These Guidance Notes are published under five subject headings: Medical, Environmental Hygiene, Chemical Safety, Plant and Machinery and General


**INTRODUCTION**

1. Liquefied petroleum gas (LPG) is kept in containers for a variety of commercial, domestic, industrial and leisure purposes. In 1981 it was estimated that 17 to 18 million cylinders were owned by LPG suppliers and used in the UK, of which some 10 million were required to provide replacements for those kept by consumers. In addition the number of small cylinders (under 4.5kg capacity) owned by leisure users was estimated to be in excess of three million.

2. About half the incidents involving LPG reported to HSE each year occur in building, construction or similar activities. Guidance Note CS6 gives specific advice for these activities.

3. Because of the expansion in the domestic use of LPG there has been a considerable increase in the numbers of retail premises selling LPG in cylinders and cartridges. More detailed advice is given in Guidance Note CS8 on the small scale storage and display of LPG at retail premises for quantities totalling less than 400kg in containers with individual capacities of not more than 20kg.

4. This Guidance Note gives advice on how the general duties of the Health and Safety at Work etc Act 1974 (HSW Act) may be met when applied to the keeping of LPG. It provides a guide to safe practice both for people storing and handling LPG containers and those given the task of enforcing safety requirements. The application of this advice need not be limited only to those premises covered by the HSW Act. It may be used as good practice in other circumstances. The recommendations are intended to minimise the risk of fire or explosion from LPG escaping from a leaking container and from the consequences of a fire, either at or near a cylinder store.

5. This guidance is given to safeguard both people at work and members of the general public. It is intended to preclude the use of alternative designs, materials or methods where these provide equivalent standards of safety; nor is it the intention that this guidance should be applied rigidly to existing premises where safe storage has been provided in accordance with earlier guidance. Only such alterations as are considered to be reasonable, or essential for safety should be made.

6. The advice covers general information on arrangements for both outdoor and indoor storage and recommendations for safe operating procedures at the premises where LPG is kept. In cases of difficulty additional advice may be obtained from the local office of the appropriate enforcing authority (see paragraph 18).

7. The storage of LPG may be subject to legal requirements additional to the general duties in the HSW Act 1974:

   (a) If the premises are subject to the Factories Act 1961, the Highly Flammable Liquids and Liquefied Petroleum Gases Regulations 1972 (Statutory Instrument 1972 No. 917) (HFL Regulations) will apply.

   (b) The Notification of Installations Handling Hazardous Substances Regulations 1982 (NIHHS) (SI 1982 No. 1357) require that all premises at which 25 000kg or more of LPG are kept should be notified to HSE. Guidance on these regulations can be found in HSE booklet HS(R)16.

   (c) The general requirements of the Control of Industrial Major Accident Hazards Regulations 1984 (SI 1984 No. 1902) (CIMAH) apply to all premises where LPG in any quantity is processed or where 50 000kg or more are stored. Further guidance on the CIMAH Regulations can be found in HSE Booklet HS(R)21 and on the emergency plans required by the regulations in HSE Booklet HS(G)25.

   (d) At premises subject to the Fire Certificates (Special Premises) Regulations 1976 (SI 1976 No. 2003), enforced by HSE, and the Fire Precautions Act 1971, enforced by the Fire Authority, the presence of LPG may be taken into account when considering the general fire precautions.

Note: although LPG itself is not subject to the Petroleum (Consolidation) Act 1928 the Petroleum Licensing Authority may take its presence into account in determining the condition to any licence that may be issued under the Act.
Scope

8 This guidance applies to the keeping of LPG in containers where the total quantity stored exceeds 15kg, but the general principles may be applied to the keeping of smaller quantities. It also applies to containers on loaded vehicles parked other than on a public highway eg at an LPG store, retail outlet, etc.

9 The guidance note does not deal with the following:

(a) LPG containers being transported by road or when the vehicle is parked for a short period eg during a meal break;
(b) cylinders fitted to a vehicle to provide fuel for any purpose on the vehicle;
(c) the storage of aerosol products in which LPG is used as a propellant;
(d) the use of LPG from cylinders;
(e) the filling of containers except where nominally empty cylinders are stored before filling and where filled containers are set aside in a designated area after filling.

10 Detailed guidance is not given on the design, construction or maintenance of containers but some information on containers and cylinder fittings can be found in Appendix 1, on cylinder marking in Appendix 2, and on maximum LPG container charges in Appendix 3.

DEFINITIONS FOR THE PURPOSE OF THIS GUIDANCE NOTE

11 Liquefied petroleum gas (LPG) A generic term used to describe liquids and gases normally consisting of C3 and C4 hydrocarbons, eg propane and butane to BS 4250 and methyl acetylene.

12 Cartridge A nonrefillable container of less than 1.4 litres water capacity, designed to be disposed of when empty and constructed to a recognised standard, eg BS 5329. The term does not include cigarette lighters and similar small containers.

13 Container A cylinder or cartridge.

14 Cylinder A portable refillable container up to 150 litres water capacity designed to a recognised standard eg BS 5045.

15 Nominally empty cylinder A cylinder from which most if not all liquid has been discharged but which will still contain LPG vapour.

16 Compartment A room separated from other parts of a building by walls, ceiling, floor etc of at least 30 minutes fire resisting construction.

17 Display Containers which have been removed from storage and are on show to the public.

18 Enforcing authority Is the authority with a duty to enforce the HSW Act and other relevant statutory provisions. This is normally HSE or the local authority for the area as determined by the Health and Safety (Enforcing Authority) Regulations 1977 (SI 1979 No. 746).

19 Element of construction Any wall, floor, ceiling, roof, door or window (including the frames) etc which forms part of a building, room or other enclosure.

20 Fire resisting A fire resisting element of construction is one that would have at least the stated period of fire resistance (ie stability, integrity and insulation) if tested, from either side, in accordance with British Standard BS 476 Fire tests on buildings and materials and structure Part 1: 1953 or Part 8: 1972:

(a) where two or more elements of construction adjoin and together provide separation, the junction between them should be bonded or fire stopped to prevent or retard the passage of flames or hot gases, thus giving effective fire separation between the rooms or spaces on either side;
(b) elements of construction should be of sufficiently robust construction so that their fire resisting properties are not impaired by damage caused by everyday wear and tear. Additional protection, eg crash barriers, reinforcing plates, wearing strips etc, may be required when mechanical damage is foreseeable;
(c) the roof or ceiling of a store should be tested as a floor where:
(i) the roof is being used for storage;
(ii) an external escape route passes over it;
(iii) the roof or facade of another part of that or any other building would suffer from thermal radiation, should the roof or ceiling of the store be breached by fire; or
(iv) where there is another room above;
(d) when this Standard is applied to a door and its frame:
(i) the door should be self closing and free from any means which would allow it to be fixed in the open position
(ii) all clearances should be kept as small as is practicable; and
(iii) the hinges and fixings should be of non-combustible material and have a melting point in excess of 800° Celsius.

21 Fire Wall A fire wall should be of at least 30 minutes fire-resisting construction, Imperforate and solid masonry or concrete. The wall should be at least as high as the highest stack with a minimum height of 2m and be long enough to ensure that the minimum distance given in column 3 of Table 2 is met when measured from the nearest cylinder in the stack around the wall. Barriers constructed of other materials eg earth banking, may be equally effective for this duty.

22 Keeping Includes storage, handling (other than conveyance) and keeping for use where there is the
intention to transfer LPG into or out of the cylinder at that place.

23 Non-combustible material A material that can be classified as non-combustible when subjected to the test for non-combustibility given in BS 476 Part 4 1970 or Part 11: 1982.

24 Separation distance The horizontal distance between the nearest cylinder in the storage area and the reference feature.

25 Storage Stocks of full or nominally empty LPG containers where there is no intention of transferring LPG out of the containers.

26 Storage area (or store) An area set aside for the storage of LPG containers where there is no intention of using the LPG.

27 Use, (Used or using) covers any activity involving the consumption of LPG in an appliance, whether immediately or within a reasonable time of the cylinder being connected to the appliance.

28 Vulnerable Population People who cannot be evacuated easily and quickly from premises because of age or infirmity eg those in a nursery school, old peoples home, hospital etc.

29 Zone 2 For the purpose of hazardous area classification a Zone 2 area is defined in BS 5345: Part 1 as one in which an explosive gas-air mixture is not likely to occur in normal operation, and if it occurs it will exist only for a short time.

PROPERTIES AND HAZARDS OF LIQUEFIED PETROLEUM GAS IN CONTAINERS

30 The LPG commonly supplied in containers is either ‘commercial butane’ or ‘commercial propane’. The characteristics and composition of these products are contained in BS 4250. Their main physical properties are given in Table 1.

31 Propane or butane gas can be easily liquefied by the application of moderate pressure. The liquid has approximately 1/250th of the gas volume and can thus be more conveniently stored in containers. The liquefied gas is normally vaporised for use as a fuel.

32 At normal temperature (15°C) liquefied ‘commercial butane’ has a gauge pressure of about 2 bar (28 psig) and liquefied ‘commercial propane’ about 7 bar (100 psig).

33 LPG forms flammable mixtures with air in concentrations of between about 2% and 10% by volume. A fire or explosion could occur if LPG escapes from a container and is ignited, particularly in a confined space where an explosion could result in serious damage. If an LPG container is involved in a fire, it will overheat and may rupture violently. Pieces of the container may be projected over considerable distances. Where a cylinder is fitted with a safety (pressure relief) valve (PRV) the risk of violent rupture is reduced significantly and the distances over which missiles will be projected will be smaller.

34 LPG is colourless and its weight as a liquid is approximately half that of the same volume of water. If LPG is split on water it will float on the surface before vaporising. The gas is at least 1 1/2 times heavier than air and does not disperse easily. It will tend to sink to the lowest possible level and may accumulate in cellars, pits, drains or other depressions. It is important that LPG is always stored or used in a well ventilated position so that any small leaks will disperse and be diluted to well below the flammable concentration.

35 As LPG is odourless, commercial grades are normally odorised before distribution so that they have a characteristic smell that can be easily recognised in low concentrations (at about 20% of the lower flammable limits).

36 Leaks of gas from a cylinder valve may be detected by sound, smell or by frosting in the area of the leak. Small leaks may be detected by brushing the cylinder with a solution of detergent in water. Bubbles will form at the leak. ON NO ACCOUNT SHOULD A NAKED FLAME BE USED TO DETECT A LEAK.

37 When LPG is vaporised, heat is drawn in from the surroundings. LPG liquid can produce severe frost burns on skin.

Table 1 Physical properties of liquefied petroleum gas

<table>
<thead>
<tr>
<th>Physical property</th>
<th>Commercial butane</th>
<th>Commercial propane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative density (to water) of liquid at 15.6°C</td>
<td>0.57—0.58</td>
<td>0.50—0.51</td>
</tr>
<tr>
<td>Litres/Tonne of liquid at 15.6°C</td>
<td>1723—1760</td>
<td>1965—2019</td>
</tr>
<tr>
<td>Relative density (to air) of vapour at 15.6°C and 1015.9 mbar</td>
<td>1.90—2.10</td>
<td>1.40—1.55</td>
</tr>
<tr>
<td>Ratio of gas to liquid volume at 15.6°C and 1015.9 mbar</td>
<td>233</td>
<td>274</td>
</tr>
<tr>
<td>Volumes of gas/air mixture at lower limit of flammability from 1 volume of liquid at 15.6°C and 1015.9 mbar.</td>
<td>12,900</td>
<td>12,450</td>
</tr>
<tr>
<td>Boiling point °C</td>
<td>—2</td>
<td>—45</td>
</tr>
<tr>
<td>Vapour pressure at 20°C bar g</td>
<td>2.5</td>
<td>9</td>
</tr>
<tr>
<td>psig</td>
<td>40</td>
<td>130</td>
</tr>
<tr>
<td>at 50°C bar g</td>
<td>7</td>
<td>19.6</td>
</tr>
<tr>
<td>psig</td>
<td>100</td>
<td>283</td>
</tr>
<tr>
<td>Lower limit of flammability, % v/v</td>
<td>1.6</td>
<td>2.2</td>
</tr>
<tr>
<td>Upper limit of flammability, % v/v</td>
<td>9.0</td>
<td>10.0</td>
</tr>
</tbody>
</table>

Source: LPGITA An Introduction to Liquefied Petroleum Gases.
STORAGE

38 Because of the fire hazards associated with LPG, containers should be held in a properly constructed and carefully controlled storage area either outdoors or where that is not reasonably practicable indoors to meet the general requirements given in paragraphs 40 to 59. More detailed advice is given for:

(a) outdoor storage in paragraphs 60 to 80;
(b) roof top storage in paragraphs 80 to 89;
(c) storage in specially designed buildings in paragraphs 90 to 103;
(d) storage in a specially designed storage area within a building in paragraphs 104 to 114;
(e) storage in cabinets and cupboards in paragraphs 115 and 116.

39 A cylinder which has held LPG and is nominally empty will still contain LPG vapour. If the valve is left open, air will diffuse into the cylinder and may form a dangerous mixture. For the purpose of this guidance a LPG cylinder should be considered full, whatever the state of its contents, unless it is:

(a) stored in the open air subject to the provisions in paragraphs 78 to 80;
(b) a new cylinder which has never been filled;
(c) a used cylinder which has been gas freed and suitably marked; or
(d) a dummy cylinder used only for display purposes.

General requirements for storage (other than roof top)

40 LPG CYLINDERS SHOULD BE STORED IN A WELL VENTILATED POSITION, PREFERABLY IN THE OPEN AIR. Effective ventilation will ensure that any small leaks will disperse and be safely diluted to well below the flammable concentration within a short distance of the source.

41 Other materials stacked near LPG containers should not obstruct or restrict natural ventilation of the storage area (Note the restriction on combustible and toxic materials in paragraph 51).

42 LPG should not be kept below ground level in cellars, basements or pits.

43 LPG containers should not impede or endanger the means of escape from the premises or adjoining premises.

44 The floor of a store should be level. The area where containers are to be stacked should be concreted, paved or compacted to provide a load bearing surface.

45 People, especially children, have been seriously injured tampering with unattended LPG containers. Steps should be taken to prevent tampering and vandalism. The arrangements should take into account both the general security of the premises and the situation in the vicinity of the storage area. Any fencing provided should be of robust industrial type wire mesh or equivalent that will not obstruct ventilation (see paragraph 64).

46 The storage area should be placed at a safe distance from the property boundary, any building or fixed sources of ignition. The safe distance is the separation distances for a given quantity of LPG shown in Table 2. This distance will minimise the hazards from incidents at or near a store, for example, the accidental release of LPG vapour from a faulty, damaged or partly opened valve, a fire on neighbouring premises or a fire on site involving cylinders. A separation distance may only be reduced where suitable fire resisting separation has been provided, for example, by the use of a fire wall (see paragraph 66).

47 The minimum separation distance may not always provide complete protection from the hazards of thermal radiation or missiles which may result from a fire in a cylinder store. For quantities over 400kg a minimum separation distance of 8m or that given in Table 2, column 3, which ever is the greater, should be provided between a storage area and any building nearby that houses a vulnerable population, to give additional protection from the effects of thermal radiation from a cylinder stack fire. This distance may be reduced to those given in Table 2, column 4 only where fire resisting separation or a fire wall has been provided, for example, where the wall of the building facing the store is imperforate and of not less than 30 minutes fire resisting construction or for a single storey building where it is protected by a fire wall.

48 Smoking, and other sources of ignition, should be prohibited in a store or within the separation distance given in Table 2. Motor vehicles other than fork lift trucks and those delivering or collecting LPG should be excluded from open air stores. Other vehicles under the control of the occupier may be parked within the separation distance but no closer than 3m. Where necessary, suitable barriers should be erected to prevent unauthorised access and accidental damage.

49 No opening into buildings, cellars or pits should be within 2m of an LPG storage area or the separation distance given in Table 2 which ever is the greater. Where a gully or drain is unavoidably within 2m, the opening should be securely covered or fitted with a suitable water seal to prevent the Ingress of vapour.

50 Only electrical equipment that is suitable for use in a Zone 2 area (eg to BS 5345) and constructed to a recognised standard (eg BS 5501) should be installed for use either in a storage area or within the separation distance given in Table 2. A summary of Zone 2 areas is given in Table 3.

51 Flammable liquids, combustible, corrosive, oxidising, toxic materials or compressed gas cylinders should be kept separate from LPG containers. Where the quantity of LPG exceeds 50kg,
such materials should be separated from stored LPG containers by either a safe distance (see paragraph 62) or a fire wall. However the storage of acetylene cylinders with LPG is permissible in specially designed buildings (see paragraph 94). Small oxygen cartridges also may be stored with LPG cartridges as described in paragraph 52 except in premises where the HFL Regulations apply.

52 LPG and oxygen sold for welding or brazing in boxed kits may be stored together, provided that each kit includes no more than one oxygen container no larger than 50g in capacity, or one container of no more than 500g of oxygen-making pellets. Spare oxygen containers of this size may be placed in the same storage area provided that they are stored either in separate stacks or in separate sections of racking. Where more than an aggregate quantity of 5 000kg of LPG is to be stored in kits specialist advice should be sought. For large welding kits that include an oxygen container of more than 50g capacity the container should be detached and together with any spare oxygen containers should be stored separately from the LPG.

53 The extent of the LPG storage area should be clearly marked and a suitable notice or notices should be displayed prominently to indicate clearly:
(a) that it is an LPG storage area;
(b) that the contents of the storage area are flammable;
(c) that smoking or other sources of ignition are prohibited;
(d) the procedures to be followed in case of fire.

### Table 2

Minimum separation distances for (1) Total LPG storage or (2) Size of maximum stack (which ever of the two result in the greater distance should be used)

<table>
<thead>
<tr>
<th>Total quantity LPG Store</th>
<th>Size of largest Stack</th>
<th>Minimum separation distance to boundary building or fixed ignition sources FROM THE NEAREST CYLINDER (where no fire wall is provided)</th>
<th>Minimum separation distance to boundary building or fixed ignition source FROM FIRE WALL (where provided) (a), (b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kilograms</td>
<td>Kilograms</td>
<td>Metres</td>
<td>Metres</td>
</tr>
<tr>
<td>15 to 400</td>
<td>1500 to 4000</td>
<td>1 (c)</td>
<td>NIl</td>
</tr>
<tr>
<td>400 1000</td>
<td>up to 1000</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>1000 4000</td>
<td>from 1000 to 3000</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>6000 12000</td>
<td>3000 7000</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>12000 20000</td>
<td>5000 7000</td>
<td>6</td>
<td>2.5</td>
</tr>
<tr>
<td>20000 30000</td>
<td>7000 9000</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>30000 50000</td>
<td>9000 10000</td>
<td>8</td>
<td>3.5</td>
</tr>
<tr>
<td>50000 60000</td>
<td>10000 20000</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>60000 100000</td>
<td>11000 20000</td>
<td>10</td>
<td>4.5</td>
</tr>
<tr>
<td>100000 150000</td>
<td>10000 20000</td>
<td>11</td>
<td>5</td>
</tr>
<tr>
<td>150000 250000</td>
<td>20000 30000</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>above 250000</td>
<td></td>
<td>20</td>
<td>6</td>
</tr>
</tbody>
</table>

Notes
(a) The distance from the nearest cylinder to a boundary, building etc should be not less than the distance given in column 3 when measured around the fire wall.
(b) Minimum distance from nearest cylinder to fire wall should be 1.5m except as qualified in paragraphs 73 and 75 for quantities up to 400kg.
(c) No separation distance is required for these quantities where boundary walls and buildings are of suitable construction (paragraphs 69 to 71).

### Table 3

Areas classified as Zone 2 for the selection of electrical equipment

<table>
<thead>
<tr>
<th>Location</th>
<th>Extent of classified area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage in open air</td>
<td>In the storage area up to a height of 1.5m (5ft) above the top of the stack, or beneath any roof over the storage place.</td>
</tr>
<tr>
<td></td>
<td>Outside the storage area or the space covered by any roof up to 1.5m above ground level and within the distance set out for a fixed source of ignition in Table 2 column (3).</td>
</tr>
<tr>
<td>Storage within a specially designed building or specially designed storage area within a building</td>
<td>The entire space within the building or storage area and outside any doorway, low level ventilator or other opening into the store within the separation distance set out in Table 2 column (3) up to a height of 1.5m above ground level.</td>
</tr>
</tbody>
</table>
If pictorial signs are provided they should conform to the Safety Signs Regulations 1980.

54 There should be no accumulation of rubbish, dry leaves, small bushes or other materials within the separation distance given in Table 2 which might easily catch fire. Long grass and weeds also should be removed within the separation distance and up to 3m from the cylinders. If weed killers are used, chemicals such as sodium chlorate, which are potential sources of fire danger, should not be selected for this purpose. Packaging other than the immediate cartridge or pallet wrappings should be removed where reasonably practicable.

55 The outlet valve of every LPG cylinder should be kept closed while the cylinder is in store or not in use. If the cylinder is required to have a protective cover, cap or plug this should be in place while the cylinder is being handled or stored.

56 LPG containers should be stored or displayed with their valves uppermost. This ensures that if there is a leak from the valve area vapour, and not liquid, will escape. Cartridges without valves, however, may be stored or displayed on their sides.

57 Cylinders kept on a vehicle or trailer parked overnight, other than on a public highway, should be treated as a single stack and the appropriate separation distance given by Table 2 column 3 applied.

58 Care should be taken with the handling and stacking of containers to avoid both injury and damage to the containers.

59 Containers, as they are received into store, or taken out for delivery, should be checked for signs of damage or leakage. This check is particularly important when a container is to be taken indoors. Stacked cylinders should be inspected daily to ensure the stacks are stable and that they contain no damaged or leaking cylinders. Such cylinders should be removed, appropriately marked and placed in a safe place in the open air awaiting attention or return to the supplier (paragraph 148).

OUTDOOR STORAGE

60 A well ventilated site in the open air should be chosen for storing LPG containers to allow easy dispersal of any small gas leaks. Surrounding tall buildings and high walls may interfere with the natural ventilation. As a general guide, not more than 50% of the perimeter of the storage area should be obstructed with the obstructions not on adjacent sides. For stores containing less than 400kg at least 25% of the perimeter should be substantially unobstructed. Figure 1 shows many of the features required for outdoor storage.

61 The storage area should be located and spaced in accordance with Table 2. The required minimum separation distances between an LPG cylinder store and any opening into buildings, combustible structures, boundaries, places to which the public have access, or fixed sources of ignition should be determined either by consideration of the total amount of LPG stored, or the size of the maximum stack in the storage area. The figure resulting in the greater distance should be used.

62 LPG cylinders in excess of 50kg total quantity should not be stored or kept within 3m of a vessel containing flammable liquid, a bunded area around a vessel containing a highly flammable liquid, compressed gas cylinders including acetylene, bulk LPG vessel of 5000 litres capacity or less, explosive or combustible materials (see paragraph 51). This distance should be increased to 7.5m in the case of a liquid oxygen installation, a bulk LPG vessel of more than 5000 litres capacity or from the cylinder filling buildings at filling plants. Advice should be sought from HSE where it is proposed to store chlorine or other toxic compressed gases.

63 The ground should be graded or diversion or bund walls provided where a dangerous liquid or dense vapour eg flammable liquid oxygen or LPG could flow towards stored cylinders should a leak occur.

64 To prevent trespassing or tampering, every LPG storage area should be enclosed by a substantial fence not less than 1.5m high unless it is otherwise adequately protected ie the area comes within a greater fenced area. The fence should not obstruct ventilation. Except as provided in paragraphs 69 and 80(b) cylinders should not be placed within 1.5m of the fence unless it is a boundary fence when the distances given in Table 2 will apply. Where vandalism is a problem additional security measures will be required but these should not interfere with the ventilation of the store. In most cases it will be appropriate to enclose the storage area in a lockable compound of robust industrial type wire mesh eg twelve gauge x 52mm x 52mm mesh welded panels or 12 gauge chain link fencing (Figure 2). Each compound should have two or more exists to provide alternative means of escape. Gates should open outwards to provide an easy means of escape for people from within. They should not be self locking but should be locked when unoccupied. A single exit is permitted provided that the escape travel distance from any part of the store to the exit is less than 12m measured round the containers.

65 For rooftop and temporary storage eg on construction sites it may not be reasonably practicable to provide a storage compound as described in paragraph 64 or a specially designed building as described in paragraphs 91 to 99. In such cases where additional security is required and where 400kg of LPG or less is stored cylinders may be kept in a small lockable wire cage in a safe place in the open air. If the 1.5m separation distance inside the cage is not maintained a small mesh size should be selected to prevent any unauthorised tampering with the valves of cylinders from outside the cage and the minimum separation distance should be maintained from the stack to a boundary, building etc.

66 Where the minimum separation distances cannot be met, the use of fire walls permits the separation
Fig 1: Typical outdoor LPG cylinder store

- Compressed gas cylinders (para 62)
- Nominal empty cylinders (para 78-80)
- Sales/office building (para 61)
- First aid fire precautions (para 138-140)
- Wire mesh fence (para 64)
- Separation distances (Table 2)

- 3.0m (min) Separation distance between nominally empty cylinders and boundary
- 3.0m (min) separation from nominated empty cylinder
- Notices displayed, (para 53)
- Bulk Flammable liquids (para 62)
- Steel wall for spillage (para 63)
- Palletized cylinders (para 76)
- Unpalletized cylinders (para 76)
- Cylinders kept on parked vehicle should be included in the total of LPG stored and be treated as storage cylinders (para 8)

- 1st exit
- Second exit

- Storage area clearly marked

- Area classification for electrical equipment (Table 3)

- Separation distances (Table 2)
distances to be reduced to those shown in column 4 of Table 2. To minimise interference with site ventilation, the total length of wall provided should be restricted to meet the ventilation requirements recommended in paragraph 60. Cylinders should not be stacked against a wall except in a small store where 400kg or less are stored (paragraphs 69 to 75). Elsewhere a space of at least 1m should be provided between the stack and the wall to allow access for inspection or the removal of a faulty cylinder.

67 The total amount of LPG stored in individual storage areas within a single site may be considered separately provided that the distance from any cylinder in one storage area to any cylinder in an adjacent storage area is not less than the sum of the minimum separation distances appropriate to each area in accordance with Table 2.

68 Where a canopy is provided over the storage area for weather protection it should be constructed of non combustible, preferably lightweight friable material that will break up quickly in a fire. The supporting structure should be of not less than 30 minutes fire resisting construction with respect to stability. Sufficient space should be maintained between the top of any stack and the underside of the canopy so that cooling water can be applied to the cylinders in a fire. Where the storage area covered by a canopy exceeds 10m x 10m fire protection should be provided either by fixed monitors or a sprinkler system designed to discharge water to cover the storage area at the rate of 12.5 litres/m²/min.

Storage of 400kg or less against a wall or between two or three walls in cylinders of 20 kg or less

69 LPG may be stored, where necessary, with the wall owner's permission, next to a boundary wall, provided that the wall is not less than 2m high, of not less than 30 minutes fire resisting construction and imperforate on either side of the storage area within 1m of a boundary, 2m of any building opening or 3m of other flammable materials. The height of the stack must not exceed the height of the wall (Figure 3).

70 If the wall against which LPG is stored is that of a building, any part of that facade, including any overhanging roof, up to a height of 9m and extending horizontally for a distance of 2m on either side of the storage area, should be of 30 minutes fire resisting construction and imperforate (Figure 4).

71 Where part of the building is used for residential accommodation the facade including any overhanging roof against which the LPG is stored should be of 60 minutes fire resisting construction and imperforate (Figure 4).
72 Passageways or yards enclosed by two or three walls and less than 3m wide by 5m long are generally unsuitable as storage areas.
73 LPG may be stored in the angle between two walls, eg in the corner of a yard (Figure 5).
74 Where the storage area is surrounded by three walls at least one should not be more than 3m high.
75 It may sometimes be convenient to store LPG in a bay between two wing walls (Figure 6). If such wing walls are less than 2m high, they should be ignored for separation purposes and the area should be treated as if the storage area were located against a single wall as in Figure 3. If the wing walls are 2m or more high, separation distances may be calculated by measuring along and around the perimeter of the wing walls (Figure 6) so that doors may be located closer to the storage area. The wing wall should not extend outwards more than 1m beyond the storage area, so that ventilation is not impeded.

Cylinder stacking — size and height of stacks and gangways between stacks
76 The general requirement for stack sizes are set out in Table 2. The maximum size of any stack should not exceed 30 000kg and:
(a) the gangway between palletised stacks should not be less than 2.5m;
(b) the gangway between unpalletised stacks should be not less than 1.5m;
(c) the maximum height of any unpalletised stack should not exceed 2.5m. The amount of LPG in any vertical column of a stack should not exceed that shown in Table 4 and there should be no more than seven pallets in any vertical column of any stack.

Table 4 Amount of LPG in vertical columns of stacks

<table>
<thead>
<tr>
<th>Amount of LPG in any cylinder (Kg)</th>
<th>Amount of LPG in any vertical column (Kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 6</td>
<td>35</td>
</tr>
<tr>
<td>from 6 to 15</td>
<td>75</td>
</tr>
<tr>
<td>&quot; 15 to 20</td>
<td>80</td>
</tr>
<tr>
<td>&quot; 20 to 55</td>
<td>110</td>
</tr>
</tbody>
</table>

77 A well planned layout is necessary for easy access to all parts of a store. Segregation of cylinders could be arranged by size, material of construction (steel or aluminium), contents (full, nominally empty, propane, butane) and whether or not they are fitted with pressure relief valves. Separate stacking of aluminium cylinders, large...
Fig 4  Storage for 400kg or less against a building

Fig 5  Storage for 400kg or less in a corner
cylinders (eg with capacities of 20kg or over) and cylinders not fitted with relief valves furthest from the site boundary will increase the degree of protection for neighbouring properties in a fire as would the storage of nominally empty cylinders nearest a boundary (see paragraphs 78 to 80).

**NOMINALLY EMPTY LPG CYLINDER STORAGE AT FILLING PLANT AND DISTRIBUTION CENTRES**

78 Paragraph 39 advises that refillable LPG cylinders should be considered full whatever the state of their contents. Although there are several reasons for this, the more important concern the difficulties in distinguishing between full and nominally empty cylinders and in keeping them apart under all working conditions. This is particularly true of retail premises and other small stores. The difficulties are not so great, however, in the larger storage areas where greater supervision is possible for example at filling plants and major distribution centres where 25 000kg or more is stored in cylinders.

79 In such cases some relaxation of the normal requirements, including separation, may reasonably be allowed for the nominally empty cylinder storage areas where the provisions in paragraph 80 can be met and maintained to ensure that full cylinders are stored separately from nominally empty cylinders.

80 Nominally empty cylinders may be kept within the separation distances indicated in Table 2 of this guidance where the following operational requirements are satisfied:

(a) the storage area is in the open air;

(b) a separation distance of at least 1m is maintained between each nominally empty cylinder and a boundary, building or fixed ignition source;

(c) a separation distance of at least 2m is maintained between each nominally empty cylinder and a cylinder containing oxygen, the bund around a vessel containing a highly flammable liquid, a combustible material or other material whose major risk is toxicity;

(d) a separation distance of at least 3m is maintained between each nominally empty cylinder and a full cylinder in an adjacent full cylinder storage area;

(e) the full and nominally empty cylinder storage areas should be clearly marked and supervised to ensure that only nominally empty cylinders are placed in any storage area which has been set aside for them;

(f) the storage area should not normally be accessible to the general public, customers or other unauthorised persons.

**ROOF TOP STORAGE**

81 Where storage cannot be provided in accordance with the preceding paragraphs for outdoor storage LPG containers may be stored in the open air on a roof providing that the total quantity does not exceed 400kg and the conditions given in paragraphs 82 to 89 are met.

82 The storage area should be located and spaced in accordance with Table 5 and the openings into any chimneys or air intakes on the roof should be at least 1m above the level of the tops of any stacked containers.
83 The section of roof used for storing LPG should not be used for storing other materials.

84 The part of the roof on which the cylinders are being stored should be substantially level, adequately supported to carry the weight and constructed to give 60 minutes fire resistance.

85 The roof should be well ventilated and not enclosed by other higher parts of the building, or adjacent buildings, on more than two sides.

86 Cylinders should be enclosed in a strongly built metal cage to prevent their being blown about in high winds and to discourage vandals. The store should be clearly marked see paragraphs 53 and 65.

87 The cage may be placed against a wall or parapet at the edge of the roof provided that the wall is at least the height of the stacked cylinders and the ventilation of the storage area is not impaired.

88 A safe means of access should be provided to the cage and access to the section of roof used for storage should be restricted to those authorised.

89 A safe system of work should be provided for the movement of containers to and from the storage area to minimise the risk of injury and damage to containers during transit. When a lift is used only the person moving the LPG containers should travel in the lift with the LPG. No other goods or passengers should enter the lift. Containers should be in the lift for as short a time as is reasonably practicable.

### Table 5 Separation distances for roof top storage

<table>
<thead>
<tr>
<th>Feature</th>
<th>Cylinders</th>
<th>Cartridges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boundaries, openings into buildings, edges of the roof, drains, vents and sources of ignition</td>
<td>3m</td>
<td>1m</td>
</tr>
<tr>
<td>Intakes of mechanical ventilation systems and outlets from chimneys, flues etc.</td>
<td>5m</td>
<td>1m</td>
</tr>
</tbody>
</table>

### INDOOR STORAGE

90 Where the storage of LPG in the open air is not reasonably practicable, and provided that the quantities do not exceed those shown in Table 6, cylinders and other containers may be stored indoors in:

(a) a specially designed single storey building;
    (paragraphs 91 to 103; or

(b) a specially designed storage place within a building; (paragraphs 104 to 114); or

(c) a cabinet or cupboard (paragraphs 115 and 116); and

may be kept for use elsewhere in a building (paragraphs 117 to 137).

Container storage in specially designed buildings

91 A total of not more than 5000kg of LPG in either cylinders or cartridges or both should be kept in a building or in each compartment of a building which is specially designed for the storage of LPG. No building should have more than five compartments.

92 The building should be of single storey construction and not below ground level. There should be no drains or other openings in the floor (Figure 7).

93 Access to the store should be restricted to authorised people who should not include customers.

94 The store should be only used for LPG containers except for acetylene and oxygen, as provided in paragraphs 51, 52 and 95.

95 Where separate storage arrangements are not reasonably practicable cartridges containing oxygen may also be stored with LPG cartridges provided that the total quantity of LPG so stored does not exceed 5000kg and the quantity of oxygen in each cartridge does not exceed 50g. Packages which contain cartridges of both oxygen and LPG should be stored in stacks which are not more than 2m high and 2m wide.

96 The building should be of not less than 30 minutes fire resisting construction, preferably of brick or concrete. Where the separation distances to a boundary, other buildings etc given in Table 2, column 3 are exceeded for the quantity of LPG

### Table 6 Storage in a building

<table>
<thead>
<tr>
<th>Type of building</th>
<th>Maximum LPG per Compartment</th>
<th>Maximum No of Compartments</th>
<th>Total Maximum in Building</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specially designed single storey building</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Cylinders and Cartridges</td>
<td>5000kg</td>
<td>5</td>
<td>25 000kg</td>
<td>See paragraph 91</td>
</tr>
<tr>
<td>(b) Cartridges only</td>
<td>50 000kg</td>
<td>5</td>
<td>250 000kg</td>
<td>See paragraph 100</td>
</tr>
<tr>
<td>Specially designed storage space within existing buildings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Cylinders and Cartridges</td>
<td>1000kg</td>
<td>1</td>
<td>1000kg</td>
<td>See paragraph 105</td>
</tr>
<tr>
<td>(b) Cartridges only</td>
<td>5000kg</td>
<td>1</td>
<td>5000kg</td>
<td>See paragraph 105</td>
</tr>
</tbody>
</table>
stored, either, in the building, or, if subdivided in each compartment, the external wall cladding and roof may be non combustible and supported by a structure which has 30 minutes fire resistance with respect to stability. Internal walls subdividing any store should be of not less than 30 minutes fire resisting construction.

97 The building should have well dispersed ventilation openings to a safe place in the open air at both high level in the walls or roof and at floor level totalling at least 2.5% of the combined area of the walls and roof. Ventilation openings are not permitted in any part of the building that is required to be fire resisting (ie that is within the specified separation distances given in Table 2 column 3).

98 The buildings should have an area equal to at least half of one wall or half of the roof made of open mesh or lightweight materials that could act as explosion relief. This relief should be designed and positioned so that the explosion would be safely vented and parts of the wall or roof would not become dangerous missiles.

99 A single exit is permitted, provided that the escape travel distance from any part of the store to the exit, including any diversion round the stored containers, is less than 12m.

Cartridges — separate storage

100 Where only cartridges are stored the quantity of LPG kept in a specially constructed building or in each separate compartment may be increased to 50 000kg provided that, in addition to meeting the requirements in paragraphs 91 to 99, the building is protected by a water sprinkler system having a minimum discharge density of 12.5mm/min ie 12.5 litres/m²/min.

101 The cartridges should be stored in stacks not more than 4m high and 2m wide. Alternatively racked storage may be used.

102 The use of combustible packaging materials should be kept to a minimum.

103 Cartridges should be inspected regularly and a system of stock rotation used to ensure that cartridges are not left to deteriorate, corrode and leak.

Container storage in a specially designed storage area within a building

104 Where storage in the open air or in separate buildings is not reasonably practicable, LPG may be stored in specially designed storage areas in buildings that comply with the conditions in paragraphs 105 to 114.

---

**Fig 7** Indoor storage in a specially constructed building
105 A specially designed storage area may be made within the confines of another building provided that the total quantity stored there does not exceed 1000kg for cylinders or 5000kg where only cartridges are stored.

106 A specially designed storage area should not be located in a building of more than one storey to which the public have access or which is used for sleeping accommodation except for the small scale storage at retail premises given in Guidance Note CS8 (see paragraphs 124 to 138).

107 The storage area should be at ground floor level. At least one side of the specially designed store should be an external wall of the containing building.

108 The internal walls should be masonry or similar construction. The doors, ceiling and floor which separate the store from the rest of the building should be of not less than 30 minutes fire resisting construction and be sufficiently robust so as not to be damaged in normal use.

109 The doorway into a store should be located in an outside wall otherwise a ramp, sill or step at least 250mm high should be provided across the doorway to the store in order to prevent heavy vapours from entering the other parts of the building.

110 Adequate natural ventilation should be provided by permanent openings in the outside wall equal in area to at least 12% of the area of one of the outside walls or 2.5% of the total area of the walls and roof which ever is the greater. They should be well dispersed at both high and low level.

111 To minimise the effect of any explosion in the store, explosion relief equivalent to half the area of one of the walls should be provided. This relief should be located in an outside wall and vent to a safe place. In the case of a single storey building, the relief may be placed in the roof. The area provided for relief may be left or covered by industrial wire mesh or lightweight panels. If panels are used, they should be designed so that in an explosion they will open and safely vent the explosion but will not break loose and become dangerous missiles.

112 The openings specified in paragraphs 110 and 111 will provide adequate ventilation and explosion relief for a normal shaped room. If the store has a floor area of more than three times the area of the external wall, specialist advice should be sought from HSE.

113 Any part of the building facade, including any overhanging roof, up to a height of 9m and extending horizontally for a distance of 2m on either side of any opening into the storage area, should be of 30 minutes fire resisting construction and imperforate.

114 Where the building is also used for residential purposes 60 minutes fire resisting separation should be provided between the two occupancies with, where possible, no connecting doors or direct access. A suitable automatic fire detection system and alarm should be provided and maintained. The alarm should be audible throughout the building, including the residential accommodation, and should be capable of giving warning of a fire anywhere in the building. The requirement for a fire alarm in such circumstances is without prejudice to any requirement to provide an alarm under the Fire Precautions Act 1971.

**Storage in cabinets and cupboards**

115 Where alternative storage is not reasonably practicable limited quantities of LPG may be stored in a cabinet or cupboard in a building provided that the following conditions and those in paragraph 116 are observed:

(a) In a single storey building not connected to, or contiguous with residential property, both cylinders and cartridges may be stored in a cabinet or cupboard, but the total quantity of LPG in the building, including that displayed for sale and kept for heating and/or lighting, or for any other purpose, should not exceed 400kg;

(b) In a multistorey building in which there is no residential accommodation, a total of 300kg of LPG in cartridges may be stored in a cabinet or cupboard; LPG in cylinders may not be stored in the cabinet or cupboard. Where a multistorey building has more than one occupier the total amount stored in the building should be limited to 400kg;

(c) In any building which includes residential accommodation no more than 70kg of LPG may be stored in a cabinet or cupboard, in cartridges. For retail premises this is in addition to any cartridges that may be displayed for sale. LPG in cylinders may not be stored in the cabinet or cupboard. Only one cabinet or cupboard should be located within the building. An automatic fire detection and alarm system should be installed and maintained eg to BS5839. The alarm should be audible throughout the building, including the residential accommodation, and should be capable of giving warning of a fire anywhere in the building. The requirement for a fire alarm in such circumstances is without prejudice to any requirement to provide an alarm under the Fire Precautions Act 1971.

116 Any cabinet or cupboard sited indoors for the storage of LPG should be:

(a) located either at or above ground level where it does not endanger any means of escape. The area around the door should be kept free of combustible materials;

(b) constructed of non combustible materials and not less than 30 minutes fire resisting construction, and should be adequately secured in position. It should have a lockable door which should be kept locked when not in use.

(c) adequately ventilated, at both high and low levels, to a safe place outside the building. If it is of more than 0.5m³ capacity, it should be fitted with explosion relief equal to half the area...
of the back or side of the unit. The relief should discharge to a safe place outside the building.

**THE KEEPING FOR USE OF CONTAINERS IN PREMISES OTHER THAN RETAIL PREMISES**

117 The quantity of LPG in a building should be kept to a minimum. Particular attention should be given to the keeping of LPG in a multi-storey building where further specialist advice may be required to establish whether the building is suitable for the keeping of a flammable gas.

118 If LPG is to be used on the premises the LPG containers should be kept in a safe place, secure against interference and preferably in the open air. Cylinders should be secured where there is any danger that they could be accidentally overturned. The supply should be connected to the appliances in a suitably safe manner, eg by permanent rigid piping, protected to prevent physical damage. The pipework should terminate at a gas tap. Short flexible hoses suitable for use with LPG (eg BS 3212) may be used for the connections between the cylinder and the pipe.

119 In the case of industrial buildings not specially designed for the storage of LPG, LPG cylinders may be kept coupled to an appliance for use (but see also paragraph 122).

120 Where it is not reasonably practicable to provide a piped LPG system in premises other than industrial buildings or retail premises, the total quantity of LPG used in cylinders or cartridges in small premises should not exceed 15kg. For larger premises 15kg may be kept in each compartment of the premises subject to paragraph 122.

121 In an emergency, such as a heating or power failure additional LPG may be required. The quantity of LPG kept in such circumstances should be no more than the minimum necessary and should be avoided where reasonably practicable in any building housing a vulnerable population. Where LPG is to be used the cylinders should be kept in accordance with the advice given in this guidance note. Once the emergency is over the additional LPG should be removed from the premises as soon as possible. Additional fire fighting equipment as outlined in paragraphs 138 to 140 may be required and clear instructions should be given on the action to be taken in an emergency (see paragraphs 146 to 155).

122 Where premises keeping LPG are occupied together with or under residential premises, 60 minutes fire resisting separation should be provided between the two occupancies with, where possible, no connecting doors or direct access. Otherwise no more than 15kg of LPG, which should include stock kept or in use for heating, lighting or other purposes, should be left in the buildings out of business hours. All other stocks of LPG should be returned to a properly constructed LPG storage area.

123 The siting of containers and appliances and their use requires careful consideration. They should be sited away from staircases, exit doors, escape routes and any combustible material. Where appliances are kept for use adequate provisions should be made for the ventilation of the room. Cylinders connected to appliances should only be changed in a well ventilated place, preferably in the open air. All nearby naked lights or other sources of ignition should be turned off. After changing a container the joint between the newly connected container and the appliance should be checked to ensure that it is gas tight.

**DISPLAY AND KEEPING FOR USE IN RETAIL PREMISES**

**General**

124 The following recommendations (paragraphs 125 to 137) are intended for the display for sale and keeping for use of LPG in containers of not more than 20kg capacity in retail premises.

125 Display stands should not be located on staircases, near exit doors, next to flammable materials or in any other place where they are likely to hinder or endanger a means of escape. In addition steps should be taken to prohibit smoking or naked lights from around the display area.

126 Only dummy or certified gas-free containers should be used for permanent display in windows, on advertising stands etc.

**Cylinders**

127 No more than five cylinders should be allowed on display in a shop. Where the largest cylinder capacity does not exceed 3kg the number on display may be increased to 20. The total contents available including cartridges should not exceed 70kg (Table 7).

128 No more than four cylinders should be connected for demonstration purposes at any one time. The total quantity of LPG in both connected cylinders and cartridges should not exceed 50kg (Table 7).

**Cartridges**

129 The number of cartridges on display and available in the retail area for sale should be as low as reasonably practicable, but the total contents available on display including cylinders should not exceed 70kg. All other LPG containers should be placed in the LPG storage area. No more than six cartridges should be connected for demonstration purposes. The total quantity of LPG connected for demonstration purposes in both cylinders and cartridges should not exceed 50kg (Table 7).

130 Cartridges have a finite shelf life and retailers should ensure adequate stock rotation. It is essential that cartridges are stored in dry, well ventilated conditions.

**Welding Kits**

131 Small kits, ie with a single 500g (max) LPG cartridge and a single 50g (max) oxygen cartridge or
500g (max) container of oxygen-generating pellets may be displayed with other LPG containers but not more than ten kits may be displayed at a time. The total number of replacement cartridges of LPG and oxygen (or oxygen-generating pellets) on display should be kept as low as is reasonably practicable but in any case should not exceed five containers of each (ie LPG and oxygen or pellets).

132 Larger welding kits should not be displayed with other LPG containers but they may be displayed separately with not more than one unit out at a time.

**LPG used for heating or lighting**

133 If LPG is to be used on the premises for heating or lighting the LPG containers in use should be kept in a safe place secure against interference and preferably in the open air. The supply should be connected to the appliances in a safe manner, eg by permanent rigid piping, protected to prevent physical damage. The pipework should terminate at a suitable gas tap. Short flexible hoses suitable for use with LPG eg to BS 3212 may be used for the final connections.

134 If it is not reasonably practicable to provide a piped system, the total quantity of LPG kept for heating, lighting, display and demonstration purposes in cylinders or cartridges should not exceed 100kg subject to paragraphs 127 to 129.

135 Heating appliances should be sited away from escape routes and any combustible material. Retailers should ensure that when appliances are used adequate provision is made for the ventilation of the room.

136 In emergencies such as heating or power failure additional LPG may, in agreement with the enforcing authority be used for heating or lighting. This should be used only for the duration of the emergency and should be removed from the premises as soon as the emergency is over.

**Premises occupied together with or under residential accommodation**

137 Where retail premises selling LPG are occupied together with or under residential premises 60 minutes fire resisting separation should be provided between the two occupancies with, where possible, no connecting doors or direct access. Otherwise no more than 15kg of LPG which should include stock for sale and LPG used for demonstration, heating or lighting purposes should be left in the retail areas of the buildings out of business hours. All other stocks of LPG should be returned to the main LPG storage area.

### Table 7 Maximum quantities of LPG displayed or kept for use in retail premises

<table>
<thead>
<tr>
<th></th>
<th>Maximum number of containers</th>
<th>Maximum quantity of LPG</th>
<th>Total LPG (including any used for heating and lighting: paragraph 133)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DISPLAY</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cylinders</td>
<td>5 or 20 if max capacity 3kg</td>
<td>70kg</td>
<td>100kg (but see also paragraph 137 where a max limit may apply out of business hours when premises are shared with residential accommodation)</td>
</tr>
<tr>
<td>Cartridges</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(paragraph 127)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cartridges</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(paragraph 129)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**FIRE PROTECTION**

First aid fire fighting equipment

138 There should be adequate portable fire fighting equipment on the premises for general use and for fires involving LPG. Further advice on fire fighting equipment and fire precautions may be obtained from either the enforcing or the fire authority.

139 The equipment for general use should be selected and located to enable fires on the premises to be extinguished at an early stage so that they do not spread to or jeopardize the LPG containers. Fire extinguishers or hose reels or an equivalent combination of the two types of equipment may be provided. Fire extinguishers should be selected, sized, located and maintained in accordance with BS 5306: Part 3: 1985, and hose reels should be selected and installed in accordance with BS 5306: Part 1: 1976.

140 In addition sufficient fire extinguishers, suitable for an LPG fire should be provided at each LPG storage area and elsewhere where containers are kept or displayed. Extinguishers should conform to BS 5423: 1980, powder extinguishers rated at 223B (eg a capacity of 9kg) will normally be suitable. Extinguishers should be located in strategic positions adjacent to the exits, round the perimeter of the store and in safe positions on access routes between stacks eg at a junction or crossing so that they will be readily available when required. At stores of less than 400kg a single extinguisher will be sufficient. There should be at least two extinguishers for stores of up to 5000kg and at larger stores an additional extinguisher should be provided for each additional 10 000kg of LPG, or part thereof, stored.
Water supplies and other fire fighting equipment

141 For stores of between 400kg and 25 000kg LPG there should be an adequate supply of water for fire protection. This should be readily available but may be provided via the public mains, or pumped from a static tank, river, canal, etc. Hydrants and hoses with spray/jet nozzles or hose reels should be installed so that any stack of cylinders may be effectively sprayed with water.

142 For stores of 25 000kg or more LPG, adequate water supplies should be arranged with a capacity to provide at least 2300 litres/minute (500 gals/min) for 60 minutes. At least two monitors should be available for use at such sites. Water mains, hydrants, pumps, etc should be installed as necessary to ensure that the water is readily available at an appropriate pressure at all times. Special consideration should be given to the possibility that there could be a loss of power to the site and the consequences that this would have for the fire fighting arrangements provided. Connections should be provided for hoses and fixed or mobile monitors so that any stack of cylinders and the adjacent stacks can be effectively cooled with water.

143 When making the provisions for fire protection care should be taken to ensure that cylinders stored in a building or under roofed areas can be effectively sprayed with water. In some cases fixed water sprays or sprinklers may be appropriate, see also paragraphs 68 and 100.

144 Vehicles loaded with cylinders and parked on the premises should be included in the provisions for fire protection.

145 Arrangements should be made to ensure an early call to the fire brigade in the event of a fire. Suitable access to the store should always be provided and maintained for fire brigade personnel, vehicles and other equipment.

EMERGENCY PROCEDURES

General

146 At all premises where LPG is kept there should be emergency procedures which set out the actions to be taken should an incident occur. The most likely incidents might include:

(a) LPG leaking from a container with or without ignition;

(b) a fire in the vicinity of LPG containers, subjecting them to radiant or direct heat and thereby affecting the safe containment of the LPG.

147 The aim of the emergency procedures should be to ensure:

(a) that everyone who might be in danger is warned;

(b) that steps are taken to control the incident and mitigate its consequences;

(c) that, where appropriate, the local emergency services are contacted;

(d) that all people not required to deal with the emergency are evacuated from the premises immediately.

Action in event of leaking container

148 If a container is found to be leaking without the gas igniting the following actions should be taken provided it is safe to do so:

(a) any nearby source of ignition should be extinguished;

(b) an attempt should be made to stop the leak by closing the valve and replacing the bung or cap;

(c) if the leak cannot be stopped, the container should be carefully removed to a well ventilated open space clear of drains, buildings and sources of ignition and other LPG containers. The leaking container should be marked faulty and left with the leak (usually at the valve) uppermost. Notices prohibiting smoking and other naked lights should be displayed. General access should be prevented, eg by barriers. The supplier of the cylinder should be informed immediately. NO ATTEMPT SHOULD BE MADE TO DISMANTLE OR REPAIR DEFECTIVE CYLINDER VALVES except by persons trained to carry out the work.

Procedure in case of fire

149 Anyone who discovers a fire should:

(a) raise the alarm, including activating any fire alarm on the premises;

(b) call the fire brigade immediately and tell them that LPG containers may be involved. The Fire Officer on arrival should be told the location of the fire and the position of the LPG containers and any other hazardous materials held on the premises.

150 If gas from a cylinder valve is alight, IF IT IS SAFE TO DO SO, either turn off the valve promptly to extinguish the flame or extinguish the flame and then turn off the valve. Where possible and IF IT IS SAFE TO DO SO the cylinder and adjacent stacks of cylinders should be cooled by spraying with copious quantities of water.

151 If the flame from the leak cannot be extinguished by turning off the valve, fire fighting should only be carried out by trained personnel or fire brigade. If the flame is extinguished but vapour continues to escape, treat the cylinder as in paragraph 148. IF THE FLAME FROM A BURNING LEAK IMPINGES ON A CYLINDER AND THIS CANNOT BE STOPPED THE AREA SHOULD BE EVACUATED IMMEDIATELY.

152 Anyone not connected with the fire fighting should be evacuated in accordance with the general procedures in case of fire drawn up for the premises. The evacuation should include anyone occupying any other accommodation connected to the building.

153 Where a fire nearby is threatening LPG containers, they should be moved to a safe place PROVIDED THIS CAN BE DONE SAFELY. Where the
cylinders cannot be moved they should be cooled by spraying with copious quantities of water.

154 It is essential that procedures for various categories of emergency are clearly defined and understood by everyone involved in the storage or handling of LPG. These procedures should preferably be written down and copies given to staff involved. At larger premises, those where 25 000kg of LPG or more is kept and premises where large numbers of the public may be present these procedures should form part of an emergency plan and should be discussed with the local emergency services.

155 For premises coming within the scope of regulation 7 of the CIMAH Regulations there is a specific requirement to prepare an on-site emergency plan and to cooperate with the local authority in the preparation of an off-site emergency plan. Further guidance is given in HSE booklets HS(R)21 and HS(G)25.

156 Some premises will be unattended for long periods, for example overnight and at weekends. At such premises, where 25 000kg or more of LPG are kept, arrangements should be made with the local emergency services to ensure that someone responsible for the premises can be contacted, as necessary. Premises which are subject to the upper level requirements of the CIMAH regulations should not normally be left unattended.

TRAINING

157 Those concerned with the storage and handling of LPG in cylinders or similar containers should be provided with adequate information, instruction, training and supervision appropriate to their responsibilities, both for their own safety and that of others in the vicinity who may be affected by the hazards presented by the material. They should be familiar with the following:

(a) the physical characteristics and hazards of LPG;
(b) the fundamentals of fire-fighting and fire control, particularly fires involving LPG, and the effect that radiant or direct heat can have on the safe containment of the product;
(c) the correct handling of fire-fighting equipment and limitations on its use as a 'first-aid' measure;
(d) the inspection procedures to be adopted to allow removal of certain categories of cylinders or similar containers from service, eg damaged or leaking containers or cylinders requiring revalving or periodic inspection and testing;
(e) the procedures for dealing with defective or leaking cylinders;
(f) the procedures for deliberately venting LPG from the cylinder or container;
(g) the action to be taken in an emergency, including the responsibilities to be assumed, by whom, and the procedures for contact with local emergency services, neighbours, etc;

(h) at premises where 25 000kg or more LPG is kept, suitable staff should be specially selected and trained in the correct procedures for attempting to contain an Incident involving LPG until the fire brigade can take over. The time element is of great significance, prompt action may prevent a small incident escalating into a major fire.

158 All staff should receive initial and refresher training as appropriate. The emergency procedures should be practised at regular intervals to ensure everyone is familiar with the actions to be taken. Where appropriate the emergency services should be invited to take part in such exercises.

REFERENCES


The Fire Certificates (Special Premises) Regulations 1976 SI 1976 No 2003 HMSO.

The Health and Safety (Enforcing Authority) Regulations 1977 SI 1977 No 746 HMSO.


British Standards Institution publications

BS 341 Valve Fittings for compressed gas cylinder.

Part 1: 1962 Valves with taper stems (excluding valves used for breathing and medical purposes).

BS 476 Fire Tests on building materials and structures.
Part 1: 1953 Fire tests on building materials and structures (superseded by Parts 7 and 8).

Part 8: 1972 Test methods and criteria for the fire resistance of elements of building construction.

Part II: 1982 Method for assessing the heat emission from building materials.

BS 3212: Flexible rubber tubing and hose (including connections where fitted and safety recommendations) for use in LPG vapour phase and LPG/air installations.

BS4250: 1975 Commercial Butane and propane.

BS 5045 Transportable gas containers.

BS 5306 Code of Practice for fire extinguishing installations and equipment on premises

Part 1: 1976 Hydrant systems, hose reels and foam inlets


BS 5329: 1976 Non-refillable metallic containers up to 1.4 litres capacity for liquefied petroleum gases

BS 5345: Code of Practice for the selection, installation and maintenance of electrical apparatus for use in potentially explosive atmospheres (other than mining applications or explosive processing and manufacture)


BS 5423: 1980 Specification for portable fire extinguishers

BS 5499: Fire Safety signs, notices and graphic symbols.

Part 1: 1984 Specification for fire safety signs

BS 5430: Specification for periodic inspection, testing and maintenance of transportable gas containers (excluding dissolved acetylene containers)

Part 2: 1977 Welded Steel containers of water capacity 1 litre up to 130 litres

BS 5501: Electrical apparatus for potentially explosive atmospheres

BS 5838: Fire detection and alarm systems in buildings


British Standards are obtainable from the British Standards Institution, Sales Department, Linford Wood, Milton Keynes, MK14 6LE.

The Liquefied Petroleum Gas Industry Technical Association (UK) (LPGITA) have produced a number of Codes of Practice on the storage and use of LPG which may be obtained from the printer William Culross & Sons., Coupar Angus, Perthshire.

### APPENDIX 1 CONTAINER CONSTRUCTION AND FITTINGS

1 All LPG containers should be designed, fabricated and tested in accordance with a recognised pressure vessel code or specification.

Small containers

2 For small LPG cartridges BS 5329 Non-refillable Metallic Containers of up to 1.4 litres capacity for LPG is an appropriate specification.

3 Small cylinders up to and including 0.5 litre water capacity, both steel and aluminium, are covered by BS 5045: Part 6.

Cylinders

4 Cylinders for storing LPG are predominantly of welded steel construction to BS 5045: Part 2 or equivalent specifications, although welded aluminium cylinders are also used in significant numbers.

Test pressure

5 The test pressure, marked on each cylinder, is related to the pressure developed by the contents at the pressure reference temperature, 55°C in the UK, and the material properties. Test pressures may not be less than 7.52 bar (109 psig) for commercial butane and 22.13 bar (321 psig) for commercial propane.

6 In practice much higher values are used, as the test pressure should not be less than the safety valve 'set pressure' at which the valve is set to start to discharge (see item 12 below). Typical current values for the set pressure are 21 bar (305 psi) for commercial butane and 26 bar (377 psi) for commercial propane.

7 Where the test pressure is lower than 21 bar for butane or 26 bar for propane, the set pressure should not be more than the test pressure specified by the cylinder manufacturer.

Cylinder valves and fittings

8 Each cylinder having a product capacity of 4kg or more should be fitted either with a manually operated shut-off valve or with a spring loaded self-sealing 'clip-on' or similar valve.

9 Valve fittings should comply, in respect of quality and materials, with the requirements of BS 341 Valve fittings for compressed gas cylinders.

10 Screw threaded valve connections should be left hand and the couplings for commercial butane cylinders should be significantly different from the couplings for commercial propane cylinders.

Safety valve

11 It is good practice to fit cylinders with a safety (pressure relief) valve (PRV) which opens at a set pressure and fully reseals at a specified reseat pressure, typically 80% of the set pressure.
Protection of valves

12 The shut-off valve and PRV, where provided, should be protected by a ventilated cover or shroud capable of withstanding severe blows which might otherwise damage the fittings.

Periodic inspection, testing and maintenance

13 Containers should be visually examined for signs of damage which may affect their integrity, each time before they are refilled. In addition, they should be inspected against specified criteria at regular intervals.

14 The periodic inspection, testing and maintenance of LPG containers should be carried out in accordance with the appropriate part of BS 5430: (Part 2 for welded steel containers of water capacity 1 litre up to 130 litres) which details frequency of inspection and testing and sets out rejection criteria for any defects or damage to the container.

APPENDIX 2 CYLINDER MARKING

A cylinder should be marked giving details of its construction and testing and warning of its flammable contents.

Details of construction

1 Each LPG cylinder should be conspicuously and permanently marked to include the following:

(a) the manufacturer's mark and serial number, together with an indication of the specification to which the cylinder is constructed and its year of manufacture;

(b) the date of test (which date may be indicated by the month and year, or by the year followed by a number within a circle to denote the quarter of the year);

(c) the test pressure;

(d) the minimum designed water capacity of the cylinder.

2 The marks should be as large as possible, preferably not less than 6mm (¼ in), but in any case not less than 3mm (¼ in) in height, and they should be permanently and legibly marked on:

(a) a plate which is continuously welded to the cylinder prior to heat treatment, or

(b) a metal tag permanently attached to the cylinder by methods not involving welding, brazing or local reduction of wall thickness, or

(c) the footring or valve shroud if these are permanently attached to the cylinder.

3 The marks required by paragraphs 1 (a) and (c) may be marked on the valve boss.

4 In addition each cylinder should be suitably marked with the tare weight (ie the weight of the cylinder, valve and other permanent fittings, but excluding the valve cover, where provided).

Contents labelling

5 Cylinders should be marked with the name of the product.

6 There is a requirement in Regulation 9 of the Classification, Packaging and Labelling of Dangerous Substances (CPL) Regulations 1984 for the labelling of any cylinder with a capacity of more than 500ml and containing LPG to be labelled as a 'flammable gas' for conveyance by road. The requirements apply in effect to both full and empty containers.

7 Certificate of Exemption Number 1 of 1985 under the CPL Regulations has been issued by HSE.

The conditions of this certificate are:

(a) the hazard warning sign is applied directly to the surface of the cylinder by stencilling, printing or other similar means of marking;

(b) the hazard warning sign stands out from its background so as to be readily noticeable;

(c) the symbol, lettering and surrounding line (if any) are in the same colour which is a colour which contrasts with the red background of the hazard warning sign so that they can be readily seen or recognised;

(d) the hazard warning sign complies in all other respects with the requirements of Part II of Schedule 2 of the Regulations except:

(i) that the surrounding line in the hazard warning sign may be omitted; and

(ii) the words 'flammable gas' may be shown on the hazard warning sign on two lines, one below the other.

APPENDIX 3 MAXIMUM LPG CHARGE

1 British Standard BS 5355 specifies a filling ratio reference temperature for cylinders of 45°C and that the maximum amount of LPG in any cylinder should not reach that amount which by expansion will cause the cylinder to become hydraulically full at 5°C above the filling ratio reference temperature, i.e. 50°C.

2 The maximum permitted net weight (kg) of LPG for any refillable cylinder may be obtained by multiplying the water capacity (litres) by the liquid density of the LPG at 50°C.

3 As a working rule the following will give an approximation adequate to establish whether the cylinder is overfilled to such an extent as to make it likely to become hydraulically full at 50°C.

(a) For commercial propane:

Maximum charge of propane in kg equals — 0.425 x marked water capacity (litres);

(b) For commercial butane:

Maximum charge in kg equals — 0.522 x marked water capacity (litres).