

Regulation DD-20.0: LP Gas Installation

20.1 These Safety Guidelines cover outdoor and indoor portable LPG cylinders installations. It is intended for commercial, industrial and residential premises with food outlets, eating places, canteens, restaurants and other eateries which use portable LPG cylinders for cooking purposes.

20.2 All eating outlets shall not be permitted to use or store LPG cylinders within buildings unless the eating outlet is located on ground level & Cylinder Storage area is in the open area & naturally ventilated.

20.3 GENERAL REQUIREMENTS

20.3.1 All LPG cylinder installations shall be located outdoors and on the ground levels for all commercial and industrial buildings. Locating LPG cylinders indoor is normally not permitted, unless otherwise approved by EHS under special circumstances.

20.3.2 Private dwelling house is allowed to have a maximum of 30kg (2 x 15kg cylinders) to be installed or stored within the dwelling unit for domestic use.

20.3.3 NFPA 54 and NFPA 58 shall be referred to for requirements not effected or covered under these Safety Guidelines.

20.3.4 All LPG cylinders installations in commercial or industrial premises, including their Manifold /piping systems, shall be approved by EHS. LPG proposal drawings/plans submitting for approval shall include the following items:

- LPG's storage and manifold system.
- Location and site plans.
- Schematic diagrams of the LPG supply system showing change-over valve, vaporizer, regulator, emergency shut-off valve, remote cut-off device, knockout pot, pipe entry and all other required safety features i.e. gas detector / sensor, pressure gauge etc.
- Drawings/Plan and elevation views showing the following details:
 - Location, quantity and capacity (in kg) of LPG cylinders.
 - Locations of ancillary fixtures and fittings, e.g. vaporizer, regulators, emergency shut-off valve, change-over valves, remote cut-off device, knock-out pot, pipe entries, etc.

- Housing for the LPG cylinders, e.g. cabinets, fencing, compartment wall, etc.
 - All openings (doors, air intakes, windows, drains, manholes, etc.) and exits adjacent to the LPG installation.
 - Locations of hydrant, access way, access road, car parking area, building and boundary lines, source of ignition, etc.
 - Fire safety provisions, e.g. fire hose reel, fire extinguisher, sprinkler protection (if any), gas leak detector (if any), etc.
- 20.3.5 For LPG cylinders installation involving mechanical ventilation system and/or fire suppression system, separate Mechanical Ventilation plan and/or Fire Protection plan shall be submitted to EHS for approval.
- 20.3.6 Kitchen hood must be protected with wet chemical agent and fusible link detectors in accordance with NFPA 17A. System shall be UL/FM listed.
- 20.3.7 Minimum one 2 kg ABC dry powder type shall be provided inside kitchen/pantry in residential building area and two 9 kgs capacity ABC dry powder type fire extinguisher to be installed near gas cylinder storage area.
- 20.3.8 Fire blankets to be provided inside the kitchen.
- 20.3.9 Manual shut off valve shall be installed upstream and in accessible location at each gas regulators.
- 20.3.10 If car park is near the LPG storage – crash barriers guards shall be installed.
- 20.3.11 Tape marking will be done for buried gas pipe lines. Pipe sleeves are not recommended.
- 20.3.12 The gas sensors shall be explosion proof and UL listed.
- 20.3.13 The maximum design operating pressure for piping system located inside building shall not exceed 5 PSI.
- 20.3.14 Gas piping inside the building shall not be installed through a clothes chute, dumb waiter, elevator shaft or air duct.

20.3.15 Cooking appliances shall have a vertical clearance above the cooking top of not less than 30 inches (760 mm) to combustible material or metal cabinets. Only listed appliances, equipment, or accessories shall be installed. In-built house hold cooking appliances shall be installed in accordance with their manufacture instructions.

20.3.16 Gas cylinders should be kept in vertical condition only.

20.4 DESIGN REQUIREMENTS

20.4.1 For Use of LPG

The following factors shall be taken into consideration while designing for the installation and use of LPG cylinders:

- Adequacy of ventilation (Natural Open ventilation Area).
- Extent of usage of individual rooms.
- Existing fire hazards, possible source of heat & ignition.
- Suitable means of escape.
- Fire fighting equipment and provisions.

20.4.2 Codes of Practice & Standards

All cylinders and their ancillary fittings shall be designed, fabricated and tested in accordance with the accepted code or standard as stated in NFPA 58.

20.4.3 Fire Stopping

All pipes penetrating fire wall or floor slab shall be fitted with fire stoppers appropriately.

20.4.4 Pressure

No liquid LPG or LPG vapor at pressure exceeding 20 psi (approximately 138 kPa) shall be piped into any building.

20.4.5 Fire Extinguisher

The LPG installation shall be provided with at least two approved portable ABC rating Dry chemical fire extinguishers having a minimum capacity of 9 kg.

20.4.6 Warning Sign / Notice

- a. A warning sign or notice of minimum size of 800mm x 600mm shall be permanently and legibly displayed at the front of the installation.
- b. Red letterings of minimum height of 40 mm which reads: "LPG / HIGHLY FLAMMABLE / NO SMOKING / NO NAKED LIGHTS" on white background shall be written on the left portion of the warning sign/notice.
- c. Immediately under the classification of Hazmat, three equal boxes showing: (1) the emergency action (Hazchem Code); (2) the capacity/quantity in litres and (3) the telephone number and name of the supplier company whose specialized advice can be obtained at all times. (see Annex B)

20.5 REQUIREMENTS FOR OUTDOOR LPG CYLINDER INSTALLATION

20.5.1 Location of LPG Cylinders

- 20.5.1.1 LPG cylinders shall be placed on a firm, clean, dry and level base. They shall be sited at ground level and in a well-ventilated area where any gas leakage can safely and rapidly disperse. They shall not be placed close to any passageways or exits and shall not cause any obstruction or danger to the occupants during gas leakage or fire.
- 20.5.1.2 LPG cylinders shall not be located within 3m of any fire exit route of a building having only one exit. If the 3m distance cannot be complied with, a 2-hour fire rated masonry wall shall be provided between the fire exit and the LPG installation so as to achieve the equivalent 3m horizontal distance. The masonry wall shall be at least 1.8 m high.
- 20.5.1.3 The LPG cylinders shall be located at least 3m horizontally away from any openings (windows, doors, air vents, balanced-flue outlets, etc.) of the building having more than one exit. If the 3m distance cannot be complied with, a 2-hour fire rated masonry wall must be provided between the openings and the installation so as to maintain an equivalent 3m horizontal distance. The masonry wall should be at least 1.8m high.
- 20.5.1.4 A minimum distance of 3m must be maintained from the edge of a vehicle/car parking lot.

- 20.5.1.5 LPG cylinders shall be located at least 5m horizontally away from any mechanical air intake which is below any part of the manifold system and 3m from any mechanical intake which is above any part of the manifold system.
- 20.5.1.6 LPG cylinders should not be installed below windows or openings.
- 20.5.1.7 LPG cylinders of total capacity up to 400kg shall be located at least 3m distance from any uncovered opening that is below the level of the cylinders, such as drains, pits, openings to basements, etc.
- 20.5.1.8 LPG cylinders shall be located at least 3m away from any boundary and any fire engine access way.
- 20.5.1.9 LPG cylinders shall be located at least 10m away from any fire hydrant.
- 20.5.1.10 For ventilation opening/louvers at lower level for gas dispersion in case of gas leak should be provided.

20.5.2 Protection to LPG Cylinder Installation

- 20.5.2.1 LPG cylinders located in places accessible to the public shall be protected and locked against tampering and accidental damage by fencing of height not less than 1.8m, a suitable housing or a cabinet made of non-combustible material.
- 20.5.2.2
- The cylinder storage cabinet shall be 0.11 inch (2.66-mm) steel minimum with self-closing doors and self closing limited access ports or noncombustible windows to access equipment controls.
 - The cabinet shall be placed directly on a firm floor.
 - The cabinet shall be adequately ventilated with openings at the bottom of the cabinet.
 - The cabinet should always be kept free of any combustible materials.
- 20.5.2.3 There shall not be any corrosive, combustible, toxic or oxidizing materials located within 6 meters from the cylinder installation.

20.5.3 Safety Provisions

- 20.5.3.1 An approved gas-leak detection system shall be provided in the area or compartment where the internal LPG pipes and fittings are installed (approved by recognized certifying bodies, e.g. PSB?, UL or FM), with a local alarm connected to a main fire alarm panel. The system shall be linked to shut off the LPG supply automatically and activate local alert alarm. The gas-leak detector shall be located at low level and near to the possible leak areas such as the connecting hoses, LPG cylinder cabinets, etc.
- 20.5.3.2 For kitchen provided with fixed fire suppression system, activation of the system shall automatically shut off the supply of LPG to the kitchen.
- 20.5.3.3 Remote Emergency shut-off valve shall be located at least 3 m away from the edge of the installation. It shall be clearly marked and placed at a suitable height for easy access during emergencies.
- 20.5.3.4 There shall be no possible heat & ignition source within 3 m from the cylinder installation.
- 20.5.3.5 All fixed electrical equipment within 1.5m of the installation shall be spark-proof and intrinsically safe in accordance with the relevant clause in NFPA-54-58 & 70.
- 20.5.3.6 Vaporizers shall not be installed inside the steel cabinet or within the same housing of the LPG cylinders. Wall-mounted vaporizers shall be located at least 1.8 m above the ground and 600mm away from any LPG cylinder.
- 20.5.3.7 The distance between two separate manifold systems shall be at least 3 m. If a 2-hour fire rated wall is constructed, the distance between the two nearest cylinders may be halved.

20.5.4 Allowable Quantities

- 20.5.4.1 LPG cylinder installation (for eating outlets) with capacity up to a maximum of 450kg by weight attached to a single manifold system installed adjacent to a building is allowed provided that the following requirements are fully complied with:
- maximum two numbers of steel cabinets are allowed for each installation, and each cabinet is allowed to house a maximum of 4 x 50kg LPG cylinders;
 - the separation distance between the two cabinets shall be at least 600mm; and
 - the building is of non-combustible construction and the wall has a fire rating of at least 2 hours resistance.

d. the maximum number of LPG manifold systems shall not exceed two per building.

20.5.4.2 LPG cylinder installation of capacity exceeding 450kg to a maximum of 1000kg by weight attached to a single manifold system is allowed to be used for industrial applications only, provided that the following requirements are fully complied with :

- a. maximum two numbers of steel cabinets are allowed for each installation and each cabinet is allowed to house a maximum of 10 x 50kg LPG cylinders; and
- b. a 2-hour fire rated wall or a spacing of 3m shall be provided to separate the LPG cylinders into two groups of maximum 10 x 50kg per group.

20.6 REQUIREMENTS FOR INDOOR LPG CYLINDER INSTALLATION IN SEPARATE COMPARTMENT

20.6.1 General

20.6.1.1 LPG cylinder installation shall be properly located so as not to cause any obstruction to the fire escape and any danger to the public. Suitable access to the cylinder for emergency services shall be provided.

20.6.1.2 The edge of the installation shall be at least 3m from any boundary or any fire engine access way.

20.6.2 Safety Provisions

20.6.2.1 The area or compartment where the LPG cylinders, pipes works and ancillary fittings are installed should be sprinkler protected and an approved gas leak detector system shall be provided in that compartment, kitchen and dining area, with a local alarm connected to a main fire alarm panel. The leak detector should link to the exhaust fan control panel and the emergency shut-off valve where applicable.

20.6.2.2 The location of the gas leak detector should preferably be not more than 30cm above the ground level and not more than 4m away from the edge of the installation and the point of consumption.

- 20.6.2.3 Emergency shut-off valve should be installed outside the kitchen/cooking area door and be at least 1.5 m away from the gas stove & edge of the installation. It shall be clearly marked and at a suitable height to access during emergencies.
- 20.6.2.4 Fixed fire suppression system, if installed, shall be linked to the LPG cylinder installation in such a way that activation of the system shall automatically shut off the supply of LPG to the kitchen.
- 20.6.2.5 Vaporizers (where applicable) shall not be installed inside the compartment or within the same housing of the LPG cylinders.
- 20.6.2.6 The compartment shall only be used for LPG cylinder installation. No other usage is allowed.
- 20.6.2.7 The floor of the compartment shall be a smooth concrete base (rough surface might cause sparking during loading/unloading of cylinders) containing no opening or drain where vapor may accumulate and shall be level or slope down towards the ventilated external wall.
- 20.6.2.8 A ramp or sill of 250 mm high shall be provided across the doorway (where applicable) into the compartment where LPG cylinders are installed to contain any heavy LPG vapor within the compartment.
- 20.6.2.9 All electrical connections and appliances shall be installed in accordance with the relevant clauses in NFPA 58 & 70.
- 20.6.2.10 LPG cylinders may be installed in a separate compartment on the ground floor, provided the following requirements are complied with:

a. Allowable Quantity

- i) A maximum of 450 kg of LPG is allowed to be installed using a single manifold system inside a compartment. The number of cylinders is restricted to 8, regardless of the capacity of each cylinder (e.g. 2 groups of 4 x 50kg cylinders or 2 groups of 4 x 25kg cylinders).
- ii) The area or compartment in which the LPG cylinders are installed shall be sprinkler protected. If the compartment is not sprinkler protected, the quantity of LPG shall be halved (i.e. 125kg).

- iii) For commercial premises, the maximum number of LPG manifold system shall not exceed two per building.

b. Compartment

- i) The compartment shall have at least one external wall and there shall be no access from the compartment into the building.
- ii) Walls common to the compartment and the internal spaces of the building shall be 2-hour fire rated and shall be of masonry construction.
- iii) Each compartment shall contain only one number LPG manifold system.

c. Ventilation

- i) Doors shall have high and low level louvers and shall be opened outwards.
- ii) Natural ventilation is allowed if the total length of the compartment external wall is not less than 6m and the distance between the external wall and its opposite wall is not more than 3m. Otherwise, mechanical ventilation shall be provided.
- iii) High and low vents shall be provided on the external wall at just below ceiling level and above floor level. The total free area of the vents provided shall be at least 300 cm²/m² of floor area.
- iv) The vent openings shall be kept free from obstruction and shall not discharge directly onto a public place, e.g. a pavement or path. It shall not be less than 5m from any air intake openings and shall be at least 1.5m horizontally away from any building opening which is below the vent opening level.
- v) Where mechanical ventilation is used, air circulation shall be at least 0.3m³/ m² of floor area. Discharge outlets shall be at least 1.5m horizontally away from any building opening which is located below the discharge level.

20.7 LPG Cylinder Installation in Recessed Area

Building recess used for housing LPG cylinder installation shall comply with the following requirements:

a. Design

- i) The maximum depth of the recess shall be not more than 1m deep.

- ii) The floor, ceiling and the dividing walls between the recess and the internal spaces of the building shall be brick or concrete, noncombustible and shall have a fire resistant rating of not less than 2 hours.
- iii) Access to the recess shall only be from the external of the building.

b. Location

- i) The recess shall be at ground-floor level and shall be for the exclusive use of housing LPG cylinders.
- ii) The recess shall not be located within 3m of any fire exit route from a building that has only one designated means of exit. If the 3m distance cannot be complied with, a 2-hour fire rated masonry wall shall be provided between the fire exit and the installation so as to achieve the 3m horizontal distance.
- iii) The recess shall be located at least 1.5m from any horizontal openings (windows, doors, air vents, balanced-flue outlets, etc.) of the building having more than one designated means of escape, measured horizontally from the nearest LPG cylinder. If the 1.5m distance cannot be complied with, a 2-hour fire rated masonry wall shall be provided between the openings and the installation so as to achieve the 1.5m horizontal distance.
- iv) The recess shall be located at least 3m from heat and ignition sources.
- v) A minimum distance of 3m horizontal distance must be maintained between the nearest edge of a vehicle parking lot to the recessed area.
- vi) Recessed area located below windows or openings shall maintain is a minimum distance of 1.5 m between the top of the recessed area or any part of the manifold system (piping, vaporizer, etc., whichever is higher) and the bottom of the windows or openings.
- vii) LPG cylinders shall be located at least 5m horizontally from any mechanical air intake which is below any part of the manifold system and 1.5 m from any mechanical intake which is above any part of the manifold system.

c. Allowable Quantity

- i) A maximum of 450 kg of LPG is allowed to be installed using a single manifold system inside the recessed area. The number of cylinders is restricted to 8, regardless of the capacity of each cylinder (e.g. 2 groups of 4 x 50 kg cylinders or 2 groups of 4 x 25 kg cylinders).

- ii) The space or compartment where the pipe works and ancillary fittings are installed should be sprinkler protected (except for the recessed area). If not, the LPG quantity would be halved (225 kg).
- iii) For commercial premises, the maximum number of LPG manifold system shall not exceed two per building.

d. Safety

- i) Any pipe penetration on the walls of the recess area shall be suitably fire stopped to maintain the 2-hour fire resistance of the walls.
- ii) An approved gas leak detector system shall be provided in the compartment where the LPG pipes pass through, with a local alarm connected to a main fire alarm panel. The gas leak detector shall be linked to the exhaust fan control panel and the emergency shut-off valve where applicable.

e. Ventilation

Permanent unobstructed high and low ventilation openings, not less than 300 cm²/m² of recess floor area, shall be provided for venting the recess space to the outside of the building.

20.8 STANDARDS AND SPECIFICATIONS FOR LPG CYLINDER INSTALLATIONS

20.8.1 A.STANDARDS

The following standards for LPG cylinders and ancillary fittings shall be complied with:

1. Cylinder: NFPA 58 & DOT Specifications
2. Regulator: BS 3016, UL144 Gas Leak Detector: BS EN 50054, BS EN 50057 and BS 5345 Part 1 and 3
3. BS 3016 – Specifications for pressure regulators and automatic changeover devices for LPG
4. BS 5345 Pt 1 & 3 – The Code of Practice for Selection, Installation and
5. Maintenance of Electrical Apparatus for use in Potentially Explosive Atmospheres

20.8.2 B. SPECIFICATIONS

LPG Cylinder Fittings

a. Flexible hoses

- i. Hoses or flexible connectors used to supply LPG to utilization equipment or appliances shall be installed in accordance with the relevant clauses of NFPA 54 and NFPA 58. The hose shall be securely connected to the appliance. The use of rubber slip ends without hose clips shall not be permitted for domestic cylinders.
- ii. Hoses must be tested and passed the performance criteria in accordance with British Standard.

b. Regulators

Regulators shall comply with the BS 3016, UL144.

c. Over Pressure Protection Device

- i. An over pressure protection device (OPD) is a device to protect the down stream installation and shut off the gas flow if the outlet pressure exceeds the set limit.
- ii. In general, a regulator with OPD shall be designed to achieve the following:
 - ensuring reliable and continuous supply of LPG;
 - protecting down stream system against over pressure; and
 - protecting against failure of any regulating device.
- iii. Setting of OPD shall not be more than 30% of maximum operating pressure.

d. Valves

- i. Cylinder Valves shall comply with the BS standards and UL Listed.
- ii. Safety Valves shall comply with the BS standards and UL Listed
- iii. Hydrostatic relief valves designed to relieve the hydrostatic pressure that might develop in sections of liquid piping between two isolating valves shall be installed in each section. Hydrostatic valves shall comply with UL 132, Standard for Pressure Relief Valves for LPG.
- iv. Emergency shut-off valve (ESV) shall be provided after the knockout pot. The ESV shall be linked to a release mechanism so that the valve can be closed from a safe distance of at least 3m from the LPG cylinders. The ESV may incorporate fusible element which melts at not more than 250 degree Celsius when exposed to fire, allowing the ESV to close by itself.
- v. An accessible gas shutoff valve shall be provided at the upstream of each gas pressure regulator. Where two gas pressure regulators are installed in series in a single gas line, a manual valve shall not be required at the second regulator.

- vi Main gas shut-off valves controlling several gas piping systems shall be prominent and readily accessible for operation and properly installed so as to protect it from physical damage. They shall be marked with a metal tag or other permanent means attached by the installing agency so that the gas piping systems supplied through them can be readily identified.
- vii An exterior shut-off valve to permit turning off the gas supply to building in an emergency shall be provided and plainly marked.

e. Piping

- i. Pipe design and specifications shall be in accordance with the relevant clauses in NFPA 54 and NFPA 58. No polyethylene material is allowed to be used for the piping system.
- ii. Pipe material shall be tested and certified according to recognized ASTM or British Standards. The pipe supplier shall produce Mill certificates.
- iii. The manifold and main LPG supply pipeline shall be welded together as far as practicable. Welders for the piping work must be qualified and certified by a recognized body.
- iv. Pipelines pressure test must be witnessed and certified by a Third Party Professional Engineer (Mechanical).
- v. The liquid LPG pipelines shall be painted in "Blue" and the vapor LPG pipelines in "Yellow" with the marking of the word "LP-Gas" at intervals of not more than 3m.
- vi. When connecting additional gas utilization equipment to a gas piping system, the existing piping shall be checked to determine if it has adequate capacity. If inadequate, the existing system shall be enlarged as required, or separate gas equipment of adequate capacity shall be provided.

f. Pigtail

- i. Pigtail shall include a 6mm flexible hose or tube, a 6mm tee-check valve or excess flow valve and a 6mm ball valve.
- ii. Flexible hose shall be fabricated of materials resistant to LPG reaction both in liquid and vapor state. It shall be designed for a minimum bursting pressure of 1,750 PSI (121 bar) and working pressure of 350 PSI (24 bar). The hose shall be marked "LPG" at intervals of not more than 3m.
- iii. The tee-check valve shall be Underwriters Laboratories Inc. (UL) listed or it shall comply with other recognized/approved standard.
- iv. The ball valve shall be rated to at least 600 PSI (41 bar).

g. Pressure Gauge

- i. Each bank of LPG cylinder manifold shall have a pressure gauge.
- ii. For high-pressure sections, the gauge shall have a range of 0 to 300 PSI (0 to 20.1 bar)
- iii. For low-pressure sections, the gauge shall have a range of 0 to 50 PSI (0 to 3.45 bar)

h. Vaporizer

- i. Vaporizers, where applicable, shall be constructed in accordance with the applicable provision of NFPA 58, ASME Code or other recognized pressure vessel codes and standards for a design pressure of 250 PSI (17.24 bar) and shall be permanently and legibly marked with:
 - markings required by the Code;
 - the allowable working pressure and temperature for which it is designed; and
 - the name or symbol of the manufacturer.
- ii. Vaporizers shall be provided with a suitable automatic means to prevent the passage of liquid through the vaporizer to the vapor discharge piping. This feature shall be permitted to be integrated with the vaporizer or otherwise provided in the external piping.
- iii. Vaporizers shall have a manual shut-off valve and an automated valve (e.g. thermostatic, magnetic or float) which closes in the event of power failure or overload.
- iv. Vaporizers shall have relevant temperature control and the necessary safety features.
- v. Vaporizers shall have a pressure relief valve set at 250 PSI (17.24 bar) with the release point directed upward.

i. Knock-out pot

The knockout pot shall have at least two drain valves. The drain shall end at ground level and plugged at the end.

j. Gas Meters

- i. Installation and application of gas meters shall be in accordance with the relevant clauses in NFPA 54 and must be able to take a pressure of 20 PSI (1 PSI = 6.895 KPa).
- ii. Gas meters shall be selected for the maximum expected pressure and permissible pressure drop.
- iii. Vapor meters of the tin or brass case type of soldered construction shall not be used at pressure in excess of 1 PSI (7 KPa).
- iv. Vapor meters of the die cast or iron case type shall be permitted to be used at any pressure equal to or less than the working pressure for which they are designed and marked.
- v. Gas meters shall be located in ventilated spaces readily accessible for examination, reading, replacement or necessary maintenance.

- vi. Gas meters shall not be placed where they will be subjected to damage, such as adjacent to a driveway, under a fire escape, in public passages, halls or where they will be subjected to excessive corrosion or vibration.
- vii. Gas meters shall be located at least 1m from sources of ignition.
- viii. Gas meters shall not be located where they will be subjected to extreme temperatures or sudden extreme changes in temperature. Meters shall not be located in areas where they are subjected to temperatures beyond those recommended by the manufacturer.
- ix. Gas meters shall be supported or connected to rigid piping so as not to exert a strain on the meters.
- x. Gas meters shall be protected against over pressure, backpressure, and vacuum, where such conditions are anticipated.

k. Strainers

Strainers shall be designed to minimize the possibility of particulate materials clogging lines and damaging meters or regulators. The strainer element shall be accessible for cleaning.

20.8.3 Electrical Bonding and Grounding

- a. Electrical circuits shall not utilize gas piping or components as conductors.
- b. All electrical connections between wiring and electrically operated control devices in piping system shall conform to the requirements of NFPA 58.
- c. Any essential safety control (in the vaporizer) depending on electrical current as the operating medium shall be of a type that will shut off (fail safe) the flow of gas in the event of current failure.

20.8.4 Gas Leak Detection

- a. Gas leak detection system shall be provided for LPG pipes running in air conditioned areas (including the dining & kitchen area) or within basement floor).
- b. Gas leak detectors shall be connected to a localized alert alarm, emergency shut-off valve as well as the kitchen exhaust systems. The gas supply safety shut-off valve system shall also be interlocking with the kitchen automatic fire suppression
- c. LPG pipe installation shall not be permitted in the following areas:
 - i. in the ground under concrete flooring within building
 - ii. under building foundations
 - iii. within lift shafts and cavity walls
 - iv. in compartments or ducts dedicated for electrical switchgears, transformers or generators.

- v. in refrigeration chambers, cold rooms, air handling rooms and ventilation or air-conditioning ducts.
- vi. adjacent to pipes and vessels containing flammable, oxidizing, corrosive and other hazardous materials.
- vii. in fire-fighting lobby, fire command centers, smoke stop lobbies, fire pump rooms, fire-fighting water tank rooms, sprinkler control valve rooms, fire fighting riser ducts, areas of refuge, protected corridors, protected staircases, bedrooms and other occupied area etc.
- d. Proper metal pipe sleeves shall be installed for the gas pipes running in enclosed, unventilated areas or basement floor, and at last one end exposed directly to the exterior open safe space (it may be used to facilitate the gas leak detection system).
- e. Gas pipe running vertically shall be enclosed within a protected riser shaft & be fully fire separated from other M&E risers. Ventilation opening shall be provided for such gas riser.

20.8.5 List of Items to be included in the Drawing Submission for obtaining EHS NOC

- a. Endorsement on this guideline, NFPA 58, NFPA 54 standards and other relevant Code.
- b. Location and site plan associated with the LPG installation.
- c. Detailed plan and elevation views associated with the LPG installation showing the following:
 - i. Location and number of cylinders as well as quantity in kilograms.
 - ii. Housing for the LPG cylinders, e.g. cabinets, fencing.
 - iii. Location of ancillary fittings, e.g. vaporizer, 1st stage regulator, emergency shut off valves, change over valve, remote cable pull, knock out pot and pipe entry.
 - iv. Hydrant location, fire engine access way, source of ignition, boundary line, building line, internal roads and parking area.
 - v. Location of exits, staircases, details of horizontal openings (e.g. doors, air intakes and windows) and ground openings (e.g. drains, manholes and entrance to basement).
 - vi. Fire safety provisions like, hose reel, fire extinguishers, indication of sprinkler protection, gas leak detectors, mechanical ventilation, exhaust systems and fire suppression systems, where applicable. (Fire Protection Plan and Mechanical Ventilation Plan shall be submitted accordingly in addition to the Building Plan submission.)
- d. Hazard sign as indicated in ANNEX B and other relevant information associated with the LPG installation.

20.9 LPG TANKS INSTALLATIONS

General.

- a. LPG Tanks shall be designed, fabricated, tested, and marked (or stamped) in accordance with the applicable international regulations. e.g. ASME Boiler and Pressure Vessel Code, Section VIII, "Rules for the Construction of Unfired Pressure Vessels," or the API-ASME Code for Unfired Pressure Vessels for Petroleum Liquids.
- b. LPG Tanks that have been involved in a fire and show no distortion shall be re-qualified for continued service before being used or reinstalled.
- c. ASME or API-ASME LPG Tanks shall be retested using the hydrostatic test procedure applicable at the time of the original fabrication.
- d. LPG Tanks that show excessive denting, bulging, gouging, or corrosion shall be removed from service.
- e. Repairs or alteration of a LPG Tank shall comply with the regulations, rules, or code under which the LPG Tank was fabricated.
- f. Field welding shall be permitted only on saddle plates, lugs, pads, or brackets that are attached to the LPG Tank by the LPG Tank manufacturer.
- g. LPG Tanks for general use shall not have individual water capacities greater than 120,000 gal (454 m3).
- h. LPG Tanks in dispensing stations not located in LP-Gas bulk plants, industrial plants, or industrial applications shall have an aggregate water capacity not greater than 30,000 gal(114m3).
- i. Heating or cooling coils shall not be installed inside storage LPG Tanks.

20.10 ASME LPG Tank Openings

- a. ASME LPG Tanks shall be equipped with openings for the service for which the LPG Tank is to be used.
- b. The openings required by NFPA-58 (5.2.5.1) shall be located either in the shell, in the heads, or in a manhole cover.
- c. ASME LPG Tanks of more than 30 gal (0.1 m3) through 2000 gal (7.6 m3) wate capacity that are designed to be filled volumetrically shall be equipped for filling into the vapor space.

- d. ASME LPG Tanks of 125 gal (0.5 m3) through 2000 gal (7.6 m3) water capacity shall be provided with an opening for an actuated liquid withdrawal excess-flow valve with a connection not smaller than ¾-in. national pipe thread.
- e. ASME LPG Tanks of more than 2000 gal (7.6 m3) water capacity shall have an opening for a pressure gauge.
- f. ASME LPG Tanks in storage or use shall have pressure relief valve connections that have direct communication with the vapor space of the LPG Tank.
- g. If the pressure relief valve is located in a well inside the ASME LPG Tank with piping to the vapor space, then the design of the well and piping shall have a flow capacity equal to or greater than that of the pressure relief valve.
- h. If the pressure relief valve is located in a protecting enclosure, the enclosure shall be designed to minimize corrosion and to allow inspection.
- i. If the pressure relief valve is located in any position other than the uppermost point of the ASME LPG Tank, the connection shall be internally piped to the uppermost point practical in the vapor space of the LPG Tank.
- j. ASME LPG Tanks to be filled on a volumetric basis shall be fabricated so that they can be equipped with a fixed maximum liquid level gauge(s) that is capable of indicating the maximum permitted filling level(s).

20.11 LPG Tanks with Attached Supports

- a. Vertical ASME LPG Tanks of over 125 gal (0.5 m3) water capacity for use in permanent installations in stationary service shall be designed with steel supports that allow the LPG Tank to be mounted on and fastened to concrete foundations or supports.
- b. Steel supports shall be designed to make the LPG Tank self-supporting without guy wires and to withstand the wind and seismic (earthquake) forces anticipated at the site.
- c. Steel supports shall be protected against fire exposure with a material having a fire resistance rating of at least 2 hours.
- d. Continuous steel skirts having only one opening of 18 in. (460 m) or less in diameter shall have 2-hour fire protection applied to the outside of the skirt.
- e. Steel legs or supports shall be either welded to the LPG Tank by the manufacturer at the time of fabrication or attached to lugs that have been welded to the LPG tank.
- f. The legs or supports or the lugs for the attachment of legs or supports shall be secured to the LPG Tank in accordance with the code or rule under which the tank was designed and built, using a minimum safety factor of 4, to withstand loading in any direction equal to twice the weight of the empty LPG Tank and attachments.

20.12 LPG Tank Marking

- a. The markings specified for ASME LPG Tanks shall be on a stainless steel metal nameplate attached to the LPG Tank, located to remain visible after the LPG Tank is installed.
- b. The nameplate shall be attached in such a way as to minimize corrosion of the nameplate or its fastening means and not contribute to corrosion of the LPG Tank.
- c. Where the LPG Tank is buried, mounded, insulated, or otherwise covered so the nameplates obscured, the information contained on the nameplate shall be duplicated and installed on adjacent piping or on a structure in a clearly visible location.
- d. ASME LPG Tanks shall be marked with the following information:
 - i. Service for which the LPG Tank is designed (for example, underground, aboveground, or both)
 - ii. Name and address of LPG Tank supplier or trade name of LPG Tank
 - iii. Water capacity of LPG Tank in pounds or U.S. gallons
 - iv. MAWP in pounds per square inch
 - v. The wording "This LPG Tank shall not contain a product that has a vapor pressure in excess of ____ psig at 100°F" (See Table 5.2.4.2 of NFPA-58.)
 - vi. Outside surface area in square feet
 - vii. Year of manufacture
 - viii. Shell thickness and head thickness
 - ix. OL (overall length), OD (outside diameter), HD (head design)
 - x. Manufacturer's serial number
 - xi. ASME Code symbol
 - xii. Minimum design metal temperature ____°F at MAWP ____ psi
 - xiii. Type of construction "W"
 - xiv. Degree of radiography "RT-____"

20.13 LPG Tank Warning label requirements

- a. Warning labels shall be applied to all cylinders of 100 lb (45.4 kg) LP-Gas capacity or less that are not filled on site.
- b. Warning labels shall include information on the potential hazards of LP- Gas.
- c. LPG Tank appurtenances shall be fabricated of materials that are compatible with LP-Gas and shall be resistant to the action of LP-Gas under service conditions. The following materials shall not be used:
 - i. Gray cast iron.

- ii. Nonmetallic materials shall not be used for bonnets or bodies of valves or regulators.
- d. Pressure-containing metal parts of appurtenances shall have a minimum melting point of 1500°F (816°C), except for the following: (d1) Fusible elements (d2) Approved or listed variable liquid level gauges used in LPG Tanks of 3500 gal (13.2 m3) water capacity or less.
- e. LPG Tank appurtenances shall have a service pressure rating of at least 250 psig (1.7 MPag).
- f. Gaskets used to retain LP-Gas in LPG Tanks shall be resistant to the action of LP-Gas.
- i. Gaskets shall be made of metal or other material confined in metal having a melting point over 1500°F (816°C) or shall be protected against fire exposure.
- ii. When a flange is opened, the gasket shall be replaced.
- iii. Aluminum O-rings and spiral wound metal gaskets shall be permitted.
- iv. Gaskets for use with approved or listed liquid level gauges for installation on a LPG Tank of 3500 gal (13.2 m3) water capacity or less shall be exempt from the minimum melting point requirement.

20.14 Pressure Relief Devices

- a. ASME LPG Tanks shall be equipped with one or more pressure relief valves that are designed to relieve vapor.
- b. Cylinders shall be equipped with pressure relief valves as required by DOT regulations.
- c. DOT non refillable metal LPG Tanks shall be equipped with a pressure relief device(s) or system(s) that will prevent propulsion of the LPG Tank when the LPG Tank is exposed to fire.
- d. ASME LPG Tanks for LP-Gas shall be equipped with direct spring-loaded pressure relief valves conforming with applicable requirements.
- e. LPG Tanks of 40,000 gal (151 m3) or more water capacity shall be equipped with either a spring-loaded pressure relief valve or a pilot-operated pressure relief valve, as follows:
 - i. The pilot-operated relief valve shall be combined with and controlled by a self-actuated, direct, spring-loaded pilot valve.
 - ii. The use of a pilot-operated pressure relief valve shall be approved.
 - iii. Pilot-operated pressure relief valves shall be inspected and maintained by persons with training and experience, and shall be tested for operation at intervals not exceeding 5 years.
- f. The flow capacity of pressure relief valves installed on underground or mounded LPG Tanks shall be permitted to be reduced to 30 percent of the flow.
- g. Each pressure relief valve shall be plainly and permanently marked with the following:
 - i. The pressure in psig at which the valve is set to start-to-leak
 - ii. Rated relieving capacity in cubic feet per minute of air at 60°F (16°C) and 14.7 psia (101 kPa)
 - iii. The manufacturer's name and catalog number

- h. Pressure relief valves shall be designed to minimize the possibility of tampering.
- i. Externally set or adjusted valves shall be provided with an approved means of sealing the adjustment.
- j. Where used on aboveground LPG Tanks of 1200 gal (4.5 m³) or less in addition to spring-loaded pressure relief valves, fusible plugs shall be in accordance with the following:
 - i. Have a yield point between 208°F and 220°F (98°C and 104°C)
 - ii. Have a total discharge area not exceeding 0.25 in.² (1.6 cm²)
 - iii. Communicate directly with the vapor space of the LPG Tank
- k. ASME LPG Tanks over 4000 gal (15.2 m³) water capacity shall also be equipped with the following appurtenances:
 - i. An internal spring-type, flush-type full internal, or external pressure relief valve (*see Annex E of NFPA 58*)
 - ii. A fixed maximum liquid level gauge
 - iii. A float gauge, rotary gauge, slip tube gauge, or a combination of these gauges
 - iv. A pressure gauge
 - v. A temperature gauge

I. Valves requirement

- i. Manual shutoff valves shall be designed to provide positive closure under service conditions.
- ii. Excess-flow check valves shall be designed to close automatically at the rated flows of vapor or liquid specified by the manufacturer.
- iii. Excess-flow valves shall be designed with a bypass that shall not exceed a No. 60 drill size opening to allow equalization of pressure.
- iv.. Excess-flow valves of less than ½ in. (1.3 cm) NPT shall have a bypass that limits propane vapor flow to 10 scf/hr at 100 psig (690 kPag).
- v. Backflow check valves shall be of the spring-loaded or weight-loaded type with in-line or swing operation and shall close when the flow is either stopped or reversed.
- vi. Internal valves (*see 3.3.72.4, Internal Valve*), either manually or remotely operated an designed to remain closed except during operating periods, shall be considered positive shutoff valves.
- vii. Every LPG Tank designed to be filled on a volumetric basis shall be equipped with a fixed maximum liquid level gauge(s) to indicate the maximum filling level(s) for the service(s) in which the LPG Tank is to be filled or used.
- viii. Vertical filling — With the letters VDT followed by the vertical distance (to the nearest

- tenth of an inch) measured from the top center of the coupling where the gauge is installed to the maximum permitted filling level
- ix. Horizontal filling — With the letters HDT followed by the vertical distance (to the nearest tenth of an inch) measured from the centerline of the coupling opening in which the gauge is installed, that is located at the maximum filling level in the horizontal position, to the inside top of the cylinder
- x. Cargo tanks and ASME LPG Tanks utilizing multiple fixed liquid level gauges shall have the loading percentage (to the nearest percent) stamped adjacent to each gauge.

20.15 Pressure Gauges

- a. Pressure gauges shall be attached directly to the LPG Tank opening or to a valve fitting that is directly attached to the LPG Tank opening.
- b. If the cross sectional area of the opening into the LPG Tank is greater than that of a No.54 drill size, an excess-flow check valve shall be provided for the LPG Tank connection.

20.16 Other LPG Tank Connections

- a. LPG Tank openings shall be equipped with one of the following:
- i. A positive shutoff valve in combination with either an excess-flow check valve or a backflow check valve, plugged
- ii. An internal valve, plugged
- iii. A backflow check valve, plugged
- iv. An actuated liquid withdrawal excess-flow valve, normally closed and plugged, with the provision to allow for external actuation
- v. A plug, blind flange, or plugged companion flange
- b. ASME LPG Tanks where excess-flow or backflow check valves are installed between the LP-Gas in the LPG Tank and the shutoff valves shall be installed either inside the LPG Tank or at point immediately outside where the line enters or leaves the LPG Tank.

- ii. If excess-flow and backflow check valves are installed outside the LPG Tank, installation shall be made so that any strain beyond the excess-flow or backflow check valves will not cause breakage between the LPG Tank and the valve.
- iii. Shutoff valves shall be located as close to the LPG Tank as practical.
- iv. Shutoff valves shall be readily accessible for operation and maintenance under normal and emergency conditions.
- v. Shut off valves either shall be located in a readily accessible position less than 6 ft (1.8 m) above ground level or shall have extension handles, stairs, ladders, or platforms for access, or shall be equipped for remote operation.
- vi. Valves, regulators, gauges, and other LPG Tank appurtenances shall be protected against physical damage.
- vii. Connections to ASME LPG Tanks installed underground shall be located within a substantial dome, housing, or manhole and shall have a cover.
- viii. Underground LPG Tanks shall be installed so that all connections for hose and any opening through which there can be a flow from pressure relief devices or pressure regulator vents are located above the normal maximum water table.
- ix. Such manholes or housings shall be ventilated.
 - x. The area of ventilation openings shall equal or exceed the combined discharge areas of the pressure relief devices and other vent lines that discharge into the manhole or housing.
- xi. Every ASME storage LPG Tank of more than 2000 gal (7.6 m³) water capacity shall be provided with a pressure gauge.

20.17 **INSTALLATION OF LPG TANKS**

General Requirements

- a. LPG Tanks shall be positioned so that the pressure relief valve is in direct communication with the vapor space of the LPG Tank.
- b. LP-Gas LPG Tanks or systems of which they are a part shall be protected from damage from vehicles.
- c. Field welding on LPG Tanks shall be limited to no pressure parts such as saddle plates, wear plates, or brackets installed by the LPG Tank manufacturer.
- d. Aboveground LPG Tanks shall be painted.
- e. LPG Tanks shall be installed so that all LPG Tank operating appurtenances are accessible.

- f. Where necessary to prevent flotation due to possible high flood waters around aboveground or mounded LPG Tanks, or high water table for those underground and partially underground, LPG Tanks shall be securely anchored.

20.18 Installation of Horizontal Aboveground ASME LPG Tanks

- a. Horizontal ASME LPG Tanks designed for permanent installation in stationary service above ground shall be placed on masonry or other noncombustible structural supports located on concrete or masonry foundations with the LPG Tank supports.
- b. Where saddles are used to support the LPG Tank, they shall allow for expansion and contraction and prevent an excessive concentration of stresses.
- c. Where structural steel supports are used, they shall comply with 6.6.3.3 as per NFPA-58.
- d. LPG Tanks of more than 2000 gal (7.6 m³) water capacity shall be provided with concrete or masonry foundations formed to fit the LPG Tank contour or, if furnished with saddles in compliance with Table 6.6.3.3 as per NFPA-58, shall be placed on flat-topped foundations.
- e. LPG Tanks of 2000 gal (7.6 m³) water capacity or less shall either be installed on concrete or masonry foundations formed to fit the LPG Tank contour, or in accordance with 6.6.3.1(E) as per NFPA-58.
- f. LPG Tanks of 2000 gal (7.6 m³) water capacity or less equipped with attached supports complying with Table 6.6.3.3 as per NFPA-58 shall be installed on a fire-resistive foundation if the bottoms of the horizontal members of the LPG Tank saddles, runners, or skids are more than 12 in. (300 mm) above grade.
- g. LPG Tanks of 2000 gal (7.6 m³) water capacity or less shall not be mounted with the outside bottom of the LPG Tank shell more than 5 ft (1.5 m) above the surface of the ground.
- h. LPG Tanks of 2000 gal (7.6 m³) water capacity or less and LPG Tank-pump assemblies mounted on a common base complying with Table 6.6.3.3 shall be placed either on paved surfaces or on concrete pads at ground level within 4 in. (102 mm) of ground level.
- i. ASME LPG Tanks that have liquid interconnections shall be installed so that the maximum permitted filling level of each LPG Tank is at the same elevation.
- j. Horizontal ASME LPG Tanks with attached supports and designed for permanent installation in stationary service shall be installed in accordance with Table 6.6.3.3 as per NFPA-58.

20.19 Installation of Permanently Installed Horizontal ASME LPG Tanks with Attached Supports

- a. Where a single ASME LPG Tank complying with Table 6.6.3.3 as per NFPA-58 is installed in isolated locations with non fireproofed steel supports resting on concrete pads or footings and the outside bottom of the LPG Tank shell is not more than 5 ft (1.5 m) above the ground level, the approval of the authority having jurisdiction shall be obtained.
- b. The part of an ASME LPG Tank in contact with saddles or foundations or masonry shall be coated or protected to minimize corrosion.
- c. In locations where the monthly maximum depth of snow accumulation, as determined from the National Weather Service or other published statistics, is more than the height of aboveground LPG Tanks, excluding the dome cover, the following requirements shall apply:
 - i. A stake or other marking shall be installed higher than the average snow cover depths, up to a height of 15 ft (4.6 m).
 - ii. The LPG Tank shall be installed to prevent its movement resulting from snow Accumulation
- d. If the LPG Tank is mounted on or is part of a vehicle in accordance with 5.2.7.2(B), the unit shall be located in accordance with 6.3.1.
- e. The surface on which the vehicle is parked shall be level and if not paved shall be able to support heavy vehicular traffic and shall be clear of dry grass and weeds and other combustible material within 10 ft (3 m) of the LPG Tank.
- f. Flexibility shall be provided in the connecting piping in accordance with 6.8.7.
- g. Portable tanks of 2000 gal (7.6 m³) water capacity or less that comply with 5.2.7.3 as per NFPA-58 shall be installed in accordance with 6.6.3.1(E) as per NFPA-58.

20.20 Installation of Vertical ASME LPG Tanks

- a. Vertical ASME LPG Tanks over 125 gal (0.5 m³) water capacity designed for permanent installation in stationary service aboveground shall be installed on reinforced concrete or steel structural supports on reinforced concrete foundations that are designed to meet the loading provisions established in 5.2.4.3 as per NFPA-58.
- b. Steel supports shall be protected against fire exposure with a material that has a fire resistance rating of at least 2 hours, except that continuous steel skirts that have only one opening that is 18 in. (460 mm) or less in diameter shall have fire protection applied to the outside of the skirts.
- c. Vertical ASME LPG Tanks used in liquid service shall not be manifolded to horizontal ASME LPG Tanks.

- d. Vertical ASME LPG Tanks of different dimensions shall not be manifolded together.

20.21 Temporary LPG Tank Installations

- a. Single LPG Tanks constructed as portable storage LPG Tanks for temporary stationary service in accordance with 5.2.7.2(A) and 5.2.7.2(B) shall be placed on concrete pads, paved surfaces, or firm earth for such temporary service (not more than 12 months at a given location).
- b. The surface on which the LPG Tanks are placed shall be level and if not paved shall be clear of dry grass and weeds and other combustible material within 10 ft (3 m) of the LPG Tank.
- c. Flexibility shall be provided in the connecting piping in accordance with 6.8.7.
- d. Where portable storage LPG Tanks are installed at isolated locations with the bottoms of the skids or runners above the ground, either fire-resistive supports shall be provided or non-fire-resistive supports shall be permitted when all the following conditions are met:
 - i. The height of the outside bottom of the LPG Tank does not exceed 5 ft (1.5 m) above the ground.
 - ii. The approval of the authority having jurisdiction is obtained.

20.22 Installation of Underground and Mounded LPG Tanks

- a. ASME LPG Tank assemblies listed for underground installation, including interchangeable aboveground-underground LPG Tank assemblies, shall be installed underground in accordance with 6.6.6.1(A) through 6.6.6.1(L) as per NFPA-58.
- b. LPG Tanks installed in areas with no vehicle traffic shall be installed at least 6 in. (15 cm) below grade.
- c. In areas where vehicle traffic is expected, a no interchangeable underground LPG Tank shall be installed at least 18 in. (460 mm) below grade, or the LPG Tank shall be protected from damage from vehicles.
- d. Protection shall be provided for the fitting housing, housing cover, tank connections, and piping against vehicular damage.
- e. Where LPG Tanks are installed underground within 10 ft (3 m) of where vehicular traffic can be expected, protection against vehicular damage shall be provided for the fitting housing, housing cover, tank connections, and piping.
- f. Approved interchangeable aboveground-underground LPG Tank assemblies installed

- underground shall not be placed with the LPG Tank shell more than 12 in. (0.30 m) below grade.
- g. Any party involved in construction or excavation in the vicinity of a buried LPG Tank shall be responsible for determining the location of, and providing protection for, the LPG Tank and piping against their physical damage from vehicular traffic.
- h. Where a LPG Tank is to be abandoned underground, the following procedure shall be followed:
- As much liquid LP-Gas as practical shall be removed through the LPG Tank liquid withdrawal connection.
 - As much of the remaining LP-Gas vapor as practical shall be removed through a vapor connection.
 - The vapor shall either be recovered, burned, or vented to the atmosphere.
 - Where only vapor LP-Gas at atmospheric pressure remains in the LPG Tank, the LPG Tank shall be filled with water, sand, or foamed plastic or shall be purged with an inert gas.
 - If purged, the displaced vapor shall be either recovered, burned, or vented to the atmosphere.
 - The discharge of the regulator vent shall be above the highest probable water level.
 - LPG Tanks shall be coated or protected to minimize corrosion.
 - Any damage to the coating shall be repaired before backfilling.
 - LPG Tanks shall be set level and shall be surrounded by earth or sand firmly tamped in place.
 - Backfill shall be free of rocks and abrasives.

20.23 Partially underground, unbounded ASME LPG Tanks

These shall be installed as follows:

- The portion of the LPG Tank below the surface, and for a vertical distance of at least 3 in.(75 mm) above the surface, shall be coated or protected to minimize corrosion.
- Any damage to the coating shall be repaired before backfilling.
- LPG Tanks shall be set level and shall be surrounded by earth or sand firmly tamped in place.
- Backfill shall be free of rocks and abrasives.
- Spacing provisions shall be as specified for aboveground LPG Tanks in 6.3.1 and Table 6.3.1. as per NFPA-58
- The LPG Tank shall be located so as not to be subject to vehicular damage or shall be

protected against such damage.

20.24 Mounded LPG Tanks

These shall be installed as follows:

- a. Mounding material shall be earth, sand, or other noncombustible, noncorrosive materials and shall provide a minimum thickness of cover for the LPG Tank of at least 1 ft (0.3 m).
- b. A protective cover shall be provided on top of mounding materials subject to erosion.
- c. LPG Tank valves and appurtenances shall be accessible for operation or repair, without disturbing mounding material, as follows:
 - i. Where LPG Tanks are mounded and the bottom of the LPG Tank is 30 in. (0.76 m) or more above the surrounding grade, access to bottom connections shall be provided by an opening or tunnel with a 4 ft (1.2 m) minimum diameter and a 3 ft (0.9 m) minimum clear area.
 - ii. Bottom connections that extend beyond the mound shall be part of the ASME LPG Tank or shall be installed in compliance with the ASME Code and shall be designed for the forces that can act on the connections.
 - iii. Mounded LPG Tanks shall be coated or protected to minimize corrosion.

20.25 Installation of LPG Tanks on Roofs of Buildings

- a. Installation of LPG Tanks on roofs of buildings shall be prohibited, unless approved by the authority having jurisdiction and the fire department.
- b. Where the authority having jurisdiction and the fire department have approved an installation of a LPG Tank, it shall comply with the following:
 - i. The building shall be of Type I, 443 or 332, or Type II, 222, construction as specified in NFPA 220, *Standard on Types of Building Construction*.
 - ii. LP-Gas LPG Tanks installed on roofs shall be 2000 gal (7.6 m³) water capacity or less.
 - iii. The aggregate water capacity of LP-Gas LPG Tanks installed on the roof or terrace of a building shall not exceed 4000 gal (15.1 m³) in one location. Additional installations on the same roof or terrace shall be located at least 50 ft (15 m) apart.
 - iv. An ASME LPG Tank installed on the roof of a building shall always be filled by two operators, one at the controls of the vehicle supplying LP-Gas and another at the controls of the LPG Tank.

- V. LPG Tanks shall be installed in external locations only.
- VI. Where a fill line to the LPG Tank is required, it shall be located entirely outside the building.
- VII. The fill connection shall be located entirely outside the building.
- VIII. The fill connection shall be located at least 8 ft (2.4 m) above ground level.
- IX. LPG Tanks shall be installed on a level surface.
- X. The LPG Tank shall be secured to the building structure.
- XI. The support of the LPG Tank shall be designed to the same seismic criteria as the building.
- XII. The roof on which the LPG Tank is located shall be able to support the weight of the LPG Tank filled with water, with the safety margins required by local codes.
- XIII. LPG Tanks shall be located in areas where there is free air circulation, at least 10 ft (3 m) from building openings (such as windows and doors), and at least 20 ft (6.1 m) from air intakes of air-conditioning and ventilating systems.
- XIV. The location of LPG Tanks shall permit access to all valves and controls and shall have enough surrounding area to permit the required maintenance.
- XV. The location of the LPG Tank shall have fixed stairs or another method to reach it.
- XVI. If the installation requires the use of more than one LPG Tank, the distances between LPG Tanks from Table 6.3.1 shall apply.
- XVII. If the LPG Tank location is higher than 23 ft (7 m) from the ground, or the filling hose cannot be observed by the operators in its entire length, the LPG Tank shall have a filling line constructed to withstand liquid transfer, and it shall have the following appurtenances: filler valve with back check valve, filler valve cap, two control valves, hydrostatic relief valve, and venting line.
- XVIII. The liquid and vapor fill connections shall be conspicuously marked or labeled.
- XIX. An incident prevention review shall be prepared in accordance with 6.23.3.

20.26 Emergency Shutoff Valves

- a. On new installations and on existing installations, stationary LPG Tank storage systems with an aggregate water capacity of more than 4000 gal (15.1 m³) utilizing a liquid transfer line that is 1½ in. (39 mm) or larger and a pressure equalizing vapor line that is 1¼ in. (32 mm) or larger shall be equipped with emergency shutoff valves.
- b. An emergency shutoff valve shall be installed in the transfer lines of the fixed piping transfer system within 20 ft (6 m) of lineal pipe from the nearest end of the hose or swivel-type piping connections.

- c. When the flow is only into the LPG Tank, a backflow check valve shall be permitted to be used in lieu of an emergency shutoff valve if installed in the fixed piping transfer system downstream of the hose or swivel-type piping connections.
- d. The backflow check valve shall have a metal-to-metal seat or a primary resilient seat with metal back-up, not hinged with combustible material, and shall be designed for this specific application.
- e. Where there are two or more liquid or vapor lines with hoses or swivel-type piping connected of the sizes designated, an emergency shutoff valve or a backflow check valve where allowed shall be installed in each leg of the piping.
- f. Emergency shutoff valves shall be installed so that the temperature-sensitive element in the valve, or a supplemental temperature-sensitive element [250°F (121°C) maximum] connected to actuate the valve, is not more than 5 ft (1.5 m) from the nearest end of the hose or swivel-type piping connected to the line in which the valve is installed.
- g. Temperature-sensitive elements of emergency shutoff valves shall not be painted, nor shall they have any ornamental finishes applied after manufacture.
- h. The emergency shutoff valves or backflow check valves shall be installed in the fixed piping so that any break resulting from a pull will occur on the hose or swivel-type piping side of the connection while retaining intact the valves and piping on the plant side of the connection.
- i. Emergency shutoff valves and backflow check valves required by the code shall be tested annually for the functions required by 5.10.4. The results of the test shall be documented.
- j. All emergency shutoff valves shall comply with the following:
 - I. Each emergency shutoff valve shall have at least one clearly identified and easily accessible manually operated remote emergency shutoff device.
 - II. The shutoff device shall be located not less than 25 ft (7.6 mm) or more than 100 ft (30.5 m) in the path of egress from the emergency shutoff valve.
 - III. Where an emergency shutoff valve is used in lieu of an internal valve in compliance with 5.7.7.2(D)(2), the remote shutoff device shall be installed in accordance with 6.9.4.including mobile kitchens and catering vehicles, shall be provided with at least one approved portable

20.27 Spacing Requirements

- a. Where all the provisions of Section 6.24 are complied with, the minimum distances from important buildings and the line of adjoining property that can be built upon to underground

and mounded ASME LPG Tanks of 2001 gal through 30,000 gal (7.6 m³ through 114 m³) water capacity shall be reduced to 10 ft (3.0 m).

- b. Distances for all underground and mounded ASME LPG Tanks shall be measured from the LPG Tank surface.
- c. No part of an underground ASME LPG Tank shall be less than 10 ft (3 m) from a building or line of adjoining property that can be built upon, and no part of a mounded ASME LPG Tank that is installed above grade shall be less than 5 ft (1.5 m) from a building or line of adjoining property that can be built upon.

20.28 Other Information

a. Applicable Standards

The design , installation & Testing shall comply with NFPA – 54 ,NFPA58 & IGEM (Institution of Gas Engineers & Managers) latest Edition including the referenced ANSI , ASME , ASTM , CGA ,ISO , UL publications

b. Chase Construction.

Chase construction shall comply with the type of construction in accordance with NFPA101& 5000 in respect to fire resistance and protection of horizontal and vertical openings.

A chase shall be ventilated to the outdoors and only at the top. The opening(s) shall have a minimum free area (in square inches) equal to the product of one-half of the maximum pressure in the piping (in psi) times the largest nominal diameter of that piping (in inches), or the cross-sectional area of the chase, whichever is smaller.

c. Third Party Inspections, Tests and Certifications:

Third party inspections, tests and certifications shall be carried out through competent agencies of international repute.

d. Post-Construction Maintenance:

Clients shall ensure that maintenance manuals and contractual agreement(s) with concerned agencies are put in place for initial & subsequent regulatory approvals. The maintenance program shall include – among other things – biennial (2 yearly) integrity inspections, tests & certifications

20.29 WARNING SIGN / NOTICE

LIQUIFIED PETROLEUM GAS
HIGHLY FLAMMABLE
NO SMOKING
NO NAKED LIGHTS
FLAMMABLE GAS
2 HAZCHEM CODE
2WE
LICENSED QUANTITY
LPG n/e XXXX LITRES
IN CASE OF EMERGENCY
CALL ABC LP GAS SUPPLY

IN CASE OF FIRE CALL 997