

Installation of Underground Petroleum Storage Systems

API RECOMMENDED PRACTICE 1615
SIXTH EDITION, APRIL 2011

REAFFIRMED, MAY 2020



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, intergranular, 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 meet 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*

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)*

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 348⁸, *Protecting Building Utilities From Flood Damage: Principles and Practices for the Design and Construction of Flood Resistant Building Utility Systems*

FTPI RP T-95-02⁹, *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 22¹⁰, *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 RP0169¹¹, *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 30¹², *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 80-106¹³, *Criteria for a Recommended Standard on Working in Confined Spaces*

NIST Handbook 44¹⁴, *Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices*

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

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.fiberglassstankandpipe.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.steel-tank.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.