



## TANZANIA STANDARD

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**Liquefied petroleum gas fuelling stations —LPG stations for  
fuelling vehicles**

For Public Comments

**TANZANIA BUREAU OF STANDARDS**

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### **MEDC 3 (3742) DTZS**

This Tanzania Standard was published under the authority of the Board of Directors of Tanzania Bureau of Standards in 2025.

Tanzania Bureau of Standards (TBS) is the statutory national standards body for Tanzania established under the Standards Act No. 3 of 1975, repealed and replaced by the Standards Act No. 2 of 2009.

The Mechanical Engineering Divisional Standards Committee (MEDC) under whose supervision this Tanzania Standard was prepared consists of representatives from the following organizations:

- \*College of Engineering and Technology, University of Dar es Salaam
- National Institute of Transport
- National Development Corporation
- Dar es salaam Institute of Technology
- Ministry of Work
- Weights and Measures Agency
- Tanzania Industrial Research and Development Organization
- Confederation of Tanzania Industries
- Aluminum Africa Limited

The organization marked with an asterisk (\*) in the above list together with the following were directly represented on the Technical Committee entrusted with the preparation of this Tanzania Standard:

- Dar es salaam Institute of Technology(DIT)
- Technology Petroleum Development Corporation (TPDC)
- Tanzania Electric Supply Company Limited(TANESCO)
- Energy and Water utilities regulatory Authority (EWURA)
- TLPGA –Tanzania LPG Association
- Taifa Gas Tanzania limited
- PUMA Energy
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## **MEDC 3 (3742) DTZS**

### **Foreword**

This Tanzania Draft Standard was prepared by the Petroleum, Petrochemical and Natural Gas Equipment and Accessories Technical Committee under the guidance of the Mechanical Division Committee, and it is in accordance with the procedures of the Tanzania Bureau of Standards.

With the need to contain climatic change effects, the country's effort to reduce air pollution by the use of LPG as an automotive fuel is a move in the right direction which needs to be embraced and therefore, the importance to have this standard developed.

During the preparation of this standard, reference was made to the following documents:

KS 2965:2022, Siting of Liquefied Petroleum Gas (LPG) automotive retail outlets — Requirements

UK LPG code of practice 20.

ANSI/ASME Boiler & Pressure Vessel Code Section VIII

Acknowledgement is hereby made for the assistance derived from these sources

# Liquefied petroleum gas fuelling stations — LPG stations for fuelling vehicles

## 1 Scope

This Draft Standard gives the design, construction, installation, testing and commissioning, operation, maintenance, layout of the LPG storage and dispensing facilities at filling stations where LPG is used as a vehicle fuel.

It includes tanks, pumps, dispensers, fittings, pipework, off-loading facilities, electrical equipment and fire protection.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

TZS 2374-2: 2020- EAS 924-2: 2018: *Handling, storage, and distribution of Liquefied Petroleum Gas (LPG) in domestic, commercial, and industrial installations — Code of practice — Part 2: LPG installations involving gas storage vessels of individual water capacity exceeding 150 L and combined water capacity not exceeding 9 000 L per installation*

TZS 2374-2: 2020- EAS 924-2: 2018: *Handling, storage, and distribution of Liquefied Petroleum Gas (LPG) in domestic, commercial, and industrial installations — Code of practice — Part 3: Liquefied petroleum gas installations involving storage vessels of individual water capacity exceeding 9000 L.*

ISO 3419: Non-alloy and alloy steel butt-welding fittings

ISO 5251: Stainless steel butt-welding fittings

## 3 Terms and definitions

For the purposes of this document, the following terms and definitions shall apply.

### 3.1

#### approved

accepted by the approving authority

### 3.2

#### Liquefied Petroleum Gas (LPG)

commercial butane, commercial propane, or a mixture of light hydrocarbons (predominantly propane, butane and butene) that is gaseous under conditions of ambient temperature and pressure and that is maintained in the liquid state by an increase of pressure or a lowering of temperature



### **3.3**

#### **maximum working pressure**

maximum internal pressure that is permitted for a tank during service

### **3.4**

#### **tank**

pressure vessel designed for the conveyance of LPG, and complying with, the regulations from Occupational Health and Safety Services

### **3.5**

#### **aboveground tank**

bulk tank which is located above ground level and not covered by sand or earth.

### **3.6 bulk tank**

receptacle for storing LPG with a water capacity of more than 450 litres.

### **3.7**

#### **competent person**

person who is competent by virtue of his/her training and substantial practical experience to perform/supervise/inspect/certify LPG installation, testing, and maintenance work.

### **3.8**

#### **Excess flow valve**

device designed to close when the liquid or vapour passing through it exceeds a prescribed flow rate.

### **3.9**

#### **Flame proof enclosure**

type of protection in which the parts, which can ignite an explosive atmosphere, are placed in an enclosure which can withstand the pressure developed during an internal explosion of an explosive mixture, and which prevents the transmission of the explosion to the explosive atmosphere surrounding the enclosure.

### **3.10**

#### **hazardous area**

area in which an explosive gas atmosphere is, or may be expected to be, present in quantities such as to require special precautions for the construction, installation and use of electrical apparatus.

### **3.11 hot work**

welding or the use of any flame or electric arc or the use of any equipment likely to cause heat, flame or spark. It also includes caulking, chipping, drilling, riveting and any other heat producing operation, unless it is carried out in such a way as keep the temperature of the tools and work below 100°C.

### **3.12**

#### **installation boundary**

boundary of LPG filling station.

### **3.13 off-loading**

transferring LPG from road tankers to bulk tanks.

### **3.14**

#### **pipng system**

system made up of pipes, tubing, valves and fittings, etc. for conveying LPG in either liquid or vapour state at various pressures from one point to another.

### **3.15**

#### **pressure relief valve**

valve designed for preventing a rise of internal pressure in excess of a specified value due to emergency or abnormal conditions.

### **3.16**

#### **Purging**

replacing the content in a system by inert gas before putting it into or out of service.

### **3.17 road tanker**

motor vehicle designed and constructed for the conveyance of LPG in bulk on roads.

### **3.18**

#### **safe area (non-hazardous area)**

area in which a flammable gas mixture is not expected to be present in quantities such as to require special precautions for the construction, installation and use of electrical apparatus.

### **3.19**

#### **source of ignition**

materials, devices or equipment which, because of their modes of use or operation, are capable of providing sufficient thermal energy to ignite a flammable gas mixture when in contact with them.

### **3.20**

#### **tanker bay**

area of the LPG filling station where a road tanker is parked during off-loading operations.

### **3.21**

#### **underground tank**

bulk tank which is located below ground level and covered with sand or earth.

### 3.22

#### water capacity

amount of water in volumetric units at 15.6°C required.

## 4 Design requirements

### 4.1 General

- 4.1.1 All equipment used in the LPG filling station shall be appropriate for the conditions of use, e.g. temperature, pressure, compatibility, area classification, etc. and should be easily accessible for maintenance and fire-fighting purposes.
- 4.1.2 Cast-iron equipment and components shall not be used for LPG installations. Other materials such as bronze, brass, copper, etc. that are confirmed as suitable for LPG service may be used.
- 4.1.3 All rubber components shall be of a grade and quality suitable for LPG service.
- 4.1.4 Pressure-containing parts shall be made of steel, nodular iron, malleable iron or brass. Internal parts and components shall be corrosion resistant.
- 4.1.5 The grading of an LPG filling station shall be such that LPG spillage will not collect beneath a parked road tanker.
- 4.1.6 The drainage system of the LPG filling station shall be sufficiently designed to prevent against the ingress of any LPG releases into the public drain.
- 4.1.7 Tanker and dispensing bays shall be designed for effective draining of rain and firefighting water. If the drainage system connects to a public drain, there shall be an LPG trap merged into the design to prevent any LPG releases from entering the public drains. See **Annex A** for typical design for an LPG trap.
- 4.1.8 Drains and pits shall be avoided in the immediate vicinity of 3m of the LPG storage tank manhole assembly, dispenser or extended fill-connection. Where drains and pits are unavoidable within this distance, the openings shall either be securely covered or suitably sealed.
- 4.1.9 Crash barriers should be provided at appropriate locations to prevent the above-ground connections of the LPG storage tank and dispenser from collision by vehicles.
- 4.1.10 Schematic diagram for a typical LPG filling station is shown in **Annex B**
- 4.1.11 No illegal shades should be provided over any open yard.

### 4.2 Storage tank

- 4.2.1 Only underground LPG tanks (of total storage capacity below 25 tonnes) should be used at an LPG filling station. Each tank shall be painted with a corrosion resistant coating, provided with cathodic protection system and put underground inside a concrete chamber which is filled with washed sand.
- 4.2.2 Double-tank arrangement should be considered wherever space is available to eliminate disruption of LPG supply when one tank is out of service.
- 4.2.3 The LPG storage tank shall not be installed in basements.

- 4.2.4** The LPG storage tank shall not be installed closer than 6 m to any vessel or bund wall of vessels containing other flammable liquids with a flash point below 66°C.
- 4.2.5** The distance between the LPG storage tank and the boundary of filling station should be at least 1.5 m.
- 4.2.6** The extended fill-connection, tank manhole assembly and pump set shall be at least 7.6 m from adjacent buildings, station boundary where the general public have legitimate access, or any fixed sources of ignition.
- 4.2.7** The LPG storage tank shall be designed and constructed in accordance with as ANSI/ASME Boiler & Pressure Vessel Code Section VIII. Use of partial standards shall not be allowed.
- 4.2.8** The LPG storage tank shall be designed to a minimum pressure of 1.725 MPa and a range of design temperature of -10°C to 50°C, with a minimum of 1 mm additional wall thickness for corrosion allowance.
- 4.2.9** The LPG storage tank shall be fully stress relieved and shall be subject to 100% radiography examination and a satisfactory "Charpy" test at the minimum design temperature.
- 4.2.10** The steel used in LPG storage tank shall be certified by the manufacturer as satisfying the design code for LPG service.
- 4.2.11** An information plate shall be firmly fixed to the LPG storage tank at a clearly visible location which shall contain the following information
- a) manufacturer and serial number;
  - b) date of manufacture;
  - c) design code;
  - d) water capacity in kilolitres;
  - e) maximum working pressure in kPa;
  - f) design temperature ranges in degree Celsius, minimum and maximum,
  - g) the test pressure and date of test; and
  - h) marking of inspecting authority.

This information plate shall be affixed to an integral part of the tank (e.g. tank shell or manhole) at the time of manufacture so as not to be detachable.

In addition to the above information plate that is supplied integral with the tank at the time of manufacture, there shall be affixed on the tank, inside the tank turret or at an alternative convenient position visible after burial of the tank, a second plate duplicating all the required information. This plate shall have sufficient space to mark the subsequent retest dates.

- 4.2.12** The LPG storage tank shall be provided with steel saddles for mounting on concrete footings.
- 4.2.13** The LPG storage tank shall be provided with a pump well for installing the submersible pump when it is used. The pump well shall be designed in accordance with respective design code for the storage tank and in such a way that it can be isolated from the storage tank in case the cover flange is removed when the tank still contains LPG.
- 4.2.14** Each LPG storage tank shall be provided with the following essential valves and fittings and be identified with suitable labels:
- a) duo-port pressure relief valve;
  - b) shut-off valve with closing mechanism and excess flow valve for pump well inlet (where applicable);
  - c) shut-off valve and excess flow valve for pump bypass and dispenser return;
  - d) shut-off valve and check valve for LPG filling;
  - e) fixed level device connected with pressure gauge;
  - f) contents gauge;
  - g) vapour balance valve between pump and storage tank complete with closing mechanism; and
  - h) plugged shut-off valve for drain connection.



- 4.2.15** The LPG storage tank shall have a manhole or an inspection port for internal inspection. The manhole shall have a minimum diameter of 450 mm for storage tank exceeding 5,000 litres water capacity. For storage tank with manhole in the form of extended nozzle, the manhole diameter shall not be less than 550 mm. All fittings shall be accessible from aboveground level.
- 4.2.16** The LPG storage tank shall have a manhole or an inspection port for internal inspection. The manhole shall have a minimum diameter of 450 mm for storage tank exceeding 5,000 litres water capacity. For storage tank with manhole in the form of extended nozzle, the manhole diameter shall not be less than 550 mm. All fittings shall be accessible from aboveground level.
- 4.2.17** All liquid and vapour connections on the LPG storage tank other than those for pressure relief valves, plugged openings and those where the outlet from this connection through the storage tank shell is not greater than 1.4 mm, shall have fire resistant shut-off valves capable of manual operation located as close as practicable to the LPG storage tank.
- 4.2.18** An excess flow valve or check valve shall be installed in all liquid connections larger than 3.0 mm diameter and in all vapour connections larger than 8.0 mm diameter with the exception of openings for pressure relief valves. Excess flow valves shall be installed inside the tank opening to safeguard its function if the connection is broken outside the bulk tank. The normal closing flow rate of an excess flow valve shall be greater than the anticipated maximum flow rate so as to prevent premature closing.
- 4.2.19** The LPG storage tank shall be provided with a drain connection for removing sediment and water contents. The drain connection shall be fitted with a shut-off valve not more than 25 mm nominal diameter. The outlet shall be blanked or plugged.
- 4.2.20** The LPG storage tank shall be filled in accordance with Gas Safety which states that the storage tank shall not be full of LPG at a temperature of 52.5°C and not more than 97% full at 47.5°C. As a rule of thumb, bulk tank should not be filled to more than 85% of the tank volume. At particular stations, this may be dictated otherwise by the conditions of construction approval / approval for use specific to the station to be even less than 85%.
- 4.2.21** Each LPG storage tank shall be equipped with at least two gauges for indicating the quantity of contents, one of which shall be of a fixed liquid level type. The contents gauges shall clearly indicate the amount of contents in % of the tank volume.
- 4.2.22** The LPG storage tank shall be provided with a pressure gauge connected to the vapour space of the tank which connection shall be protected either by a tapping reduced internally to a bleed hole not larger than 1.4 mm diameter or by a suitable excess flow valve and shut-off valve.
- 4.2.23** The contents and pressure gauges shall be arranged such that they can be read from above the ground level. There shall be installed above ground near the extended fill-connection remote displays of the contents and pressure gauges, with a permanent plate indicating the maximum volumetric capacity to which the tank can be filled under any circumstances.
- 4.2.24** Temperature gauges, where fitted, shall be installed in blind pockets. The pockets shall be in the form of blind tubes of suitable length and strength, oil filled, permanently welded to the LPG storage tank and constructed in accordance with the corresponding storage tank design code.
- 4.2.25** All components and fittings on the manhole such as submersible pump sets, valve assembly, contents gauge, etc. shall be located in an access pit or housing. The pit shall be provided with suitable means to detect and disperse any build-up of LPG vapour and a flush cover which shall be of adequate strength to withstand vehicular loading (if any) and be capable of preventing the entry of water. (The above requirements for vapour detection / dispersion and cover do not apply when the housing is aboveground).
- 4.2.26** Pipework and fittings on the LPG storage tank shall be suitably protected against mechanical damage.

### **4.3 Concrete chamber for LPG tank**

- 4.3.1** Each underground LPG storage tank shall be installed in an individual concrete chamber filled with washed sand and be provided with cathodic protection. The concrete chamber shall be wholly within the boundary of filling station. When located under driveway, the concrete chamber shall be designed to withstand the loads from vehicular traffic.

- 4.3.2** The concrete chamber shall be designed to support the total load of the LPG storage tank fully filled with water.
- 4.3.3** The anchorage system for the LPG storage tank shall be capable of withstanding the maximum residual floating force of the empty tank in case the concrete chamber is totally flooded.
- 4.3.4** The LPG storage tank, if subjected to vehicular loading, shall be covered with washed sand of a depth of 450 mm minimum and reinforced concrete of 150 mm minimum in thickness at the top. Where the tank is not subjected to vehicular loading, the depth of sand may be reduced to 150 mm minimum and the reinforced concrete thickness may be reduced to 100 mm minimum.
- 4.3.5** The walls of the concrete chamber shall be imperforated and have a thickness of 200 mm minimum and 300 mm minimum in case of common walls.
- 4.3.6** The clearance between the LPG storage tank and walls of the concrete chamber shall be of 300 mm minimum but preferably 450 mm if space is available. Bottom clearance shall not be less than 200 mm.
- 4.3.7** The concrete chamber shall be properly sealed to prevent ingress of water.
- 4.3.8** Chamber vent pipes shall be provided diagonally in each tank chamber to allow periodic checks on LPG leakage and ingress of water. The vent pipes shall be extended to a point below the bottom level of the LPG storage tank.
- 4.3.9** Chamber vent pipes shall be straight and have a nominal bore of 20 mm minimum. Each vent pipe shall be properly capped to prevent ingress of water.
- 4.3.10** If located outside the driveway, the concrete chamber may be designed to have the top protruding above the surrounding ground level (usually by not more than 0.5 m), in which case the protruding portions of the chamber and all the exposed equipment and pipework on top shall be protected against vehicular impact by means of crash barriers or bollards.

#### **4.4 Corrosion protection**

- 4.4.1** Exterior surface of the LPG storage tank shall be suitably treated by shot-blasting and be cleaned to exclude all rust, grease and dusts prior to applying surface coating.
- 4.4.2** Exterior surface of the LPG storage tank shall be covered and bonded with a corrosion resistant coating which shall:
- a) provide electrical insulation between the storage tank and the earth;
  - b) be inert, non-absorbent to moisture, of high dielectric strength and of sufficient mechanical strength to resist damage during installation; and
  - c) have sufficient flexibility to allow for any damage due to expansion or contraction of the storage tank.
- 4.4.3** Each LPG storage tank shall be protected with a cathodic protection system with a test point for such system. The design and construction of the cathodic protection system shall be carried out by experienced corrosion specialists in accordance with recognized standards.
- 4.4.4** Where sacrificial anodes are employed for the cathodic protection system, they shall be provided in accordance with clauses 4.4.5 – 4.4.6.
- 4.4.5** The size and number of anodes shall be designed by experienced corrosion specialists such that the anodes are capable for corrosion protection of the storage tank before its next revalidation date.
- 4.4.6** The choice of anodes shall be based on the surface area of the LPG storage tank and the test results on the conditions (PH scale, resistivity, etc.) of the washed sand.

**Note:** As a reference, the surface potential of the LPG storage tank to be protected shall be more negative than  $-0.85$  volt with reference to a copper/copper sulphate ( $\text{Cu}/\text{CuSO}_4$ ) electrode or more negative than  $+0.25$  volt with reference to a zinc electrode.

#### 4.5 Pressure relief valve

- 4.5.1** Each LPG storage tank shall be fitted with pressure relief valve(s) which is set in accordance with a relevant pressure vessel code to which the LPG storage tank is designed. The pressure relief valve shall have the following information stamped on the valve or on a separate metal plate securely fixed to it: -
- a) the manufacturer's identification including make and model or type number, manufacturing date, etc.; and
  - b) the pressure at which the valve starts to discharge.
- 4.5.2** Extra space shall be provided on the valve or the metal plate for subsequent stamping of periodic retest dates.
- 4.5.3** For multi-port pressure relief valves, any provision made for isolating any relief valve for testing or servicing shall ensure that the remaining relief valves connected to the LPG storage tank are of the same full flow capacity.
- 4.5.4** Pressure relief valves shall be of a direct spring loaded type or equivalent, be tamper-proof and be constructed in such a way so that breakage of any part shall not in any way lessen the relief function.
- 4.5.5** LPG should be safely discharged to the atmosphere by means of individual elevated vent pipe at least 3 m above ground level. The bore of the discharge pipe should be sufficiently sized for the full flow characteristics of the relief valves at the discharge point. The vent pipe outlet shall be suitably identified and be provided with a rain cap to prevent ingress of rain water.
- 4.5.6** Vent pipe outlet shall be located away from fixed source of ignition at a minimum distance of 0.5 m. Electrical fittings within this area shall be in accordance:

$$A = 3.1965 S^{0.82}$$

Where S (Surface) = total exterior surface of the tank in m<sup>2</sup>

A (Air Flow) = air to be allowed to escape at 15°C and atmospheric pressure in m<sup>3</sup>/min

#### 4.6 Extended fill-connection

- 4.6.1** Extended fill-connection should be as close to the LPG storage tank as practicable but not be located inside the access pit of valve assembly. It shall be positioned in such a way so as to prevent unnecessary bending of the delivery hose from road tanker.
- 4.6.2** Where more than one LPG storage tank is installed, the filling line for each storage tank shall be separated by valve in the piping system to enable isolation of each tank during operation.
- 4.6.3** Extended fill-connection shall be within the boundary of the filling station.
- 4.6.4** Extended fill-connection shall be protected against the possibility of mechanical damage by road tankers. Concrete posts, pre-cast concrete curbs or similar barriers shall be used wherever exposure to damage is possible.
- 4.6.5** A double-check valve shall be installed at the extended fill-connection to prevent the outflow of LPG liquid under abnormal conditions, e.g. fill pipe rupture.
- 4.6.6** Drive-away protection shall be provided in accordance with Regulation 40 application of the Gas Safety (Gas Supply) Regulations. This can be a suitable drive-away protection installed on the road tanker unloading hose.

#### 4.7 Pumps and Compressors

- 4.7.1** Either submersible pumps or aboveground pumps of appropriate design to meet the operating characteristics of the filling system and suitable for at least Zone 1 application shall be installed.
- 4.7.2** A by-pass valve shall be installed in the by-pass line immediately after the discharge valve of pump to control and maintain the differential pressure generated by the pump. The discharge shall be piped back to the LPG storage tank at a pre-determined pressure selected in relation with the pump curve. The function of the by-pass line is to prevent excessive pressure and overheat of the pump.
- 4.7.3** The available pressure head at the pump outlet at maximum off-take rate under the most onerous specified operating conditions of the filling station shall be adequate to ensure proper operation.
- 4.7.4** The submersible pump shall be installed in a pump well of the LPG storage tank in accordance with the requirements in clause 4.2.13.
- 4.7.5** The aboveground pump shall be installed as close to the LPG storage tank as practicable. The siting of the pump shall comply with the safety distance requirements in clause 10.6. It shall be installed in the open air in a well-ventilated position and adequately protected against vehicular damage by crash barriers or bollards.
- 4.7.6** Measures shall be taken to ensure that no foreign particles will be present that will affect the operation of the pump. Suitable means of protection shall be in place, such as strainers / filters either at the station or further upstream in the system.
- 4.7.7** Mechanical seals should be used. As a minimum, a single seal with a throttle bush should be used.
- 4.7.8** Electric motors and other electrical equipment must be suitable for use in areas described in clause 5.6. Belt drives should be of the anti-static type. Electric motors shall have an Ingress Protection (IP) rating that is suitable for their location.
- 4.7.9** Vapour compressors, when used, should be installed in the open air in a well-ventilated position at least 4.5 m from the LPG tank manhole assembly and at least 7.6 m from buildings and station boundaries.
- 4.7.10** Compressors shall have at least (a) a high pressure cut-off switch, or similar device, on the discharge side, or (b) a means to prevent liquid LPG entering the compressor, for example, a catch pot with a liquid level sensor and, where appropriate, high level trip and high discharge temperature trip.
- 4.7.11** Where remote starters are used, an explosion protected means of isolation, with lockout, should be installed adjacent to the pump motor to facilitate servicing.

#### **4.8 LPG Dispenser**

- 4.8.1** The LPG dispenser shall be of flameproof type and all components shall comply with the requirements of appropriate standards.
- 4.8.2** The dispenser shall have automatic temperature compensation device to ensure that the quantity of Auto-LPG sold to customers is not affected by variation of ambient temperature.
- 4.8.3** A vapour return line leading to the vapour space of the LPG storage tank shall be provided for the dispenser.
- 4.8.4** Remote operated emergency shut-down valves shall be provided for the liquid and vapour return lines of the dispenser.
- 4.8.5** A pump control mechanism shall be provided in the dispenser such that the pump of the filling system can be switched automatically when the dispensing nozzle is in and out of its receptacle.
- 4.8.6** Protective shearing device (e.g. breakable glass tube) shall be provided in the dispenser such that upon rupture of the shear provision as in the case of vehicular collision onto dispenser, the whole LPG filling system shall be shut down and the remote-operated emergency shut-down valves in the dispenser will actuate automatically to cut off the LPG supply.

- 4.8.7** A manually operated shut-off valve and excess flow valve shall be provided in the dispenser and as near to the inlet of dispensing hose as practicable between the dispenser cabinet and the breakaway coupling for prevention of leakage of LPG liquid under abnormal conditions, e.g. dispensing hose rupture.
- 4.8.8** Normally, the hose reach length of the dispensing hose as measured on the horizontal plane from the anchoring point should not be more than 3.6 m. For hose reach lengths longer than 3.6 m, due allowance should be made in the layout design to ensure that the relevant separation distances will be increased correspondingly.
- 4.8.9** Hose retaining or retrieving mechanism shall be incorporated, or otherwise the hose should be suitably supported, to protect the hose from touching the ground when not in use.
- 4.8.10** Other essential components in the dispenser shall include a vapour eliminator to separate vapour from the liquid prior to metering, a meter unit, differential valve, and hydrostatic relief valves. A mass flow metering system that obviates the provision of separate vapour eliminator and differential valve is an acceptable alternative.
- 4.8.11** Schematic diagram for an LPG dispenser is shown in Annex C.

#### **4.9 Dispensing Nozzle**

- 4.9.1** The dispensing nozzle shall be of low emission type, i.e. when the nozzle is uncoupled following a transfer, not more than 4 c.c. of product shall be released to the atmosphere.
- 4.9.2** The coupling threads shall be accordance with international standard.
- 4.9.3** Adequate mechanism should be incorporated in the design of the nozzle such that it cannot be disengaged inadvertently or deliberately during the dispensing operation.
- 4.9.4** A double-check arrangement or one with single check and dynamic pressure sealing arrangement should be provided at the dispensing nozzle.

#### **4.10 Breakaway Coupling**

A breakaway coupling shall be provided between the excess flow valve in the dispenser and the outgoing flexible dispensing hose to protect against excessive leakage of LPG liquid in the event the driver drives away the LPG vehicle when the dispensing nozzle is still engaged to the vehicle.

#### **4.11 Pipework and Fittings**

- 4.11.1** All pipework, except PRV vent lines and tank turret vent lines, shall be designed for liquid service, including the return lines from dispensers back to tanks.
- 4.11.2** Pipework and valve manifold should be routed in open air and aboveground as far as possible, except those routed through traffic path which should be buried underground.
- 4.11.3** Where reasonably practicable, clearance from other known buried utilities such as electrical cables to the LPG liquid pipes should be maintained at not less than 250 mm.
- 4.11.4** All underground pipework carrying liquid LPG shall be of all welded construction to reduce the chance of leakage. All underground steel pipes shall be suitably protected against corrosion by means of external coating or tape wrapping.
- 4.11.5** All LPG pipework and fittings (except vent pipes) shall be designed for high pressure operation and the pipework shall be of seamless type conforming to international standards or equivalent.

- 4.11.6** The number of flanged joints, where necessary, should be kept to a minimum. Steel flanges and flanged fittings shall conform to appropriate international standards.
- 4.11.7** Joints for pipes above 50 mm shall be butt-welded or socket-welded. Welded connection for pipe fittings shall be in accordance with ISO 5251, ISO 3419 or equivalent.
- 4.11.8** Pipe joints up to and including 50 mm nominal diameter may be threaded. Threaded pipes and fittings shall be of heavy wall thickness of Schedule 80. Threads on both pipes and fittings shall be of tapered form.
- 4.11.9** Steel socket-welded and screwed fittings and screwed couplings shall be forged carbon and alloy steel screwed and socket-welding fittings for the petroleum industry. Unions shall not be adopted.
- 4.11.10** Butt-welded fittings shall be forged seamless steel.
- 4.11.11** Polyethylene pipes and carbon steel pipes suitable for welding and threading shall not be used for pipework carrying liquid LPG. As an alternative to steel pipes, proprietary systems designed for liquid LPG application may be used underground.
- 4.11.12** Pressure gauges or plugged test points shall be provided at various strategic points of the pipework system for operational use or commissioning. Pressure gauges shall not be provided on liquid LPG pipework except pumping facilities, and can be temporarily fitted only when required.
- 4.11.13** Electrostatic precaution shall be in accordance with the requirements stated in clause 5.6.
- 4.11.14** All underground LPG pipework (with the exception of vent pipes) shall be protected against likely mechanical or vehicular loads by laying at a minimum depth of 1000 mm below ground level with continuous yellow plastic marker tape provided 100 to 300 mm above the pipe. If the minimum depth of 1000 mm cannot be met due to site constraints, concrete slabs not less than 40 mm thick or steel plates not less than 3 mm thick, at a height of 100 to 300 mm above the LPG pipe, can be used to protect it against damage. The protective slab or plate shall project at least 100 mm on either side of the pipe.
- 4.11.15** Hydrostatic pressure relief valve (HPRV) shall be fitted between any pipe sections where liquid LPG can be trapped (e.g. sections between shut-off valves and blank flanges, pumps between closed suction and discharge valves, etc.) in order to accommodate any thermal expansion.
- 4.11.16** HPRV should have a pressure rating at a range of 2.4 MPa to 2.75 MPa and shall not be higher than the weakest element in the system.
- 4.11.17** Adequate means of detecting and dissipating any build-up of LPG vapour should be provided in all underground access pits where the manifolds and shut-off valves of the dispensing system are installed. The access pits shall be provided with flush covers which shall be of adequate strength to withstand vehicular loading (if any) and be capable of preventing the entry of water.

## **4.12 Earthing**

All LPG pipework, dispensing hose and dispenser should be effectively connected to earth and bonded to prevent electrostatic accumulation.

## **4.13 Remote Emergency Shut-down System**

**4.13.1** Remote operated emergency shut-down valves (ESVs) shall be installed to isolate the tank contents in case of an emergency. They shall be installed as close as possible to the following:

- a) Filling inlet at the tank
- b) Liquid outlets at the tank

- c) Return inlet at the tank

**4.13.2** ESVs shall also be installed at dispensers as close as possible to ground level and below the protective shearing device to shut off the supply and return lines for the dispenser.

**4.13.3** All ESVs shall be capable of simultaneous activation by pressing any one ESV button in case of emergency. ESV buttons shall be provided at:

- a) the extended fill-connection
- b) as close as possible to dispensers
- c) **sales office (inside and immediately outside)**

**4.13.4** The ESV buttons shall be designed and installed such that:

- a) All ESVs are closed and pump operation shut down within 12 s.
- b) Manual action is required to re-open valves to resume operation.
- c) Button locations shall be clearly shown by placards.
- d) Clear access shall be available to the buttons and such access shall be maintained.

#### **4.14 Water Spray System**

Water spray system shall be installed as specified in clause 9.

#### **4.15 Gas Detection System**

**4.15.1** A gas detection system with adequate number of detector heads at different locations shall be provided for the LPG filling station. It is recognized that within a filling station, some areas are designated hazardous zones, where combustible vapour either will exist or likely to exist under normal operations. However, combustible vapour should not migrate beyond these zones. It is the purpose of the gas detection system to give early warnings should combustible vapour does migrate, especially to areas where it is critical, such as places frequented by customers, or where potential ignition source is likely. Guidance on location of gas detector heads is given in clauses 9.2.4 and 9.3.4 below .

**4.15.2** The system should give audible alarm when detecting LPG at a concentration of 20% of the Lower Flammable Limit and give direct signal to Fire Services Communication Centre when detecting LPG at a concentration of 40% of the Lower Flammable Limit. Each detector head should be able to be isolated individually for the purpose of maintenance and testing.

### **5 Installation**

#### **5.1 General**

**5.1.1** Construction approval from the regulatory authority shall be obtained prior to carrying out any installation work of LPG filling facilities in the filling station

**5.1.2** Installation work for the LPG system shall be carried out by suitably trained and experienced persons under the control of Contractors approved by the relevant authority.

**5.1.3** Installation sites shall be suitably prepared prior to delivery of equipment and installation work.

## **5.2 LPG Storage Tank**

- 5.2.1** LPG storage tanks of combined water capacity not exceeding 9 000 L shall be above-ground, skid mounted, mounded or underground and shall be installed in accordance with TZS 2374-2: 2020 / EAS 924-2
- 5.2.2** Installation of tank capacity above 9 000 l shall comply with requirements of TZS 2374-3/EAS 924-3
- 5.2.3** Each LPG storage tank shall be holiday and paint thickness tested (400 µm minimum) over its entire surface and any defects found shall be repaired and retested before burying the tank.
- 5.2.4** The LPG storage tank shall be installed on firm foundation and shall be secured properly.
- 5.2.5** Extreme care shall be taken when transporting and handling the storage tank to prevent against accidental damage to the coatings.
- 5.2.6** Extreme care shall be taken to avoid electrical contact between the LPG storage tank and any steelwork associated with the anchoring system unless included in the cathodic protection system.
- 5.2.7** Pressure relief valves shall be tested by the manufacturer before shipment. A manufacture / test date stamped by the manufacturer is deemed to be valid proof that the pressure relief valve has been properly tested. The pressure relief valves installed on the LPG storage tank shall not, at the time of installation, be older than 24 months from the date of manufacture; otherwise the renewal date shall be counted from the date of manufacture. For the convenience of tracking the 5-yearly replacement, a tag should be affixed to each pressure relief valve showing the next due date for replacement.

## **5.3 Cathodic Protection**

- 5.3.1** Anodes shall be so placed in washed sand that they are free from any possible contact to other objects.
- 5.3.2** Reference electrode shall be installed and terminals shall be provided for testing of the cathodic protection system.
- 5.3.3** Care shall be taken during back-fill to prevent damage to the wiring of the system and undue strain on the electrical connections.
- 5.3.4** The end of test wires shall be installed in a weatherproof testing box at ground level and be suitably identified. The box should be installed outside the electrical classified zones unless it is certified to be suitable for use in classified zones.
- 5.3.5** When installing an earthing system, care shall be taken not to interfere with the cathodic protection system.
- 5.3.6** As-built drawings and records of the cathodic protection system shall be made after installation and shall include the following data: -
  - a) quantity, type, size and location of anodes;
  - b) date of installation;
  - c) type of backfill material; and
  - d) resistivity measurement of electrolyte.

These records and subsequent periodic testing results shall be maintained for the service life of the LPG storage tank.

## **5.4 Pipework and Fittings**

- 5.4.1** LPG pipework shall be of welded construction as far as practicable. Welded joints shall be fabricated in accordance with relevant design and welding standards.
- 5.4.2** Shut-off valves shall be installed to enable isolation of equipment and between lengths of



pipework.

- 5.4.3** All above-ground pipework should be adequately protected against mechanical or vehicular damage.
- 5.4.4** Before installation, all fittings and pipe sections shall be inspected and cleaned inside to ensure absence of dusts, grease, rust and foreign matters. During installation, precautions shall be taken to prevent pipe connections from contamination. Exposed threads after connection shall be immediately treated and coated against corrosion.
- 5.4.5** Underground pipework should be wrapped with protective tape against corrosion. Wrapping should preferably be done before laying the pipe sections into the trench, so that adequate working space is allowed for proper wrapping.
- 5.4.6** Above-ground pipework should be painted and adequately supported. Pipework containing liquid LPG shall be suitably colour coded in blue with the word "Liquid" marked on the surface of the pipework.
- 5.4.7** Pipework passing through wall or ground slab shall be sleeved and sealed properly with suitable corrosion protection materials.
- 5.4.8** Pipework layout and supports shall provide adequate allowance to accommodate any movement that may occur due to thermal expansion or contraction of LPG pipework. Distance between pipe supports for vertical and horizontal pipe sections shall be in accordance with the Table 1:

**Table 1: Support Spacing for Aboveground Pipework**

| Nominal size<br>(mm) | Maximum spacing |                |
|----------------------|-----------------|----------------|
|                      | Vertical (m)    | Horizontal (m) |
| 20                   | 3               | 2.5            |
| 25                   | 3               | 2.5            |
| 32                   | 3               | 2.7            |
| 40                   | 3.5             | 3              |
| 50                   | 3.5             | 3              |
| 80                   | 4.5             | 3              |
| 100                  | 4.5             | 3              |
| 150                  | 4.5             | 3              |
| 200                  | 4.5             | 3              |

**5.4.9** The discharge outlet of HPRV shall be positioned towards ventilated areas and shall not be directed towards persons, bulk tanks or equipment. To reduce the risk of blockage, the HPRV inlet connection should not be on the underside of pipework as far as practicable.

**5.4.10** HPRV shall be protected by means of rain cap.

**5.4.11** HPRVs installed on the pipework shall not, at the time of installation, be older than 24 months from the date of manufacture; otherwise the renewal date shall be counted from the date of manufacture.

## **5.5 Dispenser**

- 5.5.1** The dispenser and its components shall be installed, tested and commissioned in accordance with manufacturer's instructions.
- 5.5.2** The dispenser should be properly anchored to a concrete foundation without straining any connections of its components.
- 5.5.3** Adequate support should be provided for the dispenser and its components, independent of piping, tubing, or conduit that may be connected.
- 5.5.4** The remote shut-off valves should be installed below or as close as possible to ground level and below the protective shearing device.
- 5.5.5** The dispenser should be suitably protected against vehicular damage.
- 5.5.6** Voids below the dispenser base shall be limited to 150 L capacity, and no more than 400 mm deep.

## **5.6 Electrical installation**

- 5.6.1** All electrical equipment shall be properly installed in accordance with manufacturers' instructions and in compliance with statutory regulations.
- 5.6.2** Where reasonably practicable, electrical equipment should be located outside hazardous areas; otherwise it shall be of flameproof type and selected, installed and maintained.
- 5.6.3** All electrical wiring and cables for use in classified zones (see Annex F) shall be certified by the manufacturer as being suitable for its intended use.
- 5.6.4** All electrical connections in the dispenser should be made in accordance with the manufacturer's instructions without negating the integrity of the flameproof protection.
- 5.6.5** The area classifications for LPG filling facilities at the filling station are listed in the Table 3.

**Table 2**

| <b>Location</b>                        | <b>Extent of Classified Area</b>                                                                            | <b>Area Classification</b>                  |
|----------------------------------------|-------------------------------------------------------------------------------------------------------------|---------------------------------------------|
| <b>LPG storage tank</b>                | (a) Within 1.5m in all directions from the tank connections or shell                                        | Zone 1                                      |
|                                        | (b) Up to 1.5m above ground level and within 3m from manhole assembly                                       | Zone 2                                      |
| <b>Pressure relief valve discharge</b> | (a) Within direct path of discharge.<br><br>(b) Within 0.5m in all other directions from point of discharge | No fixed electrical equipment<br><br>Zone 2 |
| <b>LPG road tanker unloading</b>       | (a) Within 1.5m in all directions from fill connection                                                      | Zone 1                                      |
|                                        | (b) Beyond 1.5m but within 4.5m in all directions from fill connection                                      | Zone 2                                      |

|                      |                                             |                         |
|----------------------|---------------------------------------------|-------------------------|
| <b>LPG dispenser</b> | (a) Area within dispenser casing            | Defined by manufacturer |
|                      | (b) Area around dispenser. (See Appendix F) | Zone 1                  |

Where:

Zone 0 - Area in which an explosive gas-air mixture is continuously present or present for long periods.

Zone 1 - Area in which an explosive gas-air mixture is likely to occur in normal operation.

Zone 2 - Area in which an explosive gas-air mixture is not likely to occur in normal operation and if occurs will only exist for a short time.

**Note:**

*The ullage space within the LPG tank should never contain a flammable atmosphere, as the tank is always purged with inert gas prior to filling and gas freed prior to opening up.*

- 5.6.6** LPG storage tank and pipework accessories with cathodic protection system normally should not be earthed, and all outlet connections shall be electrically insulated from the downstream pipework by means of suitable insulation flanges.
- 5.6.7** An earthing point should be provided at tanker bay for discharging static electricity from road tankers. Earthing points for dissipation of static electricity should have an electrical resistance to earth of not greater than  $1 \times 10^6$  ohms.
- 5.6.8** All pipework and fittings downstream of the insulation flanges shall have electrical continuity and be effectively connected to earth and bonded.

## **5.7 Road Markings, warning signs and identification labels**

- 5.7.1** Warning signs for the station in general shall be provided according to the relevant provisions in clause 10.
- 5.7.2** The driveway area above the underground LPG tank chamber should be demarcated with diagonal strips in yellow reflective paint, including letterings of convenient size indicating that no parking of vehicles is allowed.
- 5.7.3** The designated unloading bay for the LPG road tanker should be demarcated with the perimeter painted in yellow reflective paint, with letterings of convenient size indicating that it is for LPG road tanker unloading. It is possible that the LPG road tanker unloading bay may overlap with part of the area referred to in clause 5.7.2 above.
- 5.7.4** All aboveground valves that can be operated manually should be provided with the correct identification labels and, where applicable, diagrams of "open/closed" positions. Other critical devices / components that should also have identification labels include (but not limited to) the earthing connection for road tanker, the extended fill connection and all emergency shut-down buttons.
- 5.7.5** The critical valves and fittings within the tank manhole assembly that are accessible for operation should have the correct identification labels affixed at convenient nearby positions.

## **6.0 Testing and Commissioning**

### **6.1 General**

- 6.1.1** LPG installations shall be tested and commissioned in accordance with the appropriate standards, codes of practice, drawings, specifications, manuals, etc. Manufacturer reports/catalogues for bulk tanks, pumps, dispensers and equipment, etc. shall also be referred to accordingly.
- 6.1.2** Cathodic protection, earthing, electrical continuity, insulating flange isolation, static bonding arrangements, lightning protection shall be tested in accordance with appropriate standards.

- 6.1.3** Relevant tests on bulk tanks, pumps, dispensers and associated piping system shall be supervised by a relevant competent person.
- 6.1.4** All purging, testing and commissioning work shall be carried out by suitably trained and competent persons.
- 6.1.5** Appropriate personal protective clothing and safety equipment including handheld/portable flammable gas detectors shall be used by people involved with LPG work.
- 6.1.6** Fire service installations and equipment of the station shall be made available during purging and commissioning work.

## **6.2 Documentation and Records**

- 6.2.1** Records and certificates of all tests carried out shall be retained for the service life of the station equipment.
- 6.2.2** Test records or certificates should contain, but not limited to, the following information, as appropriate:
  - a) Testing and Examination Report of LPG Tank for revalidated tank;
  - b) Testing and Examination Report of LPG Pipes
  - c) Test Report for Pressure Relief Valves, if applicable;
  - d) Test Report for LPG Pumps;
  - e) Test Report for LPG Dispensers;
  - f) Test Report for LPG Control System;
  - g) Test Report for Emergency Shut-down System;
  - h) Test Report for Pneumatic System;
  - i) Test Report for Fire Service Installations including gas detection system such as Certificate of Fire Service Installations and Equipment
  - j) Test Report for Electrical Installations including lightning protection system, earthing, electrical continuity, static bonding arrangement, insulation flange isolation;
  - k) Cathodic Protection System Test Reports; and
  - l) Other test reports if required.

## **6.3 LPG Storage Tank and Pump Testing**

- 6.3.1** The following tests shall be required for bulk tanks: -
  - a) hydraulic test;
  - b) ultrasonic thickness test;
  - c) radiography test (for new tank only);
  - d) magnetic particle test;
  - e) paint thickness test; and
  - f) holiday test.

- 6.3.2** Bulk tanks shall be hydraulically tested at 1.5 times of their design pressure for integrity, unless otherwise specified by their respective design code.
- 6.3.3** All connections of bulk tanks and associated fittings shall be leak tested to a minimum pressure of 689 kPa by air or inert gas (check joints with soap solution).
- 6.3.4** The LPG pump and the associated control device shall be tested and commissioned in accordance with manufacturer's instruction.
- 6.3.5** Functional test of the LPG pumps and insulation test of pump motors shall be carried out.
- 6.3.6** After leak test, the system shall be purged into service as per clause 6.9.

## **6.4 Pipework Testing**

- 6.4.1** All pipework shall be tested after construction and before being placed in operation to ensure that it is structurally sound and gas-tight. In carrying out the test, precautions shall be taken to protect:
- a) the person carrying out the test;
  - b) any persons working in the vicinity; and
  - c) members of the public,

against any dangers which may arise if such pipe fails the test All pipework that will carry liquid LPG shall be pressure tested as follows:

- d) All pipework shall be hydraulically tested at 1.1 times the HPRV setting, after isolation of elements that could be damaged by the test pressure. Pressure test certificates shall state HPRV setting in addition to hydraulic test pressure.
  - e) After the hydraulic test is completed, all isolated elements shall be properly installed and the whole system shall be tested pneumatically at a minimum pressure of 1 378 kPa.
- 6.4.2** Time shall be allowed for temperature stabilisation during pressure testing. The line pressure shall be adjusted to the test pressure after stabilisation.

**Note:** *The time allowing for temperature stabilisation depends on the ambient temperature, test medium, pipe size and length. Generally, this shall not be less than 15 minutes.*

- 6.4.3** For pneumatic testing, the test shall be undertaken in phases as follows: -

- a) Initially pressurize the system to 140 kPa and hold it for sufficient time to ensure that all fittings have been adequately fastened.
  - b) The pressure shall then be raised in stages until the required test pressure is reached.
  - c) After each pressure increase, sufficient time shall be allowed to ensure system integrity.
- 6.4.4** For hydraulic and pneumatic pressure test, the test period shall be of a minimum of 30 minutes and there shall be no sign of pressure decay during this period. Care should be taken of the pipework which may suddenly rupture due to the pressure test.

**Note:** *Pressure decay indicates leakage and leaks shall then be identified by sight and sound or soap solution.*

- 6.4.5** All open ends of a piping system shall be suitably blanked before testing.

- 6.4.6** Pipework pressure tests shall be recorded and the test report and shall include the following:

- a) name of contractor, and signature of the competent person who supervised the tests;

- b) test date;
- c) maximum working pressure;
- d) test pressure, medium and duration;
- e) test results; and
- f) materials, rating and specification of pipework and fittings.

**6.4.7** The pressure of the pipework shall be reduced to zero as soon as is practicable after the pressure tests. Upon satisfactory completion of pressure tests, the pipework shall be purged into service in accordance with clause 6.9 prior to commissioning and operation of the LPG installation.

## **6.5 Dispenser Testing**

- 6.5.1** The dispenser and its components shall be tested and commissioned in accordance with the manufacturer's instructions.
- 6.5.2** All connections, pipe joints, seals and associated fittings inside the dispenser cabinet shall be subject to leak test carried out by suitably trained and competent persons.
- 6.5.3** The dispensing hose and nozzle shall be subjected to leak test carried out by suitably trained and competent persons.
- 6.5.4** The breakaway coupling of the dispensing hose shall be tested to ensure its operating mechanism is in good and efficient working order.
- 6.5.5** The functional test for the dispensing nozzle hold-open shall be carried out.

## **6.6 Testing of Remote Emergency Shut-down System**

The functional test for remote emergency shut-down system shall be carried out. Each emergency stop button shall be tested to ensure that all pneumatic valves in the station are to be closed and the entire LPG system is to be shut down within 12 second of activating any button.

## **6.7 Testing of Gas Detection System**

The functional test for gas detection system at appropriate settings as stated in clause 4.15 shall be carried out.

## **6.8 Testing of Cathodic Protection System**

The cathodic protection system shall be tested according to the procedure as specified by a corrosion specialist.

## **6.9 Purging into Service**

**6.9.1** The procedure of purging into service of bulk tanks is as follows: -

- a) After pressure testing of a bulk tank, inert gas (e.g. N<sub>2</sub>) is added to the bulk tank through a top inlet point, and air inside the tank is vented from the bottom drain port.

- b) The competent person supervising the test should be aware of any dead ends or blind pockets, and use pressure and vent procedures to ensure that the gas mixture inside the tank is reasonably homogeneous.
- c) End point is reached when the O<sub>2</sub> content is below 9% by volume.

**Note:** *If the medium of pressure test is inert gas, this procedure is not necessary as long as the inert gas is maintained above atmospheric pressure within the bulk tank.*

- d) To prevent rapid vaporisation of LPG liquid, only vapour LPG shall be admitted into the bulk tank until the tank pressure is close to the supply pressure.
- e) Before the flaring process, the Fire Services Communication Centre should be informed.
- f) A flare stack located in a safe area shall be connected to a suitable vapour connection near the top of the tank for flaring off the LPG/inert gas. The flare stack shall be equipped with a permanent pilot and a flame arrestor. Care shall be taken to ensure complete removal of the inert gas (a stable flame at the flare stack) before terminating the flaring process.
- g) Introduce vapour LPG into the tank through the bottom drain port to drive out the inert gas inside the tank. The flare stack, with the pilot permanently lit, should be connected at all times. Once the inert gas is driven out of the tank and LPG begins to pass through, the flare would be lit up by the pilot flame. Continue flaring until a steady flame is achieved.
- h) Disconnect the flare and plug off the connection. Continue filling with LPG vapour until the tank pressure reaches the vapour pressure of the LPG.
- i) The tank shall be replenished according to clause 7.3.

**Note:** *While flaring is in process, the road tanker shall not be in the LPG filling station.*

**6.9.2** The procedure for purging into service of pipework (including dispensers and associated equipment) is as follows: -

- a) Before introducing LPG into the pipework or equipment, it shall be purged with inert gas (e.g. N<sub>2</sub>) so that oxygen is reduced to a level of less than 9% by volume. Inert gas shall be introduced in a controlled manner by adjusting the pressure regulator.
- b) The competent person supervising the test should be aware of any dead ends or blind pipeline sections, and use pressure and vent procedures to ensure that the gas mixture throughout the pipeline or equipment is reasonably homogeneous.
- c) Before putting liquid LPG into the liquid pipework, vapour LPG shall be introduced into the pipework up to the delivery tank pressure in order to avoid sudden chilling of the pipework.
- d) For pipework sizes up to 32 mm nominal bore, LPG/inert gas mixture may be dispersed under proper supervision to a well-ventilated area without any source of ignition. For pipework sizes above 32 mm nominal bore, a flare stack with permanent pilot shall be used and is located at a safe distance away from the bulk tanks and other vulnerable structures.
- e) Care shall be taken to ensure removal of the inert gas (a stable flame at the flare stack) before terminating the flaring process.

**6.9.3** Direct venting of LPG or LPG / inert gas mixture from pipework to atmosphere may be done under proper supervision to a well-ventilated area and without flaring if the following conditions are met:

- a) The vent pipe is terminated at a minimum height of 2.5 m above ground level.
- b) The vent pipe is located within a manned control safe area where it is cordoned off from the public and no source of ignition exists within 15m from the controlled area.

- c) Gas detector shall be used to monitor the combustible gas concentration within and adjacent to the controlled area.
- d) Venting operation shall be stopped immediately should the gas detector reading exceeds 10% Lower Explosive Limit (LEL).
- e) Venting operation shall not recommence until the LEL level for the atmosphere in the controlled area falls below 10%.

**6.9.4** In the case of equipment repairs and replacement of parts, direct purge of air by LPG under proper supervision is permissible provided that the purge pressure is maintained at or below the maximum working pressure.

## **6.10 Commissioning**

**6.10.1** All equipment, joints and valves, etc. shall be checked for leakage, integrity and proper function before commissioning.

**6.10.2** LPG trap shall be checked to ensure that it is topped with water (see Annex A).

**6.10.3** The operation of fire service installations and equipment where fitted, shall be checked for its satisfactory performance, and a Fire Services Certificate issued by Fire Service Department and a Certificate of Fire Service Installation and Equipment issued by a registered fire service installation contractor of the appropriate class should be obtained before putting the LPG installation into operation.

## **7.0 OPERATIONS**

### **7.1 General**

**7.1.1** Operating instructions shall be in place to ensure safe, continuing and reliable operation of the installation in supplying gas to consumers.

**7.1.2** Persons engaged in LPG operation shall: -

- a) be provided with extensive training in their specific areas of responsibilities;
- b) be thoroughly familiar with the properties of LPG;
- c) have knowledge of and access to the appropriate codes of practice at all times;
- d) have specific guidance on the instructions to be followed under emergency conditions;
- e) be familiar with different types of firefighting and fire control equipment, including fire extinguishers;
- f) ensure that the LPG storage does not exceed its approved quantities; and
- g) ensure that all fire extinguishers are clearly identified for their types and expiry dates.

### **7.2 Filling Operation**

**7.2.1** All filling operators should receive proper training on handling LPG and the dispensing equipment in the filling station. They should be fully conversant with the locations and operation of the remote emergency shut-down buttons and fire-fighting equipment, emergency procedures to shut down the dispensing system and actions in an emergency such as a drive-away with the dispensing hose still connected to the vehicle.



- 7.2.2** Filling operators should wear protective gloves during refueling.
- 7.2.3** No untrained person should carry out refueling.
- 7.2.4** LPG vehicle with a defective filler cap or filler valve should not be refueled.
- 7.2.5** The filling operator shall ensure the vehicle ignition is switched off prior to the commencement of filling operation.
- 7.2.6** All LPG vehicles should not be left unattended during the filling operation.
- 7.2.7** The dispensing nozzle shall not be held open with any items such as rods, keys or any devices other than the integral component of the nozzle throughout the filling operation.
- 7.2.8** LPG vehicle refueling and road tanker operation could be performed at the same time.
- 7.2.9** Typical filling procedures are as follows:
- a) Open filler cap at the vehicle body by turning counter clockwise.
  - b) Lift nozzle off hook from dispenser and wait for display to reset itself.
  - c) Ensure that no obstacle is in the passage between the nozzle and filler valve and align nozzle nose piece to filler valve properly.
  - d) Turn nose piece clockwise to fully engage nozzle to the filler valve.
  - e) Squeeze nozzle trigger to allow LPG to flow steadily. Flow will stop automatically when tank is 85% full.
  - f) Turn nozzle nose piece counter-clockwise to disengage the nozzle and place the nozzle back on hook of the dispenser.
  - g) Close the filler cap by turning clockwise.

### **7.3 Road Tanker Operation**

- 7.3.1** Off-loading of LPG shall be carried out by at least 2 competent road tanker operators, one of whom may be the road tanker driver.

**Note:** *In the case of extended fill-connection, the driver shall stay close to the road tanker to monitor off-loading while his assistant shall monitor the filling in progress at the LPG tank.*

- 7.3.2** Persons engaged in off-loading of LPG shall be suitably trained in first aid, fire-fighting, unloading and dispensing systems of the filling station and emergency response.
- 7.3.3** Persons engaged in off-loading of LPG shall wear suitable protective clothing to avoid frostbite which can occur if LPG comes in contact with unprotected skin.
- 7.3.4** A reporting procedure shall be instituted to record every accidental LPG release, equipment failure or personal injury that may occur during the off-loading operation.
- 7.3.5** The following precautionary measures shall be observed throughout the LPG off-loading operation: -
- a) Simultaneous bulk deliveries of LPG and petrol or diesel are not permitted.
  - b) The driver should position the tanker at the designated tanker bay facing the direction of departure so that it can be towed or driven straight out in an emergency.

- c) The hand brake of the road tanker shall be applied and the chock blocks securely fitted to undersides of the wheels.
- d) The surrounding shall be checked to ensure that neither source of ignition nor flammable material is present.
- e) Earthing/bonding cable shall be engaged before connecting the fill-hose and be disengaged after disconnecting the fill-hose. Earthing/bonding cable and driveaway coupling shall be connected throughout the entire off-loading operation.
- f) Extended fill-connections shall be visually checked to ensure that they are in safe working conditions.
- g) The driver should maintain a direct sight between the tanker and the filling point while off-loading.
- h) The storage capacity of the tank to be filled shall be carefully monitored throughout the filling operation by means of the contents gauge to avoid over-filling. The storage tank shall not be filled beyond the maximum level (85% or otherwise specified).
- i) Extended fill-connections and fill-hose shall be checked for leakage throughout the operation.
- j) For installations of more than one tank, each tank shall be filled separately.
- k) Fire extinguishers shall be located at easily accessible positions with warning notices prominently displayed.

#### **7.4 General Housekeeping Procedures**

Good housekeeping procedures, which shall include but not limited to the daily attention of the following activities, should be established by the filling station management. The responsible person shall check the housekeeping records and carry out an inspection for the following items at daily intervals: -

- a) The gas detection, LPG vehicle filling and firefighting systems are under normal operation;
- b) No visual damage to the extended fill-connection, above-ground pipework and fittings, manhole covers of underground LPG storage tanks, valve pit and the associated instrumentation such as gas detector heads, remote emergency shut-down buttons, etc.;
- c) No visible damage to the dispensers, dispensing hoses, breakaway couplings and dispensing nozzles;
- d) Portable fire extinguishers for the filling station are kept in place and charged;
- e) Warning signs are kept in a legible condition and in place;
- f) Price information board is kept in good condition for displaying the auto-LPG price;
- g) Rain caps for the vent pipes of pressure relief valves remain in place;
- h) Any accumulation of flammable or combustible materials especially around the road tanker unloading area, the storage tank area and the extended fill-connection, are removed;
- i) Illumination is kept operational and effective especially at the filling point and around the dispensing area;
- j) Vegetation (if any) which might become a fire hazard is kept short; and
- k) Drain covers and pit covers should be properly sealed in dispensing and road tanker bays.

## **7.5 Emergency Procedure**

- 7.5.1** Filling station management should formulate an emergency plan with which the operating personnel should be well conversant. This plan should contain instructions for emergency shut- down of the installation, warnings to customers and other people in the installation surroundings, call for assistance and use of fire-fighting equipment. The plan should be reviewed once a year.
- 7.5.2** A copy of updated site layout plan and schematic diagram of the LPG filling system shall be kept on site for operation and emergency use.
- 7.5.3** In case of fire or serious leakage from the LPG filling facilities, the operators at the LPG filling station should call Fire Service Department immediately.
- 7.5.4** Under safe conditions, the following measures should be carried out to prevent escalation of the situation:
- a) Shut off the LPG filling system by means of remote emergency shut-down buttons.
  - b) Switch off the main switch of electrical installation.
  - c) Remove or extinguish all sources of ignition.
  - d) Activate the water spray system if it has not been automatically activated.
  - e) Warn customers to switch off or not to start vehicle engines.
  - f) Inform the gas supply company using the emergency phone number.
  - g) Keep spectators at distance.
  - h) Alert neighbours to the danger.
- 7.5.5** Regular drills on communication and procedures for different scenarios of LPG emergency cases should be carried out to ensure relevant emergency procedures to be current, comprehensive and effective and enable the station staff/management to familiarise with the emergency procedures.

## **8. Periodic inspection & Maintenance**

### **8.1 General**

- 8.1.1** The owner of an LPG installation shall have a duty to maintain and operate the installation in a safe condition and shall employ a competent person to inspect the installation at intervals as specified in clause 8.3 and 8.5.
- 8.1.2** Activities such as construction, repair, maintenance, gas freeing of storage tanks and pipelines, inspection, testing and revalidation of the LPG installations shall be undertaken by competent persons.
- 8.1.3** Tests and examinations for revalidation of tanks, dispensers, pipework and associated fittings, etc., shall be carried out in accordance with the schedule in Annex D. The schedule shall be planned well ahead to ensure timely completion of works.
- 8.1.4** Persons engaged in maintenance work shall have access to maintenance manuals and operating instructions and shall adhere to them accordingly.
- 8.1.5** No unauthorized person shall be permitted to gain access to LPG installations. A proper work permit system incorporating formal procedures shall be instituted for cold work, hot work and entry to bulk tanks.
- 8.1.6** Work permits shall be kept for 5 years as part of the maintenance records.

- 8.1.7** Before re-commissioning, care shall be taken to ensure that all tanks, dispensers, equipment and associated pipework/fittings (including electrical bonding) are properly reinstated and leak tested satisfactorily.
- 8.1.8** All purging, testing and commissioning work shall be carried out by suitably trained and competent persons.
- 8.1.9** Purging to be carried out before and after any test and examination of the LPG installation shall be performed in accordance with the procedures and recommendations in clauses 6.9 and 8.8.
- 8.1.10** Appropriate personal protective clothing and safety equipment including handheld/portable flammable gas detectors shall be used by people involved with LPG work.
- 8.1.11** Fire service installations and equipment of the station shall be made available during purging, testing and commissioning work.

## **8.2 Documentation and Records**

- 8.2.1** A systematic routine maintenance plan shall be established by the owner of the station and be documented. The plan should contain detailed instructions on what maintenance items are to be carried out, the scope of works, the intervals at which, or the circumstance in which, such works shall be carried out. It should also be reviewed and updated as necessary. When preparing the plan, sufficient regards should be paid to the relevant standards employed, the manufacturer's recommendations and the history and conditions of individual equipment.
- 8.2.2** The owner of the station shall submit a full set of test certificates as follows for tank revalidation signed by a competent person to the Regulatory Authority for review:
- a) hydraulic test report with minimum test pressure 1.5 times the maximum design pressure;
  - b) external visual inspection report (internal inspection where necessary);
  - c) plate thickness ultrasonic test report;
  - d) magnetic particle test report for welding seams;
  - e) test and examination of the tank fittings including pressure gauges;
  - f) paint thickness test and holiday test report;
  - g) cathodic protection test report;
  - h) earthing impedance report;
  - i) electrical continuity test report;
  - j) test report for electrical isolation of insulation flange;
  - k) pressure relief valves pressure test certificates (if re-tested instead of replaced),
  - l) tank pneumatic tightness test report; and
  - m) pipework hydraulic pressure test and pneumatic tightness test reports.
- 8.2.3** The owner of the station shall keep the following records at the station:
- a) P&ID of the LPG system;
  - b) P&ID of the pneumatic system controlling safety devices; and

- c) Station layout showing the locations of all gas detectors and remote emergency shut-down buttons

The P&IDs and station layout should be at least of A4 size, and shall be displayed at the sales office or control room for easy reference in case of emergencies.

- 8.2.4** The owner of the station shall submit the annual inspection report (See Appendix I) to the Regulatory Authority within 4 weeks after the inspection.

### **8.3 Revalidation of LPG Storage Tank**

- 8.3.1** Each LPG storage tank shall be revalidated once within the first 10 years and then every 5 years. A full set of test certificates as specified in Clause 8.2.2 for tank revalidation signed by a competent person shall be submitted to the regulatory Authority for review.
- 8.3.2** For visual examination of LPG storage tanks, special attention shall be given to signs of corrosion, deterioration, condition of tank supports and welded joints. Any defects shall be rectified prior to re-commissioning of the LPG storage.
- 8.3.3** All check and excess flow valves associated with the LPG storage tank shall be reconditioned/replaced and functional tested during revalidation.
- 8.3.4** The pressure relief valves of the LPG storage tank shall be replaced with new or reconditioned/re-tested units of appropriate set pressure and capacity every 5 years.
- 8.3.5** The LPG pump shall be inspected, tested or replaced at regular intervals as recommended by the equipment manufacturer.
- 8.3.6** The hydrostatic pressure relief valves at the liquid sections should be replaced with new units of appropriate set pressure and capacity every 10 years.
- 8.3.7** All LPG pipework whether it is new, modified or reinstated after disconnection shall be hydraulically tested at 1.1 times the HPRV setting. Elements that could be damaged by the test pressure shall be isolated and time shall be allowed for temperature stabilisation during pressure testing. After the hydraulic test is completed, all isolated elements shall be properly installed and the whole system shall be tested pneumatically at a minimum pressure of 1378 kPa.
- 8.3.8** All exposed LPG pipework shall be subject to annual visual examination and leak test under operating pressure using soap solution.
- 8.3.9** All underground LPG pipework shall be re-tested once within the first 10 years and then every 5 years thereafter in accordance with clause 8.3.7.
- 8.3.10** The test period for all hydraulic and pneumatic pressure tests shall be of a minimum of 30 minutes after temperature stabilisation and there shall be no sign of pressure decay during this period.
- 8.3.11** A copy of test certificate signed by a competent person should be submitted to the regulatory
- 8.3.12** Test report on the pipework pressure tests shall include the following:
  - a) name of contractor, and signature of the competent person who supervised the tests;
  - b) test date;
  - c) maximum working pressure;
  - d) test pressure, medium and duration;
  - e) test results; and
  - f) materials, rating and specification of pipework and fittings.

- 8.3.13** Test reports on the cathodic protection of LPG storage tank at intervals of 6 months shall be kept by the owner of the LPG filling station. A record of these tests shall be kept for whole life of the tank and made available to the regulatory Authority for review upon request.
- 8.3.14** The electrical and fire service installations of the filling station shall be regularly inspected and tested by competent persons in compliance with the statutory regulations.

#### **8.4 Maintenance**

- 8.4.1** The owner of the LPG filling station shall maintain the station in a safe manner by carrying out regular inspections and maintenance works of the LPG filling facilities at intervals not less than that as recommended by the equipment manufacturer.
- 8.4.2** Maintenance and repair work shall be carried out by suitably trained and competent persons.
- 8.4.3** Routine maintenance schedule shall be planned in accordance with manufacturer instructions to ensure safety and proper function of the system. The schedule may also depend on the individual site conditions and past maintenance records.
- 8.4.4** Site environment shall be maintained in good condition so that it is free of overgrown vegetation and irrelevant materials. Overgrown weeds, long grass, deciduous shrubs / trees and any combustible materials shall be removed from an area within 6 m of the extended fill connection and manhole assembly of the LPG tank. Chemical weed killers or any other method which may create a source of ignition shall not be used within these areas.
- 8.4.5** Identification labels, emergency instructions, warning signs and line diagrams shall be checked to ensure that they are in place and legible.
- 8.4.6** Any work which is likely to create an ignition source shall not be permitted within a Zone 0 area or a Zone 1 area and shall not be carried out in a Zone 2 area unless the area is subject to continuous checking to ensure that it is gas-free.
- 8.4.7** Any pit associated with an underground LPG installation shall be checked for the presence of LPG before commencement of any work in the pit.
- 8.4.8** A logbook detailing all maintenance and repair works that have been carried out shall be kept by the owner for the service life of the installation or a period of at least 6 years.
- 8.4.9** The LPG pump and the associated control equipment shall be inspected and properly maintained at regular intervals according to manufacturer's instructions.
- 8.4.10** All other equipment and instrumentation such as pressure and contents gauges, etc. shall be checked and maintained to ensure satisfactory condition and proper function in accordance with manufacturer instructions at intervals not exceeding one year and replaced with new or reconditioned units as necessary.
- 8.4.11** Tank chambers and valve chambers shall be checked for integrity and be properly maintained at regular intervals to prevent ingress of water.
- 8.4.12** The dispenser and its components such as the metering unit, excess flow valve, breakaway coupling, dispensing hose, nozzle, strainer and pipework shall be properly maintained at regular intervals as recommended by the equipment manufacturer.
- 8.4.13** All connections, pipe joints, seals and associated fittings inside the dispenser cabinet, the dispensing hose joints, breakaway coupling and dispensing nozzle shall be subject to visual examination and leak test carried out by the competent person under operating pressure using soap solution annually.
- 8.4.14** The dispensing hoses shall be replaced at an interval not more than 5 years. Permanent legible tags or labels shall be affixed to the dispensing hoses to show the month/year of first installation.

- 8.4.15** All seals (e.g. mechanical seal, lip seal, O ring and seal ring) of the dispenser and dispensing nozzle shall be replaced at regular intervals as recommended by the equipment manufacturer.
- 8.4.16** The mandatory road markings shall be checked to ensure they are in place and legible.
- 8.4.17** The earthing and bonding arrangement shall be checked and maintained at regular intervals to ensure its proper function.
- 8.4.18** Each electrical equipment and cable connection shall be inspected and properly maintained to ensure satisfactory condition in accordance with manufacturer instructions.
- 8.4.19** The fire service installations or equipment of the station shall be maintained in efficient working order at all times and shall be inspected by a registered fire service installation contractor at least once in every 12 months.
- 8.4.20** The remote emergency shut-down system including the buttons and valves shall be maintained in efficient working order at all times and shall be tested annually.
- 8.4.21** The gas detection system shall be maintained in efficient working order at all times and shall be inspected by a battery for the gas detection system shall be checked and replaced if necessary. All the gas detector heads shall be calibrated by relevant competent person/contractor to ensure satisfactory condition and proper functioning in accordance with manufacturer instructions at intervals not exceeding one year.
- 8.4.22** The bottom of each LPG storage tank shall be drained to remove any residual water or other sediments at intervals not exceeding one year.

## **8.5 Annual Inspection**

- 8.5.1** An LPG filling station shall be inspected annually by a competent person to ascertain that the installation is maintained and operated in a safe manner and it complies with the requirements of this standards at all times. The owner of the station shall submit an annual inspection report to the Regulatory Authority within 4 weeks after the inspection.
- 8.5.2** The owner of the LPG filling station shall carry out the necessary work as identified in the inspection reports.

## **8.6 Alterations to LPG Filling Facilities**

Major alterations to an LPG filling station require construction and use approvals from the regulatory Authority. In general, the following constitute major alterations:

- a) Increase in storage capacity
- b) Increase in quantity or capacity of equipment such as pumps or dispensers
- c) Changes in the station layout that will affect safety distances

The list is not exhaustive, and the regulatory Authority should be consulted if any changes are planned. Even if no construction approval or approval of use is required, notification to the regulatory Authority should be made before any work can be carried out.

## **8.7 Purging LPG Tanks Out of Service**

- 8.7.1** The procedure for purging LPG tanks out of service using inert gas is as follows: -

- a) The bulk tank to be purged shall be properly isolated and blanked off from other tanks and/or pipework using spades, blind flanges or locked valves.
- b) Liquid LPG in a bulk tank shall be depleted as far as practicable through normal consumption or decanted to a road tanker prior to purging.
- c) Decanting can be via a pump, or by a compressor forcing vapour into one tank to drive the liquid into another tank.
- d) A flare stack with a permanent pilot and flame arrestor, located in a safe area, shall be connected to a suitable vapour connection of the tank for flaring of the residual LPG vapour.
- e) The Fire Services Communication Centre shall be notified prior to any flaring, and the flaring process shall be attended to at all times during purging.
- f) When the vapour pressure inside the tank drops off, inert gas (e.g. N<sub>2</sub>) can be introduced into the top of the bulk tank to drive out the remaining LPG, which shall now come out from the bottom drain connection. Continue flaring until the flame dies out (the permanent pilot shall remain lit all the time).
- g) Flame out at the flare stack does not indicate end point of purging. A combustible gas detector shall be used to check to confirm the purging end point. The LEL of gas emerging from the tank shall be less than 5%.
- h) The competent person supervising the purging operation should be aware of any dead ends or blind pockets, and use pressure and vent procedures to ensure that the gas mixture throughout the whole tank is reasonably homogeneous. Venting using all available vents should be done, and gas samples taken to confirm purging end point.
- i) Once the bulk tank is at atmospheric pressure, the manhole cover may then be removed and air be introduced into the tank.
- j) No one shall enter into the tank until the internal atmosphere has been verified to be safe (LPG level less than 5% of the lower explosive limit and oxygen level not less than 18%). Detector probes shall be used to ensure that LPG is not present at the bottom of the tank and oxygen level is adequate inside every part of the tank.
- k) The gas free status of the tank shall be certified by a competent person. Certification by a Competent Person shall be required if gas freeing is for the purpose of hot work or entry.

**8.7.2** Water can be used as a medium for purging instead of inert gas. The procedure shall be the same as per clause 8.7.1 except that water is introduced into the bottom of the bulk tank. However, the following extra precautions should be taken with water purging:

- a) The tank must be adequately vented to avoid creating a vacuum when the water is released.
- b) The competent person supervising the purging process should be particularly aware of dead ends or blind holes where gas pockets will be trapped. These will not be eliminated by filling the tank with water, and pressure and vent method cannot be used for water purging.
- c) To minimise corrosion, the wet surface of the tank should be exposed to the air for as short a time as possible.

## **8.8 Purging LPG Pipeline & Equipment Out of Service**

**8.8.1** The procedure for purging LPG pipeline and equipment out of service using inert gas is as follows: -

- a) The section of pipeline or equipment to be purged shall be properly isolated and blanked off from the rest of the system using spades, blind flanges or locked valves.



- b) LPG in the isolated pipeline section or equipment shall be depleted by flaring or venting. A flare stack with a permanent pilot, located in a safe area, shall be connected to a suitable tee point of the pipeline, preferable at the end, for flaring of the residual LPG.
- c) The Fire Services Communication Centre shall be notified of any flaring, and the flaring process shall be attended to at all times during purging.
- d) When the vapour pressure inside the pipeline or equipment dies off, inert gas (e.g. N<sub>2</sub>) can be introduced into a tee point at the other end of the pipeline or equipment to drive out the remaining LPG. Continue flaring until the flame dies out (the permanent pilot shall remain lit all the time).
- e) Use pressure and vent method to drive out any LPG remaining in blind pockets and dead legs.
- f) Flame out at the flare stack does not indicate end point of purging. A combustible gas detector shall be used to check to confirm the purging end point. The LEL of gas emerging from all available vent points shall be less than 5%. Enough time shall be allowed for the atmosphere inside the pipeline section or equipment to settle so that it reaches a homogeneous state, and the samples taken are representative.
- g) Once the pipeline section or equipment is at atmospheric pressure, it may then be opened up for performance of work.
- h) Direct venting of LPG or LPG/inert gas mixture to atmosphere shall be done in accordance to clause 6.9.3 above.

**8.8.2** Water may be used as a medium for purging instead of inert gas. This is particularly effective for pipelines and equipment that are to be abandoned. The procedure shall be the same as 9.8.1. However, particular attention should be paid to blind pockets and dead ends, ensuring that these are adequately purged, as pressure and vent purging is not possible with water purging.

**8.8.3** The gas freeing process shall be supervised by a competent person. If hot work is required on the pipeline or equipment, gas free certification by a Competent Person is required.

**Note:** *No one shall carry out any hot work to LPG pipework or equipment until the atmosphere inside the pipework or equipment and the surrounding atmosphere is verified to contain less than 5% LEL. In addition, the competent person supervising the hot work shall determine whether additional requirements are necessary, e.g. continuous monitoring and ventilation during work.*

## **9. Fire protection and fighting service requirements**

### **9.1 General**

- 9.1.1** Building plans including the fire service installations shall be submitted to the Building Authority for approval. In case there is no building works and plans are not submitted to the Building Authority, plans showing fire service installations should be submitted to the regulatory Authority. All fire service installations and equipment shall be designed and installed to the standards acceptable to the Fire Services Department
- 9.1.2** Fire service installations and equipment shall be installed, maintained, repaired, inspected and tested by registered fire service installations contractors of appropriate class.
- 9.1.3** Relevant requirements stipulated by the regulatory Authority when and where required shall be complied with.
- 9.1.4** All requirements in this clause 9 are for general guidelines only. Detailed fire service requirements will be formulated upon receipt of formal submission of building plans or referral from licensing authority.

## 9.2 Dedicated LPG Filling Station

- 9.2.1** An automatic water spray system shall be provided to cover the surface area of the LPG dispensers and the fill connection between the LPG road tanker and the underground LPG storage tank in accordance with relevant national standards. Such system shall be automatically actuated by gas detectors and/or fire detectors and shall also have a capability for manual actuation.
- 9.2.2** A fire hose reel system shall be installed in accordance with the relevant national standards
- 9.2.3** A fire hydrant shall be provided within 100 m from the station.
- 9.2.4** An LPG detection system shall be installed to give warning of the presence of leaked/spilt LPG with detector heads installed not more than 150 mm above the adjacent ground (or dispensing island) level at the following locations (but outside their respective Zone 1 hazardous zones, see annex E:
- a) near to each LPG dispenser;
  - b) near the above-ground service pump;
  - c) near to the extended fill-connection;
  - d) at the Environmental Sampling Unit (ESU) and
  - e) at strategic locations on the station boundary to ensure that escaping LPG will be detected before reaching the outside of the station, taking into consideration the topography of the site.
- 9.2.5** A direct link connection shall be provided for connecting all fire/gas detection systems and fire suppression systems to the Fire Services Communication Centre or such other premises as may be agreed with the Fire Services Department.
- 9.2.6** Portable fire-fighting equipment of approved type shall be provided in the following scale:
- 2 x 9 kg dry powder fire extinguisher for each LPG storage tank.
  - 1 x 4.5 kg dry powder fire extinguisher for each LPG dispenser.
- 9.2.7** “**LPG – HIGHLY FLAMMABLE**”, “**NO SMOKING – NO NAKED LIGHTS**” and “**SWITCH – OFF ENGINE**” signs in block letters and characters of not less than 125 mm high and 15 mm strokes shall be provided at conspicuous locations to give warning to customers.
- 9.2.8** “**SWITCH – OFF ENGINE**” signs of convenient dimensions shall be provided near dispensing units to give warning to customers.
- 9.2.9** Other Building Fire Service Installations and Equipment formulated by the Fire Services Department upon receiving building plans through Buildings Department shall be complied with.
- 9.2.10** “**LPG FILLING STATION**” signs in block letters and characters of not less than 150 mm high and 20 mm strokes shall be provided in conspicuous locations within the station area.
- 9.2.11** No direct-fired cooking shall be permitted within the station boundary.

## 10. Filling station layout requirements

### 10.1 General

This clause sets out the siting and minimum separation distance requirements for LPG filling stations from adjacent buildings from a risk point of view. It also outlines the minimum separation distance requirements between LPG and petrol/diesel filling facilities and other critical features for compliance.

## **10.2 Location**

- 10.2.1 Sites for LPG filling stations shall be located to provide suitable distances away from habitable areas as the orientation of the property allows. In addition, they shall be sited on open ground and situated in locations which are well ventilated and which, so far as can be reasonably foreseen, will remain so, even on subsequent development of adjacent sites.
- 10.2.2 An LPG filling station should be located along designated main roads which are considered to be safe for LPG transport, or at a location which can be easily reached from these main roads without passing through highly populated areas.

## **10.3 Site Layout**

The layout of an LPG filling station should be designed in such a way so as:

- a) to minimise the likelihood of impact onto an LPG road tanker by vehicles while it is entering or leaving the site;
- b) to take into consideration road width, gradient, turning radius, line of sight, traffic volume and vehicle speed;
- c) to provide convenient access and egress for the road tanker;
- d) to enable the road tanker and all other refilling vehicles to drive into and out of the site in a forward direction without having to reverse into the site from the main road;
- e) to provide a designated parking area large enough for the road tanker during unloading operation;
- f) to provide designated areas for dispensing bays;
- g) to provide adequate illumination around the dispensing area of the forecourt and road tanker unloading area for safety purposes at all times of use;
- h) to avoid the underground tank(s) located underneath the traffic path or road tanker bay, if practicable;
- i) to provide a Price Information Board for prominent display of retail price.

## **10.4 Physical sizes of LPG Filling Station**

A minimum size of 750 m<sup>2</sup> will normally be required for a new filling station but not necessarily for an existing petrol filling station retrofitted with LPG filling facilities. The plot size of the filling station would depend on location, storage quantity, number of dispensers, and side-activities such as car washing facilities. In addition, it shall comply with the minimum separation distance requirements from surrounding buildings as set out in Section 10.5 and among filling facilities as in clause 10.6.

## **10.5 Separation distances from surrounding buildings**

LPG filling facilities should fulfil the separation requirements from surrounding buildings as specified in the following Table3.

Table 3: Separation Distances from Surrounding Buildings

| LPG Filling Facilities              | Incidental Commercial/ Recreational<br>(m) | Dwelling / Industrial/ (m) | Residential/ Institution<br>(m) |
|-------------------------------------|--------------------------------------------|----------------------------|---------------------------------|
| Underground LPG Storage Tank        | 15                                         | 15                         | 55                              |
| Fill Connection of LPG Storage Tank | 15                                         | 15                         | 55                              |
| Road Tanker Unloading Bay           | 15                                         | 15                         | 55                              |
| LPG Dispenser                       | 15                                         | 15                         | 15                              |

**Note:**

- (i) **Incidental dwelling** includes small houses dispersed over a large area and ribbon development.
- (ii) **Commercial/Industrial** includes commercial developments, supermarkets, hotels, guest houses, shops, business premises, industrial buildings, factories and workshops, etc.
- (iii) **Recreational** includes recreational facilities, swimming pools, sports fields, playgrounds, etc.
- (iv) **Residential** includes high-rise residential buildings of regular occupancy.
- (v) **Institution** includes establishments for schools, hospitals, senior citizens, child-care facilities, etc.

**10.6 Separation distance requirements**

The minimum separation distance requirements between LPG and petrol/diesel filling facilities and other critical features are shown in the following Table 4. If a radiation wall constructed of non- combustible material and with 2-hour fire resistance rating in accordance with the Fire Safety in Buildings issued by Fire Services Department or equivalent is provided, the separation distances can be suitably reduced by measuring round the edge of the wall. The height of radiation walls shall be at least 1.8 m. A radiation wall may be built on a boundary, but in such a case, it shall be wholly under the control of the owner of the station.

The distance between the LPG tank and the installation boundary shall be at least 1.5m and the tank chamber around the LPG tank shall be wholly within the installation boundary.

A typical layout of LPG filling station with separation distance requirements is shown in Annex F.

**Table 4: separation distance requirements**

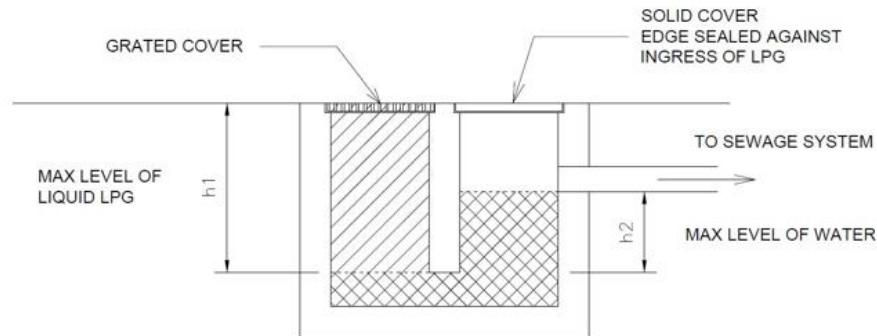
|                                          | Manhole assembly of underground LPG tank | Extended fill connection of LPG tank | LPG Pump (see Note 1) | LPG dispenser | Fill connection of LPG vehicle |
|------------------------------------------|------------------------------------------|--------------------------------------|-----------------------|---------------|--------------------------------|
| Manhole assembly of underground LPG tank | -                                        | Nil                                  | Nil                   | 3m            | 3m                             |

|                                                                                                        |      |      |      |                      |                      |
|--------------------------------------------------------------------------------------------------------|------|------|------|----------------------|----------------------|
| <b>Extended fill connection of LPG tank</b>                                                            | Nil  | -    | Nil  | 3m                   | 3m                   |
| <b>LPG dispenser</b>                                                                                   | 3m   | 3m   | Nil  | -                    | Nil                  |
| <b>Fill connection of LPG vehicle</b>                                                                  | 3m   | 3m   | 3m   | Nil                  | -                    |
| <b>Underground liquid fuels (petrol or diesel) tank manhole with fill connections or filling point</b> | 6m   | 6m   | 6m   | 6m                   | 3m                   |
| <b>Underground liquid fuels (petrol or diesel) tank manhole without fill connections</b>               | 3m   | 3m   | 3m   | 3m                   | Nil                  |
| <b>Petrol tank vents (in plan)</b>                                                                     | 3m   | 3m   | 3m   | 3m                   | 3m                   |
| <b>Petrol or diesel pumps/dispensers (flameproof)</b>                                                  | 3m   | 3m   | 3m   | 1.5m                 | 1.5m                 |
| <b>Site boundary, buildings, fixed sources of ignition</b>                                             | 7.6m | 7.6m | 7.6m | 4.1m<br>(see Note 2) | 1.5m<br>(see Note 3) |

#### **Notes:**

1. Applies to stand alone aboveground pump only; where submersible pump is used, it shall be considered as part of the LPG tank. LPG compressor, if used, shall follow the same separation distance requirements as for LPG pump except that it shall be at least 4.5 m away from the manhole assembly of an underground LPG tank.
2. The 4.1 m applies when the hose reach length after the anchoring point is not more than 3.6 m. When the hose reach length after the anchoring point exceeds 3.6 m, this distance shall be increased by the amount by which it has increased (e.g. for a 4.6 m hose reach length, the distance will increase from 4.1 m to 5.1 m).
3. Where the boundary is immediately adjoining a public footpath accessible by people, this distance of 1.5 m shall be increased to 4.1 m or otherwise as determined according to Note 2 above.

## Annex A: Typical design for LPG trap



### Design calculation of LPG trap

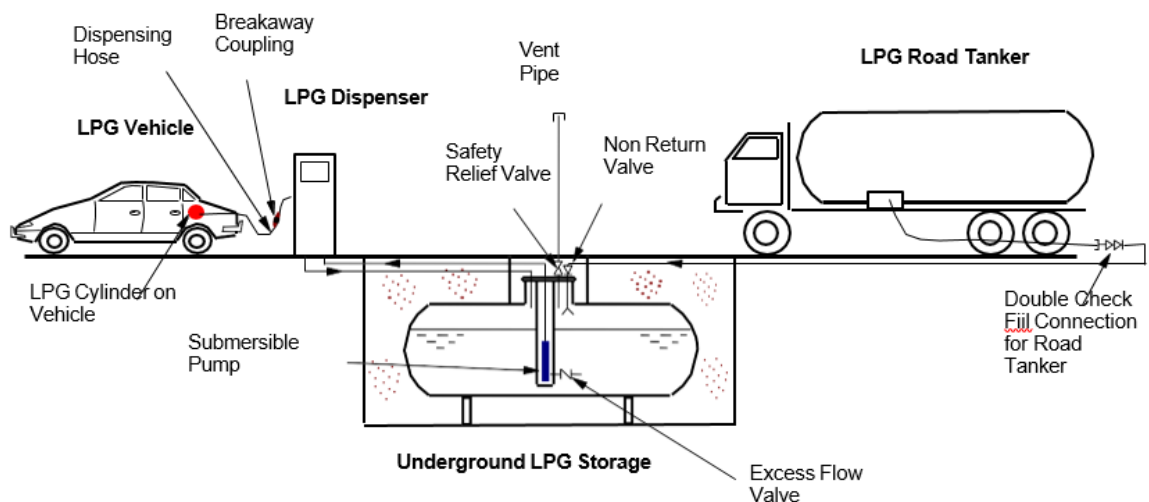
**h<sub>1</sub>** is the required depth of the weir to prevent passage of liquid LPG through the trap to the sewage system. It is calculated based on that if **h<sub>2</sub>** is filled with water up to the bottom of the outfall pipe and **h<sub>1</sub>** is filled to grade with liquid LPG, the water in **h<sub>2</sub>** can balance the LPG in **h<sub>1</sub>** and thus in a no flow position.

$$h_2 \times \text{S.G. of water} = h_1 \times \text{S.G. of LPG} \quad h_1 = h_2 \times \text{S.G. of water} / \text{S.G. of LPG}$$

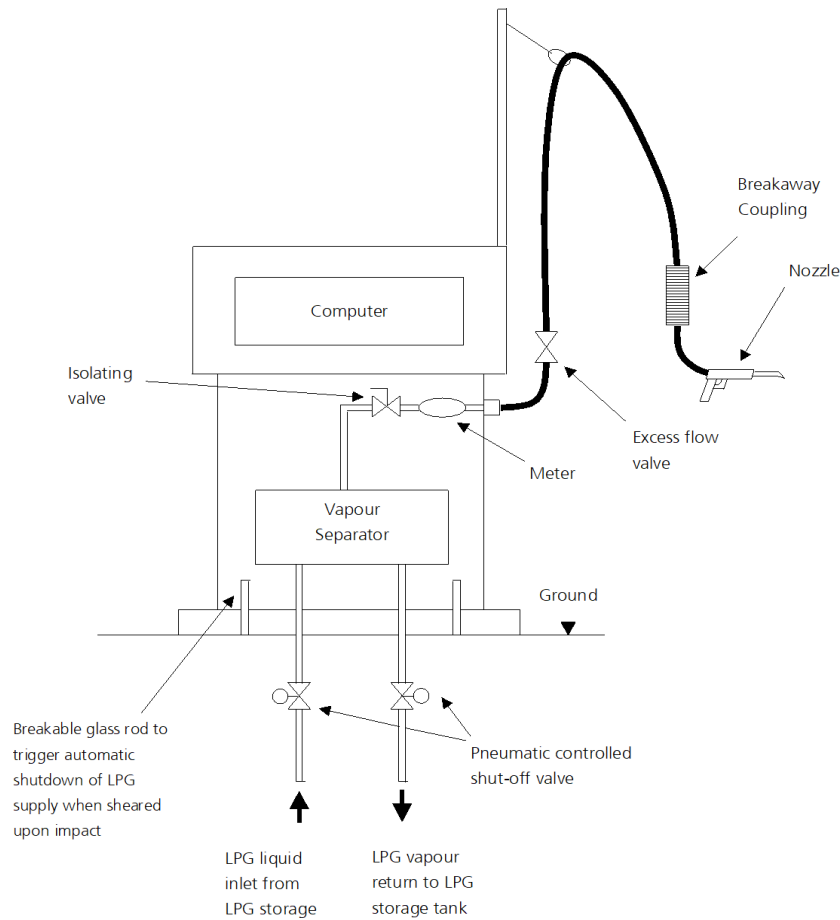
### Note

- The foregoing does not account for additional head of LPG above grade. Assuming a liquid spill, the height of the assumed layer above grade shall be added to the above calculation.
- S.G. = Specific Gravity

## Annex B: Schematic diagram for a typical LPG filling station



### Annex C: Schematic diagram for an LPG dispenser



### Annex D: Summary of tests, examinations and inspections

| Particular                 | Frequency of Test/Examination/ Inspection                                                                                                                                                                                                                                                                                                                                                                        | Examination/Test/ Inspection performed                                                                                                                                                                                                       | Reference                                                                  |
|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|
| Underground / mounded tank | i) At least once in the first 10- year period following initial use, and<br>ii) After expiration of the period referred to in paragraph (i), in the 5-year period immediately preceding continued use.<br>(Note: this 5-year period shall be counted from the date of the last test. If various tests are carried out on different dates, this is taken to be the date of certification by the Competent Person) | <ul style="list-style-type: none"> <li>Visual internal &amp; external examinations</li> <li>Hydraulic test</li> <li>Ultrasonic thickness test</li> <li>Magnetic particle test</li> <li>Paint thickness test</li> <li>Holiday test</li> </ul> | 8.3.1,<br>8.3.2<br>6.3.2<br>6.3.1<br>6.3.1<br>5.2.1, 7.3.1<br>5.2.1, 7.3.1 |
| Tank bottom                | Annually                                                                                                                                                                                                                                                                                                                                                                                                         | <ul style="list-style-type: none"> <li>Draining of tank bottom</li> </ul>                                                                                                                                                                    | 8.4.22                                                                     |
| Dispenser                  | Annually                                                                                                                                                                                                                                                                                                                                                                                                         | <ul style="list-style-type: none"> <li>Leak Test</li> </ul>                                                                                                                                                                                  | 8.4.13                                                                     |

|                                                         |                                                                                                                                                                                                                                                 |                                                                                                                      |        |
|---------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|--------|
| Pressure relief valve                                   | 5 years<br>(Note: this 5-year period shall be counted from the date of installation of PRV if the installation date is within 2 years of the manufacture date; otherwise the 5-year period shall be counted from the PRV manufacture date)      | <ul style="list-style-type: none"> <li>Replaced/reconditioned</li> </ul>                                             | 8.3.4  |
| Cathodic protection system                              | 6 months                                                                                                                                                                                                                                        | <ul style="list-style-type: none"> <li>Functional test and inspection</li> </ul>                                     | 8.3.13 |
| Exposed pipework                                        | Annually                                                                                                                                                                                                                                        | <ul style="list-style-type: none"> <li>Visual/leak test</li> </ul>                                                   | 8.3.8  |
| Underground pipework                                    | i) At least once in the first 10- year period following initial use, and<br>ii) After expiration of the period referred to in paragraph (i), in the 5-year period immediately preceding continued use.                                          | <ul style="list-style-type: none"> <li>Hydraulic test and pneumatic test</li> </ul>                                  | 8.3.9  |
| Hydrostatic pressure relief valve                       | 10 years<br>(Note: this 10-year period shall be counted from the date of installation of HPRV if the installation date is within 2 years of the manufacture date; otherwise the 10-year period shall be counted from the HPRV manufacture date) | <ul style="list-style-type: none"> <li>Replaced</li> </ul>                                                           | 8.3.6  |
| LPG installation                                        | Annually                                                                                                                                                                                                                                        | <ul style="list-style-type: none"> <li>Inspection of site, equipment and maintenance records</li> </ul>              | 8.5.1  |
| Remote Emergency Shut-down System                       | Annually                                                                                                                                                                                                                                        | <ul style="list-style-type: none"> <li>Testing of remote shut- down system</li> </ul>                                | 8.4.20 |
| Gas Detection System                                    | Annually                                                                                                                                                                                                                                        | <ul style="list-style-type: none"> <li>Testing and calibration of gas detection system</li> </ul>                    | 8.4.21 |
| Electrical and Fire Service Installations and Equipment | Annually                                                                                                                                                                                                                                        | <ul style="list-style-type: none"> <li>Inspection, testing and maintenance of installations and equipment</li> </ul> | 8.3.14 |



Annex E: Hazardous Zone Classification for LPG Dispenser Installation

