

Installation of Underground LP-Gas Systems

SCOPE

This bulletin provides guidelines for the installation and inspection of underground LP-Gas systems and outlines some of the unique problems and conditions inherent in these installations that are not encountered when dealing with aboveground systems. It is not intended to cover all facets of every application, but is meant to be of general assistance to personnel who install and inspect underground LP-Gas systems.

INTRODUCTION

Underground containers present problems not encountered with aboveground containers. It is extremely important therefore, that anyone responsible for installation and inspection of these systems be trained, knowledgeable and fully competent in the selection and application of the equipment required and have comprehensive skills in the handling of LP-Gas.

If surface drainage and water table level are disregarded at the time of installation, the housing dome may be flooded. This may cause corrosion and/or malfunction of the fittings, valves, pressure relief valves, gauging devices and regulators as well as the corrosion of the container itself. Water in the dome might freeze in the winter months in some parts of the country. Therefore, proper drainage must be provided for the housing dome to eliminate accumulation of water. See Figure 2.

Foreign matter, dirt and insects may also enter the housing dome to these containers, which can cause leakage or impairment of valves, gauges and regulators.

Underground LP-Gas systems must be designed and installed in accordance with the provisions of **NFPA 58 Standard for the Storage and Handling of Liquefied Petroleum Gases**, **NFPA 54 National Fuel Gas Code** and all applicable state, provincial and local codes and regulations covering these installations.

Three classes of underground systems are covered in this bulletin:

1. **FULLY UNDERGROUND SYSTEMS**, in which the container is completely buried, with its top below the surrounding grade level. Approved container assemblies of this type are manufactured for underground use as well as for combination aboveground/underground applications, and are equipped with basic valves and fittings.
2. **MOUNDED UNDERGROUNDS SYSTEMS**, in which the container is partially buried, with its top above the surrounding grade covered with a layer of earth or other noncombustible material.
3. **Partially EXPOSED UNDERGROUND SYSTEMS**, in which a portion of the container is aboveground and not covered with a layer of earth or other noncombustible material.

The information in this bulletin covers all three classes, unless otherwise specified.

See Figures 1 and 2 for illustrations of typical underground systems using tanks of 2000 US gallons water capacity or less. See Figure 3 for an illustration of a typical underground system incorporating a larger tank.

CONTAINER PREPARATION BEFORE INSTALLATION

1. Only ASME containers constructed for underground service and marked accordingly shall be installed underground. DOT cylinders must be installed above ground.
2. Make certain that all fittings, including any plugged openings, are tight and free from leaks. Pressurize containers with air or LP-Gas vapor to make certain there are no leaks.
3. Purge containers in accordance with generally accepted industry practices. See **NPGA Safety Bulletin 133**, *Purging LP-Gas Containers*.
4. Clean rust, dirt and other foreign matter from the surface of the container, and visually inspect for gouges, dents, pits or other defects.
5. Apply a suitable coating to the container as recommended by NFPA 58 and by the coating manufacturer, for protection against moisture and corrosive action of the soil. Allow the coating to cure properly before moving the container.
6. Protect all points of contact while the container is being loaded and transported. Tire retreading, camelback, carpet, etc., may be used at support points and between the container and holding chains to prevent damage to the protective coating.

EXCAVATION AND SETTING

1. Install the container and the rest of the system in accordance with accepted standards such as NFPA 58, and/or the authority having jurisdiction. Make sure tank is located in accordance with spacing requirements. See Figure 1 and NFPA 58.
2. All underground containers and piping must be protected against corrosion in accordance with NFPA 58. See **NPGA Bulletin 152**, *Corrosion Protection for Underground Propane Gas Systems*.

<p>WARNING! Failure to provide proper protection can cause hidden corrosion and potential leaks as well as weakening of the tank wall over a period of time.</p>

3. The bottom of the excavation must be level and free of rock~ If rocks are present, a 6-inch bed of sand should be used. For completely buried tanks, the excavation must be dug to a proper depth to provide for the housing dome to extend far enough above ground level to prevent entrance of surface water (1 to 3 inches is common practice), allowing for grading away from the dome. See item 7. If conditions require it, suitable precautionary measures such as shoring should be taken to prevent cave-ins during excavation.
4. ASME container assemblies listed for underground installation, including interchangeable

aboveground/underground container assemblies shall be installed underground in accordance with NFPA58.

5. For mounded systems, the same general procedure shall be followed, except that the aboveground surface area of the tank must be covered with at least 1 foot of earth, sand, or other noncombustible, noncorrosive materials such as vermiculite or perlite.
6. For partially exposed systems, the same general procedure shall be followed, except that the housing dome would be aboveground, and the portion of the container below the surface and for a vertical distance of at least 3 inches above the surface, shall be protected to resist corrosion as required for underground containers.
7. In high ground water level areas, provisions shall be made to adequately secure the container to the ground, or to a concrete slab, to prevent flotation. Remember that a properly filled container can float because the density of LP-Gas is about half that of water. Local soil conditions may require other provisions to allow proper drainage from within housing dome. See Figures 2 & 3.
8. Precaution must be taken to prevent damage to the tank coating while transporting, lowering the tank into the excavation and while backfilling. Nylon cargo strapping is suggested instead of chain to minimize scratching. Any damage to the coating must be carefully repaired.

<p>WARNING! Any small, unprotected areas of a coated tank or wrapped or coated piping system may be subject to concentrated corrosive action resulting in the possibility of severe metal loss and ultimately a leak!</p>
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9. The container should be set substantially level on a firm foundation (firm earth may be used) and surrounded by earth or sand firmly tamped in place. Backfill should be free from rocks or similar abrasives.
10. Grade ground down and away from the housing dome to provide surface water drainage away from dome. See Figure 2.
11. The container should be filled immediately to minimize possible shifting due to flotation or introduction of moisture into the unpressurized tank.
12. Where underground containers are installed in locations subject to vehicular movement, such as automobiles, trucks, tractors, etc., protection shall be provided as follows:
 - a. Sufficient provision shall be provided to prevent the weight of such vehicular traffic from damaging the container or appurtenances. The container shell should be at least 18 inches below grade or be protected by a concrete slab or equivalent.
 - b. Barriers shall be provided to protect the housing dome, relief valve discharge stacks, filling risers and any appurtenances that extend above grade level. Such protection shall extend to sufficient height and be identified in areas where snow

accumulations occur.

CONNECTING FOR USE

1. The required relief valve capacity for fully underground or mounded containers may be reduced to 30 per cent of that required for aboveground containers. Pressure relief valves used in partially exposed containers must have capacities in accordance with aboveground requirements. Refer to NFPA 58 for specific information.
2. The discharge from relief devices protecting containers over 2000 gallons water capacity shall be piped vertically and directly upward to a point at least seven feet above the covering over the tank, and be protected against physical damage. For all underground containers used in LP-Gas service stations, regardless of size, the discharge from relief devices must be piped at least 10 feet above the covering over the tank. A protective raincap must be placed over the outlet of the discharge piping, in accordance with NFPA 58.
3. All connections to containers installed underground shall be located within the housing dome.
4. For containers over 2000 gallons water capacity, inlet and outlet connections (except relief devices, liquid level gauging devices and pressure gauges) shall be labeled or designate whether they communicate with the vapor or liquid space. The labels may be on the valves.
5. Install regulators so the vent openings are vertically down and above the highest possible water level. If a vent line is used, it should extend upward to the top of the dome and then be turned down not more than 1-1/2 inches below the inside of the housing dome cover. Bug screens must be installed in the regulator vent or on the end of the vent line. See Figure 2.

NOTE: A two-stage regulator system is recommended with the first stage regulator installed inside the housing dome. Blockage of the vent of a single stage regulator inside the dome due to ice, flooding or other cause could result in severe over-or-under-pressurization of appliances. It is far less severe if a first stage regulator were to be subjected to the same condition, since the second stage regulator is designed to compensate for changes in first stage pressure, helping to avoid a hazardous situation.

6. It is advisable, where problem water level conditions may occur, to equip the container with extended riser pipe(s) so that appurtenances may be positioned as high as possible in the housing dome.
7. Incorporate bulkheads and emergency shutoff valves in installations over 4,000 gallons water capacity, in accordance with NFPA 58. See NPOA Safety Bulletin 128 'Protection of Transfer Areas'
8. Black iron pipe used for filling risers, distribution lines, etc., must be coated and protected against corrosion in accordance with NFPA 58. This should include use of dielectric

unions at appropriate junctions to insulate all underground piping from the tank and buildings.

9. To minimize the possibility of trespassing and tampering, the container valves, fittings and unloading facilities for containers over 2000 gallons water capacity shall be protected against unauthorized operation. Suitable devices may be employed which can be locked in place to effectively prevent operation of any of the container appurtenances, valves or equipment. Suitable fencing may be used as an alternate, as provided in NFPA 58.
10. Pressure test and leak test the system in accordance with generally accepted industry Practices. See NPGA Safety Bulletin 403 "Pressure Testing and Leak Checking [P-Gas Piping Systems".

EXISTING INSTALLATIONS

1. Each time the container is filled or the system serviced, the equipment should be checked for possible damage, and water, dirt or other foreign matter removed and corrective action taken. Any corroded or damaged piping or equipment must be replaced promptly. Continuation of use of existing installations and repairs effected must be acceptable to the authority having jurisdiction.

WARNING! Replace any regulator if a high water mark is left in the housing dome above the regulator. Reposition when replacing to assure the regulator is high enough to prevent recurrence.

2. Remove any dirt or other foreign material from regulator vent opening, pressure relief valve and other appurtenances.
3. If the dome is full of ice, the pressure relief valves and pressure regulator will not function properly. Melt the ice safely with hot water or other acceptable method (DO NO USE OPEN FLAME) and remove the water before it refreezes. The container cannot be filled, evacuated or gauged until the ice is completely removed. All valves, gauges, fittings and regulators must be examined for evidence of damage and replaced where necessary.
4. If there is any indication that water has been too high in the dome housing, the container should be banked with earth to direct drainage away to a lower point to prevent recurrence. As an alternate, install a drain pipe from the bottom of the dome housing to a lower point (level) away from the container. See Figure 2. If water cannot be drained, it may be necessary to raise the tank and regrade to correct the problem.

WARNING! Installing a higher dome housing or an extension to the present one can create a suffocation hazard for the delivery person. (This is because oxygen in the housing may be depleted by propane vapor flowing from the fixed liquid level gauge. Leaning over into the dome to reach the gauge and breathing the atmosphere inside the housing can result in suffocation.)

5. Leak test the system in accordance with generally accepted industry practices whenever the system has been turned off or after running out of gas. See NPGA Safety Bulletin 403 and 102 "Out of Gas Procedures".

6. If cathodic protection has not been provided, steps such as pipe-to-soil potential tests should be taken to ascertain if additional protection is required.
7. If cathodic protection has been provided, pipe-to-soil potential tests should be taken on a periodic basis to ascertain the condition of the anode. Note: If the meter reaches at least negative 0.85 volts, the steel container or pipe is still under cathodic protection and the anode does not need to be replaced.

CONCLUSION

Underground containers present unique problems not experienced with those installed aboveground. It is important to make sure this is given careful consideration in the installation and inspection of underground systems to minimize problems and provide satisfactory service.

FIG. 1 CONTAINER SPACING – UNDERGROUND ASME CONTAINERS

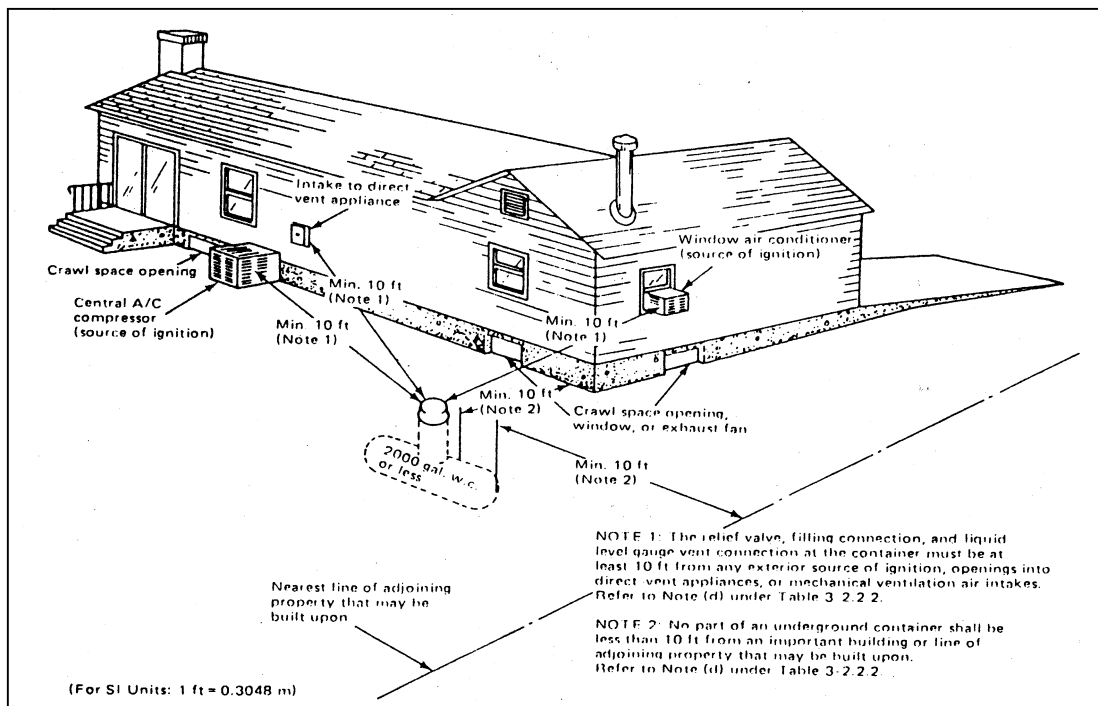


FIG. 2 UNDERGROUND LP-GAS CONTAINERS

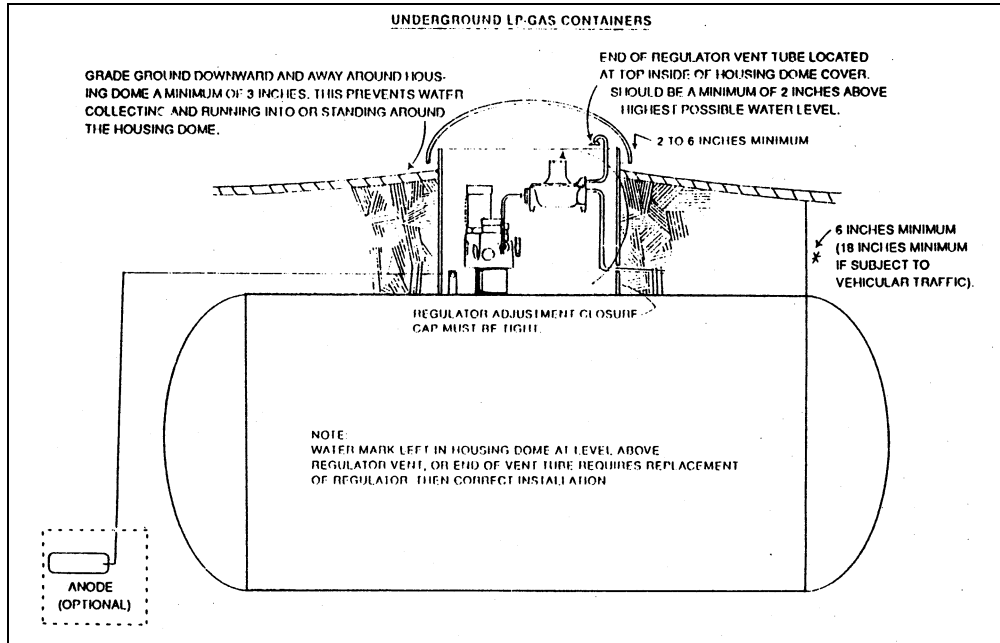
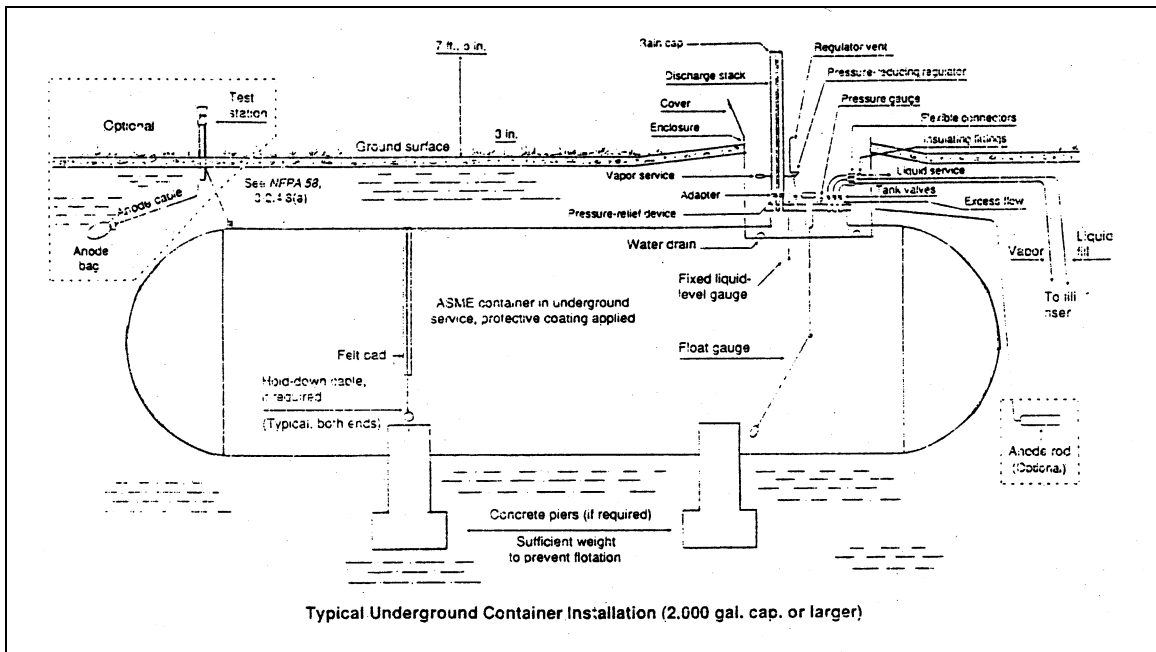


FIG. 3 TYPICAL UNDERGROUND CONTAINER INSTALLATION



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