Installation of Underground Petroleum Storage Systems

API RECOMMENDED PRACTICE 1615
SIXTH EDITION, APRIL 2011

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AMERICAN PETROLEUM INSTITUTE

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Marketing Segment

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Introduction

The proper installation of an UST system can contribute toward ensuring that the maximum utilization of the various components and equipment comprising an UST system are achieved at the lowest total cost of ownership. This will help prevent, as well as reduce, the frequency and magnitude of releases that may result from equipment failure or malfunction.

The benefits from proper installation include, but are not limited to, improved protection of the environment and reduced environmental liabilities for the UST system owner and operator.

Construction plans and written documents are often required for obtaining permits, soliciting bids, and providing precise guidance for installers. Obtaining and providing the following documentation is the responsibility of various stakeholders (e.g. general contractors, electrical contractors, equipment manufacturers, environmental assessment contractors, regulatory agencies, etc.). Those responsibilities can be designated during initial construction planning meetings with the UST owner and operator. (See also Annex A—"UST System Installation Documents Checklist")

The choice of proper equipment and materials is necessary to help provide long-term system operation and integrity. Installation checklists tailored to the intended installation site provide a convenient method for planning and documenting work. Any municipal, county, or state codes and regulations, as well as nationally-recognized industry standards or recommended practices that address the installation of the UST system should also be referenced and/or included in the document package. Any other requirements specific to local conditions that may provide information regarding safety and/or environmental considerations during construction should also be included. (See also Annex A—"UST System Installation Checklist" of items discussed in this Introduction)

Installation of Underground Petroleum Storage Systems

1 Scope

1.1 This Recommended Practice (RP) is a guide to procedures and equipment that should be used for the proper installation of underground storage systems for bulk petroleum products or used oil at retail and commercial facilities. The stored products include gasoline, diesel fuel, kerosene, lubricating oils, used oil, and certain bio-fuel blends. (For information on alcohol/gasoline blends, see API 1626. The product manufacturer and the authority having jurisdiction (AHJ) should be consulted with regard to the proper storage of all products.)

NOTE All drawings provided in this document are for reference and illustration purposes only. Drawings are not to scale and may not reflect exact details of UST system configurations, components and equipment provided by manufacturers. For exact specifications and details of components and equipment consult the manufacturer(s).

1.2 This RP is intended for use by architects, engineers, tank owners, tank operators, and contractors. Contractors, engineers, and owners or operators who are preparing to design or install an UST system should investigate the federal, state, and local requirements and current methods of compliance for vapor recovery in that region. Vapor recovery is covered in detail in Section 17 of this document. For more information on the design and installation of vapor recovery systems, see NFPA 30A, and PEI RP 300

NOTE An AHJ may reference different codes.

1.3 This RP is not intended to cover specialized installations, such as fuel storage systems at marinas or airports, heating oil storage systems (either residential or bulk), or systems installed inside buildings. However, it does outline recognized and generally accepted good engineering practices which may be of use for these specialized installations. This RP does not apply to the installation of below ground or above ground bulk storage systems greater than 60,000 gal. The reader is referred to the following standards for information on specialized storage systems:

a) marinas: NFPA 30A and PEI RP 1000;

b) residential storage of heating oil: NFPA 31;

c) storage inside buildings: NFPA 30;

d) bulk storage—general: PEI RP 800;

e) aboveground storage: NFPA 30, NFPA 30A, API 650, API 651, API 652, API 653, API 2601, and PEI RP 200.

NOTE An AHJ may reference different codes.

1.4 This RP shall not preempt any federal, state, or local laws and regulations; specifically, those referenced in 3.2.

2 Definitions and Acronyms

For the purposes of this document, the following definitions and acronyms apply:

2.1
ACGIH
American Conference of Governmental Industrial Hygienists

2.2
anode
The positive electrode from which electrons leave a device and corrosion occurs.

2.3
ANSI
American National Standards Institute.

2.4
aquifer
An underground layer of porous materials (e.g. permeable rock or other materials such as soils, sands, or gravels) that contain groundwater.

2.5
ASME
American Society of Mechanical Engineers.

2.6
ASNT
American Society for Nondestructive Testing.

2.7
ASTM
American Society of Testing and Materials.

2.8
authority having jurisdiction
AHJ
One or more federal, state, or local government agencies or individuals responsible for approving equipment, installations, testing and other procedures associated with UST systems.

2.9
automatic line leak detection
A means of automatically testing the integrity ("tightness" of piping used in the transfer of petroleum product from the UST system to dispenser fueling components. Tightness testing references standard leak rates (e.g. 3.0, 0.2 and 0.1 gph). Testing is usually done on a pre-determined testing frequency (e.g. daily, monthly, annually). Test certification documents show a probability of false alarm (Pfa) and probability of detection (Pd) established by the *Code of Federal Regulations* (40 *CFR* Part 280) and/or the AHJ.

2.10
automatic tank gauge system
ATG
An automated system used to measure the level of and provide information on petroleum product in an UST and may measure the rate of change in the volume of petroleum product contained in an UST system over a period of time.

2.11
backfill
The material that is used to fill an excavation around the UST system (tanks, piping, etc.). Backfill material supports the tank and the components above the tank and is generally a material of sufficient porosity to allow for the rapid transport of petroleum vapors from the UST system to monitoring wells. It is an engineered component of the soil-structure system. Native soils are not recommended as a backfill material unless the native soil meets the backfill specifications of the tank or piping manufacturer.

2.12
California Air Resources Board
CARB
A recognized and often referenced air quality regulatory agency associated with vapor recovery operational and equipment standards.

2.13
cathodic protection
A process that prevents or inhibits corrosion of steel (or other metal) surfaces by managing or redirecting natural or man-made underground electrical current. For information on the various cathodic protection processes, refer to API 1632.

2.14
cathodic protection tester
A person who can demonstrate to have an understanding of the principles and measurements of all common types of cathodic protection systems as applied to buried or submerged metal piping and tank systems. At a minimum, such persons must have education and experience in stray current, structure-to-soil potential, and component electrical isolation measurements of buried metal piping and tank systems.

2.15
cladding
A term used to describe the practice of covering the exterior surface of a steel UST or other component of the steel UST system with a layer of material to protect it from corrosion. Whereas a coating may be several mils thick the layer of material used for cladding may be 0.1 in. or greater in thickness. Unlike jacketing, cladding physically attaches the material to the exterior surface of the tank or other UST system component. There is no interstice between cladding and the exterior surface of the component to be covered with the cladding material.

2.16
coating
A layer of material applied to the exterior surface of a steel UST or other component of the steel UST system to protect it from corrosion. Coatings vary in thickness depending upon the type and method of application. Typically, coatings are less than 30 mils and can be as thin as a few nanometers (e.g. anodizing and electrochemical deposition). Coatings include but are not limited to: paints, chemical vapor deposition, conversion coatings such as anodizing and phosphates, electrochemical and electroless plating, and enameling.

2.17
compatibility
The ability of two or more substances to maintain, for the life of the storage tank system under conditions likely to be encountered in the storage tank system, their respective design basis physical and chemical properties upon contact with one another. See API 1626, Section 5.4.2, for a protocol for compatibility determination and API 1626, Section 7.2, for a discussion.

2.18
conduit
Flexible or rigid pipe (metal, plastic, fiber, clay) used for the protection and routing of electrical wiring. Conduits may also be part of an engineered piping system for vapor or liquids.

2.19
confined space
Any space that has restricted or limited means of entry or exit, is large enough to allow a person to enter to perform tasks, yet is not designed or configured for continuous occupancy and is more than 4 ft deep.

2.20
corrective action
Action taken to identify, report, contain, treat, and/or remove petroleum hydrocarbons that have been released underground or repair any non-conforming equipment condition or operational problems.

2.21
corrosion
The process of breaking down the properties of a material due to a reaction (e.g. chemical, or electro-chemical) with its environment. There are various forms of corrosion that include galvanic, crevice, pitting, intergrannular, leaching, erosion, stress, hydrogen damage, and microbial-induced.

2.22
corrosion expert
A person who (through a professional education and related practical experience has acquired a thorough knowledge of the physical sciences and the principles of engineering and mathematics) is qualified to engage in the practice of corrosion control on buried or submerged metal piping systems and metal tanks. Such a person must be accredited or certified as being qualified by the National Association of Corrosion Engineers (NACE) or be a registered professional engineer who has certification or licensing that includes education and experience in corrosion control of buried or submerged metal piping systems and metal tanks.

2.23
corrosion protection
A means to lessen or prevent the deterioration of a material, usually a metal, from a reaction with its environment; or the use of a material to isolate the metal from the environment. The application of non-corrosive materials as coating, cladding, or jacketing to the surfaces of materials that would normally be exposed to the environment and subject to degradation is a form of corrosion protection.

2.24
dielectric
A non-conducting substance (e.g. insulator).

2.25
double-wall pipe
A form of secondary containment in which a pipe is constructed with two shells or walls with an interstice between to contain a release from the primary (inner) pipe containing the liquid product.

2.26
double-wall tank
A form of secondary containment in which a storage tank is constructed with two shells or walls with an interstice between to contain a release from the primary (inner) tank containing the liquid product.

2.27
environment
The in situ soil surrounding and in which an UST system exists and operates. This can include, but is not limited to soil, air, fauna, flora, humans, water, geography, and the interaction of all these elements.

2.28
equivalent
Equal, as the term pertains to effectiveness, sensitivity, or accuracy.

2.29
extractor fitting
A fitting designed for use in an underground storage system that allows a valve or other component to be removed or repaired without the necessity of breaking concrete, digging down to the component, or cutting a hole in the tank.

2.30
FEMA
Federal Emergency Management Agency

2.31
fiberglass-reinforced plastic
FRP
Thermosetting resin laminate (material composed of several layers of fiberglass and resin) where the resin is a plastic substance used as a matrix for glass fibers.

2.32
fill pipes
The fill pipe is the access by which the underground tank is filled. The fill pipe is typically located directly above the tank.

2.33
filling station
A public or private facility for the storage and dispensing of motor fuels to motor vehicles. Also called a service station or fuel dispensing facility.

2.34
flexible connector
UST system application—A short (typically less than 3 ft in length) flexible pipe having connectors at each end. It is typically manufactured from steel or stainless steel. It may have a polytetrafluoroethylene (PTFE) or other petroleum compatible inner liner. The pipe is typically utilized to connect underground piping to submersible turbine pumps or to the impact valves located under the fueling dispensers. The flexible connector can be single- or double-wall construction and is frequently covered with a steel or stainless steel braid. The inner piping is usually corrugated in design to give the pipe its flexible characteristics.

2.35
flexible joint
A joint in the piping system that allows differential movement of the piping system without imposing undue stress or physical damage on the system.

2.36
foot valve
A type of check valve used on suction piping that is located at the tank end of the piping system.

2.37
FTPI
Fiberglass Tank and Pipe Institute.

2.38
groundwater monitoring well
A cased in-ground well that:

a) is in contact with groundwater, and

b) is designed to assist in detecting releases of petroleum product from a nearby UST system.

2.39
hazardous substance
A classification for a material that poses a threat to human health, the health of other living organisms, or the environment because of certain characteristics that the substance possesses. Hazardous substances include but are not limited to materials that are radioactive, corrosive, toxic, flammable, and explosive. They can be biological or man-made.

2.40
impact valve
A special valve in the piping at the base of a dispenser to provide automatic closure of liquid product flow in the event of fire or vehicular impact. An impact valve may also be referred to as a crash, fire, or shear valve.

2.41
impermeable liner
A barrier material that impedes the migration of released product. This secondary liner/barrier beneath or partially surrounding the UST system consists of material that is sufficiently thick and impermeable (at least 10^{-6} cm/sec for the regulated substance stored) to direct a release to monitoring points and facilitate detection of a release. Recognized and generally accepted good engineering practices (RAGAGEP) no longer recommend impermeable liners as a means secondary containment for tanks or underground piping at filling stations.

NOTE See state and local codes for potentially more stringent definitions of impermeability and confirmation that the use of such liners is allowed.

2.42
interstice
The space between the walls of a double-wall tank or pipe. This space is usually monitored for the presence of petroleum product—a practice that is commonly referred to as interstitial monitoring.

2.43
intrinsically safe
A term that is used to describe an apparatus, wiring system, or electric circuit that does not generate sufficient electrical or thermal energy to cause ignition in a flammable or combustible atmosphere under normal or abnormal operating conditions.

2.44
jacketed
A term used to describe the practice of surrounding the exterior surface of an UST or other component of the UST system with a layer of material to provide corrosion protection and serve as a secondary containment barrier to allow for interstitial monitoring. Whereas a coating may be several mils thick the material used for jacketing may be 0.1 in. or greater in thickness. If the material is physically attached to the exterior surface of the tank or other component it is commonly referred to as cladding. If the material is not physically attached to the exterior surface it is commonly referred to as jacketing. A small space (refer to interstice) usually separates the exterior surface of the UST system component from the inner surface of the jacketing material.

2.45
labeled
Equipment or material that has a label, symbol, or other identifying mark attached from an organization. The presence of a label from such an organization will indicate appropriate product evaluation and may require periodic inspection of production of the labeled equipment or materials. The application of the label by the manufacturer indicates compliance with appropriate standards or performance in a specified manner through this labeling.

2.46
leak
A release of product through a perforation, hole, crack, or other opening in any component of an UST system, including either primary or secondary containment hardware.

2.47
lifecycle
There are several phases in the lifecycle of an UST system beginning with component design and manufacture, followed by installation and construction, operation, maintenance, repair, and final closure and disposal. The lifecycle includes all of the various activities and processes associated with each of these phases (e.g. leak detection,

corrosion protection, inventory control, inspection, testing, spill and overfill prevention, recordkeeping, regulatory notification, spill response and corrective action, etc.).

2.48
limited-access manway
A manway utilized for observation and/or monitoring wells with restricted entry requiring the use of a special tool to gain access.

2.49
line leak detector
LLD
A device that detects pressure losses in pressurized underground product lines.

2.50
listed
Equipment or materials included in a list published by a standards and/or testing organization. The listing organization conducts equipment or materials evaluations. The outcomes of those evaluations determine whether the equipment or material will be listed with the organization. Continued listing of the equipment or material is subject to maintaining the processes and quality required by the listing standard and/or specification. The organization's listing indicates that the equipment or material meets appropriate standards or has been tested and found suitable for use in a specified manner.

2.51
manifold
The pipe used to attach two or more piping systems together for the purpose of allowing the movement and/or transfer of petroleum product liquids and/or vapors between multiple tank and piping systems.

2.52
manway
The opening in a UST designed to allow bodily entry of a person into the tank for purposes of inspection, maintenance, etc. Also referred to as a manhole.

2.53
monitoring
The periodic (or continual) checking or testing of an UST system's equipment, detection devices, and monitoring or observation wells for evidence of released petroleum product or for verifying the integrity of the system.

2.54
municipal water well
A well that is operated by a public agency to provide a community with potable water.

2.55
NEC
National Electrical Code—NFPA 70.

2.56
NFPA
National Fire Protection Association.

2.57
NIOSH
National Institute of Occupational Safety and Health.

2.58
NIST
National Institute of Standards and Technology.

2.59
noncorrosive material
A material that resists all forms of electrochemical corrosion.

2.60
NWGLDE
National Work Group on Leak Detection Evaluations.

2.61
observation well
A well, constructed with slotted pipe installed in the tank excavation area that may be used to monitor the tank backfill or be used to assist in the recovery of product. It is generally not associated with a impervious liner, but may be if one was installed. It does not met the requirements of a groundwater monitoring well and it is not in contact with groundwater.

2.62
operational life
The period beginning when the UST system is first placed in service and ending when the system is properly removed or abandoned.

2.63
OSHA
Occupational Safety and Health Administration.

2.64
overfill protection
A method, equipment, or combination of both that is used to notify the delivery driver when they are about to fill a UST beyond its total capacity during the delivery process. Regulations may require that overfill protection must prevent the filling of the UST beyond a certain percentage of its total capacity (e.g. 95 %).

2.65
PEI
Petroleum Equipment Institute.

2.66
petroleum products
Hydrocarbons, including motor fuels, such as gasoline [diesel, fuels oils (such as kerosene or No. 2)] and lubricants that are liquid at 60 °F and 14.7 psia atmospheric pressure. Although used motor oil is not a petroleum product, per se, for the purposes of this recommended practice, it should be included in the definition of petroleum products as used in the text. The UST system for the storage of used motor oil does not normally include a pump or product-line to transfer the used oil and is regulated under the UST regulations.

2.67
pipe tightness test
A test of underground piping and associated valves and fittings to demonstrate that the system is not leaking.

2.68
preinstallation tank test
A test of an UST that is conducted before the tank's installation.

2.69
pressurized piping system
A system in which the pumping units are remote from the dispensers and mounted on top of the UST. The pumps themselves are submerged into product. This is the most common pumping system in use in the U.S.

2.70
private potable water well
A well on private property that supplies potable water.

2.71
probability of detection
Pd
The probability of correctly identifying the existence of a leak that is equal to or greater than a specified rate [e.g. 0.1, 0.2 or 3.0 gallons per hour (gph)]. This value is usually expressed as a percentage.

EXAMPLE A device is required to achieve a minimum Pd of 95 % for a leak having a rate of 3 gph. If 100 leak tests are performed at the leak rate of 3 gph, then the device must correctly identify the existence of the leak no less than 95 times.

2.72
probability of false alarm
Pfa
The probability of *incorrectly* identifying the existence of a leak when no leak exists that is equal to or greater than a specified rate [e.g. 0.1, 0.2 or 3.0 gallons per hour (gph)].

EXAMPLE A device is allowed to have a Pfa that is no greater than 5 % for a leak having a rate of 3 gph. If 100 leak tests are performed when no leak is induced (e.g. 0 gph), then the device is allowed to incorrectly identify that a leak exists that is equal to or greater than the 3 gph rate no more than five times.

2.73
qualified person
An individual deemed qualified, based on education and/or experience in the area of interest, to perform a particular task or tasks.

2.74
recognized and generally accepted engineering practices
RAGAGEP
Techniques or methods that are commonly applied by qualified engineers.

2.75
rectifier
A device that converts alternating current (AC) to direct current (DC). They are used in the protection of UST systems from corrosion, which are equipped with impressed-current cathodic protection.

2.76
release
Any spill, leak, or escape of petroleum product from an UST system into the environment.

2.77
riser
A vertical pipe. It typically refers to vertical pipe used for venting vapors (vent riser) from the UST system, or the vertical pipe inside the UST that is used for filling the tank (fill riser) and manually measuring the level of product, or containing the level probe (probe riser) of an automatic tank gauging system.

2.78
secondary containment
Any system in which an outer or secondary container or impervious liner prevents petroleum product releases from the primary container from reaching the surrounding environment for a time sufficient to allow the released product detection and control.

2.79
siphon
Piping that interconnects two or more underground tanks permitting the automatic transfer of liquid between two or more tanks until level equalization is accomplished.

2.80
sole-source aquifer
An aquifer designated by the U.S. Environmental Protection Agency (EPA) as being the only source of drinking water for a segment of the public.

2.81
statistical inventory reconciliation
SIR
A procedure based on the statistical analysis (usually by a third party) of a series of daily inventory records taken by the tank owner/operator.

2.82
STI/SPFA
Steel Tank Institute/Steel Plate Fabricators Association.

2.83
storage
The holding of a petroleum product in a container for later use. The term does not include collection of the following:

a) overflows, drips, or spills in auxiliary containers (for example, sumps, catch basins, and drip-collection devices); or

b) hydraulic fluids or similar substances within machines (for example, hydraulic lifts and elevators).

2.84
structure-to-soil potential
The difference in electrical potential (measured as voltage) between a steel underground petroleum storage tank system and its surrounding soils.

2.85
structure-to-structure potential
The difference in electrical potential (measured as voltage) between underground metallic structures.

2.86
suction pumping system
A system in which a product pump is located inside the dispenser and it pulls a suction from the UST via a product suction line.

2.87
sump
For UST system applications sumps are typically manufactured from corrosion-resistant materials and designed to perform several functions. Those functions include but are not limited to the containment of both petroleum product that may leak from some component of the UST system (e.g. flexible connector), groundwater, and hold components

of the UST system (e.g. submersible turbine pump, ATG level probe, product and vapor recovery piping, etc.) for the purpose of keeping them from coming into direct contact with the backfill materials.

2.88
swing joint
An assembly of piping elbows and nipples specifically designed to provide flexibility in an underground piping system. A single swing joint consists of one ell, one close nipple, and another ell. Swing joints are not allowed in all jurisdictions and are not recommended. The owner or operator should check with the AHJ regarding their use before installing swing joints.

2.89
tank tightness test
A test of the tank. Per the EPA definition, it must be capable of detecting a 0.1 gph leak rate with a minimum probability of detection (Pd) of 95 % and a maximum Pfa of 5 % (hereinafter “Pd/Pfa of 95/5”) from any portion of the tank that routinely contains product while accounting for the effects of thermal expansion or contraction of the product, vapor pockets, tank deformation, evaporation or condensation, and the location of the water table.

2.90
total cost of ownership
TCO
The cost of all lifecycle phases of the UST system when added together. This represents the total cost incurred by the UST owner during the life of the UST system.

2.91
UL
Underwriters Laboratories.

2.92
under dispenser containment
UDC
Secondary containment that is located under a dispenser that is designed to contain a release from the dispenser or piping under the dispenser.

2.93
underground product pipes
Buried product lines connected to an UST. As used in this publication, underground product pipes do not include vent pipes, fill pipes, or vapor recovery pipes.

2.94
underground storage tank
UST
A container that has a capacity of more than 110 gal, is used to store petroleum products, and is buried completely underground.

NOTE This definition applies only to this recommended practice and is not to be confused with the EPA’s definition of an underground storage tank.

2.95
underground storage tank system
UST system
A petroleum product storage system that is underground and is generally composed of one or more storage tanks, product lines, pumps, vent lines, tank fill lines, vapor recovery pipes and other appurtenances for storing, using, and/or dispensing petroleum products.

NOTE This definition applies only to this recommended practice and is not to be confused with the EPA's definition of an UST system.

2.96
underground transit structure
A partially or totally buried structure designed to convey vehicles such as subway cars, trains, or motor vehicles.

2.97
vapor monitoring well
A cased well in the ground that is designed to detect product vapors that may indicate a liquid product released from an UST system.

2.98
vapor recovery
The control, containment, and/or disposition of gasoline vapors during gasoline delivery and dispensing operations. At retail outlets this is accomplished in the following two stages:

a) *stage I vapor control*: containment, collection and recovery of hydrocarbon vapors generated during the filling of USTs;

b) *stage II vapor control*: containment, collection and recovery of hydrocarbon vapors generated during the refueling of vehicles.

2.99
vapor recovery pipes
Piping for Stage I and Stage II Vapor Recovery systems.

2.100
vault
A structure, usually constructed of concrete and containing no backfill material, which is utilized to house or contain fuel storage tanks. Vaults are considered potentially hazardous confined spaces. The Occupational Safety and Health Administration (OSHA) 29 *CFR* 1910.146 regulates human entry into vaults.

2.101
vent
A code required opening in a tank that is designed to keep the pressures in the tank essentially at atmospheric pressure or relieve pressure variations or differentials. Also the code required means to provide emergency venting in the event of fire or explosion.(See **vent pipes**.)

2.102
vent pipes
The vent pipe provides a means for air to escape the tank when it is being filled and allows air to come into the tank during emptying. The vent pipes are also the primary mean of providing emergency venting of UST in the event of an internal fire or explosion.

2.103
visual inspection
A visual examination to detect the presence of petroleum product. Some examples are the examination of a liquid sample removed from an observation or monitoring well or the inspection of the surface of a vaulted tank.

3 Referenced Publications

3.1 Informative References

The following are documents referenced in this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

API Recommended Practice 1604, *Closure of Underground Petroleum Storage Tanks*

API Recommended Practice 1621, *Bulk Liquid Stock Control at Retail Outlets*

API Recommended Practice 1626, *Storing and Handling Ethanol and Gasoline-Ethanol Blends at Distribution Terminals and Service Stations*

API Recommended Practice 1627, *Storage and Handling of Gasoline-Methanol/Cosolvent Blends at Distribution Terminals and Service Stations*

API Publication 1628, *A Guide to the Assessment and Remediation of Underground Petroleum Releases*

API Publication 1628A, *Natural Attenuation Processes*

API Publication 1628B, *Risk-Based Decision Making*

API Publication 1628C, *Optimization of Hydrocarbon Recovery*

API Publication 1628D, *In-Situ Air Sparging*

API Publication 1628E, *Operation and Maintenance Considerations for Hydrocarbon Remediation Systems*

API Recommended Practice 1631, *Interior Lining and Periodic Inspection of Underground Storage Tanks*

API Recommended Practice 1632, *Cathodic Protection of Underground Petroleum Storage Tanks and Piping Systems*

API Recommended Practice 1637, *Using the API Color-Symbol System to Mark Equipment and Vehicles for Product Identification at Service Stations and Distribution Terminals*

API Recommended Practice 1646, Safe Work Practices for Contractors Working at Retail Petroleum/Convenience Facilities, First Edition, 2006

API Standard 2015, *Requirements for Safe Entry and Cleaning of Petroleum Storage Tanks*

API Recommended Practice 2016, *Guidelines and Procedures for Entering and Cleaning Petroleum Storage Tanks*

API Standard 2217A, *Guidelines for Work in Inert Confined Spaces in the Petroleum and Petrochemical Industries*

API Publication 2219, *Safe Operation of Vacuum Trucks in Petroleum Service*

ACGIH *Documentation of the Threshold Limit Values for Chemical Substances* [1]

ACGIH *Documentation of the Threshold Limit Values for Physical Agents*

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1 American Conference of Governmental Industrial Hygienists, Bldg. D-5, 6500 Glenway Avenue, Cincinnati, Ohio 45211, www.acigh.org.

ACGIH *Documentation of the Threshold Limit Values and Biological Exposure Indices*

ACI 318-08 [2], *Building Code Requirements for Structural Concrete*

ACI 355.2, *Standard: Evaluating the Performance of Post-Installed Mechanical Anchors in Concrete*

ANSI Z117.1 [3], *Safety Requirements for Confined Spaces*

ASME B16.3 [4], *Malleable Iron Threaded Fittings, Classes 150 and 300*

ASME B16.39, *Malleable Iron Threaded Pipe Unions, Classes 150, 250 and 300*

ASME B36.10M, *Welded and Seamless Wrought Steel Pipe*

ASNT CP-189-2005 [5], *Standard for Qualifications and Certification of Nondestructive Testing Personnel*

ASTM C 33 [6], *Standard Specification for Concrete Aggregates*

ASTM D 975-08ae1, *Standard Specification for Diesel Fuel Oils*

ASTM D 2996, *Standard Specification for Filament-Wound Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe*

ASTM D 4021, *Standard Specification for Glass Fiber-Reinforced Polyester Underground Petroleum Storage Tanks* (Withdrawn 1999)

ASTM D 6751-08, *Standard Specification for Biodiesel Fuel Blend Stock (B100) for Middle Distillate Fuels*

ASTM E 1067-07, *Standard Practice for Acoustic Emission Examination of Fiberglass Reinforced Plastic (FRP) Resin Tanks / Vessels*

ASTM G 57, *Standard Test Method for Field Measurement of Soil Resistivity Using the Wenner Four-Electrode Method*

EPA 40 *CFR* Parts 280 and 281 [7], *Technical Standards and Corrective Action Requirements for Owners and Operators of Underground Storage Tanks (UST), and Approval of State Underground Storage Tank Programs*

EPA Publication, *Manual Tank Gauging: For Small Underground Storage Tanks*

EPA Publication, *Musts for UST System: A Summary Of The Federal Regulations For Underground Storage Tank Systems*

EPA Publication, *Operating and Maintaining Underground Storage Tank Systems: Practical Help And Checklists*

EPA Publication, *Straight Talk on Tanks: Leak Detection Methods For Petroleum Underground Storage Tanks and Piping (Dollars and Sense)*

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2 American Concrete Institute, 3880 County Club Drive, Farmington Hills, Michigan 48333-9094, www.concrete.org.
3 American National Standards Institute, 1430 Broadway, New York, New York 10018, www.ansi.org.
4 ASME International, 345 E. 47th Street, New York, New York 10017, www.asme.org.
5 American Society for Nondestructive Testing, 1711 Arlingate Lane, Columbus, Ohio 43228-0518, www.asnt.org.
6 ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA, 19428-2959, www.astm.org.
7 U.S. Environmental Protection Agency, Office of Underground Storage Tanks, 401 M Street, SW, Washington, DC 20460, www.epa.gov/OUST/.

FEMA 348 [8], *Protecting Building Utilities From Flood Damage: Principles and Practices for the Design and Construction of Flood Resistant Building Utility Systems*

FTPI RP T-95-02 [9], *Remanufacturing of Fiberglass Reinforced Plastic (FRP) Underground Storage Tanks*

FTPI RP FTPI-1-05, *Field Test Protocol for Testing the Annular Space of Installed Underground Fiberglass Double-Wall and Triple-Wall Tanks with Dry Annular Space*

ICC International Fire Code® Chapter 22 [10], *Motor Fuel-Dispensing Facilities and Repair Garages*

ICC International Fire Code® Chapter 27, *Hazardous Materials - General Provisions*

ICC International Fire Code® Chapter 34, *Flammable and Combustible Liquids.*

NACE RP0169 [11], *Control of External Corrosion on Underground or Submerged Metallic Piping Systems*

NACE RP0285, *Corrosion Control of Underground Storage Tank Systems by Cathodic Protection*

NACE SP0188, *Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates*

NACE TM0101, *Measurement Techniques Related to Criteria for Cathodic Protection on Underground or Submerged Metallic Tank Systems*

NACE TM0102, *Measurement of Protective Coating Electrical Conductance on Underground Pipelines*

NACE TM0497, *Measurement Techniques Related to Criteria for Cathodic Protection on Underground or Submerged Metallic Piping*

NFPA 30 [12], *Flammable and Combustible Liquids Code*

NFPA 30A, *Code for Motor Fuel Dispensing Facilities and Repair Garages*

NFPA 31, *Installation of Oil Burning Equipment*

NFPA 70, *National Electrical Code (NEC)*

NFPA 77, *Static Electricity*

NFPA 329, *Recommended Practice for Handling Underground Leakage of Flammable and Combustible Liquids*

NIOSH Pub 80-106 [13], *Criteria for a Recommended Standard on Working in Confined Spaces*

NIST Handbook 44 [14], *Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices*

NWGLDE, *List of Leak Detection Evaluations for Storage Tank System*[15]

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8 Federal Emergency Management Agency, Mitigation Directorate, 500 C Street SW, Washington, DC 20472, www.fema.gov.
9 Fiberglass Tank and Pipe Institute, 11150 S. Wilcrest Drive, Suite 101, Houston, Texas 77099-4343, www.fiberglasstankandpipe.com.
10 International Code Council, 500 New Jersey Avenue, NW, 6th Floor, Washington, DC 20001, www.iccsafe.org.
11 National Association of Corrosion Engineers, P.O. Box 218340, Houston, Texas 77218-8340, www.nace.org.
12 National Fire Protection Association, Batterymarch Park, Quincy, Massachusetts 02269-9990, www.nfpa.org.
13 National Institute for Occupational Safety and Health, 125 Bakers Drive, Morgantown, West Virginia 26505, www.cdc.gov/niosh.
14 National Institute of Standards and Technology, Gaithersburg, Maryland 20899, www.nist.gov.

OSHA 29 *CFR* Part 1910 [16], *Safety and Health Regulations for General Industry*

OSHA 29 *CFR* Part 1910.106, *Flammable and Combustible Liquids*

OSHA 29 *CFR* Part 1910.146, *Permit Required Confined Spaces*

OSHA 29 *CFR* Part 1910.1000, *Air Contaminate Rule*

OSHA 29 *CFR* Part 1910.1200, *Hazardous Communication Standard*

OSHA 29 *CFR* Part 1926, *Safety and Health Regulations for Construction*

PEI RP 100 [17], *Recommended Practices for Installation of Underground Liquid Storage Systems*

PEI RP 300, *Vapor Recovery Instructions*

STI ACT-100 [18], *Specification for External Corrosion Protection of FRP Composite Steel Underground Storage Tanks*

STI P3, *Specification and Manual for External Corrosion Protection of Underground Steel Storage Tanks*

STI F841-91, *Standard for Dual-Walled Underground Storage Tanks*

STI R821-91, *Installation Instructions—Underground Steel Storage Tanks With STI-P3 Corrosion Control System*

STI R891-91, *Recommended Practice for Hold Down Strap Isolation*

STI R912-91, *Installation for Factory Fabricated Aboveground Tanks*

STI R913-91, *Installation Instructions—FRP Composite Steel Underground Storage Tanks*

STI R892-89, *Steel Tank Institute Recommended Practice for Corrosion Protection of Underground Piping Networks Associated with Liquid Storage and Dispensing Systems*

UL 58 [19], *Steel Underground Tanks for Flammable and Combustible Liquids*

UL 87, *Power-Operated Dispensing Devices for Petroleum Products*

UL 567, *Pipe Connectors for Flammable and Combustible Liquids*

UL 860, *Standard for Pipe Unions for Flammable and Combustible Fluids and Fire Protection Service*

UL 971, *Outline of Proposed Investigation for Non-Metallic Underground Piping for Petroleum Products*

UL 1316, *Glass-Fiber-Reinforced Plastic Underground Storage Tanks for Petroleum Products*

UL 1746, *External Corrosion Protection Systems for Steel Underground Storage Tanks*

[15] National Workgroup on Leak Detection Evaluations, www.nwglde.org.
[16] Occupational Safety and Health Administration, U.S. Department of Labor, Washington, DC 20402, www.osha.gov.
[17] Petroleum Equipment Institute, P.O. Box 2380, Tulsa, Oklahoma 74101, www.pei.org.
[18] Steel Tank Institute, 944 Donata Court, Lake Zurich, IL 60047-1559, www.steeltank.com.
[19] Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, Illinois 60062, www.ul.com.

3.2 Other Laws and Regulations

Release Prevention and Compliance—Subtitle I of the Solid Waste Disposal Act (42 U.S.C. 6991 et seq.)

CFR 40 (Protection of Environment) Part 63: *National Emission Standards For Hazardous Air Pollutants For Source Categories, Subpart C—Gasoline Dispensing Facilities*

Energy Policy Act of 2005 (Public Law 109-58, 109th Congress), *Title XV—Ethanol And Motor Fuels, Subtitle B—Underground Storage Tank Compliance Act*, Section 1501 to Section 1533

4 Safety and Health

4.1 General

4.1.1 The installation of underground petroleum storage tank systems should take into consideration the safety and health of contractor workers, employees of the UST owner a operator, regulatory personnel, and the general public. Safety and health considerations include, but are not limited to: emergency response procedures; care and use of personal protective equipment; proper selection, care and use of hand and power tools; chemical hazard communication; safe procedures for working at heights, barricading, trenching and excavation, rigging, hoisting and lifting, confined space entry, and control of electrical energy.

4.1.2 It is the responsibility of the UST system owner/operator and contractor management to determine that the installation is in compliance with all applicable OSHA standards; including, 29 *CFR* 1910 (general industry) and 1926 (construction) and associated subparts.

4.2 Contractor Work Safety

4.2.1 It is the responsibility of all contractors to verify that any employees involved with the installation of UST systems have completed and passed a training program for the on-site work safety equivalent of the API WorkSafe® program (see API 1646) prior to beginning any work related to the installation of the UST system. The work safety-training program must include, at a minimum, information and training on the following topics:

a) job safety analysis;

b) management of change;

c) environmental considerations;

d) critical equipment;

e) regulatory requirements;

f) chain-of-command;

g) incident case management;

h) prohibitions;

i) good housekeeping practices;

j) hazards of fuel deliveries;

k) proper personal lifting techniques;

l) first aid, medical treatment and CPR;

m) permit-to-work requirements;

n) personal protective equipment;

o) tool selection;

p) driving safety;

q) hazard communication;

r) working at heights;

s) barricading;

t) trenching and excavations;

u) rigging, hoisting and lifting;

v) confined space entry;

w) lockout-tagout;

x) hot work;

y) UST safety considerations:

 1) tank inerting and purging,

 2) safe removal of tanks,

 3) tank "hold-down" procedures,

 4) corrosion prevention systems,

 5) lifting and setting tanks,

 6) atmospheric hazards of gasoline vapors,

 7) equipment for removal of vapors from tanks,

 8) entering UST systems,

 9) monitoring UST systems,

 10) personal protective equipment.

4.2.2 Contractors must provide the UST owner and operator with certificates, which document that all employees who have been designated to work on the installation project have successfully completed the work safe training program in 4.2.1. Employees must have on their persons at all times proof of certification (e.g. 2×3 card) that provides the following information:

a) name of testing organization,

b) address and/or contact number for testing organization,

c) name of employee who completed the training,

d) date test was completed,

e) certification number.

4.3 Emergency Response

4.3.1 In addition to the development of practices and procedures to address the safety and health factors in 4.1 and 4.2, UST system owners/operators shall develop and implement, in consultation with the installing contractors, an emergency response plan for the installation of an UST system. All personnel who will be performing tasks related to the installation of the petroleum storage tank system shall be trained regarding emergency response actions prior to the start of the project.

4.3.2 An emergency response plan should address potential incidents involving: cave-ins, explosions, electrocution, fires, robberies, injuries resulting from slips, trips, falls, operating heavy equipment, vehicle accidents, operating tools and equipment, etc. The plan should include contact information for first responders as well as management personnel.

4.3.3 An emergency response plan shall include identified resources (i.e. material, equipment, and personnel) and procedures for responding to emergency incidents. Those resources shall be maintained in a clearly marked location on the construction site and be readily available to designated response personnel. The plan shall indicate the expected outcomes of the emergency response activities. Management shall support the development and implementation of the emergency plan.

4.3.4 All personnel involved with the installation of the UST system should be provided with a laminated wallet-sized card containing emergency contact numbers. Another laminated 5×7 card, to be affixed to the dashboard of personnel vehicles, should be provided that contains emergency communication steps and processes.

(See also Annex A—"UST System Installation Checklist" for items discussed under Section 4.)

5 Materials and Equipment

5.1 General

Applicable fire and building codes should be consulted regarding requirements for material selection and conditions for their use. Manufacturers can also provide information related to suitability and design limitations for various applications. AHJs should be consulted regarding necessary permits for new or upgraded UST systems.

5.2 Federal Requirements

5.2.1 Minimum criteria for component design and material specifications are set forth in 40 *CFR* 280. In general, installed UST systems must meet the following requirements:

a) New UST systems must be installed properly according to manufacturers' instructions and a code of practice developed by a nationally recognized association or independent testing laboratory. Owners and operators must submit a certification of installation that demonstrates compliance with the installation requirements.

b) New and existing UST systems must be equipped with devices to prevent spills at the tanker delivery connection points to the environment and overfills of the UST.

c) New underground tanks and piping in contact with the ground must be properly designed, constructed and protected from corrosion in accordance with a code of practice developed by a nationally recognized association or independent testing laboratory. All UST systems must be made of or lined with materials that are compatible with the substance stored in the UST system.

d) New and existing UST systems must be equipped with a method of detecting releases from any portion of the UST system that routinely contains petroleum product, and for which they provide the function of primary containment (e.g. tanks and piping).

e) With the exception of vapor monitoring, ground-water monitoring, and interstitial monitoring, leak detection (method and equipment) must be able to detect a release with a Pfa/Pd of 95/5. All leak detection methods meeting the this criteria should be tested by an independent third-party in accordance with testing protocols established by the EPA. Devices which have been listed by the National Work Group on Leak Detection Evaluation (NWGLDE) will provided this assurance.

f) In some States, this listing is a requirement and new and existing UST systems must employ a leak detection method whose third-party testing certification has been reviewed and approved by the NWGLDE.

g) Federal OSHA rules required that listed devices be used for nozzles, dispensers, and breakaways. OSHA rules also required that listed electrical devices be used in hazardous areas.

h) State and Local fire codes also have prescriptive requirements for selection of equipment which have listings. It is recommended that fire codes be consulted for local requirements.

i) In addition to the above approval requirements for leak detection by the NWGLDE, other devices may need approvals. Most common additional approvals are for metering and vapor recovery.

5.2.2 Federal, state, and local registration requirements should be reviewed before new tanks are installed. The EPA requires each owner to register every new underground tank within 30 days after the tank is brought into use. The designated state regulatory agency can provide registration forms.

5.3 Material Specifications

5.3.1 The materials used in an UST system should meet the criteria outlined in appropriate API, ASTM, NFPA, PEI and/or STI or UL standards and publications (see Section 3).

5.3.2 Prior to the installation of new UST system components, the owner should confirm that all new components are listed for the intended fuel service. If there is no listing indication on the equipment, then the manufacturer should certify that the components are compatible or suitable for use (see API 1626 and API 1627).

5.4 Total Cost of Ownership (TCO)

5.4.1 The TCO identifies costs related to each lifecycle phase of the UST system. The TCO may be considered when determining the type of UST system to be designed, and the alternative components that may be selected for installation at a particular location.

5.4.2 Installation represents one phase in the lifecycle of the UST system. The factors that influence the installation phase must be identified and the associated costs for each factor determined if the UST owner desires to understand and reduce the lifecycle cost of the installation of the UST system.

6 Preconstruction and Preinstallation Site Analysis

6.1 General

6.1.1 Preconstruction includes all necessary steps that should be completed before installation work begins at the site. A site-specific plan should be completed and followed by contractors and other personnel involved with the installation of the UST system. This plan should be consistent with the requirements of API 1646, RAGAGEP or other nationally recognized standards and should include the following:

a) a geotechnical analysis of the preconstruction site;

b) site-specific needs for groundwater protection and personal safety while excavation and underground work is underway;

c) determination of normal and expected high water tables, site drainage characteristics, and the potential flooding of the site;

d) a study and plot of tanker truck traffic;

e) a study and plotting of electrical hazardous areas.

6.2 Secondary Containment

6.2.1 In response to the Energy Policy Act of 2005, most states now mandate secondary containment (see Figure 1) for all new tank and piping installations.

6.2.2 For all other states where secondary containment is not mandated for all new tank and piping installations, secondary containment may be necessary depending on site-specific circumstances; such as, an existing community water system or potable drinking water is located within 1000 ft of the UST system, a sole-source aquifer underlies the location of the UST system, a private potable water well is within 1000 ft of the location, or an underground transit structure is within 100 ft. In general, secondary containment is recommended.

(See also Annex A—“UST System Installation Checklist” for items discussed under Section 4.)

7 Removal and Disposal of Used Storage Systems

7.1 Safety Considerations

7.1.1 In some cases an existing UST system must be partially or totally removed before a new system is installed. Because of the fire and safety hazards related to the removal of existing systems, specific safety precautions must be taken. Hazards associated with open trenches and excavations pose significant safety concerns to all on-site personnel and the general public. API 1604, API 2015, API 2217A and API 2219 provide appropriate safety information and procedures. Local fire officials should be consulted before any action is taken and all required permits should be secured before commencing work.

NOTE The EPA’s UST regulations require that the AHJ be notified 30 days in advance of closure unless the closure is in response to a need for corrective action. Local jurisdictions may have different requirements.

Caution—Entry into tanks and other confined spaces, including any submerged pump containment spaces, can be extremely hazardous. This should not be undertaken without compliance with all appropriate publications or regulations referenced in this text (see Section 3, especially OSHA 29 *CFR* 1910.146 and API 2015). It is recommended that tanks be removed without entry into UST's.

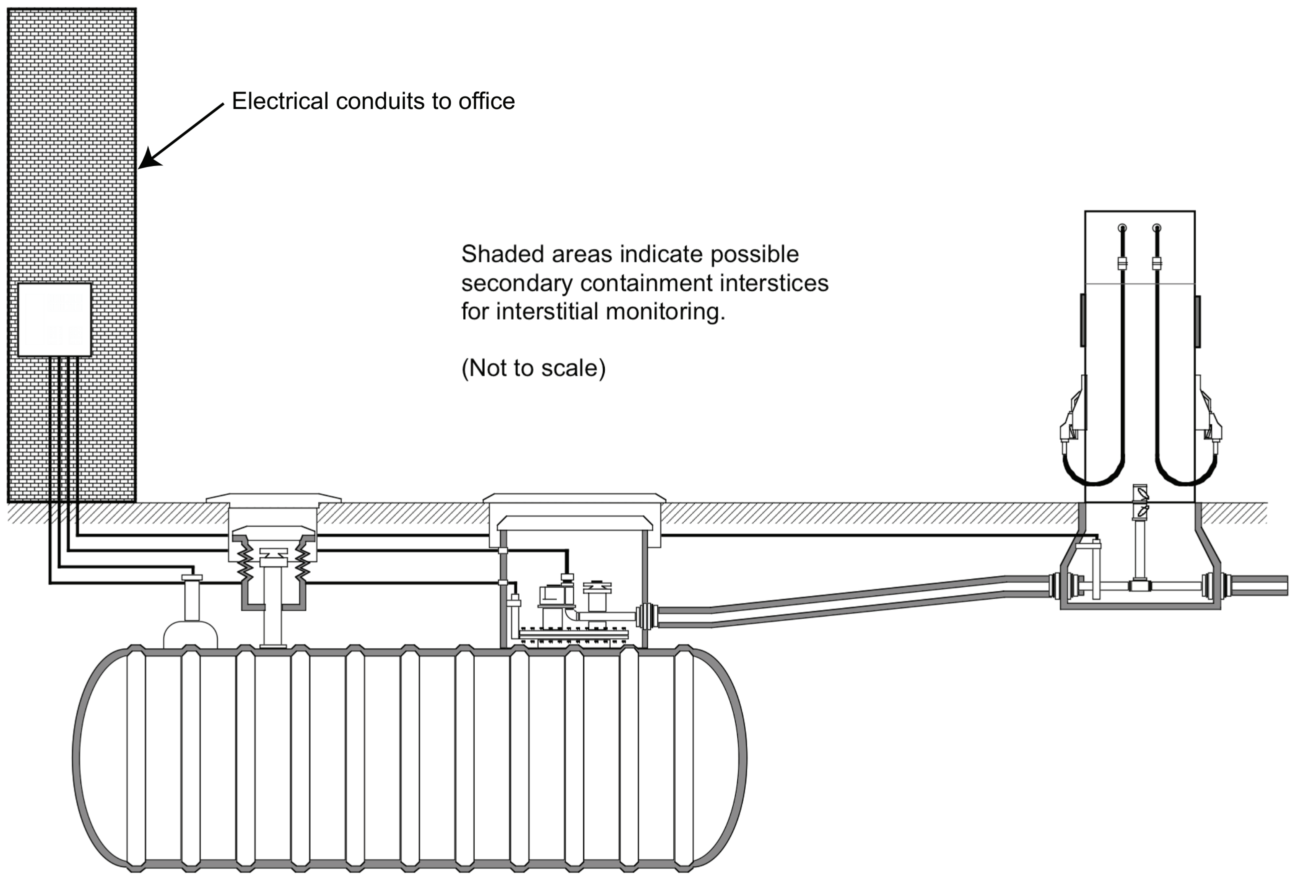


Figure 1—Sample UST System—Secondary Containment

In particular, the following specific considerations should be taken.

a) Before entering confined spaces (e.g. inside a tank or vault area), the procedures described in API 2217, API 2015, ANSI Z117.1-1977, NIOSH 80-106, and applicable sections of 29 *CFR* Part 1910 and NFPA 77 should be followed to provide for the safety of personnel.

b) Personnel entering the confined spaces shall be equipped at all times with positive pressure air-supplied respirators with full-face enclosure. Personnel entering the tank shall wear a safety harness connected to a safety line that must be securely attached outside of the tank's entry opening. Under no circumstances should any personnel be inside the tank without a safety attendant immediately outside the tank opening.

7.2 Considerations for Partial System Removal

7.2.1 Because removing and replacing backfill around existing piping and tanks can cause stresses that may damage coatings and/or the UST system, care should be taken when removing a portion of an existing UST system not to disturb the equipment that will remain.

7.2.2 If new steel equipment is to be installed to an existing steel UST system, consideration must be given to eliminating the electrochemical corrosion effect that the existing tanks might have on the new equipment. Newer tanks can become anodic to older steel tanks and corrode much faster than expected unless a properly designed cathodic protection system is installed (see API 1632 and NACE RP-0285).

7.3 Contaminated Backfill

7.3.1 When an existing UST system is partially or totally removed, contaminated backfill may be encountered. Backfill can be contaminated by releases during operation of the facility or during removal of the equipment. Contaminated backfill may be a fire and environmental hazard.

7.3.2 Releases should be contained to prevent contamination during removal. If a reportable release under federal, state, or local rules has occurred, the AHJ must be notified within 24-hours of discovery of the confirmed release. Local officials may require specific procedures for isolation, special handling and/or disposal of contaminated backfill materials (see API 1628).

7.4 Disposal of Used Equipment

Additionally, API 1604 suggests appropriate disposal methods for used petroleum product storage and handling equipment, and API 2202 addresses the dismantling and disposal of tanks that have contained leaded product.

(See also Annex A—"UST System Installation Checklist" of items discussed under Section 7.)

8 Excavation

8.1 General

Various factors affect the size and shape of the excavation for the installation of the UST system at the construction location. Manufacturer's recommendations should be consulted when determining the existence of specific factors and methods to address them. These factors could include hydro-geological conditions, proximity to nearby structures and/or utilities, the amount of covering, and the necessity for shoring, sloping or adding liners to the excavation walls. Determining the aspects and characteristics of these factors for the specific location where the UST system is to be installed will help with identifying any specific or unique safety considerations, which in turn will aid with safety planning (see Figure 2).

8.2 Safety Considerations

Any earth excavating procedure presents safety hazards related to the presence of unstable soils, water, released product, and moving equipment. Special attention should be given to sloping or shoring the sides of the excavation to make them stable (see Figure 3A and Figure 3B). Personnel involved in excavation, equipment installation, and backfilling should be knowledgeable about and should follow the safety standards given in 29 *CFR* 1926 (see also API 1646). Areas with open trenches and excavations must be securely barricaded to minimize accidental or unauthorized entry. The steps involved with the excavation, equipment installation, and backfilling should be included in the Job Safety Analysis performed prior to commencing the installation of the UST system (see API 1646, Sections 2.1, 9, 10 and 14.10).

8.3 Location of Tanks

8.3.1 Tanks should be located to minimize the amount of maneuvering necessary for the tank truck delivering product to reach the fill openings (see Figure 4). Tanks should be located so that the tank truck delivering product will not:

a) need to travel in reverse;

b) park on a public right-of-way;

c) block motorists' views of roadways entrances;

d) impede the flow of vehicles or pedestrians;

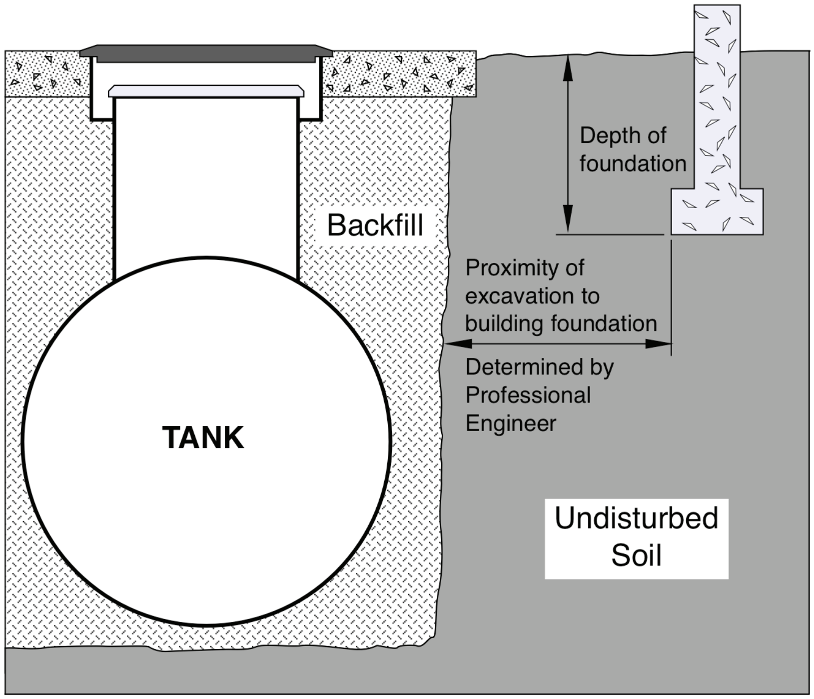
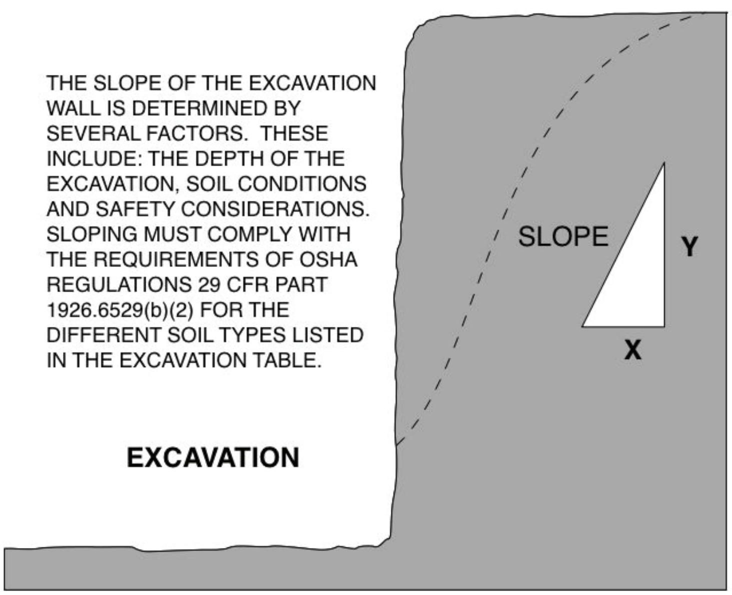


Figure 2—Tank Excavation Clearance from Existing Structures



EXCAVATION SLOPES

Soil Type [Refer to 29 CFR Part 1926.6529(b)(2)]	Maximum Allowable Slope		
	X (feet)	Y (Feet)	Angle from Horizontal (Degrees)
Stable Rock*	VERTICAL (Shoring not required)		90
Type A (< 12 feet deep)	2	4	63
Type A (> 12 feet deep)	3	4	53
Type B	4	4	45
Type C	6	4	34

* - Shoring is not required for excavations in stable rock if the depth of the excavation does not exceed 20 feet.

Figure 3A—Example of Shoring System for Unstable Soil Conditions

Figure 3B—Example of Pre-engineered Shoring System for Unstable Soil Conditions

e) require any portion of the tank truck to pass under a customer fueling canopy unless sufficient clearance exists;

f) require any sides of the vehicle to approach within 4 ft of any building or structure.

The tank truck delivering product will:

a) have an orientation where the truck manifold and driver acclivities can be monitor by shop, kiosk or store employees;

b) have direct fills;

c) have fills where water will not pond on the tank pad and possibly enter the product tank; and

d) it is also recommended that the tank location be reviewed by the terminal manager delivering fuel to the site to validate safety of the location and access.

8.3.2 In general, tanks should not be located less than 5 ft from the property line of any adjacent property on which a structure can be built. Additional tank siting requirements can be found in local fire code.

8.4 Excavation Dimensions

8.4.1 Steel Tanks—Excavations should be large enough to provide a minimum clearance of 24 in. between the tank walls and the sides of the excavation. Multiple steel tanks should be installed at least 24 in. apart. Steel tanks should be deep enough to allow 6 in. between the tank bottom and undisturbed soil under the tanks or as recommended by in the tank installation manual.

8.4.2 FRP Tanks—Excavations should be large enough to provide a minimum clearance of 24 in. between the tank walls and the sides of the excavation. Multiple FRP tanks should be installed at least 24 in. apart. The excavation should be deep enough to provide for a backfill depth of at least 12 in. below the bottom of the tank and undisturbed soil (or as recommended by the tank manufacturer).

8.4.3 It is recommended that the tanks be anchored. The burial depth of tanks will depend on manufacturer's recommendations based on site-specific circumstances, and local codes and regulations. In general the tanks should be buried such that the underground product, vent and vapor lines drain to the tank without traps or sumps. The bottom of the excavation should be routinely monitored for water ingress and any degradation in soil stability. If soil

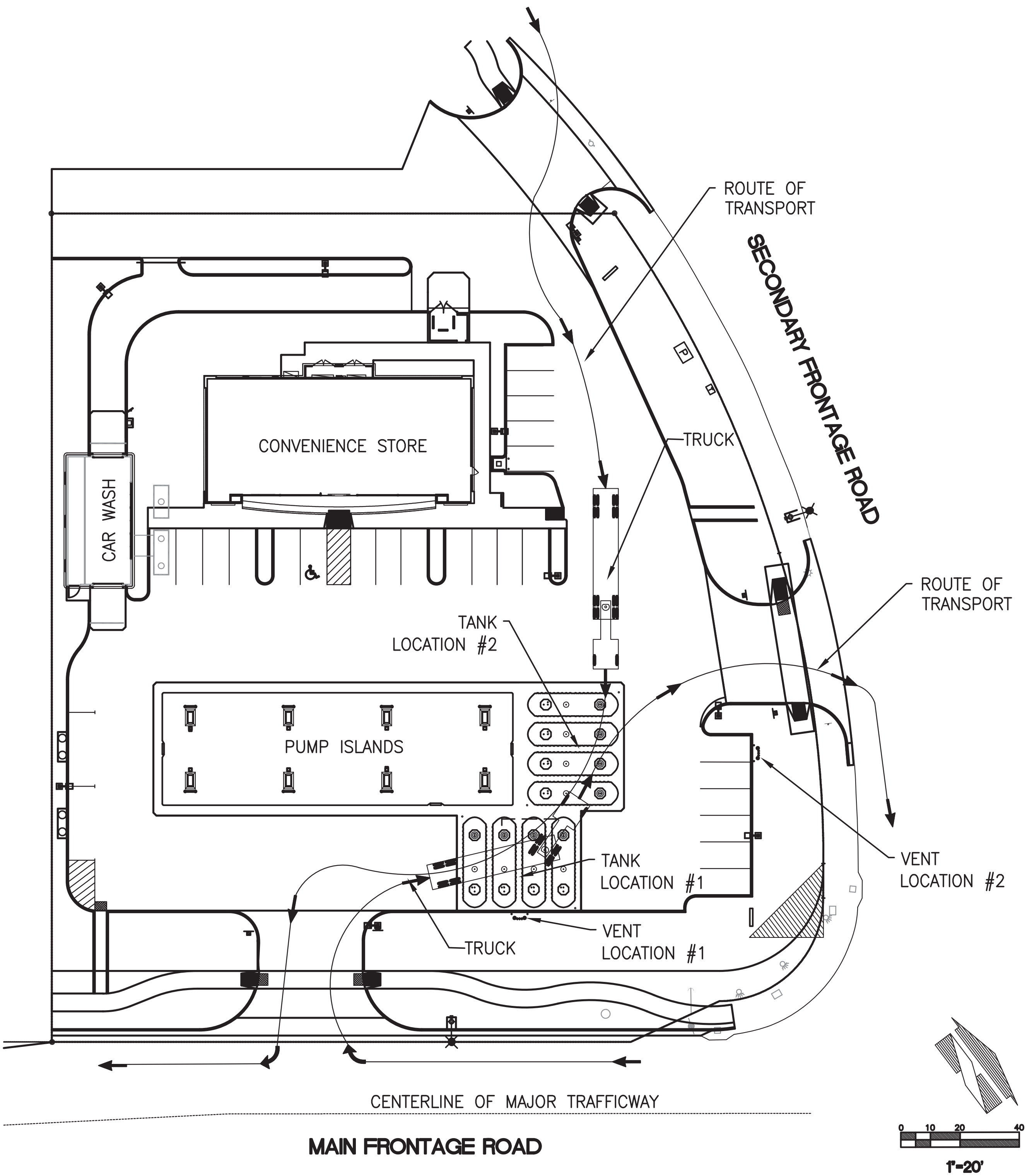


Figure 4—Typical Plot Plan Showing Typical Tank Placements

analysis determines that sloping or shoring is required of the excavation walls, then all such sloping or shoring shall comply with OSHA requirements (see Figure 3A). For wet hole installations it is recommended that filter fabric be used to preserve the integrity of the backfill.

9 Handling, Inspection and Testing

9.1 Material Handling

9.1.1 To prevent damage to coatings and structure, tanks and/or piping should be handled with care during transit, storage, and installation in accordance with the manufacturers' instructions. Tanks and/or piping should not be rolled, dropped, dragged or handled with equipment or devices that might impose physical damage or excessive stress.

9.1.2 Chains, cable, or other lines should not be placed around the tanks and/or piping to lift or move them; however, rope or strapping that will not damage the tank and/or piping may be used in accordance with the manufacturers' instructions to secure the tanks and/or piping during transit. Tanks should be unloaded with a method that does not require personnel to climb or stand on top of the tank. OSHA requirements for working at heights apply to personnel access to the top of a tank when it is on a tanker truck or staged at grade level (refer to API 1646).

9.1.3 Lifting lugs attached by the manufacturer, when used in accordance with the manufacturer's instructions, provide a safe and effective means of lifting or moving the tank. To lift or move a tank with multiple lifting lugs, chains or cable of sufficient length should be attached to all the lugs and the lifting equipment so that the angle between the vertical and one side of the chain to a lifting lug is not greater than 30°. (see Figure 5).

A spreader bar can be used so that the angle does not exceed 30°. Hand-lines should be attached to each end of the tank to provide a means of manually controlling its movement and placement. Prior to moving a tank, a determination should be made that the hoisting equipment has sufficient capacity and reach to lift and lower the tanks without dragging or dropping. The tank manufacturer should be contacted to determine the tank weight and to select the appropriate lifting equipment. As an alternative and with the agreement of the tank owner, the tank manufacturer may provide a tank without lifting lugs, provided instructions are included for alternate lifting methods (e.g. using slings).

9.1.4 Tanks and/or piping stored temporarily at the installation site should be located away from areas of activity where the tanks and/or piping could be damaged. The selected location should not interfere with the normal flow of vehicles or pedestrians. When possible, the tanks and/or piping should be placed in a location that will minimize the need for further movement prior to installation. Tanks and/or piping should rest on materials that provide sufficient protection from anything that could damage the coating.

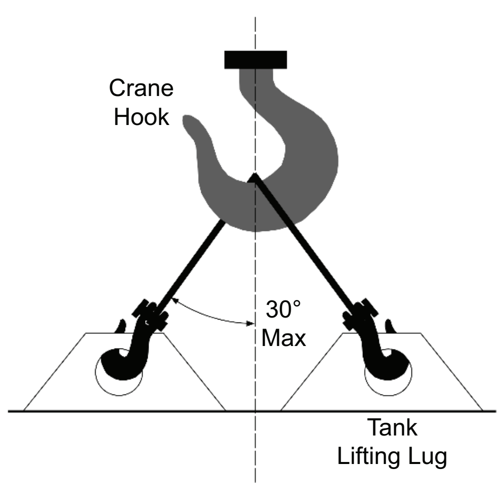


Figure 5—Proper Rigging for Lifting and Lowering Tanks

9.1.5 Nonabrasive chocks or saddles should be used to prevent direct contact of the tanks and/or piping with the ground and prevent unwanted movement that could result in injury to persons or damage to property and equipment. If high winds are expected, tanks should be tied down with nylon or hemp rope at least $^{1}/_{2}$ in. in diameter. The rope should be secured to stakes large enough to provide adequate restraint. Tie-down ropes should be secured through the lifting lugs of tanks.

9.1.6 Piping should be transported, staged, and handled with care to prevent UV damage or physical damage to coatings, structure, or threaded sections. Bending, crushing, or otherwise stressing the pipe-work should be avoided throughout the handling process.

9.1.7 All tanks should normally be vented to the atmosphere during storage and installation. All tanks should be handled and tested in accordance with the manufacturer's recommendations.

9.2 Pre-installation Inspection and Testing

9.2.1 Upon delivery at the installation site and just prior to installation, tanks and piping should be visually inspected to comply with the manufacturer's instructions, any applicable specifications and to detect any evidence of damage to coatings, materials, or structure. All methods of acceptance testing recommended and approved by the tank and/or piping manufacturer should be conducted at the time of delivery. However, the method of acceptance testing must be of sufficient sensitivity to assure that the tank will effectively achieve positive tightness test results in accordance with the regulatory requirements for monthly and annual leak detection. It is the responsibility of the UST owner, in consultation with the tank manufacturer and a qualified testing contractor, to determine the best method for achieving this objective).

9.2.2 Visual inspections should be conducted just prior to installation and should follow the tank manufacturer's instructions. If performed, "Holiday" testing for steel tanks should be done in accordance with NACE SP 0188-2006, and performed by an individual certified by NACE or ASNT to conduct this test. Visual inspection of FRP tanks just prior to installation should include at a minimum a pressure / soap test performed in accordance with the tank manufacturer's instructions (see Figure 6 and Figure 7).

Any identified defects or damage to coatings or laminates should be repaired at the installation site with manufacturer-supplied materials and in accordance with the manufacturer's instructions. If this is not possible or if significant damage such as denting, puncturing, or cracking has occurred, the manufacturer should be contacted to repair the equipment, tank or coatings and to recertify or replace the tank as required. The manufacturer should be consulted concerning limits and requirements for maintaining new tank warranty.

9.2.3 Deflection of the tank shell can contribute to the failure of an FRP UST. Periodically measuring tank deflection can aid in determining when or if any pre-emptive action may be needed to prevent failure of the UST. FRP Tanks are designed to be round—within the manufacturer's tolerance (typically 1.0 % to 1.5 %).

9.2.4 Before an FRP tank is installed, its inside vertical diameter should be measured and permanently recorded for comparison with post-installation measurements and for future reference. The inside vertical diameter of the tank can be measured from the top of a bung (or opening) in the middle and both ends of the tank when possible. The position of the bungs used for this measurement can affect the result. The ends of a tank are reinforced by the caps and are less likely to demonstrate deflection than the middle of the tank away from the influence of the caps. At minimum, deflection for at least one bung opening should be measured. The deflection (difference between pre-installation and post-installation measurements) must not exceed the tank manufacturer's recommendations. All measurements should be documented for comparison to any future measurements.

Figure 6—Typical "Holiday" Test for Steel USTs

Figure 7—Typical Pressure/Soap Test for FRP USTs

9.3 Testing—General

9.3.1 USTs and piping should be tested for tightness integrity during the installation process for quality assurance and risk mitigation purposes. The following other preliminary tests are recommended to be completed prior to start-up of the UST system:

a) tanks should be tested for tightness on site but prior to installation;

b) piping should be tested after installation but prior to backfilling;

c) optionally, it may be helpful to test tanks and piping after backfilling;

d) if other work, excavation, drilling, staking, has occurred at the site which may have damaged the complete system prior to opening, it may be helpful to test the entire system of tanks pipes and sumps after all paving is complete.

9.3.2 All testing must be performed in accordance with applicable regulatory requirements, as well as manufacturer's recommendations and owners specifications. There are different testing requirements and methods of testing for single-wall and double-wall tanks and piping. Consult with the equipment manufacturers for the correct and/or accepted testing method.

9.4 Safety Precautions

Leak testing methods can present various hazards to the safety of personnel performing and/or observing the testing. Each method may present unique hazards that must be clearly understood prior to commencing any testing. Hazards must be identified and steps implemented to prevent or eliminate the potential for accidents as a result of those hazards. All tasks associated with performing leak testing should be included in the job safety analysis performed prior to commencing any work related to the installation of the UST system (see API 1646, Section 2.1).

9.5 Pressure Testing of Single-wall Tanks

Prior to installation, each underground tank should be subjected to a pre-installation tank test. Some jurisdictions may also require an air test after the tank is installed (see Figure 8).

Caution—A preinstallation tank test is a potentially dangerous procedure and should therefore be conducted with the following safety precautions.

a) Before any of the procedures described in this section are initiated, the tank manufacturer's instructions should be consulted regarding specific testing requirements.

b) The internal tank pressure must not exceed the specific tank manufacturers' recommendations. Remember to stay away from the tank ends while the tank is under pressure. Barricades should be put in place to keep personnel clear of the end of the tanks.

Caution—Personal injury and tank damage can result from over-pressurization.

NOTE Some jurisdictions may require an air test after the tank is installed. If so, this should be performed in addition to the aboveground test. A pre-installation tank test may be conducted as follows.

a) All factory-installed plugs are removed from the tank, and a pipe-thread sealant certified for petroleum service or for the fuel to be stored is applied to them. The bungs are then replaced and tightened so that no air is released during testing. Any temporary bungs or dust covers should be replaced with solid bungs. Care should be taken to avoid cross threading when the bungs are replaced.

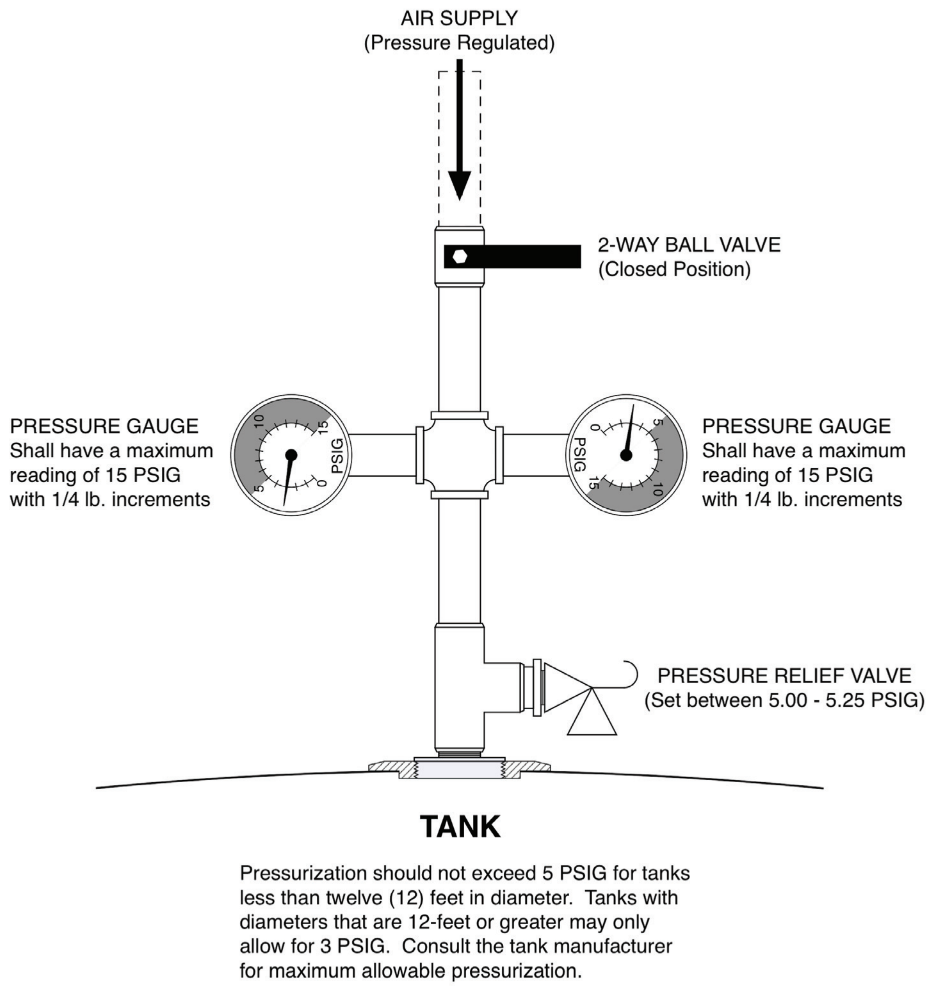


Figure 8—Pressure Test Gauge Setup for Single-wall Tanks

b) Prior to pressurization, the external surface of the tank should be inspected for defects. A compressed-air source is applied (according to the manufacturer's recommended procedures) to raise the internal tank pressure to a level recommended for this test by the tank manufacturer. A pressure gauge with a maximum range of 10 psig to 15 psig with graduations of no more than $^1/_4$ lb increments should be used to confirm proper pressurization.

c) When the internal pressure is achieved, the compressed air source should be disconnected from the tank and the entire tank shell, as well as all seams, bungs, and manways should be uniformly coated and recoated as necessary with a soap solution. Leaks are indicated by the presence of bubbles identified by a visual inspection. The importance of this visual inspection cannot be over emphasized.

d) If bubbles are observed around fittings, the fittings should be checked for tightness and repaired as necessary. If leaks are detected in seams or the shell, the supplier and/or the manufacturer should be notified and the leak eliminated prior to installation.

e) When the inspection is completed, the air pressure should be released.

A valve should be provided to allow the air to be released after the test is complete. When opening this valve, take care that it is not pointed at any personnel. The use of eye and hearing protection should be required.

9.6 Pressure Testing of Double-Wall Tanks

9.6.1 Double-wall tanks provide a form of secondary containment by way of a space between the inner and outer tank walls called an interstice. This space may also be referred to as an interstitial space, an annulus, or an annular space. The interstice is a feature that provides for containment and detection of releases and is not meant to provide permanent storage of product. The primary containment vessel is referred to as the inner tank, and the exterior of the tank as the outer tank.

9.6.2 Both the inner and the outer shells of a double-wall tank should be tested prior to installation. The manufacturer will designate the exact test methods and protocols for their tank product. It is extremely important that the manufacturer's instructions be followed without deviation. When the tank is shipped from the manufacturer with a vacuum or liquid filled interstice, different tests may be necessary. The following should be considered when testing the interstice (see Figure 9).

a) The capacity of the interstice is very small. Compressors commonly used for testing can over-pressurize the space in seconds, possibly causing serious damage to the tank. To avoid over pressurization, the inner tank should first be pressurized to 35 kPa (5 psi) and checked for leaks (loss of pressure). A connection should then be made between the inner tank and the interstitial space and air should be bled from the inner tank into the interstitial space until the pressure equalizes.

b) Manufacturer's field test requirements vary. The methods used should comply with the specific manufacturer's instructions and only those tanks that pass the manufacturer's test should be installed.

Warning—Pressurization of the interstice directly from an outside air source is dangerous and should be strictly prohibited. Remember to stay away from the tank ends while the tank is under pressure. Barricades should be provided to prevent personnel access to ends of the tanks while under pressure

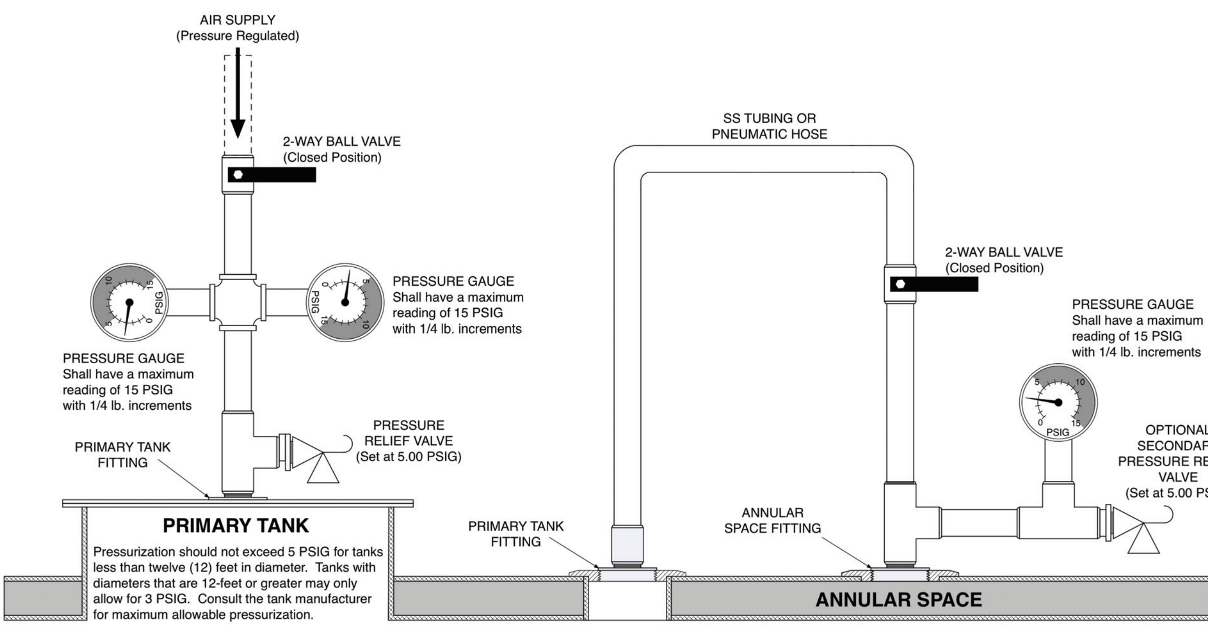


Figure 9—Pressure Test Gauge Setup for Double-wall Tanks

9.7 Testing of Piping and Sumps

9.7.1 Visual inspection is generally the only pre-installation testing of piping and containment sumps done at the jobsite. After the piping is installed and before the backfill is placed, the piping should be isolated from the tanks and tested in accordance with the manufacturer's instructions and, as necessary, in accordance with a test method that has been approved by the AHJ or the NWGLDE.

9.7.2 Sumps should be subjected to a pressure, vacuum, or hydrostatic test in accordance with the manufacturer's requirements. Testing of single-wall and double-wall sumps should be completed after the installation of all penetration fittings and should be tested up to the top of the sump. The interstitial space of double wall sumps must also be tested.

9.7.3 Tank sumps are typically bonded to the tank and are independently testable.

9.7.4 The leak testing method should be chosen based on the leak rate sensitivity desired or required by regulation, and the component being tested for tightness integrity. Consult with the tank or piping manufacturer regarding the selection of a method for testing the tightness of tanks or piping.

9.7.5 Test methods should be performed by personnel who have been properly trained in the use of the testing method used for assessing the integrity or tightness of the tanks and/or piping. Depending upon the testing method, the individual performing the testing may need to be certified to conduct the testing. Qualifications for certification should meet or exceed the requirements of the American Society for Nondestructive Testing standard CP-189-2005, *Standard for Qualifications and Certification of Nondestructive Testing Personnel* for the applicable testing method listed above.

9.7.6 This RP provides information regarding testing requirements specified in the code of federal regulations (40 *CFR* 280). However, additional testing of various components of the UST system may be performed for purposes of managing the health and safety, protection of the environment, and impacts to other business-related risk factors including property value, business assets and business reputation.

(See also Annex A—"UST System Installation Checklist" for items discussed under Section 9.)

10 Equipment Placement, Anchorage, Secondary Containment, and Ballasting

10.1 Placement

10.1.1 Moving tanks on site should be done with extreme caution due to their size and weight. A "restricted access" exclusion zone should be established surrounding the excavation area. The radius of the exclusion zone can be approximately determined by adding the diameter of the tank to the maximum allowable boom swing radius for the crane, which can be obtained from the crane manufacturer. Only personnel responsible for the control of hand lines for assisting with the movement and location of tanks within the excavation area should be allowed within the "restricted access" area. All other personnel should be kept outside the exclusion zone whenever the tanks are being moved with a crane to avoid the possibility of injury. The crane or backhoe used should be rated to pick up the load at the required operating distance safely.

10.1.2 A procedure for moving the tanks should be determined prior to moving the tanks and should be reviewed and agreed to with the crane operator.

10.1.3 A "No Entry" area should be identified and blockaded to prevent access by any personnel. This area represents a 90° field of vision that is opposite to the direction the crane operator is facing when the boom is perpendicular to the tank excavation (see Figure 10).

10.1.4 Steel and FRP tanks should be placed on a bed of suitable backfill (see Section 11) that has been graded, leveled, and compacted to the depth specified in 8.4.2.

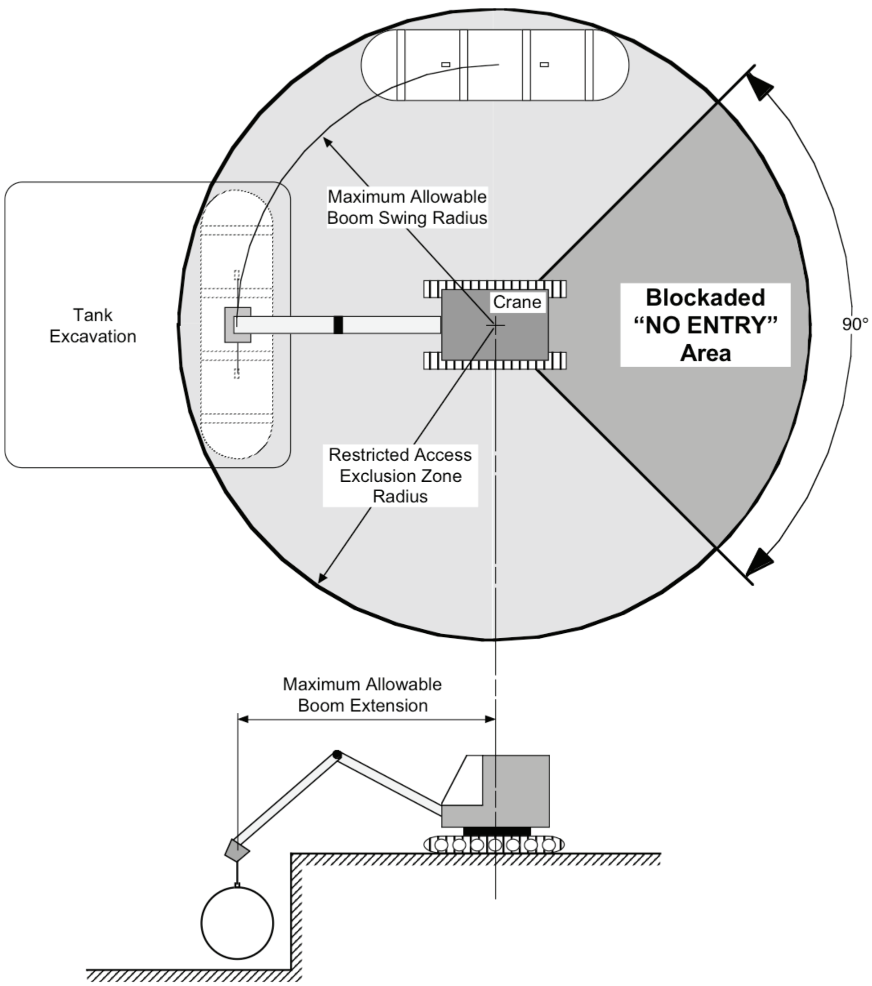


Figure 10—Backhoe Boom Swing Radius Exclusion Zone

10.1.5 An underground tank should never be installed directly on a hold-down pad, compacted earth, or any other hard surface.

10.1.6 Care should be taken when the tank is lowered into the excavation to prevent tank damage. The use of hand-lines for manual control will facilitate this procedure.

10.1.7 It is occasionally necessary to install more than one storage tank for a given product. Such tanks may be interconnected by means of a siphon connection, a manifold or both, which permits the equalization of the product level in the connected tanks (see 13.2.5). Interconnected tanks should have the same diameter, top elevation, and siphon-end elevation to avoid operational and/or regulatory problems (see Figure 11). Some AHJs prohibit siphoned tanks or may have other installation requirements (see 13.2.5).

10.2 Tank Buoyancy

10.2.1 Insufficient anchoring of an UST system can result in the tank floating out of the ground when high water-table conditions exist. In order to prevent this from occurring, it is necessary to offset the maximum potential buoyancy of each tank by the weight of overburden. Overburden includes backfill, surface paving, the weight of the tank and any anchoring devices. (A sample buoyancy calculation can be found in Annex B).

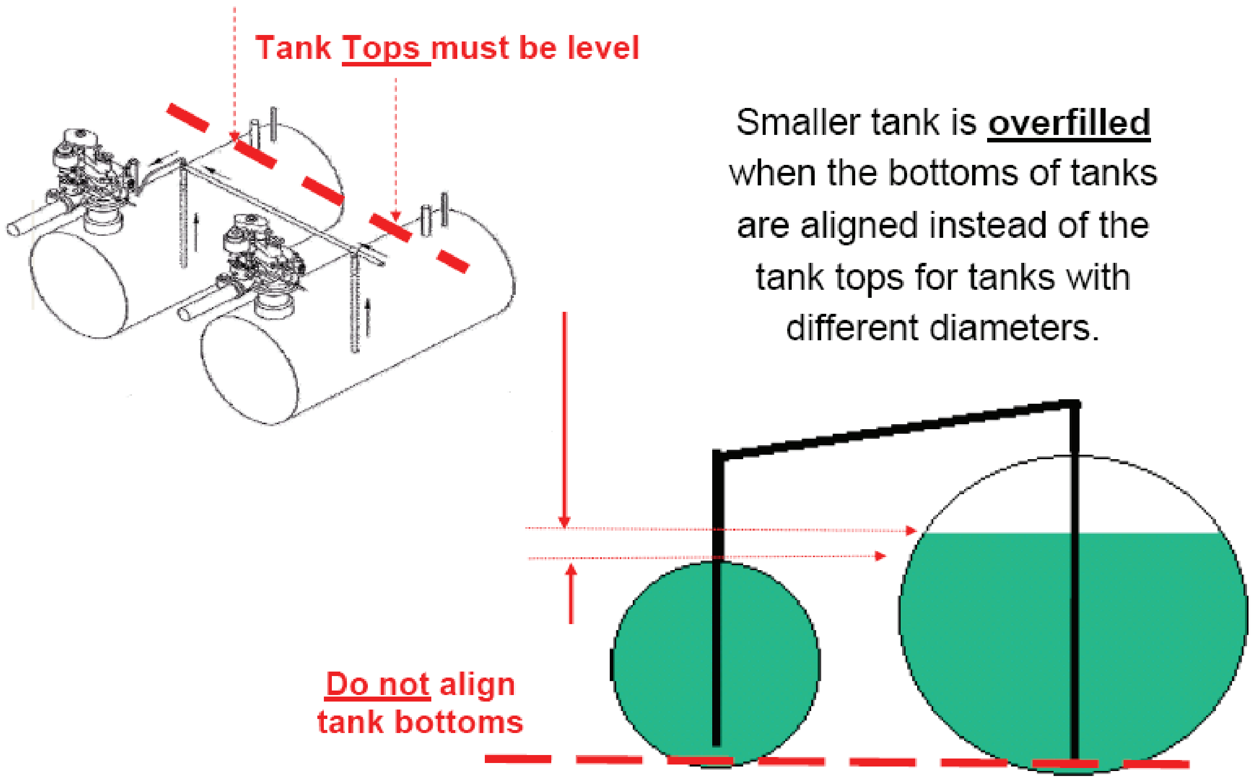


Figure 11—Proper Tank Alignment

The volume and empty weight of UST of the tank can be found on the manufacturer's tank strapping chart that is provided with the tank, or directly from the manufacturer.

10.3 Anchorage

10.3.1 Anchorage can be used to prevent USTs from floating in the presence of water (see Figure 12 and Figure 13). If anchorage is necessary, consult the tank manufacturer for anchorage recommendations.

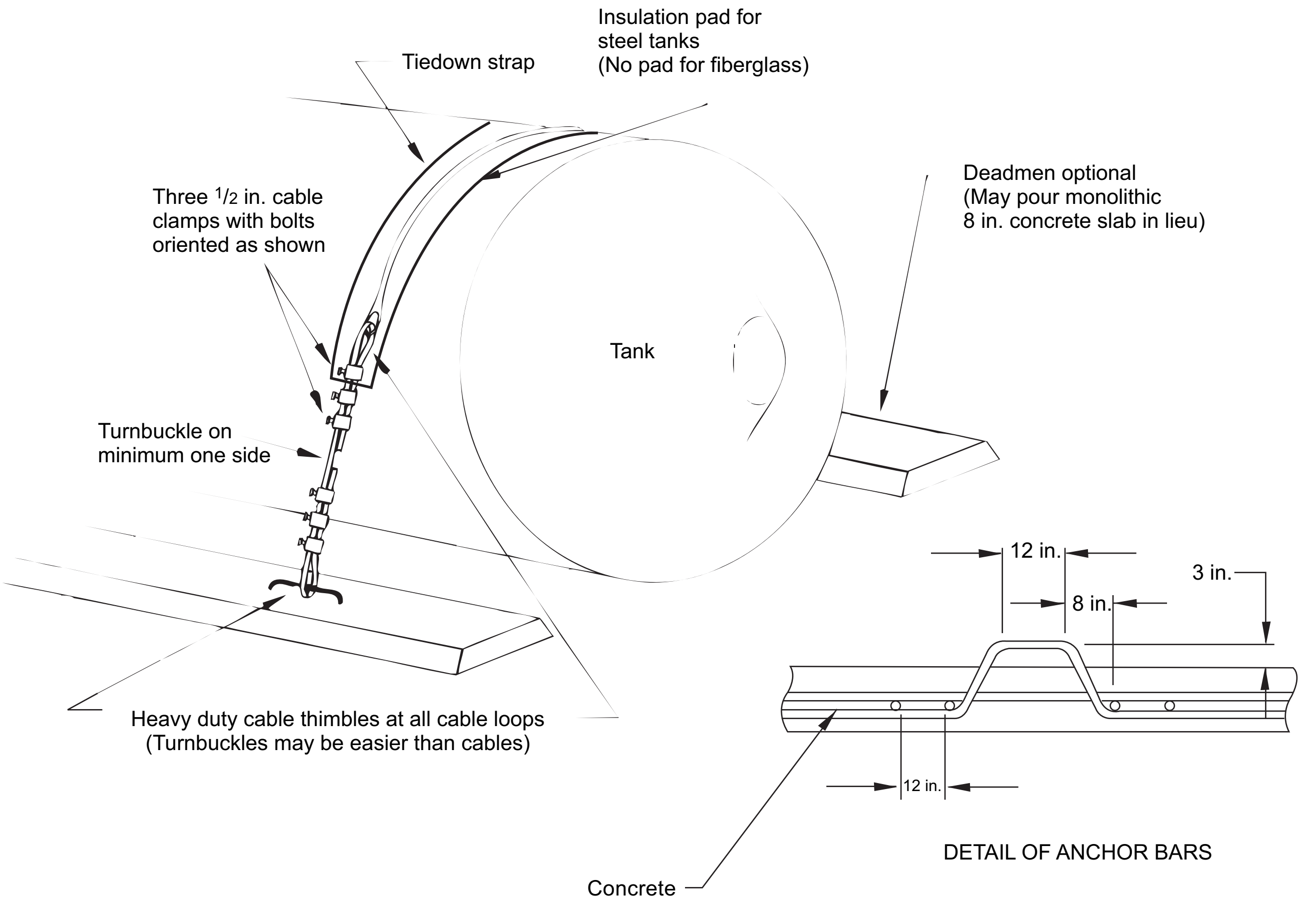
It is recommended that tanks be anchored.

NOTE Anchorage is recommended by the Federal Emergency Management Agency (FEMA) if the tank is to be installed in a designated flood plain. [20]

10.3.2 Tanks can be anchored in several ways. If it is determined that anchorage is necessary, professional assistance should be obtained to determine which method should be used and to help in designing the installation. This assistance may be available from the tank manufacturer, professional engineers, or professional tank installers. The following are some of the most common methods used:

a) Hold-down Pad—Anchoring the tank to a concrete slab (hold-down pad) under the tank, with a 6-in. to 12-in. cushion of proper backfill between the bottom of the tank and the slab. The length of the hold-down pad should exceed the length of the tank by at least 6 in. at each end. The width of the hold-down pad should extend a minimum of 12 in. beyond each side of the tank.

[20] Federal Emergency Management Agency (FEMA). *Protecting Building Utilities From Flood Damage: Principles and Practices for the Design and Construction of Flood Resistant Building Utility Systems*. Mitigation Directorate, Washington, DC 1999 (Refer to Section 3.2, “Fuel Systems”).



Notes:
1. The tank manufacturer should be consulted for recommendations for anchorage and installation.
2. This figure shows a tank installation where subsurface water may be present.
3. Anchor straps for FRP tanks are available from the tank manufacturer and are custom fitted FRP straps. Some FRP tank manufacturers recommend steel cable top of FRP straps for wet hole installations.
4. Steel tank manufacturers recommend flat steel straps with insulation material between the strap and the tank to electrically isolate the tank and protect the integrity of the cathodic protection. Steel tank manufacturers prohibit the use of steel cable or round steel bars for steel tanks.
5. Strap connection details shown are typical for any tank. Consult the specific tank manufacturer for recommendations.

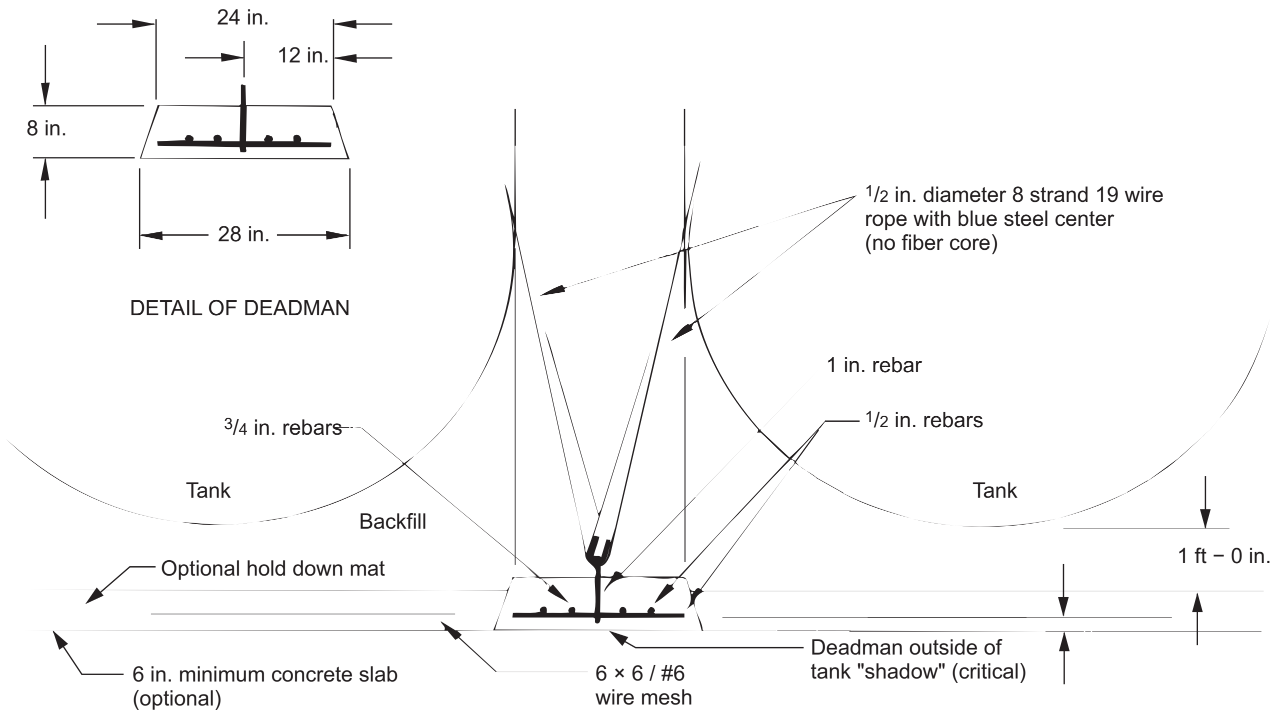
Figure 12—Typical Anchorage for Underground Storage Tanks

b) Deadmen—Anchoring the tank to deadmen (long reinforced concrete beams) buried on either side of the tank. Deadmen must be placed outside the shadow (that is, vertical plane) of the tank.

10.3.3 When anchor straps are required, the straps shall be installed in accordance with the manufacturer's instructions. In general, anchor straps should be firmly secured to anchor points with threaded turnbuckles, or with properly installed steel cables and clamps (note that all cables and clamps should be protected from corrosion).

10.3.4 Straps must be snubbed down before backfilling, and care taken to prevent damage or tank deflection from over-tightening. Anchor straps should not elongate excessively under service conditions because the tank could lift up and that could disrupt the piping connections.

10.3.5 Straps must be electrically isolated from the surface of steel tanks. Therefore, straps may be: constructed of nonmetallic and nonconductive materials; encapsulated in a dielectric material; or, isolated by placing a nonconductive material between the tank straps and the surface of the tank.



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5. Strap connection details shown are typical for any tank. Consult the specific tank manufacturer for recommendations.

Figure 13—Typical Anchorage for Underground Storage Tanks

10.4 Ballasting

10.4.1 Underground tanks can be ballasted to prevent flotation of the tank during installation or during construction. Ballasting should be done after the tanks are installed and backfill has been placed around the tank (see Section 11).

10.4.2 For all FRP tanks, it is recommended that the height of the ballast in the tank not exceed the level of backfill around the tank. For both FRP and steel tanks, at no time during the backfilling process should the height of the ballast in the tank exceed 1 ft above the level of backfill around the tank because tank damage is possible (refer to the manufacturer's recommendations).

10.4.3 Water ballast should be the first choice with a new tank installation; however, submersible pumps should not be installed until after the water ballast is removed (refer to the manufacturer's recommendations). Consult the AHJ for proper disposal of water ballast.

10.4.4 When product is used as ballast, care is required in handling, controlling inventories, and safeguarding against fires, accidents, and thefts. All fill caps and pumps should be kept locked when the system is unattended. If product is used as ballast, the contractor must follow all regulations applicable to operating a UST system.

10.4.5 The tanks must always be vented to the atmosphere in accordance with NFPA 30. Tanks should never be completely capped/sealed as temperature changes, etc. may result in excessive pressures that could damage a tank.

(See also Annex A—"UST System Installation Checklist" for items discussed under Section 10.)

11 Backfilling

11.1 General

Backfilling operations should be continuously supervised by a qualified person to ensure that only specified materials and installation methods are used. It is the responsibility of the contractor to provide assurance to the UST owner and operator that the backfilling operation meets all regulatory requirements and any requirements specified by the tank and piping manufacturers.

Unless the excavated material from the UST installation is specifically examined and approved for use per the tank manufacturer's recommendations, it should not be used as backfill. Contaminated soil may be treated on site, removed, and disposed of according to applicable regulations. Refer to API 1628.

11.2 Pipe Tightness Test

Before the contractor commences pipe backfilling activities, piping should be isolated from the tanks and subjected to a pneumatic tightness test. Piping should be subjected to a second tightness test after paving activities have been completed. Refer to 13.8 for the correct procedure.

11.3 Placement of Materials and Compaction of Backfill

11.3.1 General

The backfill material must be free of ice, snow, debris, and any organic material that might adversely affect compaction or damage the tanks, tank coating, and/or lines. The AHJ may require inspection of the backfill prior to use. Filter fabric can be installed within the excavated areas before installing the backfill material to help protect the compaction of the backfill and impede migration of soil fines into the backfill. This is most important when installing a tank in a wet hole with a high water table.

NOTE Pea gravel size and shape should comply with ASTM C-33, Section 9.1 and the requirements of the tank manufacturer (see Figure 14).

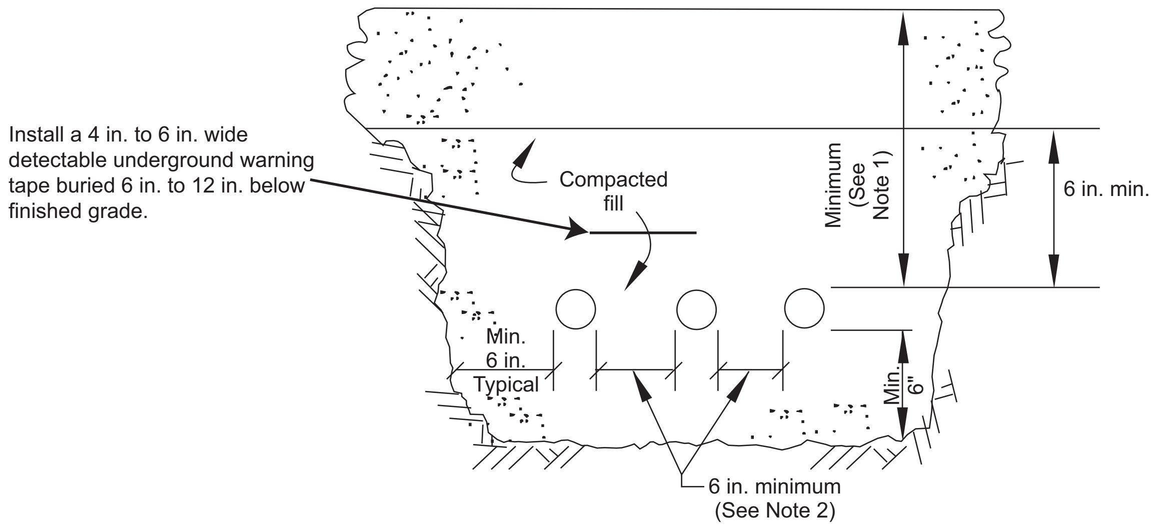
11.3.2 Underground Piping

A bed of well-compacted backfill at least 6 in. deep, or as recommended by the manufacturer, should be placed in the base of the trench. The bed must be free from ice, snow, debris, and organic material. All trenches should be sized to permit piping clearance in keeping with the manufacturer's recommendations and applicable codes. Check with the piping manufacturer for approved materials for use in backfilling the piping trenches. It is also recommended that a 4 in. to 6 in. detectable underground warning tape be buried 6 in. to 12 in. below the finish grade and above the piping.

11.3.3 Underground Tanks

11.3.3.1 Steel and Steel-Composite Tanks

Backfill for steel and fiberglass-clad steel tanks should be well compacted, as recommended by the manufacturer, and the backfill bed for all tanks should be 6 in. deep on top of the hold-down pad or the bottom of the excavation. A minimum of 18 in. of backfill (or the amount required by the manufacturer) should be placed between all tanks and at the ends and sides of all tanks. Multiple tanks should be installed at least 24 in. apart. All bedding material, backfill around the tanks, and covering over the tanks (see 8.4) should be of the same material.



PIPING BACKFILL AND BURIAL DETAILS

Notes:
1. For paved areas 12 in., for unpaved areas 18 in., over any pipe. Refer to NFPA 30 or the manufacturer's recommendations or applicable codes.
2. This is the recommended pipe spacing dimension to give ample workspace, but may not reflect all applications.

Figure 14—Piping Backfill and Burial Details

11.3.3.2 Fiberglass-reinforced Plastic Tanks

The backfill bed for FRP tanks should be 12 in. deep on top of the hold-down pad or the bottom of the excavation. A minimum of 24 in. of backfill should be placed between all tanks and at the ends and sides of all tanks (or the amount required by the manufacturer). All bedding material, backfill around the tanks, and covering over the tanks (see 8.4) should be of the same material.

NOTE The combined depth of backfill overburden and mat above the tanks should not exceed the manufacturer's recommendation without prior consultation with the manufacturer. Burial depths greater than 5 ft for steel tanks or 7 ft for fiberglass tanks must be reviewed and approved by the equipment manufacturer and possibly the AHJ.

11.3.3.3 Compaction of Backfill for All Tanks

It is especially important that the bottom quadrant of all tanks (both FRP and steel) be evenly and completely supported. The backfill material should be carefully placed along the bottom and under the sides and end caps of the tanks by manual shoveling and tamping. The backfilling may then be completed in 12-in. lifts, uniformly placed around the tanks. When self compacting pea gravel is used, after the first two 12-in. lifts, placing the remaining material in 12-in. lifts is not required. Care must be taken to avoid damage to the tanks or their coating.

11.4 Covering

The cover over the tanks (e.g. concrete, asphalt, etc.) will vary depending on the type of traffic over the tanks and the possible tank float-out conditions. In areas that are not subject to traffic, the cover should consist of a minimum of 24 in. of backfill, or a minimum of 12 in. of backfill plus at least 4 in. of reinforced concrete. The thickness and compressive strength of the concrete and design of the reinforcing shall meet the minimum requirements for engineering design defined in ACI 318-05.

In areas that are subject to traffic, the cover should consist of one of the following options (see Figure 15):

a) a minimum of 36 in. of well-tamped backfill;

b) a minimum of 18 in. of well-tamped backfill, plus at least 6 in. of reinforced concrete;

c) a minimum of 18 in. of well-tamped backfill, plus at least 8 in. of asphaltic concrete.

(See also Annex A—"UST System Installation Checklist" for items discussed under Section 9.)

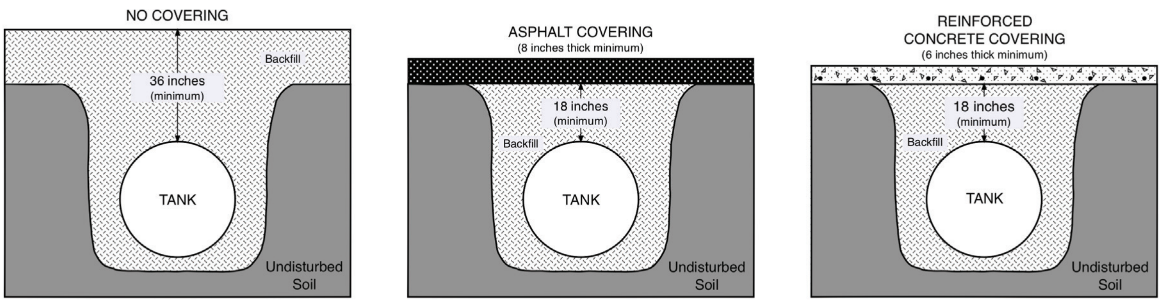


Figure 15—Depth of Covering Over Tanks and Excavation

11.5 Grading and Paving

Caution—Extreme care should be taken during final grading operations to avoid damage to piping and equipment by heavy tractor blades and cleats. Equal care should be taken when stakes are driven for grading or paving to avoid damage to piping and an underground release of product. Upon completion of any grading or paving, it is recommended that an additional tightness test of the product lines be performed to attempt to identify any damage that may have occurred to the product lines.

11.6 Post-backfill Inspection of FRP Tanks

After backfilling has been completed but before concrete or asphalt paving has been installed, the inside vertical diameter of FRP tanks should be measured and compared with the same dimension measured prior to installation as recommended in 9.2.5. This is to determine that tank deformation resulting from backfilling does not exceed the manufacturer's specifications. The diameter measurements should be retained permanently for future reference. Some tank manufacturers may require the UST owner to document and submit this information for warranty purposes. The UST owner should verify this requirement with the tank manufacturer (see Figure 9 and 9.2.4).

Caution—Tanks should not be entered for any purpose unless the proper safety precautions, as outlined in API 2217, are carefully followed.

12 Pumping Systems Design

12.1 General

Consideration should also be given to the type of pumping system to be used in conjunction with the underground tanks and piping because of the potential impacts to piping design and leak detection. The most common system in use in the U.S. is a pressure pumping system.

12.2 Pressure Pumping Systems

12.2.1 In a pressure pumping system, a submerged pump is located in the tank. This permits the use of a single product line from each submerged pump to the dispensers on the pump islands which in turn allows more efficient distribution of product in situations where several fueling positions per product grade exist. Pressure pumping systems are recommended by this RP.

12.2.2 The pump manufacturer or a competent filling station engineer should be consulted regarding tank and piping design requirements of the pressure pumping system. Generally, the tank diameter and the length of piping between the pump and the dispenser are not as critical as with suction piping systems. However, larger diameter piping, variable speed turbine pumps and/or multiple turbine pumps should be considered if there will be more than four dispensers (eight fueling positions) per turbine pump.

12.3 Suction Pumping Systems

12.3.1 A suction pumping system consists of one or more suction pumps located within each dispenser, with individual product suction lines running from each pump to each tank. Some installations connect one pipe to each pump, while others, like high-speed diesel pumps, may require two pipes for each pump.

12.3.2 When a suction pumping system is used, the height to which the pumps can lift the product is a critical design factor. The tank diameter, tank burial depth and the length of product piping between the tank and the pump should therefore be kept to a minimum. This is especially important in warmer climates and at higher altitudes where either condition can noticeably limit pump lift capability. These restrictions required tank placement close if not under the dispensers. This then restricts locations of tank fills, or promotes the use of remote or offset fills, as direct fills may be under the canopy, which may cause traffic conflicts

12.3.3 There are two primary types of suction pumping systems distinguished by the location of the check ("foot") valve. The European type locates the check valve at or near the dispenser pump. The European suction system will allow product to flow back to the tank in the event of a leak in the piping system, but it requires air eliminators at the base of the dispenser which can lead to minor releases, as the air is push out of the pipeline prior to metering. The American or "standard suction" type locates the check valve at or near the tank. This keeps the suction line full and eliminates the need for air eliminators. Due to these multiple concerns, cost of installs when applied to large scale U.S. sites and lack commercial choices in equipment selection suction pumping system is not recommended by this RP.

12.4 Other Factors

Other factors to be considered in the selection and installation of pumping systems include the following.

a) Pump seals and materials of construction must be designed for and be compatible with the liquids handled. Possible future changes in product components should also be taken into account.

b) The remote submerged turbine pump motor inlet should extend so that it is no closer than 4 in. to the bottom of the tank or to the level recommended by the pump manufacturer.

c) For pumping systems, an impact valve, with the shear section level with the top of the island (± $^{1}/_{2}$ in.), must be installed in each product pipe serving each dispenser (see NFPA 30A). Double poppet or secondarily contained double poppet impact (shear) valves should be considered for additional safety.

12.5 Tank Fittings

12.5.1 Prior to purchasing tank fittings, the number, size, and spacing of tank openings needed should be considered. Some of the more frequent uses for tank openings are as follows:

a) automatic tank gauges (ATGs),

b) manual gauging (gauge stick),

c) fill line,

d) vent line,

e) lines to each suction pump or for a submerged turbine pump

NOTE Four suction pumps require four suction lines in most cases, additional tank bung fittings may be required.

f) stage I vapor recovery line,

g) stage II vapor recovery line,

h) siphon connection line,

i) manway,

j) tank interstice monitoring.

12.5.2 Tank openings, fill pipes, fill caps, and fill tubes should normally be at least 4 in. in diameter. Submersible pumps designed with the capacity to meet the normal layout and operation requirements of service stations are built to fit 4-in. tank openings. If greater pumping capacity is needed, larger pumps and tank openings may be required.

12.5.3 Double-tapped bushings may be used to reduce the size of the tank opening so that appropriate smaller hardware can be attached.

NOTE Nonmetallic tanks are fitted with threaded steel openings to facilitate hardware/piping connections.

12.5.4 Fill pipes may be located at any opening in the tank. The tank manufacturer should be instructed to install reinforcing plates (strike plates) under fill and gauge openings, at a minimum, in all tanks to prevent possible damage to the tank bottoms.

12.5.5 All fill connections should be of a tight fill design, including a liquid-tight fill cap, with locking capabilities. A drop tube should be inserted at the fill opening and should extend to within 4 in. to 6 in. of the tank bottom. The use of tight fill connections and drop tubes will increase the rate of product flow during filling and decrease turbulence and product vapor loss.

12.6 Identification of Driveway Manways

The product being handled and the size of the tank should be marked on the fill assembly or manway cover. The product can be identified by using a color code (see API 1637) and/or by stamping or otherwise applying the product name to the fixed portion of the fill assembly. ID collars can be installed under the street lids of the tank slab fill access points. It may also be helpful to install 4 in. × 4 in. reflective markers to help identify the fills. These can be color coded per API standards, and epoxied to the concrete. In some markets, brass id tags may be required to be fix next to the fills

NOTE Some state and local jurisdictions have specific identification requirements.

(See also Annex A—"UST System Installation Checklist" for items discussed under Section 12.)

13 Piping

13.1 General

Historically, many of the piping failures and product releases have occurred because of corrosion of steel pipe and non-metallic pipe being incompatible with fuel and underground conditions in addition to improperly installed piping or damage to piping during construction or remodeling work. Consequently, it is important to be familiar with the permits and regulations for installation, testing, and operation of piping systems. This includes identifying and following the requirements of any recommended practices referenced by local, state or federal UST regulations. The installation of all piping shall meet the requirements of NFPA 30, Chapter 3, and NFPA 30A, Chapter 5.

There are several kinds of piping systems available for petroleum service. This recommended practice covers the following systems most commonly installed:

a) fiberglass-reinforced plastic (FRP), per UL 971;

b) flexible and semi-flexible plastic piping and hybrid steel/plastic pipes per UL 971;

c) coated steel, cathodically protected.

NOTE In general this RP does not recommend coated steel, cathodically protected pipe on new installations.

13.2 Layout and Design

13.2.1 A carefully planned, clearly detailed layout should be prepared for each installation (see Figure 17). A properly planned layout will ensure that pipe run length is minimized, operation is efficient, and maintenance is manageable. If the location of pipe runs is changed from that shown on the installation drawings, the actual location should be noted on as-built drawings. Photographs of the underground installation, prior to backfilling, may be taken and retained as part of the permanent records for that location. Final measurements should be made of the piping runs and noted on the as-built drawings. This provides a permanent record that can be referenced to verify correct programming of automatic line leak detection systems and ensure proper functionality of those systems (see Figure 16). It is also recommended that a 4 in. to 6 in. detectable underground warning tape be buried 6 in. to 12 in. below the finish grade and above the piping.

13.2.2 Underground piping from tanks to dispensers should be sized to accommodate site requirements. In determining size, consideration must be given to the length of runs, desired flow rates, the number and size of pumps, and the number of dispensers to be served. Install piping in accordance manufacturer's instructions. It is recommended that the underground piping drain back to the tanks.

13.2.3 Underground vapor return lines (if required) must have a uniform (no low spots) slope of not less than $^1/_4$ in. per ft down towards the tank (see Figure 17).

13.2.4 It is occasionally necessary to install more than one storage tank for a given product. Such tanks may be interconnected by means of a siphon connection or manifold downstream of the pumps. Care must be taken that all joints in the siphon manifold are tight. It is recommended that any screwed or non permanent joint be installed in secondary containment.

Pressure pumps are available with a siphoning attachment that can be connected to a siphon manifold. This permits one pump to draw the contents from two or more interconnected tanks (see Figure 19). The pump manufacturer's

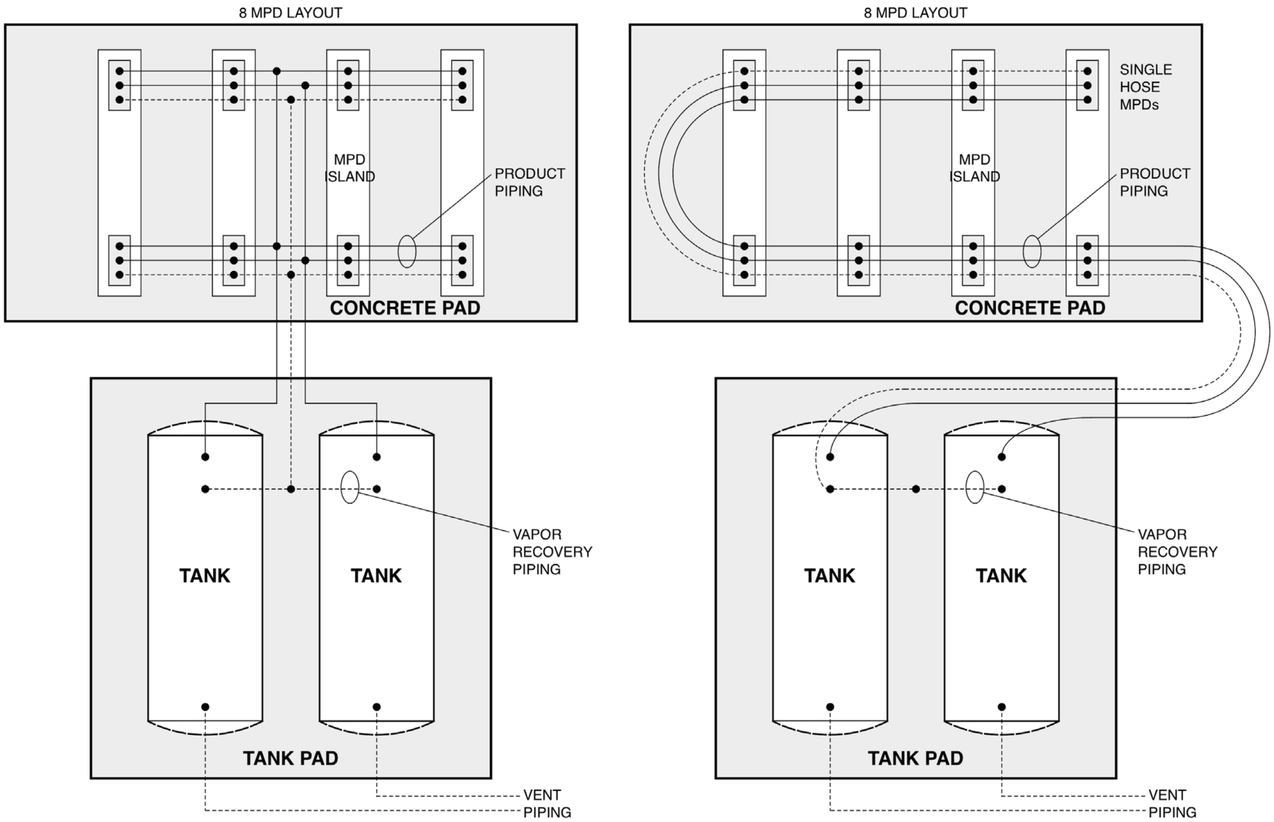


Figure 16—Typical Piping Configurations

installation instructions should be followed. Siphon piping is typically 2 in. in diameter. Siphon piping need not have secondary containment, but this RP recommends secondary containment.

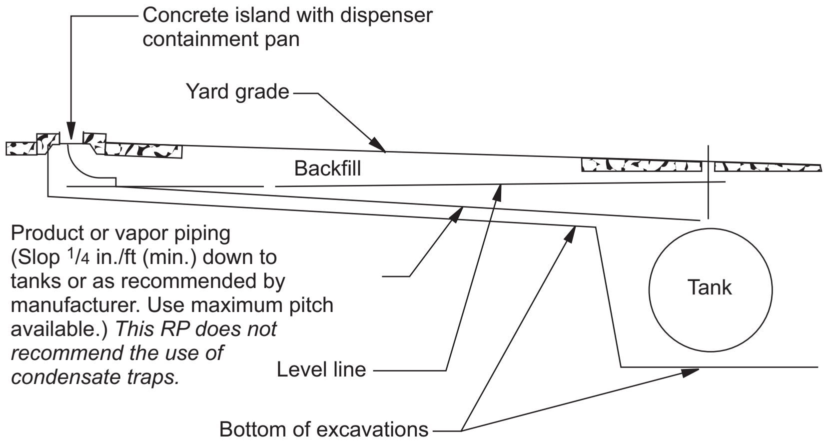
If it is necessary to connect tanks of different diameters at a new installation by means of siphons, both the tops of the tanks and the ends of the suction piping in each tank should be at the same elevation, or slope the siphon line $^{1}/_{4}$ in per foot back to the passive or siphon tank.

NOTE Siphons may complicate testing tanks for tightness. Some AHJs may require that the siphon be disabled during tightness testing. Some jurisdictions prohibit siphoned tanks or may have other installation requirements (e.g. the installation of a ball valve in the siphon piping to allow for separate testing of each tank).

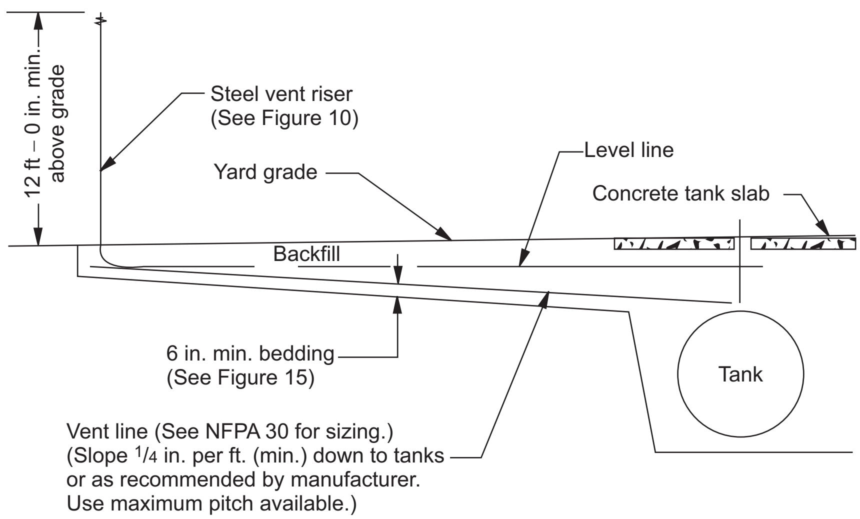
13.2.5 The advent of blending dispensers has resulted in the increasingly common practice of manifolding two or more tanks together via their product lines. The piping is manifolded down-stream from the submersible turbine pumps. Piping manifolds should be contained in a secondary containment sump for ease of access in case of repair or maintenance. Typical manifold arrangements are shown in Figure 18.

13.2.6 Whenever piping is manifolded together, it is important to carefully follow any requirements specified by the manufacturer of line leak detection equipment. It is the responsibility of the contractor to bring questions regarding manifold design to the attention of the line leak detector manufacturer and the UST System owner or operator. Improper design of the piping manifold can result in malfunction or abnormal operation of line leak detection equipment.

13.2.7 Remote Fills. This RP does not recommend the use of remote fills.—Additional care must be exercised when designing and installing a UST system that will use remote fills. These extra steps should include sloping the lines $^{1}/_{4}$ in. per foot back to the UST, secondary containment, leak detection, and a means to drain the spill buckets.



(A) PRODUCT & VAPOR PIPING



(B) VENT PIPING

Figure 17—Piping Slope Details

The use of a common riser for measuring fuel inventory with a remote fill is not recommended by this RP. If a common riser pipe is used for the remote fill piping and for the gauge stick to measure the level of fuel in the UST, a means for preventing the delivery of fuel to the UST when the level reaches 95 % of the total volume of the tank must be provided.

13.3 Vent Piping

13.3.1 The vent piping for all tanks must be adequately sized per the requirements of NFPA 30. This is necessary to prevent excessive pressure build up while the tank is being filled or emptied.

13.3.2 Vent piping should be at least 18 in. below grade in unpaved areas and a minimum of 12 in. below grade in paved areas. Vent piping should slope uniformly down toward the tank at no less than 1/4 in./ft, and the piping must be laid to avoid sags or traps in the line in which liquid could collect (refer to Figure 19). It is recommended that rigid or CARB approve pipe only be used for vent and vapor piping

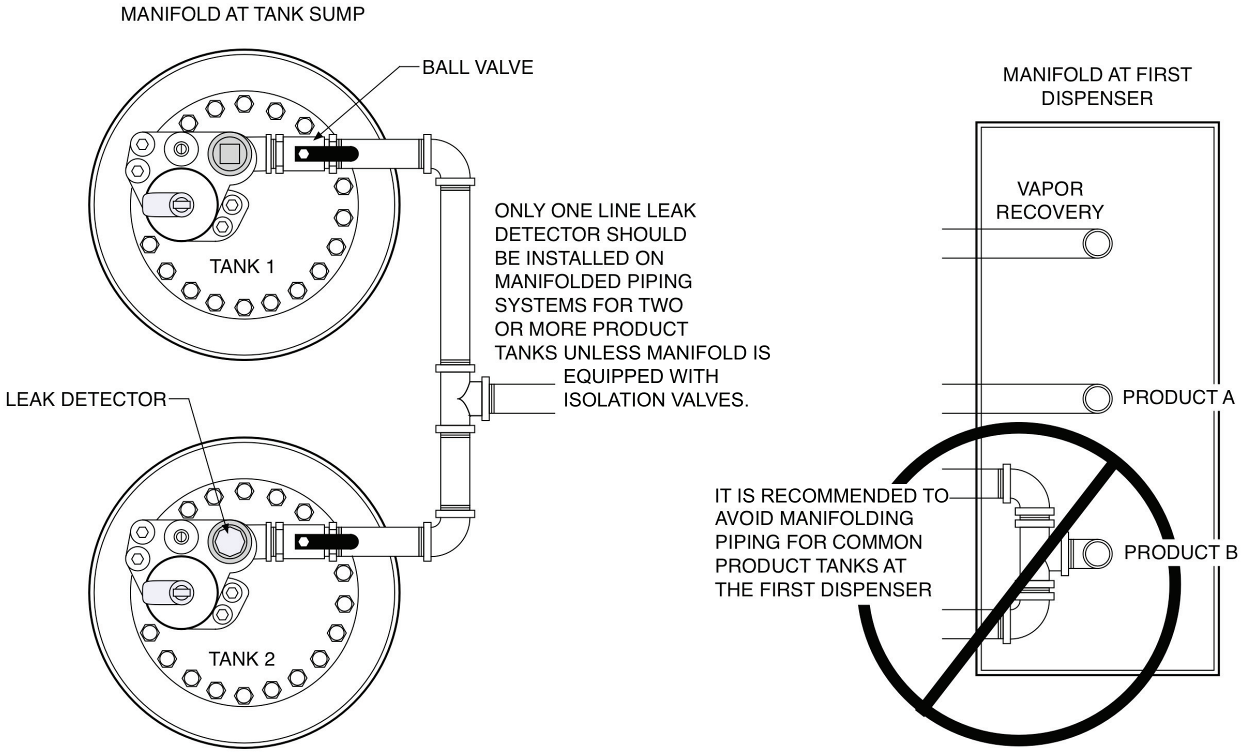


Figure 18—Piping Manifold Configurations

13.3.3 Aboveground vent piping should conform to following recommendations.

a) Composed of Schedule 40 galvanized steel.

b) Located, or protected and anchored, to prevent damage from traffic and other sources.

c) FRP and flexible piping should not be used aboveground unless specifically designed for and engineered for above ground use.

d) Vents should be installed with a vertical support. It is not recommended that vents be attached to building or car washes. It is not recommend that tank vents be routed up through canopy columns, and vent above dispenser canopies.

e) Vent outlets should be located to prevent flammable vapors from reaching confined areas, building air-conditioning and/or ventilation intakes, or potential ignition sources.

f) Vent outlets must discharge upward, and the discharge point must be no less than 12 ft above the adjacent ground. It is also required in some markets that the top of vent be 12 ft above the highest tank fill.

g) Where required by local ordinances or special conditions, rain shields or other special devices may be required (see NFPA 30A, Section 5.6). It is recommended that Pressure vacuum (P/V) valves be used even when not required AHJ. P/V valves can reduce odors and stock loses. Also, P/V provide some additional protection from fires, by acting as substitute flame arrestor.

   Also, it is recommend that API 1626 be consulted for recommendations on P/V valves and flame arrestors for ethanol fuels and gasoline/ethanol blends.

   P/V valves should be listed for the product stored.

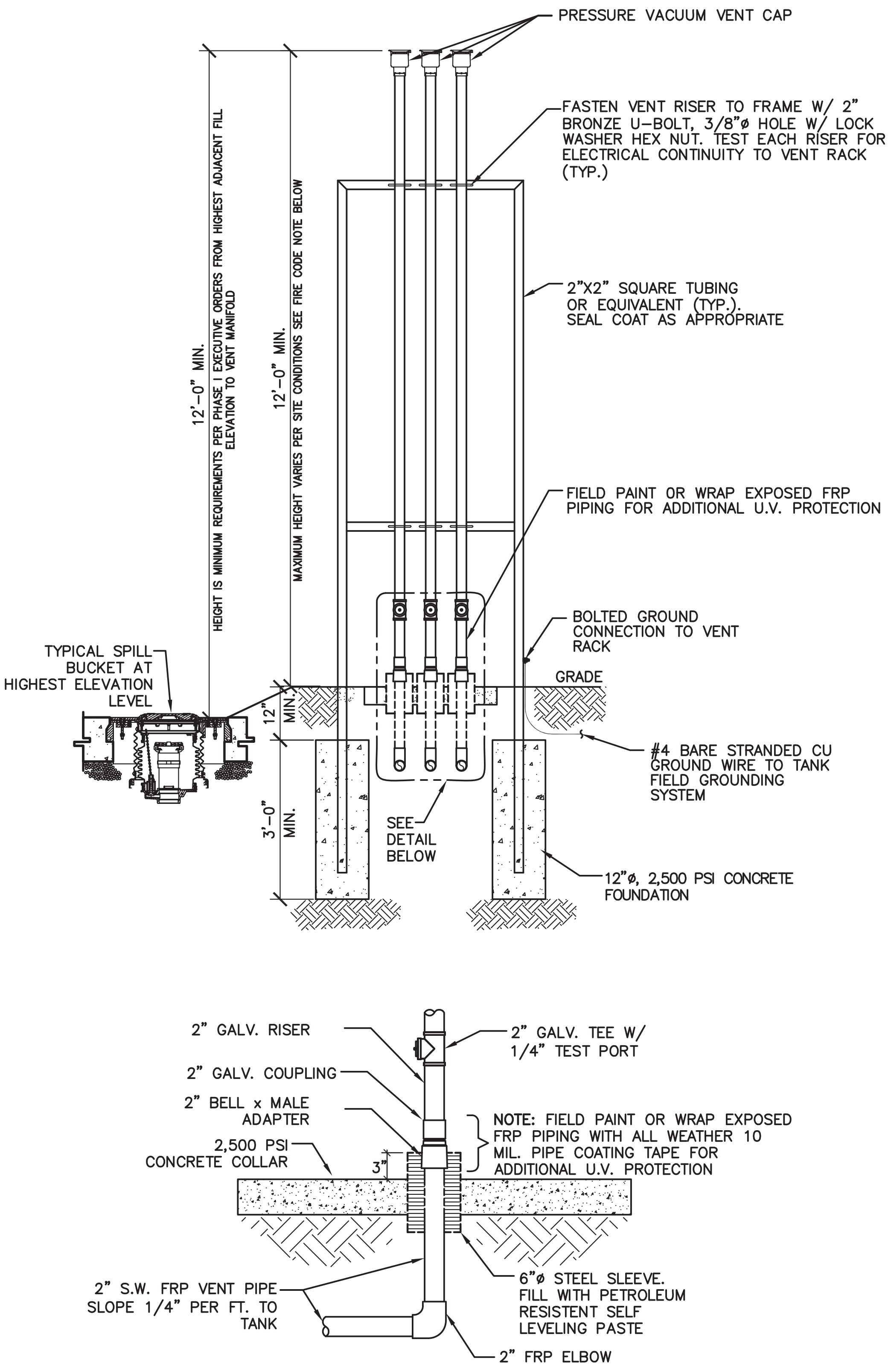


Figure 19—Typical Vent Piping Details

13.3.4 Pressure/Vacuum (P/V) Vent Valves—P/V vent valves must be installed and operated on storage tank vent pipes in accordance with 40 *CFR* Part 63. P/V vent valves installed at any retail gasoline dispensing facility with a monthly throughput equal to or greater than 100,000 gal. must conform to the following recommendations:

a) positive pressure setting between 2.5 in. and 6 in. of water and a negative pressure setting between 6 in. and 10 in. of water;

b) combined leak rate at new, reconstructed, or existing retail gasoline outlets shall not exceed 0.17 ft^3/h at a pressure of 2 in. of water and 0.63 ft^3/h at a vacuum of 4 in. of water.

13.3.5 There must be a means of support for anchoring and/or attaching a device (e.g. a ladder) to access the P/V valve located at the top of the aboveground vent piping. The aboveground vent piping should be of sufficient structural strength to support the additional weight of the device for accessing the P/V valve and of the individual accessing the P/V valve with tie-off gear (see Figure 19).

13.4 Fiberglass-Reinforced Plastic (FRP) Piping

13.4.1 Any FRP pipe used in an underground petroleum installation should be listed for the products to be stored, including alcohols, and alcohol/gasoline mixtures. FRP piping must meet the requirements of UL 971.

13.4.2 Pipe and fittings connections should conform to the following recommendations:

a) be fully inserted and properly aligned;

b) use adhesive that is listed for use with the specific product (supplied only by the pipe manufacturer);

c) properly cure the adhesive used at the connection, practical attention should be made in lower temperatures.

NOTE Procedures are given for curing of adhesive bonded joints at ambient temperatures below the recommended minimum in the manufacturer's installation instructions. These typically involve electrical heating blankets or chemical heat packs.

Caution—If hydrocarbons are present in the area, caution should be exercised in the use of electric heat collars for curing joints.

13.4.3 FRP piping from different manufacturers should not be mixed at a site due to possible violations of the product's listing. However, connection to steel can be done with connective adapters. This is useful when transiting to steel pipe at vents, pumps or dispensers (such as NPT male and female threads).

13.5 Steel Piping

Underground steel piping should conform to the following recommendations.

a) Composed of Schedule 40 galvanized steel.

b) Be cathodically protected (see API 1632).

c) Tees, elbows, unions class 150 / PN 20 ASTM A 197 malleable iron.

d) Steel pipe nipples class 150 / PN 20 ASTM A 53.

e) Steel pipe class 150 / PN 20 Schedule 40 ASTM A 53.

f) A thread sealant certified for petroleum service should be used for all fittings. If other liquids are to be stored in the UST system (i.e. methanol, ethanol, MTBE, biodiesel blends, etc.), sealants certified for use with those substances should be used.

13.6 Flexible and Semi-flexible Plastic Piping

13.6.1 Any flexible or semi-flexible plastic pipe used in an underground petroleum installation must be compatible with the products to be stored, including alcohols, alcohol/gasoline blends, and biodiesel mixtures. Flexible and semi-flexible piping must be UL listed.

13.6.2 Flexible plastic piping is shipped in straight lengths or in coils. Semi flexible plastic piping is shipped in straight lengths only. The pipe joints may be hydraulically swaged fittings, mechanical barbed fittings, or fusion welded to the pipe. The pipe and some joints may be directly buried or installed in a non-corrosive duct or conduit pipe. Duct pipes may allow the pipe to be removed and replaced in the future without digging up the site. Threaded connections are used at the end of the pipe to connect to steel pipe threads at the pressure pump, shear valve or suction pump connections.

13.6.3 Flexible or semi-flexible plastic piping must be installed in the excavation trench and backfilled using only clean material (e.g. pea gravel or sand that is not contaminated with petroleum product). Verify that the backfill material meets the manufacturer’s specification. See 11.3.2

13.6.4 Care must be taken that all piping bends for flexible plastic piping meet or exceed the minimum radius requirements specified by the manufacturer to avoid kinking in the piping.

13.6.5 There should not be any damage to the exterior surface of the outer piping wall. Any piping with cuts, breaks or lighter colored marks, indicating prior overbending or “kinking”, in the outer surface must be replaced with undamaged piping.

13.7 Pipe Connections

13.7.1 General

Underground FRP and steel piping and vent lines, as well as loosening of steel pipe fittings, can be minimized by the proper use of flexible joints or use of 4 ft offsets as allowed under NFPA 30, and by properly engineered pipe layouts. Flexible joints, if installed, should be installed in both FRP and steel lines at points wherever differential movement may create a problem, including where piping connects with the underground tanks and where the piping ends at the pump islands and vent risers. See also 13.6.1. It good practice not to directly bury any flexible connector. It is recommended to design in secondary containment for these devices.

13.7.2 Steel Piping

In steel piping, manufactured flexible connectors are recommended. The use of swing joints or double swing joints in any future installations is not recommended.

13.7.3 Fiberglass-reinforced Plastic Piping

FRP piping can be used to create its own flexible connection if at least 4 ft of straight run (for up to 2-in. diameter piping) is provided where piping connects at the underground tanks and where piping ends at the dispenser islands and vent risers. In lieu of the minimum length straight run, commercially available flexible connectors that are certified for petroleum service, as described in 13.6.1, may be used under dispensers, suction pumps, pressure pumps and tanks, and where vents go aboveground. Normal FRP fittings may be used at other routine directional changes in pipe runs.

13.7.4 Flexible Connectors

Commercially manufactured flexible connectors can be made of metallic and non-metallic materials and are available in various sizes and lengths. Flexible connectors made of nonmetallic material does not require cathodic protection. However, if the flexible connector is made of metallic materials, corrosion protection will be required. Although many commercially available flexures offer a corrosion protection boot, cathodic protection may be necessary. It is recommended that manufactured flexible connectors be installed in secondary containment, like tank sumps, UDC's or transition sumps. Installs using secondary containment will in most cases negate the requirements for cathodic protection for flex connectors.

13.8 Pipe Tightness Testing

The pipe manufacturers' recommendations should be followed for piping tightness testing during the installation process (see Figure 20). Any conflict that may exist between the manufacturer's recommendations and engineering specifications should be resolved prior to administering the tightness test. Other testing methods may also be acceptable if approved by the AHJ. A typical construction pipe test is conducted as follows.

a) The product piping to be tested is isolated from the tank, pump and dispenser and pressurized using water, or compressed air or inert gas to 150 % of the maximum system operating pressure (or a minimum of 50 psig; maximum as recommended by the component manufacturer) for a minimum of 30 minutes [see 40 *CFR* Part. 280.44(b)].

NOTE A pipe or tank should not be tested with air if the pipe has previously contained fuel.

b) All piping surfaces, including valves, fittings, and joints, are wetted with a soap solution and inspected for bubbles.

c) Leaks, as indicated by bubbles, are repaired or replaced, and the piping retested as necessary.

d) If double wall piping is used, the inner pipe walls shall be tested for tightness before closing the outer pipe. The outer pipe must be tested between 5 psig minimum and 30 psig maximum, or per the manufacturer's requirements, before backfilling. Care should be taken to prevent over-pressurization of the interstice.

NOTE When the piping is installed and operational, a hydrostatic test of the piping, as specified in NFPA 329, or 40 *CFR* Part 280.44(b) may be required by codes.

Caution—Extreme care should be exercised in conducting the pipe tightness test. Pressurized piping is potentially dangerous because of the possibility of violent rupture. This test should be conducted with minimum exposure of personnel and without moving or disturbing the piping being tested. When the test is completed, the piping pressure can be reduced or released completely for the remainder of construction. Refer to the piping manufacturer's recommendations for safe procedures.

(See also Annex A—"UST System Installation Checklist" for items discussed under Section 13.)

14 Overfill Protection and Spill Containment

14.1 Spill and overfill protection are required by 40 *CFR* Parts 280.20(c) and 280.30(a). It is the responsibility of the UST owner and operator to ensure that releases due to spilling or overfilling of the UST during the delivery process do not occur. If a spill or overfill does occur, it must be contained.

14.2 Various methods and types of equipment have been developed to prevent spills and overfills from occurring during the transfer of product into the UST, as well as notify the transfer operator of the occurrence of either condition. The design and performance of this equipment varies from manufacturer to manufacturer. Equipment must be installed in accordance with the manufacturer's requirements. This RP recommends using spill and overfill protection methods which have been approved by the NWGLDE.

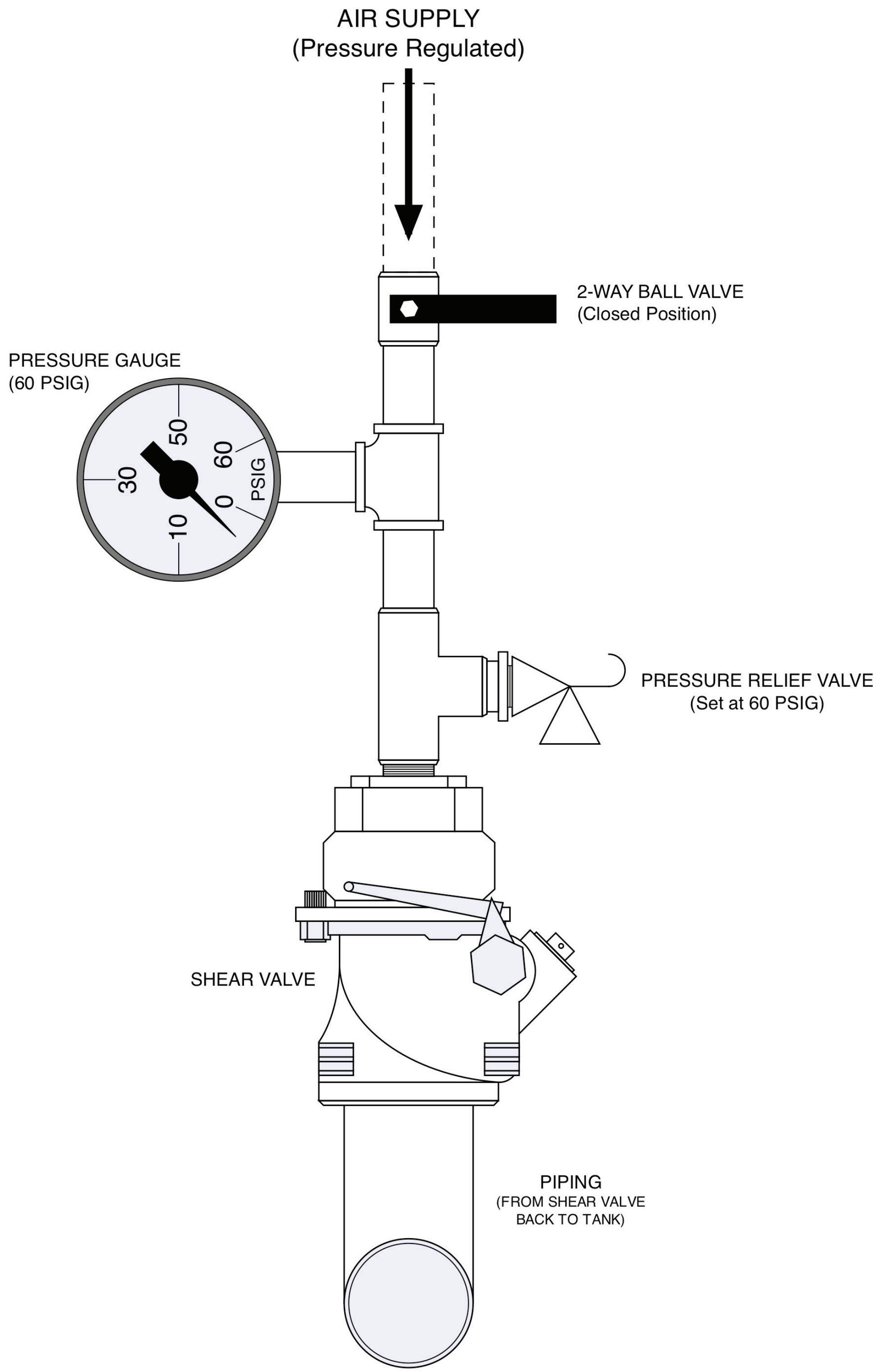


Figure 20—Typical Piping Tightness Test Gauge Setup

14.2.1 Spill Containment—Each fill port must have a spill bucket installed below-grade or grade-level. Manufacturers provide spill containers in numerous configurations including single-wall and double-wall for secondary containment. Regardless of the type or configuration, these containers must be constructed of materials that are compatible with the product being stored in the UST. The capacity of spill containers can vary by manufacturer, but should be no less than 5-gals capacity. A few markets required larger buckets and local requirements should be confirmed prior to final design (see Figure 21A and Figure 21B). It is recommended that spill buckets be double wall. It is also recommended that spill buckets be provided for Stage One vapor connections.

Figure 21A—Typical Spill Containment Device

14.2.2 Overfill Prevention—Overfill equipment must be installed that will meet one of the following criteria:

a) The equipment must automatically shut off the flow of product from the delivery tanker into the UST when the level of product in the tank reaches 95 % of capacity.

b) The equipment must alert the transfer operator when the tank reaches 90 % of capacity. This must be accomplished by either triggering an audible high-level alarm, or by restricting the flow of product into the UST.

NOTE The UST owner and operator does not have to install spill and overfill prevention equipment if the UST system is filled by transfers that do not exceed 25-gal at a time. For additional information about options and requirements see also API 1621.

Current technology can be separated into three categories: ball-float valves, flapper valves, and in-tank alarms. All overfill device components that come into contact with a regulated substance must be compatible with that substance. The UST designer should obtain documentation from the manufacturer that certifies the device is compatible for use the substances stored in the UST and will continue to function under normal operating conditions throughout the operational life of the UST system.

14.2.2.1 Ball-float Valves—These devices operate on the principle of buoyancy to slow-down the continued delivery of product into the UST.

Ball floats are no longer recommended as means of overflow protection. However, they can still be used to help prevent wetting of vent and vapor lines with product.

A ball-float valve is constructed of a short tube with a ball in a cage or disk float at one end. The opposite end of the tube is mounted inside a fitting that is threaded into the bung located along the top of the tank used for attaching the vent pipe to the UST. This fitting is commonly referred to as an "Extractor Fitting" and allows for the removal of the

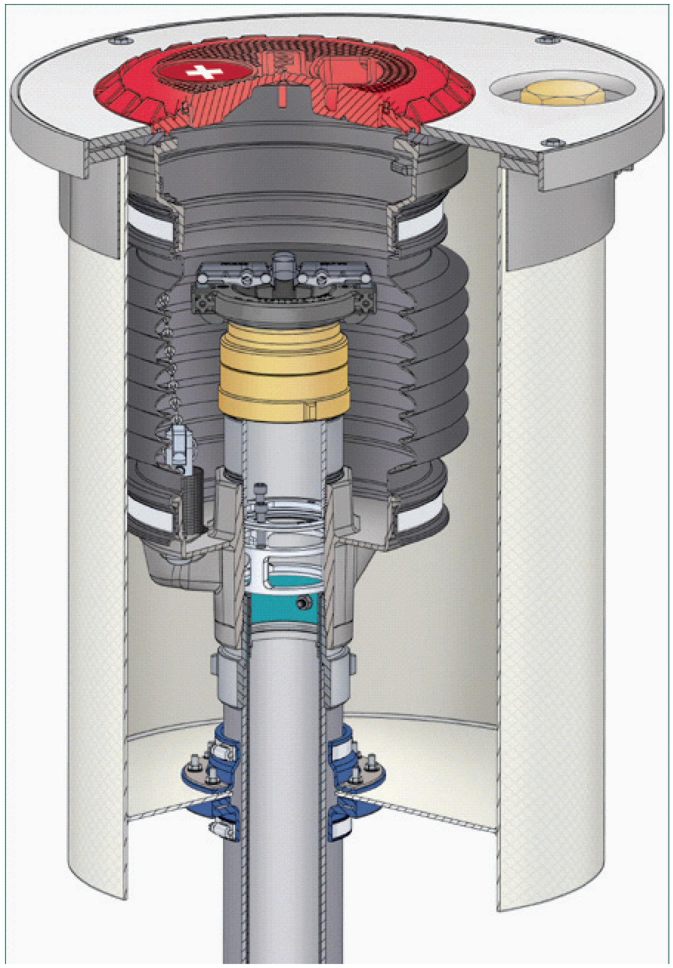


Figure 21B—Typical Overfill Spill Containment Detail with Secondary Containment

ball-float valve assembly from the UST for inspection, repair and maintenance, and tightness testing purposes. Install ball-float valves per the manufacturer's instructions.

The hollow ball of the ball-float valve assembly is designed to float on the surface of the product. The ball is larger in diameter than the inside diameter of the tube (usually between 2 in. to 4 in.) so that it cannot slide inside the tube. If the product level in the tank rises to the level of the ball float, the float will rise with the fluid and eventually close off the vent opening. When this occurs vapors are blocked from escaping through the vent valve (except for a small pressure relief hole), allowing the vapor pressure inside the tank to reach the point where it overcomes the head pressure of product contained in the delivery hose. When this happens the delivery hose will suddenly jump or twitch due to the hydraulic shock that occurs when the ball-float seals against the vapor pipe. This action alerts the delivery driver that the tank is full of product to 90 % capacity. The AHJ may allow an alternative setting for the ball float valve that meets the 30 minute rule. That valve will close off the vent at slightly more than 95 % of tank capacity. See manufacturer's instructions for properly sizing vent vales for the 30 minute rule.

NOTE In a "pressure fill" situation, the system can become over-pressurized.

The use of a ball-float valve requires that all entry points (e.g. fill riser, tank probe riser, vent riser, etc.) into the UST are air tight. Any leaks will render the ball-float valve ineffective at preventing an overfill of the UST. Ball float valves must not be installed in USTs that have the following equipment and/or configurations:

a) the delivery process requires the use of a pump,

b) suction pumps with air eliminators,

c) coaxial Stage I vapor recovery system.

14.2.2.2 Flapper Valve Positive Shutoff Device—The positive shutoff device is a mechanism comprised of a float attached to a flapper valve to operate as follows. During the delivery process, as the level of product exceeds 90 % of the tank capacity, the float begins to rise. As the float rises it begins to move the flapper valve into the product delivery flow stream. At some point between 90 % and 95 % of capacity the float pushes the flapper valve sufficiently far enough into the flow stream that the downward force of the product flow closes the valve against its valve seat. When this happens the flow of product into the tank is immediately reduced to approximately 5 GPM. The closure of the valve occurs so quickly as to cause a slight hydraulic shock. This shock causes the delivery hose to “jump” alerting the delivery operator that the tank is 95 % full.

If the delivery operator fails to cease filling after the hose “jumps”, then the flapper-valve will close 100 % when the level of product in the tank reaches approximately 98 % of capacity. The valve remains closed so long as there is fill line pressure greater than the height of the tank truck hose valve. The positive shutoff device contains a very small bypass hole to allow product to drain from the delivery hose into the tank. When the level of product in the tank drops low enough to allow the float to hang free, the weight of the float pulls the flapper valve open to its normal position (see Figure 22). Install flapper valves per the manufacturer’s instructions.

NOTE Flapper valves are mandated in some markets.

Caution—The use of a positive shutoff device (e.g. flapper valve) may be rendered inoperative by inserting a stick or other tool into the valve mechanism to physically keep the valve open during the delivery procedure. If discovered, the tool should be removed from the valve mechanism and the positive shutoff device inspected by a qualified technician to verify that it is functioning properly. If the device has been damaged it should be replaced immediately.

NOTE Flapper valves should be used with caution in applications that involve the use of pumped deliveries into the tanks because damage can occur to the flapper valve assembly.

Figure 22—Typical Flapper Valve

14.2.3 Audible Alarms—If one of the above methods is not used to restrict or stop the flow of product into the tank, an audible alarm must be used to alert the delivery operator that the level of product in the UST has exceeded 90 % of capacity. Configurations of audible alarm systems are too numerous to address in this document. Audible alarms must be able to generate a sound of sufficient noise level (decibels) and distinction so that it can be readily heard and understood by the delivery operator and other facility personnel.

Some audible alarms are equipped with a flashing light to enhance the ability of the device to alert personnel that the UST is more than 90 % full. Selection of an audible alarm is dependent upon the method of overfill prevention selected by the UST owner. Depending upon the distance of the USTs from the facility building, more than one audible and visible alarm may be needed or required. Audible or audible/visible alarms should be located near the delivery area and in such a position as to be readily visible by the delivery operator. Given the limitations of ball floats and flapper valves, designs should consider proper application of audible alarms as primary means of overfill protection.

14.2.4 The lifecycle of devices described above have not been determined with any degree of certainty. The UST owner and operator should develop and implement a plan for the periodic inspection of these devices to assure they continue to functioning properly. It is the responsibility of the UST owner and operator to comply with any regulatory requirements concerning the regular inspection and repair of overfill protection and spill prevention devices.

15 Corrosion Protection

15.1 General

Corrosion protection is required by means of a cathodic protection system by 40 *CFR* 280.12, 280.31 and 280.33 for all parts of an UST system that are:

a) constructed of metal,

b) in contact with the ground, and

c) routinely carry product.

NOTE 1 This RP recommends construction of new UST systems that do not required cathodic protection. UST systems constructed of non-corrosive material (e.g. fiberglass or steel fiberglass-reinforced-plastic composite) do not required corrosion protection.

NOTE 2 corrosion expert may certify that corrosion protection is not necessary for any UST system.

15.1.1 Cathodic protection systems must be designed, operated, and maintained in accordance with recognize and generally accepted good engineering practices.

NOTE 1 Cathodic protection systems operate more efficiently with properly coated or wrapped steel tanks and piping.

NOTE 2 The design of a cathodic protection system must take into account the potential for stray-current effects due to electrical utilities and/or equipment located on or near the facility where the UST system is to be installed and operated (see Figure 23).

15.1.2 There are two types of systems of cathodic protection: the impressed-current system and the sacrificial-anode system. Impressed-current systems are typically installed on new or existing UST systems that need to be upgraded to meet regulatory requirements for corrosion protection. Refer to API 1632, Section 4 for impressed current systems, and API 1632, Section 3 for sacrificial anode systems.

15.1.3 The installation of a cathodic protection system shall be done in accordance with the requirements of API 1632, NACE RP0169 and NACE RP 0285.

NOTE Federal and state regulations require that a corrosion expert design field-installed cathodic protection systems.

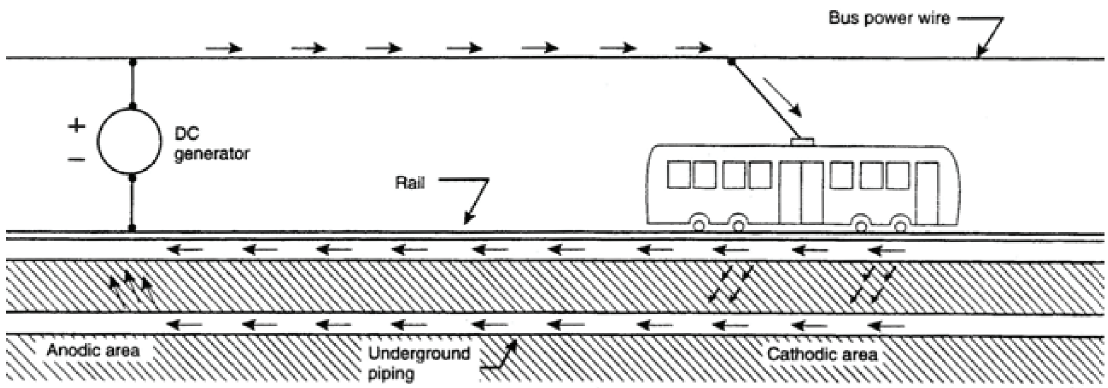


Figure 23—Stray Current Corrosion

15.2 Sacrificial Anode System

15.2.1 A sacrificial-anode system protects steel equipment by managing the flow of underground electrical currents. Sacrificial anodes are electrically connected to the steel equipment and are constructed of a more reactive metal than steel. Any underground electrical currents will corrode the more reactive sacrificial anode and prevent the steel equipment from corrosion. (see Figure 24).

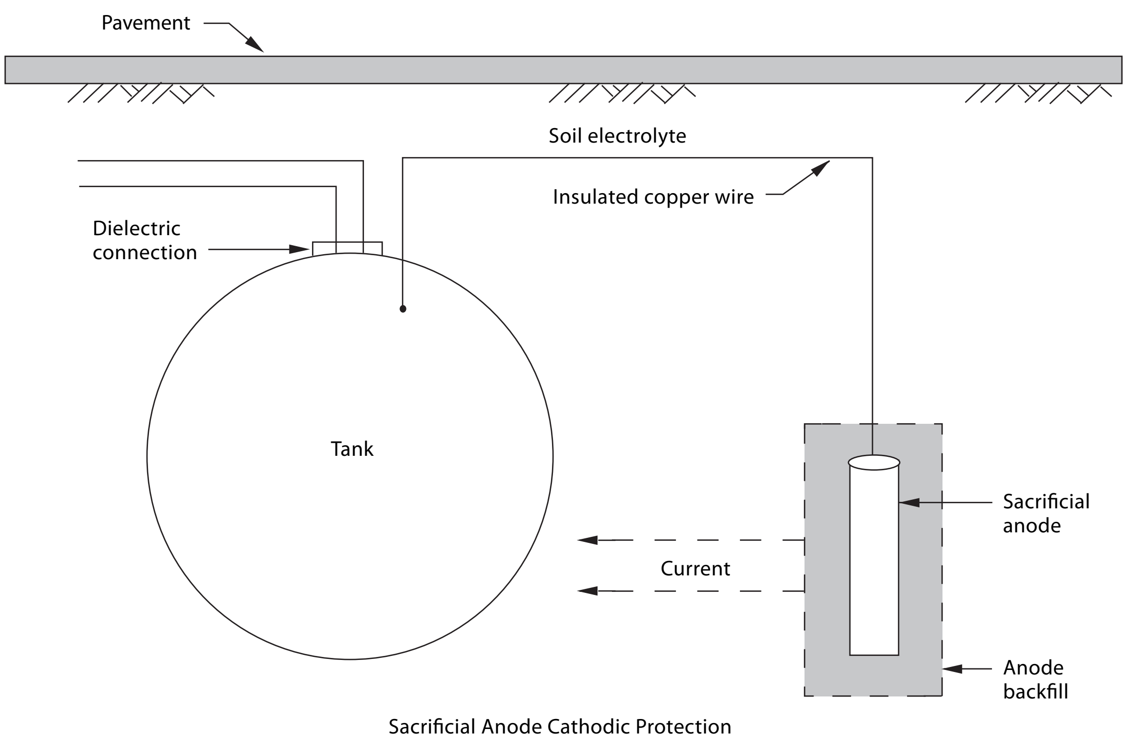


Figure 24—Sacrificial Anode Cathodic Protection

15.2.2 Pre-engineered, cathodically protected steel tanks are delivered to the site ready for installation. These tanks will be properly coated, with sacrificial anodes electrically connected to the tanks.

15.2.3 If pipes or fittings are to be protected separately from the tanks, electrical isolation between tank and piping is necessary. Piping may be protected separately by field-installed sacrificial anodes which must be designed by a corrosion expert. Refer to the manufacturer's recommendations.

15.3 Testing

15.3.1 Before installation, static, earth grounding, and all corrosion protection equipment should be inspected to ensure that it remains undamaged, that electrical continuity has been maintained, and that the equipment is operating properly. After installation but before the UST system is placed in operation, all equipment should again be inspected and tested by a qualified electrician.

15.3.2 If underground work is performed at the site, grounding and any cathodic protection systems should be tested.

16 Electrical

16.1 General

16.1.1 The installation of equipment and components of an UST system that require electrical power for operation shall comply with the requirements of NFPA 30A, Section 8.3 for Class I, Division 1 locations, and the requirements of NFPA 70 for special occupancies described under Chapter 5 in the following articles:

a) Article 500—Hazardous (Classified) Locations,

b) Article 501—Class I Locations,

c) Article 504—Intrinsically Safe Systems,

d) Article 514—Motor Fuel Dispensing Systems.

16.1.2 This RP recommends that careful attention be paid to proper grounding and bonding of tank fill/stage I pipe, pumps, vent stacks, and dispensers to ensure the proper and safe operation of equipment.

See typical detail for vent stack (see Figure 19).

16.2 Equipment Selection

16.2.1 All electrical wiring and electrical equipment shall be listed for the location in which it is installed per the requirements of 16.1.1. The selection of electrical wiring, conduit, emergency disconnects, junction boxes, sealing, breakers, electrical enclosures, or other electrical components and equipment must be suitable for use with the UST and dispenser systems.

16.2.2 Selection of the components mentioned in 16.1.1 must take into consideration the following aspects: the expected life of the UST and dispenser systems, corrosion protection, mechanical strength and durability, electrical insulation, grounding requirements, electrical load requirements, equipment spacing, and the area classification type. The effects of the environment must also be considered—including temperature and moisture, or other deteriorating agents that may have an effect on the wiring or electrical equipment such as hazardous vapors, fumes and chemicals

16.3 Emergency Disconnects

Emergency disconnects should be located in accordance with NFPA 30A, Section 6.7. They shall disconnect power to all electrical equipment located within the classified area including dispensing devices, remote pumps and all associated power, control, and signal circuits as per NEC 514.11-13. Intrinsically safe sensors or other intrinsically safe equipment does not need to be powered off.

16.4 Intrinsically Safe

The site design or manufacturers of equipment for use in the UST system that require the use of intrinsically safe wiring should provide the installing contractor with a control drawing that details approved interconnections between the intrinsically safe wiring and associated components or equipment.

16.5 Connections

All electrical connections for grounding and cathodic protection must be secure. For new installations where product is not present, and where safety considerations permit, these connections should be powder-weld connections. If necessary, pressure-type grounding clamps or other clamps designed for this purpose can be used. Electrical work must conform to federal, state, and local codes.

Caution—If tanks or lines contain or have contained flammable or combustible liquids, powder welds should not be used.

(See also Annex A—”UST System Installation Checklist” for items discussed under Section 16.)

17 Vapor Recovery

17.1 General

17.1.1 The use of Stage I and Stage II vapor recovery systems is required in some areas of the U.S. The purpose of vapor recovery is to reduce vapor emissions from gasoline dispensing facilities to the atmosphere. There are a variety of different systems or variations that can be used to accomplish compliance with both Stage I and Stage II vapor recovery requirements. Designers should study the cost and benefits of various systems, be familiar with compliance requirements (see Figure 25).

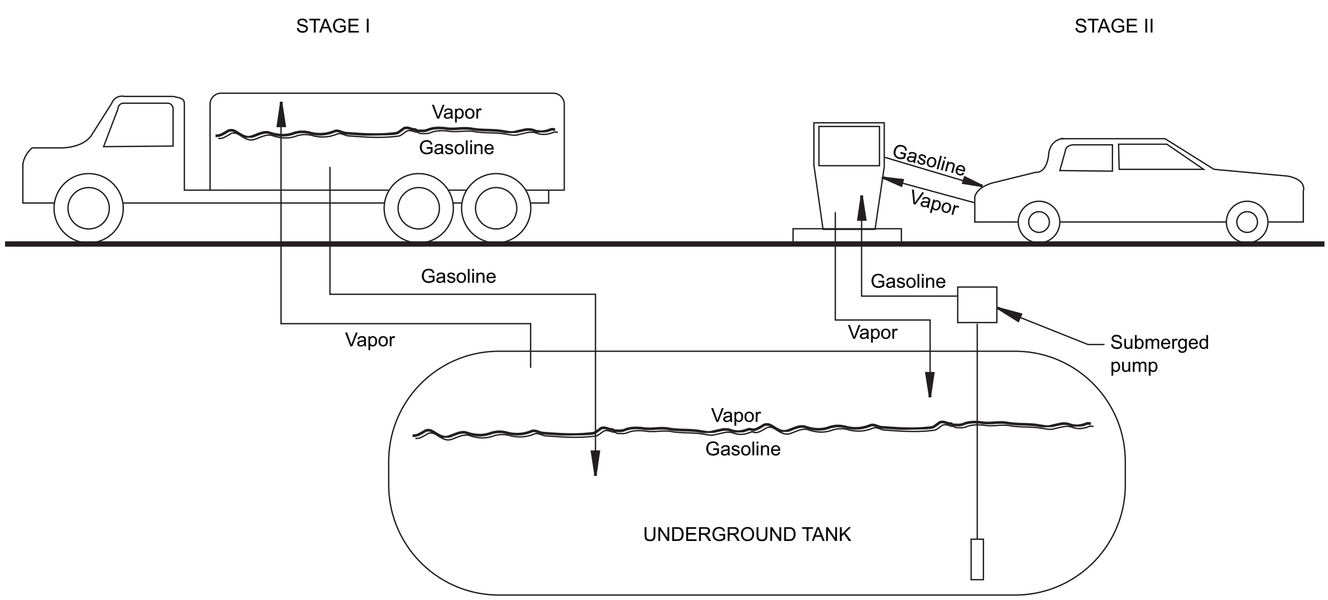


Figure 25—Typical Vapor Recovery System

17.1.2 Stage I Vapor Recovery—This type of vapor recovery is required in specified areas (as designated by the state and or local air pollution control agencies and as required by federal rules) during transfer operations; namely, the unloading of the contents of a transport truck into USTs.

17.1.3 Stage II Vapor Recovery—Vapor recovery may also be required during the dispensing of gasoline into the fuel tank of a motor vehicle. This type of vapor recovery is referred to as Stage II vapor recovery.

17.1.4 Onboard Refueling vapor recovery (ORVR)—This is a system that traps the vapor in the vehicle for eventual reuse. The inclusion of ORVR on vehicles has lead to the decommissioning or removal of Stage II equipment at some locations. See the PEI RP 300 for information on decommissioning Stage II systems.

17.2 Stage I Vapor Recovery

17.2.1 General

In any Stage I vapor recovery balance system, UST vapors are automatically returned to the transport truck when the liquid product is delivered to the UST. The small vacuum created in the transport truck by the removal of liquid during unloading coupled with the increasing pressure inside the UST from the rising liquid level force the vapors through the vapor return line into the transport truck; thus, resulting in minimal vapor discharges from the UST. Three of the most common designs for Stage I vapor recovery balance systems are as follows:

a) two-point balance system,

b) single-point manifold balance system,

c) coaxial balance system.

NOTE The coaxial balance system is not recommended by this RP. The UST owner should contact the AHJ to determine if this type of Stage I vapor recovery system is approved.

17.2.2 Two-Point Balance System

17.2.2.1 The two-point balance system uses a separate Stage I vapor recovery connection point (or Stage I vapor return riser) in addition to the fill-pipe opening in each UST required to have Stage I vapor recovery. These two openings—the Stage I vapor return riser and fill-pipe opening—are usually immediately next to one another.

17.2.2.2 A Stage I vapor return riser extends from the tank top to the surface and terminates in a manway similar to a fill manway. A Stage I vapor pickup adapter is installed on top of the riser pipe to provide a quick-disconnect connection for the transport truck's Stage 1 vapor pickup hose. The vapor pickup adapter must have a spring-loaded poppet valve that is closed when the vapor pickup hose is not connected. A spill bucket is similar to product fill is recommended for the vapor connection.

17.2.2.3 If more than one UST is used to store a single product and only the primary UST has vapor recovery connections, a 3-in. diameter tank vapor manifold is typically provided for Stage I vapor transfer between the USTs.

17.2.3 Single-point Manifold Balance System

The single-point manifold balance system is very similar to the two-point balance system. The primary difference is that, in the single-point manifold system, the Stage I vapor return riser in each UST regardless of gasoline product grade is connected to a tank vapor pipe manifold header. A single (3-in. or 4-in.) riser off the header is brought to the surface where the same adapter and poppet are installed within a manway for each tank. It is common for the tank vapor and Stage II vapors to share the same manifold.

17.2.4 Coaxial Balance System

The coaxial balance system uses one opening in each UST. This opening accommodates both a fill tube and a Stage I vapor return from the UST to the surface in concentric pipes without a wye fitting. At the surface, a special adapter is installed within a manway. A special tight-fill delivery elbow with combination product and vapor conductors must be used with the adapter on the top of the riser. Both the transport-truck fill hose and the vapor return hose are connected to this special coaxial elbow.

This RP does not recommend the use of coaxial balance systems for new installations.

17.3 Stage II Vapor Recovery

17.3.1 When a Stage II system is in operation, car refueling vapors are automatically returned to the UST when product is dispensed into the vehicle fuel tank. The Stage II vapor recovery system collects vehicle refueling vapors through a vapor return line which connects the Stage II dispensing nozzle to the UST. The Stage II vapor line and line sizing from under the dispenser to the UST must be approved by CARB. A common vapor line, manifolded at the tanks, can be used for all gasoline products. This is manifolding is often used for tank vapors and Stage II. Also it is recommended that the Stage II vapors return to the lowest octane product UST first.

NOTE E85 and other high blend ethanol tank or Stage II vapors should not be commingle with gasoline products. See API 1626 for additional details.

17.3.2 Two basic systems are available for Stage II vapor recovery, the balance system and various vacuum-assist systems. The two methods are discussed below:

17.3.2.1 A balance system uses the pressure that develops in the vehicle fuel tank and a small amount of vacuum that develops in the UST to force vapors from the vehicle tank back through the nozzle, coaxial hose, and vapor return piping into the UST without the assistance of pumps or aspirators. Balance system nozzles use a face seal and compressible bellows to provide a tight seal at the vehicle fill pipe. Interlocks prevent the nozzle from dispensing gasoline if the bellows are not compressed. Vapor check valves prevent the escape of vapors from the nozzles when not in use.

17.3.2.2 Vacuum-assist systems utilize vacuum pumps or aspirators to create a vacuum and/or pressure to assist in the collection and movement of vapors back to the USTs. The vacuum producing device is most commonly located in each dispenser. Some vacuum-assist systems use nozzles without the bellows traditionally found on balance systems, while other vacuum-assist systems use nozzles with bellows that are loose fitting and do not require compression before product will flow.

17.3.3 The minimum diameter for individual field installed Stage II vapor return lines is 2 in. Larger sizes are used for manifolds and are typically 3 in., but may be larger base on local codes.

17.3.4 The Stage II system design and installation must allow the vapor return piping to be continuously sloped from the dispenser or island down to the USTs without traps or sags. Any trap or sag in the Stage II vapor return line will provide pockets in which liquid product may collect and restrict the flow of vapor to the UST. This is easily accomplished with careful site layout. If site elevations will not allow proper slope, a dropout tank should be provided. Recognized and general accepted good engineering practices should be used in any drop out tank design, including secondary containment and lead detection. Legacy field fabricated pipe designs should be avoided.

This RP does not recommend the use of dropout tanks for Stage II vapor recovery systems.

17.4 Equipment

Petroleum equipment manufacturers and suppliers can furnish the certified equipment required for Stage I and Stage II vapor recovery.

17.5 System Design

If regulations require the installation of either Stage I or Stage II vapor recovery, professional assistance should be obtained in designing the system. In some areas, vapor recovery and UST systems are regulated by different agencies, and additional permits may be required. For more information on the design and installation of vapor recovery systems, see NFPA 30A and PEI RP 300.

(See also Annex A—"UST System Installation Checklist" for items discussed under Section 17.)

18 Detection of Releases

18.1 General

Release detection of tanks and piping is a requirement of Federal Regulations 40 *CFR* Parts 280.40 through 280.45. All new and existing UST systems must be equipped with a method of release detection that meets the requirements of these sections of 40 *CFR* Part 280 and/or additional requirements of the AHJ. All release detection equipment must be installed in accordance with the manufacturer's instructions.

18.2 Federal Requirements—General

In general, owners and operators of UST systems are required to provide a method or combination of methods of release detection that meet the federal requirements listed as follows.

a) Be included on the list of approved release detection methods in 40 *CFR* Parts 280.43 and 280.44. The equipment manufacturer must provide in writing any performance claims in relation to these requirements.

b) Detect a release from any portion of the UST system that routinely contains product with a Pfa/Pd of 95/5. However, Pfa/Pd does not apply to vapor, groundwater, or interstitial monitoring methods.

c) Owners and operators must notify the implementing agency in accordance with the requirements of Subpart E of 40 *CFR* Part 280, whenever the release detection method indicates a release has occurred.

d) Tanks must be monitored at least every 30-days for releases using one of the methods described in 40 *CFR* Part 280.43. However, the frequency of recordkeeping for release detection results is typically accepted on a monthly basis, which varies slightly from the 30-day cycle for actual release detection monitoring.

e) Be Installed, calibrated, operated and maintained in accordance with instructions and requirements of the manufacturer. This would include any inspection and testing for functionality.

Caution—The UST owner and operator should check with the AHJ to determine whether there are more stringent state or municipal requirements than those listed above or discussed under section 18.3.

18.3 Leak Detection Methods—Requirements

Before an UST system is installed, the owner must decide what release detection method(s) will be used. Any equipment necessary for the method chosen must be included in the design of the UST system and must be properly installed. All release detection methods must be third-party tested and certified that they are capable of meeting the leak detection requirements discussed in 18.4. The following release detection alternatives are allowed by federal regulations (Subpart D of 40 *CFR* Part 280), subject to various restrictions, for newly installed UST systems. Some of these methods may no longer be approved for use in certain states. Refer to state and local AHJ to determine whether there are more stringent requirements than those listed below, or whether a particular monitoring method or combination of methods is no longer allowed for use.

18.3.1 Tank Tightness Testing

A tank tightness test must be capable of detecting a leak rate of 0.1 gph from any portion of the tank that routinely contains product. In addition to tightness testing the owner or operator must also perform monthly inventory control. The tank tightness test must be capable of accounting for other effects during the test. Those effects include: thermal expansion or contraction of the product, vapor pockets, tank deformation, evaporation, condensation, and the location of the water table. *Tank tightness testing is no longer allowed as a method for monthly tank leak detection.* This method had been previously allowed for use with tanks that met the federal performance requirements specified in 40 *CFR* Parts 280.20 or 280.21 and the monthly inventory control requirements in 40 *CFR* Part 280.43(a) or (b). This allowance expired on December 22, 2008.

NOTE It is assumed that at the date of the publication of this recommended practice all new and existing UST systems are in compliance with 40 *CFR* Parts 280.20 and 280.21.

18.3.2 Line Tightness Testing

18.3.2.1 Pressurized Piping—If line tightness testing is used with pressurized piping systems, it must be capable of detecting a 0.1 gph leak rate from any portion of the piping that routinely contains product at one and one-half times the operating pressure [see 40 *CFR* Parts 280.41(b)(1)(ii) and 280.44(b)]. This method must be capable of accounting for other effects during the test, including: thermal expansion or contraction of the product, vapor pockets. This method can be used for the life of the UST systems. Federal regulations [see 40 *CFR* Part 280.41(b)(1)(ii)] require pressurized piping systems that use line tightness testing to be tested annually.

18.3.2.2 Suction Piping—If line tightness testing is used with suction piping systems, it must be performed at least once every 3-years [see 40 CFR Part 280.41(b)(2)]. Suction piping systems can use a monthly monitoring method as an alternative to line tightness testing. However, a monthly monitoring method must be performed in accordance with the approved methods for tanks and must be designed to detect a release from any portion of the piping that routinely contains product.

18.3.3 Manual Tank Gauging

Manual tank gauging can be used as the sole method of leak detection for the life of tanks that have a capacity less than or equal to 550 gals. Tanks having capacities between 551 and 1000 gals using manual tank gauging, depending upon the diameter of the tanks, may also require the use of tank tightness testing as a method of leak detection. Tanks with capacities between 1001 and 2000 gals using manual tank gauging must also use tank tightness testing for the life of the tank. This method is not applicable to piping.

For information about allowable variances in gallons during the testing periods based on tank capacities and test durations, refer to EPA Publication, *Manual Tank Gauging: for Small Underground Storage Tanks*. [Refer to 40 *CFR* Part 280.43(b) for additional requirements.]

18.3.4 Automatic Tank Gauging

Automatic tank gauging must be capable of detecting a 0.2 gph leak rate from any portion of the tank that routinely contains product. In general, inventory control for tanks must also be used with automatic tank gauging, but some states only require the additional use of inventory control if the automatic tank gauging system cannot meet the federal requirements for Pfa/Pd. Refer to 40 *CFR* Part 280.43(d). This RP recommends automatic tank gauging.

18.3.5 Automatic Line Leak Detection

Automatic line leak detectors (LLDs) are required for all pressurized piping systems (see Figure 26). Automatic LLDs must be able to detect a 3.0 gph leak from any portion of the piping at 10psi within one hour. This method must respond to the presence of a leak by restricting or halting the flow of regulated substance through the piping or generate an audible and visual alarm. This RP recommends electronic line leak detections on new construction.

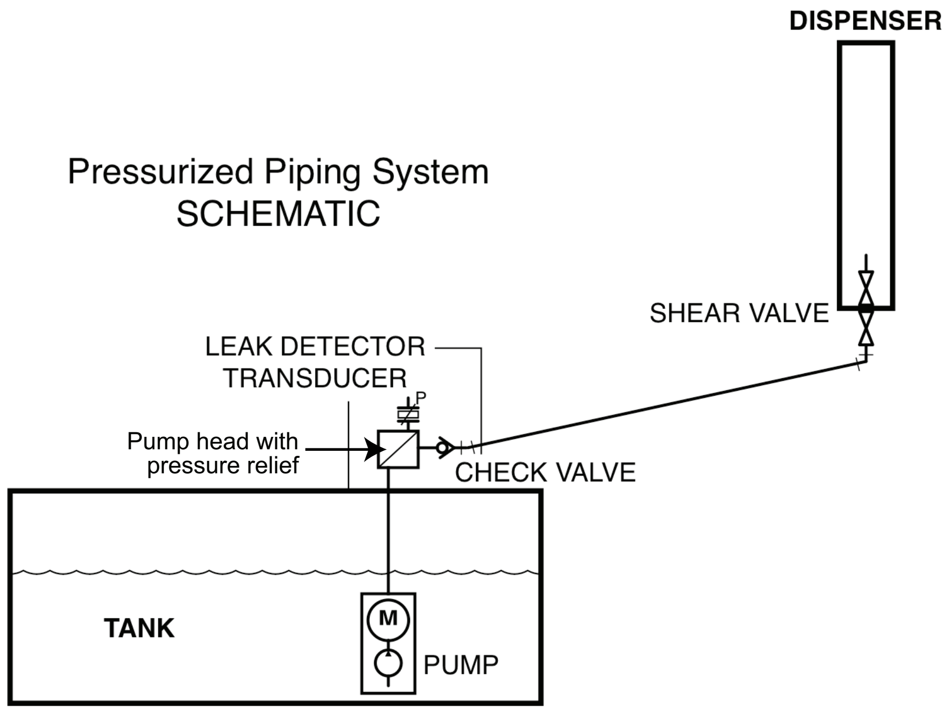


Figure 26—Typical Leak Detector or Pressure Transducer

An annual operational test of the line leak detector must also be performed in accordance with the manufacturer's requirements and meet the federal requirements (40 *CFR* Part 280.44(a)) for line tightness requirements discussed under section 13.8.

NOTE It is recommended that the annual test of a mechanical line leak detector should determine whether it can detect a 3.0 gph leak at 10 psi within one hour. If electronic line leak detectors are used for complying with the 0.1 gph and 3.0 gph leak detection requirements of federal or state regulations, the electronic line leak detectors should be tested to determine whether they can detect a 3.0 gph and 0.1 gph leak. If electronic line leak detectors are not used for complying with the annual 0.1 gph leak test requirements, then the 3.0 gph leak test should be sufficient. (Refer to Figure 27)

18.3.6 Interstitial Monitoring and Secondary Containment

This method can be used for the tank and piping (see Figure 28). Monitoring of the space between (interstice) a secondary barrier that surrounds the UST system must meet the following requirements.

— Double-wall Tanks—Must be capable of detecting a release through the inner wall in any portion of a double-walled tank that routinely contains product. This RP recommends double wall tanks on new installations.

— Double-wall Piping—Must be capable of detecting a release through the inner wall in any portion of double-wall piping that routinely contains product. Piping must also have a line leak detection capable of detecting a leak rate of 3 gph at 10psi within 1 hour and can shut off or restrict the flow of product. This RP recommends double wall product piping on new installations.

— Tanks fitted with an internal bladder and that use interstitial monitoring for release detection. This RP does not recommend internal bladder tanks for release detection.

[Refer to section 40 *CFR* Part 280.43(g), (g)(1), and (g)(3) of the federal regulations for additional requirements.]

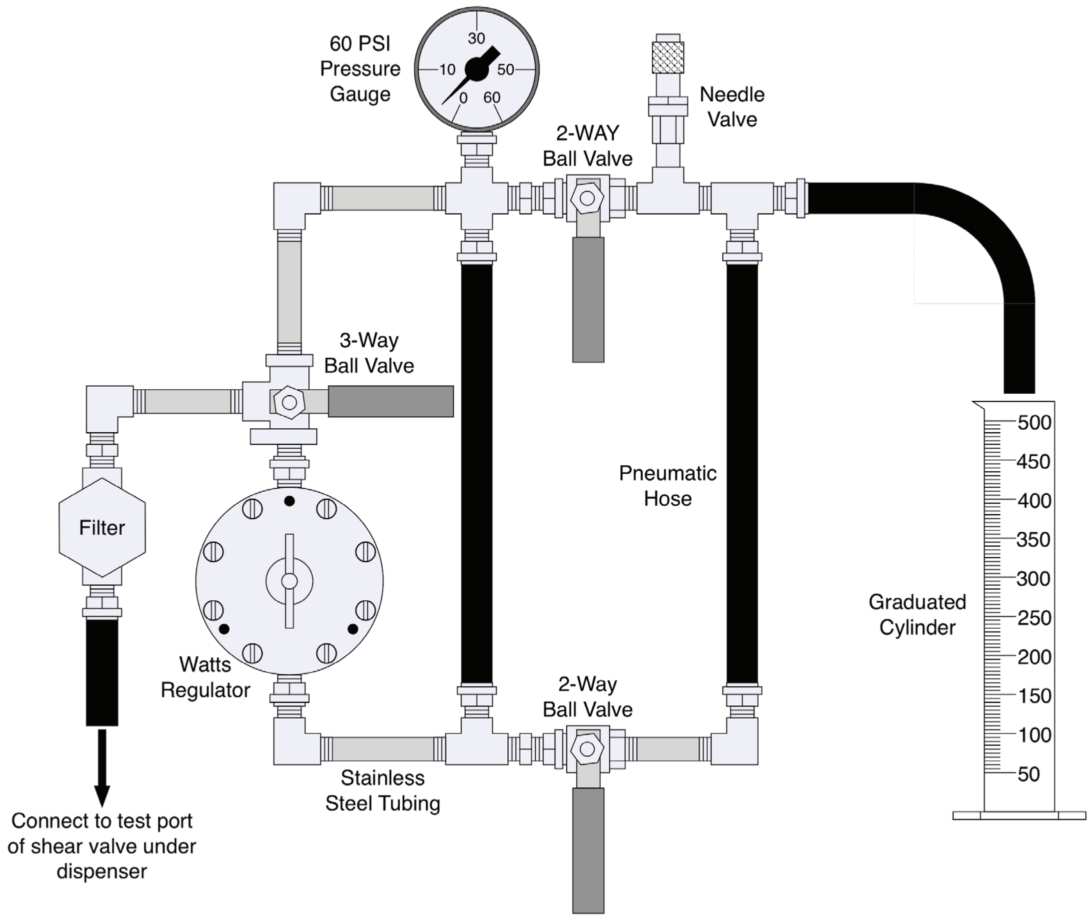


Figure 27—Example of a Functional Test Apparatus for Mechanical Line Leak Detectors

18.3.7 Secondary Barrier

This RP does not recommend that a secondary barrier be used as a method of leak detection.

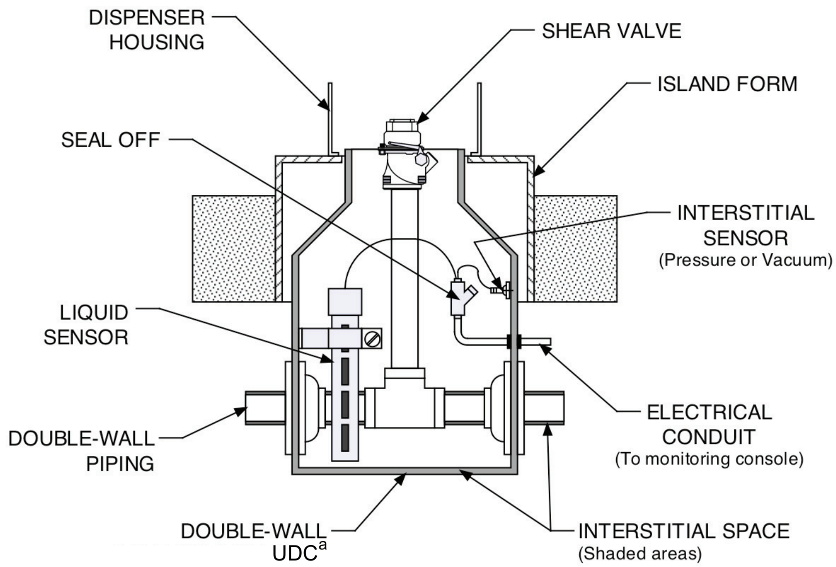
18.3.8 Vapor Monitoring

This method can be used for the tank and piping. It must be able to detect releases into the excavation zone from any portion of the UST system that routinely contains product. Therefore, the materials used for the backfill must be of sufficient porosity to allow for the ready diffusion of vapors from releases into the backfill. However, the presence of vapors from background contamination must not interfere with the ability of the vapor monitoring systems to detect a release from the tank or piping.

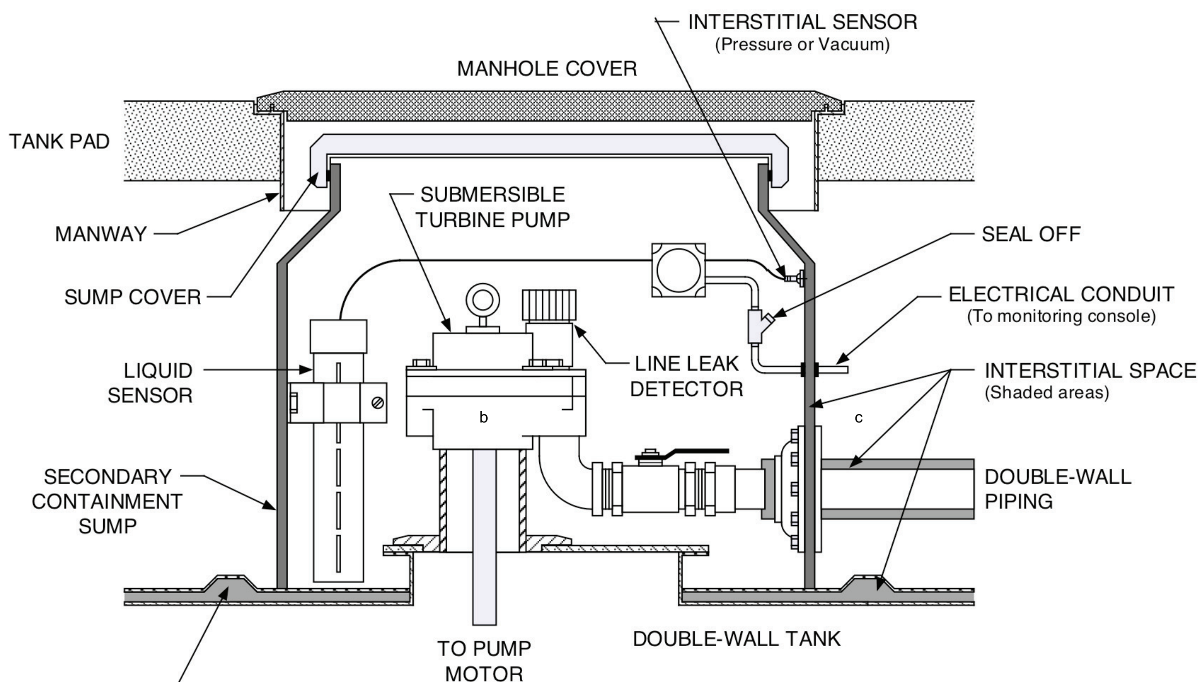
This RP does not recommend vapor monitoring

18.3.9 Groundwater Monitoring

This RP does not recommend that groundwater monitoring be used as a method of leak detection.



DISPENSER SECONDARY CONTAINMENT

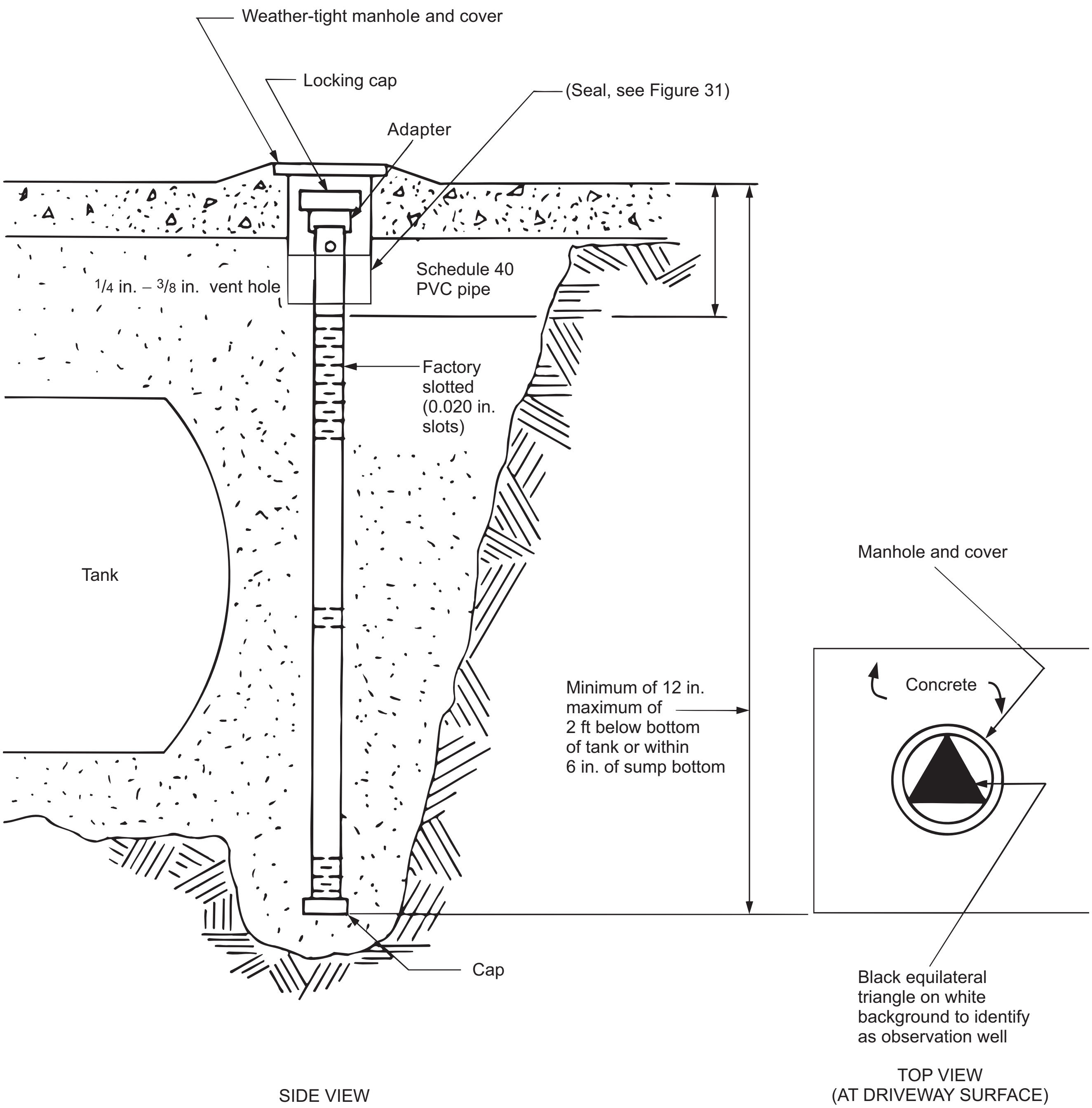


TANK & SUMP SECONDARY CONTAINMENT

THE INTERSTITIAL SPACE OF THE TANK CAN BE MONITORED USING PRESSURE, VACUUM, OR DRY SENSORS FOR BOTH STEEL, FRP AND COMPOSITE TANKS. IT CAN ALSO BE MONITORED USING HYDROSTATIC FLOAT SENSORS FOR FRP TANKS THAT HAVE A BRINE SOLUTION WITHIN THE INTERSTITIAL SPACE.

a Illustrated double wall UDC's are optional, unless otherwise required by State law.
b Pump may also be installed in bung vs Manway.
c Illustrated double wall tank sump is optional, unless required by State law.

Figure 28—Typical Interstitial Monitoring Systems (Tanks, Piping, and Sumps)



Note: PVC = polyvinyl chloride

Figure 29—Typical Observation Well Used Within the Tank Excavation

18.3.10 Other Methods

Other release detection methods than those listed above must be approved by the AHJ after a demonstration by the owner or operator that the method is as effective as the methods allowed under the regulations. An example of such a method is statistical inventory reconciliation (SIR).

For more detailed information on leak detection requirements, refer to 40 *CFR* Part 280, the Energy Act of 2005 (Title XV—*Ethanol and Motor Fuels*, Subtitle B—*Underground Storage Tank Compliance*), and the EPA reports listed in Section 3. Refer to API 1621 for information and procedures for inventory control and manual tank gauging.

18.4 Leak Detection Certification

18.4.1 Third Party Certification that release detection equipment or test methods meet EPA standards must be available in writing from the equipment manufacturer or installer. The owner should obtain a copy of this documentation prior to installing any leak detection method to document compliance with EPA regulations. This documentation must be kept on file to satisfy the EPA's recordkeeping requirement.

Although it is not a federal requirement some states may have the additional requirement that testing results must be reviewed and approved by the NWGLDE. It is recommended by this RP the leak detection devices be approved by the NWGLDE.

18.4.2 All release detection methods must be capable of detecting a release from any portion of the UST system that routinely contains product. Release detection methods must be able to detect a 0.2 gph release with a Pfa/Pd of 95/5 while taking into account the effects of volume change resulting from thermal changes of the product, vapor pockets, tank deformation, and the level of the water table. These requirements do not apply to vapor, groundwater, and interstitial monitoring.

18.5 Technical Considerations

The purpose of this section addresses various technical considerations when selecting an approved method of leak detection. API does not endorse any particular method of leak detection or leak detection equipment or product. The information provided in this section is for reference purposes only. The UST owner or operator should consult with the AHJ and manufacturers of leak detection equipment regarding any performance and/or technical issues prior to selecting a particular method of leak detection or associated equipment.

Compliance with federal or state regulations for release detection does not prevent releases. Release detection methods are designed for early detection and leak mitigation. The UST owner should consider this fact when designing the UST system for installation, and in making the decision to choose specific release detection and/or release prevention technology. The use of release prevention technologies (e.g. double-wall components and secondary containment) can offer a lower risk of contamination to the environment when properly installed, operated, regularly maintained, and carefully inspected.

19 Final Testing

Prior to placing the tank system in operation, the following tests should be conducted:

a) A tightness test of all tanks and piping (primary and secondary) after all paving over the tanks and piping has been completed and before the system is placed in operation. Refer to 9.3, 9.5, and 9.6 for the requirements regarding conducting a tightness test of the tank. Refer to 13.8 for the requirements regarding conducting a tightness test of pressurized piping, and 18.3.2.2 for suction piping.

b) An operational test of all other equipment, including impact (shear) valves, line leak detectors, other leak detection sensors and alarms, ATG setup, and overfill prevention devices, and emergency shutdown switches in accordance with the manufacturer's instructions.

c) A functional 3 gph test should be performed on stand-alone ELLDs or an ATG-ELLD system, if installed, to verify that the system has been properly programmed with the correct data regarding the parameters of the piping system. The recommended procedure for conducting a functional 3 gph leak test provided by the ELLD or ATG manufacturer must be followed. This test can only be performed by an individual who has received the proper certification by the ELLD or ATG manufacturer to conduct such a test. The testing contractor technician must show proof of certification to the UST owner or operator prior to starting the test. Upon completion of the test, the testing contractor must provide documentation to the UST owner and operator certifying that the ELLD or ATG passed the 3 gph functional test and is correctly programmed.

(See also Annex A—"UST System Installation Checklist" for items discussed under Section 19.)

Annex A
(informative)

UST System Installation Documents Checklist
(Check off documents and items as they are obtained and verified correct)

Project Name and Location

Project Name:________________________________ Project #:______________
Address: ____
City:___________________________________ State: _______ ZIP: _______

Engineering Drawings

- ☐ Plat of survey with legal description
- ☐ Site plan and utilities layout that includes any easements, underground obstructions (e.g. building footings)
- ☐ As-built changes, if applicable
- ☐ Location of any required soil borings, monitoring and observation wells
- ☐ Installation workmanship notes and specifications (see "Specifications")
- ☐ Bill of equipment and materials
- ☐ UST system configuration assembly and details that include excavation size, shape and depth
- ☐ Submersible turbine pump and line leak detection equipment and sump details
- ☐ Overfill and spill prevention equipment and sump details
- ☐ Under-dispenser piping and containment sump details
- ☐ Piping layout / manifolding and trenching details
- ☐ Tank siphon details
- ☐ ATG sump details (if different from fill or STP sump)
- ☐ ATG power and intrinsic safe wiring schematic and details
- ☐ UST system equipment electrical wiring schematic and details

Permits

- ☐ Site plan
- ☐ UST registration
- ☐ Construction and demolition
- ☐ Site excavation
- ☐ Hazardous materials use and waste
- ☐ City sidewalk "Right of Way" permit
- ☐ Groundwater runoff and sensitive receptors evaluation
- ☐ Confined space (removal of tanks)
- ☐ Sloping/shoring
- ☐ Tank closure/removal/disposal
- ☐ Air
- ☐ Special use
- ☐ Other ________________________________

Specifications

- ☐ ATG installation specifications
- ☐ Concrete—Mix and compressive strength
- ☐ Backfill material—Pea gravel, sand, etc.
- ☐ Electrical wiring (conduit type, wiring awg, J-box types, seal-off types, etc.)
- ☐ Excavation sloping/shoring details
- ☐ Piping run details
- ☐ CP anodes—impressed current
- ☐ CP anodes—sacrificial
- ☐ Impressed current—Rectifier type and mounting specs
- ☐ Temporary storage requirements for USTs
- ☐ Clean site requirements
- ☐ Tank tightness test requirements
- ☐ Piping tightness test requirements
- ☐ Functionality testing for:
- ☐ ATG probes
- ☐ Line leak detectors
- ☐ Sensors
- ☐ Overfill prevention
- ☐ Spill containment
- ☐ Shear/impact/fire/crash valves
- ☐ Sump tightness

Certifications

- ☐ ATG probe third-party
- ☐ ATG LLD third-party
- ☐ ATG sensor third-party
- ☐ ATG installation certification
- ☐ Mechanical LLD third-party
- ☐ UST installation contractor—State approval certification
- ☐ ATG installation technician certificate
- ☐ ATG setup / programming technician certificate
- ☐ Corrosion protection system
- ☐ Sacrificial anode
- ☐ Impressed current
- ☐ Professional engineer (corrosion protection)
- ☐ Equipment manufacturer material compatibility certificates

Warranties

- ☐ Tanks
- ☐ Piping
- ☐ Submersible turbine pumps
- ☐ ATG components
- ☐ Other Equipment __________________________

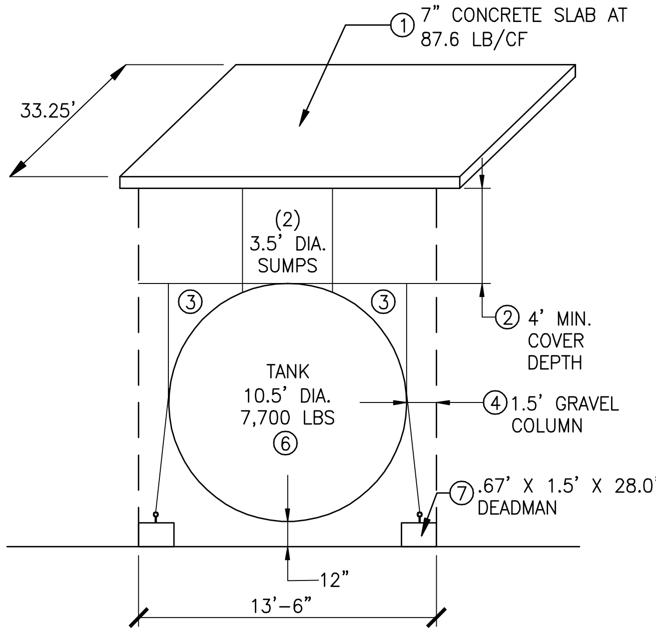
Other

- ☐ Hydro-geological survey
- ☐ Site geophysical
- ☐ Environmental phase I assessment

Annex B
(informative)

Sample Buoyancy Calculation

NOTE Submerged (net) weight represents the gross weights for overburden materials minus the weight of water for the corresponding volume of overburden material. This is necessary because the float out scenario assumes the worst-case conditionoverburden materials are entirely submerged in water. Water weighs 62.4 lb/ft^3 at 32 °F and this value must be subtracted from the gross weights of the various overburden materials.



BUOYANCY CALCULATIONS

CALCULATION BASED ON SUBMERGED WEIGHT OF MATERIALS:
TANK WITH SPHERICAL ENDS, 10.5' O.A. DIAM. (10' NOMINAL)
TANK LENGTH: 29' 2-1/2" TANK DIAMETER 10'-6"
TRY 28'-0" DEADMAN, EACH SIDE, 18" WIDE X 8" HIGH

EMPTY TANK UPLIFT = $\frac{\text{15,000 GAL}}{\text{7.48 GAL./CF}}$ = 2,005 CU FT

2,005 CU FT X 62.4 LBS/CF = 125,112 LBS (DISPLACED WATER)

TANK SUMP UPLIFT = (2) X 3.14 X 1.75'^{2} X 4' = 76.9 CU FT

76.9 CF X 62.4 LBS/CU FT = 4,799 LBS (DISPLACED WATER)

TOTAL TANK UPLIFT = 125,112 LBS + 4,799 LBS = 129,911 LBS ↑

HOLD DOWN CALCULATION

1 TANK SLAB: .58' X 13.5' X 33.25' = 260.4 CU FT
260.4 CU FT X 87.6 LBS/CU FT = 22,811 LBS ↓

2 CUBED BACKFILL ABOVE TANK:
4' X 10.5' X 29.25' = 1,229 CU FT − 76.9 CU FT = 1,152.1 CF
1,152.1 CU FT X 57.6 LBS/ CU FT = 66,361 LBS ↓

3 CURVED BACKFILL ABOVE TANK:
3.14 X 5.25'^{2} X 29.25' = 2,531.5 CU FT
10.5' X 10.5' X 29.25' = 3,224.8 CU FT
3,224.8 CU FT − 2,531.5 CU FT = $\frac{\text{693.3 CU FT}}{2}$ = 346.7 CU FT
346.7 CU FT X 57.6 LBS/ CU FT = 19,970 LBS ↓

4 GRAVEL COLUMN ABOVE DEADMEN:
1.5' X 14.5' X 28.0' X 2 = 1,302 CU FT
1,272 CU FT X 57.6 LBS/ CU FT = 74,995 LBS ↓

5 CONCRETE DEADMEN:
.67' X 1.5' X 28.0' = 28.14 CU FT
28.14 CU FT X 87.6 LBS/ CU FT X (2) = 4,930 LBS ↓

6 DRY WEIGHT OF TANK: 7,700 LBS ↓

TOTAL HOLD DOWN: 196,767 LBS ↓

$\frac{\text{TOTAL HOLD DOWN: 196,767 LBS}}{\text{TOTAL TANK UPLIFT: 129,911 LBS}}$ = 1.51 SAFETY FACTOR

Figure B.1—Buoyancy Calculation—15,000 Gallon Tank

Annex C
(informative)

Optional UST System Checklist

Project Name and Location

Project Name:________________________________Project #:______________
Address: ____
City:___________________________________ State: ______ ZIP: ______

PRECONSTRUCTION and PREINSTALLATION

Contractors–Manufacturers

☐ **Architect**

Name:
Address:
Contact:
Phone:

☐ **General Contractor**

Name:
Address:
Contact:
Phone:

☐ **Piping Contractor**

Name:
Address:
Contact:
Phone:

☐ **Electrical Contractor**

Name:
Address:
Contact:
Phone:

☐ **Tank Removal Contractor**

Name:
Address:
Contact:
Phone:

☐ **ATG Manufacturer**

Name:
Address:
Contact:
Phone:

Authority Having Jurisdiction

☐ **State Implementing Agency**

Name:
Address:
Contact:
Phone:

☐ **Municipal Implementing Agency**

Name:
Address:
Contact:
Phone:

☐ **Municipal Zoning Board**

Name:
Address:
Contact:
Phone:

☐ **County Agency**

Name:
Address:
Contact:
Phone:

☐ **Regional / State EPA**

Name:
Address:
Contact:
Phone:

☐ **Other**

Name:
Address:
Contact:
Phone:

General Contractor—Supervisor: ____Date: ______________________

Project Name and Location

Project Name: ______________________________ Project #:__________
Address: ____
City:________________________________ State: __________ZIP:_______

PRECONSTRUCTION and PREINSTALLATION

Contractor Licenses

UST Installer

Name: ______________________________
- ☐ State # __________________________
- ☐ Municipal # _______________________

UST Remover

Name: ______________________________
- ☐ State # __________________________
- ☐ Municipal # _______________________

Tank and Piping Testing

Name: ______________________________
- ☐ State # __________________________
- ☐ Municipal # _______________________

Master Electrician

Name: ______________________________
- ☐ State # __________________________
- ☐ Municipal # _______________________

Journeyman Electrician

Name: ______________________________
- ☐ State # __________________________
- ☐ Municipal # _______________________

Plumber

Name: ______________________________
- ☐ State #__________________________
- ☐ Municipal # _______________________

Hazardous Substance Removal

Name: ______________________________
- ☐ State #__________________________
- ☐ Municipal # _______________________

Earthwork and Paving

Name: ______________________________
- ☐ State #__________________________
- ☐ Municipal # _______________________

Other Contractors

____
____
____
____
____
____
____
____
____

Documentation

- ☐ Documentation of expected or required specialized training for contractors and operating personnel has been developed and approved.

General Contractor—Supervisor:____ Date:___________________________

Project Name and Location

Project Name: ______________________________ Project #:__________
Address:____
City: _______________________________State: _________ ZIP:_______

SAFETY and HEALTH

Person Having Responsibility

Name: ___________________________________
Phone: ___________________________________
Email: ___________________________________

Certification—Training

- ☐ The person having responsibility has completed and passed a job safety course equivalent to API 1646, *Safe Work Practices for Contractors Working at Retail Petroleum/Convenience Facilities*.
- ☐ Proof of training—Certificate/card

Emergency Response Plan

- ☐ In place and understood by all workers.
- ☐ Evacuation route/procedure understood by all workers.
- ☐ Daily employee check-in verification procedure established.
- ☐ Emergency response equipment obtained and in-place.
  - ☐ Eye wash station
  - ☐ Medical kit
  - ☐ Oxygen respirator
  - ☐ Stretcher

HAZCOM

- ☐ Workers have completed training and understand the chemical hazards associated with their work.
- ☐ Labeling—Appropriate labeling and notices attached to all chemical containers located at the work site.
- ☐ MSDS located on-site and clearly identified for accessibility.

Personal Protective Equipment (PPE)

- ☐ Workers provided with appropriate PPE.
  - ☐ Hard hats
  - ☐ Safety boots
  - ☐ Reflective vests
  - ☐ Hearing protection
  - ☐ Fire resistant clothing
  - ☐ Leather gloves
  - ☐ Chemical resistant gloves
  - ☐ Protective Eyeware
  - ☐ Face shields—goggles

PPE Inspection

- ☐ Workers have inspected PPE for condition. **MUST BE PERFORMED AT THE BEGINNING OF EACH WORK DAY**

Tools and Equipment

- ☐ Workers have completed training in the proper care and use of tools and equipment.
- ☐ Non-sparking tools used for any work performed on decommissioned tanks.

Tool and Equipment Inspection

- ☐ Tools and equipment have been inspected for condition, and malfunctioning or broken tools have been repaired or replace. **MUST BE PERFORMED AT THE BEGINNING OF EACH WORK DAY**
  - ☐ Extension and power cords—No nicks or cuts
  - ☐ Grounding plugs—Three prongs, no damage
  - ☐ Air hoses—No kinks, nicks or cuts
  - ☐ Air hose connectors—In proper functioning order
  - ☐ Safety switches—In proper functioning order
  - ☐ Safety shields and guards—Attached and in working order
  - ☐ Emergency cutoff switches—In proper functioning order
  - ☐ Pressure switches—in proper functioning order

Pathways

- ☐ Working pathways have been identified and properly delineated with barrier tape, cones, etc.

Working from Heights

- ☐ Appropriate equipment has been obtained and inspected for condition and proper functioning order.
- ☐ Scaffolding
- ☐ Scissor Lift
- ☐ Bucket truck
- ☐ Ladders
- ☐ Fall protection / prevention
  - ☐ Tie-off harnesses
  - ☐ Anchors and connectors
  - ☐ Shock absorbers—deceleration device
  - ☐ Lanyards

General Contractor—Supervisor: ____Date: ________________________

Project Name and Location

Project Name: ______________________________ Project #:__________
Address: ____
City:______________________________ State: _________ZIP:_______

SAFETY and HEALTH| (continued)

Electrical Hazards

- ☐ The location of overhead power lines has been identified and a safe work perimeter established for equipment and ladders.
- ☐ Location of electrical power panels identified and circuit breaker labeling has been verified.
- ☐ Main power breaker located and properly identified.
- ☐ Sources of electrical energy entering the excavation area has been disabled.
- ☐ Lockout-Tagout procedures are understood and in-place.
- ☐ Lockout-Tagout equipment has been obtained and distributed

Utilities

- ☐ Location of underground utilities have been identified and clearly marked.
- ☐ Underground utilities that enter the excavation zone have been disabled.
  - ☐ Natural Gas
  - ☐ Water
  - ☐ Electrical
  - ☐ Sewer

Barricades and Signage

- ☐ Tank excavation
- ☐ Piping trenches
- ☐ Tripping hazards
- ☐ Heavy equipment swing area
- ☐ Temporary storage for tanks
- ☐ Pedestrian walkways
- ☐ Entrances and exits

Excavation and Trenching

- ☐ Required slopping or shoring in use.
- ☐ **INSPECTED FOR HAZARDOUS ATMOSPHERE EACH MORNING.**
- ☐ **INSPECTED FOR SOIL FRACTURING, SETTLING, OR MOVEMENT EACH MORNING.**
- ☐ Excavated soils at least 3 ft from edge of excavation.
- ☐ Ladders within 25 ft of each other.

Rigging and Lifting

- ☐ Lifting plan developed, understood and in-place.
- ☐ Rigging equipment inspected for condition.
- ☐ Crane operators have proper certifications.

Confined Space

- ☐ Excavation zone checked for hazardous atmosphere. **MUST BE PERFORMED AT THE BEGINNING OF EACH WORK DAY.**
- ☐ Decommissioned tanks checked for hazardous atmosphere prior to entry. **MUST BE CHECKED CONTINUOUSLY DURING ENTRY WORK.**
- ☐ Confined space worker is properly dressed with protective clothing and equipped with air respirator.
- ☐ Tank inerting or purging follows state implementing agency requirements.
- ☐ If vacuum truck is used to remove vapors ñ it is certified as explosion proof.

Fire Response

- ☐ Fire extinguishers (Class ABC) readily available.
- ☐ Fire blanket located on-site and readily available.

Parking and Traffic

- ☐ Location for worker and construction vehicles identified and appropriately marked.
- ☐ Entrances and Exits to site clearly marked and can be secured during non-work hours.

Good Housekeeping

MUST BE CHECKED AT THE BEGINNING AND END OF EACH WORK SHIFT.

- ☐ All extension cords, air hoses, etc. are stored when not in use.
- ☐ All cords in walking paths are properly identified and anchored for protection against tripping hazards.
- ☐ No materials stored in front of doorways.
- ☐ No materials stored in walking paths.
- ☐ No materials stacked closer than 36 in. of an electrical panel.
- ☐ No materials stacked higher than 5 ft.
- ☐ No debris accumulating in pathways.
- ☐ Area clearly designated for location of debris.

General Contractor—Supervisor:____ Date:_________________________

Project Name and Location

Project Name: ______________________________ Project #: __________
Address: ____
City: ______________________________ State: __________ ZIP: _______

MATERIALS and EQUIPMENT

- ☐ Certificates of compatibility have been obtained for all UST system equipment that may come into contact with contained product.
- ☐ Verify that all materials and equipment meet applicable local and national fire and building codes.
- ☐ Manufacturers instructions have been provided for all UST system equipment.
  - ☐ Instructions have been read and understood
- ☐ The following UST system components have been delivered to the installation site.
- ☐ **Automatic Tank Gauge (if applicable)**
  - ☐ ***Electronic console***
    - ☐ Manufacturer ____________________
    - ☐ Model No. ____________________
    - ☐ Serial No. ____________________
    - ☐ Modules (if applicable)
      - ☐ Ethernet
      - ☐ RS-232
      - ☐ Dispenser Interface
      - ☐ Fax
      - ☐ ORVR
      - ☐ ISD
      - ☐ Continuous Tank Leak Detection
      - ☐ Line Leak Detector
      - ☐ Other ____________________
  - ☐ ***Tank probes***
    - ☐ Manufacturer ____________________
    - ☐ Model No. ____________________
    - ☐ Serial No. ____________________
    - ☐ Qty ____________________
    - ☐ #1 Length ____________________
    - ☐ #2 Length ____________________
    - ☐ #3 Length ____________________
    - ☐ #4 Length ____________________
    - ☐ #5 Length ____________________
    - ☐ Proper Type
      - ☐ Magnetostrictive
      - ☐ Ultrasonic
      - ☐ Other ____________________
  - ☐ ***Sensors***
    - ☐ Qty ____________________
    - ☐ Manufacturer ____________________
    - ☐ Model No. ____________________
    - ☐ Serial No. ____________________
    - ☐ Proper Type
      - ☐ Discriminating
      - ☐ Non-discriminating
      - ☐ Hydrostatic
      - ☐ Other ____________________
  - ☐ ***Electronic line leak detectors***
    - ☐ Qty ____________________
    - ☐ Manufacturer ____________________
    - ☐ Model No. ____________________
    - ☐ Serial No. ____________________
    - ☐ Proper Type
      - ☐ Wireless
      - ☐ Pressurized
      - ☐ Volumetric
      - ☐ Flow
- ☐ **Dispenser sumps and mounting hardware**
  - ☐ Qty ____________________
  - ☐ Manufacturer ____________________
  - ☐ Model No. ____________________
- ☐ **Drop tubes**
  - ☐ Qty ____________________
  - ☐ Manufacturer ____________________
  - ☐ Model No. ____________________
  - ☐ Serial No. ____________________
- ☐ **Electrical conduit**
  - ☐ Correct material
  - ☐ Proper Diameters
  - ☐ Proper Lengths ____________________ (ft.)
  - ☐ QTY ____________________
- ☐ **Electrical conduit connectors**

General Contractor—Supervisor: ____ Date: ______________________

Project Name and Location

Project Name: ______________________________ Project #:__________
Address: ____
City:_______________________________ State: _________ZIP:_______

MATERIALS and EQUIPMENT (continued)

- ☐ **Fill riser pipes**
  - ☐ Qty ______________________________
  - ☐ Manufacturer ______________________
  - ☐ Model No. ________________________
  - ☐ Serial No. ________________________
  - ☐ Proper Type
    - ☐ Swivel
    - ☐ Coaxial
    - ☐ Standard non-coaxial
- ☐ **Riser caps and adaptors**
  - ☐ Qty ______________________________
  - ☐ Manufacturer ______________________
  - ☐ Model No. ________________________
- ☐ **Shear/fire/crash/impact valves and mounting hardware**
  - ☐ Qty ______________________________
  - ☐ Manufacturer ______________________
  - ☐ Model No. ________________________
  - ☐ Proper Type
    - ☐ Single-poppet
    - ☐ Double-poppet
- ☐ **Explosion-proof J-boxes**
- ☐ **Manholes**
  - ☐ Qty ______________________________
  - ☐ Manufacturer ______________________
  - ☐ Model No. ________________________
- ☐ **Manhole covers**
  - ☐ Qty ______________________________
  - ☐ Manufacturer ______________________
  - ☐ Model No. ________________________
- ☐ **Overfill prevention devices**
  - ☐ Qty ______________________________
  - ☐ Manufacturer ______________________
  - ☐ Model No. ________________________
  - ☐ Proper Type
    - ☐ Ball Float
    - ☐ Flapper Valve
- ☐ **Piping**
  - ☐ Manufacturer ______________________
  - ☐ 1.5 in. Flexible—Qty ________ (ft.)
  - ☐ 2.0 in. Flexible—Qty ________ (ft.)
  - ☐ 3.0 in. Flexible—Qty ________ (ft.)
  - ☐ 1.5 in. FRP—Qty __________ (ft.)
  - ☐ 2.0 in. FRP—Qty __________ (ft.)
  - ☐ 3.0 in. FRP—Qty __________ (ft.)
  - ☐ 1.5 in. Semi-rigid—Qty ______ (ft.)
  - ☐ 2.0 in. Semi-rigid—Qty ______ (ft.)
  - ☐ 3.0 in. Semi-rigid—Qty ______ (ft.)
- ☐ **Piping connectors/fittings**
- ☐ **Seal-offs**
- ☐ **Spill containers**
  - ☐ Qty ______________________________
  - ☐ Manufacturer ______________________
  - ☐ Model No. ________________________
  - ☐ Proper Type
    - ☐ Threaded
    - ☐ Slip-On
- ☐ **Submersible Turbine Pumps**
  - ☐ Qty ______________________________
  - ☐ Lengths (ft.) ______________________
    ____
  - ☐ Horsepower Rating _________________
  - ☐ Manufacturer ______________________
  - ☐ Model No. ________________________
  - ☐ Serial No. ________________________
  - ☐ Proper Type
    - ☐ Variable Speed / Flow
    - ☐ Fixed Speed / Flow

General Contractor—Supervisor:____ Date:_________________________

Project Name and Location

Project Name: ______________________________ Project #: __________
Address: ____
City: ______________________________ State: __________ ZIP: _______

MATERIALS and EQUIPMENT (continued)

- ☐ **Sumps**
  - ☐ Qty ______________________________
  - ☐ Manufacturer ______________________
  - ☐ Model No. ________________________
- ☐ **Sump Covers**
  - ☐ Qty ______________________________
  - ☐ Manufacturer ______________________
  - ☐ Model No. ________________________
- ☐ **Tanks**
  - ☐ Manufacturer ______________________
  - ☐ ***#1 Tank***
    - ☐ Capacity (gals) _________________
    - ☐ Diameter (ft) ___________________
    - ☐ Type __________________________
    - ☐ Model Number __________________
    - ☐ Serial Number __________________
  - ☐ ***#2 Tank***
    - ☐ Capacity (gals) _________________
    - ☐ Diameter (ft) ___________________
    - ☐ Type __________________________
    - ☐ Model Number __________________
    - ☐ Serial Number __________________
  - ☐ ***#3 Tank***
    - ☐ Capacity (gals) _________________
    - ☐ Diameter (ft) ___________________
    - ☐ Type __________________________
    - ☐ Model Number __________________
    - ☐ Serial Number __________________
  - ☐ ***#4 Tank***
    - ☐ Capacity (gals) _________________
    - ☐ Diameter (ft) ___________________
    - ☐ Type __________________________
    - ☐ Model Number __________________
    - ☐ Serial Number __________________
  - ☐ ***#5 Tank***
    - ☐ Capacity (gals) _________________
    - ☐ Diameter (ft) ___________________
    - ☐ Type __________________________
    - ☐ Model Number __________________
    - ☐ Serial Number __________________
- ☐ **Anchorage straps (if required)**
- ☐ **Deadmen (if required)**
- ☐ **Hold-down pads (if required)**
- ☐ **Monitoring Wells**
  - ☐ Qty ______________________________
  - ☐ Manufacturer ______________________
  - ☐ Model No. ________________________
- ☐ **Monitoring Well Covers**
  - ☐ Qty ______________________________
  - ☐ Manufacturer ______________________
  - ☐ Model No. ________________________
- ☐ **Pressure/Vacuum Valves or Vent caps**
  - ☐ Qty ______________________________
  - ☐ Manufacturer ______________________
  - ☐ Model No. ________________________
  - ☐ Serial No. ________________________
  - ☐ Proper Type
    - ☐ Pressure-Vacuum
    - ☐ Atmospheric
- ☐ **Vent risers**
  - ☐ Qty ______________________________
  - ☐ Material of construction and diameter ______________________
  - ☐ Other Vent Rack Equipment _____________

General Contractor—Supervisor: ____ Date: ________________________

Project Name and Location

Project Name: ______________________________ Project #:__________
Address: ____
City:________________________________ State: _________ ZIP:_______

HANDLING, INSPECTION and TESTING

Tanks

- ☐ Tanks inspected for damage BEFORE removal from truck semi flatbed trailer.
- ☐ Tank manufacturer installation instructions supplied with tanks.
- ☐ Tanks properly rigged for lifting from delivery trailer and storage in staging area.
- ☐ Tanks located in staging area and supported from contact with the ground surface by non-abrasive chocks or protective cradles.
- ☐ Tanks properly anchored to prevent movement or rollover during storage.
- ☐ Tank coatings "Holiday" tested.
- ☐ Damaged tank coatings repaired prior to installation.
- ☐ Double-wall tanks with vacuum interstice verified for minimum required vacuum prior to installation.
- ☐ Inside vertical height of tanks measured prior to installation.
  - ☐ Regular 1 ___________________________ (in.)
  - ☐ Regular 2 ___________________________ (in.)
  - ☐ Mid-grade ___________________________ (in.)
  - ☐ Premium 1 ___________________________ (in.)
  - ☐ Premium 2 ___________________________ (in.)
  - ☐ Diesel ___________________________ (in.)
  - ☐ Other ___________________________ (in.)
- ☐ Testing hazards identified and appropriate safety precautions implemented prior to testing.
- ☐ Correct pressure gauges and safety relief valves installed on tanks prior to tightness testing for monitoring internal pressure.
  - ☐ Over-pressurization prevention-relief installed and operating.
- ☐ All bungs properly sealed with pipe thread sealant prior to tightness testing.
- ☐ Single-wall tanks pressure tested prior to installation per manufacturer's specifications.
- ☐ Double-wall FRP tanks pressure tested prior to installation per manufacturer's specifications.
  - ☐ Inner and outer walls tested.
- ☐ Tanks tightness tested and verified tight.
  - ☐ Regular 1
  - ☐ Regular 2
  - ☐ Mid-grade
  - ☐ Premium 1
  - ☐ Premium 2
  - ☐ Diesel
  - ☐ Other

Piping and Sumps

- ☐ Piping inspected for damage BEFORE removal from delivery truck or trailer.
- ☐ Piping manufacturer installation instructions provided with piping.
- ☐ Piping properly rigged for lifting from delivery trailer and storage in staging area.
- ☐ Piping located in staging area and supported from contact with the ground surface by non-abrasive chocks or protective cradles.
- ☐ Piping properly anchored to prevent movement or rollover during storage.
- ☐ Piping inspected for damage prior to immediate use.
- ☐ Installed piping is properly pressure tested for tightness before backfilling in accordance with state and federal codes.
- ☐ Post installation piping tested and verified tight:
  - ☐ Regular
  - ☐ Mid-grade
  - ☐ Premium
  - ☐ Diesel
  - ☐ Other
- ☐ Tank and/or dispenser sumps inspected for physical damage prior to receipt on-site.
- ☐ Tank and/or dispenser sumps located in staging area - properly supported and protected from possible damage during storage.
- ☐ Tank and/or dispenser sumps hydrostatically tested AFTER installation of all penetration fittings.

Other Equipment and Testing Requirements

- ☐ All testing of tanks and piping is performed by personnel who are properly trained and qualified by the equipment manufacturer or testing organization, and licensed by the AHJ.
- ☐ Equipment part numbers and quantities verified.
- ☐ All other equipment has been stored in secure location free from vandalism or theft.

General Contractor—Supervisor:____ Date:___________________________

Project Name and Location

Project Name: ______________________ Project #:________
Address:______________________________________
City: ______________________State: ________ ZIP:______

REMOVAL and DISPOSAL

Pre-Work

- ☐ All work meets the requirements of the following API documents.
  - ☐ Recommended Practice 1604
  - ☐ Standard 2015
  - ☐ Publication 2217 and Publication 2219
- ☐ Above documents have been read and fully understood by assigned removal personnel.
- ☐ Proper permits secured for used tanks.
  - ☐ Removal
  - ☐ Abandonment-in-Place
  - ☐ Confined Space Entry
- ☐ The need to dewater the tank excavation has been determined.
- ☐ The location of all underground utilities identified and disabled.
  - ☐ Site underground electrical
  - ☐ Natural gas lines
  - ☐ Municipal electrical power
  - ☐ Water lines
  - ☐ Septic and sewer
  - ☐ Telecommunications lines
- ☐ A location has been identified for the temporary storage of all removed tanks and product lines.
- ☐ Potential ignition sources (e.g. electricity) identified and isolated prior to start of removal process.
- ☐ A non-smoking exclusion zone established around tanks.
- ☐ Using only non-sparking tools when working around the tank to be removed.
- ☐ Conduct on-site safety review.
  - ☐ Emergency Response procedures described and understood.
  - ☐ Evacuation procedure described and understood.
- ☐ Using only explosion-proof combustible gas indicator for monitoring hazardous vapor concentration in tank and excavation area.
  - ☐ UL listed for intrinsic safety (913) and explosion-proof (1203).
- ☐ Applicable circuit breakers and power panels identified and lockout-tagout completed.
  - ☐ Equipment complies with NFPA 70
  - ☐ Power shutoff verified with ohm-meter
- ☐ The following equipment disabled and removed
  - ☐ Submersible turbine pumps
  - ☐ Dispensers
  - ☐ Automatic tank gauge equipment
  - ☐ Wireless devices
- ☐ All power tools and equipment used for work is properly grounded.
- ☐ Person entering tank will be equipped with positive pressure air-supplied respirator with full face enclosure and Class B PPE.

Product Removal and Excavation

- ☐ Piping disconnected from dispensers at fire/impact/shear valves.
- ☐ Product drained and flushed from piping into tank(s).
- ☐ If using vacuum truck is it located away from possible path of vapors.
- ☐ Using only explosion-proof pump(s) to remove product from UST.
- ☐ Any pumps or other electrical equipment used for the removal of product from tank is properly bonded to tank.
- ☐ All piping (excluding fill riser) removed from the tank.
  - ☐ Verify that vapors will vent through vent lines during vapor freeing process.
  - ☐ If eductor is used—do NOT remove fill drop tube.
- ☐ All openings (except fill riser and vents) properly sealed with threaded bungs with sealant.
  - ☐ Tank area regularly monitored using explosion-proof combustible gas meter.
- ☐ Excavation area regularly monitored for the presence of hazardous vapors.
- ☐ All workers performing the above work are wearing proper PPE.
  - ☐ Head
  - ☐ Eyes
  - ☐ Respiratory organs
  - ☐ Hands
  - ☐ Feet

Site Assessment

- ☐ Upon completion of excavation soil samples are taken from excavation area and shipped to lab for analysis.
  - ☐ Release identified.
    - ☐ Yes
    - ☐ No
  - ☐ IF “yes” corrective action required per state regulations and/or API 1628 and API 1629.

General Contractor—Supervisor: ________________________________Date: ________________

Project Name and Location

Project Name: ______________________________ Project #:__________
Address: ____
City:_______________________________ State: _________ZIP:_______

EXCAVATION

- ☐ The following factors have been considered in determining the size and location of the tank excavation:
- ☐ Soil structure and stability
- ☐ Depth of water table
- ☐ Necessity for sloping or shoring
- ☐ Proximity to building foundations
- ☐ Diameter and length of tanks
- ☐ Number of tanks
- ☐ Type of tanks
- ☐ The buoyancy forces of the tanks
  - ☐ Buoyancy calculations have been reviewed and approved by a person having appropriate training, knowledge and experience.
- ☐ Depth of overburden
- ☐ Location of buried utilities
- ☐ Thickness of tank bedding
- ☐ Distance between tanks
- ☐ Distance between tanks and excavation wall
  - ☐ Allowances for piping slope
  - ☐ Location of tanker truck during delivery
    - ☐ Is not on public right-of-way
    - ☐ Does not impede flow of vehicles or pedestrians
    - ☐ Does not block motorists view of roadways and access / exit points
    - ☐ Provides sufficient space for maneuvering around buildings and other structures (e.g. canopy, car wash, etc.).
  - ☐ Proximity of tanks to property lines meets local building codes
  - ☐ Other requirements or recommendations by the tank manufacturer.
- ☐ If required, all sloping and shoring meets OSHA requirements.
- ☐ All open trenches and excavations are properly barricaded per OSHA requirements.
- ☐ Compressive strength of concrete covering meets ACI 318-05 requirements.

General Contractor—Supervisor:_____________________________________ Date:_____________________

Project Name and Location

Project Name: ______________________________ Project #:__________
Address:____
City: ______________________________State: _________ ZIP:_______

EQUIPMENT PLACEMENT, ANCHORAGE, SECONDARY CONTAINMENT, AND BALLASTING

- ☐ All factors necessary for calculating buoyancy have been confirmed.
  - ☐ Weight of overburden (backfill and surface paving)
  - ☐ Weight of tank
  - ☐ Weight of water that can be contained in the tank
  - ☐ Weight of any anchoring mechanisms
  - ☐ Displaced volume of any tank sumps
- ☐ Tanks are placed on a bed of appropriate material that has been properly graded, leveled and compacted to the depth specified in the engineering drawings.
- ☐ Tanks are not placed directly on hold-down pads, compacted earth or other hard surfaces.
- ☐ Tanks are lowered into the excavation with care such that they are not damaged or come into contact the walls of the excavation.
- ☐ The equipment used for lifting and lowering the tanks into the excavation has been determined to be of sufficient size and capacity.
- ☐ The swing radius of the lifting equipment has been determined and is clearly marked using barricades around the excavation area.
- ☐ After placement of tanks sufficient backfill is added to prevent any unwanted movement.
- ☐ Tanks to be siphoned have been placed within the excavation such that their tops are at the same elevation.
- ☐ Tanks that are to be siphoned together have the same diameter.
- ☐ The siphon mechanism is approved by the AHJ.
- ☐ The need for anchorage (size, weight, and type) has been determined prior to installing the tanks in the excavation.
- ☐ If required, the type and method of anchorage has been determined and specified.
  - ☐ Hold-down pad
  - ☐ Deadmen
  - ☐ Deep burial
- ☐ The correct anchorage devices have been confirmed to be on-site.
- ☐ Anchor straps are firmly secured using anchor points and turnbuckles.
- ☐ Anchor straps have been electrically isolated from the surface of steel or composite tanks.
- ☐ Any secondary containment devices (e.g. sumps, pans, etc.) have been confirmed to be on-site.
- ☐ Installation of USTs in secondary containment vaults comply with all local, state and federal requirements and nationally-recognized standards of practice for aboveground storage tanks including:
  - ☐ EPA
  - ☐ OSHA
  - ☐ NFPA
  - ☐ API
  - ☐ ANSI
- ☐ If necessary or required by code tanks are filled with ballast after they have been installed and secured from unwanted movement.
- ☐ If water is used as ballast it will be disposed of per local and state requirements.
- ☐ If gasoline is used as ballast appropriate measures have been put in-place to prevent explosion from sparking and/or other ignition sources.
- ☐ Tanks are vented to atmosphere per NFPA 30 during installation.

General Contractor—Supervisor: ____Date: __________________________

Project Name and Location

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DETECTION OF RELEASES

General

- ☐ The method of release detection meets the federal requirement for 95 % probability of detection (Pd) and 5 % probability of false alarm (Pfa).
- ☐ The method of release detection has been third-party certified in accordance with a testing protocol approved by the US EPA.
- ☐ Documentation of third-party certification has been obtained and provided by the manufacturer of the release detection equipment or the installing contractor to the UST owner.
- ☐ The National Work Group lists the method of release detection as an approved method for Leak Detection Equipment (NWGLDE).
- ☐ The method of release detection is installed, setup, programmed, and/or tested in accordance with the manufacturer's instructions.
- ☐ The method of release detection is approved for use with the installed UST system by the AHJ.
- ☐ The UST owner is in possession of a tank gauge stick that is in good working order and that is not worn or damaged.

Tank Release Detection

- ☐ The method of release detection is capable of detecting a 0.2 gallon per hour (gph), or smaller, leak within 30-days from any portion of the UST that routinely contains product.

Piping Release Detection

- ☐ (See ATG and MLLD sections, and Section 13, Piping)

Automatic Tank Gauge (ATG)

- ☐ If using an ATG for tank and/or piping release detection the following items have been verified:
- ☐ The ATG system (console, probes, sensors and wiring) has been installed per the manufacturer's requirements.
- ☐ The ATG system has been installed per local building code requirements.
- ☐ The ATG system has been installed using only properly qualified and certified technicians.
- ☐ The ATG console has been programmed for the physical characteristics of the UST system installed.
  - ☐ Tank type and/or material
  - ☐ Tank maximum capacity
  - ☐ Tank diameter
  - ☐ Piping type and/or material
  - ☐ Piping length and diameter
  - ☐ Tanks linked to correct piping runs
  - ☐ Tank tilt (if necessary)
  - ☐ Tank probes and electronic line leak detectors (ELLDs) programmed and assigned to correct tanks and product lines.
  - ☐ Alarms programmed in accordance with requirements of the UST owner/operator.
  - ☐ Alarms programmed in accordance with any regulatory requirements of the AHJ.
  - ☐ Minimum % volume testing threshold per AHJ requirements.
- ☐ The ELLD is certified for the length, diameter and type of piping used in the UST system.
- ☐ Materials of the tank probes (e.g. probe shaft and/or floats) are compatible with the fluid stored in the USTs.
- ☐ Electrical continuity and communications signal between the ATG console and all probes and sensors.
- ☐ Depending upon the frequency of testing chosen the ATG has been programmed to monitor the tank for a 0.2 gph leak rate, and the piping programmed for either a monthly 0.2 gph leak rate or an annual 0.1 gph leak rate and/or another requirement per the AHJ.
- ☐ After completion of installation the ELLD for each product line has been functionally tested for detecting a 3.0 gph leak.
- ☐ Test results have been provided to the UST owner / operator.
- ☐ A copy of the third-party certification for the tank probes and line leak detectors has been provided to the UST owner / operator.

General Contractor—Supervisor:____ Date:________________________

Project Name and Location

Project Name: ______________________________ Project #:__________
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PIPING

General

- ☐ The piping system has been designed and sized to meet the requirements of the dispensing system.
- ☐ All piping has been installed in accordance with any requirements of the AHJ.
- ☐ All piping has been installed per the requirements of API 1615, Section 11.
- ☐ All piping has been installed per the manufacturer's instructions and requirements.
- ☐ Installation of piping meets the requirements of NFPA 30.
- ☐ Installation of piping meets the requirements of NFPA 30A, Chapter 5.
- ☐ Drawings have been prepared that show the layout of piping including all piping run lengths, piping types (e.g. model number and material), and piping diameters, etc.
- ☐ The completed piping installation is shown on an "as built" drawing indicating the location of all piping runs, their lengths, connections to tanks and dispensers, and product types.
- ☐ Piping is installed using only properly trained and qualified technicians (e.g. "certified" by the piping manufacturer).
- ☐ Installing contractor is licensed by the AHJ.

Overfill Protection

- ☐ Meets one or more of the following requirements of 40 *CFR* 280.20(c).
  - ☐ Positively shuts off the flow of product into the storage tank when the level reaches 95 % of the maximum volume of the tank.
  - ☐ Triggers an alarm when the level of product reaches 90 % of the maximum volume of the storage tank.
  - ☐ Deliveries are made to the storage tank that do NOT exceed 24-gal at one time.
- ☐ Equipment has been verified functional.
- ☐ The overfill prevention equipment and all of its components are compatible with the fluid stored in the USTs.

Spill Containment

- ☐ The capacity of the spill container meets the minimum requirements of the AHJ.
- ☐ The components of the spill containment device are compatible with the product stored in the UST.
- ☐ The spill containment device has a drain valve that can be opened to allow contained spilled product to flow into the UST.
- ☐ The spill containment device is attached to a riser pipe connected to the UST using a sealant that is compatible with the product stored in the UST.

Tightness Testing

- ☐ The assembled piping system is tightness tested at 150 % operating pressure for 30-min, or per the requirements of the manufacturer and the AHJ.
- ☐ All piping surfaces including valves, fittings, joints and connectors are wetted with a soap solution prior to testing.
- ☐ Any leaks are repaired.
- ☐ The outer piping of double-wall systems is tightness tested at no more than 5 psi.

General Contractor—Supervisor: ____Date: _________________________

Project Name and Location

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ELECTRICAL

- ☐ Installation of all electrical equipment for use with the UST system complies with the requirements of the following codes and standards:
  - ☐ NFPA 30A, Section 8.3 for Class I, Division I
  - ☐ NFPA 70, Chapter 5,
    - ☐ Article 500—Hazardous locations
    - ☐ Article 501—Class I locations
    - ☐ Article 504—Intrinsically safe systems
    - ☐ Article 514—Motor fuel dispensing systems
  - ☐ Municipal, county and/or state codes
- ☐ The following electrical wiring equipment is approved for use for the location in which the UST system is installed and shall be operated:
  - ☐ Electrical wiring
  - ☐ Electrical conduit
  - ☐ Emergency disconnects
  - ☐ Junction boxes
  - ☐ Sealing compounds
  - ☐ Breakers
  - ☐ Electrical enclosures
  - ☐ Other electrical components
- ☐ Electrical wiring equipment is rated for the electrical loads (e.g. amperage, voltage, etc.) specified for the proper operation of all equipment within the UST system requiring electrical power.
- ☐ Emergency disconnects have been verified to disconnect power to the equipment for which they are labeled.
- ☐ Any intrinsically safe wiring meets the requirements of the equipment manufacturer.
- ☐ No electrical conduits contact the exterior surface of any tanks and/or the piping.

THIS SECTION SHOULD BE SIGNED BY THE ELECTRICAL CONTRACTOR

Signature: ___________________________________

Date: ____

General Contractor—Supervisor:____ Date:___________________________

Project Name and Location

Project Name: ______________________________ Project #:__________
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BACKFILLING

- ☐ Piping has been tightness tested prior to beginning backfilling operations.
- ☐ Backfill material is free of:
  - ☐ Ice
  - ☐ Snow
  - ☐ Debris
  - ☐ Material that can adversely affect compaction of the backfill
- ☐ The backfill material been inspected prior to use by the AHJ if required.
- ☐ The backfill material meets the requirements of the tank manufacturer.
- ☐ Pea gravel, if used, complies with the specifications of ASTM C-33.
- ☐ A minimum of 6 in. of well-compacted backfill (pea gravel excluded) material has been installed in all piping trenches.
- ☐ The tank excavation and piping trenches are free of ice, snow, debris and/or any material that can damage the tanks or piping.
- ☐ The backfill bedding for the tanks is no less than 12 in. deep.
- ☐ If using sand as a backfill material it is compacted in successive lifts that are no greater than 12 in. thick.
- ☐ If using hold-down pads, they are covered with no less than 12 in. of backfill material prior to installing the tanks.
- ☐ If using deadmen anchors they are placed outside the diameter of the tanks.
- ☐ Anchor straps are isolated from the surface of the tanks using a non-abrasive and electrically non-conductive material.
- ☐ Anchor straps are verified as being securely attached to the hold-down pads or deadmen anchors.
  - ☐ The inside vertical height of FRP tanks has been verified after completing the backfilling process.
    - ☐ The above height measurement does not exceed the allowable difference from the unloaded static measurement as specified by the FRP tank manufacturer.
  - ☐ If required, the above height measurements are documented and provided to the tank manufacturer and/or AHJ.
- ☐ The location of all piping has been identified prior to any grading or paving operations.
- ☐ Tightness testing of piping is performed upon completion of all grading or paving operations.
  - ☐ Test results indicate piping is tight.
    - ☐ Yes
    - ☐ No
    - ☐ If “No” then repairs are made to the appropriate piping prior to start-up of the UST system.
- ☐ The following testing is performed upon completion of all backfilling, grading and paying operations:
  - ☐ Tightness tests of tanks
  - ☐ Tightness tests of piping
  - ☐ Functionality of:
    - ☐ Impact/shear/crash valves
    - ☐ Line leak detectors (3.0 gph leak rate)
    - ☐ ATG LLD alarms
    - ☐ Emergency shutdown switches
    - ☐ Audible/visible overfill alarms
  - ☐ The ATG LLD testing contractor has proof of certification.
  - ☐ Documentation is provided to the UST owner/operator verifying functionality of the ATG and LLDs.

General Contractor—Supervisor: ____Date: __________________________

Project Name and Location

Project Name: ______________________________ Project #:__________
Address: ____
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OTHER EQUIPMENT

Pumping Systems

- ☐ The pump is rated for service with the product to be stored in the USTs.
- ☐ The capacity of the pump is sufficient to guarantee minimum required flows rates for Stage II vapor recovery nozzles.
- ☐ The flow rate of fuel from the Stage II vapor recovery nozzles has been verified to be between 7.5 gal/min and 10 gpm.
- ☐ The pump suction inlet is no closer than 4 in. from the bottom of the tank.
- ☐ The pump is rated for operation in a location classified NFPA 30 as "Class I, Division I."
- ☐ The pump is UL® listed.

Tanks and Fittings

- ☐ The number, size and location for all fittings that are to be installed on the tanks have been verified.
- ☐ The placement and location of striker plates inside the storage tanks has been verified.
- ☐ The location of the bottom of the drop tube from the bottom of the tank has been verified.
- ☐ All manhole covers for tank fills have been properly identified as to product type.

Other Equipment

- ☐ Dispensers comply with NIST Handbook 44 requirements.
- ☐ Dispensers are rated for use with the product to be dispensed.
- ☐ All shear/impact/crash valves have been checked for functionality after installation and prior to start-up of the UST fueling system.

General Contractor—Supervisor:____ Date:___________________________

Project Name and Location

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VAPOR RECOVERY

- ☐ The required use of vapor recovery for the location has been verified with the AHJ.
  - ☐ Stage I: YES / NO
  - ☐ Stage II: YES / NO

Stage I Vapor Recovery

- ☐ The type of Stage I vapor recovery system to be used is specified in the engineering specifications.
  - ☐ Two-point balance system
  - ☐ Single-point manifold balance system
  - ☐ Coaxial balance system
- ☐ Stage I vapor recovery system components have been certified for the particular UST system application per CARB or other state-certifying agency.
- ☐ The manufacturers of all Stage have provided certification documentation I vapor recovery equipment.
- ☐ If using a two-point balance system separate vapor recovery connection points are installed in each tank.
- ☐ The vapor recovery riser pipe is no less than 3 in. in diameter.
- ☐ A quick-disconnect vapor pickup adaptor is installed on the top of each vapor recovery riser pipe.
- ☐ The vapor pickup adaptor is equipped with a spring-loaded poppet valve.
  - ☐ The spring-loaded poppet valve is in the closed position when the vapor pickup hose is not connected.
- ☐ If multiple tanks are used to store the same product a vapor manifold has been installed between the two tanks for allow for vapor transfer between the tanks.
  - ☐ The vapor manifold pipe is 3-in. to 4-in. in diameter.
- ☐ If using a coaxial vapor recovery system the UST is NOT equipped with a ball-float overfill prevention valve.
- ☐ If using a single-point manifold balance vapor recovery system the vapor recover riser for each UST is connected to the manifold header.
  - ☐ The vapor recovery manifold header piper is 3-in. to 4-in. in diameter.
- ☐ The use of a coaxial vapor recovery system is approved for use with the Stage II vapor recovery system by the AHJ.
- ☐ All Stage I vapor recovery equipment has been installed in accordance with the manufacturer's requirements.
- ☐ All installed Stage I vapor recovery equipment complies with local, state and/or federal requirements.
- ☐ Vapor tightness of Stage I vapor recovery equipment has been verified.

Stage II Vapor Recovery

- ☐ Stage II vapor recovery system components have been certified for the particular UST system application per CARB or other state-certifying agency.
- ☐ Stage II vapor return lines have been installed from the fueling dispensers to the corresponding USTs (or UST if using a common vapor manifold).
- ☐ If using a common vapor manifold for all fueling dispensers the vapor return piping is connected to the tank that will contain regular gasoline.
- ☐ The return lines have been installed with the proper slope without any traps or sags to meet local and/or state requirements.
- ☐ All Stage II vapor recovery return lines are constructed of materials certified to be compatible with the product to be stored in the USTs.
- ☐ The inside diameter of vapor return lines meets the minimum requirements by local and state AHJs.
- ☐ All Stage II vapor recovery return piping has been installed per local and state requirements.
- ☐ All installed Stage II vapor recovery return piping has been tightness tested per local and/or state regulatory requirements.

System Design

- ☐ The installation and testing of all Stage I and Stage II vapor recovery equipment and piping conforms with applicable national codes of practice and/or regulatory bodies including:
  - ☐ CARB
  - ☐ NFPA 30A
  - ☐ PEI RP300
  - ☐ UL
  - ☐ Other state certifying agencies

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