

# Underground Storage Tanks

An Informational and Guidance Document for the University Community. Please contact Yale Environmental Health and Safety for latest Regulatory Requirements.



A typical UST installation

## Introduction

The use of underground storage tanks (“USTs”) for fuels and other liquids has many advantages. These include space considerations, appearance, fire safety, and protection from the elements and from vandalism. However, unless installed and maintained properly, USTs have the potential for leakage from the tank or related piping. These leaks can exist undetected for years and cause pollution of the surrounding soil and even groundwater.

## Materials of Construction

USTs are usually made from either steel with a protective coating, or of fiberglass. Selection of UST type may depend on use and installation location. Fiberglass tanks are typically unsuitable for storage of heated materials, and for high load locations. However, they are lower maintenance and are not susceptible to corrosion. Steel tanks must be coated with a corrosion resistant coating, and corrosion protection is required. Contact plates at the bottom of the tank under fill and measurement ports should be installed. This prevents wear from measurement sticks hitting the bottom of the tanks.

## Piping

Piping is usually steel with a protective coating, or fiberglass. Other piping material may be copper or hydraulic flex hosing. Piping can be the same material as the tank or different. Metallic piping must be coated with a corrosion protective coating, and corrosion protection is required.

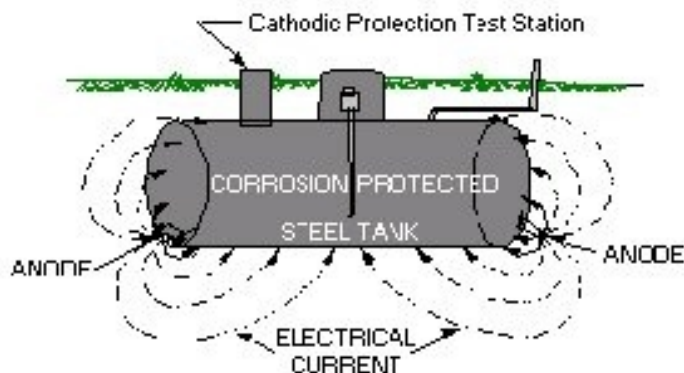
## Corrosion Protection Systems

Corrosion is an electrochemical reaction, an example of which is the rusting of steel tanks (iron to iron oxide). Click here for a demonstration of the corrosion process: <http://www.youtube.com/watch?v=hfmD1RyUWgY&feature=related>

This reaction can be slowed or prevented by the application or creation of an electrical current to the tank. This method is called cathodic protection. Steel structures are considered protected if a current with -0.85 volts is created from the surrounding soil to the tank.

Smaller tank systems typically use the installation of magnesium anodes connected to the tank to create a current. This current is created by the difference in corrosion potential of dissimilar metals, the faster corroding anode material will protect the steel, thus the term “sacrificial anode.”

### Steel UST protected by sacrificial anodes

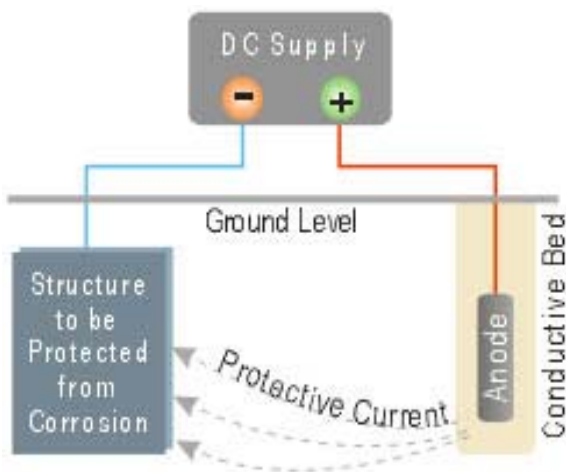


A short video on how sacrificial anodes work: <http://www.youtube.com/watch?v=RAIC75xG4qU>

Because of their sacrificial nature, anodes, and the protective current, can diminish over time. This can be checked by periodic measurements from the soil (or a reference electrode buried in the soil) to the tank. If determined necessary, anodes can either be replaced or supplemented.

Larger steel UST systems typically use an external applied electrical current to provide corrosion protection. A rectifier is used to control this power supply, with the negative terminal of the unit connected to the tank system, and the positive terminal to an inert (such as graphite) anode or anodes, which are buried around the tank. These anodes are not consumed during the process and typically do not need to be replaced.

Impressed current cathodic protection system



The rectifier output should be checked monthly to verify adequate current is being supplied. Amps and volts meter readings should be recorded and checked against set requirements.

It is important that metallic piping receive corrosion protection as well. This can be done through the tank's protection system or a separate system can be used. If a separate system is used, the piping should be electrically isolated from the tank by the use of non-conductive bushings. The piping must also be electrically isolated from equipment or building it services. Cathodic protection systems are designed to protect the mass of the underground tank and/or piping, and will provide inadequate protection if it is trying to protect additional electrically connected structures, such as the entire steel frame of a building.

Cathodic protection surveys should be done on an annual basis. These surveys measure the voltage of the current between the soil and the tank or piping for comparison against the -0.85 volt standard. The tests can be done with a voltmeter using a test station, which provides leads to the tank and to a permanent reference cell buried in the soil near the tank. If there is no test station, or to check at various location around the tank, a direct connection from the voltmeter can be made to the tank or piping and to the ground surface.

## Leak Prevention

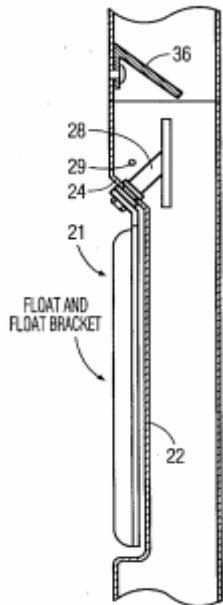
The most common releases from USTs are during filling, either from fill hose disconnection or from overfills. Prior to delivery, an accurate assessment of delivery volume should be made. Verification of tank volume meters with sticking of the tank (and conversion to volume using appropriate tank chart) should be conducted. Delivery volume should be such as to not fill the tank above 90% of capacity. Overfill alarms (audible, strobe, or both), which operate based on floats within the tank, are usually set at 85% to warn delivery person to cease filling, with another high level alarm at 90%. These alarms should be adjacent to the fill connection area to ensure they are seen and heard.

## Audible and strobe overfill alarm



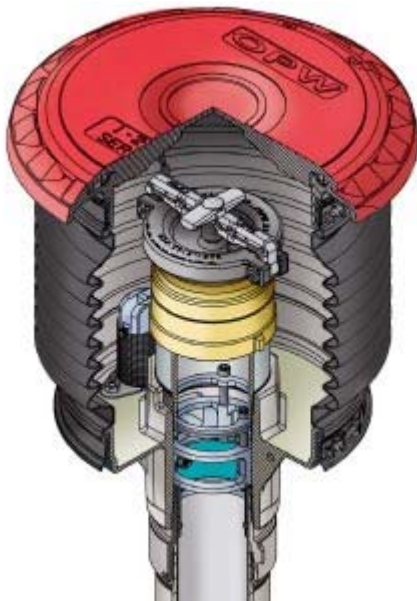
In the absence of alarms, fill piping cut-off valves can be used. These valves operate off floats as well, and close when the tank reaches the pre-set volume. These valves typically are within the fill drop-tubes. However, if filling is done utilizing high pressure pumps, this can keep valves forced open, resulting in overfill and possible spills onto the ground surface.

Typical drop tube float valve



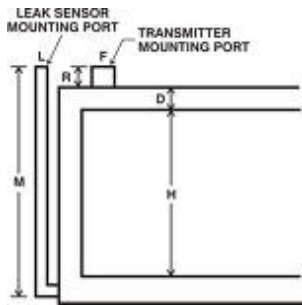
Spill catchment basins, around filling connections, are used to contain small volumes of releases from hose disconnections or overfills. It is important to keep these basins clean so they retain their full capture volume. These may or may not have drain valves within them. If so equipped, the valve can be pulled open so the contained oil or fuel can be drained back into the tank. However, if water or other contamination is present, it should be absorbed or pumped out for proper disposal.

Fill catch basin cut-out



Leak Detection

The most common leak detection method, for double-walled USTs is interstitial sensors. These normally are floats that will rise when liquid is present, completing a circuit and sounding an alarm. Optical sensors are used as well, which sense the presence of liquid as an interference with the path of light.



Typical Mounting point for interstitial sensor

Sensor would be installed in port L to sit on bottom

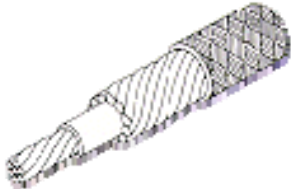
Other tank leak detection methods include automatic tank gauging, manual inventory control, soil vapor sensors, and groundwater monitoring. The advantage of a double wall tank with interstitial monitoring is that leaks will be detected before they are released to the environment.

Leak detection for piping can use similar methods. For double-walled piping, leak detection cables can be installed along the entire piping run, or at sumps at the tank or point of use, depending upon the slope of the piping.



Sensor within a tank mounted piping sump

The advantage of the use of a leak detection cable is the location of the leak can be indicated on the sensor panel.



A typical leak detection cable

## Regulatory Requirements

The Environmental Protection Agency (EPA) defines USTs as tanks containing a regulated substance and having at least 10% of volume below ground and not visible for inspection. Tanks in basements and accessible vaults are not considered USTs. These federal regulations apply to gasoline and diesel USTs, but the EPA does not regulate USTs used for storing heating oil for on-site consumption. The federal UST regulations can be found at:

<http://www.epa.gov/oust/fedlaws/cfr.htm>

However, the state of Connecticut does regulate on-site heating oil tanks, with the exception of residential USTs. The CT UST regulations can be found at: <http://www.ct.gov/dep/cwp/view.asp?A=2692&Q=322596>, and include regulations for EPA regulated tanks as well. Connecticut has required, by statute since 2003, that all new USTs and UST piping be double-wall with a leak monitoring system.

When a new UST is required to be installed, the tank must meet certain design requirements as outlined below:

- Tank material must be either fiberglass-reinforced plastic or steel with a factory applied corrosion resistant coating. Fiberglass tanks require tank-tightness testing 3-6 months after installation.
- Contact plates required under all fill and gage openings.
- Corrosion protection (impressed current or sacrificial anode) required for all steel tanks and piping, with permanent cathodic protection monitoring device.
- Corrosion protection function test required annually.
- Double wall tanks and interstitial monitoring required
- Spill and overflow protection fill pipe required for federally-regulated tanks, recommended for on-site heating oil tanks.

A signed installation certificate from the installer is required. Any USTs that do not meet the above design criteria require written approval from CTDEEP prior to installation.

Federal and State regulations require UST cathodic protection systems be tested annually to meet the above-referenced -0.85 volts minimum soil-to-structure requirement. Sacrificial systems are tested as is, impressed current system readings are taken as "instant-off" (immediately after the rectifier is turned off). If a system does not meet the corrosion protection requirement, repairs or adjustments must be done, the system currents allowed to stabilize, and a retest be conducted within 30 days.

Oil spill prevention plans also require that all UST level, leak, and alarms be tested minimum annually to ensure proper function and accuracy.

**Table of Inspection Requirements**

UST Type	Soil-to-Structure Cathodic Test (Steel Tanks)	Impressed Current Rectifier Readings	Leak and Level Detectors	Visual per SPCC
On-site Fuel Oil	Annual	Monthly	Annual	Per SPCC Plan (Powerplants weekly)
Gasoline/Diesel (Federally Regulated)	Annual	Monthly	Annual	Per SPCC Plan (quarterly, monthly if leak detection required)

Removal

Most USTs have a life expectancy of 30 years, after which they must be closed by removal (preferred) or abandonment in place. Often historical USTs may be encountered during construction excavation or on purchased property, necessitating removal. Removal is to be conducted per the requirements of RCSAs 22a-449(d)-1 for on-site heating oil USTs, and 22a-449(d) 101 through 107 for all other USTs, and latest edition of NFPA 30. The following are typical UST removal contractor requirements:

- (1) Notification to "Call before you Dig" program before commencement of excavation activities.
- (2) Preparation of and adherence to site-specific Health & Safety Plan, including confined space entry procedures as applicable.
- (3) Notification to Yale EHS and Office of New Haven Fire Marshall of removal schedule.
- (4) Excavation of surrounding material and shoring if required of excavation area.
- (5) Removal and proper disposal of all liquid from UST. Yale EHS Environmental Affairs only shall sign disposal manifest.
- (6) Removal of UST from tank grave. Yale EHS to witness UST removal.
- (7) Rendering UST unfit for reuse and proper documented disposal off-site, with copy of disposal document to be provided to Yale.
- (8) On-site monitoring equipment to determine possible areas of contaminated soil.
- (9) Removal of contaminated soil as an add-on, price per cubic yard. All disposal sites are subject to Yale approval. Manifests or Bill of Lading shipments must accompany each shipment, signed by Yale EHS Environmental Affairs only as the generator.
- (10) Sampling of tank grave per DEP guidance at [http://www.ct.gov/dep/cwp/view.asp?a=2692&q=322592&depNav\\_GID=1652](http://www.ct.gov/dep/cwp/view.asp?a=2692&q=322592&depNav_GID=1652)  
Results must meet CT Remediation Standard Regulations prior to backfill.
- (11) Backfill of tank grave and pavement restoration to previous condition.
- (12) Preparation of and submittal to Yale a Closure Report, documenting the UST removal activities, including on-site monitoring results, tank grave soil laboratory analytical data, copies of all disposal documents (including tank), and photographs of various stages of removal.



Notifications

Any change in UST status, such as installation, abandonment in place, or removal, requires that a written notification be provided to CTDEEP. EHS will prepare, arrange for proper signature of authorized Yale official, and submit the form to CTDEEP.

Database

EHS maintains a database of all campus USTs. Each UST is assigned a unique identification number for tracking purposes. This database tracks status, removal due dates, annual testing, and notification.