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Bangladesh Energy Regulatory Commission

Notification

Dated:.....,2016

BERC Codes and Standards No...../2016 – In exercise of the powers conferred by section 22 of 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 codes and standards shall be called the Bangladesh Energy Regulatory Commission LPG Storage, Bottling, Transportation and Dispensing Codes and Standards, 2016.

1.2. Commencement

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

2. General

2.1. Objective

To provide minimum requirement to ensure quality, safety and environmental protection for LPG Storage, Bottling and Dispensing.

2.2. Scope

The scope of these codes and standards are to cover Storage, Bottling, Transportation and Dispensing including container, piping and associated equipment and appurtenances. These shall extend 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. “Act” means Bangladesh Energy Regulatory Commission Act2003 (Act No.13 of 2003).

3.1.2. “Adequate” means facilities so provided are in accordance with the prevalent recognized codes and standards of safety.

3.1.3. “Area of operation” means the area within which a licensee is authorized for storage, bottling, refueling, distribute and marketing LPG.

3.1.4. “Auto gas” means LPG used in automobile as laid down in Appendix B.

3.1.5. “BERC” means Bangladesh Energy Regulatory Commission established under the Bangladesh Energy Regulatory Commission Act 2003.

3.1.6. “Boundary” means the boundary of the whole of the site under the same occupancy as

that on which the installation is included.

3.1.7. "Bulge" means swelling of cylinder wall.

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

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

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

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

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

3.1.13. "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.

3.1.14. "Container" means any cylinder, tank or vessel, portable or otherwise, used for storing, transporting and distributing LPG.

3.1.15. "Conversion kit" or original equipment manufacturer (OEM) fitting means a complete system assembly duly approve for use in bi-fuel mode, the tank with accessories of the conversion kit should be fixed firmly in the boot of the car and it should be installed under the driver's seat.

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

3.1.17. "Cylinder" means any container having water capacity more than 500 milliliter (ml) but less than 1,000 liter as laid down in Appendix D.

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

3.1.19. "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.

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

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

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

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

storing and distribution of LPG in cylinders, exceeding 500 kg/month, to a consumer and also be a licensee of Commission.

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

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

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

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

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

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

3.1.30. "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.

3.1.31. "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.

3.1.32. "Flammable liquid" means liquid petroleum whose flash point does not exceed 37.8°C when tested by closed-cup test methods.

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

3.1.34. "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.

3.1.35. "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.

3.1.36. "Leak grades 1" means -An 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.

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

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

3.1.39. "LPG" or "LP Gas" means Petroleum Gas, predominantly 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 Appendix C,.

3.1.40. "LPG bottling facilities" means the licensed facility used for storage and bottling of LPG for domestic, commercial or industrial use.

3.1.41. "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.

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

3.1.43. "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.

3.1.44. "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.

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

3.1.46. "Pit" means local corrosion not in excess of 6 mm diameter and occurring not more frequently than 1 (one) in any 500 mm² of the surface.

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

3.1.48. "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.

3.1.49. "Positive shut-off" means a valve which when actuated to the closed position blocks off all flow. The actuating stem shall be permanently connected to the flow blocking components.

3.1.50. "Product" means LPG.

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

3.1.52. "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.

3.1.53. "Protected work" means building in which persons dwell or assemble, docks, wharves, furnace, heater, kiln, or chimney or any public road or railway line or overhead high-tension power line.

3.1.54. "Psi" means a unit of pressure expressed in pound per square inch, "a" denotes absolute pressure & "g" denotes gauge pressure.

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

3.1.56. "Regulation" means any regulation framed under the Bangladesh Energy Regulatory Commission Act- 2003.

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

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

3.1.59. "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 bar or less.

3.1.60. "Shall" means provision that is mandatory.

3.1.61. "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.

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

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

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

3.1.65. "Technical competence" means such technical competence of a company entitled by its memorandum of association or any other appropriate instrument to engage in the operation activities like stripping, separation, liquefaction, processing/blending and/ or distribution activity 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.

3.1.66. "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.

3.1.67. "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.

3.1.68. "Vehicle" means all carriage including animal drawn carriage for transportation of petroleum products either in bulk or otherwise than in bulk.

3.1.69. "Water Capacity or WC" means the amount of water ,either in Kg(Kilogram) or liter at 15°C required to fill a container full of water.

3.1.70. "Water deluge system" means a system in which all the water is applied at the top of the vessel and allowed to run down the sides.

3.1.71. "Works" include plants, installation, 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.

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

2.89 "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.

2.90 Zone 2 – An area in which an explosive gas-air mixture is not likely to occur in normal operation, and if it occurs it will only exist for a short time. By implication an area which is not classified 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.

3.2.13. "Psi" means pound per square inch.

4. LPG Storage Tank (above and underground)

4.1 Tank and Tank Accessories

4.1.1. Tanks shall be constructed in accordance with API 650 and meet the requirements of ASME code, section VIII, division 1 and 2 or equivalent recognized by good engineering standards container and vessel shall meet the requirements of the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 and 2 or other equivalent internationally accepted codes and standards. All material of construction shall meet the requirements of section II of this code for LPG having minimum design pressure 17 kg/ cm² at 38⁰ C.

4.1.2. Low-melting-point materials of construction, such as aluminum and brass, shall not be used for LPG vessels or container.

4.1.3. Flange connections shall be a minimum of ASME Class 150.

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

4.1.5. Stationary Storage facilities shall have equipment to add odorant to LPG.

4.1.6. The LPG container shall be located outside of Buildings.

4.1.7. No container or tank shall be located within spill containment area.

4.1.8. The minimum horizontal distance between:

4.1.8.1. 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 of the Table1.

Table 1

Water Capacity, liters	Minimum Distance, meters	
	Aboveground tank	Underground/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

4.1.8.2. The shells of LPG tanks, spheres or pressurized vessels shall be 1.5 meters or half of the diameter of the larger vessel, whichever is the larger.

4.1.8.3. The shells of LPG Sphere or tanks and other non pressurized tanks:

4.1.8.3.1. 1(one) diameter of the larger tank, if the flash point of the contain material is less than 38⁰ Celsius

4.1.8.3.2. $\frac{1}{2}$ (half) the diameter of the larger tank, if the flash point of the contain material is greater than 38^o Celsius.

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

4.1.10. The containers shall not be located and installed underneath any building. It shall be set upon firm foundation.

4.1.11. Horizontal LPG tanks with capacities of 45 M³ or greater shall not be formed into groups of more than six tanks each.

4.1.12. 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 distances.

4.1.13. Tanks shall not be located less than 4 m from the fire wall.

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

4.1.15. 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.

4.1.16. 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.

4.1.17 **Minimum safety distances:**

4.1.17.1 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	---

4.1.17.2 For Total Storage not above 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	--

4.1.7.3 Minimum Safety distances (in metres) between facilities associated with storage and dispensing of LPG in liquefied Petroleum gas dispensing station as automotive fuel to motor vehicles

Table 4

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

4.1.18 Above ground Tank

4.1.18.1 Design of the foundation of aboveground tank should take into consideration:

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

4.1.18.1.2. The necessity to avoid flotation, if there is a risk of flooding, by securely anchoring, weighting or the use of adequate height.

4.1.18.1.3. The necessity to avoid settlement particularly differential settlement.

4.1.18.1.4. Expansion and contraction of the tank shell.

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

4.1.18.2 No permanent source of heat should be located within 15 m of an LPG storage tank.

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

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

4.1.19 Underground tank

4.1.19.1 Tanks shall be set on firm foundations and shall be securely restrained against flotation. It should meet the requirement of NFPA 30.

4.1.19.2 Tank venting system shall be provided with:

4.1.19.2.1. Sufficient capacity to prevent back flow of vapor or liquid.

4.1.19.2.2. Overfill protection equipment that will operate :

4.1.19.2.2.1. Automatically shut off the flow of liquid into the tank when the tank is more than 90 percent full.

4.1.19.2.2.2. 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.

4.1.19.2.2.3. Other method approved by the authorized having jurisdiction.

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

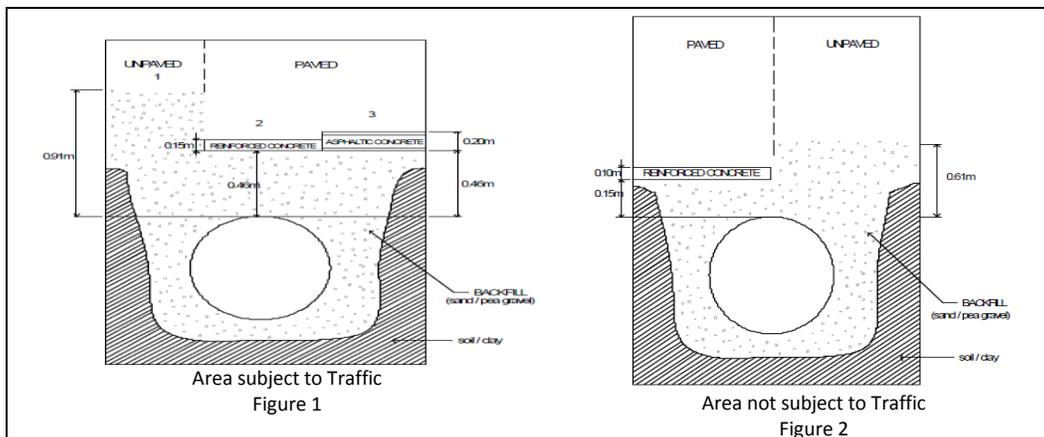
4.1.9.4 Underground tank installed in areas with no vehicle traffic shall be installed at least 0.15 m (6 in.) below grade. In areas where vehicle traffic is expected, a non-interchangeable underground tank shall be installed at least 0.460 m (18 in.) below grade, or the tank shall be protected from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

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

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

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

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



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

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

4.1.19.8 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.

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

4.1.20 Tank and 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.

4.1.20.1. An independent high-level alarm shall be provided. The alarm shall be set to give the operator the 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.

4.1.20.2. 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 vapour space of not less than 5% of its capacity shall be kept in each case.

4.1.20.3. Columnar glass level gauges shall not be used.

- 4.1.20.4. 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 pressure 25 kg/cm² 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.
- 4.1.20.5. Pressure relief valves installed on LPG tanks shall be designed to provide adequate flow capacity to protect the tank during fire exposure.
- 4.1.20.6. The pressure relief valve shall be installed to provide direct connection to the vapor space and to minimize liquid carry-over during vapor relief, especially when the tank is nearly full.
- 4.1.20.7. The possibility of tampering with the adjustment mechanism shall be minimized. If the adjustment mechanism is external, it shall be sealed.
- 4.1.20.8. 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.
- 4.1.20.9. 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.
- 4.1.20.10. The stem of any gate valve installed in the pressure relief system shall be in a horizontal or below-centerline position.
- 4.1.20.11. Discharge vents shall lead to the open air or to a flare system. Discharging directly to 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 automatic shutdown of filling operations prior to over filling.
- 4.1.20.12. Discharge vents shall be protected against mechanical damage.
- 4.1.20.13. Discharge vents shall be designed to handle any thrust developed during venting. Discharge shall not be less than 3 meters above the operating platform.
- 4.1.20.14. Pressure relief valves shall be tested for correct set pressure before being placed in service. Pressure relief valves should be set to start to discharge at a pressure 125 % of the maximum service pressure.
- 4.1.20.15. All pressure relief valves should be provided with a rubber cap at all times to protect it from dust, dirt, foreign particles, rain water and prevent the corrosion and pitting on top of valves.
- 4.1.20.16. Shutoff valves shall be located as close to the tank as is practical. The preferred location is at the shell nozzle. Shutoff valves shall be readily accessible for operation and maintenance.
- 4.1.20.17. All shutoff 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.

4.1.20.18. 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 nominal diameter. 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 of any accumulated water, is minimized. The additional pipe work and second valve may be fitted at time of draining provided that the fixed drain valve is protected by an excess flow valve fitted upstream. The outlet of the drain valve system should be blind- flanged, plugged or otherwise secured against tampering when not in use.

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

4.1.20.20. When the capacity of the vessel exceeds 40 M³, all shutoff 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.

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

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

4.2 Valve, Piping and Hose.

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

4.2.2. 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.

4.2.3. 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 to atmosphere, the discharge should not endanger personnel or equipment.

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

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

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

4.2.7. 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.

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

4.2.9. Piping shall be seamless, electric-resistance-welded, or submerged-arc-welded pipe.;

4.2.10. Piping applications of 5.1 cm or smaller shall be seamless.

4.2.11. Piping shall be provided with adequate Flexibility to accommodate the following:

4.2.11.1. Settling of tanks or shifting of foundations.

4.2.11.2. Expansion or contraction of tanks or piping with changes in temperature,

- 4.2.11.3. Soil movement.
- 4.2.11.4. Cooling or heating of unloading connections, vent connections, or loading and unloading headers.
- 4.2.11.5. 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.
- 4.2.12. The number of joints of any type between the vessel and the first block valve shall be minimized.
- 4.2.13. Welded joints shall be used where practical.
- 4.2.14. The number of flanged joints shall be minimized and Gaskets for flanged joints shall be resistant to liquid phase LPG.
- 4.2.15. Gasket of natural rubber or bonded with natural rubber shall not be used.
- 4.2.16. Metallic gaskets or stainless steel, spiral wound "graphite-filled" gaskets shall be used for flanged connected joints.
- 4.2.17. Threaded connections shall be minimized.
- 4.2.18. The pipe wall thickness shall be equal to or greater than that required by ASME B31.3.
- 4.2.19. Tubing shall be constructed of steel.
- 4.2.20. Butt-Welding Fitting shall be made from seamless steel and of same thickness and schedule as the piping.
- 4.2.21. 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/cm².
- 4.2.22. Packed-sleeve and resilient-sealed couplings shall not be used.
- 4.2.23. Weld-neck flanges are preferred.
- 4.2.24. Socket-weld NPS 2 and smaller are acceptable. If slip-on flanges are used, they shall be welded both inside and outside.
- 4.2.25. Plugs shall be constructed of steel.
- 4.2.26. Unions shall be of forged steel, shall have a working pressure of at least 210 Kg/cm² 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.
- 4.2.27. The primary shutoff valves for a tank (specifically the valves nearest the vessel that can shut off flow) shall be made from steel.
- 4.2.28. Valves constructed of free-machining steel similar to AISI Series 1100 and 1200 shall not be used.
- 4.2.29. Union or screwed-bonnet valves shall not be used unless they are equipped with bonnet retainers or the bonnets are tack welded.
- 4.2.30. 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.
- 4.2.31. Ball valves shall meet the requirements of API Std 607.
- 4.2.32. Check valves shall be installed on the discharge side of all centrifugal pumps.

- 4.2.33. Pressure relief valves shall be constructed of steel.
- 4.2.34. Suitable thermal relief valves shall be considered on liquid lines that can be blocked between two shutoff valves.
- 4.2.35. The equipment that can be blocked between shutoff valves shall be provided with protection from overpressure due to thermal expansion of the liquid.
- 4.2.36. Where liquid is likely to be trapped in valve cavities, the 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.
- 4.2.37. All liquid withdrawal opening and vapor withdrawal opening 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.
- 4.2.38. The internal valve shall remain closed except during time of operation. The internal valve shall be equipped for remote closure and automatically shutoff through thermal (fire) actuation.
- 4.2.39. Additional manual shutoff valve shall be installed, as close as practicable to each internal valve.
- 4.2.40. 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 emergency.
- 4.2.41. Hose shall be fabricated of 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.
- 4.2.42. 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 in:
- 4.2.43.1. 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^2 g.
- 4.2.43.2. Hose assemblies, after the installation of connections, shall be tested to a pressure not less than 50 Kg/cm^2 g.
- 4.2.43.3. Hose assemblies shall be visually inspected before each use for damage or defects.
- 4.2.43.4. Hose assemblies shall be tested at least once in a year at maximum pump discharge pressure or relief valve setting pressure whichever is higher.
- 4.2.43.5. Hose shall be protected from the elements and physical damage.
- 4.2.43.6. 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 Emergency Shutoff Valve.

Emergency shutoff valves shall be provided in the loading-unloading system for tank cars, trucks, and marine facilities.

4.3.1 Emergency shutoff valve shall incorporate the following means of closing:

4.3.1.1. Manual shutoff at the installed location.

4.3.1.2. Manual activation from a location accessible during an emergency,

4.3.1.3. Automatic shut off in the event of an LPG release.

4.3.1.4. Automatic shutoff through thermal (fire) actuation.

4.3.2 A remote shutdown capability including power supply to all transfer equipment shall be installed at distance not less than 8 meters or more than 30 meters.

4.3.3 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.

4.3.4 A check-valve may be used in place of an emergency shutoff valve where the flow is in one direction only.

4.3.5 If the check valve is installed in a dedicated storage vessel fill line or vapor return line.

4.3.6 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.

4.3.7 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 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 weakness or shear fitting.

4.3.8 If block valves are manually operated, they shall be accessible during an emergency.

4.4. Transfer Pumps and Compressor.

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

4.4.2. 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.

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

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

4.4.5. 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 passage of LPG to another portion of the electrical installation.

- 4.4.6. Pump should be protected by suitable strainer/filter.
- 4.4.7. Compressors for loading and unloading LPG shall be designed for the maximum outlet pressure to which they may be subjected.
- 4.4.8. 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.
- 4.4.9. Each positive displacement compressor shall be equipped with a pressure-relieving device on the discharge side.
- 4.4.10. A suitably sized scrubber or liquid knockout drum shall be installed immediately upstream of vapor compressors. The scrubber shall be equipped with a high-liquid-level device to shut down the compressor.

4.5. Electrical equipment and installations

- 4.5.1. Electrical installations and equipment shall conform to the provisions of NFPA 70.
- 4.5.2. All electrical apparatus shall be intrinsically safe and flame proof certified by an inspector approved by the Commission.
- 4.5.3. 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.
- 4.5.4. Conductors of safe and sound circuit shall be effectively protected against mechanical damage.
- 4.5.5. All electrical wiring other than conductor of intrinsically safe and sound circuit shall be effectively sealed at all joints, mechanically protected and adequately supported throughout its length and shall consist of :
 - 4.5.5.1. 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
 - 4.5.5.2. Metal sheathed cable with correctly designed and installed terminations.
- 4.5.6. Single or multi-cored insulated cables accommodated in solid drawn heavy gauge creased 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.
- 4.5.7. Single or multi-cored mineral insulated cable of approved type in conjunction with approved flame proof type glands at all joints and terminals.

4.6 Dike and Drainage

- 4.6.1. 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.

- 4.6.2. Walls, dikes, trenches, or channels are permitted to assist in draining the area.
- 4.6.3. 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.
- 4.6.4. 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 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.
- 4.6.5. 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.
- 4.6.6. The holdup of the remote impoundment area shall be at least 50% of the volume of the largest vessel draining to it.
- 4.6.7. 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.
- 4.6.8. Drain lines shall not be directed into a public sewer or into a drain not designed to contain flammable materials.
- 4.6.9. 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.
- 4.6.10. Provision should be made for handling the run-off of cooling water applied under fire conditions.
- 4.6.11. 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.
- 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.

4.7 Fire Protection.

The Installation shall be fire protected. 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. Emergency escape as well as access for firefighting shall be considered. LPG storage vessels shall be protected by water deluge systems, fixed monitors, water spray systems, or any combination of these systems. The water reserve for fire protection should be for 10 hours. 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. 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. The fire-water pumps shall be installed in a location which 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. They shall be accessible to facilitate maintenance, and be provided with hoisting facilities. 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 two by diesel engines. The stand-by fire-water pumps shall be provided with automatic starting facilities which 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. Portable equipment may be used but shall not be a primary method of water application. Control of LPG fire shall be coordinated with local emergency handling authority like police and fire department

4.7.1 The fire water system.

The fire water system shall be designed in accordance with:

4.7.1.1. Looped fire water system shall be provided around the storage and handling portions of an LPG facility.

4.7.1.2. 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.

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

4.7.1.4. 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.

4.7.1.5. 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.

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

4.7.1.7. 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.

4.7.1.8. 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.

4.7.1.9. 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.

4.7.1.10. 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.

4.7.1.11. 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.

4.7.1.12. 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.

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

4.7.1.14. 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.

4.7.2 Water deluge system.

Water deluge system for the protection of LPG storage facilities:

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

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

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

4.7.2.4. Pipe used for main water distribution lines shall have a diameter of at least 75 mm.

4.7.2.5. 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.

4.7.2.6. The system shall be manually operated from a safe location that is outside the spill containment area and that is at least 15 meters from the vessel being protected.

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

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

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

4.7.3 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:

4.7.3.1. The entire surface of each vessel shall be reached with streams from the monitors.

4.7.3.2. Each monitor shall be accessible during a fire or shall be remotely activated and controlled.

4.7.3.3. Monitor nozzles shall be adjustable for fog or straight stream, as required, to provide the most effective coverage of the protected vessel.

4.7.4. 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 under:

4.7.4.1. 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 litre per minute per square meters of exposed surface.

4.7.4.2. Allowance for rundown is to be provided.

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

4.7.4.4. 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.

4.7.4.5. Spray orifice size shall be at least 6 mm, larger orifice sizes will reduce the tendency of the nozzles to become clogged.

4.7.4.6. The system shall be manually operated from a safe location that is outside the spill containment area and that is at least 15 meters from the vessel being protected.

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

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

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

4.7.4.10. Flush-out connections shall be installed in the system to permit flushing at periodic intervals.

4.7.4.11. Accessible low-point drain connections shall also be provided.

4.7.4.12. The sizing of all piping shall be based on hydraulic calculations.

4.7.4.13. Pipe used for main water distribution lines shall have a diameter of at least 75 mm.

4.7.4.14. Pipe used for branch lines to spray heads is permitted to not be less than NPS 3/4 in size.

4.7.4.15. A full-flow strainer with a valve blow-off connection shall be installed in the main feeder line to the spray system.

4.7.4.16. The maximum size of the opening in the strainer shall be 6 mm.

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

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

4.7.5. 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.

4.7.6. Fire Detection System.

Fire Detection System shall be used to determine the need for fire and hydrocarbon detection systems. Where provided, fire and hydrocarbon detection systems shall be arranged to sound their alarms whenever fire or hydrocarbons are present. It is permitted to use detection systems to automatically activate isolation or fire protection systems in remote or unattended facilities.

4.7.7. Fire Extinguishers.

4.7.7.1. 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.

4.7.7.2. 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.

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

4.7.8. Fireproofing of LPG vessels.

4.7.8.1. 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.

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

4.7.8.2.1. 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,

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

4.7.8.2.3. Thermal insulation used for fireproofing shall be jacketed with rust-resistant steel.

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

4.7.8.2.5. 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.

4.7.9. Fireproofing of Structural Supports.

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

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

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

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

4.7.9.4. 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.

4.7.9.5. 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.

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

4.7.9.7. 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.

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

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

4.7.9.10. 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 Carrier

5.1 Road

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

- 5.1.1. The vehicle used for transportation of LPG shall be well constructed and designed to comply with DOT cargo tank vehicle specification for transportation of LPG and be properly maintained.
- 5.1.2. There shall no sharp projection on the inside of the vehicle.
- 5.1.3. The vehicle shall be driven by diesel or internal combustion engine.
- 5.1.4. Its exhaust shall be wholly in front of the tank.
- 5.1.5. In The vehicle there shall have ample clearance from fuel system and combustible material.
- 5.1.6. The vehicle shall not be exposed to leakage or spillage of any flammable material.
- 5.1.7. The exhaust pipe of the vehicle shall be fitted with approved spark arrestor.
- 5.1.8. The muffler or silencer shall not be cut off from the exhaust system.
- 5.1.9. The engine air intake shall be fitted with effective flame arrester and capable of preventing emission of flame from the side of the engine.
- 5.1.10. The cab of the vehicle shall be of metal construction and its rear window, if provided, shall be covered with wired glass.
- 5.1.11. The fuel tank shall be securely place so as to prevent unusual hazard, to permit drainage without removal from the mounting and protected against blow.
- 5.1.12. Quick action cut – off valve, clearly marked, shall be fitted with fuel feed pipe in an easily accessible position.
- 5.1.13. If liquid self-closing valve or remote emergency actuator for the liquid cargo valve is not function properly, the vehicles shall be taken out of the service.
- 5.1.14. Suitable fire extinguisher, about 1 kg dry powder, shall be kept in diver’s cabin.
- 5.1.15. The vehicle shall be constantly attended to by at least 1(one) person who is familiar with these codes and standards.
- 5.1.16. The driver shall not be under the age of 21 and properly trained.
- 5.1.17. No vehicle shall be parked on public road or any congested road or at a place within 9 (nine) meters from any source of fire.
- 5.1.18. Cargo tank vehicles unloading into storage container shall be at least 3 meters from the container and so positioned that the shutoff valves on truck and container are easily accessible.
- 5.1.19. The cargo tank shall not transfer LPG in to dispensing storage while parked on public way.
- 5.1.20. The voltage for electric light or instrument of the vehicle shall not exceed 24 volts.
- 5.1.21. The electric wire shall be heavily insulated.
- 5.1.22. The electric system shall be flame-proof and provided with over current protection device, in the form of fuses automatic circuit breaker and to be installed so as to be protected from any physical damage and contact with possible product spill.

5.1.23. Pipe line connected with fuel system shall be electrically continuous and properly earthed.

5.1.24. During loading and unloading operation:

5.1.24.1. The engine shall be stopped and battery shall be isolated,

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

5.1.24.3. The driver shall not leave the vehicle so as to take any appropriate action in case of emergency.

5.2. Rail

LPG should not be carried by rail.

5.3 River

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

5.3.2. LPG cylinder shall not be carried in country boat.

5.3.3. LPG in cylinder may be carried in barge/ tankers / any riverine transport tanker approved by Chief Inspector of Explosive provided:

5.3.3.1. Loading and unloading of LPG cylinder is carried out under the constant supervision of a competent qualified and trained person.

5.3.3.2. All safety procedures are followed.

5.3.3.3. Necessary fire extinguishers are kept ready at the place of loading and unloading operation.

5.3.3.4. LPG cylinder shall not be carried inside deck.

5.3.3.5. LPG cylinder shall be carried on deck where sufficient ventilation is present.

5.3.3.6. LPG cylinder shall not be stored in place where the temperature is more than 60^o C.

5.3.3.7. LPG cylinder shall not be carried with explosive or any other dangerous material.

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

5.3.3.9. Smoking is prohibited in the store area.

5.3.3.10. Public movement is restricted in store area.

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

5.3.3.12. The captain/mater of the tanker shall be responsible all the mishap and casualties.

6. LPG Cylinder

6.1 Cooking Gas Cylinder

6.1.1. Only the approved cylinders conforming to these codes and standards shall be used.

6.1.2. No oil, grease or similar lubricating shall be used on any valves or any other fittings.

6.1.3. Valves of Every cylinder containing gas shall be securely closed so as to prevent any leakage.

6.1.4. Every cylinder shall be handled properly.

6.1.5. No person shall:

6.1.5.1. Fill LPG from one cylinder or container to another cylinder or container.

- 6.1.5.2. Transport or store LPG filled cylinder except in upright position.
- 6.1.6. The seal of the cylinder shall not be removed prior to use.
- 6.1.7. 2(two) wheeled vehicle shall not be used for transportation of cylinder.
- 6.1.8. Conveyors, trolley, fork lift or cradles of adequate may be used.
- 6.1.9. No lifting magnet shall be used for loading and unloading of cylinder.
- 6.1.10. Cylinder shall always be kept away from any source of heat and in a ventilated place in upright position with valve at the top and shall be so placed that they cannot be knocked over.
- 6.1.11. No cylinder shall be dropped or thrown from any elevated place.
- 6.1.12. No cylinder shall be rolled or allowed to roll on its side or its rim; it shall be moved only by approved lifting equipment.
- 6.1.13. Cylinder shall not be stored under conditions which cause them to corrode.
- 6.1.6. Cylinder shall not be stored with combustible materials.
- 6.1.7. Empty cylinder shall be handled in the same manner as full ones.
- 6.1.8. Empty cylinder shall be marked "empty" and stored separately in well-ventilated area.
- 6.1.9. Cylinder may be moved within a building for tar/bitumen kettle or torch operation on a roof, provided such movement shall be done under the personal supervision of a trained and qualified operator/competent person,
- 6.1.10. Only the approved tools shall be used for connection /disconnection of hose to the cylinder.
- 6.1.11. All valves shall be closed while changing the cylinder.
- 6.1.12. After replacing the cylinder every connection shall be rechecked for any leaks.
- 6.1.13. Leak- test shall be done using soap and water solution.
- 6.1.14. Cylinder shall be carried by approved vehicle.
- 6.1.15. Under no circumstances cylinder shall be transported through tunnel.
- 6.1.16. No cylinder shall be kept or stored near 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 any hot place.
- 6.1.17. A minimum distance of 600 mm shall be provided between front of the cylinder and other structure.
- 6.1.18. Cylinder compound shall be accessible by cylinder trolley.
- 6.1.19. The access route should be firm and compact even in wet conditions.
- 6.1.20. No cylinder or any weight shall be supported by cylinder.
- 6.1.21. No Cylinder valve shall be opened/ closed with tool.
- 6.1.22. Any cylinder that is out of qualification date shall not be refilled until re-qualified by Chief Inspector of Explosive.
- 6.1.23. Cylinder that has been involved in a fire and shows no distortion may be re-qualified for continued services provided it passes being properly done hydraulic test and container-appurtenance are removed.
- 6.1.24. New Cylinder shall be tested within 10 (ten) years but subsequently it shall re- tested within every 5(five) years by the authorized inspection agency and No objection certificate be given by the Chief Inspector of Explosive for reuse.
- 6.1.25. Particular attention to be paid to entire area inside the foot ring, this area shall be free from any dirt, mud or any foreign materials.
- 6.1.26. All the cylinders shall be visually examined for dents, cuts, gouges, bulges, cracks,

laminations, corrosion at external and internal surfaces of cylinder.

6.1.27. Cylinder beyond the acceptable limits shall be declared unserviceable.

6.1.28. Cylinder shall be declared unserviceable when :

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

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

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

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

6.1.29. The rejection criteria for cylinders will be recorded.

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

6.1.31. Cylinder 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 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 /rubber cap to prevent the entry of primer and paint in to the cylinder.

6.2 Industrial Gas cylinder

Same as stated in Section 6.1.

6.3 Auto Gas Cylinder

3.1.73. The container or cylinder capacity is between 500 milliliters to 1000 liters as laid down in Appendix E. It shall be mounted in the boot of the vehicle permanently. It should be installed under the driver's seat.

7. LPG Dispenser

LPG dispensers shall not be located within 3 m 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.

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

7.2. 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:

7.3.1. A manually operated positive shut-off valve and AN excess-flow valve.

7.3.2. 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.

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

7.3.4. The dispensing nozzle shall comply with the following requirements:

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

7.3.4.2. 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 quarterturn valve, a safety catch shall be provided; and

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

7.3.4.3.1. it shall not be possible to discharge fuel unless the nozzle is connected to a vehicle filler connection; and

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

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

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

7.3.5.2. 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.

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

7.3.6. 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.

7.3.7. 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:

7.3.7.1. 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.

7.3.7.2. 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)

7.3.8. 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 stage 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.

7.3.9. The LPG tank truck unloading position shall be such that:

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

7.3.9.2. 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 wall may be reduced to 3.1 m.

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

The unloading of a 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.

8. Auto Gas 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. Autogas is widely used as a "green" fuel, as its use reduces CO₂ exhaust emissions by around 15% compared to petrol. It has an octane rating between 90 and 110 depending upon the ratio of propane and butane in fuel composition. Autogas is the third most popular automotive fuel in the world. Vehicles are fitted with only one cylinder, but multiple cylinders may be used. The conversion kit or original equipment manufacturers fitting shall have tanks with accessories, regulators and venturi mixer. The tanks shall have fittings for filling, liquid outlet, emergency relief of excess pressure, fuel level gauge and sometimes a vapour outlet.

9. 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 meter, weighbridge, platform scale, storage tanks, calibrations and container with respect to the quantity of LPG.

9.1 Storage Tank.

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

9.2 Cylinder

The quantity of LPG shall be measured in Kg.

9.3. Dispenser

The quantity of LPG shall be measured in Kg.

10. Lighting, Fencing and Roadway

10.1 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.

10.2 Fencing

LPG storage installation area shall be fenced, height of the fence shall 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

10.3 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.

11. Safety Sign and Marking

11.1 Safety Sign

Appropriate safety precaution signs shall be placed to provide notification and instructions concerning safety requirements and emergency systems.

11.2 Marking

11.2.1 Storage Tank

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

- 11.2.1.1. name and address of tank manufacturer or trade name of the tank or tank supplier
- 11.2.1.2. Design code;
- 11.2.1.3. Manufacturer's serial number;
- 11.2.1.4. Water capacity in liters, kiloliters;
- 11.2.1.5. Design and maximum operating pressure in Bar, Mpa or kg/cm²;
- 11.2.1.6. Design metal temperature in °C;
- 11.2.1.7. Outside surface area in M² or sft;
- 11.2.1.8. Shell thickness and head thickness;
- 11.2.1.9. OL (overall length),
- 11.2.1.10. OD (outside diameter),
- 11.2.1.11. HD (head design) ;

- 11.2.1.12. Material specification;
- 11.2.1.13. Year of manufacture/test date; Inspecting authorities' identification if any.

11.2.2. Cylinder

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

- 11.2.2.1. Name of the Manufacturer;
- 11.2.2.2. Name of the Specification used for construction of Valve & body ;
- 11.2.2.3. Serial/rotation number;
- 11.2.2.4. Date of Manufacture;;
- 11.2.2.5. Date of Last Inspection;
- 11.2.2.6. Working Pressure;
- 11.2.2.7. Test pressure;
- 11.2.2.8. Tare weight;
- 11.2.2.9. Water Capacity;
- 11.2.2.10. Direction for opening the valve;
- 11.2.2.11. Symbol of the Inspector;
- 11.2.2.12. Brand name of the Licensee.

12. Fire Insurance and compensation

12.1 Fire Insurance

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

12.2 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 the loss of life and property, as determined by the Commission on 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.

13. Inspection

- 13.1. Tanks shall be inspected externally and internally, before being placed into service, by authorized and qualified engineers for the following:
 - 13.1.1. After installation:
 - 13.1.2. After construction,
 - 13.1.3. After it has contained materials other than LPG,
 - 13.1.4. after it has been reinstalled in other location,

- 13.1.5. After it has been exposed to fire,
- 13.1.6. Because of marked damage due to handling and other exposures and
- 13.1.7. At periodic intervals required by competent authority depending upon the nature of operation and conditions of the tanks.
- 13.2. The manufacturer's certificate and the records of inspection shall be kept and made available for examination during the operating life of the tank.
- 13.3. Inspection of tanks shall consist of any or a combination of the following tests:
- 13.3.1. Visual examination;
- 13.3.2. Tests for leakage;
- 13.3.3. Ultrasonic thickness tests;
- 13.3.4. radiographic tests;
- 13.3.5. Magnetic particle tests;
- 13.3.6. HYDROSTATIC test when considered necessary by the competent authority and
- 13.3.7. other related tests.
- 13.4. Major examinations of LPG storage tanks shall be carried out by a competent person and the data plate marked with the date of examination month and year .
- 13.5. Tank records for above ground installations should distinguish between 5 year visual external inspection 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.
- 13.6. The frequency of examinations for identified storage tanks shall comply with the following table 5.

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 to be determine by competent person.
Above ground	Every 10 years	Full visual internal examination, thickness check and hydrostatic test.
Underground / Mounded Tanks	Every 5 years	Full, external visual examination, thickness check or hydrostatic test. In case of tanks without manhole, alternate procedure may be considered subject to 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.

13.7. Above ground 5 year examination:

- 13.7.1. Visual examination of external surfaces and all welds for signs of defects, where considered necessary, defects can be assessed by non-destructive test (NDT) methods.
- 13.7.2. Leak test for fitting and appurtenances.
- 13.7.3. Relief valves.
- 13.7.4. The pressure relief valves should satisfy the design requirements of the tanks in terms of set pressure and capacity.
- 13.7.5. After satisfactory examination ensure that the date is marked on the data plate.
- 13.7.6. Issue report.

13.8 Above ground 10 year examination

- 13.8.1. Carry out stages as listed in five year examination as mentioned in 12.1.4 and replace the pressure relief valve.
- 13.8.2. Carry out wall thickness checks or hydraulic test or internal examination.
- 13.8.3. After satisfactory examination ensure date is marked on the data plate.
- 13.8.4. Issue report.

13.9. Underground/Mounded 5 year examination

- 13.9.1. Identify tank by data plate markings or stampings.
- 13.9.2. Full internal visual examination and also 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).
- 13.9.3 Check that fittings are in order.
- 13.9.4 Check that pressure relief valves. The pressure relief valve should satisfy the design requirements of the tank in terms of set pressure and capacity.
- 13.9.5. After satisfactory examination ensure date is marked on the data plate.
- 13.9.6 Issue report. Such test shall be considered as minimum requirement, otherwise follow the manufacturer's recommended schedule and procedure.
- 13.9.7. 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 inspector 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 inspection of the works of a licensee from time to time, at least once in 1(one) year, to verify that the works of the licensee conform to the LPG codes and Standards.

14. Instructions

14.1 Licensee

- 14.1.1. 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 pungent odor for leak detection

in case of any leakage.

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

14.1.3. 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.

14.1.4. 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 premise or an alternative location that will ensure.

14.1.5. The Licensee shall have an Electronic weighing machine having digital display of 50 KG weighing capacity & least count of maximum 10grams.

14.1.6. On request, an LPG Licensee must give a Customer a copy of these Codes and Standards.

14.1.7. The container and equipment shall be marked and colored properly, tampering of cylinder, changing of original color or replacing of cylinder shroud and footing is prohibited.

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

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

14.1.9.1. The permission of the competent authority.

14.1.9.2. Supervision of experienced and competent engineer/technical person and approval in writing from the authority concerned.

14.1.9.3. 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.

14.1.10. Before putting into operation all pipeline, container, tank and vessel should be properly hydraulically tested.

14.1.11. All the used empty containers shall be kept securely closed until they are thoroughly cleaned and freed from LPG.

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

14.1.13. All precaution shall be taken at all times to prevent escape of LPG into drain, sewer, river, public roads, railway lines, river or any watercourse.

14.1.14. Public access to the areas where LPG operation is carried out shall be prohibited.

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

14.1.16. Fenced area shall be well ventilated.

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

14.1.18. Competent person with proper qualification, training and experience shall be in charge during the operation.

14.1.19. Smoking is prohibited.

14.1.20. 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.

14.1.21. No person shall Commit or attempt to commit any act which may tend to cause a fire or explosion.

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

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

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

14.1.25. Adequate fire fighting facilities with trained personnel must be kept ready at all places where LPG operation is undertaken.

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

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

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

14.1.29. In the instances of Leakage grade 1, one or more of the following may require:

14.1.29.1. Implementation of company emergency plan.

14.1.29.2. Evacuating premises.

14.1.29.3. Blocking off an area.

14.1.29.4. Rerouting traffic.

14.1.29.5. Eliminating sources of ignition.

14.1.29.6. Venting the area.

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

14.1.29.8. Notifying police and fire departments.

14.1.30. In the instances of Leakage grade 2, one or more of the following may require:

14.1.30.1. Because of their location and magnitude, can be scheduled for repair on a normal routine basis with periodic re-inspection as necessary.

14.1.30.2. Product may not be introduced into a container with a Grade 2 leak on a container appurtenance until the leak is repaired.

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

14.1.32. The Commission or any person duly authorized by the Commission shall, at any reasonable time, have access to ensure the correctness of meter, weighbridge, platform scale,

storage tanks, calibrations and container with respect to the quantity of LPG.

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

14.2. Customer

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

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

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

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

14.2.5. 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.

14.2.6. It is advisable to wear apron while working in the kitchen. Use of sari or orna should be avoidable as far as practicable while cooking.

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

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

14.2.9. Use only hot plates/oven/ stove of approved international standard.

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

14.2.11. Fry Pan / Pressure Cooker should be placed in a manner so that their handle is away from the flame.

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

14.2.13. Rubber tube should be avoided ,if used it must be regularly checked and changed immediately in case any visible cracks / damage/deform are noticed.

14.2.14. LPG hose as specified in section 4.2 should be used.

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

14.2.16. In the event of leakage or in case there is smell of gas:

14.2.16.1. Turn the pressure regulator knob to the "OFF" position.

14.2.16.2. Put out all fires in the kitchen /vicinity.

14.2.16.3. Do not light matchstick/lighter.

14.2.16.4. Do not switch "ON" or "OFF" any electrical switch.

14.2.16.5. Open door and windows for ventilation.

14.2.16.6. Get in touch with distributor/ emergency Service cell.

14.3 Motorist

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

- 14.3.2. 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.
- 14.3.3. 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.
- 14.3.4. Any hot work on the body or other parts of LPG driven vehicle should only be done by trained staff at authorized work shop.
- 14.3.5. Do not carry out any hot work in LPG system unless it is LPG free.
- 14.3.6. Do not assume the LPG system is LPG free unless tested by an explosive meter.
- 14.3.7. Do not take any Vehicle with leak LPG system to any workshop or building without stopping LPG leak.
- 14.3.8. 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.
- 14.3.9. Repair of LPG tank is not permitted under any circumstances. However, repair / maintenance of 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 Auto LPG system to the vehicle.
- 14.3.10. Auto LPG tank, container, cylinder and the piping system shall be checked regularly in 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.
- 14.3.11. In case of leakage in the LPG system, cut off LPG supply and park the car in open area, away from ignition sources and Move all the people to a safe distance from the vehicle, opposite to the wind direction and seek assistance of nearest authorized installer/workshop.
- 14.3.12. 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.
- 14.3.13. Do not use domestic or any other detachable LPG cylinder as auto fuel as it is punishable offense and is also highly unsafe.
- 14.3.14. Auto LPG re-fuelling to the vehicle tank should be done only at the authorized Auto LPG Dealers, through the dispensing nozzle.
- 14.3.15. 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 it may fail Engine in long run.
- 14.3.16. After refueling LPG, please ensure that the dust plug is inserted back on the filler valve.
- 14.3.17. 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.
- 14.3.18. It is a good practice to put the selector switch in neutral position for a while before switching over to LPG. Switching over directly from petrol mode to LPG may lead to engine stalling or backfire due to mixing of both fuels.
- 14.3.19. Never tamper with any of the components in the LPG system.
- 14.3.20. Any other safety recommendation by vehicle/kit manufacturer should be followed.

15. Emergency Procedure

LPG Storage, Bottling, Transportation and Dispensing and Marketing operator shall 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

15.1. 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.

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

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

15.4. 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:

15.4.1. Activate internal facility alarms or communication systems, where applicable, to notify all facility personnel.

15.4.2. Notify appropriate state or local agencies with designated response roles if their help is needed.

15.5 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.

15.6 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.

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

15.7.1. Immediately notify appropriate local authorities.

15.7.2. Be available to help appropriate officials decide whether local areas should be evacuated,

15.7.3. Immediately notify either the government official designated as the on-scene coordinator for the geographical are or the national response center. The report shall include all of the following:

15.7.3.1. Name and telephone number of reporter.

15.7.3.2. Name and address of facility.

15.7.3.3. Time and type of incident (e.g., release, fire).

15.7.3.4. Name and quantity of materials involved, to the extent known.

15.7.3.5. The extent of injuries, if any.

15.7.4. The possible hazards to human health, or the environment, outside the facility.

15.7.5. 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.

15.7.6. 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.

15.7.7. Immediately after an emergency, the emergency coordinator shall inform the concern person.

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

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

15.7.10. 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:

15.7.10.1. Name, address and telephone number of the owner or operator.

15.7.10.2. Name, address and telephone number of the facility.

15.7.10.3. Date, time and type of incident (e.g., fire, explosion).

15.7.10.4. Name and quantity of materials involved.

15.7.10.5. The extent of injuries, if any.

15.7.10.6. An assessment of actual or potential hazards to human health or the environment, where applicable.

16. Reporting

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

16.2 Incase of major fire and explosion the matter should be reported to police and fire department

17. Violation

If any of the terms and conditions of the codes and standards is violated, Commission may cancel the license or impose penalty.

18. Revision

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

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

18.3. Users of these Code Standards should ascertain that they are in possession of the latest amendment or edition.

19. Complain and Appeals

19.1 Complain

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

19.2 Appeal

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

20. Reference codes and standards

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

Appendix A

Design and Construction of LPG Plant and Installation:

API Standard 2510 Covering Design, Construction, Siting Requirement & Spill Containment, Foundation, and Support & Accessories LPG Tanks, Piping Requirement, Transfer, Loading & unloading Facilities and Fire Protection.

1. **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.
2. **Overfilling Protection for Storage Tanks in Petroleum Facilities: API RP 2350** covering overfill protection for all above ground storage Tanks in Petroleum Facilities.
3. **Fire Protection Consideration for design and Operation of LPG Storage Facilities: API Pub 2510A** which **supplements** API Std 2510 covering Design, operation, maintenance of LPG Storage Facilities from the standpoints of prevention, and control of release, fire protection design & fire control measures.
4. **Fire Protection in Refineries: API RP 2001** covering basic concepts of refinery fire Protection.
5. **Protection Against Ignitions Arising Out of Static, Lighting and Stray Current: API Std 2003.**
6. **Safe Welding, Cutting and Hot work Practice in Petroleum and Petrochemical Industries: API Std. 2009.**
7. **Flame Arrester in Piping System: API RP 2008.**
8. **Application of Fixed Water Spray System for Fire Protection in Petroleum and Petrochemical Industries. API RP 2030.**
9. **Safe Hot Tapping Practices in Petroleum and Petrochemical Industries: API Publ.2201.**
10. **Flame Arresters for Vent of Tanks Storing Petroleum Products: API RP 2210.**
11. **Portable Fire Extinguishers: NFPA 10.**
12. **Installation of Sprinkler System: NFPA 13.**
13. **Installation of Stationary Pumps for Fire Protection: NFPA 20.**
14. **Flammable or Combustible liquid Storage Tank NFPA 30.**
15. **Installation of Lighting Protection System: NFPA 780.**
16. **Standard for Storage, use and Handling of LPG in Portable Cylinders: NFPA 55** covering Storage, use, handling of LPG in portable Cylinders; emergency Plan & Safety Precautions.
17. **Storage and Handling of LPG: NFPA 58 (2001 Edition)** Covering LPG Containers, Piping, Associated equipment, Design, Construction, Installation, Storage, Venting to atmosphere and Operation of Marine Terminals, Highway Transportation, use in building .
18. **Storage and Handling of LPG at Utility Plants: NFPA 59.**
19. **National Electrical Code: NFPA 70. USA.**
20. **Electrical Installation at Petroleum Facilities: API RP 500.**
21. **Sizing, selection and installation of Pressure Relieving System : API RP 520**
22. **Metallic Gaskets for Raised Face Pipe Flange and Flanged Connection: API 601.**

23. **Process measurement Instrumentations: API 551.**
24. **Design and Construction of Large, Welded, Low pressure Storage Tanks : API RP 620.**
25. **Welded Tanks for Oil Storage: API 650.**
26. **Cathodic Protection of Aboveground Storage Tanks: API RP 651.**
27. **Pressure Vessel and Materials: ASME Boiler and Pressure Vessel Codes.**
28. **Pressure Vessel Plates: ASTM.**
29. **Liquid Petroleum Transportation piping System; ANSI B31.4.**
30. **Model Code of Safe Practice: Institute of Petroleum (IP).**
31. **Transportation of Hazards Liquid by Pipeline: DOT, USA.**
32. **Welded steel cylinders: DOT Specifications 4B, 4BA and 4BW.**
33. **Electrical Apparatus for Explosive Gas Atmosphere: IEC 79.**
34. **Wiring Regulations for Electrical Installation: IEE.**
35. **Instrumentation: ISA.**
36. **Recommendations for the safe filling of LPG cylinders at depots: Code of Practice 12 prepared by Liquefied Petroleum Gas Industry Technical Association, UK, (LPGITA).**
37. **Safe handling and transport of LPG in bulk by road: Code of Practice 2 prepared by LPGITA.,**
38. **Hoses for transfer of LPG in bulk installation, installation, inspection, testing and maintenance: Code of Practice 14 prepared by LPGITA.**
39. **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	<i>Limit</i>
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
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 ^{i 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		
		<i>PB Mixture</i>	<i>Propane</i>	<i>Butane</i>
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 ^{ii 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 stenching purpose.

Appendix D

Technical Specifications for Cylinder.

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

*Supply of LPG to domestic category consumer shall be made in 12 kg. Supply of LPG in 35 and/or 45kg may also be made especially for non domestic category of consumer. Only on special case, LPG in 5.5 kg is acceptable. Valve shall be uniform in all cases and regulator of the valve shall be capable of releasing LPG at a rate of 1/kg 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 L P 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/automatic submerged arc welding process. The internal threading are clean cut, even, without crack and machined to gauge tolerance.

Specification of thread: $\frac{3}{4}$ 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 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

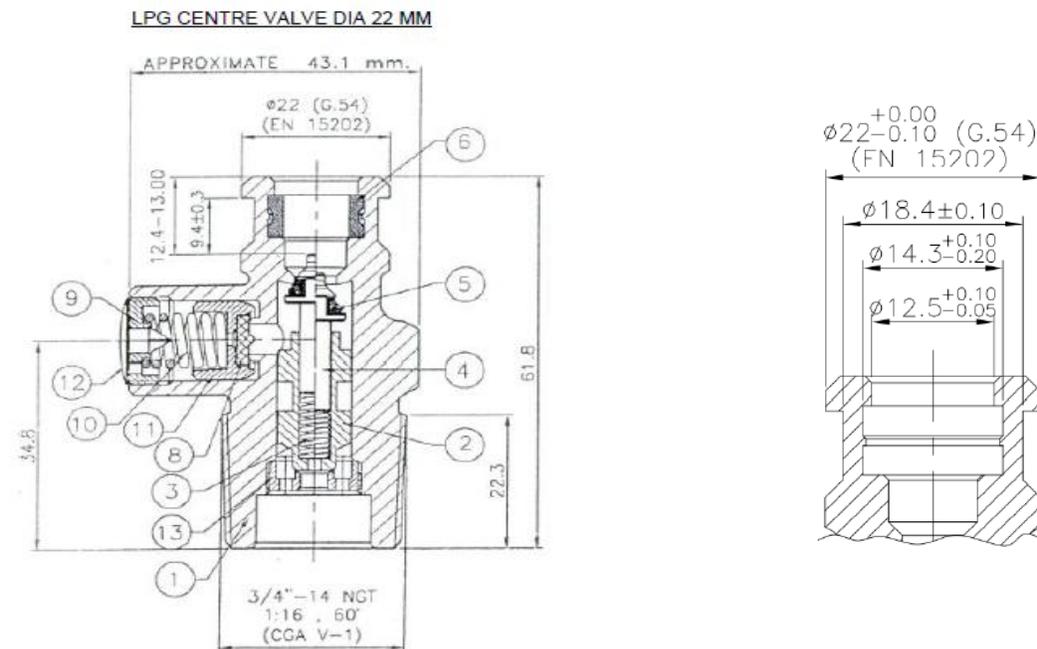
Metal thickness: 3 mm minimum.

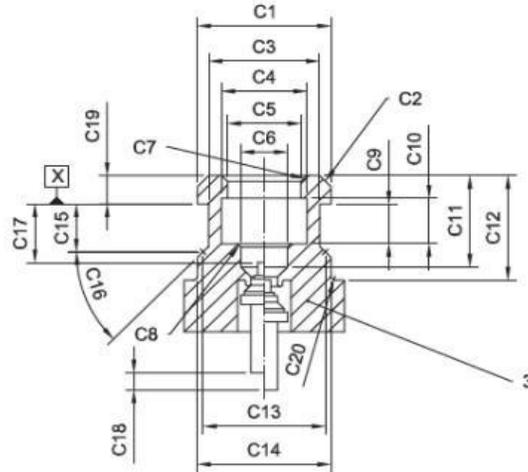
D.2.4. The foot ring: will be welded to the cylinder body in a position below circumferential weld at six locations of 55 mm length by automatic welding under inert gas or manual arc welding.

Material: JIS G3101-SS41/Q235 or NFA 35.501 GR-24.2 or equivalent

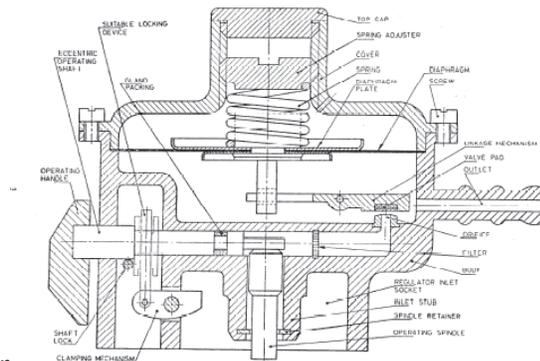
Metal thickness: 3 mm minimum.

D.2.5 The Valve: Cylinder shall be fitted with compact valve with side safety release arrangement similar to Kosan Gas Compact Valve Code No. 186 G001 with safety release arrangement (22 mm version) and 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





Valve			
C1	$\varnothing 22 \pm 0.1$	C11	15.1min.
C2	$\varnothing 18.9 \pm 0.2 \times 45^\circ$	C12	16.1min.
C3	$\varnothing 18.40 \pm 0.15$	C13	$\varnothing 20.0$
C4	$\varnothing 14.25 \pm 0.15$	C14	$\varnothing 22.1 \pm 0.05$
C5	$\varnothing 12.5 \pm 0.1$	C15	7.0 ± 0.1
C6	$\varnothing 9.1 \pm 0.05$	C16	45°
C7	$0.8 \pm 0.2 \times 45^\circ$	C17	9.2 ± 0.03
C8	$0.4 \pm 0.1 \times 45^\circ$	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

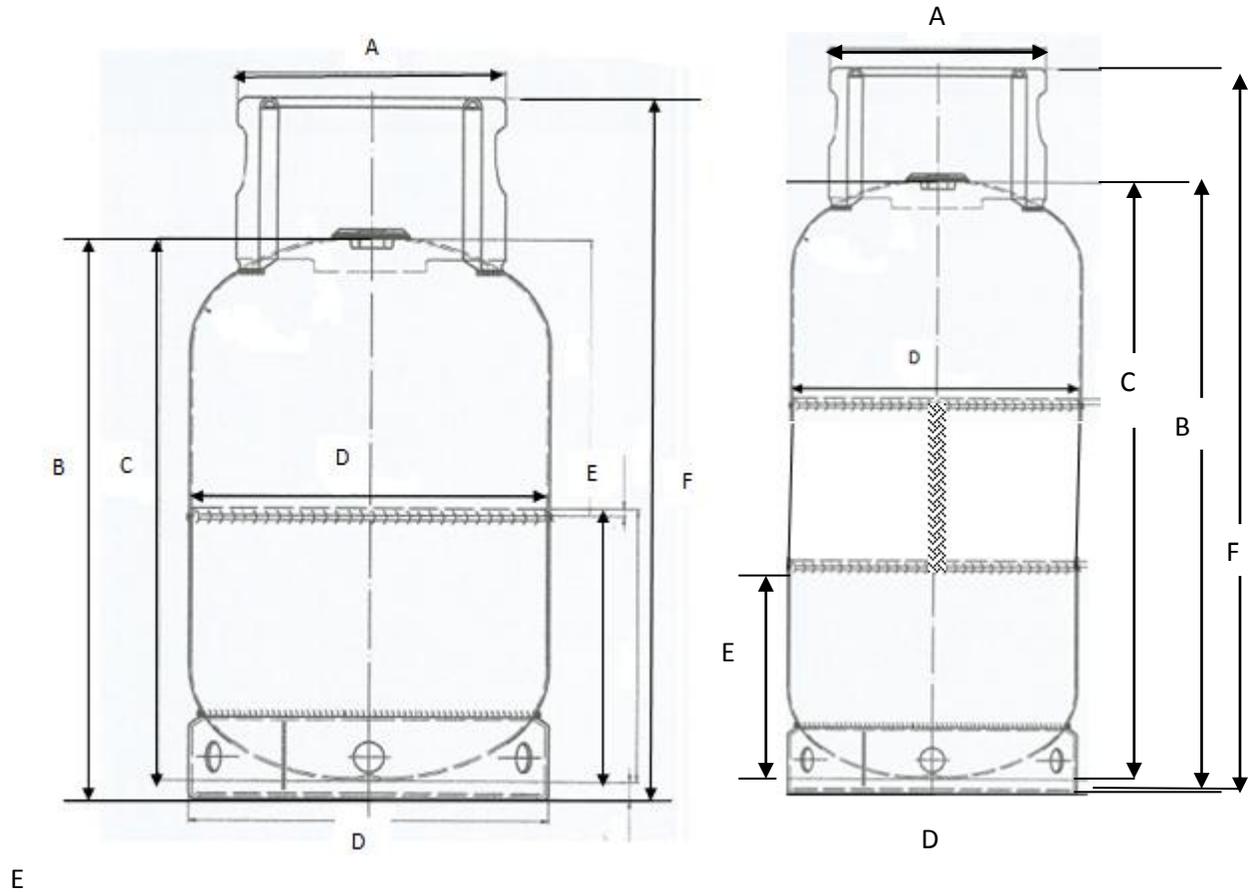
Spring : Steel.

2. for industry:

As per specific requirement.

D.3. Dimension*

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



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 as 5.rkg or 12 kg and industrial gas cylinder is standardized as 35 or 45 kg.

D.4. Thickness of Cylinder Body

Thickness of the cylinder body is to be decided as per design regulations of SNCT code or equivalent for the manufacture of unfired pressured vessels. In any case the minimum wall thickness of cylindrical and domed end shall not be less than 3.00 (three) mm. 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

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 the finished wall thickness of any cylinder at cylindrical and domed end shall 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 cylinder must be more than 3(three) mm

D.5. Heat Treatment

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

D.6. Painting

Before painting surface of the cylinder shall be cleaned thoroughly 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 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 Purchaser.

D.7. Hydrostatic Testing

D.7.1_Every cylinder shall undergo a hydrostatic pressure test of 34 Kg/cm² for 60 seconds minimum.

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 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. Any cylinder fails with bursting pressure less than 84 Kg/cm² 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 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/cm² by fully immersing 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 cylinder as follows:

Name of the Manufacturer;

D.10.1. Name of the Specification used for construction of Valve & 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. Brand name of the Licensee piercing on collar of the cylinder.

Size of 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 independent survey by a bonafide inspection agency appointed by Purchaser at its

own cost. The Manufacturer shall also provide steel makers test certificate showing chemical analysis, mechanical strength & sheet thickness for each lot No. and the test certificates of 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 test by the applicable method depending on steel mill recommendation. Heat treatment must be accomplished after all forming and welding operations.

D.18. 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.20. Mechanical Test

The mechanical test shall be carried 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 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:

- D20.1. Tensile test on parent material.
- D20.2. Tensile test on welded joint;
- D20.3. Bend test on parent material.
- D20.4. Bend test on weld, outer surface in tension.
- D20.5. Bend test on weld, inner surface in tension.
- D20.6. 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 as 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, <i>Min</i>	Yield Stress, MPa, <i>Min</i>	Percentage Elongation at 50mm Gauge Length, <i>Min</i>
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, minimum percentage elongation value shall not be less than 25%. Such steel should be certified by the steel maker to be other than of rimming quality, suitable for pressing or drawing, with acceptable non ageing properties and shall be fully 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

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

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 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 each side of the intersection) of the production shall be taken at random for radiographic examination 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 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 dished end shall not deviate from the approved dimensions by more than 1.25 percent of the nominal diameter in respect of radial dimensions and 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 of 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 container, MIG or TIG welding with argon as inert gas shall be employed in fabrication.

E.5.2.5. **Longitudinal weld** shall be executed in the form of a butt weld on the full 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 from two or three parts, the longitudinal welds shall be shifted/rotated with 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. **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 valve plate or ring one run of weld from outside and one run from inside shall be given. For valve plate or ring either one run of weld from outside and one run from inside or two runs of welds 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 case of butt welds, the misalignment of the joint faces shall not exceed one-fifth of the thickness of the walls.

E.5.5.3 Inspection of Welds

E.5.5.3.1. 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.5.5.3.2. The frequency and extent of radiographic examination shall be as follows:

E.5.5.3.2.1. For the main longitudinal weld, 100 mm of each end of the longitudinal weld shall be radiographed 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 at random basis.

E.5.5.3.2.2. For circumferential welds, 100 mm of each circumferential weld shall be radiographed on container taken from the first five consecutively welded containers and one container taken from the last five consecutively welded container of a production run.

E.5.5.3.2.3. On re-commencement of welding operation following shutdown exceeding four hours, the extent of radiographic examination specified above shall apply.

E.5.5.4. Treatment of imperfection disclosed by radiographic examination

E.5.5.4.1. Imperfection disclosed by radiographic examination shall require the subject container to be deemed unacceptable. Containers, which are deemed unacceptable, shall be condemned, or be repaired in accordance.

E.5.5.4.2. 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.5.5.4.2.1. 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.5.5.4.2.2. Where the additional radiographic examination discloses any imperfections 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.5.5.4.2.3. Joints or section of joints re-welded or repaired to remove defects shall be radiographed. Each radiograph shall include the identification symbol R1 or R2 to denote that a first or second weld repair has been carried out in the length of weld represented by those radiographs. Not more than two attempts shall be made to repair any one section

E.5.5.5. 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 on the containers to ensure their correct installation.

E.6.1.5 An identification plate shall be fixed on 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 kind of protection device over the container accessories.

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

E.6.2 Openings for Fittings

E.6.2.1 Size of the opening in the shell of the container shall be 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 adequately strong pad to withstand the tests prescribed in this standard.

E.6.2.2 In case any housing for the cover of 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 test 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 values used in design calculation and elongation shall be minimum 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 showed 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

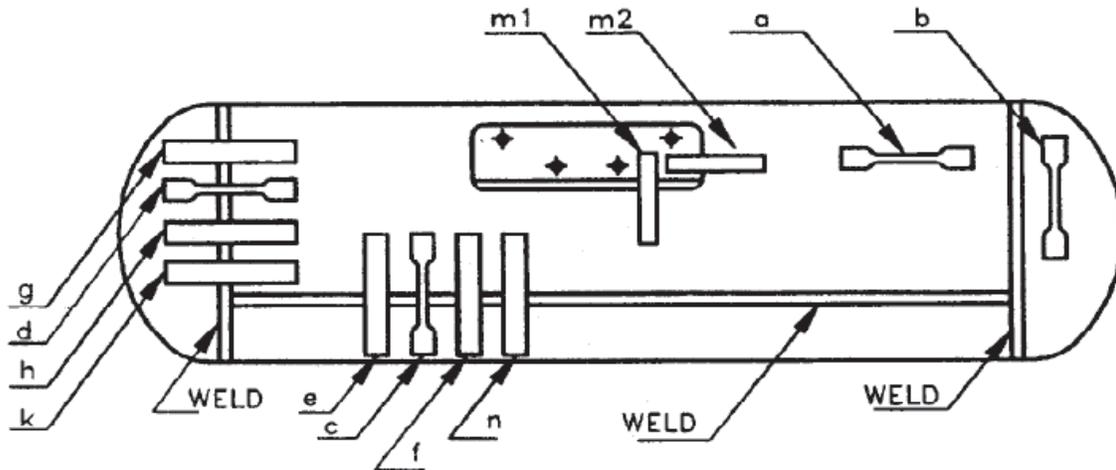
From every batch (consisting of 200 or less heat-treated and finished containers), one test container shall be selected at random and various acceptance tests shall be carried out on the test specimens taken from this container.

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)*

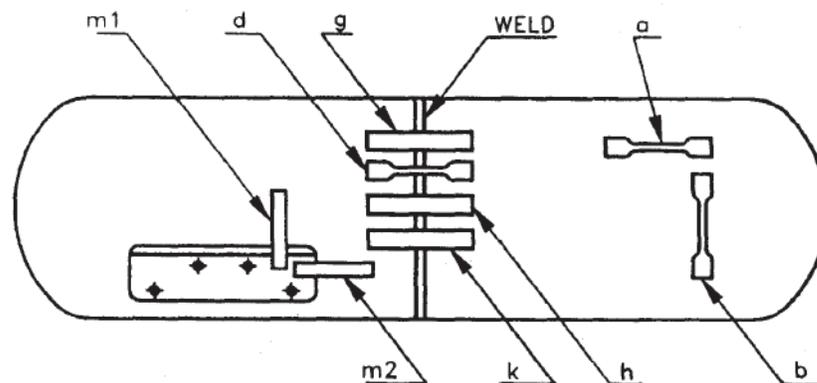
On test-pieces taken from the places shown in Figure below:



- 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 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/plate sections shall be conducted as shown m1, 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



Tensile test :on the parent metal at location a & b

1. The minimum value for yield stress shall comply with 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 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.

8.1.3 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 round 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 failure.

E.8.1.4. Checking of Water Capacity

The water capacity of the cylinders shall be checked. This shall be done by weighing or by volumetric method. The tolerance for water capacity shall be \pm^5_2 percent for cylinders up to and including 13 litres - water capacity and \pm^5_3 percent or 0.65 litres whichever is more for cylinders above 13 litres water capacity.

E.8.14. Macroscopic Examination

The macroscopic examination of a full transverse section of the weld shall show a good penetration and absence of lack of fusion.

E.8.15. Hydrostatic Test

Each container shall be subjected to hydrostatic test. During the hydrostatic test, the pressure shall be increased gradually till 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.8.1.6. 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 horizontal position shall be immersed in water tank, which shall be adequately illuminated with light both from outside and inside the tank.

E.8.1.7. Non-Destructive Examination

E.8.1.7.1. Radiographic Examination

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.8.1.7.2. When a wire-type indicator is used, the smallest diameter of the wire visible may not exceed the value of 0.10 mm.

E.8.1.7.3. When a stepped and holed type indicator is used, the diameter of the smallest hole visible may not exceed 0.25 mm.

E.8.1.7.4. The film density shall preferably be between 2 and 3 but in no case less than 1

E.8.1.7.5. The following defects are not acceptable:

E.8.1.7.5.1. Cracks,

E.8.1.7.5.2. inadequate welds,

E.8.1.7.5.3. inadequate penetration.

E.8. 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 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 construction of Valve & 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



