Bangladesh Energy Regulatory Commission
(LPG Codes and Standards) Regulations, 2023
(Draft)

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Bangladesh Energy Regulatory Commission

Notification

Dated:.....,2023

BERC Codes and Standards No...../2023 – In exercise of the powers conferred by section 22 of the Bangladesh Energy Regulatory Commission Act.2003 (Act No 13 of 2003), the Commission is pleased to make the following codes and standards namely: -

1. Short title

1.1. Short title

These regulations shall be called the Bangladesh Energy Regulatory Commission (LPG Codes and Standards) Regulations, 2023.

1.2. Commencement

They shall come into force on the date of their publication in the Bangladesh Gazette.

2. General

2.1. Objective

The objectives of these Codes and Standards are to provide minimum requirement to protect the health, safety and environment for LPG Storage, Bottling, Transportation and Dispensing.

2.2. Scope

The scope of these Codes and Standards is to cover Storage, Bottling, Transportation and Dispensing including container, piping and associated equipment and appurtenances. These shall extend to the whole of Bangladesh.

These Codes and Standards do not cover refrigerated storage tanks or containers.

2.3. Interpretation

For any clarification the matter must be referred to the Commission. The decision of the Commission on any question relating to these codes and standards or any procedural matter there under shall be final and binding

3. Definitions, Terminology and Abbreviations

3.1. Definitions and Terminology

Some of the terms used in these Codes and Standards are defined below.

3.1.1. "LPG Codes and Standards" means LPG Storage, Bottling, Transportation and Dispensing Codes & Standards;

3.1.2. "Act" means the Bangladesh Energy Regulatory Commission Act, 2003 (Act No.13 of 2003).

3.1.3. "Adequate" means facilities so provided are in accordance with the prevalent recognized Codes and Standards of safety.

3.1.4. "Area of operation" means the area within which a licensee is authorized for storage, bottling, dispensing, transportation, refueling, distribution and marketing of LPG.

3.1.5. "Autogas" means LPG used in automobiles as laid down in Appendix B.

3.1.6. "BERC" means Bangladesh Energy Regulatory Commission established under the

Bangladesh Energy Regulatory Commission Act 2003.

3.1.7. "Bottling" means filling or refilling of cylinders (bottles) with LPG for the purpose of storage and distribution.

3.1.8. "Boundary" means the boundary of the whole of the site under the same occupancy as that on which the installation is included.

3.1.9. "Bulge" means swelling of the cylinder wall.

3.1.10. "Bulk Storage" means LPG base stock or LPG contained in a Tank having a capacity of more than 1,000 liters.

3.1.11. "Burn" means isolated heat affected section of cylinder wall caused by high temperature flame impingement.

3.1.12. "Capacity" means the total volume of the space enclosed within the tank or cylinder expressed in liters or kiloliters which is often referred to as water capacity.

3.1.13. "Combustible liquid" means liquid petroleum whose flash point is 37.8° C or higher, also when tested by closed-cup methods.

3.1.14. "Commission" means the Bangladesh Energy Regulatory Commission established under the Bangladesh Energy Regulatory Commission Act, 2003.

3.1.15. "Consumer" means any person or company who is supplied with LPG by a licensee for his own consumption and not for storage, processing, filling, sale, re-sale or distribution.

3.1.16. "Container" means any cylinder, tank or vessel, portable or otherwise, used for storage, transportation and distribution of LPG.

3.1.17. "Conversion kit or original equipment manufacturer (OEM) fitting means a complete system assembly duly approved for use in bi-fuel mode, the tank with accessories of the conversion kit should be fixed firmly in the boot of the car.

3.1.18. "Cut" or "Gauge" means a sharp impression where the metal has been removed or redistributed.

3.1.19. "Cylinder" means any container having a water capacity of more than 500 milliliters (ml) but less than 1,000 liter as laid down in Appendix A.

3.1.20. "Decanting" means the transfer of LPG from one container to another.

3.1.21. "Defaulter" means a person or company or its directors or any employee who fails to fulfill its contractual and legal obligations whether willfully or negligently.

3.1.22. "Degassing" means gas free of the cylinders which shall be done by purging the same by inert gas, steam or by filling water till it overflows. In the case of purging by water, the water shall be retained for not less than one hour to ensure that the entire vapour or gas remaining in the cylinder comes out. After emptying out the water, the cylinders shall be kept in inverted position and tapped gently with a non-metallic hammer to remove dust, rust or any loose remnants in the cylinder. After degassing the inside of the LPG cylinder shall be checked by an explosive meter to ensure that the cylinder is gas free and shall again be taken up for degassing until it is completely gas free.

3.1.23. "Dent" means a blunt depression where the surface material has not been penetrated.

3.1.24. "Dig" means a blunt depression where the surface material has been penetrated.

3.1.25. "Distributor" means a person or company appointed by a licensee for the purpose of

storing and distributing of LPG in cylinders, exceeding 500 kg/month, to a consumer and also being a licensee of the Commission.

3.1.26. "Dispenser" means a device or system designed to transfer and measure LPG into engine fuel and mobile container on the vehicle.

3.1.27. "Dispensing Station" means the premises with fixed equipment in which LPG is stored and dispensed in to portable container or motor vehicles for automotive purposes.

3.1.28. "Earthing" means a system connected with the equipment through which electricity can flow to the earth.

3.1.29. "Electric Apparatus" means motors, starters, lamps, switches, junction boxes, fuse, cut-outs, or any other appliance, equipment, or fitting that operates on electricity.

3.1.30. "Emergency shut-off-system" means a control system that facilitates safe LPG shut-down in an emergency.

3.1.31. "Excess flow valve" means a normally open valve that closes automatically when a predetermined flow rate in a particular direction has been exceeded.

3.1.32. "Firewall" means a wall or other barrier constructed and placed with the object of preventing the spread of fire or the radiation of heat from any one place to some other place.

3.1.33. "First-Stage Regulator" means a pressure regulator for LPG designed to reduce pressure from a container to 10.0 psig (69 kPa g) or less.

3.1.34. "Flammable liquid" means liquid petroleum whose flash point does not exceed 37.8^{O}C when tested by closed-cup test methods.

3.1.35. "Hot work" means any work that involves welding, burning, soldering, brazing, sand blasting, chipping by spark producing tools, use of power-driven tools, non- flame proof electrical equipment, equipment with an internal combustion engine or any other machine or work that is likely to produce spark or sufficient heat capable of igniting inflammable gas.

3.1.36. "Ignition source" means a source of energy sufficient to ignite a flammable atmosphere and includes naked flames, smoking, exposed incandescent material, electrical welding arcs and electrical or mechanical equipment not suitable for use in the particular hazardous zone.

3.1.37. "Installation" means the premises, in any place wherein tanks, vessels, pumps, compressors, piping, and accessories have been specially prepared, earmarked or required for the receipt, storage and transfer of LPG.

3.1.38. "Leak Grades 1" means -A LPG leak that represents an existing or probable hazard to persons or property, and requires immediate repair or continuous action until the conditions are no longer hazardous.

3.1.39. "Leak Grades 2" means that it is recognized as being nonhazardous at the time of detection, but requires a scheduled repair based on a probable future hazard.

3.1.40. "Licensee" means a company or individual who holds a license under BERC regulations,2006.

3.1.41. "LPG" or "LP Gas" means Petroleum Gas, predominantly a mixture of propane, propylene, butane (normal or isobutene), butylenes which is gaseous at normal

temperature and pressure, and liquefiable under reduced temperature or moderate pressure as laid down in Appendix 'C'.

3.1.42. "LPG Bottling Facilities" means the licensed facility used for the storage and bottling of LPG for domestic, commercial, or industrial use.

3.1.43. "LPG Reticulation System" means the system where LPG is supplied through a pipeline network from a centralized storage (Cylinder bank/manifold or Bulk Tank) to end users (domestic, commercial, industrial, etc.).

3.1.44. "Meter" means any equipment or apparatus used for the purpose of measuring any quantity of or LPG supplied and includes all kinds of apparatus upon whose reading or indication for any supply or sale of LPG as the case may be, is wholly or partly determined in a specified or unspecified time.

3.1.45. "Order" means any order, directive or decision of the Commission.

3.1.46. "Overfilling Prevention Device" means a safety device that is designed to provide an automatic means to prevent the filling of a container in excess of the maximum permitted filling limit.

3.1.47. "Overpressure Shutoff Device" means a device that shuts off the flow of LP-Gas vapor when the outlet pressure of the regulator reaches a predetermined maximum allowable pressure.

3.1.48. "Person" means any individual, company, co-operative society or a group of persons incorporated together.

3.1.49. "Pit" means local corrosion not in excess of 6 mm diameter and occurring not more frequently than 1 (one) in any 500 mm^2 of the surface.

3.1.50. "Portable Container" means a container designed to be moved readily, as opposed to a container designed for stationary installations;

3.1.51. "Portable Storage Container" means a container similar to but distinct from a container that is designed for stationary installation, and that is designed and constructed to be moved readily over a highway from one usage locations to another, substantially empty of liquid.

3.1.52. "Positive shutoff" means a valve that, when actuated to the closed position blocks off all flow. The actuating stem shall be permanently connected to the flow blocking components.

3.1.53. "Product" means LPG.

3.1.54. "Project" means any proposed activity or any prescribed activities in addition to the present activity of the licensee that has been sent to the Commission for approval.

3.1.55. "Protected area "or "protected place" means any of the following:

(a) A dwelling, place of worship, public building, school or college, hospital, theater or any building or open area in which persons are accustomed to assemble in large numbers, whether within or outside the property boundary of the installation;

(b) A factory, workshop, office, store, warehouse, shop or building where the people are employed, that is outside the property boundary of the installation.

3.1.56. "Protected work" means a building in which persons dwell or assemble, docks, wharves, furnaces, heaters, kilns, or chimneys or any public road, railway line or

overhead high-tension power line.

3.1.57. "psia/psig" means a unit of pressure expressed in pounds per square inch, "a" denotes absolute pressure and "g" denotes gauge pressure.

3.1.58. "Public place" means any place, other than private property, open to the public and including a street or road

3.1.59. "Regulation" means any regulation framed under the Bangladesh Energy Regulatory Commission Act, 2003.

3.1.60. "Retailer" means a licensee or a person or company appointed by a licensee for the purpose of storing and/or distributing or selling of LPG in cylinders directly to a consumer.

3.1.61. "Scheme" means any program or project to be undertaken by the licensee on the basis of the licensee's requirements.

3.1.62. "Second-Stage Regulator" means a pressure regulator for LPG vapor service designed to reduce first-stage regulator outlet pressure to 0.58 psig, 4.0 kPag, 40 milli barg or less.

3.1.63. "Shall" means a provision that is mandatory.

3.1.64. "Source of LPG" means any refinery or unit connected to well-head for the production, separation, stripping or liquefying of LPG by chemical or any other process within the country or any country from where LPG may be supplied into Bangladesh.

3.1.65. "Store" means to store LPG for transportation, distribution and marketing.

3.1.66. "Tare weight" means the weight of a container, including the weight of the regulator and safety cap is deducted from the total weight to determine the weight of the content.

3.1.67. "Transportation" means the activity of transporting LPG through a pipe line, tank lorries, trucks or bowsers, except where the pipe line is an integral part of the refueling station or LPG facilities.

3.1.68. "Technical competence" means the technical competence of a company entitled by its memorandum of association or any other appropriate instrument to engage in operational activities like stripping, separation, liquefaction, processing/blending and/or distribution activities like loading, unloading, transmission, storage, filling and/or supply of LPG and to possess a team of qualified and trained (refresher training shall be provided at least every 3 (three) years and be documented) technical and professional personnel, with at least one experienced and trained graduate Engineer, to safely undertake or cause to be undertaken the above mentioned activities which are to be finally inspected and certified by the Commission or an independent third party agency appointed by the Commission.

3.1.69. "Transmission line" means a pipeline used for transportation of LPG whether in liquid or gaseous form for the purpose of storage, sale to or by a licensee.

3.1.70. "Undertaking" means any entity or part of it relating to Operation, Storage, Supply, Distribution and Marketing of LPG that includes supplying LPG Refueling station or the Retailer.

3.1.71. "Vehicle" means all carriage for transportation of LPG either in bulk or otherwise

than in bulk.

3.1.72. "Water Capacity or WC" means the amount of water, either in Kilograms or liters at 15C required to fill a container full of water.

3.1.73. "Water deluge system" means a fixed fire protective system that completely floods an area with pressurized water through piping with open nozzles and sprinklers.

3.1.74. "Works" include plants, installations, transmission lines, machinery or equipment owned, controlled, operated or managed, by a licensee for the purposes of operation, storage, bottling, dispensing and distribution of LPG.

3.1.75. "Zone 0" means an area in which an explosive gas-air mixture is continuously present in normal operation.

"Zone 1" means an area in which an explosive gas-air mixture is likely to occur in normal operation, and if it occurs it will only exist for a short time.

Zone 2 – An area in which an explosive gas-air mixture is not likely to occur in normal operation, and if it does, it will only exist for a short time. By implication an area that is not classified as Zone 0, 1 or 2 is deemed to be non-hazardous or safe with respect to the operation of electrical equipment.

3.2. Abbreviations

The abbreviations used in these Codes and Standards are defined below:

3.2.1. "ANSI" means American National Standard Institute.

3.2.2. "API" means American Petroleum Institute.

3.2.3. "ASME" means American Society of Mechanical Engineers.

3.2.4. "ASTM" means American Society for Testing and Materials.

3.2.5. "BERC" means Bangladesh Energy Regulatory Commission established under the Bangladesh Energy Regulatory Commission Act, 2003.

3.2.6. "BS" means British Standards.

3.2.7. "DOT" means Department of Transportation, USA.

3.2.8. "IEE" means the Institute of Electrical Engineers.

3.2.9. "IP" means Institute of Petroleum.

3.2.10. "LPG" means liquefied Petroleum Gas.

3.2.11. "LPGITA" means Liquefied Petroleum Gas Industry Technical Association, UK.

3.2.12. "NFPA" means National Fire Protection Association, USA.

4. LPG Storage Tank and Tank Accessories

4.1 LPG Storage Tank (Aboveground, Underground and Mounded)

4.1.1. Location

i. The LPG container shall be located outside of buildings.

ii. Pressurized LPG tanks or containers shall not be located within buildings, within the spill containment area of flammable or combustible liquid storage tanks.

iii. The containers shall not be located or installed underneath any building. It shall be set upon a firm foundation.

4.1.2. Odorant

i. Stationary storage facilities shall have equipment to add odorants to LPG.

4.1.3. Design and Construction

a. **General:**

i. Containers and vessels shall meet the requirements of the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 or 2 or other equivalent internationally accepted codes and standards. All material of construction shall meet the requirements of Section II of the same code for LPG having a minimum design pressure of 17 kg/ cm^2 at 65^0 C.

ii. The minimum horizontal distance between the shells of aboveground LPG tanks, spheres or pressurized vessels shall be 1.5 meters or half of the diameter of the larger vessel, whichever is larger.

iii. Horizontal LPG tanks with capacities of 45 m^3 or greater shall not be formed into groups of more than six tanks each

iv. The maximum permissible filling height of an LPG tank or cylinder shall be set to provide adequate vapor space to accommodate any thermal expansion that may occur after filling is completed. A vapor space of not less than 15% of its capacity shall be kept in each case.

v. Flange connections shall be a minimum of ASME Class 300.

vi. All fittings shall be a minimum of NPS ¾.

b. **Aboveground**: The design of the foundation of the aboveground tank should take into consideration:

i. Ground conditions with special reference to the allowable bearing pressures.

ii. The necessity to avoid flotation, if there is a risk of flooding, by securely anchoring, weighting or using an adequate height.

iii. It is necessary to avoid settlement particularly differential settlement.

iv. Expansion and contraction of the tank shell.

v. The greatest combined effect incurred by static loading is due to the weight of the tank, its contents, water used for hydrostatic testing, wind loading and operational loading such as vibration, thermal effects etc.

vi. No permanent source of heat should be located within 15 meters of an LPG storage tank.

vii. Weeds, long grass, deciduous shrubs and trees, and any combustible material should be removed from an area within the required minimum safety distances.

viii. LPG storage tanks shall not be located directly beneath electrical power cables.

c. Underground:

i. Tanks shall be set on firm foundations and shall be securely restrained against flotation. It should meet the requirements of NFPA 58.

ii. Tank venting systems shall be provided with:

(a) Sufficient capacity to prevent the back flow of vapor or liquid.

(b) Overfill protection equipment that will operate:

1. Automatically shut off the flow of liquid into the tank when the tank is more than 90 percent full.
2. Alert the transfer operator when the tank is no more than 90 percent full by restricting the flow of liquid into the tank or triggering the high-level alarm.
3. Other methods are approved by the authorized person having jurisdiction.

iii. The back-fill material should be free of rocks or other abrasive material and should be carefully consolidated.

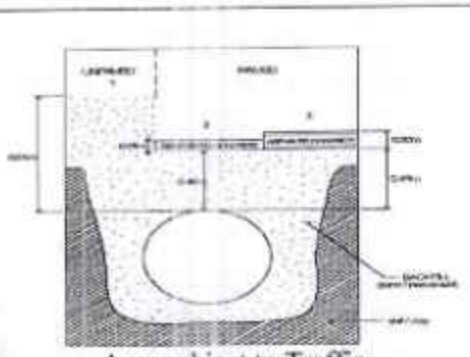
iv. Underground tanks installed in areas with no vehicle traffic shall be installed at least 0.15 m (6 in.) below grade. In areas where vehicle traffic is expected, a non-interchangeable underground tank shall be installed at least 0.460 m (18 in.) below grade, or the tank shall be protected from damage from vehicles.

v. In areas that are subject to or are likely to be subject to traffic (see Figure 1 and Figure 2), the cover shall consist of one of the following options:

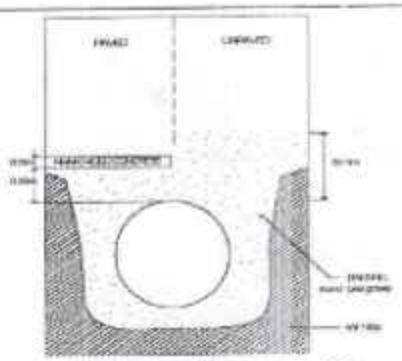
(a) a minimum of 0.91 m (36 in.) of well tampered backfill

(b) a minimum of 0.46 m (18 in.) of well tampered backfill, plus at least 0.15 m (6 in.) of reinforced concrete

(c) minimum of 0.46 m (18 in.) of well-tempered backfill, plus at least 0.20 m (8 in.) of asphaltic concrete.



Area subject to Traffic
Figure 1



Area not subject to Traffic
Figure 2

vi. Tank fittings and appurtenances shall be accessible for operation or repair without disturbing the mounding materials.

vii. Protection shall be provided for the fitting housing, housing cover, tank connections and piping against vehicular damage.

viii. Underground tanks shall be protected from superimposed above ground loading, e.g. due to vehicular traffic or other cause, either by fencing off the area under which tanks are buried or protecting them with a reinforced concrete slab or other adequate cover. If the tank area is not fenced off, the tank manhole cover and the tank fittings should be protected against damage and tampering.

ix. Underground tanks must be protected against corrosion by suitable coatings and cathodic protection.

4.1.4. Safety Distance

The minimum horizontal distance between the shell of a pressurized LPG tank and the line of adjoining property, installation, building, public gathering place, heater or furnace shall be in accordance with Table1.

Table 1

Water Capacity, liters	Minimum Distance, meters	
	Aboveground tank	Underground or mounded tank
Up to 2,000	5	3
2,001-10,000	10	5
10,001-20,000	15	7.5
20,001-40,000	20	10
40,001-250,000	25	15
250,001-350,000	30	15
350,001-450,000	40	15
450,001-750,000	60	15
750,001-3,800,00	90	15
Over 3,800,000	120	15

The minimum safety distance in meters for Total Storage above 100 MT:

Table 2

From/To	Storage Vessel	Property line/ buildings not associated with storage and operation	Sheds for filling storage evacuation of cylinders	Tank Truck loading/ Unloading gantry	Tank Wagon gantry	Pump/ compressor Shed	Fire Water Pump room
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Storage vessel	Table-1	Table-1	30	30	50	15	60
Property line/ buildings not associated with storage and operation	Table-1	--	30	30	50	30	--
Sheds for filling storage evacuation of cylinders	30	30	--	30	50	15	60
Tank Truck loading/unloading gantry	30	30	30	--	50	30	60
Tank Wagon gantry	50	50	50	50	--	30	60
Pump/compressor Shed	15	30	15	30	30	--	60
Fire Water Pump room	60	--	60	60	60	60	--

The minimum safety distance in meters for total storage up to 100 MT:

Table 3

From/To	Storage Vessel	Property line/buildings not Associated with storage and operation	Sheds for filling storage, evacuation of cylinders	Tank truck unloading/ loading gantry	Fire Water Pump room
Storage Vessel	Table-1	Table-1	Table-1	15	30
Property line/buildings not associated with storage & operation	Table-1	--	15	15	--
Sheds for filling storage, evacuation of cylinders	Table-1	15	--	15	30
Tank truck unloading/loading gantry	15	15	15	--	30
Fire Water Pump room	30	30	30	30	--

Minimum Safety distances (in meters) between facilities associated with storage and dispensing of LPG in dispensing station as automotive fuel to motor vehicles:

Table 4

From	LPG Storage Vessels (m)	Fill point of LPG storage vessel and Centre of LPG Tank-Truck unloading hard stand (m)	LPG Dispenser (m)	Property Line (m)	Petrol or diesel service Station (m)		
					Fill point of petrol / diesel tanks	Vent pipe of petrol / diesel tanks	Petrol / diesel dispensing pump
Petrol/ diesel dispensing pump	Table-1	3 (underground vessel) 6 (aboveground/mounded vessels not exceeding 7500 litres) 9 (aboveground/mounded vessels exceeding 7500 litre)	9 (aboveground vessels not exceeding 20,000 litres or underground/ mounded vessels) 15 (aboveground Vessels exceeding 20,000 litres)	Table -1	9	9	9
Fill point of LPG storage vessel and Centre of LPG Tank-Truck unloading hard stand	9 (aboveground/mounded vessels exceeding 7500 litres capacity) 6 (aboveground/mounded vessels not exceeding 7500 litres capacity)	--- 6	6 ---	9 6	6 6	6 6	6 6
LPG Dispenser	3 (Underground tank) 9 Vessels not exceeding 20,000 litres or underground/ mounded vessels 15 (aboveground vessels Exceeding 20000 Litres)	9	---	6	3	4	6
Property line	Table-1	6	6	---	6	6	6

4.1.5. Firewall

i. Fire or radiation walls may permit separation distances to be reduced. They should be of such length that the distance from the tank to a boundary or fixed ignition source measured around the end of the wall is not less than the required safety distance.

ii. The fire wall must be solid, without openings, and constructed from brick, concrete or other suitable non-combustible material and for tanks up to and including 500 liters of water capacity, they shall not be less than the height of the tank. For larger tanks they shall not be less than 2 m high or the height of the tank, whichever is greater.

iii. Not more than two fire walls should be provided for any storage tank and the remaining two sides should be such that natural ventilation is not significantly impaired.

iv. A fire wall may be built on a boundary, but in such cases, it must be wholly under the control of the occupier of the LPG storage site.

4.1.6. Tank Accessories

Each tank shall be equipped with manhole, drain, pressure relief valve, a reliable level indicating system including pressure gauge and temperature connection, maximum level indicator and others.

a. Alarm

i. An independent high-level alarm shall be provided. The alarm shall be set to give the operator sufficient time to stop the flow before the maximum permissible filling height. The alarm shall be located so that it is audible and visible to the operating personnel controlling the filling operation.

b. Level gauge

i. Columnar glass level gauges shall not be used.

c. Pressure Relief Valve and Discharge Vent

i. Each tank shall be provided with one or more spring loaded or pilot-operated pressure relief valves. The pressure relief valve or valves shall be set to discharge at a pressure of 25 kg/cm^2 or as required by the ASME Code. Pilot-operated pressure relief devices shall be designed so that the main valve will open automatically and protect the tank if the pilot valve fails.

ii. Pressure relief valves installed on LPG tanks shall be designed to provide adequate flow capacity to protect the tank during fire exposure.

iii. The pressure relief valve shall be installed to provide a direct connection to the vapor space and to minimize liquid carry-over during vapor relief, especially when the tank is nearly full.

iv. The possibility of tampering with the adjustment mechanism shall be minimized. If the adjustment mechanism is external, it shall be sealed.

v. The inlet and outlet piping for the pressure relief valve shall be designed to pass the rated capacity of the valve without exceeding the allowable pressure-drop limits.

vi. The pressure relief system shall be protected from the closure of any block valves installed between the tank and the pressure relief valve or between the pressure relief valve and its discharge vent outlet.

vii. The stem of any gate valve installed in the pressure relief system shall be in a horizontal or below-centerline position.

viii. Discharge vents shall lead to the open air or to a flare system. Discharging directly into the atmosphere is unacceptable if liquid LPG might be released into the atmosphere, unless the discharge is through thermal relief valves. Positive design and operational steps shall be taken to prevent the discharge of liquid LPG from atmospheric vents. Such steps include the automatic shutdown of filling operations prior to over filling.

ix. Discharge vents shall be protected against mechanical damage.

x. Discharge vents shall be designed to handle any thrust developed during venting. The discharge shall not be less than 3 meters above the operating platform.

xi. Pressure relief valves shall be tested for the correct set pressure before being placed in service. Pressure relief valves should be set to start to discharge at a pressure of 125 % of the maximum service pressure.

xii. All pressure relief valves should be provided with a rubber cap at all times to protect them from dust, dirt, foreign particles, rain water and corrosion and pitting on top of the valves.

d. Shutoff valve

i. Shut off valves shall be located as close to the tank as is practical. The preferred location is at the shell nozzle. Shut off valves shall be readily accessible for operation and maintenance.

ii. All shut off valves located on nozzles below the maximum liquid level shall be designed to provide a visual indication of the valve position and shall be capable of maintaining an adequate seal under fire conditions.

iii. When the capacity of the vessel exceeds 40 M^3, all shut off valves on inlet and outlet piping located below the maximum liquid level shall either close automatically or be remotely operable during the first 15 minutes of fire exposure.

e. Drain

i. Drain connections maybe fitted at either the top or bottom of the tank. It should be provided with an excess flow valve and a shut off valve not more than 50 mm in nominal diameter.

ii. The outlet of the drain valves should be provided with a length of piping terminating with a second shut off valve during draining. The length of piping should be such that the risk of simultaneous obstruction of the two valves, e.g. by freezing any accumulated water, is minimized.

iii. The additional pipe work and second valve may be fitted at the time of draining provided that the fixed drain valve is protected by an excess flow valve fitted upstream.

iv. The outlet of the drain valve system should be blind- flanged, plugged or otherwise secured against tampering when not in use.

v. No drain should discharge into or be in the proximity of any drainage system.

f. Others

i. Each tank shall be fitted with a suitable thermometer well.

ii. Ductile (nodular) iron, cast aluminum, malleable iron and brass shall not be used in any pressure-retaining tank accessories.

4.2 Piping, Valve and Hose

4.2.1. Piping

i. Piping at facilities covered under this standard shall conform to the provisions of ASME B31.3 or B31.4.

ii. Pipe joints over 50 mm in nominal size shall be welded or flanged. Joints 50 mm in nominal size or smaller may be welded, flanged or screwed with taper threads conforming to API standards. If the pipe connection is screwed or threaded, the pipe shall be SCH 80.

iii. Pipelines in which liquid LPG may be trapped, e.g. between shut-off valves, shall be protected against excessive pressure caused by thermal expansion of the contents. If pressure relieving devices discharge into atmosphere, the discharge should not endanger personnel or equipment.

iv. Pipelines shall be adequately supported and have adequate flexibility to compensate for thermal expansion, contraction, or any operational stresses.

v. Exposed above-ground pipe work interconnecting two adjacent, parallel above-ground tanks shall be located within the fenced enclosure of the tank area.

vi. Buried steel pipe work shall be adequately protected against corrosion.

vii. Piping shall be seamless, electric-resistance-welded, or submerged-arc-welded pipe. The pipe to be used in piping applications of 5.1 cm. or smaller shall be seamless

viii. Piping shall be provided with adequate flexibility to accommodate the following:

(a) Settling of tanks or shifting of foundations.

(b) Expansion or contraction of tanks or piping with changes in temperature

(c) Soil movement

(d) Cooling or heating of unloading connections, vent connections, or loading and unloading headers.

(e) Headers located on piers shall be designed to permit unrestrained movement of the piping in the direction of expansion or contraction except at necessary anchor points.

ix. The number of joints of any type between the vessel and the first block valve shall be minimized.

x. Welded joints shall be used where practical.

xi. The number of flanged joints shall be minimized and gaskets for flanged joints shall be resistant to liquid phase LPG.

xii. A gasket of natural rubber or one bonded with natural rubber shall not be used.

xiii. Metallic gaskets or stainless steel, spiral wound "graphite-filled" gaskets shall be used for flanged connected joints.

xiv. Threaded connections shall be minimized.

xv. The pipe wall thickness shall be equal to or greater than that required by ASME B31.3.

xvi. The tubing shall be constructed of steel.

xvii. If these are exposed to a corrosive atmosphere, stainless steel shall be used.

xviii. Butt-Welding Fitting shall be made from seamless steel and of the same thickness and schedule as the piping.

xix. Socket-welding fittings 50 mm or smaller in size, such as elbows, tees, and couplings, shall be of forged steel and shall have a working pressure of at least 140 kg/cm^2.

xx. Packed-sleeve and resilient-sealed couplings shall not be used.

xxi. Weld-neck flanges are preferred.

xxii. Socket-weld NPS 2 and smaller are acceptable. If slip-on flanges are used, they shall be welded both inside and outside.

xxiii. Plugs shall be constructed of steel.

xxiv. Unions shall be of forged steel, shall have a working pressure of at least 210 kg/cm^2 and shall have ground metal-to-metal seats. Gasket unions shall not be used. Unions shall not be used between the vessel and the first valve.

4.2.2. Valves

i. Valves and fittings shall be made of steel, hot stamping brass or nodular iron with equivalent strength and ductility over the design pressure and temperature range.

ii. Cast iron valves and fittings other than those of nodular iron shall not be used.

iii. The primary shutoff valves for a tank (specifically the valves nearest the vessel that can shut off flow) shall be made from steel.

iv. Valves constructed of free-machining steel similar to AISI Series 1100 and 1200 shall not be used.

v. Union or screwed-bonnet valves shall not be used unless they are equipped with bonnet retainers or the bonnets are tack welded.

vi. Valves that are sandwiched between two flanges by long, exposed bolts shall not be used, unless the valves have lug-type bodies that cover the bolts.

vii. Ball valves shall meet the requirements of API STD 607.

viii. Check valves shall be installed on the discharge side of all centrifugal pumps.

ix. Pressure relief valves shall be constructed of steel.

x. Suitable thermal relief valves shall be considered on liquid lines that can be blocked between two shutoff valves.

xi. The equipment that can be blocked between shutoff valves shall be provided with protection from overpressure due to the thermal expansion of the liquid.

xii. Where liquid is likely to be trapped in valve cavities, pressure relief shall be installed. Pressure gauges shall be provided in enough locations in the liquid and vapor lines to enable the operator to monitor operating pressure and pressure differentials constantly to ensure safe operation.

xiii. All liquid withdrawal openings and vapor withdrawal openings that are more than 40 mm or larger shall be equipped with an internal valve with an integrated excess flow valve or excess flow protection.

xiv. The internal valve shall remain closed except during operation. The internal valve shall be equipped for remote closure and automatic shutoff through thermal (fire) actuation.

xv. Additional manual shutoff valves shall be installed, as close as practicable to each internal valve.

xvi. All liquid and vapor inlet openings shall be equipped with a back-flow check valve or excess -flow valve and a positive manual shutoff valve, installed as close as practicable to the container. Facility boundary limit block valves and check valves shall be provided if the feed or product is transported by pipeline. These valves shall be accessible during emergencies.

4.2.3. Hose

i. Hose shall be fabricated from materials resistant to LPG in both liquid and vapor form. If wire braid is used for reinforcement, it shall be made from corrosion-resistant material such as stainless steel.

ii. Hose, hose connections, and flexible connectors used for transferring LPG liquid or vapor at pressures in excess of 0.5 kg/cm^2 (5 psig) shall conform to the criteria specified below:

(a) Hose shall be designed for a minimum working pressure of 24.5 kg/cm^2 g and a minimum bursting pressure of 125 kg/cm^2g.

(b) Hose assemblies, after the installation of connections, shall be tested to a pressure not less than 50 kg/cm^2g.

(c) Hose assemblies shall be visually inspected before each use for damage or defects.
(d) Hose assemblies shall be tested at least once in a year at the maximum pump discharge pressure or relief valve setting pressure whichever is higher.
(e) Hose shall be protected from the elements and physical damage.
(f) The hose pipe connection shall be capable of withstanding a test pressure of 1.5 times the design pressure for its part of the system

4.3 Loading-Unloading Equipment/ Accessories

4.3.1. Emergency Shutoff Valves

i. Emergency shutoff valves shall be provided in the loading-unloading system for tank cars, trucks, and marine facilities.
ii. The emergency shutoff valve shall incorporate the following means of closing:
    (a) Manual shutoff at the installed location.
    (b) Manual activation from a location accessible during an emergency
    (c) Automatic shut off in the event of an LPG release.
    (d) Automatic shutoff through thermal (fire) actuation.
iii. A remote shutdown capability including power supply to all transfer equipment shall be installed at a distance not less than 8 meters or more than 30 meters.
iv. An emergency shutoff valve shall be installed, when hose or swivel piping is used for liquid or vapor transfer, in the fixed piping of the transfer system within 6 linear meters of pipe from the end to which the hose or swivel piping is connected.
v. A check-valve may be used in place of an emergency shutoff valve where the flow is only in one direction.
vi. If the check valve is installed in a dedicated storage vessel fill line or vapor return line.
vii. When two or more hoses or swivel piping arrangements are used, either an emergency shutoff valve or a check-valve (for unloading lines only) shall be installed in each leg of the piping.
viii. 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 piping side of the connection while the valves on the plant side of the connection remain intact. This may be accomplished by the use of concrete bulkheads or equivalent anchorage or by the use of a weak or shear fitting.
ix. If block valves are manually operated, they shall be accessible during an emergency.

4.3.2. Transfer Pumps and Compressors

i. Transfer Pumps may be centrifugal, reciprocating, gear, submersible or another type designed for handling LPG.

ii. The design pressure and construction material of the pumps shall be capable of safely withstanding the maximum pressure that could be developed by the product, the transfer equipment, or both.

iii. When centrifugal pumps are used, mechanical seals shall be used.

iv. Positive displacement pumps shall have a suitable relief device on the discharge side unless other provisions are made for the protection of the equipment.

v. When submersible pumps are used, each interface between the LPG system and an electrical conduit or wiring system shall be sealed or isolated to prevent the passage of LPG to another portion of the electrical installation.

vi. The pump should be protected by a suitable strainer or filter.

vii. Compressors for loading and unloading LPG shall be designed for the maximum outlet pressure to which they may be subjected.

viii. Each centrifugal compressor discharge connection shall be equipped with a check valve. Each centrifugal compressor shall be evaluated for conditions that may cause overpressure, and a relieving device shall be provided if required.

ix. Each positive displacement compressor shall be equipped with a pressure-relieving device on the discharge side.

x. A suitably sized scrubber or liquid knockout drum shall be installed immediately upstream of the vapor compressors. The scrubber shall be equipped with a high-liquid-level device to shut down the compressor.

4.4. Electrical equipment and installations

i. Electrical installations and equipment shall conform to the provisions of NFPA 70.

ii. All electrical apparatus shall be intrinsically safe and flame-proof-certified.

iii. All the conductors of an intrinsically safe and sound circuit in connection with intrinsically safe and sound apparatus in the installation area shall be so laid down as to prevent invasion of such circuit by current arising from contact or electrostatic or electromagnetic induction from any other circuit.

iv. Conductors of safe and sound circuit shall be effectively protected against mechanical damage.

v. All electrical wiring other than the conductor of an intrinsically safe and sound circuit shall be effectively sealed at all joints, mechanically protected and adequately supported throughout its length and shall consist of:

(a) Approved armored cable with correctly designed terminations, complete with an armor clamp, the armoring being carried and electrical clamps to provide mechanical support to the cables and electrical continuity or

(b) As Metal sheathed cable with correctly designed and installed terminations.

vi. Single or multi-cored insulated cables are accommodated in solid drawn heavy gauge crewed galvanized conduits used in conjunction with approved flame proof fitting, the conduit being sealed at both ends and installed in such a manner as to permit internal condensation to drain to a point(s) from which it may be removed.

vii. Single or multi-cored mineral insulated cable of approved type in conjunction with approved flame proof type glands at all joints and terminals.

4.5. Dike and Drainage

i. The drainage system shall be designed to prevent liquid spilled from one tank from flowing under any other tank and shall minimize the risk to piping from spilled LPG.

ii. Walls, dikes, trenches, or channels are permitted to assist in draining the area.

iii. Any drainage system provided shall include a valve or shear gate located in an accessible position outside the spill containment area. The valve or shear gate shall normally be kept closed.

iv. Grading of the area under and surrounding the vessels shall direct any liquid leaks or spills to the edge of the diked area and to the remote impoundment area. Grading shall be at a minimum of 1% slope. Within the diked area, grading should cause spills to accumulate away from the vessel and any piping located within the diked area.

v. The remote impoundment area shall be located at least 15 meters from the vessels draining to it and from any hydrocarbon piping or other equipment.

vi. The holdup of the remote impoundment area shall be at least 50% of the volume of the largest vessel draining to it.

vii. Any dike or wall enclosure used for LPG containment shall include adequate access provisions (such as stairs for personnel and ramps for vehicles, if required), shall be designed to permit its free ventilation, and shall be constructed to retain the spilled liquid. All water draw offs shall be extended so that they do not terminate under the vessel.

viii. Drain lines shall not be directed into a public sewer or into a drain not designed to contain flammable materials.

ix. The ground beneath or adjacent to tank connections or ancillary equipment should be cemented or compacted and arranged to prevent either the accumulation of any liquid beneath them or its flow affecting other tanks or important areas.

x. Provision should be made for handling the run-off of cooling water applied under fire conditions.

xi. To prevent the formation of gas pockets the vicinity of LPG storage tanks should be free from pits and depressions within the required separation distance.

xii. Water drain lines and similar small lines shall be adequately supported or shall be fabricated with sufficient strength to be self-supporting under operating conditions, including the condition of maximum flow reaction thrust.

4.6. Fire Protection

4.6.1. General

i. The Installation shall be fire protected.

ii. The layout of the storage facility, including the arrangement and location of plant roads, walkways, doors, and operating equipment, shall be designed to permit personnel and equipment to reach any area affected by fire rapidly and effectively. The layout shall permit access from at least two directions.

iii. Emergency escape as well as access for firefighting shall be considered.

iv. LPG storage vessels shall be protected by water deluge systems, fixed monitors, water spray systems, or any combination of these systems.

v. The effective capacity of the water reservoir for fire protection shall be minimum 4 hours of aggregate working capacity of pumps.

vi. Portable equipment may be used, but shall not be the primary method of water application. Control of LPG fire shall be coordinated with local emergency handling authorities like the police and fire departments.

4.6.2. Fire water pump

i. Fire-water shall be provided by at least two identical pumps, each pump shall be able to supply the maximum required capacity for a fire water ring main system.

ii. Fire water pumps shall be of the submerged vertical type when taking suction from open water and of the horizontal type when suction is taken from a storage tank.

iii. The fire-water pumps shall be installed in a location that is considered to be safe from the effects of fire and clouds of combustible vapor, and from collision damage by vehicles and shipping. They should for example, be at least 100 m away from loading points and from moored tankers or barges handling liquid hydrocarbons.

iv. They shall be accessible to facilitate maintenance, and be provided with hoisting facilities.

v. The main fire-water pump shall be driven by an electric motor and the second pump, of 100% stand-by capacity, by some other power source, preferably a diesel engine. Alternatively, three pumps, each capable of supplying 60% of the required capacity may be installed, with one pump driven by an electric motor and the other by diesel engines.

vi. The stand-by fire-water pumps shall be provided with automatic starting facilities that will function if the main fire-water pumps do not start, or having started, fail to build up the required pressure in the firewater ring main system within 20 seconds.

vii. The fire water system pressure needs to be maintained at the required pressure at the farthest end of the hydrant system with the help of the Jockey Pump operating automatically.

4.6.3 Fire Water System

The fire water system shall be designed in accordance with:

i. A looped fire water system shall be provided around the storage and handling portions of an LPG facility.

ii. Sufficient isolation valves shall be provided in the fire water grid to prevent loss of the grid due to a single break in the water main.

iii. Block valves shall be arranged so that all parts of the plant can be protected by a portion of the fire water main system when an impaired section is isolated for repair.

iv. The capacity of the fire water system shall be equal to the amount of fire water required to cool the largest vessel being protected (or if multiple vessels are on a commonly activated fixed deluge or spray system, the capacity of the system), plus the amount required to cool adjacent vessels plus reserve capacity for up to three additional 1000 liters per-minute cooling streams.

v. Where the capacity of the fire water system is determined by the requirement for LPG storage, the system is permitted to be sectionalized to reduce the maximum simultaneous requirement for fire water.

vi. Pipe used for fire water mains and branch lines to hydrants shall be at least 6 NPS in size.

vii. Branch lines to deluge, monitor, or spray systems are permitted to be smaller, provided hydraulic calculations show that the size selected will supply the design demand at the required pressure.

viii. The fire water system shall be functional in all seasons and shall be capable of delivering 100% of the design rate for at least 4 hours.

ix. The fire water grid shall be designed so that at least half the water required by the single largest incident can be delivered if any single section of the fire water main is lost.

x. Regardless of the fire water application method used, the location of hydrants shall be arranged so that each storage vessel can be reached from at least two

directions by at least three cooling streams none of which uses more than 95 meters of hose.

xi. The fire water system shall be designed to provide water for cooling to the protected equipment within 60 seconds of activation to achieve design water delivery rates within 10 minutes of system activation.

xii. Storage facilities may consist of an open tank of steel or concrete or a basin of sufficient capacity. The tank or basin should have two compartments to facilitate maintenance, each containing 60% of the total required capacity and there should be adequate replenishment facilities. A single compartment of 100% capacity is acceptable providing that an alternative source of water, e.g. from temporary storage will be available during maintenance periods. The replenishment rate shall normally not be less than 60% of the total required fire-water pumping capacity.

xiii. The fire water system shall be designed to facilitate testing to assure reliability, adequate flow rate, and an adequate coverage of the protected equipment.

xiv. The fire water systems shall be tested to verify that their performance is as designed. Since the capacity of the water grid can deteriorate gradually as a result of scale buildup in the water mains, a Hazen-Williams coefficient no greater than 100 shall be used for unlined steel pipe.

4.6.4 Water Deluge System

Water deluge system for the protection of LPG storage facilities:

i. Shall be designed so that under non-fire conditions, the water flows evenly over the entire surface of the vessel.

ii. The adequacy of the water coverage shall be determined by means of performance tests.

iii. If weirs are used to improve distribution, they shall be provided with drainage to prevent standing water, which may increase corrosion.

iv. The pipe used for main water distribution lines shall have a diameter of at least 75 mm.

v. Top-mounted water distribution nozzles shall be at least 40 mm in size and shall be provided with suitable deflectors or weirs to achieve good water distribution.

vi. A system with a manually operated isolation valve located at a safe distance of 15 meters shall be provided.

vii. The location of the actuating valve shall be clearly and prominently marked.

viii. In locations with unattended or partially attended operations, additional methods of system activation such as automatic or remote operation will be provided.

ix. When the system is remotely or automatically operated, a full-size manually operated bypass valve shall also be provided in an accessible, safe location.

4.6.5 Fire Water Monitors

Fire water monitors permanently connected to the fire water grid can be used to apply cooling water to the shell of LPG storage vessels. Where protection by means of monitors is selected, the system shall include the design features described herein under:

i. The entire surface of each vessel shall be reached with streams from the monitors.
ii. Each monitor shall be accessible during a fire or shall be remotely activated and controlled.
iii. Monitor nozzles shall be adjustable for fog or straight stream, as required, to provide the most effective coverage of the protected vessel.

4.6.6 Water Spray System

A water spray system uses many spray nozzles arranged in a grid pattern to distribute the water evenly over the LPG vessel. When a water spray system is selected for the protection of LPG storage facilities, it shall include the design features described herein:

i. The system shall be designed so that the water is applied evenly over the entire surface of the vessel that may be exposed to fire. The recommended rate is 6.0 liter per minute per square meter of exposed surface.
ii. Allowance for rundown is to be provided.
iii. The adequacy of the water coverage shall be determined by performance tests.
iv. The spray system shall be an open-head system, with all nozzles supplied from the top of the supply branch line and each branch line shall be from the top of the water distribution main line.
v. The spray orifice size shall be at least 6 mm, larger orifice sizes will reduce the tendency of the nozzles to become clogged.
vi. A fixed water spray system with an isolation valve to be operated manually and placed at a safe distance of 15 meters from the shed shall be provided.
vii. The location of the actuating valve shall be clearly and prominently marked.
viii. In locations with unattended or partially attended operations, additional methods of system activation such as automatic or remote operation shall be provided.
ix. When the system is remotely or automatically operated, a full-size manually operated bypass valve shall also be provided in an accessible, safe location.
x. Flush-out connections shall be installed in the system to permit flushing at periodic intervals.
xi. Accessible low-point drain connections shall also be provided.
xii. The sizing of all piping shall be based on hydraulic calculations.
xiii. The pipe used for main water distribution lines shall have a diameter of at least 75 mm.
xiv. The pipe used for branch lines to spray heads is permitted to not be less than NPS 3/4 in size.
xv. A full-flow strainer with a valve blow-off connection shall be installed in the main feeder line to the spray system.
xvi. The maximum size of the opening in the strainer shall be 6 mm.

xvii. A full-size valve bypass shall be provided.

xviii. Galvanized piping shall be considered downstream of the strainers to reduce the potential for rust scale plugging spray nozzles.

4.6.7 Portable Equipment

Portable Equipment such as fire hoses and portable monitors shall not be used as the only means of protecting exposed LPG vessels. It is permitted to use portable equipment when vessels are fireproofed as outlined in Fireproofing of LPG vessels.

4.6.8 Fire Detection System

i. A Fire Detection System shall be used to determine the need for fire and hydrocarbon detection systems.

ii. Where provided, fire and hydrocarbon detection systems shall be arranged to sound their alarms whenever fire or hydrocarbons are present.

iii. Fire alarms shall be provided at strategic places.

iv. It is permitted to use detection systems to automatically activate isolation or fire protection systems in remote or unattended facilities.

4.6.9. Fire Extinguishers

i. Portable fire extinguishers shall be used to extinguish an LPG fire only after the source of LPG has been shut off, to prevent the formation of a hazardous vapor cloud.

ii. Dry chemical fire extinguishers shall be provided at strategic locations such as those near pumps and loading racks so that they are readily available for operator use.

iii. Fire-fighting foam shall not be used to extinguish LPG fires.

4.6.10. Fireproofing of LPG Vessels

i. Except for remote facilities, which require no protection, fireproofing shall be used to protect vessels if portable equipment is the only means of applying fire water.

ii. Where fireproofing is used, it shall provide protection for the structural steel or LPG vessel for the time period required for the operation of fire water systems. When fireproofing is used, it shall comply with the provisions stated herein under:

(a) The outside surfaces of LPG vessels that may be exposed to fire shall be covered with a fireproofing material that is suitable for the temperatures to which the vessel will be exposed.

(b) The thickness of the fireproofing material should be equivalent to a fire endurance of 1.5 hours.

(c) Thermal insulation used for fireproofing shall be jacketed with rust-resistant steel.

(d) The fireproofing material shall be suitably protected against weather damage and sealed to prevent water entry.

(c) The fireproofing system shall be capable of withstanding exposure to direct flame impingement and shall be resistant to dislodgment by direct impingement of fire water streams.

4.6.11. Fireproofing of Structural Supports

Except for remote facilities, which require no protection, structural supports shall be provided with fireproofing, as specified herein:

i. Fireproofing shall be provided on the aboveground portions of the vessel's supporting structures.

ii. The fireproofing shall cover all support members required to support the static load of the full vessel.

iii. Fireproofing shall not encase the points at which the supports are welded to the vessel.

iv. Fireproofing shall be provided on horizontal vessel saddles where the distance between the bottom of the vessel and the top of the support structure is greater than 300 mm.

v. Where such fireproofing is provided, it shall extend from the support structure to the vessel, except that it shall not encase the points at which the saddles are welded to the vessel.

vi. When a vertical vessel is supported by a skirt, the exterior of the skirt shall be fireproofed.

vii. Fireproofing shall be provided on all pipe supports within 15 meters of the vessel and on all pipe supports within the spill containment area of the vessel.

viii. Support structures of concrete or masonry shall be considered adequately fireproofed, if the thickness of the fireproofing material is equivalent to a fire endurance of 1.5 hours.

ix. Fireproofing is not required for diagonal bracing, including tie rods, or for redundant members that are not necessary for supporting static loads.

x. Fireproofing material shall be suitably protected against weather damage and sealed to prevent water entry and it shall be resistant to dislodgment by direct impingement of fire water streams.

5. LPG Bottling or Cylinder Filling

5.1 Prohibition on Filling LPG in Cylinders or Portable Containers

5.1.1 No person shall fill LPG in cylinder or any other portable containers without following the provisions of this regulation.

5.1.2 No person shall fill LPG in a cylinder or any other portable container without a license granted for filling LPG and without fulfilling the conditions of the license.

5.1.3 No person shall fill any cylinder with LPG that- (i) is not approved by the Explosive Department; (ii) is not painted in identification colors in accordance with LPG rules,

2004; (iii) was filled with LPG by any other person; and (iv) is filled with any other gas.

5.1.4 No LPG gas filling licensee shall fill any cylinder of another brand except their own brand of cylinder.

5.1.5 No LPG gas filling licensee shall supply licensable or above quantity of LPG to any person who does not have LPG storage license.

5.1.6 LPG cylinders shall not be transported or handled except by trained personnel.

5.2 Cylinder Filling Building or Platform

5.2.1 LPG shall not be filled in any building or open space other than a building constructed for the purpose of filling LPG cylinders or an approved open space, and LPG cylinders shall not be filled in rooms below the ground floor or upper floors of buildings.

5.2.2 The floor may be raised near the ground level or up to the car platform.

5.2.3 If the floor is raised, the void space below shall be well filled or, if left open, it shall be free of holes and unobstructed to ensure ventilation.

5.2.4 The empty space below the floor shall not be used for storing anything and the said empty space shall be kept clean and free from inflammable material.

5.2.5 The building area or floor shall be freed from drains or holes, as far as possible, where gas may accumulate

5.2.6 If it is necessary to keep drains or holes in the floor of the building for the carrying system or equipment, they should be provided with adequate ventilation to the outside of the building.

5.2.7 A Covered platform shall be used for filling cylinders, provided that both sides of the platform shall be left open or in the alternative, such ventilation shall be provided as may be approved by the authority.

5.2.8 If the work of filling LPG is not done in any protected area provided with the enclosure, at least a two meters high enclosure should be arranged to surround the said area.

5.2.9 Buildings or enclosures shall have at least two means of egress reasonably spaced so that doors or gates open outwards, and do not close automatically and can be opened immediately from inwards.

5.2.10 Ducts, conduits or steam pipes shall not be placed in or near underground sewers used for other purposes.

5.2.11 The drainage system in the filling area or building shall be effectively and securely closed if it flows into an external drainage system.

5.2.12 Pipes installed within concrete or brick walls shall be protected by casings capable of free movement within.

5.2.13 Storage areas and working areas should be adequately lit.

5.2.14 Access to and use of fire-fighting equipment shall be provided.

5.2.15 LPG filled cylinders shall not be stored in filling areas.

5.3 Safety Distance

The filling area of buildings or open spaces shall be set at the minimum distance prescribed in this regulation and shall be at least 10 meters from the boundary.

5.4 Observation or Inspection of the Cylinder before Filling

5.4.1 All cylinders shall be purged of air by replacing them with LPG vapor before filling with LPG and nitrogen or water may be used to remove the air.

5.4.2 Before filling the cylinder with LPG, the cylinder should be inspected on site for mechanical damage and damage due to external tear through pitting or corrosion and any unsafe cylinder should be discarded.

5.4.3 During the on-site observation it should be checked whether the cylinders are eligible for periodic inspections and the cylinder valves should also be brought under observation.

5.5 Filling Procedure

5.5.1 LPG should be filled into the cylinder in correct quantity and measures should be taken to prevent overfilling.

5.5.2 Filling shall be by weight or volume.

5.5.3 The cylinder shall be filled to capacity if a liquid level gauge is permanently attached to the cylinder. Provided that no cylinder shall be filled with LPG below the prescribed weight unless safety requirements are compromised.

5.5.4 The system should be designed so that very little gas escapes after disconnection from the cylinder valve.

5.5.5 Each branch pipe line exiting from the main header filling pipe shall be fitted with a shut-off valve at an accessible location upstream of the end filling unit and an approved emergency shut-off device shall be installed in the liquid supply line at the filling stage.

5.6 Prescribed Level of Filling

5.6.1 LPG shall not be filled in any cylinder or container in excess of the filling ratio specified in British Standard Specification No. **BS 5355.**

5.6.2 The maximum amount of LPG filling in the cylinder shall not be such that the internal liquid occupies more than 97% of the capacity of the cylinder due to expansion at a temperature of 65 degrees Celsius during transport or use.

5.7 Prohibition of LPG Filling from One Cylinder to Another

No person shall transfer LPG from one cylinder to another cylinder by filtration system with the help of differential pressure of cylinders except by using a pump for sale or distribution purposes.

5.8 Inspection after Filling

After filling the cylinder with LPG, each cylinder and valve should be inspected to ensure that they are free of leaks and fit for use.

5.9 Electrical Connections

All electrical cables and equipment of LPG filling plants in cylinders or containers shall be explosion proof.

6. LPG Cylinder

6.1 Standard

6.1.1 The design and construction of transportable refillable welded steel cylinders for LPG should be in compliance with the **BDS ISO 22991:2023** standard.

6.1.2 Procedures for checking before, during and after filling of refillable welded steel cylinders for LPG should be in compliance with the **BDS ISO 10691:2023 (ISO 10691:2004)** standard.

6.1.3 Periodic inspection and testing of refillable welded steel cylinders for LPG should be in compliance with the **BDS ISO 10464:2023 (ISO 10464:2004)** standard.

6.1.4 Refillable composite cylinders for LPG should be in compliance with the BDS **ISO 11119-1** standard.

6.2 Cooking Gas Cylinder

6.2.1 Only the approved cylinders shall be used.

6.2.2 No oil, grease or similar lubricants shall be used on any valves or any other fittings.

6.2.3 The valves of every cylinder containing gas shall be securely closed so as to prevent any leakage.

6.2.4 Every cylinder shall be handled properly.

6.2.5 No person shall:

- **i.** Fill LPG from one cylinder or container into another cylinder or container.
- **ii.** Transport or store the LPG filled cylinder except in an upright position.

6.2.6 The seal of the cylinder shall not be removed prior to use.

6.2.7 2(two) wheeled vehicles shall not be used for transportation of cylinders.

6.2.8 Conveyors, trolleys, fork lifts or cradles of adequate size may be used.

6.2.9 No lifting magnet shall be used for loading and unloading the cylinder.

6.2.10 Cylinders shall always be kept away from any source of heat and in a ventilated place in an upright position with valve at the top and shall be so placed that they cannot be knocked over.

6.2.11 No cylinder shall be dropped or thrown from any elevated place.

6.2.12 No cylinder shall be rolled or allowed to roll on its side or its rim; it shall be moved only by approved lifting equipment.

6.2.13 Cylinders shall not be stored under conditions that cause them to corrode.

6.2.14 Cylinders shall not be stored with combustible materials.

6.2.15 Empty cylinder shall be handled in the same manner as full ones.

6.2.16 Empty cylinder shall be marked "empty" and stored separately in well-ventilated areas.

6.2.17 Cylinder may be moved within a building for tar or bitumen kettle or torch operation on a roof, provided such movement shall be done under the personal supervision of a trained and qualified operator or competent person.

6.2.18 Only the approved tools shall be used for the connection or disconnection of the hose to the cylinder.

6.2.19 All valves shall be closed while changing the cylinder.

6.2.20 After replacing the cylinder every connection shall be rechecked for any leakage. The leak- test can be done using soap and water solution.

6.2.21 Cylinders shall be carried by approved vehicle.

6.2.22 No cylinder shall be carried by a 2-wheeler.

6.2.23 Under no circumstances shall a cylinder be transported through a tunnel.

6.2.24 No cylinder shall be kept or stored near a drain, under a stairway, or buried in the ground or in a location where there would be no air movement across the cylinders, in a place that would obstruct egress from the building, where damage is likely to occur or in any hot place.

6.2.25 A minimum distance of 600 mm shall be provided between the front of the cylinder and other structures.

6.2.26 Cylinder compound shall be accessible by a cylinder trolley.

6.2.27 The access route should be firm, compact and even in wet conditions.

6.2.28 No cylinder or any weight shall be supported by cylinder.

6.2.29 No cylinder valve shall be opened or closed with tools.

6.2.30 Any cylinder that is past its qualification date shall not be refilled until re-qualified by Chief Inspector of Explosive.

6.2.31 A cylinder that has been involved in a fire and shows no distortion may be re-qualified for continued services provided it passes properly done hydraulic test and container- appurtenance is removed.

6.2.32 New Cylinder shall be tested within 10 (ten) years, but subsequently it shall be re-tested within every 5(five) years by the authorized inspection agency and no objection certificate shall be given by the Chief Inspector of Explosives for reuse.

6.2.33 Particular attention is to be paid to the entire area inside the foot ring; this area shall be free from any dirt, mud or any foreign materials.

6.2.34 All the cylinders shall be visually examined for dents, cuts, gouges, bulges, cracks, laminations, and corrosion on the external and internal surfaces of the cylinders.

6.2.35 Cylinders beyond the acceptable limits shall be declared unserviceable.

6.2.36 Cylinder shall be declared unserviceable when:

i. Wall thickness has become less than 90 percent of the designed wall thickness.

ii. Cylinder having lost its weight by more than 5% of its original tare weight.

iii. Cylinder that shows serious denting, bulging, gouging or excessive corrosion.

iv. Cylinder having lost its identity (manufacturer's name, serial number, test date, original tare weight).

6.2.37 The rejection criteria for cylinders will be recorded.

6.2.38 Repair or alteration of the cylinder shall comply with the regulation, rules or code under which the cylinder was first fabricated.

6.2.39 Cylinders found acceptable in all the tests described above shall be taken for primer coating. Before applying the primer coat, it should be ensured that the external surface of the cylinder is properly cleaned of dirt, dust and loose remnants of previous paints so that a uniform coating is obtained. The bung threads should be closed by a plastic or rubber cap to prevent the entry of primer and paint in to the cylinder.

6.3 Industrial Gas cylinder

Same as stated in Section 6.2

6.4. Auto Gas Cylinder

The container or cylinder capacity is between 500 milliliters to 1000 liters as laid down in Appendix E. It shall be permanently mounted in the boot of the vehicle.

7. LPG Reticulation System

The LPG Reticulated System is a piped gas system or Cylinder Bank System for the supply of gas. The LPG reticulated system uses a piped network to directly supply gas to households and commercial complexes from a centralized gas bank.

7.1 Tank Installation Method

7.1.1 LPG storage tanks shall be installed in the following ways for the reticulated system:

(a) Above ground;
(b) Underground;
(c) Semi-buried (partially buried in the ground);
(d) Mounded (above ground but covered by an earth mound).

7.1.2 For storage capacity of more than 10,000 liters, priority shall be given to the installation of underground or mounded tanks.

7.1.3 For the installation of above-ground tanks, the tanks shall be placed on a strong foundation and for the installation of underground, semi-buried or mounded tanks, the tanks shall be placed on a concrete pit and the empty space between the pit and the tanks shall be filled with clean sand.

7.2 Tank or Cylinder Installation Location Selection:

7.2.1 LPG tanks or cylinder installations should be placed at a ground level outside the main building where there is sufficient air circulation.

7.2.2 The installation of tanks or cylinders should not be done in any inhabited house, building basement, deep drain, or any other low-lying area where the LPG discharged from the leakage is obstructed from mixing with the air.

7.2.3 A minimum clear space of 1 meter should be paved around the installation, and an area of at least 2 meters should be kept clear from any trees, shrubs, or tall grass on the outer side of the paved area.

7.2.4 The approach road for refilling vehicles should be designed in such a way that they can easily access the tanks or cylinders, and the route for the fire fighting vehicle should also be kept clear and accessible at all times.

7.2.5 The installation of tanks or cylinders should be done in such a manner that the vehicle movement, maintenance work, or any other activities do not cause any damage to the existing system, equipment, pipes, or other equipment. Fencing should be installed around the tanks or cylinders for safety purposes.

7.2.6 The location where cylinders are installed should have a natural arrangement for adequate air circulation.

7.3 Selection of Tank or Cylinder Capacity

7.3.1 The holding capacity of the tank or cylinder should be chosen in a way that ensures a continuous supply of LPG with sufficient pressure in the LPG supply line at all times.

7.3.2 To fulfill the purpose of sub-section (1), the volume of the tank should be such that the rate of vaporization of the liquid LPG in the tank is equal to or greater than the maximum demand for gas.

7.4 Design of Tank or Cylinder Installed using the Reticulated Method

7.4.1 Tanks or cylinders installed using the reticulated method should be approved and designed by the Chief Inspector of the Explosive Department and shall adhere to the following guidelines:

(a) For Tank:

Code of Construction	ASME Section VIII Div-2 or other identical standard specification approved by the Chief Inspector of Explosives in official gazette notification.
Design Pressure	17.5 kg/cm^2 (g)
Radiography	100%
Heat Treatment	Yes (680^0 C-840^0 C)
Coating	450 Microns total
Mechanical Test	Must be maintained at 34 bars for 30 minutes.
Chemical Composition of Cylinder Making Raw Materials	HR coils must be tested at the chemical lab. The test result should be submitted to the Chief Inspector of Explosives for customs clearance.
X-Ray Test of Welded Cylinder	100%

(b) For Cylinder:

Code of Construction	DOT 4 BA, BS 5045 part-2 IS 3196 Part-1, AS 2469, AS 2470, ISO 4706, ASNZ 3509, DOT 4BW, AS/NZ-3509.
Design Pressure	17.5 kg/cm^2 (g)
Radiography	100%
Heat Treatment	Yes
Coating	40 Microns with Zinc galvanizing and 40 Microns with powder coating

7.4.2 In the reticulated LPG method, all types of vaporizers, their valves, pressure control devices, metering devices and other control instruments shall be approved and designed by the Chief Inspector of the Explosive Department as per general or special orders and shall adhere to the specified instructions.

7.5 Tank or Cylinder Corrosion Prevention Measures

7.5.1 Due to rust, the tank, cylinder, bundled cylinders, or connected apparatus may undergo corrosion, leading to the deterioration of the existing system, which can create hazardous conditions. Therefore, appropriate corrosion prevention measures must be in place.

7.5.2 In the case of underground tanks, cathodic protection measures will be implemented for corrosion prevention.

7.6 Caution for Electrical and Static Electricity Related Hazards

7.6.1 In areas with tanks and bundled cylinders, fire resistant or explosion preventive apparatus must be used and an earthing system should be present for these purposes.

7.6.2 Electrical cables should not be installed directly above tanks and bundled cylinders (overhead) and within 1.5 meters of their perimeter.

7.7 Activities Related to the Storage of Bundled Cylinders

7.7.1 In the case of storage of LPG with bundled cylinders, each bundle will consist of one active and one standby cylinder assembly with equal number of cylinders.

7.7.2 Each bundled cylinder shall be connected to each other and will have an auto changeover regulator to ensure activation of the standby cylinder.

7.7.3 The following conditions shall be adhered for the installation of bundled cylinders:

i. The water-holding capacity of each cylinder in the bundle will not exceed 125 liters.

ii. The distance between the two bundles will be as follows: - For 1000 kg: 3 meters. - For 4000 kg: 5 meters. - For 8000 kg: 7 meters. - For 12000 kg: 9 meters. - Above 12000 kg: 10 meters. - If the FRR (2H2M) wall is present: 3 meters.

iii. Suitable enclosures with locks will be provided for the Reticulated System's installed LPG yard to prevent unauthorized access.

iv. The distance between the door, window, or ventilator of the building and the relief valve of the cylinder will be at least 1 meter.

v. If one or more cylinders are installed near a window then the valve of the cylinder shall be at least 15 cm away from the lower end of the window.

vi. The cylinders shall be placed at least 5 meters away from any ignition source, combustible liquids, or other flammable substances.

vii. The cylinders are to be located at least 1.5 meters away from an external fire source, mechanical or direct vent system.

viii. A specially prepared room within the outer wall of a building may be fitted with a bundled cylinder applying security measures under this chapter and it may be treated as outdoor storage for serving the purpose of these rules. In that case, the following safety measures shall be maintained such as:

a) The room shall be separated from the adjoining building by a FRR (2H2M) wall and no part of the FRR wall shall be open towards the building;

b) The floor of the room should be smooth so that sparks cannot be generated during cylinder movement;

c) The room shall have a door of 1.5-meters in width and shall be located on the opposite side of the building and shall be open outward.

ix. All materials, parts, fittings and other items used shall be as per the manufacturer's own design of the reticulated system, subject to compliance with the instructions mentioned in Rule 110 (umo) of LPG Rules 2004.

x. The pipes connected to the bundled cylinders, fittings, hose pipes connected to the cylinder regulator and other parts shall be capable of withstanding the pressure of 1.5 times the internal pressure of the cylinder.

xi. There shall be sufficient space for easy inspection of the hose pipes and their junctions connecting each cylinder and main pipe.

xii. The appropriate type of hose pipes shall be used for connection with the cylinder in the reticulated system.

xiii. Fittings made of cast iron and aluminum shall not be used, and

xiv. Pipes connected to appliances or stoves where there is a possibility of movement in the piping system shall be elastic type and protected against frictional wear.

7.8 Supply through LPG Pipelines from Tank

During transportation through LPG pipelines, the following steps of pressure reduction, excess pressure relief, and, if necessary, supply shutdown will be undertaken:

7.8.1 Vaporization: At the moment of entry into the piping system from the tank, the liquid LPG will be vaporized.

7.8.2 First-stage regulator: The first-stage regulator will reduce the gas pressure from 80-100 PSI to 5 PSI.

7.8.3 Second-stage regulator: Before entering the kitchen in the final stage of the piping system, the second-stage regulator will be installed and will reduce the LPG pressure from 5 PSI to 0.5 PSI, the appropriate pressure for the stove.

7.8.4 Pressure relief valve: For controlling pressure rise, an automatic pressure relief valve shall be installed.

7.8.5 Low-pressure valve: In the event of a sudden pressure drop due to pipe leakage, an automatic low-pressure valve shall be installed to shut off the supply.

7.8.6 Isolation valve: To provide a manual shut-off option during emergencies, isolation valves will be installed near the tank, operated by a hand lever and placed outside the building.

7.8.7 Pressure gauge: Pressure gauges shall be installed at convenient locations in the pipeline for pressure monitoring.

7.9 Vaporizer

The Vaporizer equipment shall be installed after the LPG tank or cylinder-

7.9.1 If the Liquefied Off Take (LOT) method is used to receive LPG from the tank or cylinder.

7.9.2 In case of using the Vapor Off Take (VOT) method to receive LPG, when the weather is extremely cold (10 degrees Celsius) or the rate of vapor usage exceeds the rate of vaporization.

7.10 LPG Supply through Pipes from Bundled Cylinders

The following steps shall be taken during LPG transportation from the bundled cylinders to the stove for pressure reduction, excess pressure relief and if necessary, discontinuation of the supply:

7.10.1 The switching of the LPG supply source from the empty cylinder to the standby cylinder will be done automatically. For this purpose, in the first step, the pressure will be reduced from 80-100 PSI to 16-18 PSI, however, instead of an auto-changeover regulator a regular changeover switch and pressure regulator may also be installed at the same time or separately.

7.10.2 If excess pressure is detected in the pipeline set at 16 PSI, the second step will be initiated along with the facility of automatic shutdown of the valve, and the second-stage pressure reduction regulator will regulate the gas flow from 16-18 PSI to 5 PSI.

7.10.3 A low-pressure relief valve shall be installed before the gas meter as a pressure relief valve for the pressure relief regulator and for that purpose there should be arrangement to reduce gas pressure from 5 PSI to 0.5 PSI.

7.10.4 In case of any event (such as a pipe rupture, leakage etc.), causing the gas pressure in the pipeline to fall below 0.5 Psi, it will automatically shut off and stop the gas supply in the pipeline.

7.10.5 To shut off the LPG outside the building and close to the tank during emergencies, a manually operated isolation valve shall be installed.

7.10.6 Isolation shut off valves shall be installed at various positions in the pipeline before the stove, before the meter, before the regulator, at the riser or at the start of the pipeline, and as required for urgent maintenance.

7.10.7 Pressure gauges will be installed at convenient locations for pressure monitoring in the pipeline.

7.11 Pipe Selection

7.11.1 In the case of LPG supply using the reticulated method, the following types of pipes shall be used:

(a) Steel pipes (ASTM A106 or API5L Grade-B);

(b) Copper pipes (EN 1057);

(c) Polyethylene pipes (ASTM D2513 or ISO 4437).

7.11.2 High and medium-density polyethylene (HDPE) pipes may be used for transportation below the pressure of 60 PSI.

7.11.3 Seamless copper pipes may be used for pressure below 20 PSI, but cast iron or aluminum pipes shall not be used.

7.12 Working Pressure for Reticulated System

The working pressure for the reticulated system shall be as follows:

7.12.1 The pipes and other equipment used for gas transportation through the reticulated system shall be capable of withstanding internal pressure and external impact.

7.12.2 The reticulated system shall be leak proof so as not to allow the release of flammable or explosive gas.

7.12.3 The pressure in the pipes installed in the building for safety purposes shall be kept within 5 PSI. However, for gas pipes installed in concealed locations, the pressure can be used above 5 PSI without the possibility of exposure.

7.12.4 All LPG tanks, cylinders, and pipe fittings shall be capable of withstanding a pressure of 250 PSI.

7.12.5 The pressure of the pipes and other components used in the reticulated system shall be tested at 1.5 times the working pressure and the pipes and other equipment shall be compatible with the specified working pressure.

7.13 Pipe and Valve Installation

7.13.1 The following conditions shall be met when using an elastic hose pipe:

i. The connected components shall be installed in the same compartment using a cylinder hose pipe;

ii. The elastic hose pipe shall be limited to a maximum of 2 meters whenever possible;

iii. The elastic hose pipe shall not pass through doors, windows, walls, partitions, ceilings, or floors from a room to its balcony or any similar places;

iv. The elastic hose pipe shall be installed in a location that is easy to inspect;

v. The elastic hose pipes shall not be used in areas where the temperature exceeds 50 degrees Celsius; and

vi. Stabilizer hose pipes shall be installed in a manner that does not allow external pressure and are not bent or twisted.

7.13.2. The pipe installation shall fulfill the following conditions:

i. Pipes shall be installed in such a way that there is no excessive contraction or expansion in the pipeline due to external extreme heat or cold and no gas leakage or condensation takes place;

ii. Pipelines shall not be installed in areas in close contact with corrosive environment or materials and as much as possible inside walls or in a covered state;

iii. Pipe lines shall not be installed in lifts, chimneys, air vents etc. or near the said paths;

iv. For installation of pipes with a diameter less than 12 millimeters, it should be attached firmly by means of clamps every 50 cm;

v. The upper pipes mentioned in item (d) shall be secured with clamps at convenient distances to prevent swinging or movement;

vi. A minimum of 50 millimeters of gap shall be maintained between the pipe line and electrical wiring;

vii. LPG pipelines shall always be installed below electrical wiring;

viii. In the case of installing LPG pipe lines alongside hot vapor pipes, a minimum of 150 millimeters of clearance shall be maintained and LPG lines shall be installed below the steam lines;

ix. The pipe lines shall be installed in such a way that parts of the pipe do not come in contact with water during the rainy season;

x. Before the entrance of pipelines into the building, a main valve shall be installed in an iron box with transparent glass;

xi. The LPG transportation pipelines shall be painted in a color approved by the Chief Inspector of explosives department;

xii. firmly established equipment shall be connected through a firmly established pipe.

7.14 Gas Metering

Gas meters shall be installed in such a way that:

7.14.1 Meter reading can be easily taken from it;

7.14.2 It is not susceptible to damage;

7.14.3 It does not come into contact with excessive heat or rainwater; and

7.14.4 It is located at least 1 meter away from a source of fire.

7.15 Pipe Size

7.15.1 The size of the pipes shall be such that it can meet the demands of all stoves or other appliances installed in the building.

7.15.2 In case of gas transportation, the pressure drop in the pipe should not exceed 15% and the speed of gas shall not exceed 20 meters per second.

7.16 Pressure Testing of Reticulated Systems

7.16.1 The pipe and all fittings of the reticulated system shall be tested at a pressure 1.5 times higher than the maximum pressure of gas in the tank or cylinder, according to the design temperature of the tank and cylinder.

7.16.2 The sub-clause (1) test shall be done by using air, nitrogen, or LPG.

7.16.3 During the pressure test, a sensitive pressure gauge shall be used.

7.16.4 Open flame shall not be used to check for any gas leakage from any connection point or appliance.

7.16.5 Soap solution or similar substance shall be used to check for gas leakage from any part of the pipe.

7.16.6 Defective pipes or components shall be completely replaced, and they shall not be repaired while in a connected state.

7.17 Fire Safety Measures

7.17.1 Adequate provisions shall be made for the entrance of fire service vehicles into the building.

7.17.2 At least two portable 6-kilogram capacity dry chemical powder fire extinguishers (monometer type) shall be stored within 4 meters bracket of tanks or bundled cylinder storage that is visible.

7.17.3 In buildings where, tanks or bundled cylinder are stored, a visible warning sign "NO SMOKING" shall be hanged or established in a signboard format.

7.17.4 From Fire Service and Civil Defense Department, training arrangements regarding fire prevention and control shall be made for the building security personnel.

7.17.5 To ensure fire safety management, the instructions of the Fire Service and Civil Defense Department shall be strictly implemented.

7.18 Maintenance and Inspection Responsibility for Reticulated System

The responsibility for the maintenance and inspection of reticulated systems shall be determined as per the contract executed between the user and the installer according to the prescribed form by the Chief Inspector of Explosives Department and a copy of the contract shall be sent to the Chief Inspector;

However, it is important to note that if the reticulated system is installed by the user, they will be responsible for its maintenance and repairment.

7.19 Instructions for Users of Reticulated System

Suppliers of reticulated systems shall provide necessary instructions or training to the users regarding the following:

(a) Operational procedures of the reticulated system;
(b) Methods for detecting leaks in the system;
(c) Prevention measurements to be taken in case of a leakage;
(d) Prevention measurements to be taken in case of fire hazard;
(e) Provide ideas for the replacement or repair process if any part of the reticulated system becomes damaged or inoperative.

7.20 Approval of the Reticulated System Installer

No reticulated system shall be installed without obtaining approval from the Chief Inspector of the department of explosives.

7.21 Inspection of Reticulated System

7.21.1 In order to ensure the safety of the equipment, tools and facilities of any reticulated system and safe operation, the reticulated system licensee shall ensure that the system is inspected every two years by a qualified independent inspector from the date of commencement of the reticulated system.

7.21.2 If the inspection is conducted by a qualified independent inspector as per sub-section (1), a certificate shall be issued by the inspector in the form prescribed by the Chief Inspector.

7.21.3 During the inspection, the qualified independent inspector shall record the inspection findings in the inspection checklist as per Form 'D'.

7.22 LPG Procurement Assurance

7.22.1 No industrial establishment or multi-storied residential building shall install a reticulated LPG system unless the LPG procurement is ensured by the owners or operators of the respective establishment or building.

7.22.2 Reticulated LPG systems can be installed in tanks (Bulk Storage) and manifold cylinders.

8. Autogas System

Autogas is the common name for LPG when it is used as a fuel in internal combustion engines in vehicles as well as in stationary applications such as generators. The specification has been laid down in Appendix B. It has an octane rating between 90 and 110 depending on the ratio of propane and butane in the fuel composition. Autogas driven vehicles are fitted with only one cylinder, but multiple cylinders may be used. The conversion kit or original equipment manufacturer's fittings shall have tanks with accessories, regulators and venture mixers. The tanks shall have fittings for filling, liquid outlet, emergency relief of excess pressure, fuel level gauge and sometimes a vapour outlet.

9. Autogas Dispenser

9.1 LPG dispensers shall not be located within 3 meters of an above-ground tank. The length of any dispenser service line that is above-ground shall be the minimum, and shall be protected against damage as far as practicable. A dispenser open to the public shall incorporate provisions for locking the nozzle to the dispenser when the unit is not available for operation. The dispenser shall be locked when it is not intended to be available for operation.

9.2 All equipment of all dispensers must be suitable for "explosive atmospheres". The dispenser shall be provided with an excess flow valve and a manual shut-off valve in all LPG pipes attached to the cabinet.

9.3 For dispensers in retail stations, they must additionally be equipped with remote operated shut-off valves and a pipe shear provision with the valves below or as close as possible to ground level, with the shear provision above them. Where the remote-operated valve can be relied upon to shut-off automatically in the event of pipe shear, the excess flow valve may be omitted. Dispensers should be suitably protected against damage from impact. Use of bollards and guardrails should be provided. The system shall incorporate the following:

9.3.1 A manually operated positive shut-off valve and an excess flow valve

9.3.2 Pump control switch within or adjacent to the dispenser which can shut down the remote pump; alternatively, this switching action may be performed automatically by the positioning of the hose nozzle in and out of its receptacle.

9.3.3 Return line, equipped with excess flow and positive shut-off valves. A continuous liquid bypass in the dispenser shall be provided.

9.3.4 Return The dispensing nozzle shall comply with the following requirements:

9.3.4.1 The connection provision shall be of the quick-connect type;

9.3.4.2 A provision to start and stop gas flow shall be incorporated and shall be quick-acting (i.e. not a screw-down valve). Where accidental discharge is possible, e.g. a quarter turn valve, a safety catch shall be provided; and

9.3.4.3 Shall be self- sealing, dish type and conforming to the following:

9.3.4.3.1 It shall not be possible to discharge fuel unless the nozzle is connected to a vehicle filler connection; and

9.3.4.3.2 The liquid released on disconnection shall not exceed 4.5 cc.

9.3.5 The location of the hose reach zone on the dispenser shall permit compliance with the following requirements:

9.3.5.1 No part of the vehicle being refueled shall be in a public place.

9.3.5.2 A public place, a protected place, an entry into a building, a pit or opening into a closed drain, a basement or an above-ground tank for flammable liquids, shall not be within the hose reach zone of the dispenser.

9.3.5.3 The standing area for the vehicle being filled shall not slope more than 1 in 20.

9.3.6 The area within which the filling connection can be made shall be illuminated to a level of not less than 50 lux whenever the unit is available for service.

9.3.7 The ground below an above- ground tank shall be treated to prevent the accumulation of any flammable liquid or LPG beneath the tank, in particular:

9.3.7.1 The ground area not less than 1.5 m beyond the tank or up to the boundary wall or barrier (if within 1.5 m) shall be paved or be resistant to saturation by flammable liquids.

9.3.7.2 It shall not be possible for any spillage elsewhere to flow under the tank. (Kerbs or diversions, grading to not steeper than 1 in 40, humps, or plinths under the tank are recognized control methods)

9.3.8 The configuration and character of the entrance from and the exit to the roadway shall be such as to minimize the likelihood of a vehicle hitting the LPG tank truck while it is entering or leaving the site. Features to be considered during the installation and design stages shall include road width, gradients, line of sight, traffic volumes and traffic speed. The LPG tank truck entry and exit driveways should be located to ensure that the tank truck has ready access to the site so as to reduce the time it may need to be exposed to traffic while entering or leaving the site.

9.3.9 The LPG tank truck unloading position shall be such that:

9.3.9.1 The LPG tank truck is positioned wholly within the site during unloading; and

9.3.9.2 The LPG tank truck parking area has a separation distance of 7.6 m from any building, structures and/or any ignition sources and 15 m away from any outdoor places of public assembly including schoolyards, athletic fields and playgrounds. Separation distance from buildings or structures with fire resistive walls may be reduced to 3.1 m.

9.4 The recommended airborne exposure limit (REL) of LPG is 1,000 ppm averaged over a 10-hour work shift and should be maintained in the working area

NOTE: The possibility of a high momentum impact on the tanker from vehicles accidentally leaving roadways shall be avoided at all times.

The unloading of an LPG tank truck shall only proceed when the exit is not obstructed and it is positioned in such a manner that it can leave the site without recourse to reversing.

Where the LPG tank truck parking area is away from the fill point, vehicles shall be prevented from driving over the filling hose.

10. LPG Transportation

10.1 Road

10.1.1 LPG shall not be carried by any vehicle used for public transportation.

10.1.2 The vehicle used for the transportation of LPG shall be well constructed and designed to comply with the DOT cargo tank vehicle specification for transportation of LPG and be properly maintained.

10.1.3 There shall be no sharp projection on the inside of the vehicle.

10.1.4 The vehicle shall be driven by diesel.

10.1.5 It's exhaust shall be wholly in front of the tank.

10.1.6 In the vehicle there shall be ample clearance from the fuel system and combustible material.

10.1.7 The vehicle shall not be exposed to leakage or spillage of any flammable material.

10.1.8 The exhaust pipe of the vehicle(s) shall be fitted with an approved spark arrestor.

10.1.9 The muffler or silencer shall not be cut off from the exhaust system.

10.1.10 The engine air intake shall be fitted with an effective flame arrester capable of preventing the emission of flames from the side of the engine.

10.1.11 The cab of the vehicle shall be of metal construction and its rear window, if provided, shall be covered with wired glass.

10.1.12 The fuel tank shall be securely placed so as to prevent unusual hazards, to permit drainage without removal from the mounting and be protected against blows.

10.1.13 A quick action cut – off valve, clearly marked, shall be fitted with fuel feed pipe in an easily accessible position.

10.1.14 If the liquid self-closing valve or remote emergency actuator for the liquid cargo valve does not function properly, the vehicles shall be taken out of the service.

10.1.15 A Suitable fire extinguisher, about 1 kg dry powder, shall be kept in the diver's cabin.

10.1.16 The vehicle shall be constantly attended to by at least one person familiar with these codes and standards.

10.1.17 The driver shall be properly trained and shall not be under the age of 21.

10.1.18 No vehicle shall be parked on a public road or any congested road or at a place within 9 (nine) meters from any source of fire.

10.1.19 Cargo tank vehicles unloading into storage container shall be at least 3 meters from the container and so positioned that the shutoff valves on the truck and container are easily accessible.

10.1.20 The cargo tank shall not transfer LPG in to dispensing storage while parked on a public road.

10.1.21 The voltage for the electric light or instrument of the vehicle shall not exceed 24 volts.

10.1.22 The electric wire shall be heavily insulated.

10.1.23 The electric system shall be flame-proof and provided with an over current protection device, in the form of a fused automatic circuit breaker and to be installed so as to be protected from any physical damage and contact with a possible product spillage.

10.1.24 The Pipe line connected to the fuel system shall be electrically continuous and properly earthed.

10.1.25 During loading and unloading operations:

i. The engine shall be stopped and the battery shall be isolated;

ii. The vehicle shall be securely and efficiently stopped and no movement of the vehicle is allowed;

iii. The driver shall not leave the vehicle so as to take any appropriate action in an emergency.

10.2 Rail

LPG shall not be carried by rail.

10.3 River

10.3.1 LPG in bulk shall not be carried in tanker or country boat.

10.3.2 LPG cylinders shall not be carried in country boats

10.3.3 LPG in cylinders may be carried in barges/ tankers or any riverine transport tanker approved by the Chief Inspector of Explosive, provided:

i. Loading and unloading of LPG cylinders are carried out under the constant supervision of a competent, qualified and trained person.

ii. All safety procedures are followed.

iii. Necessary fire extinguishers are kept ready at the place of loading and unloading operations.

iv. LPG cylinders shall not be carried inside the deck.

v. LPG cylinders shall be carried on deck where sufficient ventilation is present.

vi. LPG cylinders shall not be stored in places where the temperature is more than 60^{0}C.

vii. LPG cylinders shall not be carried with explosives or any other dangerous material.

viii. LPG shall be carried at the back of the tanker on high deck.

ix. Smoking is prohibited in the store area.

x. Public movement is restricted in the storage area.

xi. The load line of the tanker should be well above the water level.

xii. The captain or master of the tanker shall be responsible for all the mishaps and casualties.

11. Measurement

The quantity of LPG supplied to a licensee, and LPG supplied to a consumer shall be

ascertained by means of a correct meter or weighbridge or platform scale.

The Commission or any person duly authorized by the Commission shall, at any reasonable time, have access to ensure the correctness of the meter, weighbridge, platform scale, storage tanks, calibrations and container with respect to the quantity of LPG.

11.1. Storage Tank

The tanks shall be properly calibrated. A tank dipping system or automatic system of metering with temperature and density correction facilities may be used.

11.2. Cylinder

The quantity of LPG shall be measured in Kg.

11.3. Dispenser

The quantity of LPG shall be measured in Kg or Liter.

11.4. Reticulation System

The quantity of LPG shall be measured in Kg or Liter or Cubic meter (m^3).

12. Lighting, Fencing & Roadways

12.1. Lighting

In all storage and operating areas, lighting that is adequate for operations under normal conditions shall be provided. In addition, lighting that is sufficient to enable safe operations during an emergency shall be provided.

12.2. Fencing

LPG storage installation areas shall be fenced, the height of the fence shall be at least 2.0 meters and at least two means of exit shall be provided. Enclosure shall be designed to prevent public though fare and unauthorized access by motor vehicles. Exits shall be located so that a single emergency cannot prevent egress from any part of the installation

12.3. Roadways

Suitable roadways or other means of access for fire-fighting equipment such as wheeled extinguishers or fire trucks shall be provided. Access to LPG handling and storage areas shall be restricted and controlled.

13. Safety Sign and Marking

13.1 Safety Sign

The Globally Harmonized System of Classification and Labeling of Chemicals (GHS) signs shall be placed to provide notification and instructions concerning safety requirements and emergency systems.

13.2 Marking

13.2.1 Storage Tank

The storage tanks shall be marked with conspicuous signs on the place at which they are located indicating:

i. Name and address of the tank manufacturer or trade name of the tank or tank supplier;
ii. Design code;
iii. Manufacturer's serial number;
iv. Water capacity in liters or kiloliters;
v. Design and maximum operating pressure in bar, mpa or kg/cm^2;
vi. Design metal temperature in °C;
vii. Outside surface area in m^2 or sqft;
viii. Shell thickness and head thickness;
ix. OL (overall length),
x. OD (outside diameter),
xi. HD (head design);
xii. Material specification;
xiii. Year of manufacture/test date; Inspecting authorities' identification if any.

13.2.2 Cylinder

All markings, including those mentioned hereinafter, except the manufacturer's marking, shall be stamped on the collar or neck end of the cylinder:

i. Name of the Manufacturer;
ii. Name of the specification used for the construction of Valve and body;
iii. serial/rotation number;
iv. Date of Manufacture;
v. Date of Last Inspection;
vi. Working Pressure;
vii. Test pressure;
viii. Tare weight;
ix. Water Capacity;
x. Direction for opening the valve;
xi. Symbol of the Inspector;
xii. Brand name of the Licensee.

14. Fire Insurance and compensation

14.1 Fire Insurance

No licensee shall operate its works unless the same are insured against loss and damage to public life and property due to fire or any operational reason, accident, etc.

14.2 Compensation

A licensee shall be responsible for any mishap that takes place at his works, LPG outlets, distributor's premises or during transportation of LPG due to incompetence, negligence or use of substandard material or equipment and shall be liable to compensate for the loss of life and property, as determined by the Commission on a case-to-case basis. The compensation so fixed by the Commission shall be paid within a period of one month of the issuance of an order by the Commission.

15. Inspection

15.1 Tanks shall be inspected externally and internally, before being placed into service, by authorized and qualified engineers for the following:

i. after installation,

ii. after construction,

iii. after it has contained materials other than LPG,

iv. after it has been reinstalled in another location,

v. after it has been exposed to fire,

vi. because of marked damage due to handling and other exposures and

vii. at periodic intervals required by competent authority depending upon the nature of the operation and conditions of the tanks.

15.2 The manufacturer's certificate and the records of inspection shall be kept and made available for examination during the operating life of the tank.

15.3 Inspection of tanks shall consist of any or a combination of the following tests:

i.visual examination;

ii. tests for leakage;

iii. ultrasonic thickness tests;

iv. radiographic tests;

v. magnetic particle tests;

vi. hydrostatic test when considered necessary by the competent authority and

vii. other related tests.

15.4 Major examinations of LPG storage tanks shall be carried out by a competent person and the data plate shall be marked with the date of examination month, and year

15.5 Tank records for above-ground installations should distinguish between 5-year visual external inspections and 10-year examinations. Examinations must be carried out before the end of the fifth or tenth year (as appropriate), following the year of the previous examination.

15.6 The frequency of examinations for identified storage tanks shall comply with the following table:

Table 5

Type of installation	Frequency	Storage Tank inspection
Above ground	Every 5 years	Full external visual examination. NDT may be used to supplement the external examination if necessary. Tanks with thermal insulations should have separated areas of tanks exposed for visual inspection or NDT. The number and spacing of such exposed areas are to be determined by a competent person.
Above ground	Every 10 years	Full visual internal examination, thickness check and hydro test.
Underground / Mounded Tanks	Every 5 years	Full, external visual examination, thickness check or hydrostatic test. In case of tanks without manholes, alternate procedures may be considered subject to the approval of a competent person and, where appropriate, the inspecting authority.

NOTE: It is suggested that advantage might be taken of an occasion when a tank is empty to start a new cycle.

15.6.1 Above-ground 5-year examination

i. Visual examination of external surfaces and all welds for signs of defects, where considered necessary, can be assessed by non-destructive testing (NDT) methods

ii. Leak test for fitting and appurtenances.

iii. Relief valves.

iv. The pressure relief valves should satisfy the design requirements of the tanks in terms of set pressure and capacity.

v. After satisfactory examination ensure that the date is marked on the data plate.

vi. Issue report.

15.6.2 Above-ground 10-year examination

i. Carry out the stages as listed in the five-year examination as mentioned in 12.1.4 and replace the pressure relief valve.

ii. Carry out wall thickness checks, hydraulic test or internal examinations.

iii. After a satisfactory examination, ensure the date is marked on the data plate.

iv. Issue report.

15.6.3 Underground/Mounded 5-year examination

i. Identify tanks by data plate markings or stampings.

ii. Full internal visual examination and also a wall thickness check or hydrostatic test. (Where internal examination is not practical the outside surfaces of the tank must be exposed for examination or as directed by the competent person).

iii. Check that the fittings are in order.

iv. Check the pressure relief valves. The pressure relief valve should satisfy the design requirements of the tank in terms of set pressure and capacity.

v. After a satisfactory examination ensure the date is marked on the data plate.

vi. Issue report. Such tests shall be considered as minimum requirement, otherwise follow the manufacturer's recommended schedule and procedure.

vii. The Commission will inspect the installation, at any reasonable time, when the Commission feels necessary and may appoint one or more third party inspectors for the purpose of verification of works of a licensee and the licensee shall pay to such third- party inspectors or inspectors a reasonable fee, as determined by the Commission, from time to time, for the purpose of any such inspection. The Commission may also appoint one or more third party inspectors for the purpose of inspecting the works of a licensee from time to time, at least once in a year, to verify that the works of the licensee conform to the LPG codes and standards.

16. Instructions

16.1 Licensee

16.1.1 LPG shall be odorized with ethyl mercaptan or any odorizing agent, not exceeding 20% of the lower limit of its flammability may be added to impart a pungent odor for leak detection in case of any leakage.

16.1.2 Adequate safety equipment shall be installed at in the installation, it shall be in full working conditions, guide lines shall be issued and instructions shall be displayed for its staff and customers to ensure safe operation.

16.1.3 An LPG licensee must implement education and training programs to ensure its employees and agents understand that the LPG retailer has volunteered to comply with this code and know what they must do to ensure compliance.

16.1.4 An LPG licensee will cooperate with and facilitate a Department of Human Services initiated annual training session covering LPG energy concessions and rebates. This training session is to be conducted at an LPG retailer's premises or an alternative location that will ensure.

16.1.5 The Licensee shall have an electronic weighing machine with a digital display of 50 KG weighing capacity and a minimum count of 10 grams.

16.1.6 On request, an LPG licensee must give a customer a copy of these Codes and Standards.

16.1.7 The container and equipment shall be marked and colored properly, tampering the cylinder, changing the original color, or replacing the cylinder shroud and footing are prohibited.

16.1.8 A container shall not be used if it is out of its qualification date and range.

16.1.9 No repair or maintenance work involving cutting or re-welding of any pipe shall be carried out without:

i. The permission of the competent authority.

ii. Supervision of an experienced and competent engineer or technical person and approval in writing from the authority concerned.

iii. The section is properly isolated, drained and degasified, purged with inert gas or steam or kept filled with water or in other way instructed by the authority concerned.

16.1.10 Before being put into operation, all pipelines, containers, tanks and vessels should be properly hydraulically tested.

16.1.11 All the used empty containers shall be kept securely closed until they have been thoroughly cleaned and freed from LPG.

16.1.12 Container shall be repaired by hot work only after it has been thoroughly cleaned and freed from LPG.

16.1.13 All precaution shall be taken at all times to prevent the escape of LPG into drains, sewers, rivers, public roads, railway lines, or any watercourse.

16.1.14 Public access to the areas where LPG operations are carried out shall be prohibited.

16.1.15 Every installation shall be fenced with fence having a height of at least 2 (two) meters.

16.1.16 The Fenced area shall be well ventilated.

16.1.17 Children under the age of 18(eighteen) or person in a state of intoxication shall not be allowed to load, unload, transport or operate LPG.

16.1.18 A competent person with proper qualifications, training and experience shall be in charge during the operation.

16.1.19 Smoking is prohibited.

16.1.20 It is prohibited to carry naked light or carry match, or lighter, mobile phone or other appliance capable of producing ignition or explosion or carry out any hot work at any time in the proximity to a place where LPG is operated, refueled, loaded or unloaded within the installation or within 6 meters of the installation.

16.1.21 No person shall commit or attempt to commit any act that may tend to cause a fire or explosion.

16.1.22 All precautions shall be taken to prevent any accident by fire or explosion.

16.1.23 When loading and unloading any container is suspended or discontinued all incoming and outgoing connections shall be closed immediately.

16.1.24 Adequate flame proof electric lighting shall be provided at the place of loading and unloading of LPG.

16.1.25 Adequate firefighting facilities with trained personnel must be kept ready at all places where LPG operations are undertaken.

16.1.26 Fire extinguishers suitable for LPG shall be placed at convenient points.

16.1.27 Not less than 2(two) fire extinguishers and not less than 10 kg of dry chemical powder or equivalent, shall be placed in the working place.

16.1.28 LPG fire shall not be extinguished until the source of the burning gas has been shut off.

16.1.29 In instances of leakage grade 1, one or more of the following may be required:

i. Implementation of a company emergency plan.

ii. Evacuating premises.

iii. Blocking off an area.

iv. Rerouting traffic.

v. Eliminating sources of ignition.

vi. Venting the area.

vii. Stopping the flow of gas by closing valves or other means.

viii. Notifying police and fire departments.

16.1.30 In instances of leakage grade 2, one or more of the following may require:

i. Because of their location and magnitude, they can be scheduled for repair on a regular basis with periodic re-inspection as necessary.

ii. A product may not be introduced into a container with a Grade 2 leak on its appurtenance until the leak is repaired.

16.1.31 The quantity of LPG, supplied to a consumer, shall be ascertained by means of a correct meter or weighbridge or platform scale

16.1.32 The Commission or any person duly authorized by the Commission shall, at any reasonable time, have access to ensure the correctness of the meter, weighbridge, platform scale, storage tanks, calibrations and containers with respect to the quantity of LPG.

16.1.33 Emergency controls shall be conspicuously marked and the controls shall be located so as to be readily accessible in case of emergency.

16.2 Customer

16.2.1 Before taking delivery the weight of the cylinder should be checked.

16.2.2 The hot plate or oven or stove should always be placed on a platform (made of non-flammable material) above the cylinder level.

16.2.3 Switch off the pressure regulator when the stove is not in use, especially at night.

16.2.4 Never tamper with or try to repair the cylinder or allied equipment yourself.

16.2.5 Make sure all parts of the installation are in good condition. If anything seems wrong with any part, call for the distributor's trained mechanic.

16.2.6 It is advisable to wear an apron while working in the kitchen. The use of saree or scarf should be avoided as much as possible while cooking.

16.2.7 A fire-retardant apron should be worn as much as possible while cooking.

16.2.8 Children must be kept away from the installation while cooking.

16.2.9 Use only hot plate or oven or stove of approved international standard.

16.2.10 Never leave the hotplate, oven or stove unattended while in use, as the burner flame could get extinguished due to an overflow of cooking material or even a gust of wind. This would lead to gas leakage from the burner. The accumulated gas could get ignited by the second or other burner in operation or any other source of ignition, resulting in fire.

16.2.11 The fry pan or pressure Cooker should be placed in such a way that its handle is away from the flame.

16.2.12 Plastic items must be kept away from the gas stove.

16.2.13 Rubber tube should be avoided, if used it must be regularly checked and changed immediately in case any visible cracks, damages or deformation are noticed.

16.2.14 LPG hose as specified in Section 4.2, should be used.

16.2.15 The safety cap must always be put on the valve of the unused cylinders, whether full or empty.

16.2.16 In the event of leakage or if there is smell of gas:

- **i.** Turn the pressure regulator knob to the "OFF" position.
- **ii.** Put out all fires in the kitchen or vicinity.
- **iii.** Do not light matchstick/lighter.
- **iv.** Do not switch "ON" or "OFF" any electrical switch.
- **v.** Open the door and windows for ventilation.
- **vi.** Get in touch with the distributor or emergency Service cell.

16.3. Motorist

16.3.1 LPG being highly inflammable, only the approved conversion kit shall be used and the Auto LPG tank or container shall be permanently fitted in the motor vehicle.

16.3.2 Provide safe places for parking and working on vehicles, e.g. away from drains, pits and other openings in the ground, and all sources of ignition.

16.3.3 Clearly identify vehicles, e.g. with suitably positioned signs, as a reminder to people working on them, especially those who may be carrying out 'hot work.

16.3.4 Any hot work on the body or other parts of an LPG driven vehicle should only be done by trained staff at authorized work shop.

16.3.5 Do not carry out any hot work in the LPG system unless it is LPG free.

16.3.6 Do not assume the LPG system is LPG free unless tested by an explosive meter.

16.3.7 Do not take any vehicle with a leaky LPG system to any workshop or building without stopping the LPG leak.

16.3.8 Ensure that the vehicle battery is disconnected when any part or all of the LPG system is to be removed. Always check reassembled systems for leaks.

16.3.9 Repair of the LPG tank is not permitted under any circumstances. However, repair and maintenance of the Auto LPG system and its components should be carried out at authorized workshops. Ideally, repairs should be done by the same retrofitter who has originally fitted the Auto LPG system to the vehicle.

16.3.10 Auto LPG tanks, containers, cylinders and the piping system shall be checked regularly every 5 (five) years for any leakage; however, if any distinct deformation of any tank, container or piping is noticed beforehand it shall be immediately checked for its usefulness and acceptability.

16.3.11 In case of leakage in the LPG system, cut off the LPG supply and park the car in an open area, away from ignition sources, move all the people to a safe distance from the vehicle, opposite to the wind direction and seek the assistance of the nearest authorized installer or workshop.

16.3.12 Train all staff in the emergency arrangements in the event of a fire or uncontrolled release of LPG, including the first-aid actions for dealing with cold burns.

16.3.13 Do not use domestic or any other detachable LPG cylinder as auto fuel as it is punishable offense and is also highly unsafe.

16.3.14 Auto LPG re-fueling to the vehicle tank should be done only by the authorized Auto LPG Dealers, through the dispensing nozzle.

16.3.15 Do not fill domestic LPG or any other gas in a LPG tank because domestic LPG does not meet octane requirement of Auto LPG and may fail the engine in the long run.

16.3.16 After refueling LPG, please ensure that the dust plug is inserted back into the filler valve.

16.3.17 It is recommended to run the vehicle 5-7 km in petrol mode after every 100-150 km run in LPG mode, to keep the petrol system in good condition.

16.3.18 It is a good practice to put the selector switch in the neutral position for a while before switching over to LPG. Switching directly from petrol mode to LPG may lead to engine stalling or backfire due to the mixing of both fuels.

16.3.19 Never tamper with any of the components in the LPG system.

16.3.20 Any other safety recommendation by the vehicle or kit manufacturer should be followed.

17. Emergency Procedure

LPG Storage, Bottling, Transportation, Dispensing and Marketing operators shall have a written emergency procedure. There shall be an emergency coordinator and all staff shall be trained in the emergency arrangements for events such as an uncontrolled release of LPG from any system, a fire in the vicinity of an LPG vehicle, or people suffering from cold burns

17.1 At all times, there shall be at least one employee either on the facility premises or on call (i.e., available to respond to an emergency by reaching the facility within a short period of time) with the responsibility for coordinating all emergency response measures.

17.2 The emergency coordinator shall be thoroughly familiar with all aspects of the facility's contingency plan and all operations and activities at the facility.

17.3 This person shall have the authority to commit the resources needed to carry out the contingency plan.

17.4 Whenever there is an imminent or actual emergency situation, the emergency coordinator (or the designee when the emergency coordinator is on call) shall immediately do all of the following:

- **i.** Activate internal facility alarms or communication systems, where applicable, to notify all facility personnel.
- **ii.** Notify appropriate state or local agencies with designated response roles if their help is needed.

17.5 Whenever there is a release, fire or explosion, the emergency coordinator shall immediately identify the character, exact source, amount and areal extent of any released materials. The emergency coordinator may do this by observation or review of facility records or manifests and, if necessary, by chemical analysis.

17.6 Concurrently, the emergency coordinator shall assess possible hazards to human health or the environment that may result from the release, fire or explosion. This assessment shall consider both direct and indirect effects of the release, fire or explosion.

17.7 If the emergency coordinator feels or determines that the facility could threaten human health, or the environment, outside the facility, the emergency coordinator shall:

- **i.** Immediately notify the appropriate local authorities.
- **ii.** Be available to help appropriate officials decide whether local areas should be evacuated,
- **iii.** Immediately notify either the government official designated as the on-scene coordinator for the geographical area or the national response center. The report shall include all of the following:
  - **a)** Name and telephone number of the reporters.
  - **b)** Name and address of the facility.
  - **c)** Time and type of incident (e.g., release, fire).
  - **d)** Name and quantity of materials involved, to the extent known.
  - **e)** The extent of injuries, if any.
- **iv.** The possible hazards to human health, or the environment, outside the facility.
- **v.** During an emergency, the emergency coordinator shall take all reasonable measures necessary to ensure that fires, explosions and releases do not occur, recur or spread. These measures shall include, where applicable.

vi. If the facility stops operation in response to a fire, explosion or release, the emergency coordinator shall monitor for leaks, pressure buildup, gas generation or ruptures in valves, pipes or other equipment, wherever this is appropriate.

vii. Immediately after an emergency, the emergency coordinator shall inform the concerned person.

viii. The emergency coordinator shall ensure that, reasonable measure have been taken to prevent the re occurrences of the emergency.

ix. The owner or operator shall note in the operating record the time, date and details of any incident that requires implementing the contingency plan.

x. Within 15 days after the incident, the owner or operator shall submit a written report on the incident to the department. The report shall include all of the following:

a) Name, address and telephone number of the owner or operator.
b) Name, address and telephone number of the facility.
c) Date, time and type of incident (e.g., fire, explosion).
d) Name and quantity of materials involved.
e) The extent of injuries, if any.
f) An assessment of actual or potential hazards to human health or the environment, where applicable.

18. Reporting

18.1 In case of any accident, an initial report shall be submitted immediately, but not later than 24 (twenty-four) hours after the occurrence, to the Commission by quickest means of communication (fax or email) narrating details of the accident and any remedial measures taken thereto.

18.2 In case of a major fire or explosion the matter should be reported to the police and fire departments.

19. Violation

If any of the terms and conditions of the codes and standards is violated, the Commission may impose a penalty or cancel the license or take any other punitive measure as per law.

20. Revision

20.1 The Commission may amend and revise any part of these Codes and Standards suo moto or at the request of any person and the revised Codes and Standards will be published in the Bangladesh Gazette.

20.2 All the inclusions and/or revisions will be part of the Codes and Standards.

20.3 Users of the Codes and Standards should ascertain that they are in possession of the latest amendment or edition.

21. Complain and Appeal

21.1. Complain

Any person aggrieved by any decision of the Commission or its authorized person or inspector may appeal and file a complaint to the Commission against the decision within 15 (fifteen) days from the date of the decision.

21.2. Appeal

Any person aggrieved by any decision of the Commission or its authorized person or inspector may appeal and file a complaint to the Commission against the decision within 15 (fifteen) days from the date of the decision.

22. Reference codes and Standards

The codes and standards that have been approved and referred hereinafter for design and construction are presented in Appendix A.

Appendix A

Design and Construction of LPG Plants and Installation:

1. **API Standard** 2510 Covering Design, Construction, Sitting Requirement & Spill Containment, Foundation, and Support & Accessories LPG Tanks, Piping Requirement, Transfer, Loading & unloading Facilities and Fire Protection.
2. **Requirements for Safe Entry and Cleaning of Petroleum Storage Tanks: API Std 2015** provides safety practices for preparing, emptying, isolating, venting, cleaning, entry and hot work.
3. **Overfilling Protection for Storage Tanks in Petroleum Facilities: API RP 2350** covering overfill protection for all above ground storage Tanks in petroleum facilities.
4. **Fire Protection Considerations for design and Operation of LPG Storage Facilities: API Pub 2510A** which **supplements** API Standard 2510 covering Design, Operation, Maintenance of LPG Storage Facilities from the standpoints of prevention, and control of release, fire protection design and fire control measures.
5. **Fire Protection in Refineries: API RP 2001** covering basic concepts of refinery fire Protection.
6. **Protection Against Ignitions Arising Out of Static, Lighting and Stray Current: API Std 2003.**
7. **Safe Welding, Cutting and Hot Work Practice in Petroleum and Petrochemical Industries: API Std. 2009.**
8. **Flame Arrester in Piping System: API RP 2008.**
9. **Application of Fixed Water Spray System for Fire Protection in Petroleum and Petrochemical Industries. API RP 2030.**
10. **Safe Hot Tapping Practices in Petroleum and Petrochemical Industries: API Publ.2201.**
11. **Flame Arresters for Vent of Tanks Storing Petroleum Products: API RP 2210.**
12. **Portable Fire Extinguishers: NFPA 10.**
13. **Installation of the Sprinkler System: NFPA 13.**
14. **Installation of the Stationary Pumps for Fire Protection: NFPA 20.**
15. **Flammable or Combustible liquid Storage Tank NFPA 30.**
16. **Installation of the Lighting Protection System: NFPA 780.**
17. **Standard for Storage, Use and Handling of LPG in Portable Cylinders: NFPA 55** covering Storage, use, handling of LPG in portable Cylinders; Emergency Plan and Safety Precautions.
18. **Storage and Handling of LPG: NFPA 58** (2001 Edition) Covering LPG Containers, Piping, Associated Equipment, Design, Construction, Installation, Storage, Venting to the atmosphere and Operation of Marine Terminals, Highway Transportation and Use in Building.
19. **Storage and Handling of LPG at Utility Plants: NFPA 59.**

20. **National Electrical Code: NFPA 70. USA.**
21. **Electrical Installation at Petroleum Facilities: API RP 500.**
22. **Sizing, selection and installation of Pressure Relieving System: API RP 520**
23. **Metallic Gaskets for Raised Face Pipe Flange and Flanged Connection: API 601.**
24. **Process measurement Instrumentations: API 551.**
25. **Design and Construction of Large, Welded, Low pressure Storage Tanks: API RP 620.**
26. **Welded Tanks for Oil Storage: API 650.**
27. **Cathodic Protection of Aboveground Storage Tanks: API RP 651.**
28. **Pressure Vessels and Materials: ASME Boiler and Pressure Vessel Codes.**
29. **Pressure Vessel Plates: ASTM.**
30. **Liquid Petroleum Transportation Piping System; ANSI B31.4.**
31. **Model Code of Safe Practice: Institute of Petroleum (IP).**
32. **Transportation of Hazards Liquid by Pipeline: DOT, USA.**
33. **Welded steel cylinders: DOT Specifications 4B, 4BA and 4BW.**
34. **Electrical Apparatus for Explosive Gas Atmosphere: IEC 79.**
35. **Wiring Regulations for Electrical Installation: IEE.**
36. **Instrumentation: ISA.**
37. **Recommendations for the safe filling of LPG cylinders at depots:** Code of Practice 12 prepared by the Liquefied Petroleum Gas Industry Technical Association, UK, (LPGITA).
38. **Safe handling and transport of LPG in bulk by road: Code of Practice 2 prepared by LPGITA.,**
39. **Hoses for transfer of LPG in bulk installation, installation, inspection, testing, and maintenance: Code of Practice 14 prepared by LPGITA.**
40. **Domestic butane and propane-gas-burning installations: BS 5482: Part 1: 1979, Code of Practice.**

Appendix B

Auto Liquefied Petroleum Gas (ALPG) Specification

Tests	Test Method	Limit
Density a 15 °C, Kg/liter	ASTM D 1657	to be reported
Vapor Pressure, PSIG, at 37.8 °C	ASTM D 1267	Min.75 Max. 150
Propane content minimum	-	30-40%
Volatility: Evaporation Residue, mg/kg	ASTM D 1837	Max. - 100
Pentane and Heavier	ASTM D 2163	Max. 2.0
Free Water content		Nil
Moisture Content ppm.	ASTM D 2713	Max. 10
Residue on Evaporation, ml/100ml	ASTM D 2158	Max. 0.05
Total Volatile Sulfur Content[1], % mass.	ASTM D 2784	Max. 0.015
Hydrogen Sulfide	ASTM D2420/ UOP 212	Pass
Copper Strip Corrosion, at 1hour &37.8° C	ASTM D 1838	Max. 1
Octane, RON	ASTM D 2699	Min.87

Appendix C

Liquefied Petroleum Gas (LPG) Specification

Tests	Test Method	Limit		
		PB Mixture	Propane	Butane
Density a 15 °C, Kg/liter	ASTM D 1657	Min. 0.55 Max. 0.60	to be reported	to be reported
Vapor Pressure, PSIG, at 37.8 °C	ASTM D 1267	Max. 208	Max. 208	Max. 70
Volatility: Evaporation Temperature for 95% vol.° C	ASTM D 1837	Max 2.2	Max. - 38.3	Max. 2.2
Butane and Heavier Pentane and Heavier	ASTM D 2163	..... 2.0	2.5	..... 2.0
Moisture Content (ppm)	ASTM D 2713	Max. 10	Max. 10	Max. 10
Residue on Evaporation, ml/100ml	ASTM D 2158	Max. 0.05	Max. 0.05	Max. 0.05
Total Volatile Sulfur Content[1], % mass.	ASTM D 2784	Max.0.0 14	Max. 0.0185	Max. 0.0 14
Hydrogen Sulfide	ASTM D 2420 / UOP 212	Pass	Pass	Pass
Copper Strip Corrosion, at 1hour &37.8° C	ASTM D 1838	Max. No1	Max. 1	Max. 1

[1]The total sulfur limits in these specifications do not include sulfur compound used for stanching purpose.

Appendix D

Technical Specifications for Cylinders

D.1. Information Data*

Service Pressure : 17 Kg/cm^2.
Hydrostatic Test Pressure : 34 Kg/cm^2.
Standard Specification : DOT-4BA-240 OR Equivalent
Quality Control Standard : ISO 9001/ 9002.
Internal Valve Pad Threading : ¾ inch 14 NGT.

Equivalent means other standards, that assures a technical specification of LPG Cylinder of equal or better quality than that of DOT-4BA-240. Any bidder offering an equivalent standard must be supported with Manufacturers Test Certificates to prove the equivalency in respect of manufacturing process, quality control standard, inspection procedures and standard, performance, size/ dimension and other characteristics.

*Supply of LPG to domestic category consumers shall be made in 12 kg. Supply of LPG in 35 and/or45kg may also be made especially for non-domestic consumers. Only in special case, LPG in 5.5 kg is acceptable. The valve shall be uniform in all cases and the regulator of the valve shall be capable of releasing LPG at a rate of 1kg per hour at 30 mbar or 300 mm Water column.

D.2. Construction

Each cylinder consists of five main parts:

D.2.1. The body
D.2.2. The Valve Pad
D.2.3. The Valve Protection Shroud
D.2.4. The Foot ring
D.2.5. The Valve

D.2.1. The Body: Consists of two pressings joined by one circumferential weld. The circumferential joint is of joggled butt type with the edge of the top half cylinder end off-setted to form a perfect internal backing strip and welded using automatic submerged arc welding process.

D.2.1.1. Material: The steel used for the construction of the cylinder body shall conform to the following requirements: Cold rolled steel sheet or hot rolled steel sheet, silicon killed or semiskilled quality at mill option pickled-oiled deep drawing quality, suitable for making LP gas cylinders. The material should be in accordance with JIS G3116 SG 295 or NFA 36.211 or equivalent.

D.2.2. The Valve Pad: is inserted from the inside and is welded to the cylinder opening by metal inert gas welding or automatic submerged arc welding process. The internal threading is clean-cut, even, without cracks and machined to gauge tolerance.
Specification of thread: ¾ inch 14 NGT.

Material: Forged Steel JIS G4051 S20C or NFA 36.501 or equivalent

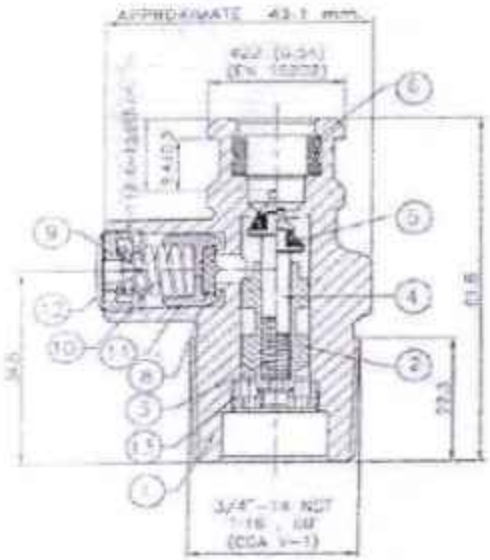
D.2.3. The Valve Protection Shroud: The valve of the cylinder is protected against any damage by a metal shroud fabricated in accordance with the drawing. The shroud is permanently welded on to the cylinder body by automatic welding under inert gas or manual arc welding.

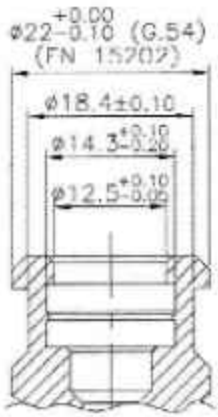
Material: Weldable Steel as per JIS G3101-SS41/Q235 or French Code NFA 35.501 GR-24.2 or equivalent
Metal thickness: 3 mm minimum.

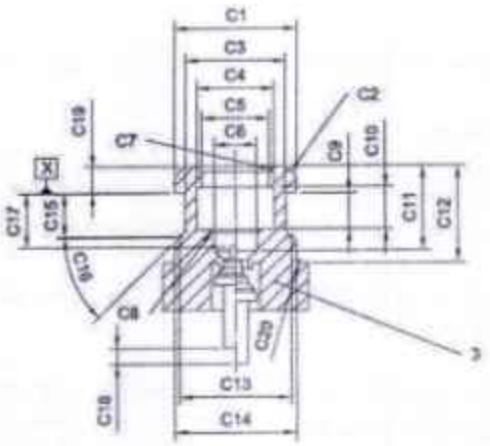
D.2.4. The foot ring: will be welded to the cylinder body in a position below the circumferential weld at six locations of 55 mm length by automatic welding under inert gas or manual arc welding.
Material: JIS G3101-SS41/Q235 or NFA 35.501 GR-24.2 or equivalent
Metal thickness: 3 mm minimum.

D.2.5 The Valve: Cylinder shall be fitted with a compact valve with a side safety release arrangement similar to Kosan Gas Compact Valve Code No. 186 G001 with a safety release arrangement (22 mm version) and a protection cap. Details of it are given hereinafter. Equivalent valves in respect of quality (not in respect of dimension) if offered, must be supported with Manufacturer's Test Certificates to prove the equivalency in respect of valve material, manufacturing standard, size/dimension, performance, and other characteristics

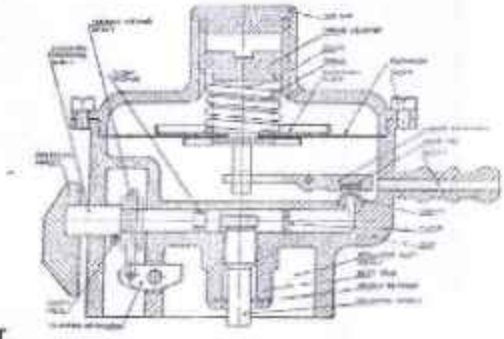
LPG CENTRE VALVE DIA 22 MM







Valve			
C1	Ø22±0.1	C11	15.1min.
C2	Ø18.9±0.2x45°	C12	16.1min.
C3	Ø18.40±0.15	C13	Ø20.0
C4	Ø14.25±0.15	C14	Ø22.1±0.05
C5	Ø12.5±0.1	C15	7.0±0.1
C6	Ø9.1±0.05	C16	45°
C7	0.8±0.2x45°	C17	9.2±.03
C8	0.4±0.1x45°	C18	2.65min.
C9	7.2±0.1	C19	3.5±0.1
C10	7.3±0.1	C20	RO.5-RO.8



Regulator

1. **For cooking gas**:

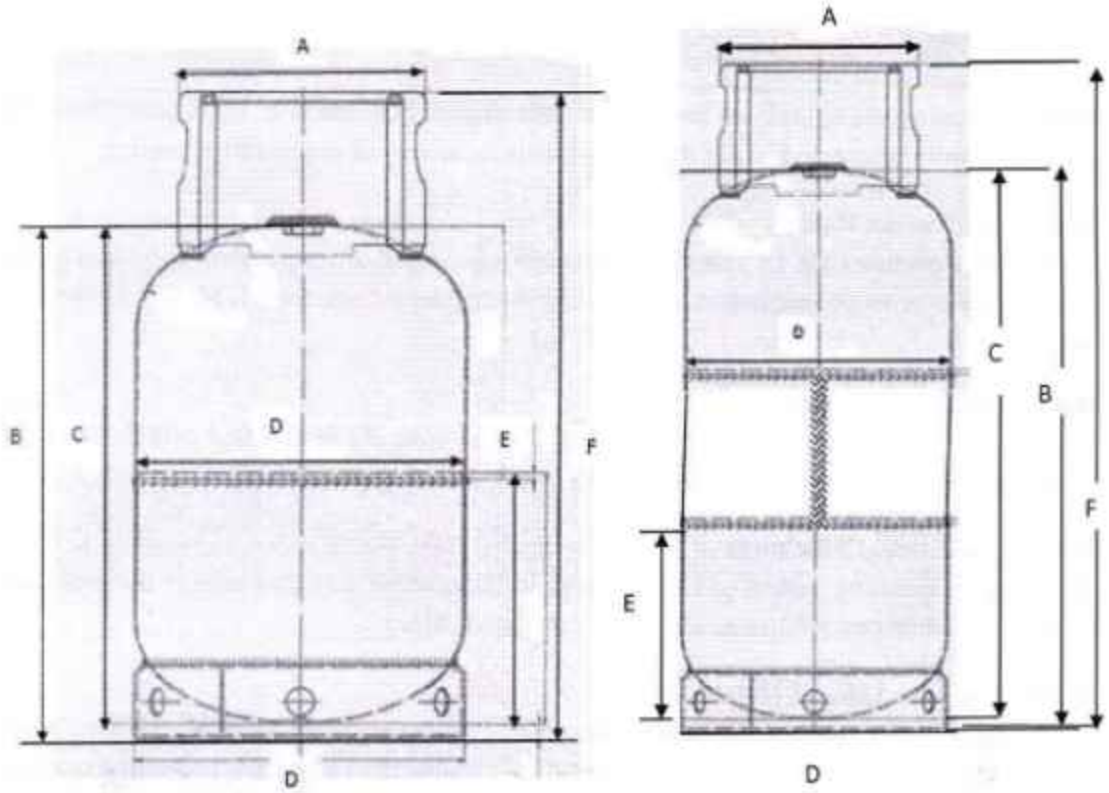
Nominal Size: 22 mm
Outlet pressure: 30 milli bar (300 mm Water Column)
Capacity: 1 Kg/hr
Material:
Body: die cast Zinc.
Diaphragm: synthetic rubber
Spring: Steel.

2. **For industry**:

As per specific requirement.

D.3. Dimension*

The basic size of the cylinder shall conform to the following requirements:



E

Cylinder Capacity,		A±5	B±5	C±2	D±5	E±5	F±5
Kg LPG	WC±1, liter						
5.5(cooking gas)	12	228	270	245	300	130	385
12(cooking gas)	26	228	470	450	300	230	580
35(industrial gas)	74	228	860	840	360	#	990
45(industrial gas)	108	228	1150	1130	360	#	1285

to be reported

* If not mentioned otherwise, denotes mm. The cooking gas cylinder is standardized at 5kg or 12 kg and the industrial gas cylinder is standardized at 35 or 45 kg.

D.4. Thickness of Cylinder Body

The thickness of the cylinder body is to be decided as per the design regulations of the SNCT code or equivalent for the manufacture of unfired pressured vessels. In any case the minimum

wall thickness of the cylindrical and domed ends shall not be less than 3.00 (three) mm. The measured wall thickness shall not include galvanizing or any other protective coating

D.4.1. Corrosion Rate

Corrosion allowances for 15 years determined by equivalent of copper strip corrosion of 4C or 2 mils/year or as per regulation for handling dangerous substances (RTMD), whichever is higher.

D.4.2. Impact Strength

The cylinder wall should be able to withstand flat or vertical fall of filled cylinder on hard ground from a height of 3 meters without any major dent or damage.

D.4.3. Additional Thickness

The ordinary handling pattern of LPG cylinder in Bangladesh may also require the provision of additional thickness of 0.1mm above the calculated value.

D.4.4. Service Life: 15 (fifteen) years

In no case shall the finished wall thickness of any cylinder at the cylindrical and domed end be less than 3(three) mm, which shall not include galvanizing or any other protective coating. To maintain the minimum thickness at any point as said above, the sheet used for the manufacture of the cylinder must be more than 3(three) mm.

D.5. Heat Treatment

Cylinders shall be stress relieved at $620^0C \pm 10$ in a continuous oven for about 25 minutes or alternatively normalized at 920^0C depending on the steel mills recommendation and the certificate thereof shall be forwarded to the purchaser as part of the shipping documents.

D.6. Painting

Before painting, the surface of the cylinder shall be thoroughly cleaned to ensure that there is no dirt, dust, or any remnants of old paint. The cylinder shall be shot blasted to SSPC-5/63/SA-3 (white metal) and immediately applied to the flowing painting systems:

A.6.1. One coat of zinc metallization (minimum 40 micron thick).

A.6.2.One coat of primer and one coat of finish (40 micron minimum dry film thickness) spray painting stoving epoxy colour signal red with prior approval from the purchaser.

D.7. Hydrostatic Testing

D.7.1 Every cylinder shall undergo a hydrostatic pressure test of 34 Kg/cm^2 for minimum of 60 seconds.

D.7.2 Permanent Expansion Stretch Test: At least one cylinder selected at random out of each lot of 200 or less will be selected for the permanent expansion stretch test. The permanent volumetric expansion of the cylinders must not exceed 10% of the total volumetric expansion at test pressure.

D.7.3. Destruction of Burst Test: At least one cylinder selected at random out of each lot of 400 or less will be subjected to hydraulic pressure until bursting. If any cylinder fails

with bursting pressure less than 84 Kg/cm^2 the batch of cylinders shall be considered as rejected.

D.8. Tensile Test

At least one cylinder selected at random out of each lot of 200 or less from one steel mill charge number will be used as a specimen for mechanical property testing to determine:

D.8.1 Tensile strength.

D.8.2. Yield stress

D.8.3. % Elongation.

D.9. Tightness Test

Every complete cylinder shall be subjected to an internal pneumatic pressure of 7 Kg/cm^2 by fully immersing it in water. If any leakage occurs the cylinder shall be regarded as having failed the test.

D.10. Marking

Every cylinder shall be permanently stamped on the valve protection shroud and on the top head of the cylinder as follows:

Name of the Manufacturer;

D.10.1. Name of the Specification used for the construction of the valve and body;
D.10.2. Serial/Rotation number;
D.10.3. Date of Manufacture;
D.10.4. Date of Last Inspection;
D.10.5. Working Pressure;
D.10.6. Test pressure;
D.10.7. Tare weight;
D.10.8. Water Capacity;
D.10.9. Direction for opening the valve;
D.10.10. Symbol of the Inspector;
D.10.11. The brand name of the Licensee piercing on collar of the cylinder.

The size of the marks shall be as per space permitting but not less than 6 mm high.

D.11. Manufacturers Report

Every cylinder will be accompanied by a manufacturer's certificate before leaving the factory and that of an independent survey by a bonafide inspection agency appointed by the purchaser at its own cost. The Manufacturer shall also provide steel makers test certificates showing chemical analysis, mechanical strength, and sheet thickness for each lot number and the test certificates of the valve manufacturer.

D.12. Steel

The steel plate or sheet used for the cylinder manufacturing shall conform to the following requirements:

D.12.1. Chemical Composition:

Carbon	:	0.20% Maximum
Manganese	:	1.00% Maximum
Phosphorus	:	0.04% Maximum

Sulphur	:	0.04% Maximum
Silicon	:	0.35% Maximum

D.12.2. Mechanical Properties:

Tensile Stress	:	45 Kg/mm^2 Minimum
Yield Stress	:	30 Kg/mm^2 Minimum
Elongation	:	26% Minimum

D.13 Welding

The attachment to the tops and bottoms only or cylinders by welding of neck rings, foot rings, bosses, pads, and valve protection shroud is authorized provided that such attachments and the portion of the cylinder to which they are attached are made of weldable steel the carbon content of which must not exceed 0.25 percent.

Each cylinder must be uniformly and properly heat treated prior to testing by the applicable method depending on the steel mill recommendation. Heat treatment must be accomplished after all forming and welding operations.

D.14. Checking of Water Capacity

The water capacity of each cylinder shall be checked. This shall be done by weighing the empty cylinder and then by filling the cylinder with a calibrated volume of liquid or by other means approved by the independent inspecting authority in order to ensure compliance with the required minimum specified water capacity.

D.15. Mechanical Test

The mechanical test shall be carried out on both the parent material and the welds to determine yield strength, tensile strength, % elongation, bend test, nick break test, minimum thickness, reduction of area of material etc. One cylinder selected having passed the hydrostatic test or part thereof heat treated as required was taken at random out of each lot of 200 or less.

The following, test pieces are required for each cylinder from a lot of 200 or less:

D.15.1 Tensile test on parent material.
D.15.2 Tensile test on welded joint;
D.15.3 Bend test on parent material.
D.15.4 Bend test on weld, outer surface in tension.
D.15.5 Bend test on weld, inner surface in tension.
D.15.6 Nick break test on weld.

The test pieces should be prepared in accordance with DOT-4BA-240 specifications.

Appendix E

Technical Specification for Cylinder/Container of Autogas

The size of auto-gas cylinder will be as per requirement of specific vehicle.

E.1. Material

The material used for the manufacture of the stress resistant container shells shall conform to Chemical composition and mechanical properties are given in Tables 1 and 2 respectively

Table 1 Chemical Composition

Stainless steel	C% *Max*	S_i% *Max*	M_n% *Max*	N_i%	C_r%		P% *Max*	N% *Max*
Type 304L	0.03	0.75	2.00	8.00-12.00	18.00-20.00	0.03	0.05	0.10

Table 2 Mechanical Properties

Tensile Strength, MPa, *Min*	Yield Stress, MPa, *Min*	Percentage Elongation at *50*mm Gauge Length, *Min*
550	310	40

Other types of suitable low carbon steel or stainless steel may be used with the prior permission of the statutory authority. In such a case, the minimum specified value of yield strength guaranteed by the container manufacturer for the finished cylinder shall be used for the purpose of calculating the wall thickness of the container. However, the minimum percentage elongation value shall not be less than 25%. Such steel should be certified by the steel maker to be of other than rimming quality, suitable for pressing or drawing, with acceptable non-ageing properties and shall be filly killed.

E.2. Design Temperature

The design operating temperature of the container shall be from (–) 20 to 65°C.

E.3. Design Pressure

The design pressure of the container shall be 3 MPa intended for Liquefied Petroleum Gas having vapour pressure at 65°C not exceeding 2 MPa.

E.4. Calculation of Minimum Wall Thickness

The wall thickness of the cylindrical shell of the container shall not be less than that calculated by the following formula.

1 *Containers without longitudinal welds*

$$a = \frac{P_h \cdot D}{2\frac{R_e}{4/3} + P_h} = \frac{P_h \cdot D}{1.5R_e + P_h}$$

2 *Containers with longitudinal welds*

$$a = \frac{P_h \cdot D}{2\frac{R_e \cdot z}{4/3} + P_h} = \frac{P_h \cdot D}{1.5R_e \cdot z + P_h}$$

Where,

P_h = hydrostatic test pressure in MPa,

R_e = minimum yield stress in MPa guaranteed by the manufacturer of container and it shall not be more than the minimum specified by the material standard,

a= calculated minimum thickness of the cylindrical shell wall, in mm,

D= nominal outside diameter of the container, in mm,

z= weld joint factor.

z = *0.85* where the manufacturer radiographs each weld intersection and 100 mm of the adjacent longitudinal weld and 50 mm (25 mm on each side of the intersection) of the production shall be taken at random for radiographic examination of the adjacent circumferential weld. For each welding machine, one out of every 50 consecutive containers from continuous production shall be taken at random for radiographic examination.

E.5. Construction and Workmanship

E.5.1. General Requirements

The manufacturer shall demonstrate by having a suitable quality control system that he has and maintains the manufacturing facilities and processes to ensure that the cylinder produced satisfy the requirements of sound engineering practice. The manufacturer shall ensure through adequate supervision that the parent plates and pressed parts used to manufacture the containers are free from defects likely to jeopardize the safe use of the containers. The contour of the dished end shall not deviate from the approved dimensions by more than 1.25 percent of the nominal diameter in respect of radial dimensions, or by more than 1.00 percent of the nominal diameter in respect of radial dimensions and by more than 1.00 percent in respect of axial dimensions. Such deviations shall not be abrupt changes and shall be outside the specified shape.

E.5.2. Weld

E.5.2.1. The butt welds shall be executed by an automatic welding process.

E.5.2.2. The butt welds on the stress-resistant shell shall not be located in any area where there are changes in profile.

E.5.2.3. Fillet welds shall not be superimposed on butt welds and shall be at least 10 mm away.

E.5.2.4. For stainless steel containers, MIG or TIG welding with argon as an inert gas shall be employed in fabrication.

E.5.2.5. A Longitudinal weld shall be executed in the form of a butt weld on the till section of the material of the wall. The shell of the container may be made up of one, two or three parts. When the shell is made up of two or three parts, the longitudinal welds shall be shifted or rotated by a minimum of 10 times the thickness of the container wall. The ends shall be in one piece. There shall not be more than one longitudinal weld on any shell section.

E.5.2.6. A Circumferential weld shall be executed in the form of a butt weld on the full section of the material of the wall.

E.5.2.7. A joggle weld is considered to be a special type of butt weld.

E.5.2.8. Welds of the studded valve plate or ring shall be carried out. For the valve plate or ring one run of weld from outside and one run from inside shall be given. For the valve plate or ring either one run of weld from outside and one run from inside or two runs of welding from outside shall be given.

E.5.2.9. A weld fixing the collar or supports to the container shall be either a butt or fillet weld.

E.5.2.10. Welded mounting supports, if provided, shall be welded in the circumferential way. The welds shall be strong enough to withstand vibration, braking actions and outside forces of at least 30 times the gravitational force in all directions.

E.5.2.11. In the case of butt welds, the misalignment of the joint faces shall not exceed one-fifth of the thickness of the walls.

E.5.3. Inspection of Welds

E.5.3.1 The manufacturer shall ensure that the welds show continuous penetration without any deviation of the weld seam and that they are free from defects likely to jeopardize the safe use of the container.

E.5.3.2 The frequency and extent of radiographic examination shall be as follows:

E.5.3.2.1 For the main longitudinal weld, 100 mm of each end of the longitudinal weld shall be radio graphed on one container taken from the first five consecutively welded containers and one container taken from the last five consecutively welded container of a production run. Remaining samples shall be selected on random basis.

E.5.3.2.2 For circumferential welds, 100 mm of each circumferential weld shall be radio graphed on a container taken from the first five consecutively welded containers and one container taken from the last five consecutively welded containers of a production run.

E.5.3.2.3 On re-commencement of welding operations following a shutdown exceeding four hours, the extent of the radiographic examination specified above shall apply.

E.5.4. Treatment of imperfection disclosed by radiographic examination

E.5.4.1 Imperfection disclosed by radiographic examination shall require the subject container to be deemed unacceptable. Containers that are deemed unacceptable, shall be condemned, or repaired in accordance with.

E.5.4.2 Where a container deemed unacceptable represents a batch, the entire batch shall be deemed unacceptable or radiographic examination shall be carried out on the weld(s) under consideration of two additional containers. These containers shall be from the group of containers consecutively welded from not more than 20 containers earlier and not more than 20 containers later than the failed container. The batch shall then be assessed as follows:

E.5.4.2.1 Where the additional radiographic examination of both containers discloses no imperfections, the batch shall be deemed to comply with the requirements of the radiographic examination.

E.5.4.2.2 Where the additional radiographic examination discloses any imperfection these containers shall be deemed unacceptable and radiographic examination shall be carried out on all the welds under consideration of all remaining containers of that batch or all remaining containers shall be deemed unacceptable.

E.5.4.2.3 Joints or section of joints re-welded or repaired to remove defects shall be radio graphed. Each radiograph shall include the identification symbol RI or R2 to denote that a first or second weld repair has been carried out within the length of weld represented by those radiographs. Not more than two attempts shall be made to repair any one section

E.5.5. Out-of-Roundness

The out-of-roundness of the cylindrical shell of the container shall be limited so that the difference between the maximum and minimum outside diameter of the same cross-section is not more than 1 percent of the average of those diameters.

E.6. Fittings

E.6.1 General Fittings

E.6.1.1 The supports shall be manufactured and welded to the container body in such a way as not to cause dangerous stress concentration or be conducive to the collection of water.

E.6.1.2 The mounting of the container shall be sufficiently strong and made of metal compatible with the type of steel used for the container. The form of the base shall give the container sufficient stability.

E.6.1.3 The top edge of the base shall be welded to the container in such a way as not to be conducive to the collection of water or to allow water to penetrate between the base and the container.

E.6.1.4 A reference mark shall be affixed to the containers to ensure their correct installation.

E.6.1.5 An identification plate shall be fixed to the stress resistant shell and shall not be removable. All the necessary corrosion prevention measures shall be taken.

E.6.1.6 The container shall have provisions to mount a gas-tight housing or other kind of protection device over the container accessories.

E.6.1.7 The material used for the housing shall have adequate strength, and all risk of container end corrosion is eliminated.

E.6.2 **Openings for Fittings**

E.6.2.1 The size of the opening in the shell of the container shall be the maximum which can be included within a square of 110 mm x 110 mm but shall not exceed 50 percent of the inside diameter of the container in any direction. Any other size of opening for fittings may be provided with prior approval of statutory authority. This shall have an adequately strong pad to withstand the tests prescribed in this standard

E.6.2.2 In case any housing for the cover of the fitting is required to be welded around the valve pad, it shall be done as per relevant clauses for welded attachments to the container.

E.7. Heat Treatment

E.7.1 All containers shall be normalized or stress relieved suitably after manufacture and completion of all welding (including that of attachments) and before hydrostatic testing is applied. A complete record of the heat treatment shall be maintained.

E.7.2 No post fabrication heat-treatment is required for stainless steel containers, however the yield strength (0.2 percent proof stress) and tensile strength of the finished container as determined from the mechanical tests shall not be less than the values used in the design calculation, and elongation shall be a minimum of 25 percent.

Note: Container made from steel produced by using fully killed fine grain steel making practice with grain refining elements need not be stress relieved, provided type testing shows that the desired properties are achieved without stress relieving, This provision may be invoked provided it is approved by the statutory authority.

E.8. Test

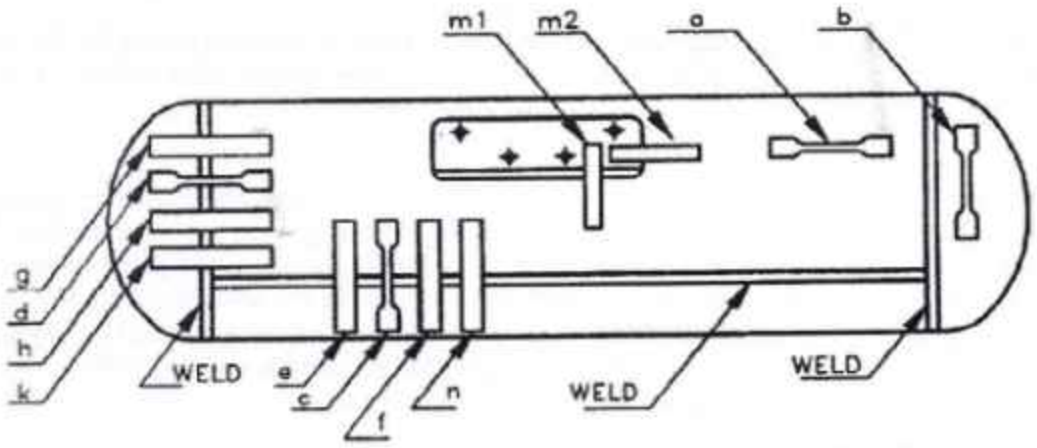
E.8.1 Mechanical Tests

From every batch (consisting of 200 or less heat-treated and finished containers), one test container shall be selected at random and various acceptance tests shall be carried out on the test specimens taken from this container.

E.8.1.1 All the mechanical tests for checking the properties of the parent metal and welds of the stress resistant shells of the container shall be carried out on test pieces taken from finished containers after heat treatment, if employed procedurally.

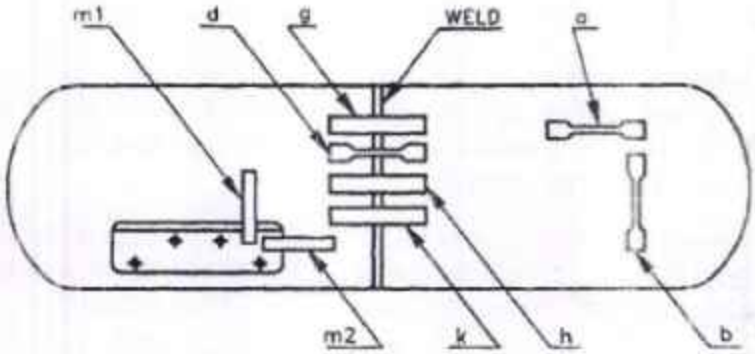
E.8.1.2 Acceptance Tests and Evaluation of Test Results Each sample container shall be subjected to the following tests:

E.8.1.2.1. Container with longitudinal and circumferential welds (three sections)
On test-pieces taken from the places shown in the Figure below:



a) One tensile test on parent material; the test piece to be taken in the longitudinal direction

(If this is not possible, it may be taken in the circumferential direction),
b) One tensile test on the parent material of the bottom,
c) One tensile test perpendicular to the longitudinal weld,
d) One tensile test perpendicular to the circumferential weld,
e) One bend test on the longitudinal weld, the inner surface in tension,
f) One bend test on the longitudinal weld, the outer surface in tension,
g) One bend test on the circumferential weld, the inner surface in tension,
h) One bend test on the circumferential weld, the outer surface in tension,
k) One macroscopic test of circumferential weld; and one macroscopic test of longitudinal weld.
m) A minimum of two macroscopic tests of valve boss or plate sections shall be conducted as shown in ml or m2 in Figure above.
E.8.1.2.2 Containers with circumferential welds only (two sections)
On test-pieces taken from the places shown in Figure below



E.8.2 Tensile test: *on the parent metal at location a and b*

1. The minimum value for yield stress shall comply with the values of steel specified herein above or as guaranteed by the container manufacturer, which is used at the time of approval of the design.
2. The minimum tensile strength and elongation after the parent metal breaks shall comply with the values for steels specified here in above.

The tensile strength value obtained shall be at least equal to that guaranteed for the parent metal irrespective of whether the fracture occurs in the cross section of the central part of the test piece.

E.8.3 Bend Test

The test shall be carried out by placing the test piece on two supports consisting of parallel rollers. The test piece shall be slowly and continuously bent by applying in the middle of the span on the axis of the weld, a concentrated pad perpendicular to the test piece surface. The load shall be applied by means of a mandrel. The width of the test piece shall be minimum 25 mm. Cracks shall not appear in the test-piece when it is bent around a mandrel as long as the inside edges are separated by a distance not greater than the diameter of the mandrel.
Any crack initiated from the edges shall not be treated as a failure.

E.8.4 Checking of Water Capacity

The water capacity of the cylinders shall be checked. This shall be done by weighing or by the volumetric method. The tolerance for water capacity shall be $\pm^{5}_{2}$ percent for cylinders up to and including 13 litres of water capacity and $\pm^{5}_{3}$ percent or 0.65 litres whichever is more for cylinders above 13 litres water capacity.

E.8.5 Macroscopic Examination
The macroscopic examination of a full transverse section of the weld shall show a good penetration and the absence of a lack of fission.

E.8.6 Hydrostatic Test
Each container shall be subjected to a hydrostatic test. During the hydrostatic test, the pressure shall be increased gradually untill the required test pressure of 3 MPa is reached. After the test pressure is reached and the external surfaces of the container are dried, it shall be retained for a period of not less than 60 seconds. Any reduction in pressure noticed during this retention period or any leakage, or visible bulge or deformation shall be treated as a case of failure in the test.

E.8.7 Pneumatic Leakage Test
Each container, after it has been dried and fitted with all accessories, as applicable, using a suitable jointing material as agreed to between the purchaser and the manufacturer, shall be tested for leakage by subjecting to air pressure of not less than 2 MPa for a period of not less than 60 seconds while immersed in water and shall show no leakage from the body of the container and valve pad joint. This test shall be carried out after fixing the safety cap on the valve(s) fittings as applicable. The container in a horizontal position shall be immersed in water tank, which shall be adequately illuminated with light both from outside and inside the tank.

E.8.8 Non-Destructive Examination

E.8.8.1 Radiographic Examination
A radiographic examination shall be done and the radiographic technique used shall be sufficiently sensitive to reveal a defect having a thickness equal to 2 percent of the combined thickness of the weld and the strip.

E.8.8.2 When a wire-type indicator is used, the smallest diameter of the wire visible may not exceed the value of 0.10 mm.
E.8.8.3 When a stepped and holed type indicator is used, the diameter of the smallest hole visible may not exceed 0.25 mm.
E.8.8.4 The film density shall preferably be between 2 and 3 but in no case less than 1
E.8.8.5 The following defects are not acceptable:
E.8.8.5.1 cracks,
E.8.8.5.2 inadequate welds,
E.8.8.5.3 inadequate penetration.

E.9. Surface Coating and Colour
The surface coating shall provide corrosion protection by zinc base, lead base or iron oxide base coat primer and top coat synthetic enamel paint with minimum combined thickness of 75 microns or as agreed to between the manufacturer and the buyer. Surface coating is optional for stainless steel. The colour scheme shall be as specified by the statutory authority.

E.10. Markings
Every cylinder shall be permanently stamped on the valve protection shroud and on the top head of the cylinder as follows:
E.10.1. Name and trade mark of the Manufacturer,

E.10.2. Name of the specification and design code used for the construction of Valve and body,
E.10.3. Serial/Rotation number,
E.10.4. Date of Manufacture,
E.10.5. Date of Last Inspection,
E.10.6. Working Pressure,
E.10.7. Test pressure,
E.10.8. Tare weight,
E.10.9. Water Capacity,
E.10.10. Symbol of the Inspector,
E.10.11. Enough space for requalification mark.

By the order of the Commission

Secretary
Bangladesh Energy Regulatory Commission