UNDERGROUND STORAGE TANKS FOR FLAMMABLE LIQUID FUELS

DESIGN REQUIREMENTS

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1. GENERAL

1.01 This section lists engineering information covering design requirements of underground tanks for storing flammable liquid fuels, such as gasoline, diesel fuel, kerosene, and liquid building heating fuels.

1.02 Whenever this section is reissued, the reason(s) for reissue will be given in this paragraph.

1.03 Sections 760-220-161 and 760-220-162 cover dispensing systems for motor vehicle fuels. See Section 770-210-306 for Building Heating Fuel Storage Operating Methods. See Section 065-320-301 for Engine Fuel Storage Operating Methods.

2. RECOMMENDED FUEL STORAGE PRACTICES

2.01 The first consideration in designing a fuel storage tank installation is adherence to the National Board of Fire Underwriters requirements. These standards classify fuels as class I, II, and III, depending on their flash point. Any storage tank serving gasoline dispensers is known as a class I installation. Any storage tank serving an oil burner in a building is known as a class II installation.

2.02 The maximum permissible size of fuel storage tanks depends upon the location, distance from the building, and adjoining properties. Construction and piping of storage tanks are subject to local codes, safety requirements, and/or insurance regulations.

2.03 Storage tanks should be located so that piping to the end use is as short as possible, consistent with regulations and requirements as to the minimum distances from buildings and other structures.

2.04 At the present time there are three primary types of underground fuel storage tanks, ie, steel with a protective coating, steel with a factory installed corrosion control system, and fiberglass reinforced polyester.

3. STORAGE TANK FITTINGS AND ACCESSORIES

3.01 Certain fittings and tank accessories are required for all underground fuel storage tanks. In addition, certain types of products stored, the means of product removal, the type of installation, or local conditions may require additional fittings and/or accessories.

3.02 All underground fuel storage tanks are equipped as follows:

(a) A fill line or fill pipe for placing product into the tank. This line should terminate outside any building, in a suitable grade level enclosure such as a curb box, at least 2 feet away from any building.

(b) A vent line of not less than 1 1/4 inch diameter and should be larger than the diameter of the fill line. A vent whistle may be provided for protection against overflowing of the tank.

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(c) A measuring well to provide for "sticking" of the tank to determine the amount of product contained therein.

(d) A suction or fuel delivery line to supply fuel to the heating plant and emergency engine or turbine. The size of the fuel delivery piping is determined by the type, viscosity and quantity of fuel to be delivered. A spare tap should be provided in the tank if a need for an extra suction line is anticipated.

(e) A gauge connection to permit the remote determination of the quantity of fuel contained within the tank. The size and location of the gauge connection is determined by the type and size of the gauging system being used.

(f) Tank fittings to permit future installation of a vapor recovery system. See Part 8 for specific details.

3.03 Gasoline tanks must comply with federal, state, and local regulations and may have the following fittings and accessories in addition to those called for in paragraph 3.02:

(a) A Stage I vapor recovery system to return hydrocarbon vapors back into the transport tank through a closed circuit system. See Part 8 for specific details.

(b) A Stage II vapor recovery system, in addition to the Stage I vapor recovery system, to return hydrocarbon vapors back into the underground storage tank when a vehicle fuel tank is refueled.

3.04 Building fuel tanks must comply with federal, state, and local regulations and may have the following fittings and accessories in addition to those called for in paragraph 3.02:

(a) A return line since burner supply pumps usually discharge more fuel than required by the burners, and the excess is returned to the tank.

(b) A portable sludge pump connection, while not always provided, can be of considerable service if sludge accumulates.

(c) A manhole is a very desirable provision. Should the fuel sludge, because of instability or abnormal length of storage, access to the tank for cleaning is required.

3.05 Reserve power plant fuel tanks must comply with federal, state, and local regulations and may have the following fittings and accessories in addition to those called for in paragraph 3.02:

(a) A return line since the fuel supply pumps on certain reserve power plants will discharge more fuel than is required by the prime mover, and the excess is returned to the tank.

(b) A portable sludge pump connection, while not always provided, can be of considerable service if sludge accumulates.

(c) A manhole is a very desirable provision. Should the fuel sludge, because of instability or abnormal length of storage, access to the tank for cleaning is required.

4. EQUIPMENT INSTALLATION

4.01 Equipment installation for underground storage tank (steel and fiberglass) is described below:

(a) ***Testing:*** Pressure test tank at 5 psi and soap fittings for a period of at least 12 hours after placing tank into excavation. Tank under pressure should not be left unattended.

(b) ***Backfill:*** The tank shall be set on a firm foundation and provided a minimum 6 inch level backfill bed. In rock, stone, shale, or clay areas, provide a 12 inch bed. At least 12 inches of backfill shall be provided from sides of hole. The level from end to end shall be within 1 inch in 10 feet with the low end at the fill pipe end of the tank.

(c) ***Pea Gravel:*** Use pea gravel as backfill material. Use 1/4 inch nominal naturally rounded aggregate with particles ranging from 1/8 inch to 3/8 inch in diameter, clean and free flowing. Use this description since material is known by different names in different areas.

(d) ***Anchoring requirements are as follows:***

(1) Steel tank where required by water conditions. The tank shall be anchored to a reinforced concrete pad where required by water conditions. The weight of the pad shall be greater than the buoyant force of the empty fuel tank in water. Straps, rods, turn-buckles, and

other hardware used to anchor tank to the pad shall be galvanized steel.

(2) Fiberglass tank where required by water conditions. The tank shall be anchored using fiberglass anchor straps per Owens-Corning Publication PE-C21.1.1 or use 4-inch wide by 1/4 inch thick steel straps covering at least the top 180 degree of the tank in all strap guides that are provided on tank. Do not use cables over tank. Anchor points should be 10 feet apart widthwise on 8 foot diameter tanks and 8 foot on 6 foot diameter tanks. The tank shall be anchored to a reinforced concrete pad. The weight of the pad shall be greater than the buoyant force of the empty tank in water.

(e) ***Corrosion protection requirements are as follows:***

(1) Steel tanks should be coated with an adhering asphaltic-type material such as Tapecoat 20 with Mastic Primer to provide the minimum corrosion protection.

(2) Depending upon the soil resistivity and stray currents, cathodic protection may be considered to minimize the corrosion damage to steel tanks. Cathodic protection properly designed, installed, and maintained can provide an excellent corrosion protection. Pre-engineered protection systems are available but they do not provide effective internal corrosion protection at all locations.

(3) Cathodic protection does not safe-guard the internal surfaces and internal corrosion can be a significant factor in steel tank life. Corrosion can take place in both the water and fuel environment. Plastic and zinc linings for an effective internal corrosion protection is recommended.

(4) Cathodic protection is provided by permanently attaching sacrificial anodes, usually Magnesium, to a steel tank. An electrical lead wire from the anode and a test wire from the tank are terminated in a box at grade level so that voltage potential and anode current output can be measured to assure proper protection.

(5) Steel tanks with proper coatings and cathodic protection cost about the same as fiberglass tanks but still have the disadvantages of leakage, corrosion potential, and high maintenance. Fiberglass tanks ***do not*** need any coating for corrosion protection. Fiberglass tanks are an attractive alternative both from the standpoint of overall cost and its immunity to corrosion attacks.

(f) Pea gravel should be used to maintain a distance of at least 12 inches from the reinforced concrete pad to the bottom of the tank. The level from end to end shall be within 1 inch in 10 feet with the low end at the fill pipe end of the tank.

(g) The tank shall be buried underground with the top below the level of any piping connected to the tank and not less than 2 feet below the surface of the ground. Except in lieu of the 2 foot cover, the tank may be buried under 1 foot of earth and a slab of reinforced concrete or equivalent construction at least 4 inches thick except at the manhole used for accessibility to piping. This slab shall be set on a firm, well tampered earth foundation and shall extend at least 1 foot beyond the outline of the tank in all directions.

(h) If the tank is under a driveway subject to traffic by heavy vehicles, the total coverage above the top shall be not less than 3 feet, except that 2 feet is permissible if the driveway has 1 foot 6 inch well tampered earth and a 6-inch reinforced concrete pavement.

4.02 ***Caution: Both fiberglass and steel tanks should be installed in strict accordance with manufacturer's instructions.***

5. PREHEATING HEAVY FUEL OIL

5.01 The heavy grades of fuel oil required conditioning by the application of heat before use. Preheating is employed to reduce the viscosity so that it can be pumped to the end using equipment.

5.02 A number of factors affect the selection of a fuel oil preheating system. Three basic factors are:

(a) Type of installation (commerical, industrial, etc)

(b) Type of operation (automatic, semi, manual)

(c) Type of fuel.

5.03 Four media for preheating fuel oil are in common use: steam, hot water, gas, and electricity.

(a) With steam as the heating medium, the heater may be of the shell and tube or the bayonet type inserted in the tank. The steam method has several limitations; mainly, it is dependent on continuous firing of the boiler. Steam condensate, from preheaters, should not be returned to the boiler because of the possibility that oil may penetrate into the boiler through a faulty heater exchanger.

(b) The hot water preheating method utilizes equipment similar to that used for steam. Because of the possibility that oil may penetrate into the boiler through a faulty heat exchanger, double transfer heaters are used.

(c) The indirect gas fired preheating method is a package arrangement that uses gas as the primary energy source. It generates its own supply of low pressure steam in a closed vapor condensate cycle.

(d) The electrical preheating method involves use of immersion heaters along with special designs for fuel oil piping.

6. WATER DETECTION AND REMOVAL

6.01 Free water (water not in emulsion with the fuel) will settle to the bottom of fuel storage tanks and must be pumped out. Each storage tank should be checked for water accumulation at least once a year. Water accumulation can be determined with a dipstick coated with water finder paste. The dipstick coated with the paste, at least the bottom 6 inches, should be inserted through the fill part until it touches the bottom of the tank.

6.02 A certain amount of water may be expected in any storage tank due to condensation of atmospheric moisture. The accumulation of water is an undesirable condition and provision must be provided to permit the detection and removal of water.

7. SECURITY OF STORAGE TANKS

7.01 All fuel oil fill pipes, and other openings that would permit the unauthorized removal of fuel, should be equipped with the proper type of locking device. Arrangements for the key distribution should be in accordance with acceptable security measures.

7.02 Manhole entrances to fuel oil storage tanks should be equipped with a safe method of entering the tank.

8. POLLUTION CONTROL

8.01 Federal and state regulations covering the storage and handling of liquid hydrocarbon fuels are becoming more prevalent and design engineers must be cognizant of them in their work.

8.02 The thrust of current regulations, covering petroleum-based hydrocarbon fuels, is in the areas of leaks or spills resulting in contamination of ground water or navigable waters. System Letter RL 82-03-505 discusses the requirements for gasoline and fuel storage facilities to comply with Spill Prevention and Countermeasure (SPCC) Plans. In addition, hydrocarbon vapors released into the atmosphere, primarily from gasoline, are covered in certain geographic areas.

8.03 Leakage of liquid fuels can be minimized by proper design, careful installation and periodic testing of underground fuel storage tanks. (See Part 9, In Service Testing.)

8.04 In certain areas of the country and under specific conditions, hydrocarbon vapor containment or recovery systems are presently mandated. All underground fuel storage tanks should, whenever practicable, have spare tank fittings accessible for future installation of a vapor recovery system.

8.05 Any underground fuel storage tank to be used for storage of gasoline shall have necessary fittings for both a Stage I and Stage II vapor recovery system.

8.06 A Stage I vapor recovery system is a means of preventing hydrocarbon vapors from escaping into the atmosphere while making transport drops into underground storage tanks by diverting the vapor back into the transport tank through a closed circuit system. During the drop, vapor which is already present, and additional vapor generated by the drop, being displaced by volume, is forced to the top of the tank and out through the vent line (or a special vapor return pipe), then diverted to the transport tank where it replaces the liquid being emptied from the transport.

8.07 A Stage II vapor recovery system is a means of controlling vapors emitted when a vehicle fuel tank is refueled. This requires, in addition to Stage I equipment, the provision of vapor return lines (from the dispenser location to the tank), vapor recovery nozzles, and vapor return lines from the nozzle to the pedestal containing the dispenser.

8.08 Due to the expense of excavating for vapor recovery piping at some future date, all new gasoline fueling installations should have the piping for a Stage II system installed before paving is put down. The vapor recovery piping should be capped off at the pump location and suitably identified for future use should a Stage II system be required. Size of vapor recovery piping shall be not less than supply piping.

9. IN SERVICE TESTING

9.01 Building codes usually cite the National Fire Protection Association (NFPA) Code 30 for requirements on handling and storage of flammable and combustible liquids.

9.02 As indicated in NFPA Code 30, accurate inventory records of fuel use, deliveries, and inventory on hand will provide an indication of possible leakage from tanks or piping. A tank system tightness test performed periodically only shows the tightness of the tank system on the day of the test. There is no assurance that the tank system will not develop a leak between that date and the date of the next periodic test.

9.03 Chapter IV of NFPA Code 329, "Leakage of Flammable Liquids," covers testing for underground leaks.

9.04 ***Warning: Under no circumstances shall air pressure greater than atmospheric be applied to any tank containing flammable liquids.***

9.05 Standpipe testing, as outlined in NFPA 329, is useful where it is desired to check the tightness of any underground fuel storage tank and its connected piping for gross leaks. It is not adequate for detecting small leaks nor for determining that a tank system is tight.

9.06 The final test, described in NFPA Code 329, will conclusively determine whether or not an underground liquid storage and handling system is leaking. An NFPA Code 329, "Final Test," will detect leaks as small as 0.05 gallons per hour.

9.07 A tank testing system that meets the NFPA 329 final test and results requirements is known as the Petro Tite Tank Tester. This system is manufactured by Health Consultants, Incorporated, Stoughton, Massachusetts, with branch offices throughout the United States.