

## **FIRE SAFETY REQUIREMENTS FOR LIQUEFIED PETROLEUM GAS (LPG) CYLINDER INSTALLATIONS**

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### **1 SCOPE**

- 1.1 This Fire Safety Guidelines covers outdoor and indoor LPG cylinder installations. It is intended for commercial, industrial and residential premises with eating outlets, eating places, canteens, restaurants and other eateries which use LPG for cooking purposes. It is also intended for industrial applications involving hot works.

### **2 GENERAL REQUIREMENTS**

- 2.1 All LPG cylinder installations shall be located outdoors and on the ground levels for all commercial and industrial buildings. Locating LPG cylinders indoor is normally not permitted, unless otherwise approved by the Commissioner SCDF under special circumstances (please refer to the fire safety requirements for use/storage of LPG cylinders within eating outlets are as stated in Annex H).
- 2.2 Private dwelling house is allowed to have a maximum of 30kg (2 x 15kg cylinders) to be installed or stored within the dwelling unit for domestic use.
- 2.3 NFPA 54 and NFPA 58 shall be referred to for requirements not effected or covered under this Fire Safety Guidelines.
- 2.4 All LPG cylinders installations in commercial or industrial premises, including their manifold/piping systems, shall be approved by SCDF. LPG plans submitting for approval shall include the following items:
- a. QP's endorsements of LPG's storage and manifold system
  - b. Location and site plans
  - c. Schematic diagrams of the LPG supply system showing change-over valve, vaporizer, regulator, emergency shut-off valve, remote cut-off device, knock-out pot, pipe entry and all other required safety features
  - d. Plan and elevation views showing the following details:
    - Location, quantity and capacity (in kg) of LPG cylinders
    - Locations of ancillary fixtures and fittings, e.g. vaporizer, regulators, emergency shut-off valve, change-over valves, remote cut-off device, knock-out pot, pipe entries, etc.
    - Housing for the LPG cylinders, e.g. cabinets, fencing, compartment wall, etc.

- all openings (doors, air intakes, windows, drains, manholes, etc.) and exits adjacent to the LPG installation
  - Locations of hydrant, access way, access road, car parking area, building and boundary lines, source of ignition, etc.
  - Fire safety provisions, e.g. fire hose reel, fire extinguisher, sprinkler protection (if any), gas leak detector (if any), etc.
- 2.5 For LPG cylinders installation involving mechanical ventilation system and/or fire suppression system, separate Mechanical Ventilation plan and/or Fire Protection plan shall be submitted to SCDF for approval.

### **3 DESIGN REQUIREMENTS**

#### **3.1 Main Considerations for Use of LPG**

The following factors shall be taken into consideration when deciding on the practicality and reasonableness to use LPG:

- a. Adequacy of ventilation
- b. Extent of usage of individual rooms
- c. Existing fire hazard
- d. Suitable means of escape
- e. Fire fighting equipment and provisions.

#### **3.2 Codes of Practice & Standards**

All cylinders and their ancillary fittings shall be designed, fabricated and tested in accordance with the accepted code or standard as stated in [Annex A](#).

#### **3.3 Fire Stopping**

All pipes penetrating fire wall or floor slab shall be fire stopped appropriately.

#### **3.4 Pressure**

No liquid LPG or LPG vapor at pressure exceeding 20 psi (approximately 138 kPa) shall be piped into any building.

#### **3.5 Fire Extinguisher**

The LPG installation shall be provided with at least one approved portable B:C rating dry chemical fire extinguisher having a minimum capacity of 9kg.

#### **3.6 Warning Sign / Notice**

- 3.6.1 A warning sign or notice of minimum size of 800mm x 600mm shall be permanently and legibly displayed at the front of the installation.

- 3.6.2 Red letterings of minimum height of 40mm which reads: "LPG / HIGHLY FLAMMABLE / NO SMOKING / NO NAKED LIGHTS" on white background shall be written on the left portion of the warning sign/notice.
- 3.6.3 Immediately under the classification of Hazmat, three equal boxes showing: (1) the emergency action (Hazchem Code); (2) the licensed quantity in litres and (3) the telephone number and name of the supplier company whom specialized advice can be obtained at all times. (see [Annex G](#))

## **4 REQUIREMENTS FOR OUTDOOR LPG CYLINDER INSTALLATION**

### **4.1 Locating of LPG Cylinders**

- 4.1.1 LPG cylinders shall be placed on a firm, clean, dry and level base. They shall be sited at ground level and a well-ventilated area where any gas leakage can safely and rapidly disperse. They shall not be placed close to any passageways or exits and shall not cause any obstruction or danger to the occupants during gas leakage or fire.
- 4.1.2 LPG cylinders shall not be located within 3m of any fire exit route of a building having only one exit. If the 3m distance cannot be complied with, a 2-hour fire rated masonry wall shall be provided between the fire exit and the LPG installation so as to achieve the equivalent 3m horizontal distance. The masonry wall shall be at least 1.8m high.
- 4.1.3 The LPG cylinders shall be located at least 1.5m horizontally away from any openings (windows, doors, air vents, balanced-flue outlets, etc.) of the building having more than one exit. If the 1.5m distance cannot be complied, a 2-hour fire rated masonry wall must be provided between the openings and the installation so as to maintain a 1.5m horizontal distance. The masonry wall should be at least 1.8m high.
- 4.1.4 A minimum distance of 3m must be maintained between the edge of a vehicle parking lot.
- 4.1.5 LPG cylinders shall be located at least 5m horizontally from any mechanical air intake which is below any part of the manifold system and 1.5m from any mechanical intake which is above any part of the manifold system.
- 4.1.6 LPG cylinders may be installed below windows or openings provided that there is a minimum distance of 150mm between the top of any cylinder or the manifold system and the bottom of the windows or openings.
- 4.1.7 LPG cylinders of total capacity up to 600kg shall be located at least 1.5m from any uncovered opening that is below the level of the cylinders, such as drains, pits, openings to basements, etc. For LPG cylinders having total capacity above 600kg, the distance from any uncovered opening shall be at least 3m.
- 4.1.8 LPG cylinders shall be located at least 3m away from any boundary and any fire engine accessway.
- 4.1.9 LPG cylinders shall be located at least 10m away from any fire hydrant.

#### 4.2 **Protection to LPG Cylinder Installation**

- 4.2.1 LPG cylinders located in places accessible to the public shall be protected and locked against tampering and accidental damage by fencing of height not less than 1.8m, a suitable housing or a cabinet made of non-combustible material.
- 4.1.2 There shall not be any corrosive, toxic or oxidizing materials located within 6 meters from the cylinder installation.

#### 4.3 **Safety Provisions**

- 4.3.1 For air-conditioned premises, an approved gas-leak detection system shall be provided in the area or compartment where the internal LPG pipes and fittings are installed, with a local alarm connected to a main fire alarm panel. The system shall be linked to the exhaust fan system and the emergency shut-off valve where applicable. (see Annex A)
- 4.3.2 For kitchen provided with fixed fire suppression system, activation of the system shall automatically shut off the supply of LPG to the kitchen.
- 4.3.3 Remote Emergency shut-off valve shall be located at least 3m away from the edge of the installation. It shall be clearly marked and placed at a suitable height for easy access during emergencies. (see Annex B).
- 4.3.4 There shall be no ignition source within 3m from the cylinder installation.
- 4.3.5 All fixed electrical equipment within 1.5m of the installation shall be spark-proof and intrinsically safe in accordance with the relevant clause in SS 254.
- 4.3.6 Vaporizers shall not be installed inside the steel cabinet or within the same housing of the LPG cylinders. Wall-mounted vaporizers shall be located at least 1.8m above the ground and 600mm away from any LPG cylinder.
- 4.3.7 The distance between two separate manifold systems shall be at least 3m. If a 2-hour fire rated wall is constructed, the distance between the two nearest cylinders may be halved.

#### 4.4 **Allowable Quantities**

- 4.4.1 LPG cylinder installation (for eating outlets) with capacity up to a maximum of 600kg by weight attached to a single manifold system installed adjacent to a building is allowed provided that the following requirements are fully complied with (see Annex B1 and C):
  - a. maximum two numbers of steel cabinets are allowed for each installation, and each cabinet is allowed to house a maximum of 6 x 50kg LPG cylinders;
  - b. the separation distance between the two cabinets shall be at least 600mm; and
  - c. the building is of non-combustible construction and the wall has a fire rating of at least 2 hours resistance.

- d the maximum number of LPG manifold system shall not exceed two per building.
- 4.4.2 LPG cylinder installation of capacity exceeding 600kg to a maximum of 1000kg by weight attached to a single manifold system is allowed to be used for industrial applications only, provided that the following requirements are fully complied with (see Annex B2 and C):
- a. maximum two numbers of steel cabinets are allowed for each installation and each cabinet is allowed to house a maximum of 10 x 50kg LPG cylinders; and
  - b. a 2-hour fire rated wall or a spacing of 3m shall be provided to separate the LPG cylinders into two groups of maximum 10 x 50kg per group;

## **5 REQUIREMENTS FOR INDOOR LPG CYLINDER INSTALLATION**

### **5.1 General**

- 5.1.1 LPG cylinder installation shall be properly located so as not to cause any obstruction to the fire escape and any danger to the public. Suitable access to the cylinder for emergency services shall be provided.
- 5.1.2 The edge of the installation shall be at least 3m from any boundary or any fire engine access way.

### **5.2 Safety Provisions**

- 5.2.1 The area or compartment where the LPG cylinders, pipes works and ancillary fittings are installed should be sprinkler protected. If sprinkler system is not provided or the premises is air-conditioned, an approved gas leak detector system shall be provided in that compartment, kitchen and dining area, with a local alarm connected to a main fire alarm panel. The leak detector should link to the exhaust fan control panel and the emergency shut-off valve where applicable. (see Annex A)
- 5.2.2 The location of the gas leak detector should preferably be not more than 30cm above the ground level and not more than 4m away from the edge of the installation and the point of consumption.
- 5.2.3 Remote Emergency shut-off valve shall not be installed inside the compartment and be at least 1.5m away from the edge of the installation. It shall be clearly marked and at a suitable height to access during emergencies.
- 5.2.4 Fixed fire suppression system, if installed, shall be linked to the LPG cylinder installation in such a way that activation of the system shall automatically shut off the supply of LPG to the kitchen.
- 5.2.5 Vaporizers (where applicable) shall not be installed inside the compartment or within the same housing of the LPG cylinders.

- 5.2.6 The compartment shall only be used for LPG cylinder installation. No other usage is allowed.
- 5.2.7 The floor of the compartment shall be a smooth concrete base (rough surface might cause sparking during loading/unloading of cylinders) containing no opening or drain where vapor may accumulate and shall be level or slope down towards the ventilated external wall.
- 5.2.8 A ramp or sill of 250mm high shall be provided across the doorway (where applicable) into the compartment where LPG cylinders are installed to contain any heavy LPG vapor within the compartment.
- 5.2.9 All electrical connections and appliances shall be installed in accordance with the relevant clauses in SS 254.

5.3 **LPG Cylinder installation in separate compartment**

LPG cylinders are allowed to be installed in a separate compartment on the ground floor, provided with the following requirements are complied with: (See Annex D and E)

a. Allowable Quantity

- i) A maximum of 400kg of LPG is allowed to be installed using a single manifold system inside a compartment. The quantity of cylinder is restricted to 8, irregardless of the capacity of each cylinder (e.g. 2 groups of 4 x 50kg cylinders or 2 groups of 4 x 15kg cylinders).
- ii) The area or compartment in which the LPG cylinders are installed shall be sprinkler protected. If the compartment is not sprinkler protected, the quantity of LPG shall be halved (i.e. 200kg).
- iii) For commercial premises, the maximum number of LPG manifold system shall not exceed two per building.

b. Compartment

- i) The compartment shall have at least one external wall and there shall be no access from the compartment into the building.
- ii) Walls common to the compartment and the internal spaces of the building shall be 2-hour fire rated and shall be of masonry construction.
- iii) Each compartment shall contain only one number LPG manifold system.

c. Ventilation

- i) Doors shall have high and low level louvers and shall be opened outwards.
- ii) Natural ventilation is allowed if the total length of the compartment external wall is not less than 6m and the distance between the external wall and its opposite wall is not more than 3m. Otherwise, mechanical ventilation shall be provided.
- iii) High and low vents shall be provided on the external wall at just below ceiling level and above floor level. The total free area of the vents provided shall be at least 300 cm<sup>2</sup>/m<sup>2</sup> of floor area.
- iv) The vent openings shall be kept free from obstruction and shall not discharge directly onto a public place, e.g. a pavement or path. It shall not be less than 5m from any air intake openings and shall be at least 1.5m horizontally away from any building opening which is below the vent opening level.
- v) Where mechanical ventilation is used, air circulation shall be at least 0.3 m<sup>3</sup>/min.m<sup>2</sup> of floor area. Discharge outlets shall be at least 1.5m horizontally away from any building opening which is located below the discharge level.

5.4 **LPG Cylinder Installation in Recessed Area**

Building recess used for housing LPG cylinder installation shall comply with the following requirements: (See Annex E and F)

a. Design

- i) The maximum depth of the recess shall be not more than 1m deep.
- ii) The floor, ceiling and the dividing walls between the recess and the internal spaces of the building shall be brick or concrete, non-combustible and shall have a fire resistant rating of not less than 2 hours.
- iii) Access to the recess shall only be from the external of the building.

b. Location

- i) The recess shall be at ground-floor level and shall be for the exclusive use of housing LPG cylinders.

- ii) The recess shall not be located within 3m of any fire exit route from a building that has only one designated means of exit. If the 3m distance cannot be complied with, a 2-hour fire rated masonry wall shall be provided between the fire exit and the installation so as to achieve the 3m horizontal distance.
- iii) The recess shall be located at least 1.5m from any horizontal openings (windows, doors, air vents, balanced-flue outlets, etc.) of the building having more than one designated means of escape, measured horizontally from the nearest LPG cylinder. If the 1.5m distance cannot be complied with, a 2-hour fire rated masonry wall shall be provided between the openings and the installation so as to achieve the 1.5m horizontal distance.
- iv) The recess shall be located at least 3m from ignition source.
- iv) A minimum distance of 3m horizontal distance must be maintained between the nearest edge of a vehicle parking lot to the recessed area.
- v) Recessed area located below windows or openings shall maintain a minimum distance of 150mm between the top of the recessed area or any part of the manifold system (piping, vaporizer, etc., whichever is higher) and the bottom of the windows or openings.
- vi) LPG cylinders shall be located at least 5m horizontally from any mechanical air intake which is below any part of the manifold system and 1.5m from any mechanical intake which is above any part of the manifold system.

c. Allowable Quantity

- i) A maximum of 400kg of LPG is allowed to be installed using a single manifold system inside the recessed area. The quantity of cylinder is restricted to 8, irregardless of the capacity of each cylinder (e.g. 2 groups of 4 x 50kg cylinders or 2 groups of 4 x 15kg cylinders).
- ii) The space or compartment where the pipes works and ancillary fittings are installed should be sprinkler protected (except for the recessed area). If not, the LPG quantity would be halved (200kg).
- iii) For commercial premises, the maximum number of LPG manifold system shall not exceed two per building.

d. Safety

- i) Any pipe penetration on the walls of the recess area shall be suitably fire stopped to maintain the 2-hour fire resistance of the walls.
- ii) For air-conditioned premises, an approved gas leak detector system shall be provided in the compartment where the LPG pipes pass through, with a local alarm connected to a main fire alarm panel. The gas leak detector shall be linked to the exhaust fan control panel and the emergency shut-off valve where applicable. (see Annex A)



e. Ventilation

Permanent unobstructed high and low ventilation openings, not less than  $300\text{cm}^2/\text{m}^2$  of recess floor area, shall be provided for venting the recess space to the external of the building.

**STANDARDS AND SPECIFICATIONS FOR LPG CYLINDER INSTALLATIONS****A. STANDARDS**

The following standards for LPG cylinders and ancillary fittings shall be complied with:

S/N	ITEM	STANDARDS	PLS LISTING
1	Cylinder	SS 99	Yes
2	Cylinder Fittings		
	a) Flexible Hose	SS 233	Yes
	b) Regulator	SS 281, BS 3016, UL144	Yes
	c) Cylinder valve	SS 294	Yes
3	Gas Leak Detector	BS EN 50054, BS EN 50057 and BS 5345 Part 1 and 3	Yes

Note:

- (a) SS 99 – Specifications for welded low carbon steel cylinders for storage and transportation of low-pressure liquefiable gases.
- (b) SS 233 – Specifications for flexible rubber tubing for use in domestic and commercial appliance
- (c) SS 281 – Specifications for pressure regulators for liquefied petroleum gases
- (d) BS 3016 – Specifications for pressure regulators and automatic changeover devices for LPG
- (e) SS 294 – Specifications for valves for use with domestic and industrial Liquefied Petroleum Gas (LPG) cylinders
- (f) BS 5345 Pt 1 & 3 – The Code of Practice for Selection, Installation and Maintenance of Electrical Apparatus for use in Potentially Explosive Atmospheres

**B. SPECIFICATIONS**1. LPG Cylinder Fittingsa. Flexible hoses

- i. Hoses or flexible connectors used to supply LPG to utilization equipment or appliances shall be installed in accordance with the relevant clauses of NFPA 54 and NFPA 58. The hose shall be securely connected to the appliance. The use of rubber slip ends without hose clips shall not be permitted for domestic cylinders.
- ii. Hoses must be tested and passed the performance criteria in accordance with Singapore Standard SS 233.

b. Regulators

Regulators shall comply with the standards as specified in the table above.

c. Over Pressure Protection Device

- i. An over pressure protection device (OPD) is a device to protect the down stream installation and shut off the gas flow if the outlet pressure exceeds the set limit.
- ii. In general, a regulator with OPD shall be designed to achieve the following:
  - ensuring reliable and continuous supply of LPG;
  - protecting down stream system against over pressure; and
  - protecting against failure of any regulating device.
- iii. Setting of OPD shall not be more than 30% of maximum operating pressure.

d. Valvesi. Cylinder Valves

Cylinder valves shall comply with the standards as specified in the table above.

ii. Safety Valves

- (a) Hydrostatic relief valves designed to relieve the hydrostatic pressure that might develop in sections of liquid piping between two isolating valves shall be installed in each section. Hydrostatic valves shall comply with UL 132, Standard for Pressure Relief Valves for LPG.
- (b) Emergency shut-off valve (ESV) shall be provided after the knockout pot. The ESV shall be linked to a release mechanism so that the valve can be closed from a safe distance of at least 3m from the LPG cylinders. The ESV may incorporate fusible element which melts at not more than 250 degree Celsius when exposed to fire, allowing the ESV to close by itself.
- (c) An accessible gas shutoff valve shall be provided at the upstream of each gas pressure regulator. Where two gas pressure regulators are installed in series in a single gas line, a manual valve shall not be required at the second regulator.
- (d) Main gas shut-off valves controlling several gas piping systems shall be prominent and readily accessible for operation and properly installed so as to protect it from physical damage. They shall be marked with a metal tag or other permanent means attached by the installing agency so that the gas piping systems supplied through them can be readily identified.
- (e) An exterior shut-off valve to permit turning off the gas supply to each building in an emergency shall be provided and plainly marked.

e. Piping

- i. Pipe design and specifications shall be in accordance with the relevant clauses in NFPA 54 and NFPA 58. No polyethylene material is allowed to be used for the piping system except for necessary industrial applications.
- ii. Pipe material shall be tested and certified according to recognized ASTM or British Standard. The pipe supplier shall produce Mill certificates.
- iii. The manifold and main LPG supply pipeline shall be welded together as far as practicable. Welders for the piping work must be qualified and certified by a recognized body.

- iv. Pipelines pressure test must be witnessed and certified by a Professional Engineer (Mechanical).
  - v. The liquid LPG pipelines shall be painted in “Blue” and the vapor LPG pipelines in “Yellow” with the marking of the word “LP-Gas” at intervals of not more than 3m.
  - vi. When connecting additional gas utilization equipment to a gas piping system, the existing piping shall be checked to determine if it has adequate capacity. If inadequate, the existing system shall be enlarged as required, or separate gas equipment of adequate capacity shall be provided.
- f. Pigtail
- i. Pigtail shall include a 6mm flexible hose or tube, a 6mm tee-check valve or excess flow valve and a 6mm ball valve.
  - ii. Flexible hose shall be fabricated of materials resistant to LPG reaction both in liquid and vapor state. It shall be designed for a minimum bursting pressure of 1,750 PSI (121 bar) and working pressure of 350 PSI (24 bar). The hose shall be marked “LPG” at intervals of not more than 3m.
  - iii. The tee-check valve shall be Underwriters Laboratories Inc. (UL) listed or it shall comply with other recognized/approved standard.
  - iv. The ball valve shall be rated to at least 600 PSI (41 bar).
- g. Pressure Gauge
- i. Each bank of LPG cylinder manifold shall have a pressure gauge.
  - ii. For high-pressure section, the gauge shall have a range of 0 to 300 PSI (0 to 20.1 bar)
  - iii. For low-pressure section, the gauge shall have a range of 0 to 50 PSI (0 to 3.45 bar)
- h. Vaporizer
- i. Vaporizers, where applicable, shall be constructed in accordance with the applicable provision of NFPA 58, ASME Code or other recognized pressure vessel codes and standards for a design pressure of 250 PSI (17.24 bar) and shall be permanently and legibly marked with:

- (a) markings required by the Code;
  - (b) the allowable working pressure and temperature for which it is designed; and
  - (c) the name or symbol of the manufacturer.
- ii. Vaporizers shall be provided with a suitable automatic means to prevent the passage of liquid through the vaporizer to the vapor discharge piping. This feature shall be permitted to be integrated with the vaporizer or otherwise provided in the external piping.
  - iii. Vaporizers shall have a manual shut-off valve and an automated valve (e.g. thermostatic, magnetic or float) which closes in the event of power failure or overload.
  - iv. Vaporizers shall have relevant temperature control and the necessary safety features.
  - v. Vaporizers shall have a pressure relief valve set at 250 PSI (17.24 bar) with the release point directed upward.
- i. Knock-out pot

The knockout pot shall have at least two drain valves. The drain shall end at ground level and plugged at the end.
  - j. Gas Meters
    - i. Installation and application of gas meters shall be in accordance with the relevant clauses in NFPA 54 and must be able to take a pressure of 20 PSI (1 PSI = 6.895 KPa).
    - ii. Gas meters shall be selected for the maximum expected pressure and permissible pressure drop.
    - iii. Vapor meters of the tin or brass case type of soldered construction shall not be used at pressure in excess of 1 PSI (7 KPa).
    - iv. Vapor meters of the die cast or iron case type shall be permitted to be used at any pressure equal to or less than the working pressure for which they are designed and marked.
    - v. Gas meters shall be located in ventilated spaces readily accessible for examination, reading, replacement or necessary maintenance.

- vi. Gas meters shall not be placed where they will be subjected to damage, such as adjacent to a driveway, under a fire escape, in public passages, halls or where they will be subjected to excessive corrosion or vibration.
- vii. Gas meters shall be located at least 1m from sources of ignition.
- viii. Gas meters shall not be located where they will be subjected to extreme temperatures or sudden extreme changes in temperature. Meters shall not be located in areas where they are subjected to temperatures beyond those recommended by the manufacturer.
- ix. Gas meters shall be supported or connected to rigid piping so as not to exert a strain on the meters.
- x. Gas meters shall be protected against over pressure, backpressure, and vacuum, where such conditions are anticipated.

k. Strainers

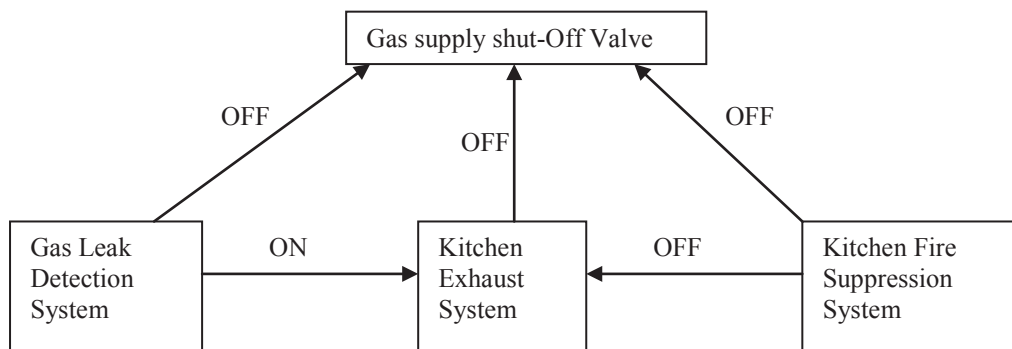
Strainers shall be designed to minimize the possibility of particulate materials clogging lines and damaging meters or regulators. The strainer element shall be accessible for cleaning.

2. Electrical Bonding and Grounding

- a. Electrical circuits shall not utilize gas piping or components as conductors.
- b. All electrical connections between wiring and electrically operated control devices in a piping system shall conform to the requirements of SS 254.
- c. Any essential safety control (in the vaporizer) depending on electrical current as the operating medium shall be of a type that will shut off (fail safe) the flow of gas in the event of current failure.

3. Gas Leak Detection

- a. Gas leak detection system shall be provided for LPG pipes running in air conditioned areas (including the dining & kitchen area) or within basement floor).
- b. Gas leak detectors shall be connected to a localized alert alarm, emergency shut-off valve as well as the kitchen exhaust systems. The gas supply safety shut-off valve system shall also be interlocking with the kitchen automatic fire suppression system (see figure below).

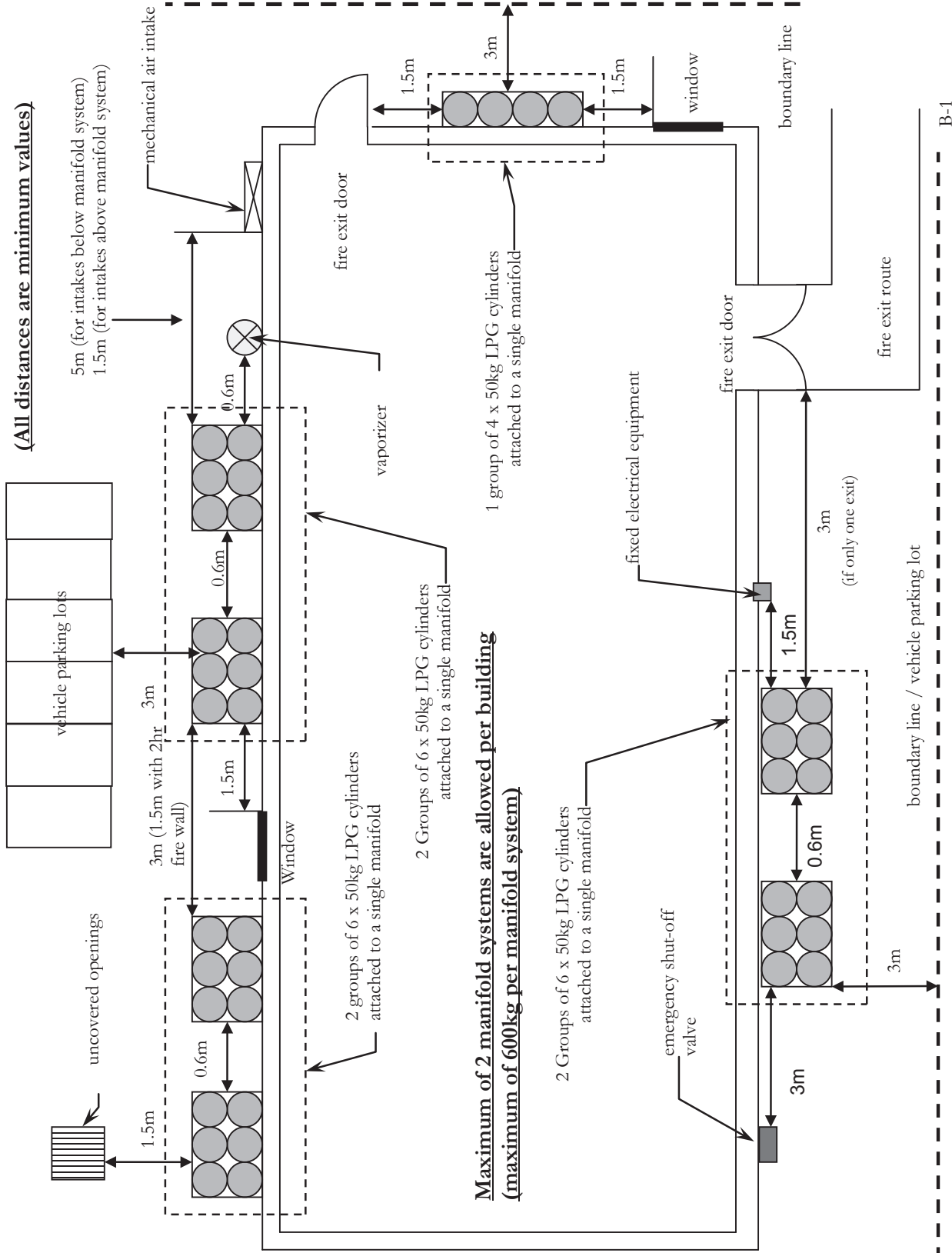


- c. LPG pipe installation shall not be permitted in the following areas:
  - i. in the ground under concrete flooring within building
  - ii. under building foundations
  - iii. within lift shafts and cavity walls
  - iv. in compartments or ducts dedicated for electrical switchgears, transformers or generators
  - v. in refrigeration chambers, cold rooms, air handling rooms and ventilation or air-conditioning ducts
  - vi. adjacent to pipes and vessels containing flammable, oxidizing, corrosive and other hazardous materials
  - vii. in fire-fighting lobby, fire command centers, smoke stop lobbies, fire pump rooms, fire-fighting water tank rooms, sprinkler control valve rooms, fire fighting riser ducts, areas of refuge, protected corridors, protected staircases, bedrooms and other occupied area etc.



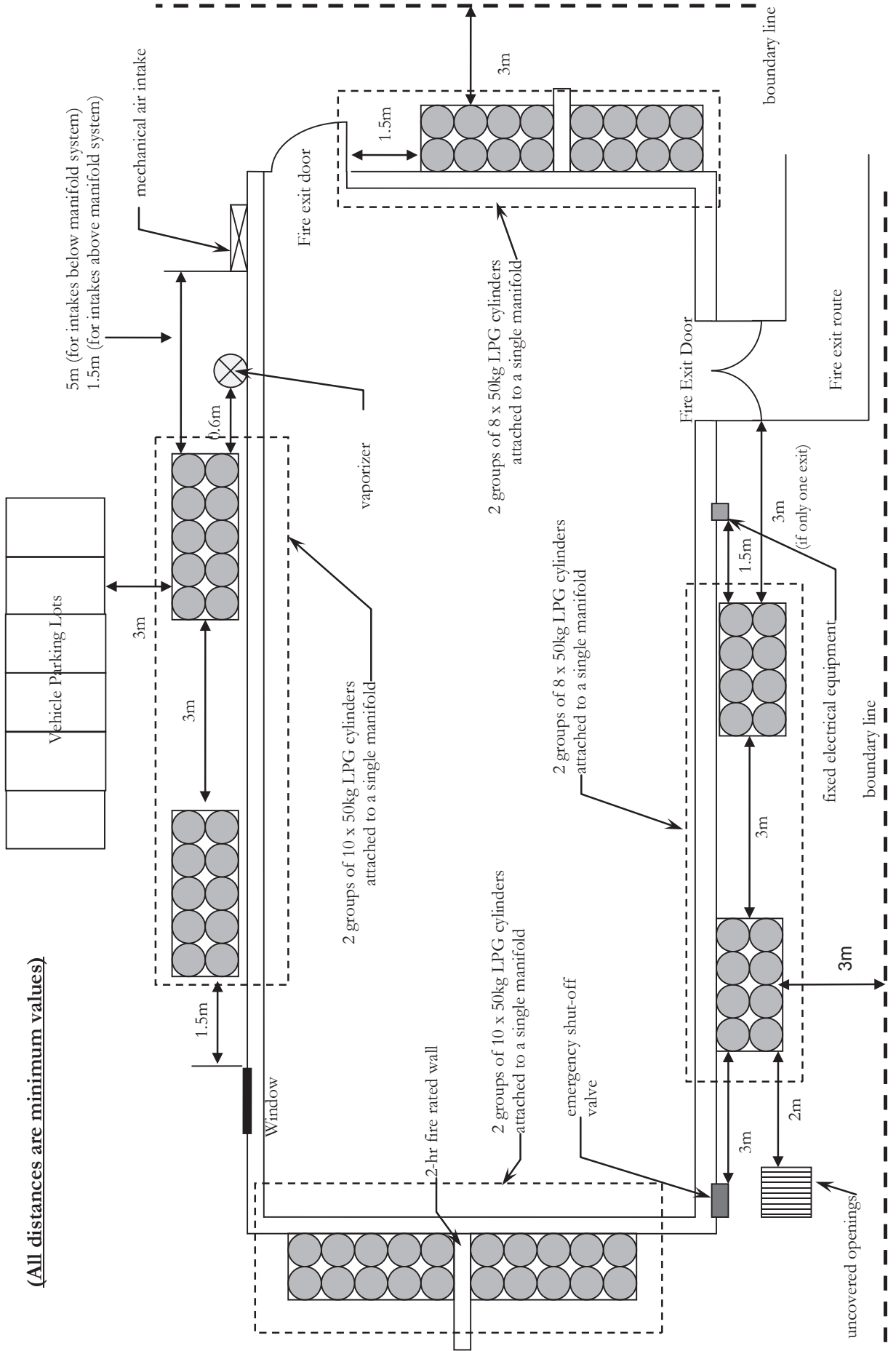
- d. Proper metal pipe sleeves shall be installed for the gas pipes running in enclosed, unventilated areas or basement floor, and at last one end exposed directly to the exterior open safe space (it may be used to facilitate the gas leak detection system).
  - e. Gas pipe running vertically shall be enclosed within a protected riser shaft & be fully fire separated from other M&E risers. Ventilation opening shall be provided for such gas riser.
4. List of Items to be included in the Plan Submission
- a. Endorsement on this guideline, NFPA 58, NFPA 54, other relevant and approved standards and the Fire Code.
  - b. Location and site plan associated with the LPG installation.
  - c. Detailed plan and elevation views associated with the LPG installation showing the following:
    - i. Location and number of cylinders as well as quantity in kilograms.
    - ii. Housing for the LPG cylinders, e.g. cabinets, fencing.
    - iii. Location of ancillary fittings, e.g. vaporizer, 1<sup>st</sup> stage regulator, emergency shut off valves, change over valve, remote cable pull, knock out pot and pipe entry.
    - iv. Hydrant location, fire engine access way, source of ignition, boundary line, building line, internal roads and parking area.
    - v. Location of exits, staircases, details of horizontal openings (e.g. doors, air intakes and windows) and ground openings (e.g. drains, manholes and entrance to basement).
    - vi. Fire safety provisions like, hose reel, fire extinguishers, indication of sprinkler protection, gas leak detectors, mechanical ventilation, exhaust systems and fire suppression systems, where applicable. (Fire Protection Plan and Mechanical Ventilation Plan shall be submitted accordingly in addition to the Building Plan submission.)
  - d. Hazard sign as indicated in ANNEX G and other relevant information associated with the LPG installation.

**OUTDOOR LPG INSTALLATIONS (Eating Outlet)**



**OUTDOOR LPG INSTALLATIONS (INDUSTRIAL)**

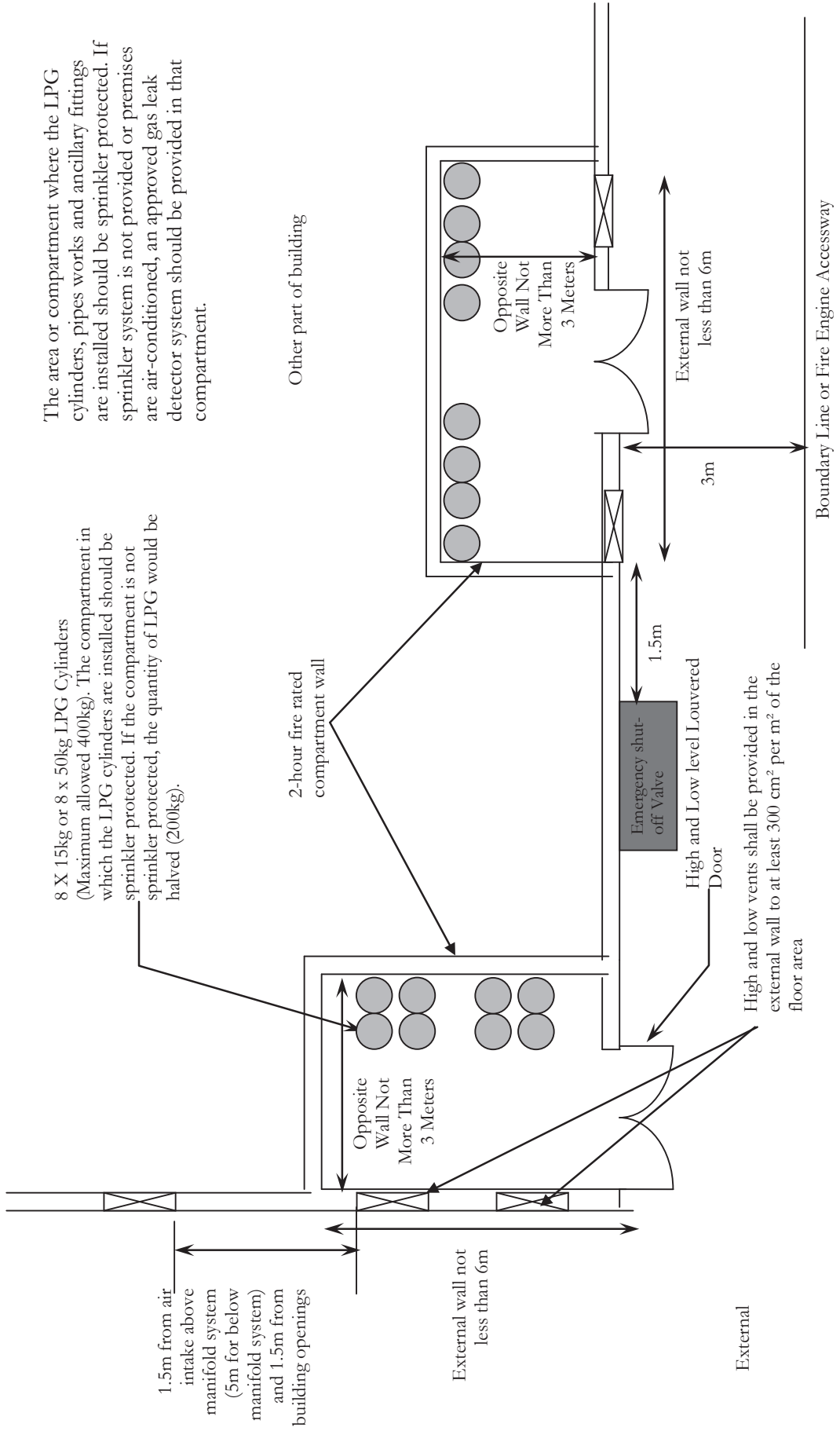
**(All distances are minimum values)**



**VARIOUS DISTANCES FOR OUTDOOR LPG INSTALLATIONS**

LPG quantity	Distance from boundary	No. of cabinets per manifold	No. of cylinders per cabinet / cluster	No. of cylinders per manifold	Distance between cabinet / cluster	Distance from drains, pit, manhole, oil tank bund wall, basement opening etc.	Distance from fire exit route	Horizontal distance from windows, doors, vents, balance flue outlets, etc.	Distance from mechanical air intake	Distance between manifold systems	Distance from vehicle parking lot
kg	m	no.	no.	no.	m	m	m	m	m	m	m
Not more than 600kg	3 min.	2 max.	6 max.	12 max.	0.6 min.	1.5 min.	3 min. (one exit only) 1.5 min. (more than one exit)	1.5 min.	5 min. (intakes below manifold system) 1.5 min. (intakes above manifold system)	3 min. (no fire rated wall) 1.5 min. (with 2-hr fire rated wall)	3.0 min.
600kg to 1000kg (Industrial applications only)	3 min.	2 max.	10 max.	20 max.	3m min. or 2-hr fire rated wall	2 min.	3 min. (one exit only) 1.5 min. (more than one exit)	1.5 min.	5 min. (intakes below manifold system) 1.5 min. (intakes above manifold system)	6 min. (no fire rated wall) 3 min. (with 2-hr fire rated wall)	3.0 min.

**INDOOR LPG CYLINDER INSTALLATION IN SEPARATE COMPARTMENT**

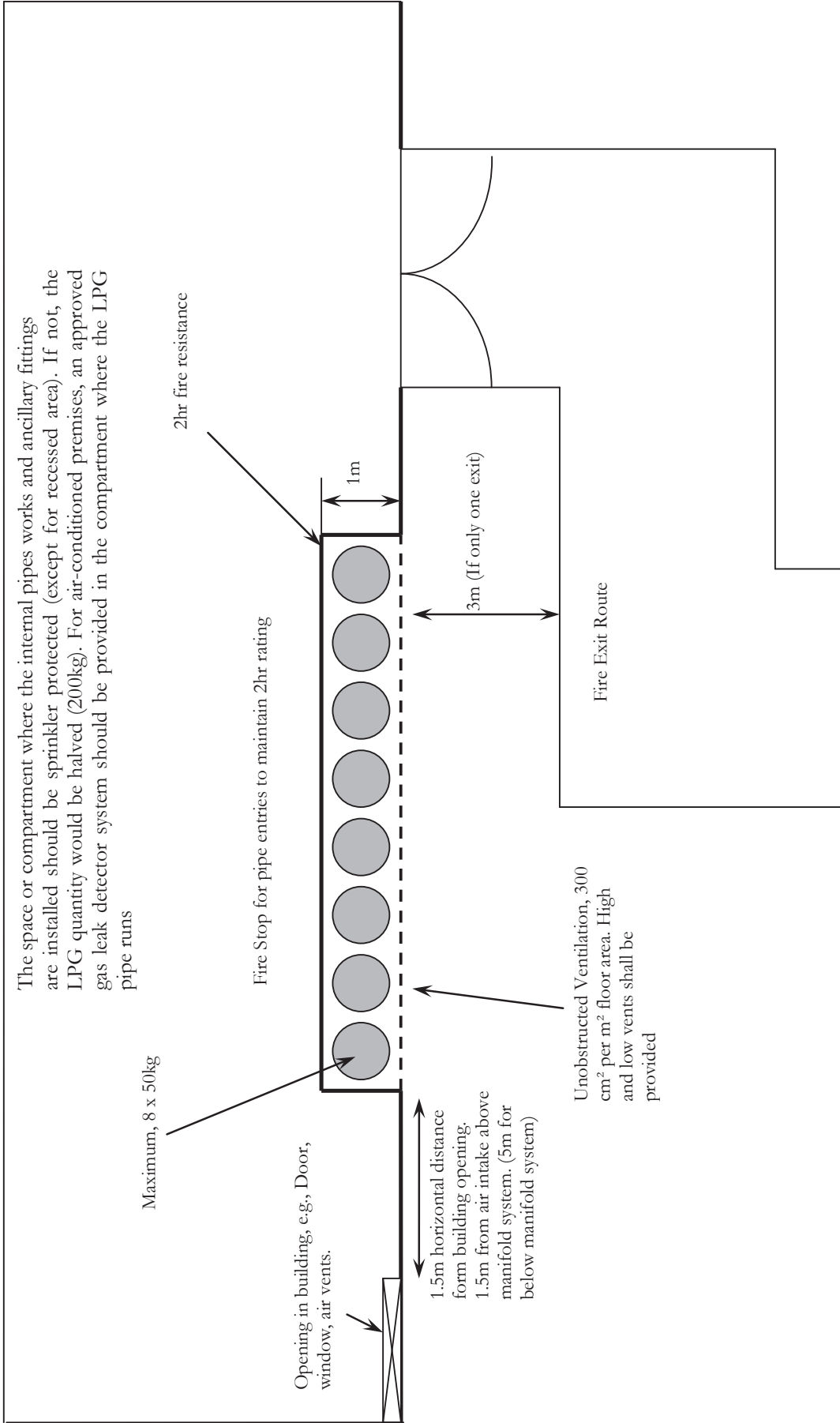


The area or compartment where the LPG cylinders, pipes works and ancillary fittings are installed should be sprinkler protected. If a sprinkler system is not provided or premises are air-conditioned, an approved gas leak detector system should be provided in that compartment.

8 X 15kg or 8 x 50kg LPG Cylinders (Maximum allowed 400kg). The compartment in which the LPG cylinders are installed should be sprinkler protected. If the quantity of LPG would be halved (200kg).

High and low vents shall be provided in the external wall to at least 300 cm<sup>2</sup> per m<sup>2</sup> of the floor area

**RECESSED AREA LPG CYLINDER INSTALLATIONS**

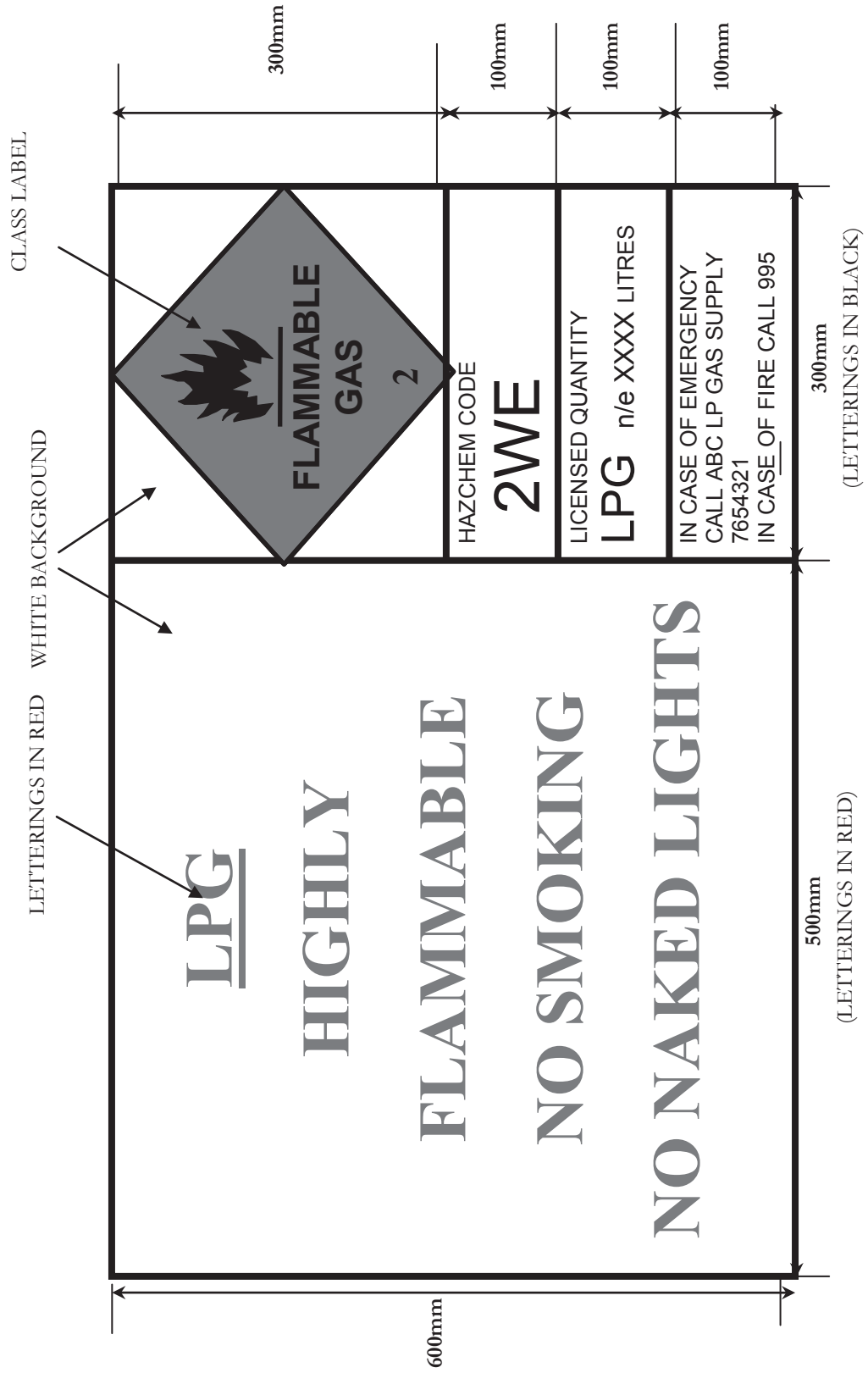


ANNEX F

**TECHNICAL DETAILS FOR INDOOR LPG INSTALLATIONS**

Location of LPG	Quantity Allowed	Fire rating of compartment	Distance from Open flame, ignition source	Sprinkler / Gas Leak detector	Natural Ventilation	Mechanical Ventilation	Distance from exits	Min. Dist. Of discharge from mech. air intake
	kg	hr	m			m <sup>3</sup> / min	m	m
Separate Compartment	400 max. (8 x 50kg or 8 x 15 kg) Maximum 8 cylinders	2	Not applicable	Sprinkler required else only max. 200kg of LPG is allowed  If no sprinkler or if air-conditioned, gas leak detector is required	a) 300cm <sup>2</sup> opening per m <sup>2</sup> of compartment floor area b) high and low vents shall be provided c) min. length of external wall : 6m	0.3 per meter square of compartment floor area	1.5	1.5 min. (intakes above manifold system)  5 min. (intakes below manifold system)
Recessed Area	400 max. (8 x 50kg or 8 x 15 kg) Maximum 8 cylinders	2	3	Sprinkler required (excluding recessed area) else only max. 200kg of LPG is allowed  If no sprinkler or if air-conditioned, gas leak detector is required (excluding recessed area)	a) 300cm <sup>2</sup> opening per m <sup>2</sup> of compartment floor area b) high and low vents shall be provided	Not applicable	3m if only one exit, otherwise 1.5m	1.5 min. (intake above manifold system)  5 min. (intakes below manifold system)

WARNING SIGN / NOTICE





**CONDITIONS FOR INDOOR STORAGE/USE OF LPG IN EATING OUTLETS****A. DEFINITION**

Eating outlet - shop unit/units operated as food outlet, food court, eating place, restaurant, hawker centre or coffee shop

Food stall - stall operated by independent operator within an eating outlet

**B. General Requirements**

All eating outlets shall not use or store LPG cylinders within building unless the following conditions are fulfilled :

- a. The eating outlet is located on or above ground level;
- b. It shall be naturally ventilated;

**C. Allowable Quantity**

- a. The maximum allowable quantity of LPG shall be limited to 2 x 15kg cylinders (including standby cylinder) per food stall; and
- b. The total capacity for each eating outlet shall not be more than 200 kg.

**D. Fire Safety Requirements**

- a. The eating outlet shall be separated by fire-resistant walls (1-hour fire resisting for sprinkler protected building and 2-hour for non-sprinkler protected building) from other areas.
- b. Stalls within food court or coffee-shop shall be separated from each other with 1-hour fire-resisting side-walls.
- c. Each cylinder shall be connected to cooking hob/stove with flexible hose. The LPG cylinders shall not be connected together with manifold system.
- d. LPG Cabinet
  - i. LPG cylinders shall be housed in a 2.5mm thick steel cabinet. There shall be not more than 2 x 15 kg cylinders in each cabinet.
  - ii. The cabinet shall be placed directly on a firm floor.

- iii. The cabinet shall be adequately ventilated with openings at the bottom of the cabinet.
- iv. The cabinet should always be kept free of any combustible materials.
- e. Gas-Leak Detection System
  - i. Gas-leak detection system (approved by recognized certifying bodies, e.g. PSB, UL or FM) shall be provided (be supplied directly from the building electrical power supply). The system shall be linked to shut off the LPG supply automatically and activate local alert alarm. The gas-leak detector shall be located at low level and near to the possible leak areas such as the connecting hoses, LPG cylinder cabinets, etc.
  - ii. If kitchen automatic fire suppression system is provided, it shall also be linked to shut-off the LPG supply automatically.

### **Plan Approval**

- 1) Plan submission is not necessary (unless the system is linked to the kitchen automatic fire suppression system). However, the LPG supplier/dealer and the user shall be responsible to ensure that the LPG installation is carried out by a competent person.

### **Note**

- To facilitate the storage/use of 15kg LPG cylinders within building, the above-mentioned conditions and the Reg. 53 of the “Fire Safety (Petroleum And Flammable Materials) Regulations 2005” shall be observed strictly by all parties including the gas supplier, dealer, user and the building management (or FSM).
- The eating outlet or food stall operator together with the gas supplier/dealer are responsible to ensure that the automatically shut off system is well maintained and that the gas leak detection system is checked and calibrated periodically basing on the manufacturing recommendation by a competent person.
- The building’s Fire Certificate inspection programme shall include the “automatic detection and shut off system”.