatic tank gauge (ATG) or dipstick.

\_ Order special water detection paste suitable for ethanol fuels. Order and install 10 micron filter specifically designed to detect and shut down delivery if phase separation occurs. (see attached list of needed items)

\_ Procure proper ethanol pump labels if required by your state. Check with State for any additional regulatory compliance requirements.

### **Dispenser Filters**

\_ Check dispenser filters.

\_ A 10 micron alert or duo-purpose filter designed for particulates and water or phase separation detection should be used.

\_ When water or phase separated fuel reaches the filter, the filter should slow dispensing rate to 1 gallon per minute.

### **Conversion – First Delivery**

\_ Shut pumps down during the initial delivery.

\_ Allow present tank inventory to be reduced to a maximum of 10% by volume of tank capacity.

\_ Introduce the blend into the tank as soon as possible. This initial delivery should fill the tank to 90% of capacity to safeguard against phase separation.

\_ Purge all lines until blend is clear. Check product at all dispenser nozzles for clarity. If product is bright and clear, product can be sold.

\_ Install ethanol dispenser labels if required by your state.



\_ Paint manhole covers to proper API recommended color. ( see attached chart)

\_ Check product at all dispenser nozzles for clarity. If product is bright and clear, product can be sold.

\_ Recheck tank bottoms with water/phase separation detection paste within 24 hours

o If using Kolor Cut paste, the brown paste will turn yellow if you have phase separation. If it all turns yellow, then apply further up the stick. If it continues to turn yellow all the way up to the product level, then you may not have phase separation, but you should closely monitor flow rates and check regularly with the manual gauge stick. If at some point you get a clear line between brown and yellow, it means you have phase separation up to that point.

o If using Sargel, you may not see a solid red, but you may see little red dots sprinkled through out the paste. If so, then you have phase separation.

o If there is still a question if the product has phase separated, a tank bottom sample should be taken. Place the sample in a clear glass cup or beaker. If there are two layers, water and fuel, the product has phase separated? If a single layer is present add a small amount of water to it. If it goes to the bottom and forms a second layer the product is fuel and phase separation has not occurred. If water mixes with the product so it is homogeneous or not layered, the product is water and the product has phase separated.

\_ Keep tanks as full as possible the first seven to ten days.

\_ Check flow rate of dispensers regularly and replace if running slow.

\_ Check each pumps calibration two weeks after the initial load.



**Note on Water in Storage Tanks:**

Water can enter an underground storage tank in numerous ways:

- \_ Condensation caused by air entering through the air vents.
  
- \_ Damaged fill cap gaskets or spill buckets.
  
- \_ Loose fittings or plugs.
  
- \_ Swings in fuel temperatures (more likely in above ground tanks).

**Ongoing Precautionary Measures**

\_ If using an ATG for inventory purposes you should use a manual stick gauge to monitor for water/phase separated product at least weekly to ensure the UST is dry. Because of the specific gravity of phase separated product, the ATG will be slow to register any water in the UST. Consequently, if the ATG shows any water at all, you should investigate further by manually sticking the tank. If water/phase separated product is detected, immediately stop sales, remove and dispose of the phase separated product.

\_ Monitor dispenser flow rate to detect any slowing. If the flow rate has dropped to the 4 gallon per minute or less rate; check for water/phase separated product before replacing the filter. If slowing occurs shortly after replacing the filter, you should check both ends of the UST for water problems.

\_ Tanks should be manually gauged checking for water after heavy rains or snow melting.

\_ Snow and ice can alter the flow of water around the fills and cause the spill buckets to remain underwater which can lead to water incursion into the UST's.

\_ Limit the filling of tanks in times of heavy precipitation.

\_ Inspect all fill and vapor recovery caps to insure secure closure and prevention of water entry.

\_ Inspect and clean the spill buckets daily.

\_ Standing water above the underground tank openings should be removed as soon as possible in an environmentally safe manner.



### **Note on Dispenser Filters:**

Ethanol acts as a cleaning agent. Rust, dirt, and particulates may break loose from the tank bottom, walls, and piping shortly after conversion. Frequent filter changes are likely after the initial delivery. Once the system is clean, filter life will return to normal.

### **Phase Separation**

#### ***Water Tolerance:***

Ethanol blended gasoline will absorb water if present. This is unlike conventional gasoline which does not have a high tolerance for water, and the water quickly separates to the bottom.

Ethanol will absorb trace amounts of water and pull it through the fuel system. In ethanol blended gasoline, water can be absorbed to a saturation level, typically around 0.5% (one-half %) before separation will occur. The amount of water absorbed by the ethanol is dependent on the product temperature. At 60 degrees Fahrenheit, an E10 ethanol blended fuel can absorb around 5 gallons of water per 1,000 gallons of fuel.

Once saturation occurs, the ethanol and water will separate from the gasoline forming two separate layers. The gasoline layer left at the top will be lower in octane (due to the loss of the ethanol) and likely will be out of specification. The mixture of ethanol, water, and some hydrocarbon will fall to the bottom of the tank. Depending on the conditions, 30% to 70% of the ethanol could be drawn away from the gasoline by the water.

If the ethanol/water phase is above the UST pump suction, this mixture could be dispensed to a consumer vehicle. Due to the potentially low octane of the product, a vehicle receiving this product could stop running shortly after fueling or experience drivability problems. (NOTE: This potential can be reduced by using the proper filters designed to detect water or phase separation. These filters reduce dispensing rates to 1 gallon per minute when water or phase separation is detected.) In flexible fuel vehicles (FFVs), the presence of water in the fuel mixture can cause the optical fuel sensor to malfunction, which could lead to drivability problems.



**If Phase Separation is Suspected or Detected**

- \_ Stop sales from tank.
  
- \_ Check product clarity at the nozzle. Hazy or cloudy product indicates possible phase separation.
  
- \_ Check for water in the tank by manually sticking the tank with water detecting paste. Note: The ATG may not detect water in the tank if the product has already separated. The ATG may give an inaccurate Reading due to the small amount of the hydrocarbon in the water/ethanol phase.
  
- \_ Remove phase separated product and dispose of entire tank contents in a manner consistent with state and federal guidelines.
  
- \_ Determine source of water contamination.
  
- \_ Carefully monitor tank for water bottoms.