

GUIDANCE NOTE ON STORAGE OF DISPOSABLE LPG CYLINDERS IN STORES OTHER THAN RETAIL OUTLETS

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1. DEFINITIONS

- 1.1 'Basement' is any storey of a building or any compartment with four walls wholly or partially below the level of the street or streets on which such building abuts.
- 1.2 'Bulk storage of disposable LPG cylinders' refers to storage of disposable LPG cylinders in a place (including part of any premises) where the aggregated nominal water capacity of the cylinders is more than 130 litres.
- 1.3 'Competent person' is a person who is competent to carry out inspections on the store by virtue of his practical and theoretical training and actual experience.
- 1.4 'Dangerous goods store (D.G. Store)' is a store licensed by the Fire Services Department for storage of dangerous goods.
- 1.5 'Disposable LPG cylinder' is a receptacle which is not constructed or intended to be refilled with LPG after once containing such gas, and includes an aerosol can.
- 1.6 'Fire compartment' is an enclosed space in a building that is separated from all other parts of the building by enclosing construction providing a fire separation that may be required to have a fire resistance rating.
- 1.7 'Fire resistance rating' is the period for which the element of construction is capable of resisting the action of fire when tested in accordance with BS 476.
- 1.8 'Gas Authority' is the Director of Electrical and Mechanical Services and is appointed by the Government to promote and provide for the implementation of safe working practices for and in relation to, amongst others, the storage and transport of LPG.
- 1.9 'Ignition source' is one that is sufficient to start an ignition. This includes heat, a flame, a spark and static electricity.
- 1.10 'Liquefied petroleum gas (LPG)' includes propane, propylene (propene), butane, isobutane, butylene (butene), isobutylene (isobutene), and mixtures thereof.
- 1.11 'Retail outlet' is an area that is open to the public for the purpose of viewing and purchasing goods, wares and merchandise.

1.12 'Store', if not preceded by 'dangerous goods', means any place (including part of any premises) where LPG cylinders are kept, and the aggregated nominal water capacity of the cylinders exceeds 130 litres.

1.13 'Water capacity' is the capacity of a cylinder measured in terms of the volume of water it can contain.

2. OBJECTIVES

This guidance note has been prepared as a general outline of minimum safety standards to be followed by owners and operators of stores (other than retail outlets) keeping disposable LPG cylinders in bulk so as to ensure, in carrying on their business, the health and safety at work of their employees and to conduct their operations in a safe manner so that members of the public are not exposed to undue risks.

3. APPLICABILITY

This guidance note shall be applicable to bulk storage of disposable LPG cylinders each with a water capacity of less than 1.4 litres (l) in existing as well as any new stores other than retail outlets* in Hong Kong. Disposable LPG cylinders include those containing 100% LPG such as stove cartridges, cigarette lighters, and lighter refills; as well as cylinders with partial LPG content which mainly include aerosol cans.

Types and quantity of storage		Location of Storage	
		Stores Other Than Retail Outlets*	Retail Outlets
Storing a combination of any types of disposable LPG cylinders with an aggregated storage water capacity greater than 130 l		This guidance note	Guidance Note on Storage of Disposable LPG Cylinders in Retail Outlets
Storing disposable LPG cylinders with an aggregated water capacity less than or equal to 130 l	LPG cartridges for portable gas appliances	--	Gas Utilisation Guidance Note GU08 – Minimum requirements for the storage and display of LPG disposable cylinders (cartridges) at retail outlets
	Other types of cylinders	--	Guidance Note on Storage of Disposable LPG Cylinders in Retail Outlets

* 'Stores Other Than Retail Outlets' include warehouses, dangerous goods stores and back stores at retail outlets.

4. SCOPE

This guidance note stipulates the legal and technical requirements for bulk storage of disposable LPG cylinders in stores other than retail outlets. While the legal requirements which the note refers to are mandatory, the technical requirements as set out in the note shall serve as guidelines for designing and operating stores in the interests of gas safety.

5 REQUIREMENTS FOR BULK STORAGE OF DISPOSABLE LPG CYLINDERS

5.1 Legal Requirements

5.1.1 Construction and use approval of store

Prior to the construction and use of a store for bulk storage of disposable LPG cylinders with an aggregated water storage capacity in excess of 130l, an application to the Gas Authority shall be made for construction and use approval respectively in accordance with the Gas Safety (Gas Supply) Regulations. In the event the actual LPG storage quantity exceeds 25,000 kg, an application shall be made in accordance with Chapter 11 of the Hong Kong Planning Standards and Guidelines as well.

5.1.2 Annual inspection of store

The owner of an approved store shall ensure that the store is inspected annually by a competent person in accordance with the Gas Safety(Gas Supply) Regulations.

5.2 Technical Requirements

5.2.1 Identification of disposable cylinders containing LPG

The owner of a store shall have the duty to identify and sort out disposable cylinders kept in his store which contain LPG by such means as information on the labels of individual cylinders, material safety data sheets, etc.; to distinguish cylinders with 100% LPG and those with partial LPG; and to maintain a database of the cylinders accordingly.

It is recommended the owner shall also identify any hazardous or combustible ingredients other than LPG inside the cylinders.

5.2.2 Aggregated storage quantity

- (a) The following table shows the maximum allowable aggregated LPG storage quantity (in terms of aggregated net weight or aggregated water capacities of disposable LPG cylinders) in a fire compartment of a store under various conditions: (Note: the other conditions set out in this Guidance Note need to be satisfied also.)

<i>Location of Store</i>	<i>Provision of Fire Services Installations *</i>	<i>Max. Allowable Storage Quantities</i>
<i>In a Basement</i>	<i>-</i>	<i>None is allowed</i>
<i>At Street Level, Or on Upper Floors of Floor Height \leq 30 m from Surrounding Street or Area with Vehicular Access</i>	<i>With a Sprinkler System Or Other Approved Automatic Fire Protection System</i>	<i>< 25,000 kg in terms of aggregated net weight of disposable LPG cylinders</i>
	<i>Without a Sprinkler System Or Other Approved Automatic Fire Protection System</i>	<i>< 5,000 kg in terms of aggregated net weight of disposable LPG cylinders</i>
<i>On Upper Floors of Floor Height > 30 m from Surrounding Street or Area with Vehicular Access</i>	<i>With a Sprinkler System or Other Approved Automatic Fire Protection System</i>	<i>\leq 130l in terms of aggregated water capacities of disposable LPG cylinders</i>
	<i>Without a Sprinkler System or Other Approved Automatic Fire Protection System</i>	<i>\leq 130l in terms of aggregated water capacities of disposable LPG cylinders</i>

* *Fire services installations are those which meet the minimum requirements specified by the Fire Services Department*

- (b) Where the storage quantity in a fire compartment is in excess of the applicable allowable quantity as set out above, or where the aggregated storage level within a building exceeds 25,000 kg, a quantitative risk assessment (QRA) may be required to be carried out to demonstrate that associated risks are acceptable and a safety management system shall be in place.
- (c) Where a sunken compartment is used for storage, this shall be limited to a maximum depth of 0.3 m with a requirement that low level mechanical ventilation must be provided. This allowable limit shall only apply to existing stores while for new stores, no sunken compartment shall be allowed.

- (d) The amount of storage of stove cartridges, cigarette lighters and cigarette lighter refills together in a general warehouse shall be limited to 10% of the max. allowable quantities specified in Section 5.2.2 (a).

5.2.3 Store location

- (a) The store shall be located away from populated or habitable areas as far as practicable. A separation distance of at least 3 metres from the storage place is recommended. A wall, roof or floor with a fire resistance rating of at least 2 hours could serve as a separation barrier. The store shall also be situated in a location which is well ventilated.
- (b) Where cylinders comprise mainly those containing 100% LPG, the store shall be located against at least one outside wall of the building.
- (c) Where cylinders comprise mainly those containing partial LPG, it is recommended the store be located against at least one outside wall of the building.
- (d) It is recommended that the store be situated on ground floor. However, the store can be located at an upper floor provided that it is readily accessible for transportation, fire extinguishing and rescue purposes. In any case, the store shall not be located more than 30 metres above the surrounding street level or an area with vehicular access.
- (e) The store shall not be located in a basement and any place where accumulation of any leaked LPG is possible.
- (f) Bulk storage of disposable LPG cylinders in buildings which include residential accommodation shall not be allowed in general.
- (g) The store shall be at least 3 metres away from any ignition sources including naked flame and hot work.
- (h) The store shall not be located in such areas as exits where it would defeat the purpose of safe egress of people.
- (i) Disposable LPG cylinders shall not be located in the same room where there is battery charging. Otherwise, a

separation distance of at least 6 meters between the storage and charging area is recommended.

5.2.4 Store layout

- (a) Aisles for access and escape shall be clearly demarcated on floor and free of storage. Where a store does not have any fork lift truck operation, a width of no less than 1.2 metres is required. Otherwise, the width shall be at least 1.5 metres.
- (b) A minimum clear space of 1 meter from the top of cylinders under storage to ceiling should be provided.
- (c) It is recommended that all disposable LPG cylinders be aggregated and stored in a designated area to facilitate identification and control.
- (d) It is recommended storage of cylinders containing 100% LPG be segregated from that with partial LPG. Cylinders containing partial LPG shall be permitted to be stored in a place which meets the requirements for storage of cylinders with 100 % LPG.
- (e) The storage area should be close to where natural or mechanical ventilation is most effective.
- (f) No hazardous commodities (including flammable liquid and compressed gases) shall be located within 3 meters from the storage area.

5.2.5 Store construction

- (a) Where LPG cylinders are stored in a compartment and the compartment has no proper automatic fire detection/extinguishing system, the fire resistance rating of the building elements separating the compartment and any adjacent one should be at least 2 hours.
- (b) Where LPG cylinders are stored in a compartment and the compartment has a proper automatic fire detection/extinguishing system, the fire resistance rating of the building elements separating the compartment and any adjacent one should be at least 1 hour.
- (c) If cylinders are stored mixed with other commodities in a store which is properly fire protected, and the proportion of cylinder storage is less than 10 % by volume or mass,

no explicit fire compartmentation as per Section 5.2.5(b) is required since the associated fire and explosion risks will be limited. Instead, the designated cylinder storage area shall be enclosed by a full-height fencing fabricated of steel wires not lighter than 3.8mm diameter woven into 50mm max. diamond meshes, or alternatively, of steel wires not lighter than 2mm diameter woven into meshes no more than 25mm by 25mm. (Exemption: no enclosure is required if the volume of the store does not exceed 100 m³ .) If the proportion of cylinder storage exceeds 80 % by volume or mass, no separation partition between the cylinders and other commodities is required.

- (d) All exit doors of the designated area for storage of LPG cylinders shall be normally closed and self-closing; or a labyrinth opening shall be arranged to prevent rocketing of cylinders through the door opening in the event of a fire.
- (e) Walls and ceilings of the store shall be designed in accordance with the requirements of Buildings Department.

5.2.6 Ventilation

- (a) Adequate natural ventilation at low level (i.e. the bottom of any venting openings is less than 150mm above floor) for removal and dilution of any leaked LPG is required while that at high level is recommended.
- (b) Where cylinders comprise mainly those containing 100% LPG, the bottom of venting openings shall be less than 150mm above the floor; there shall be at least one opening per every six metre length of wall; each opening shall have a minimum size of 320 sq. cm; and the total area of openings shall be more than 1/144 of floor area.
- (c) Where natural ventilation is considered inadequate, mechanical ventilation at 0.3m³/min/m² is required.
- (d) Where a re-circulation system is employed in lieu of ventilation, a gas detection system should be installed.

5.2.7 Explosion relief

- (a) For storage of cylinders comprising mainly cigarette lighters or those containing partial LPG, no explosion vent is required (unless storage is in a very confined area).
- (b) For storage of cylinders comprising mainly those containing 100% LPG other than cigarette lighters, an explosion venting area of at least $0.07\text{m}^2/\text{m}^3$ shall be provided; or the walls, ceilings, and roofs of the store shall be of lightweight material designed for explosion venting.

5.2.8 Electrical equipment

No electrical equipment shall be installed within 1 meter from the floor in the storage area as well as in the vicinity of 3 m from the area; or the equipment shall be suitable for use in a zone 2 hazardous area in accordance with BS 5345 or equivalent. (Note: electrical equipment includes electrical material handling equipment, socket outlets and switches.)

5.2.9 Fire detection/extinguishing equipment

- (a) A proper sprinkler system or equivalent automatic fire detection/extinguishing system should be in place; and 3-kg capacity portable powder-type fire extinguishers shall be provided at strategic locations.
- (b) The requirements prescribed by the Fire Services Department shall also be met.

5.2.10 Means of escape

Means of escape shall be in compliance with the Building Regulations as well as other relevant ones.

5.2.11 Other conditions

- (a) Drains should be avoided in the storage area and in the vicinity of 2 metres from the area; where they are

unavoidable, they shall be properly sealed under normal circumstances to avoid ingress of any leaked LPG.

- (b) LPG cylinders should be stored in a cool and dry area and should not be exposed to direct sunlight, corrosive products or the weather.
- (c) The temperature of the storage area should not exceed 40°C.
- (d) Risk of collapse of stacks or any damage to cylinders should be avoided.
- (e) Stock of LPG cylinders shall be regularly inspected and rotated.
- (f) Access to the storage area shall be restricted to authorised persons only.
- (g) Appropriate warning notices such as 'LPG Storage', 'Highly Flammable', 'No Smoking' in both Chinese and English shall be prominently displayed.
- (h) 'No smoking' and 'No flame' policies shall be rigorously enforced in the store.
- (i) No LPG powered fork lift truck shall be used in an LPG cylinder storage area.
- (j) Any damaged cylinders (either by rusting, impact or other causes) shall be immediately removed from the storage area to the open air where any vapours can be safely dispersed. The route to the open air shall be as short as practicable and any sources of ignition shall be avoided on the way. Some form of containment shall be in place for transferring any leaking LPG cylinders in the store. Electrical, petrol, diesel or LPG powered vehicles shall not be used to move any damaged stock.
- (k) It is recommended that forks of any fork-lift trucks used in an LPG storage area be made out of stainless steel and of only one pallet long. The fork tips should not be sharp but blunt rounded off to reduce the risk of piercing cylinders.

5.2.12 Safety management

- (a) A proper safety management system should be in place addressing housekeeping, operation, maintenance, inspection, emergency response and training on safety in relation to LPG storage.
- (b) As regards training, operators responsible for handling of LPG cylinders and driving of any fork lift trucks, if applicable, shall be given training on hazards posed by the cylinders and associated safety precautions.
- (c) Operating procedures for handling LPG cylinders as well as procedures for dealing with emergencies such as spill of LPG and fire shall be in place.

6. APPENDIX --- CHARACTERISTICS AND HAZARDS OF LPG

- 6.1 At normal atmospheric temperature and pressure, LPG exists as a gas. However LPG is normally stored as a liquid under pressure inside a disposable cylinder and its weight as a liquid is approximately half that of an equivalent volume of water.
- 6.2 LPG is colourless. It is lightly anaesthetic causing suffocation if present in sufficiently high concentrations.
- 6.3 LPG in refillable cylinders and disposable cylinders alike serving as fuel is usually odourised to enable detection of any escaped gas by smell. However, LPG in cigarette lighter refills and aerosol cans is not odourised.
- 6.4 At normal temperature, the LPG inside a disposable cylinder has a pressure of some 300 kpa (43 psig. Approx.). However, vapour pressure of LPG will increase rapidly with temperature, and at an elevated temperature (e.g. above 50⁰C), the cylinder may burst and release all of its contents.
- 6.5 When liquid LPG escapes from a cylinder, it will expand rapidly under atmospheric pressure forming LPG vapour at a volume of about 250 times of liquid released. If liquid LPG in the process of vaporisation is brought into contact with skin, severe frost burns will result.
- 6.6 LPG is a mixture of butane and propane and is denser than air; commercial butane being about twice as heavy as air and commercial propane about one and a half times as heavy as air. Therefore, the vapour may flow along the ground and into drains, sinking to the lowest level of the surroundings and be ignited at a considerable distance from the source of leakage. In still air any vapour will disperse slowly.
- 6.7 When mixed with air, LPG can form a flammable mixture; the flammable range at ambient temperature and pressure extends between approx. 2% to 10 % of vapour in air by volume. Within this range there is a risk of explosion when an ignition source is present. Outside this range any mixture is either too weak or too rich to propagate. However, over-rich mixtures can become hazardous when diluted with air.
- 6.8 If an LPG vapour/air mixture within the flammable range is ignited, a flash will occur. If the mixture is ignited within a confined space with insufficient ventilation, an explosion will result.

- 6.9 On some occasions, leakage of LPG (especially in liquid form) can be noticeable by sight, as at the location of leakage, vaporisation of LPG will bring about a cooling effect causing condensation and even freezing of surrounding water vapour.
- 6.10 A lighted match or other naked flames should not be used to trace leakage, as it is not only dangerous but also an offence.

