

Phase Separation Guidelines



Retail sites which have never experienced phase separations may be more susceptible to water leaking into underground storage tanks as the water table rises. The Site Operator must confirm that product in all underground storage tanks is not contaminated with water and that no phase separation has occurred.

Some suggested guidelines are listed below, as well as more detailed industry guidelines in the links:

- Do not attempt to check product in tanks until fill well covers can be opened (no standing water on top)
- If spill basin contains water, it should be pumped out before removing cap on drop tube; water must **not** be released into the tank
- Check tank bottoms for water or phase separation with Gasoila AP paste – do **not** rely on Veeder-Root tank gauging system

If no water is detected:

1. Pump 15 gallons of each grade from dispenser that is **closest** to the tanks
2. Dispenser flow rate must be **> 5 gpm** and the fuel from dispenser should be clean and bright and a single phase
3. If it's determined that all is OK and a new delivery is made, driver should **wait at least 15 minutes** and then stick tank again (down the fill tube) with Gasoila AP paste
4. If no water is found, sales can resume and station personnel should monitor dispenser flow rate to ensure it remains **> 5 gpm**

If water is detected:

1. Tank has likely experienced a phase separation
2. **Immediately stop sales**, "bag" dispenser nozzles to prevent sale of contaminated product, and notify your Parent Marketing Representative
 - If a consumer complains about a vehicle issue, please refer to your brands water claim process and follow your brands process for filing a claim
3. Procure a vacuum truck to remove entire volume of contaminated product (both the ethanol-water phase and the octane-deficient gasoline phase) and flush underground lines between tanks and dispensers
4. Once the contaminated product has been removed, it should be delivered to a transmix tank or possibly sold to a fuel re-processor
5. After a new delivery is made, driver should **wait at least 15 minutes** and then stick tank again (down the fill tube) with Gasoila AP paste
6. If no water is found, sales can resume and station personnel should monitor dispenser flow rate to ensure it remains **> 5 gpm**

Technical bulletin

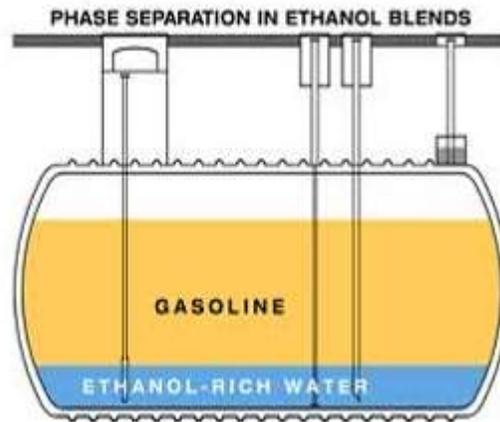
Water & Phase Separation in Gasoline-Ethanol Blends (E10)

What is Phase Separation?

Water contamination in any underground storage tank (UST) can lead to fuel quality issues, but due to water's solubility properties, it can cause particularly serious problems in USTs containing gasoline-ethanol blends (such as E10).

When water is introduced into a tank containing a gasoline-ethanol blend, it can lead to an issue known as phase separation. Phase separation occurs when water latches on to the ethanol in the gasoline, and extracts it down to the bottom of the tank. This results in two distinct layers (Figure 1):

1. The ethanol-depleted gasoline on top may be hazy due to suspended water.
2. The water-ethanol mixture is heavier and has separated to the bottom of the tank. It may look murky if the underground storage tank (UST) is dirty.



The water-ethanol layer that forms during a phase separation could be several inches in depth, enough to reach the suction of the pump and then be dispensed into a vehicle, potentially resulting in vehicle problems. A common misconception of site owners is that water problems only happen when multiple consumer complaints are received. This is not true – phase separation can and does happen to single motorists, and in some cases, they might not notice the effects immediately.

It is also important to note that continuing to dispense the top layer of ethanol-deficient fuel poses problems as well. It has reduced octane, which could result in engine knocking.

The product also may not meet regulatory standards due to its insufficient ethanol content or related changes to vapor pressure.

Preventing Phase Separation

Water can enter a fuel storage system via many different avenues: product delivery mishaps or UST leaks from damaged or malfunctioning gaskets, fittings, or any place that is not water tight. It is possible for water entering the storage tank to initially seep to the bottom without causing an issue, but a phase separation may be triggered by a delivery, when the fuel and water undergo turbulent mixing. The occurrence of phase separations can be minimized by preventing water contamination downstream of the terminal. It is important to be diligent about monitoring for water.

Water Absorbing Shut-Off Filters

Installing water-absorbing shut-off filters can help prevent dispensing phased-separated fuel. The dispenser filters may become blocked or partially blocked, leading to slow flow of product from the dispenser or even inoperable dispensers. These may help warn you of a water-related issue and keep separated fuel from reaching the consumer.

Automatic Tank Gauging Systems

It is important to use the proper tank gauging system and to periodically inspect your gauge for cleanliness.

Most older automatic tank gauging (ATG) systems were designed for use in straight non-ethanol gasoline, so they often overlook a phase separation in E10 gasoline blends. These older water floats used buoyancy to indicate the height of the water bottom phase, if existent. However, this design has not been successful in E10 gasoline. In tanks containing phase separated E10, the water bottom is rich in ethanol and is less dense than a bottom layer containing only water. In this case, a float will sink to the bottom of the tank and offer no indication of a substantial bottom layer, and the phase separation will not be detected.

There are modern gauging systems available to help detect water in ethanol-blended gasolines. Veeder-Root has designed a Phase II water detection float that can indicate when gasoline containing up to 15% ethanol has phase separated. Such systems include two floats of varying density (Figure 2).

The outer (heavier) float is buoyant on a water bottom layer with no ethanol. The inner (lighter) float is buoyant in an ethanol-rich water layer and will detect phase separation. Older equipment can be upgraded to the newer floats

Parent is not endorsing Veeder-Root products but is providing a summary of a technology available for detecting phase separation so fuel retailers can identify the issue. Further information can be found at this site: www.detectphaseseparation.com.

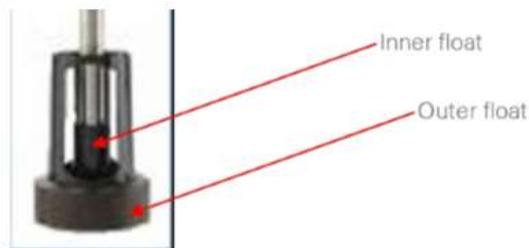


Figure 2 (from Veeder Root)

Water Finding Pastes

Retail sites selling ethanol blended gasoline and delivery drivers should manually stick underground storage tanks with an ethanol-compatible water finding paste on a regular basis. For ultimate prevention, many major brands recommends doing this before and after each load to identify and quantify any water presence in a UST. Refer to the instructions that come with the paste for proper use. For sites selling non-ethanol gasoline, water bottoms should be drained when more than one inch of water is found.

Many major brands have conducted laboratory and field testing on a variety of water finding pastes and has found Gasoila All Purpose (AP) Water Finding Paste to be effective for E10 blends.

Be sure to refer to the instructions when using Gasoila All Purpose (AP) Water Finding Paste. It is important to submerge the paste-coated tank gauging stick for 10 seconds (and not longer) for the color-changing reaction to complete, and then check the color within 5 seconds of removal from the tank for the result to be valid.

If water is present, the paste will change from brown to bright green. A chart is available to determine the presence or absence of water and water/ethanol bottoms.

For the most current user information and Safety Data Sheet, please contact Gasoila Chemicals at +1.216.464.6440 or on the web at <http://www.gasoila.com>.

Remediating a Phase Separated Tank

If phase separation is suspected:

1. Immediately stop sales from the tank and notify your Parent Marketing Representative. Consumers with complaints should follow the guidelines as outlined for by your brand for water claim issues..
2. Pump the entire volume of tainted product (both the ethanol-water phase and the ethanol-deficient gasoline phase) out of the tank and dispose of properly.
3. Before new fuel is delivered, ensure the fuel lines to the dispensers are flushed and filters are replaced. The tank should be stuck with an ethanol compatible water finding paste to ensure that no water is present after new fuel is dropped.
4. Please report the cause of the phase separation to your Parent Marketing Representative.

If you need additional assistance, please reach out to your Parent Marketing Representative Development. Although there are aftermarket products that claim to reverse phase separation, several major brands have tested these products and do not recommend them for use in any incidents.

Underground Storage Tank Housekeeping

Overview

Underground storage tanks, also known as USTs, can be a source of fuel contamination if they are neglected and diligent housekeeping is not maintained. Identifying and cleaning contaminated USTs can prevent consumer product quality problems.

Contamination Sources

There are three main types of UST contamination to look out for, often they are found together:

Water

Significant water from rain or melting snow can leak into the UST via the tank opening or from other water sources. Water entering the UST is a serious quality problem. In ethanol-gasoline blends, phase separation could occur. Please see the Phase Separation technical bulletin for more information on what it is, how to prevent it, and what to do if it happens at your site.

Sediment (dirt, etc.)

- Sediment/dirt can enter in places where tank closures are not in place or are ineffective. For example, this can occur when a load of fuel is being dropped.
- Sediment accumulation can occur with aging of tanks and internal equipment as rust and other oxidation products are formed.

Sediment in fuel can lead to plugged dispenser filters or vehicle problems.

Microbes (bugs, etc.)

- Microbial content can grow in USTs if the tank is not properly maintained. The highest risk is in diesel storage tanks with water contamination.

Microbial growth in an underground storage tank can be difficult to alleviate. For further information regarding microbial contamination and to see the list of approved biocides, please refer to the Technical Bulletin titled "Microbial Contamination".

Identifying and Preventing Contamination

Consumer Complaints

Unfortunately, site owners often discover they have a contamination problem after it is too late. A consumer complaint can be a strong indicator that there might be tank contamination.

UST Sampling

Tank bottom sampling can be an effective way to identify water contamination or microbial growth. Preferably, bottom samples should be drawn from the low point of the tank to access water that may be present. Keep in mind that tanks may be tipped one direction or another during installation, or may have settled in the ground over time, so the low point may not necessarily be where you think it is. It is a good idea to sample from both the fill port and the level indicator port, which are at either end of the tank.

UST Cleaning Methods

If tank sampling indicates that contamination is present and cleaning is needed, a number of nonentry type UST tank cleaning methods have been evaluated by major brands. The least complex method is to simply pump out the tank contents for reclamation or disposal as is appropriate in a phase separation.

A more advanced cleaning technique involves filtration systems that remove sediment prior to returning the fuel to the tank. These techniques are often sufficient when the fuel is suspending sediment or the accumulation has become a concern without an excessive buildup of corrosion, microbial growth, or debris on the walls of the tank.

The most advanced tank cleaning methods are appropriate for severe sediment buildup sometimes encountered in older tanks that have had infrequent maintenance or in tanks experiencing rapid corrosion from microbial growth. These methods use an agitation technology to loosen and release rust, sludge, or other contaminants sticking on the walls of the tank.

These advanced methods should then follow up with either a filtration step or a disposal/reclamation of the tank contents.

It is also best practice to perform a tank tightness test after any tank cleaning, as UST cleaning may reveal an unknown tank defect.

The extent of fuel cleaning achieved is highly operator dependent. The practice of intermittent tank sampling and visual inspection during cleaning is often the most practical determination of cleanliness. The use of monitors can have mixed results and may be dependent on factors such as cleaning hose location, timing, and system pressure. All remaining tanks should also be checked when one requires cleaning.

Dispenser Filters

Having to frequently change dispenser filters is a strong indicator that there may be contamination in the UST. If the contamination is severe enough, dispenser filters will foul rapidly.

Never solve chronic filter plugging by removing or bypassing the filter! Contaminants will then pass to consumer vehicles, potentially leading to complaints and repair claims.

Most major brands recommend that all sites have dispenser filters, as they are an effective control to prevent product quality problems. A variety of filter types and sizes are available; typically 10 micron filters provide good protection for the consumer. If a site has a high risk of water contamination, then water absorbing filters would be appropriate.

Water Detection and Prevention

Any amount of water present in ethanol-blended gasoline is a sign of a problem and can lead to phase separation. The source of the water should be found and corrected immediately.

For more information on phase separation, please refer to the Phase Separation technical bulletin. Basic water monitoring and control maintenance should include the following:

1. Automatic gauging systems: These are most effective for diesel or non-ethanol blended gasoline. For ethanol-blended fuels, there are modern gauging systems available.
2. Regular use of water-finding paste is helpful: Most experts recommend using these after each new load of fuel is dropped. Gasoila paste is effective for E10 fuel. Refer to the instructions that come with the paste to ensure proper use.
3. Fill wells, fill caps, fill cap gaskets, fill well plungers, vapor caps, and other fittings and gaskets should be inspected routinely for proper fit and function to ensure that water is not entering at those locations. Replace worn or malfunctioning parts.
4. Water in product and spill containment buckets should be disposed of properly. Never drain it back into the storage tank.
5. Ensure that qualified personnel are periodically inspecting the tank and removing any water that may be found.

Water and Phase Separation Detection Strategies

Phase separation occurs when excess water combines to the ethanol in the gasoline extracting it to the bottom of the UST and resulting in two distinct layers. Please refer to the Water & Phase Separation in Gasoline-Ethanol Blends Technical Bulletin for more information.

Early detection of phase separation is crucial to help prevent consumer incidents at filling stations. Early detection could save a tank owner from vehicle repairs, fuel replacement, remediation expenses as well as, protecting the brand and the tank owner's reputation.

Phase Separation Tank Gauges

Phase separation detection systems are commercially available that alarm and can be programmed to stop fuel dispensing when phase separation is detected. To make this improvement, have a trained service contractor install the kit and program the system. These systems can help prevent water contaminated fuel from reaching consumer vehicles.

These phase separation solutions are in no particular order and we are not endorsing any specific brand but are providing a summary of technology available for detecting phase separation so fuel retailers can identify the issue. Based on your site's wet stock management solution, one of these options might be a valuable upgrade.

Veeder-Root



The Phase-Two separation float system from Veeder-Root is designed to retrofit with existing Veeder-Root automatic tank gauges and float kits. The detector provides early detection and continuous monitoring of in-tank phase separation.

Veeder-Root's detector is compatible with the TLS-450 console (v3A or higher) or the TLS-350/300 (v30B or higher) and with the Veeder-Root Mag Plus Probe (Series 8463). Further information can be found:

<https://www.veeder.com/us/products/phase-twoseparation-float>

Franklin Fueling Systems



The phase separation kit from Franklin Fueling Systems can be retrofitted on existing Franklin installations. The single float is used to detect fuel level and the presence of both water and phase separated fuel.

They are compatible with all TSP-LL2 and TSP-LL2-I probes. The T5series with Colibri software version 1.8.0 are necessary for use. Further information can be found: <http://www.franklinfueling.com/americas/fms/product/2007/en/phase-separation#Highlights>

OPW



The OPW Aqueous Ethanol Float (AEF) Sensor provides early detection through temperature corrected density measurements. Real time fuel density measurements allow alarms to be set at thresholds that can allow for corrective actions prior to phase separation occurring.

OPW's AEF sensor can be installed on new and existing OPW magnetostrictive tank gauging equipment. Further information can be found: <http://www.opwglobal.com/products/us/electronicssystemsfuel-management-systems/tankgauging/aqueous-ethanol-float-sensor>

Water and Phase Separation Detection Strategies

Water & Phase Separation Detecting Filters

It is GFT's recommendation to use 10 micron filters.

Cim-Tek Filters

Cim-Tek's UL® recognized multi-fuel filters can be used with both straight gasoline and ethanol blended fuel up to E25. The filters remove particulates like dirt and rust while also detecting water and phase separation. When water or phase separation makes contact with the filter, it drastically reduces the flow through the filter and thus indicates an issue. The filters use a micro glass filter media designed for fuel dispensers and come in a variety of sizes meant to be compatible with every major dispenser manufacturer.

Compatible products (multi-fuel filters):

- Neat Gasoline and up to E25 Gasoline
 - 260MB-10
 - 300MB-10 / 30
 - 400MB-10 / 30
 - 450MB-10
 - 475MB-10

- Neat Gasoline or Diesel NOT containing biodiesel
 - 260HS-10 / 30
 - 260-AHS-10 / 30
 - 300HS-10 / 30
 - 400HS-10 /30
 - 450HS-10 /30
 - 475HS-10 /30
 - 800HS-10 /30
- Neat Gasoline, Diesel, Biodiesel blends up to 20% and 100% Biodiesel
- 260HG-2 / 10 • 260-AHG-2 / 10 • 300HG-10 • 400HG-10 • 800HG-2 / 10



PetroClear Filters

PetroClear manufacturers UL® recognized filters that can remove particulates, detect and react to phase separation and has filters that sense water in neat gasoline, diesel and biodiesel. The filters have the ability to absorb 175mL of water and then are designed to restrict the flow through the filter dramatically. The mounting threads are standard sizes and compatible with Gilbarco, Wayne, Bennett, Tokheim and other major manufacturer's dispenser. Adapters are also available for non-standard sizes.

Compatible products:

- Blue Filters -Up to E15 Gasoline
 - 40510A
 - 40530A
 - 40510A-AD
 - 40530A-AD
- Green Filters - Neat Gasoline, Diesel, Biodiesel and up to E25 Gasoline
 - 40510D
 - 40510D-AD