SRI LANKA STANDARD 1196 : PART 4 : 2000
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CODE OF PRACTICE FOR
TRANSPORT, STORAGE AND HANDLING OF LPG
PART 4 : SAFE FILLING OF LPG CYLINDERS AT FILLING PLANTS

SRI LANKA STANDARDS INSTITUTION

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PART 4 : SAFE FILLING OF LPG CYLINDERS AT FILLING PLANTS

SLS 1196 : Part 4 : 2000

Gr.13

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SRI LANKA

Sri Lanka Standards are subject to periodical revision in order to accommodate the progress made by industry. Suggestions for improvement will be recorded and brought to the notice of the Committees to which the revisions are entrusted.

This standard does not purport to include all the necessary provisions of a contract.

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FOREWORD

This standard was approved by the Sectoral Committee on Liquefied Petroleum Gas Industry and was authorized for adoption and publication as a Sri Lanka Standard by the Council of the Sri Lanka Standards Institution on 2000-09-21.

The objective of this part of the Code of Practice is to give guidance on safe practices at LPG cylinder filling plants.

other parts of this code of Practice are as follows:

Part 1 : General provisions
Part 2 : Design installation and maintenance of bulk LPG storage at fixed installation
Part 3 : LP Gas piping system - Design and installation
Part 5 : Storage of full and empty LPG cylinders and cartridges
Part 6 : Use of LP gas in cylinders at residential premises
Part 7 : Transport of LP gas in cylinders by road, rail or on water
Part 8 : Safe handling and transport of LPG in bulk by road

The Sri Lanka Standards Institution gratefully acknowledges the use of the following publications, in the preparation of this code:

a) **Code of practice 12** - Recommendations for the safe filling of LPG cylinders at Depots - published by the Liquefied Petroleum Gas Association (UK).
b) Malaysian Standard **MS 830 : 1994** - Code of practice for the storage, handling and transportation of LPG.

1 SCOPE

This part of the Code of Practice applies to filling plants where cylinders are filled, stored and maintained. It also covers the filling of cylinders at consumers' premises for its own consumption. The bulk LPG storage required to supply cylinder filling is covered in Part 2 of this Code of Practice.

This part of the code does not cover the following :

a) the filling of aerosols and cartridges;
b) the transportation of cylinders outside the filling plant and the stowage of cylinders on road vehicles; and
c) the filling of LPG for automobiles.

NOTE

This code does not preclude the use of alternative designs, materials and methods where these could provide equivalent to better standard of safety to the satisfaction of authority having jurisdiction.

2 REFERENCES

BS 476	Test method and criteria or the fire resistance elements of construction
BSEN 1429	Transportable refillable welded steel cylinders for LPG-Periodic requalification
BS 5306	Parts 0 and 1 Guide for selection of installed systems and other fire equipment
BS 5345	Parts 1-7 Code of Practice for the selection, installation and maintenance of electrical apparatus for use in potentially explosive atmospheres
BS 5430 containers	Periodic inspection testing maintenance of transportable gas (excluding dissolved acetylene containers) Part 2 Welded steel containers of water capacity 1 l up to 130 l
BSEN 60079-10	Electrical apparatus for explosive gas atmosphere
SLS 712	Liquefied petroleum gas
SLS 785	Portable fire extinguishers - powder type
SLS 1172	Specification for hoses and hose assemblies for liquefied petroleum gas. Part 1 : Rubber hoses and hose assemblies. Part 2 : Composite hose assemblies. Part 3 : Flexible metallic hose assemblies.
SLS 1177	Filling ratios and developed pressures for liquefied petroleum gases.
SLS 1178	Transportable welded steel gas containers of 0.5 *l* up to 150 *l* water capacity for liquefied petroleum gas
SLS 1180	Pressure regulators and automatic changeover devices for liquefied petroleum gases
SLS 1184	Valve fittings for use with liquefied petroleum gas cylinders
SLS1196	Code of practice for transport,storage and handling of LPG Part 2 : Design, installation and maintenance of bulk LPG storage at fixed installations

3 DEFINITIONS

For the purpose of this standard the following definitions shall apply :

3.1 aerosols .and cartridges: Non-refillable transportable containers up to 2 litres capacity which may contain LPG only, or LPG in mixtures with other components.

3.2 cylinder : A transportable, refillable container suitable for use with LPG. (See **SLS 1178**).

3.3 filling plant: An establishment for the filling and maintenance of LPG cylinders, including bulk storage vessels, buildings and service areas.

3.4 LPG: Commercial butane and commercial propane to **SLS 712** and any mixtures thereof.

3.5 hazardous areas: Areas defined as in **BS 5345 : Part 2** and described in Appendix **A** of this Code of Practice, in which flammable atmospheres may be present.

3.6 volumetric filling: The filling of a cylinder with a fixed volume of LPG.

3.7 weight filling: The filling of a cylinder with LPG, controlled by weight.

4 PLANT AND EQUIPMENT

4.1 Site Layout and security

4.1.1 Filling plants shall be enclosed by a boundary fence. This fence shall be an industrial security fence, at least 1.8 m high and may include radiation or building walls for part of its length. The fence shall have at least two means of exit not adjacent to each other and these shall be kept clear at all times.

4.1.2 Access to Filling Plants shall be strictly controlled to ensure that the discipline of hazardous areas is observed and that casual access by members of the public is not permitted.

4.1.3 Within the boundary fence, areas shall be designated as safe, or hazardous in accordance with **BS 5345 : Part 2**. Details of this and the effects of area classification are given in **4.8** and Appendix **A**.

4.1.4 The site layout must be such that the hazardous areas can be kept free of all sources of ignition. This include matches, lighters, all naked flames, spark producing processes, spark ignition engines and intrinsically unsafe electrical equipment.

4.1.5 Elements of the filling plant which must be located outside the hazardous areas include all sources of ignition, such as flame fired boilers, welding and grinding units, smoking areas and parking areas for spark ignition vehicles.

4.1.6 Adequate warning signs shall be displayed to indicate 'hazardous' areas.

4.1.7 A wind direction indicator shall be provided for use in emergency situations. (See **12.2.2)**

4.2 Bulk storage and security

Reference shall be made to Part 2 of this Code of Practice: Design Installation and Maintenance of bulk LPG storage at fixed installations.

4.3 LPG Transfer pumps and compressors

4.3.1 The design of pumps and compressors, and the materials of construction shall be suitable for the grade of LPG handled and the service conditions including the maximum outlet pressure to which they may be subjected.

4.3.2 The available pressure head at pump inlets at maximum off-take rate under the most onerous operating conditions shall be adequate to ensure proper operation and avoid cavitation.

4.3.3 Positive displacement pumps must have a by-pass or other suitable protection against excessive pressure. Consideration shall be given to the design of the pump by-pass system to minimise heating of recirculated product which could yield to cavitation.

4.3.4 Consideration shall be given to the protection of pumps by suitable strainer/filter units.

4.3.5 Mechanical seals are preferable to packed glands.

4.3.6 Consideration shall be given to the provision of stop/start controls at the cylinder filling point.

4.3.7 Isolating valves and a safe system of venting and provision or positive isolation shall be provided at the inlet and outlet connections of pumps and compressors to facilitate maintenance.

4.3.8 All transfer pumps and compressors shall be installed and regularly maintained in accordance with the manufacturer's instructions.

4.3.9 All electrical equipment used shall be those suitable for use in the respective areas as classified in **4.8.**

4.3.10 Where belt drives are used they shall be anti-slip type.

4.4 Pipework and fittings

4.4.1 All pipework and fittings shall be in accordance with Part **3** of this Code of Practice.

NOTE

Remotely operated isolation valves shall be installed at the points where LPG lines enter filling buildings.

4.5 Filling buildings

4.5.1 Buildings which house filling equipment are classified as hazardous zone 1 and shall be treated as such.

4.5.2 The floor at which the filling is done may be at or above ground level, but not below. If the floor is above ground level, any spaces beneath the floor shall be open and without depressions, to ensure adequate natural ventilation.

4.5.3 If the buildings have two or more sides permanently open, no additional ventilation is required.

If the buildings have only one side open, then the wall opposite the opening must have low level ventilation spaces amounting to not less than 1.5 percent of that area of the wall.

Where shutters or similar devices are provided for weather protection on otherwise open sides, they must be kept fully open whilst cylinder filling is in operation.

If the building has no openable sides, then forced ventilation shall be provided together with floor level vents in the wall to the outside of the building, not less than 1.5 per cent of the total wall area. The extractor fans shall be interlocked with the LPG supply in such a way that filling cannot take place unless the fans are running.

4.5.4 The ground level area surrounding the filling building shall be free of pits and depressions.

4.5.5 Separation distances from filling buildings shall be as shown in Table **1**.

4.5.6 All parts of the building structure shall have two hours fire resistance to **BS 476 : Part 20.**

TABLE 1- Separation distances from filling buildings

Reference feature	**Distance (m)**
Non-controlled area or buildings, boundary or fixed source of ignition.	15
Above ground bulk storage tanks	
Up to 4 tonnes	7.5
Up to 60 tonnes	10
Over 60 tonnes	15
Valve assemblies or other exposed features of buried or mounded bulk storage tanks	
Upto 1 tonne	5
1.1 tonnes to 60 tonnes	7.5
61 tonnes to 150 tonnes	11
over 150 tonnes	15

4.6 Hoses

All hoses for the transfer of LPG in the liquid phase, including those used on cylinder filling shall comply to **SLS 1172** or any other equivalent standard. They shall have electrical continuity and those with wire braiding shall have the braiding in stainless steel.

4.7 Cylinder filling equipment

4.7.1 The design and selection of cylinder filling equipment shall take account of the range of cylinder sizes it is intended to fill and check.

4.7.2 The location of cylinder filling equipment shall take account of;

a) the need for good ventilation;
b) adequate separation between adjacent weighing platforms; and
c) clear access for empty cylinders moving to and full cylinders moving from the filling equipment.

4.7.3 Equipment shall be designed and built to operate such that cylinders are filled in accordance with the required quantity and tolerances.

4.7.4 Cylinders may be filled on equipment designed to fill by weight or by volume.

Cylinder filling by weight is the most widely used method. Filling by volume is generally employed on small cylinder sizes.

4.7.5 When filling by weight, the scales used for checking need to be approved by Weights and Measures Division of the Ministry of Trade or the relevant authority.

4.7.6 When filling by volume, the first stage equipment must remove residual liquid from the cylinder, usually by connection to a vacuum line. The second stage will dispense a measured volume of LPG, adjusted for temperature compensation.

4.7.7 The filling head shall be correctly designed to couple with the cylinder valve, with the amount of LPG released on disconnection kept to a minimum.

4.7.8 Equipment must be available to remove excess LPG in a safe manner immediately from any over filled cylinder found at checking. This is preferably done by connecting the cylinder to a vacuum installation.

4.8 Electrical installation and electrostatic hazard precautions

4.8.1 The selection, installation and use of electrical apparatus in hazardous areas shall be in accordance with the recommendations of **BS 5345 : Part 1 to Part 7.**

4.8.2 The areas detailed in Appendix **A** are classified according to the degree of probability that flammable concentrations of gas (or vapour) may arise. The hazardous area definitions are as follows:

Zone 0 - An area in which an explosive gas-air mixture is continuously present, or present for long periods;

Zone 1 - An area in which an explosive gas-air mixture is likely to occur in normal operation; and

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

By implication an area which is not classified as zone 0,1 or 2 is deemed to be non-hazardous or safe with respect to the selection of electrical apparatus.

4.8.3 The boundary of the hazardous area shall be clearly marked. There shall be no source of ignition, including prohibition of smoking, any spark or flame producing process or spark ignition vehicles within any hazardous area.

4.8.4 All electrical apparatus for use in classified zones must have certification by a recognized authority e.g BASEEFA, for the appropriate zone, gas group and temperature classification as detailed in **BS 5345 : Part 1 and part 2.**

4.8.5 All wiring and cables shall be in accordance with **BS 5345** : Part **1** Section **24**.

4.8.6 Maintenance shall be in accordance with **BS 5345** : Part **1** Section **33**.

4.8.7 The main electrical switch gear shall be installed outside the hazardous areas.

4.8.8 Consideration shall also be given to the following :

a) Residual Current Circuit Breakers (RCCBs);
b) high quality earthing for the electrical circuits. This shall be separate from earth connections on the storage vessels and pipework;
c) complete circuit breaks, i.e. isolation of all phases and the neutral of each item of equipment with the facility for locking in the 'off' position;
d) local start/stop switches suitable for the zones in which they operate;
e) emergency stop buttons, clearly identified, capable of shutting down all or part of the electrical circuits;
f) back-up generators with automatic start and circuit selection; and
g) forced ventilation of the switch gear room.

4.8.9 Consideration shall be given to Electrostatic Hazard Precautions:

a) pipelines, fittings and hoses conveying liquid LPG shall have electrical continuity and be effectively connected to earth;
b) all earthing points for the dissipation of static electricity shall have an electrical resistance to ground of not greater than 1×10^6 ohms.

4.9 Other Services

4.9.1 *Compressed air*

This is generally used for the operation of valves, filling equipment, air tools and emergency shutdown systems. Any shutdown device operating on air shall be a fail safe device i.e. in the event of air failure it moves to the safe position. The compressor shall be located in a non-hazardous area.

4.9.2 *Water*

This covers all water supplies from the mains but not include water supplied for fire fighting purposes.

Suitable personnel wash areas shall be provided adjacent to messing areas. In the event of corrosive chemicals being used , e.g. for cylinder maintenance, eye baths and safety sprays shall be provided.

The provision of toilets, washing and shower facilities shall comply with the requirements of the Factories Ordinance.

4.9.3 *Process water*

Any water used in plant processes shall be properly treated before letting off to external drains. Closed circuit systems shall be provided with suitable filters where necessary.

When water is used to purge cylinders, it shall come via a header tank and go into a separate draining system to allow any gas to separate out safely.

4.9.4 *Drains*

Drains that are installed in the hazardous areas shall be fitted with water traps and consideration shall be given to installing a full size interceptor at the property boundary. The design must minimise the chance of any leakage of gas in to drainage mains.

4.9.5 *Vacuum/venting installation*

Vacuum systems may be installed to evacuate cylinders containing air prior to gas charging. They can also be used to remove product from cylinders requiring maintenance, or from overfilled cylinders.

There are two types of vacuum systems to be considered:

a) that which deals with LPG vapour only ; and
b) that which deals with both liquid and vapour.

Type (a) can be relatively simple with the air or vapour being passed through the pump and vented via a vent stack at a safe location.

Type (b), the design of the system must consider;

a) selection of suitable vacuum pump capable of withstanding maximum vapour pressure and with suitable motor and drive arrangement;
b) installing a catch-pot to prevent liquid being drawn into the pump;
c) use of hoses and fittings suitable for maximum vapour pressure created by any liquid left in the system if the pump is turned off;
d) installation of hydrostatic relief valves where liquid may get trapped between shut-off valves.; and
e) installation of suitable pressure/vacuum gauges to monitor the pump performance.

For vapour only, an alternative system to vacuum is a free discharge into the inlet of an exhaust fan system, discharging into a suitable vent stack. (See Appendix **A** for separation distances)

A suitable vent stack shall be fitted with a flame arrestor and be designed to ensure that any vapour is diluted to less than 25 per cent of the lower explosion limit before reaching ground level or any source of ignition.

If vapour is to be flared, specialist advice shall be sought.

4.9.6 *Inert gas supplies*

These may be provided as nitrogen in cylinders under pressure as back up for pneumatic control equipment, or for purging. The cylinder pressure is upto 20 MPa and suitable pressure regulators and associated equipment must be used.

4.9.7 *Steam heating*

Steam heating may be used as a safe means of heating within hazardous areas.

Live steam may be used for gas freeing of cylinders.

Where steam boilers are flame fired, they shall be sited outside hazardous areas.

5 CYLINDER FILLING OPERATIONS

5.1 General

5.1.1 Only the cylinders manufactured to comply with **SLS 1178** or any other equivalent standard shall be used for gas filling.

5.1.2 The cylinders to be filled shall have a certificate fitness issued by a competent authority.

NOTE

This regulation is not yet framed but could be possible in the near future.

5.2 Inspection and segregation of cylinders

All cylinders received into the Filling Plant must be inspected and segregated into categories. This is laid out as a flow diagram in Appendix **B**, and described in the paragraphs below.

5.2.1 Cylinders without authority for filling/maintenance. These should be referred to appropriate owner/filler.

5.2.2 Cylinders due for periodic inspection and testing. (See **7.1).**

5.2.3 Faulty or defective cylinders including those with damaged valves, shrouds, carrying handles, foofings, dented or fire damaged cylinders. (See **7.2).**

5.2.4 Cylinders with incomplete markings or labeling or cylinders with unacceptable surface finish.(See **7.3**)

5.2.5 Cylinders with air content, i.e. new cylinders or maintained cylinders which have air content. (See **8**)

5.2.6 Cylinders fit for filling.

5.3 Cylinder filling

5.3.1 *Before commencing filling operations*

5.3.1.1 All personnel carrying out the filling operation must have received the level of training required to make them competent to carry out all duties expected of them efficiently and safely, including a sound understanding of the plant operating procedures and site evacuation plan.

5.3.1.2 A visual check of the filling plant, storage area and compound must be carried out, looking for any unusual or potentially dangerous situations. Operations shall not commence until it is safe to do so.

5.3.1.3 The correct product line must be connected for the cylinders to be filled.

5.3.1.4 The scales used for check weighing must have been approved by Weights and Measures Division of the Ministry of Internal Trade.

5.3.1.5 If ventilation fans are required and fitted, it shall be verified that such fans have started before commencing filling.

5.3.1.6 All operatives shall be wearing appropriate protective clothing. A list of the recommended protective clothing is given in Appendix **C**.

5.3.2 *While filling cylinders*

5.3.2.1 The necessary protective clothing shall continue to be worn throughout the filling operation.

5.3.2.2 For each batch of cylinders segregated as fit for filling it must be ensured that

a) all the cylinders in the batch are of the correct capacity and for the same grade of LPG;
b) the filling weight or volume for the size of cylinder is known.

5.3.2.3 Where cylinders are to be filled by volume, these must be completely emptied of any liquid before being sent for filling.

5.3.2.4 Where cylinders are filled by weight, care must be taken to ensure that the tare weight of each individual cylinder is correctly set on the filling scale, and the correct net fill weight is set.

5.3.2.5 Each time a cylinder is connected for filling care must be taken to ensure that the connection between the fill connector and the cylinder is correctly made.

5.3.2.6 Any fault developing or becoming apparent while filling is in progress, must be attended to immediately, and the filling operation stopped if the fault is judged by the operator as a potential hazard.

5.3.2.7 Reported faults must be inspected promptly by supervisory staff. It is recommended that a written log is maintained of all reported faults and the action taken thereon.

5.3.2.8 The number of full and nominally empty cylinders within the filling building shall be kept to a minimum.

5.3.3 *Post fill operations*

5.3.3.1 After filling, and before other finishing operations, each cylinder shall be check weighed for correct fill within the appropriate tolerance.

5.3.3.2 Under-filled cylinders if any shall be returned for correct filling. Over-filled cylinders shall be made safe immediately by the removal of the excess product in a safe manner. (See **4.9.5**).

5.3.3.3 If there is reason to suspect the presence of air in the cylinder, it shall be checked e.g. by noting the vapour pressure. If air is indicated it shall be removed it shall be removed through a suitable venting system. (See **4.9.5**).

5.3.3.4 Cylinders shall be checked for absence of leakage from any source, including valves and fittings. Leaking cylinders shall be made safe immediately. For clip-on valves, a test shall be included to test the seal between the valve and the regulator/connector. Faulty seals must be replaced.

5.3.3.5 All appropriate labels, valve sealing caps or plugs and valve protection caps shall be fitted prior to despatch.

5.3.4 *Fill plant shut down*

At the conclusion of filling operations, carefully follow the operating procedure to shut down the plant, giving special attention to the closure of valves, etc.

6 CYLINDER LABELING

6.1 Marking

6.1.1 The following information shall be legibly and indelibly marked on the filled LPG cylinders before despatch :

a) type of LPG supplied;
b) name and address/registered trade mark of the supplier;
c) precautionary and safety advice applicable; and
d) any other markings imposed by legislation.

6.1.2 The cylinder shall also be marked with the caution label '**flammable gas**' together with the corresponding symbol for labeling dangerous goods. (See Figure **1**)

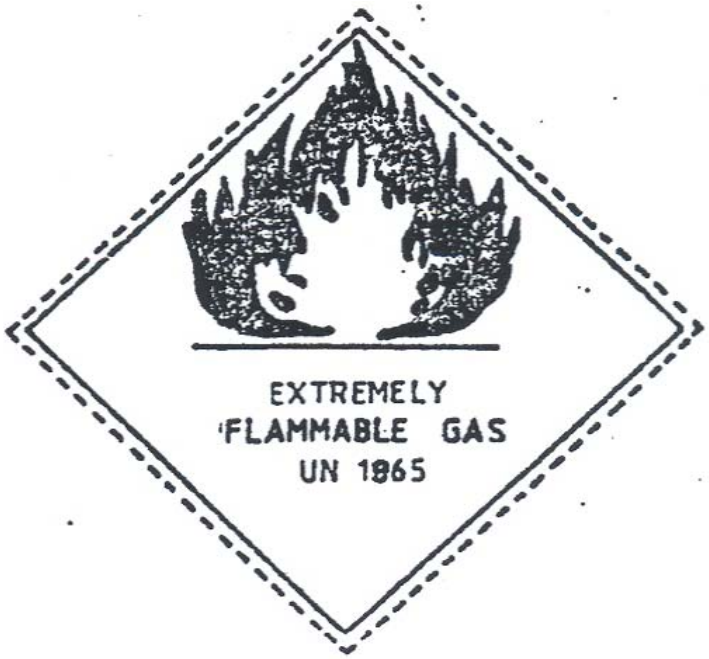

FIGURE 1 - Pictorial marking for "flammable gas"

7 CYLINDER MAINTENANCE OPERATIONS

7.1 Periodic examination and testing

Periodic examination and testing of cylinders shall be carried out in accordance with **BS 5340 : Part 2** or other written industry standard approved by a competent person ensuring an adequate level of safety.

7.2 Treatment of defective cylinders

7.2.1 Reference shall be made to **BS 5430 : Part 2** for rejection limits relating to physical and other faults on defective cylinders segregated in accordance with **5.1.3.** Cylinders which are considered unsuitable for further service shall be completely emptied, gas freed and destroyed as specified in **BS 5430 : Part 2.**

7.2.2 For repairs involving welding and/or de-denting or any other hot work, cylinders shall be de-pressurised to atmospheric pressure and gas freed. All such hot work repairs shall be referred to cylinder reconditioning specialists. After satisfactory repair and hydrostatic test the cylinders shall have a new or reconditioned valve fitted and have the valve-bung joints checked for leaks.

7.2.3 For other defects requiring the removal and/or replacement of valves or internal fittings, cylinders shall be de-pressurised to atmospheric pressure, the contents being discharged in a safe manner. (See **4.9.5**) This shall be carried out in a designated zone 1 or otherwise the cylinders shall be fully gas freed.

7.2.4 For minor defects not covered by **7.2.2** or **7.2.3** the necessary repairs shall be carried out in a safe manner deemed suitable.

7.3 Surface treatment and cleaning of cylinders

7.3.1 Cylinders with surface rust or deposits that cannot be removed by other cleaning methods, and which require complete surface treatment, shall be de-valved, gas freed and plugged prior to being shot blasted, metal sprayed if required, painted and re-valved in accordance with **7.2.2.**

7.3.2 It is not necessary to de-valve or gas free cylinders segregated in accordance with **5.1.4** requiring only cleaning or repainting provided that the valves are closed and suitably protected. Where heat is used during the washing or drying process, care must be taken to ensure that cylinders are not overheated to the extent that excessive internal pressure could develop.

7.3.3 LPG cylinders shall be painted in red or blue.

8 GAS CHARGING OF CYLINDERS

All cylinders known to contain, or suspected to contain air, (i.e. new, reconditioned or re-valved cylinders) must have the air removed and replaced with LPG vapour before being filled with LPG. Failure to properly gas charge cylinders in vapour or liquid off take duty can give rise to safety problems due to instability of combustion in user equipment.

The method used must not create flammable atmospheres in uncontrolled situations. Two methods described below are considered satisfactory.

(a) using a vacuum pump suitable for handling LPG/air mixtures, which discharges through a vent stack.

Evacuate the cylinder and then charge it with LPG vapour to a positive pressure. Repeat the evacuation/gas charge cycle if necessary. An example of a suitable cycle of operations is as follows:

Evacuate to 32 kPa absolute
Gas charge to 35 kPa gauge; and
Repeat the evacuation and gas charge.

(b) inject a quantity of liquid LPG into the cylinder. Vent the cylinder to an evacuation system with sufficient volume of air to dilute the LPG vapour to below the lower explosive limit at the high level discharge point. No electrical equipment shall be installed in the extraction system. An example of suitable cycle of operations is as follows:-

Inject 1.0 kg of LPG per 30 litres of cylinder capacity and vent for 2 minutes.

The operator must monitor the process to ensure that the quantity of liquid and the time of venting gives adequate gas charging.

The system shall be designed to ensure adequate air flow for dilution of the contents of the maximum number of cylinders being vented at any one time.

Suitable venting systems are described in **4.9.5.**

9 BULK TRANSFER

9.1 General

9.1.1 The information in this section is specific to road tanker transfer operations.

9.1.2 Appropriate protective clothing must be worn by all persons involved in the transfer operation as recommended in Appendix **C**.

9.1.3 All site personnel involved in bulk transfer operations must have received the level training required to carry out all duties expected of them competently and safely.

9.1.4 The off loading operation must be under the control of a competent person.

9.1.5 Deliveries outside daylight hours must only be carried out where adequate, safe, artificial lighting is provided.

9.1.6 The tanker escape route and/or emergency vehicle access must be kept clear of parked vehicles or other obstacles.

9.1.7 Note shall be taken of regulations governing conveyance of inflammable or dangerous substances on road.

9.2 Before commencing off-loading

Ensure that the supervisor of operations knows the location of emergency pump isolators, shut-off valves, alarm buttons or other safety devices likely to be used in the event of an emergency and is familiar with the site emergency procedures. There shall be at least two persons on site during a tanker discharge.

9.3 Product Transfer

Product transfer shall be carried out in accordance with the appropriate section of the **SLS 1196 : Part 2.**

10 PLANT MAINTENANCE

10.1 A comprehensive schedule of inspection and maintenance shall be drawn up covering the entire installation. This shall generally be based on the recommendations of **10** of **SLS 1196 : Part 2**. 'Inspection and Examination', and manufacturers instructions. It should include preventive maintenance and periodic inspections.

11 FIRE PROTECTION

11.1 Provision shall be made for adequate supplies of water for fire protection.

11.1.1 Consultations shall take place with the local Fire Authority with regard to the overall water requirement and the minimum duration of any onsite emergency water storage and pumping facility.

11.1.2 Consideration shall be given at the plant design stage to the means of application of water to the following areas;

a) bulk storage vessels (fixed drenching). (See **SLS 1196 : Part 2**);
b) road tanker off loading (fixed drenching recommended where frequent bulk deliveries occur). (See **1196 : Part 7**);
c) cylinder filling points (fixed drenching recommended); and
d) cylinder storage areas (hoses and/or monitors).

11.1.3 Fixed drenching systems may be manually or automatically operated.

Manually operated valves, positioned in safe locations, shall be included in automatic systems too, to ensure that water could be directed to those areas of obvious risk.

Galvanised piping shall be employed throughout, with underground pipework further protected with protective wrapping.

The entire fire protection system shall be tested at intervals of not more than three months to ensure correct operation.

11.1.4 Connection points for fire brigade appliances shall be provided at safe locations in the water supply pipeline to fixed drenching systems.

11.1.5 Systems used for protection of LPG bulk storage vessels, road tankers and cylinder storage areas shall be capable of discharging water at a rate sufficient to maintain an adequate film of water over the entire surface of the vessels and supports or to stored cylinders under fire conditions. The recommended minimum drenching density is 7 litres per minute per square metre of vessel surface area. To achieve this application density, fixed spray systems shall be designed to discharge 9.8 l/sq.m/minute.
(See **SLS 1196 : Part 2**)

The recommended drenching rate for application on cylinder filling points shall be not less than 7.5 l/sq.m/minute over the required floor area.

11.1.6 Hydrants, where provided, shall be readily accessible at all times and so spaced as to provide adequate protection to areas not otherwise protected. Sufficient lengths of fire hose fitted with standard couplings shall be provided to equip the outlet of each hose

line with a combination jet and spray nozzle. For details of hydrants, standard fire hose couplings and ancillary equipment reference could be made to **BS 5306 : Parts 0 & 1.**

11.2 First aid fire extinguishers

A sufficient number of first aid transportable fire extinguishers of adequate size and suitable for LPG fires shall be provided at strategic locations. The use of dry powder fire extinguishers to **SLS 785** is recommended.

11.3 Alarm systems

11.3.1 An alarm system could be initiated manually, electrically, pneumatically or hydraulically.

11.3.2 The purpose of an alarm is two fold; firstly to indicate to those responsible for the plant at the earliest possible moment that a fault may exist, and secondly to give those working in the plant or storage area the maximum amount of time to evacuate.

11.3.3 The alarm shall be clearly audible over the area to be evacuated, and every employee must be familiar with the sound and understand the action to be taken if the alarm is activated.

11.3.4 Alarms can be activated automatically by sensing devices and/or manually. The manual initiation points shall be carefully positioned so that a point can be easily reached from all areas of the plant or storage area at least on point shall be located outside the plant and storage areas manual activation points must be clearly marked and the method of operation simple and obvious.

11.3.5 Audible alarms shall be subject to a weekly check, each being recorded and witnessed in a log book.

12 EMERGENCY PROCEDURES

12.1 LPG filling plants are industrial major accident hazard areas, and must have adequate emergency procedures.

Irrespective of the total LPG inventory, an on-site emergency procedure is required and where the declared inventory is 200 tonnes or more, an off-site emergency plan is also required. The off-site plan is the responsibility of the local authority and shall be prepared in conjunction with the site occupier.

12.2 On site emergency procedure

12.2.1 The procedure shall identify the hazards and risks applicable to the site and shall detail action deemed necessary to ensure the safety of personnel, the minimizing of damage to plant and property and minimizing effects on third parties.

12.2.2 Consideration should be given to the types of emergency that could occur and account shall be taken of the areas likely to be effected. Particular attention should be paid to the effect of the wind direction and strength and effect these may have on the spread of vapour or fire.

12.2.3 Emergency alarms, as defined in **11.3** shall be the means of alerting all personnel on site when an emergency situation arises.

12.2.4 A member of staff with a thorough knowledge of the site processes and associated hazards shall be nominated as Emergency Controller. A deputy shall also be appointed to take charge in the absence of the Emergency Controller.

The Emergency Controller shall wear a distinctive garment, e.g. a bright coloured luminous jacket and helmet to make it easy to identify him.

12.2.5 The duties of the Emergency Controller shall include the following :

a) locate the incident and assess situation;
b) ensure Fire Brigade or other services are contacted if necessary;
c) observe wind direction and condition;
d) initiate local response where possible using authorised personnel; and
e) hand over control to Emergency Services on arrival.

12.2.6 All other personnel shall evacuate to a predetermined assembly point in a safe area. A person should be appointed to supervise evacuation and ensure that all persons on site are accounted for.

12.2.7 An Emergency Control Centre shall be set up in a safe zone from where operations can be safely directed.

12.2.8 *Emergency actions*

12.2.8.1 Anyone discovering a fire that cannot be immediately put out, or major leakage of LPG, an explosion or other serious emergency, should operate the nearest alarm.

12.2.8.2 If there is a plant emergency stop button adjacent, this should be actuated.

12.2.8.3 On arrival of the Emergency Controller, give details of the incident and render assistance as directed.

12.2.8.4 The emergency alarm invalidates all work permits. These may only be reauthorised after the all clear and return to work has been established.

12.2.8.5 Any tanker driver shall stop filling or discharging operation. If considered safe to do so, disconnect the tanker and remove it to a safe location. Otherwise, switch off engine and emergency valves and proceed to assembly point.

12.2.8.6 No return to work shall be permitted until authorised by the Emergency Controller.

12.2.8.7 These emergency procedures shall be practiced at regular intervals and recorded.

13 TRAINING

13.1 Personnel involved in cylinder filling, handling and distributing shall be trained to a level commensurate with their involvement with the products and should have a clear understanding of the following:-

a) emergency procedures relevant to situations that may arise in the course of their work. (See **12**.);

b) product identification, properties and hazards; and

c) basic knowledge of cylinders including handling and operation of container valves, safety devices and the purpose of valve protection guards and caps.

13.2 Special requirements

In addition to **13.1** above, personnel involved in inspecting and testing of LPG cylinders shall be trained to have a good practical knowledge of the operations they are required to perform and an understanding of all equipment and products they are handling.

13.3 Operating procedures

All processes and operations relating to the handling and processing of LPG shall be properly documented and written procedures available to relevant personnel.

13.4 Personnel training records

A formal training record shall be maintained for each employee, detailing the training and information they have received.

APPENDIX A

AREA CLASSIFICATION

This table shows the application of area classification as specified in **BS 5345 : Part 2** to the main elements of Filling Plants.

TABLE 2 - Application of area classification

Elements of Plant (1)	Extent of Classified Area (2)	Area Classification (3)
Cylinders in the open air	In the storage place upto a height of 1.5 m above the top of the stack or beneath any roof over the storage place	Zone 2
	Outside the storage area or the space covered by any roof upto 1.5 m above ground level and decreasing uniformly to zero within the distance set out for a fixed source of ignition as shown in Table 2.	Zone 2
Cylinders within a building	a) Within the building	Zone 2
	b) Outside any doorway, low level ventilators or any opening into the store upto 1.5 meter above ground level and decreasing to uniformly to zero within the distance set out for a fixed source of ignition as shown in Table 2.	Zone 2
Storage tanks	a) Within 1.5 m from the discharge orifice of liquid level detection devices, e.g. fixed liquid level.	Zone 1
	b) Up to 1.5 m above ground level and decreasing to zero uniformly within the distance set out for a fixed source of ignition as shown in Table 3.	Zone 2

Table 2 – Application (continued)

Elements of plant (1)	Extent of classified area (2)	Area classification (3)
Relief valve discharge	a) Within direct path of discharge. b) Within 1.5 m in all other directions from point of discharge. c) Beyond 1.5 m but within 4.5 m (3 m in the case of tanks of water capacity not exceeding 2500 litres) in all other directions from point of discharge.	ixed electrical equipment shall not be istalled. Zone 1 Zone 2
Tank for product transfer vehicle connection	a) Within 1.5 m in all directions from a point where connections are regularly made or broken for product transfer. b) Beyond 1.5 m but within 4.5 m from point of connection or disconnection.	Zone 1 Zone 2
Pumps, compressors and vaporisers other than direct fired a) Outdoor in open air at or above ground level b) Indoor location with adequate ventilation	 a) Within 1.5 m in all directions b) Beyond 1.5 m but within 4.5 m in all directions Entire room and any adjacent room not separated by a vapour-tight partition	 Zone 1 Zone 2 Zone 1
Vent Stack	a) Within direct path of discharge b) Within 1.5 m in all other directions c) Beyond 1.5 m but within 4.5 m in all other directions from the point of discharge	Zone 0 Zone 1 Zone 2

TABLE 2 - (Concluded)

Elements of plant **(1)**	**Extent of classified area** **(2)**	**Area classification** **(3)**
Cylinder Filling Points		
a) Indoor location	Entire room	Zone 1
	Outside room to within 15 m of filling room	Zone 2
b) Outdoor location	Within 1.5 m of filling point	Zone 1
	Within 16.5 m of filling point	Zone 2
Cylinder Maintenance Room	Entire room	Zone 1
	Within 7.5 m of maintenance room	Zone 2

TABLE 3 - Minimum separation distances for open air storage

Total LPG Storage **kg** **(1)**	**Minimum Separation distance to boundary building or fixed ignition source from the nearest cylinder (with no radiation walls).** **m** **(2)**	**Minimum Separation distance to boundary building or fixed ignition source from the radiation wall (where provided)** **m** **(3)**	**Size of stack** **kg** **(4)**
Up to 400	1	nil	400
400 - 1,000	3	1	1,000
1,000 - 4,000	4	1	1,000
4,000 - 6,000	5	1.5	3,000
6,000 - 12,000	6	2	3,000
12,000 - 20,000	7	2.5	7,000
20,000 - 30,000	8	3	9,000
30,000 - 50,000	9	3.5	9,000
50,000 - 60,000	10	4	10,000
60,000 - 100,000	11	4.5	10,000
100,000 - 150,000	12	5	20,000
150,000 - 250,000	15	6	30,000
Above 250,000	20	7	30,000

NOTE

Unless they have been gas-freed, or have never been charged with LPG, empty refillable cylinders should be treated in the same way as full ones. This could be relaxed if storage areas for empty cylinders are clearly identified and separated from the storage areas for full cylinders.

TABLE 4 - Distances from buildings, boundaries and sources of ignition - for above ground vessels

Maximum water capacity			Minimum separation distances		
Of any single vessel in a group		Of all vessels in a group	Above ground vessels		
Litres	Nominal LPG capacity (tonnes)	Litres	From building boundary, property line or fixed source of ignition (a)	With fire wall (b)	Between vessels (c)
(1)	(2)	(3)	(4)	(5)	(6)
150 to 500	0.05-0.25	1,500	2.5	0.3	1
>500 to 2,500	0.25 to 1.1	7,500	3	1.5	1
>2,500 to 9,000	1.1 to 4	27,000	7.5	4	1
>9,000 to 135,000	4 to 60	450,000	15	7.5	1.5
>135,000 to 337,500	60 to 150	1,012500	22.5	11	1/4 of sum of the
>337,500	150	2,250000	30	15	dia. of 2 adj. vessels

TABLE 5 - Distances from buildings, boundaries and sources of ignition for buried or mounded vessels

Maximum water capacity			Minimum separation distances m		
Of any single vessel in a group		Of all vessels in a group	Buried or mounded vessels		
Litres	Nominal LPG capacity (tonnes)	Litres	From buildings etc. to valve assembly(d)	From buildings etc. to vessel (e)	Between vessels (f)
(1)	(2)	(3)	4)	(5)	(6)
150 to 500	0.05 to 0.25	1,500	2.5	0.3	0.3
>500 to 2,500	0.25 to 1.1	7,500	3	1	1.5
>2,500 to 9,000	1.1 to 4	27,000	7.5	3	1.5
>9,000 to 135,000	4 to 60	450,000	7.5	3	1.5
>135,000 to 337,500	60 to 150	1,012,500	11	3	--
>337,500	150	2,250,000	15	3	--

APPENDIX B

FLOW DIAGRAM FOR CYLINDER FILLING

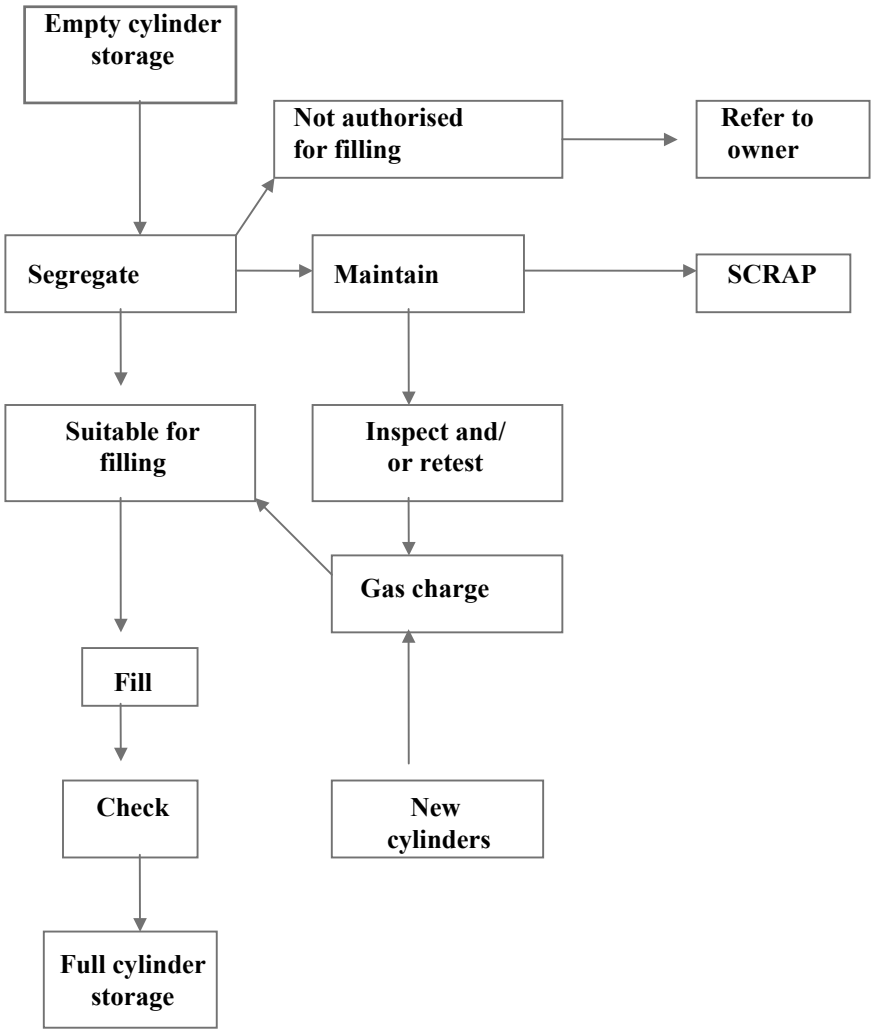

FIGURE 2 - Flaw diagram for cylinder filling

APPENDIX C

RECOMMENDED PROTECTIVE CLOTHING

Protective clothing shall be worn by personnel working in filling plants to minimise the risk of accident or injury.

All clothing worn must be anti static to minimise the risk of inducing sparks. Fabrics such as nylon shall not be worn as these can increase the severity of burns in case of fire.

Protective footwear with covered impact resistant toe-caps shall be worn by all personnel. There shall be no steel tips on sole or heels.

Gloves to resist cold burns shall be worn by all relevant personnel, e.g. those involved in bulk transfer or filling of LPG. Eye protection is also recommended for such operations.

In addition to these specific items, good industrial practices shall be followed to reduce risks.

SLS CERTIFICATION MARK

The Sri Lanka Standards Institution is the owner of the registered certification mark shown below. Beneath the mark, the number of the Sri Lanka Standard relevant to the product is indicated. This mark may be used only by those who have obtained permits under the SLS certification marks scheme. The presence of this mark on or in relation to a product conveys the assurance that they have been produced to comply with the requirements of the relevant Sri Lanka Standard under a well designed system of quality control inspection and testing operated by the manufacturer and supervised by the SLSI *which includes surveillance inspection of the factory, testing of both factory and market samples.*

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