

MRA LPG

CODE OF PRACTICE E3:2008

Use of LPG cylinders

Use of LPG in Cylinders at Commercial and Industrial Premises

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The information in this Code of Practice is given in good faith and belief in its accuracy at the time of its publication, but does not imply any legal liability or responsibility by the Malta Resources Authority.

Users of this Code of Practice must give regard to any relevant legislation or authoritative recommendations, especially to those which may have evolved subsequent to the date of publication.

This guidance is not an authoritative interpretation of the Law, but if you do follow the Guidance, you will normally be doing enough to comply with the Law.

Malta Resources Authority Officials may refer to this Guidance as illustrating good practice.

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This Code has been prepared by the Malta Resources Authority in consultation with the Malta Environment and Planning Authority (MEPA), the Malta Standards Authority (MSA), the Occupational Health and Safety Authority (OHSA), the Civil Protection Department (CPD) and Enemalta Corporation (EMC).

Before publication, the contents of this document were sent out for wide consultation to all stakeholders with an interest in the transportation, storage or use of L P Gas. Many of the comments received have been incorporated in the document.

The aforementioned Authorities believe that the contents of this Code demonstrate good practice in the L P Gas Industry and commend its use.

**The MRA
LPG Code of Practice E3
Use of LPG in Cylinders at Commercial and Industrial Premises**

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Section 1: Introduction, Scope and References

1.1. Introduction

This Code has been prepared by the Malta Resources Authority in consultation with the Occupational Health & Safety Authority (OHSA), the Civil Protection Department (CPD), the Malta Standards Authority, (MSA) and the Malta Environment and Planning Authority (MEPA) to provide guidance to those using LPG in cylinders in commercial and industrial premises.

- Other relevant Standards are listed in Appendix B and further related MRA LPG Codes of Practice can be obtained from the Malta Resources Authority
- This Code of Practice adopts the recommendations of BSI, CEN and ISO for the presentation of numeric values. The thousand separator is therefore a space (e.g. one million is represented as 1 000 000) and the decimal separator a comma (e.g. one point five is represented as 1,5).

1.2. Scope

1.2.1. This Code covers the installation and safe use of LPG in cylinders at commercial and industrial premises.

1.2.2. This Code relates to LPG cylinders located out of doors supplying appliances via a fixed pipework installation, and LPG cylinders connected to equipment indoors.

1.2.3. Cylinders covered by this Code are refillable and designed, manufactured and maintained in accordance with appropriate regulations, e.g. the Transportable Pressure Equipment Regulations (LN 331 of 2002) and standards e.g. EN 13322-1:2003.

1.2.4. This Code does not cover use of the following:

- non-refillable LPG cartridges and associated equipment;
- the use of LPG fuelled Mechanical Handling and Maintenance Equipment for which reference should be made to MRA Code of Practice C4.

1.3. References

This Code of Practice incorporates by dated or undated reference, provisions from other publications. These references are cited at the appropriate places in the text and the publications are listed in Appendix B. For dated references, subsequent amendments to or revisions of any of their publications apply to this Code of Practice only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

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Section 2: Definitions

For the purposes of this Code the following definitions together with those in Regulations relating to LPG, apply.

2.1 Commercial Premises

Structure of a permanent nature, to which appropriate building regulations apply, which is a place of work and which is used for office, catering, retailing and similar purposes.

2.2 Industrial Premises

Structure of a permanent nature, to which appropriate building regulations apply, which is a place of work and which is used for manufacturing purposes.

2.3 Cylinder

A portable and refillable vessel of approved design containing LPG under pressure.

2.4 Cylinder Valve

A device designed to release LPG for use from a cylinder when open and to ensure a leak free seal when not in use and closed.

2.5 Liquefied Petroleum Gas (LPG)

A generic term used to describe liquids and gases normally consisting of C3 and C4 hydrocarbons, e.g. propane and butane to BS 4250:1997 or equivalent.

2.6 Automatic Changeover Valve

A device for use with LPG cylinders which maintains continuity of gas supply by automatically switching supply from empty to full cylinders.

2.7 Regulator

A device for automatically maintaining a constant gas outlet pressure at the level recommended for the application.

2.8 Emergency Shut-Off Valve

A manual valve located at the supply entry to premises. It corresponds to the 'emergency control' required by current Regulations.

2.9 Room Sealed

A room sealed appliance is one which when in operation has the combustion air inlet and the combustion products outlet isolated from the room in which the appliance is installed.

2.10 Gas Fitting

Gas pipework, valves (other than emergency shut-off valves), regulators and meters, and fittings, apparatus and appliances designed for use by consumers of gas for heating, lighting, cooking or other purposes for which gas can be used (other than the purpose of an industrial process carried out on industrial premises), but it does not mean any part upstream of emergency shut-off valves.

Section 3: Legal and Contractual Responsibilities

3.1 Legal Responsibilities

3.1.1 It is an offence for any person to work on a gas fitting unless he or she is a competent person or supervised by a competent person as defined in LN 249 of 2008.

3.1.2 It is the duty on any person carrying out work on installation pipework, gas fittings or appliances, who knows or suspects that a defect exists, making a gas appliance unsafe for further use, to inform the occupier, or the owner, or failing that, the gas supplier.

The Regulations list the following as constituting an unsafe appliance.

- Insufficient combustion air
- Insufficient room or compartment ventilation
- Gas leakage
- Faulty or maladjustment of the appliance.

3.2 Contractual Responsibilities

3.2.1 Where cylinders are supplied from retail premises, dealers, stockists etc. the point of supply should make available basic safety information regarding the use of the cylinder and the LPG it contains.

3.2.2 Where the LPG cylinders are supplied under a term contract, the LPG supplier should ensure that the consumer has been provided with full instructions which should include the following as appropriate:

- the properties and characteristics of LPG;
- normal operating procedures;
- contract arrangements for a gas supply;
- arrangements for maintenance;
- action in the event of loss of gas pressure;
- action in the event of emergencies.

3.2.3 Contractual arrangements regarding the ownership, refilling and maintenance of cylinders should be made clear to the customer.

Section 4: Training

- 4.1** Everyone responsible for installing or using LPG cylinders and/or appliances that operate on LPG should be trained to ensure that they understand the properties and hazards of this gas and appropriate fire and other precautions.
- 4.2** Installation and servicing work should only be carried out by or supervised by appropriately trained competent persons.

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Section 5: Cylinder Location

5.1 Recommended cylinder locations for cylinders located outside are given in figure 1.

5.2 Cylinders should be installed in the upright position with valves uppermost so that only vapour will be withdrawn in use.

5.3 With the exception as allowed in Section 6, cylinders should be located in the open air outside buildings and situated on firm level ground in a well-ventilated location. Subject to paragraphs 5.4 to 5.8 cylinders should be located against a wall or structure of the building. When selecting a location for cylinders consideration should be given to positions which are adjacent to a wall or structure with a fire resistance of not less than 30 minutes tested to BS 476 or equivalent.

5.4 Cylinders should be located:

- where they remain readily accessible at all times;
- where they do not obstruct any means of access to or from the premises;
- where they are reasonably protected from accidental damage.

Where necessary suitable protection should be provided against possible damage or interference by persons, animals or vehicles.

5.5 Cylinders should not be located:

- (a) In any cellars, basements (which have no natural floor level ventilation) nor in sunken areas;
- (b) Less than 1 metre measured in the horizontal plane from the nearest cylinder valve from fixed sources of ignition, unprotected electrical equipment, excessive heat sources, and readily ignitable materials etc. or, apertures in the property etc. such as doors, openable windows, ventilation ducts, air bricks or flue terminals etc;
- (c) less than 0,3 metres measured vertically above the cylinder valve(s) from the items listed in (b) unless a non-combustible weather protection hood which does not impair access to valves is provided;
- (d) closer than 2 metres measured in the horizontal plane from untrapped drains or unsealed gullies or openings to cellars unless an intervening diversion wall not less than the height of the cylinders is provided such that the distance measured round the wall to the opening is at least 2 metres;
- (e) within 3 metres of any corrosive, toxic or oxidising materials unless a fire resistant barrier is interposed.

5.6 Consideration should be given to the degree of protection required (if any) for environmentally exposed locations.

5.7 The area around cylinders should be kept clear of litter, vegetation or other flammable material.

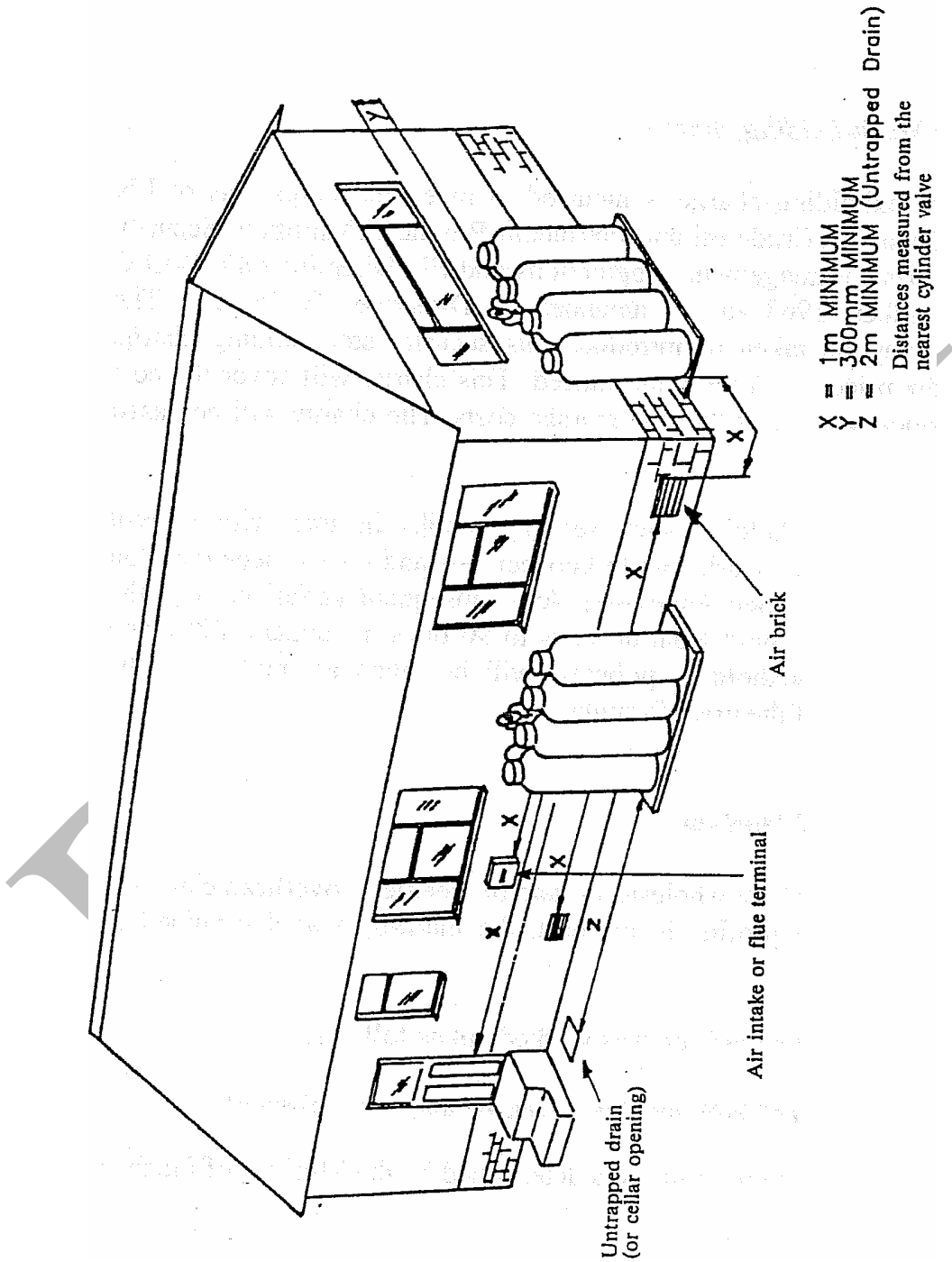
5.8 Associated equipment e.g. manifolds, automatic change-over devices, pressure regulators etc. should be located as close as practicable to the cylinder(s). Flexible connections should be as short as practicable whilst being long enough to provide the flexibility required without excessive strain on the hose or the end fittings.

5.9 Storage of full or empty cylinders

Full and empty cylinders which are not connected to equipment should be stored in accordance with MRA LPG Code of Practice B1.

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FIGURE 1



Section 6: Use of LPG Cylinders Inside Premises and in internal yards

If it is not reasonably practicable to install the cylinder header serving the appliances outside or under the conditions described in MRA COP B1, the total quantity of LPG used inside the premises or inside yards with 4 walls should not exceed 100 kg unless a full, documented, risk assessment has been carried out and presented to the National Authorities. Cylinders inside premises should not supply gas to more than one appliance.

Appliances should be sited away from escape routes and combustible material. Adequate provision for the ventilation of the room should be made when the appliances and cylinders are used.

Cylinders should be positioned in the upright position on a firm, level hard standing. Cylinders which are liable to be knocked over should be secured or provided with barriers.

Where reasonably practicable, cylinders should be protected from unauthorised interference.

The storage of rubbish, cardboard or other flammable material should not be permitted adjacent to LPG cylinders. Where necessary, a physical barrier protecting the space around the cylinders should be considered.

Associated equipment e.g. manifolds, pressure regulators etc. should be located as close as practicable to the cylinder(s). Flexible connections should be as short as practicable whilst being long enough to provide the flexibility required without excessive strain on the hose or the end fittings.

Cylinders should be accessible to authorised persons and emergency services at all times.

Where commercial or industrial premises share a building with or under residential accommodation:

- either no more than 15 kg of LPG should be left in the premises out of hours;
- or 60 minutes fire resisting separation should be provided between the premises and the accommodation.

There should be no direct connecting doors or access between the two premises.

Section 7: System Design

7.1 Security

Any part of a LPG installation which may be liable to accidental damage or interference by persons, animals, vehicles etc. should be suitably protected. (See also 5.4).

7.2 Cylinder Off-take Rates

7.1.1 Respecting legislation in force, the number of cylinders required will depend on the number and type of appliances installed. Maximum vapour off-take rate should be 1,545 kg/h for a 25kg cylinder.

7.1.2 For a continuous supply, multiple cylinders may be installed in pairs or in banks of cylinders interconnected via an automatic changeover valve which will switch supplies as cylinders empty.

7.3 System Pressure

LPG vapour lines should not enter a building except under the control of a pressure regulator. For most heating and cooking appliances the nominal working pressure should be 37 mbar or lower.

Where four or more cylinders are connected to an automatic changeover valve the working pressure to the premises should be limited by an overpressure protection device meeting the requirements of MSA EN13785:2005.

7.4 Fittings

7.1.3 Cylinder valve connections should comply with MRA LPG Code of Practice D3.

7.1.4 Hoses used as flexible connections to cylinders should comply with BS 3212:1991, or equivalent, and should be marked accordingly. Hose diameter should be compatible with the hose connection nozzles.

Hoses to BS EN 559, or equivalent, may be used for welding and cutting purposes.

Hoses should be securely connected at both ends with appropriate fittings.

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Worm drive clips should not be used to secure hoses operating at vapour pressure (i.e. without a regulator).

7.1.5 Regulators and automatic changeover valves should comply with the relevant parts of MSA EN13785:2005 and MSA EN 13786: 2004 or equivalent and should be located at or above the level of the cylinder outlet valve connection. Attention is drawn to the importance of ensuring that non-return valves are fitted to the inlets of automatic changeover devices, in compliance with MSA EN13785:2005, to prevent accidental discharge of gas when disconnecting cylinders.

7.1.6 The regulator may be fitted directly to the cylinder valve outlet for single cylinder use, or mounted separately on a manifold for multiple cylinder use.

7.1.7 Vent holes in regulators should be carefully orientated or otherwise protected against the possible ingress of water or substances that could cause blockage and also to allow for drainage.

7.5 Emergency Shut-Off Valve

Multiple cylinder installations should be fitted with an emergency shut-off valve located externally at the point where the supply enters the premises.

The valve should be clearly identified and its direction of closure indicated.

7.6 Pipework

Pipework should conform to the requirements of BS 5482-1:2005 or equivalent, and MRA LPG Code of Practice No. D6.

Pipes passing through cavity walls should take the shortest route and be sleeved.

Section 8: LPG Appliances and Installations

8.1 Appliances

- 8.1.1 All appliances should have been designed and proven suitable for commercial LPG at a working pressure compatible with the supply regulator.
- 8.1.2 New appliances (other than those for industrial processes) should bear a CE mark indicating that they are suitable for use with LPG at a working pressure compatible with the supply regulator.
- 8.1.3 Modifications to appliances, or their installation, should only be made by a competent person in accordance with the appliance manufacturers' instructions.

8.2 Installation

- 8.2.1 The installation of LPG appliances and equipment should only be undertaken by competent persons and should comply with the requirements of relevant Building Regulations where applicable.
- 8.2.2 All LPG appliances should be installed in compliance with regulations in force.
- 8.2.3 It is essential that all flueing and ventilation is adequate. Detailed guidance may be found in BS 5440-1:2008 and BS 5440-2:2000 or their equivalents respectively.
- 8.2.4 Appliances should be installed and maintained to ensure satisfactory performance and proper combustion to avoid excessive carbon monoxide being produced.
- 8.2.5 LPG fired appliances should not be installed in cellars or basements (which have no natural floor level ventilation).
- 8.2.6 Only room sealed appliances may be installed in bathrooms or shower rooms.
- 8.2.7 Modifications to the LPG system or equipment should only be made by or under the supervision of a competent person.

Section 9: Commissioning

9.1 The commissioning of the cylinders, fittings, pipework and appliances should only be undertaken by or under the supervision of competent persons.

9.2 The cylinders and any connected fittings should be examined to check for any visual damage.

9.3 On completion of the installation and prior to commissioning:

- the installer(s) should test the installation to verify that it is gas tight in accordance with the requirements detailed in BS 5482-1:2005, or its equivalent, or MRA LPG Code of Practice D6;

Note: Where leak testing has been carried out by persons other than the gas supplier,

- written certification should be available to the supplier;
- all shut-off valves should be checked for correct operation;
- emergency shut-off valves should be checked for accessibility and labelling;
- flues and ventilation should be inspected and checked for adequacy and for compliance with BS 5440-1:2008 or equivalent.

9.4 Pipework systems up to appliances should be purged of air and tested for leaks in accordance with MRA LPG Code of Practice D6 taking particular care to ensure that the air-gas mixture released does not accumulate inside premises or in confined spaces. When purging through individual appliances a source of ignition should be held adjacent to the burner to ensure immediate ignition when the gas is rich enough. Steps should be taken to ensure that no other sources of ignition are present and to prevent inadvertent operation of electric switches or appliances and to prohibit smoking or naked lights in the vicinity of the purge point.

9.5 The supply pressure from regulators should be verified as correct. Regulators should not be readjusted except by or under the supervision of competent persons after which they should be sealed.

9.6 Appliances should be checked for safe operation, and commissioned in accordance with the manufacturer's instructions which should be available for each appliance.

9.7 The user should be provided with instructions as detailed in Sections 10 and 12.

Section 10: Handling and Storage of Cylinders

10.3 General requirements for the storage of full or empty cylinders not in use

- 10.1.1 Spare cylinders (i.e. not connected to any gas system) should be kept to a minimum consistent with the rate of usage.
- 10.1.2 Full and empty cylinders should be stored out of doors in a well ventilated position.
- Detailed requirements are given in MRA LPG Code of Practice B1.
- 10.1.3 Cylinders should be stored and used in an upright position with the valve closed and with the protective plugs or caps in position. If necessary, tall cylinders should be secured to protect against falling.
- 10.1.4 Cylinders should not be stored near to any source of heat, sources of ignition, or quantities of combustible or ignitable material. The storage should always be at or above ground level.
- 10.1.5 The storage area should be essentially flat and level, without any low unventilated cavities and well away from any drains or gullies.
- 10.1.6 The storage area should not obstruct means of access, passageways or emergency exits.
- 10.1.7 LPG cylinders should not be stored within 3 m of any compressed gas cylinders, corrosive, toxic or oxidant materials.

10.2 Handling and changing of cylinders

- 10.2.1 Cylinders should not be used for any purpose other than that for which they are intended.
- 10.2.2 All cylinders should be handled with care. They should not be dropped or allowed to come into violent contact with any object.
- 10.2.3 Cylinders should be handled and used in an upright position (valve uppermost).
- 10.2.4 During the changing of cylinders no sources of ignition should be allowed nearby and the outlet valves on the empty and the replacement cylinders should be firmly closed before disconnection or removal of the cylinder outlet plug.
- 10.2.5 The pressure regulator should be the correct size and type for the cylinder valve and the duty required.

10.2.6 All appliances should be turned off; except where an automatic changeover valve to BS EN13785:2005, or equivalent, is fitted. The valve of the empty cylinder should be closed before disconnecting the cylinder and the valve of the new full cylinder closed before removal of the protective plug and not opened until the cylinder has been connected.

10.2.7 The cylinder valve mating connections should be checked for cleanliness and damage before making the joint. Screwed connections of this type have left-hand threads and should always be loosened and tightened with a correct sized, suitable spanner.

Note: Caution should be exercised to ensure that American standard connections are not used with British cylinder valves. Although similar they are not compatible and risk of leakage can arise if such connections are intermixed. The supplier should be contacted if in doubt.

10.2.8 After changing a cylinder the valve and connection should be checked for leaks. Leaks may be detected by sound, smell or by frosting in the area of the leak. Leaks may also be detected by brushing connections and joints with a leak detection fluid. Bubbles will immediately form at the leak. The recommended action, should leakage be detected, is contained in Section 12.

ON NO ACCOUNT SHOULD A NAKED FLAME BE USED TO SEARCH FOR A LEAK.

10.2.9 After changing cylinders, valves on nominally empty cylinders should be kept firmly closed even when no internal pressure is evident, to prevent air diffusion into the cylinder. This could form a flammable mixture with the vapour. Therefore nominally empty cylinders should be treated as full.

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Section 11: Maintenance

11.1 Cylinders and cylinder valves

The inspection and maintenance of LPG cylinders and valves is the responsibility of the Company that owns them (e.g. in accordance with BS 5430 (Part 2), or equivalent) and is carried out when the cylinders are returned for filling.

11.2 System fittings

11.1.1 All flexible hoses should be periodically inspected for deterioration, cracking etc. and be replaced when necessary.

11.1.2 Regulators and changeover valves should be checked at regular intervals for general condition and satisfactory performance.

11.1.3 Isolation valves should be checked regularly for ease of operation and tight shut-off.

11.3 Appliances

All appliances should be correctly maintained and regularly serviced in accordance with the manufacturer's instructions by a or under supervision of a competent person to ensure continued safe and satisfactory operation.

Section 12: User Instructions

12.1 General

- 12.1.1 Users of LPG cylinders and appliances should be supplied with adequate safety and operating instructions. These should include safety information on LPG and details of how and where to change cylinders safely; (see sections 10 and 11), the necessity to observe appliance instruction, and the need for regular appliance servicing by a competent person to maintain proper combustion and the need for adequate ventilation.
- 12.1.2 Ownership of cylinders, valves, regulators etc., should be clearly defined, and also the consequent responsibilities for maintenance, and servicing. Attention should be drawn to the need to keep the area around cylinders clear of litter, vegetation or other potentially flammable material.
- 12.1.3 User information for appliances and equipment which are the property of the user should give clear guidance on operation, maintenance and/or replacement.
- 12.1.4 User information should draw attention to regular servicing of appliances and flues/ventilation with warnings of the dangers which could arise from neglect.

12.2 Emergency procedures

- 12.2.1 LPG suppliers should provide all users with instructions on the action to take in the event of an emergency i.e. a gas leak, or fire in the vicinity of cylinders.
- 12.2.2 In the event of GAS LEAKAGE or SUSPECTED LEAKAGE:
- extinguish all naked flames and ignition sources;
 - turn off all gas appliances;
 - do not switch on or off any electrical equipment;
 - turn off the gas supply at cylinder(s);
 - if leak is indoors, open doors and windows to increase ventilation;
 - NOTIFY the emergency service provider or the gas supplier.

Do not turn on the gas supply until it has been made safe to do so by a competent person.

- 12.2.3 In the event of FIRE:

- call the CPD immediately and inform them that LPG cylinders are on the premises;
- do not go near cylinder(s) in the vicinity of fire;
- turn off the gas supply if practicable and safe to do so.

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Do not turn on the gas supply until it has been made safe to do so by a competent person.

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Appendix A: Safe Handling and Properties of LPG

A.1 Safe Handling of LPG

The liquid petroleum gas which is generally available in Malta consists of a mixture of Butane and LPG (70-80% and 30-20% respectively) according to MSA EN 589 depending on the season. These component gases of the present LPG mixture may be made available for sale and use as separate products in accordance with BS 4250: 1997 or equivalent.

The mixture is normally supplied in cylinders up to 25 kg capacity and has a much lower vapour (or cylinder) pressure than LPG.

The combustion of LPG produces carbon-dioxide (CO₂) and water vapour, but sufficient air must be available. Inadequate appliance flueing and/or ventilation, or poor air-gas mixing e.g. due to lack of servicing, can result in the production of toxic carbon monoxide.

Everyone concerned with the storage and handling of LPG should be familiar with the following characteristics and potential hazards:

- (a) LPG is stored as a liquid under pressure. It is almost colourless and its weight is approximately half that of an equivalent volume of water.
- (b) LPG vapour is denser than air, butane is about twice as heavy as air and LPG about one and a half times as heavy as air. Consequently, the vapour may flow along the ground and into drains, sinking to the lowest level of the surroundings and be ignited at a considerable distance from the source of leakage. In still air vapour will disperse slowly.
- (c) LPG can form a flammable mixture when mixed with air. The flammable range at ambient temperature and pressure extends between approximately 2 % of the vapour in air at its lower limit and approximately 10 % of the vapour in air at its upper limit. Within this range there is a risk of ignition. Outside this range any mixture is either too weak or too rich to propagate flame. However, over-rich mixtures can become hazardous when diluted with air. At pressures greater than atmospheric, the upper limit of flammability is increased but this increase with pressure is not linear.
- (d) Escape of even small quantities of the liquefied gas can give rise to large volumes of vapour/air mixture and thus cause considerable hazard. A suitably calibrated explosimeter may be used for testing the concentration of LPG in air.

A NAKED FLAME SHOULD NEVER BE USED TO SEARCH FOR A LEAK.

- (e) At very high concentrations in air, LPG vapour is anaesthetic and subsequently an asphyxiant by diluting or decreasing the available oxygen.

- (f) Commercial LPG is normally odorised before distribution by the additional of an odorant such as ethyl mercaptan or dimethyl sulphide, to enable detection by smell of the gas at concentrations down to one-fifth of the lower limit of flammability (i.e. approximately 0,4 % of the gas in air). However in certain cases where the odorant may be detrimental to a process (for example in aerosol applications) the LPG is not odorised.
- (g) Escape of LPG may be noticeable other than by smell. When the liquid evaporates, the cooling effect on the surrounding air causes condensation and even freezing of water vapour in the air. This effect may show itself as frost at the point of escape and thus make it easier to detect an escape of LPG. Because the refractive index of LPG differs from air, leaks can sometimes be seen as a 'shimmering'.
- (h) Owing to its rapid vaporisation and consequent lowering of temperature, LPG, particularly liquid, can cause severe frost burns if brought into contact with the skin. Personal protective equipment (e.g. hand and eye protection) should be worn if this hazard is likely to occur.
- (i) A container, which has held LPG and is 'empty' may still contain LPG in vapour form and is thus potentially dangerous. In this state the internal pressure is approximately atmospheric and if a valve is leaking or is left open, air can diffuse into the container forming a flammable mixture and creating a risk of explosion; alternatively, LPG can diffuse to the atmosphere.

Note: These properties are general characteristics of LPG and items such as (h) should not occur in normal cylinder usage.

A.2 Typical properties of commercial LPG

	Commercial Butane	Commercial LPG
Relative density of liquid at 15°C	0,57 to 0,58	0,50 to 0,51
Imperial gallons / ton at 15°C	385 to 393	439 to 448
Litre / tonne at 15°C	1 723 to 1760	1 965 to 2 019
Relative density of gas compared with air at 15°C & 1 013,25mbar	1,90 to 2,10	1,40 to 1,55
Volume of gas (litres) per kg of liquid at 15°C & 1 013,25mbar	406 to 431	537 to 543
Volume of gas (ft ³) per lb of liquid at 60°F and 30 in Hg	6,5 to 6,9	8,5 to 8,7
Boiling point at atmospheric pressure °C approx.	-2	-45
Vapour pressure for products at their maximum specified vapour pressure (gauge):		
Temp. °C	bar	bar
-40	-	0,5
-18	*	2,3
0	0,9	4,5
15	1,93	6,9
38	4,83	14,5
45	5,86	17,6
Latent heat of vaporisation (kJ/kg) at 15°C	372,2	358,2
Latent heat of vaporisation (Btu/lb) at 60°F	160	154
Specific heat of liquid at 15°C (kJ/kg °C)	2,386	2,512
Sulphur content per cent weight	Negligible to 0,02	Negligible to 0,02
Limits of flammability (percentage by volume of gas in a gas-air mixture to form a combustible mixture)	Upper 9,0 Lower 1,8	Upper 10,0 Lower 2,2
Calorific Values:		
<i>Gross:</i>		
(MJ / m ³) dry	121,8	93,1
(Btu / ft ³) dry	3 270	2 500
(MJ / kg)	49,3	50,0
(Btu / lb)	21 200	21 500
<i>Nett:</i>		
(MJ / m ³) dry	112,9	86,1
(Btu / ft ³) dry	3 030	2310
(MJ / kg)	45,8	46,3
(Btu / lb)	19 700	19 900
Air required for combustion (m ³ to burn 1m ³ of gas)	30	24

* Minimum Commercial Butane vapour pressure at -18 °C is minus 524 mbar g.

Appendix B: References

Legal

LN 249 of 2008 – LPG Market Regulations (7th October 2008)

Standards

British Standard

Description

BS 1179-6:1980

Glossary of Terms used in the Gas Industry.
Combustion and Utilisation including Installation at
Consumers' premises

BS 4250:1997

Specification for commercial Butane and commercial
LPG

BS 3212:1991

Specification for flexible rubber tubing for use with
LPG vapour

BS 5482-1:2005

Code of Practice for domestic butane & LPG gas
burning installations

BS 5440-1:2008

Flueing and ventilation for gas appliances

BS 5440-2:2000

Installation and maintenance of flues and ventilation
for gas appliances

BS 5430

Periodic Inspection, Testing and Maintenance of
Transportable Gas Containers

MSA Standard

Description

MSA EN 13322-1:2003

Transportable Gas Cylinders. Refillable welded steel
gas cylinders. Design and Construction

MSA EN 13785: 2005

Specification for pressure regulators for LPG

MSA EN 559: 2003

Gas Welding Equipment. Rubber hoses for welding
and cutting

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MRA LPG CODES OF PRACTICE	
<u>Number</u>	<u>DESCRIPTION</u>
	<u>GROUP A - BULK VESSELS</u>
A1	Design and Installation
A2	Examination and Inspection
A3	Buried/Mounded LPG Storage Vessels
A4	Purging LPG Vessels and Systems
A5	LPG Central Storage and Distribution Systems for Multiple Consumers
	<u>GROUP B - SMALL CYLINDERS STORAGE AND FILLING</u>
B1	Storage of Full and Empty Vessels
B2	Recommendations for the Safe Filling of LPG Cylinders at Depots
B3	Hazard Information and Packaging for Commercial LPG Cylinders
	<u>GROUP C - LPG DRIVEN MACHINERY</u>
C1	Autogas Installations
C2	The Safe Use of LPG as a Propulsion fuel for boats, yachts and other craft
C3	Automotive LPG Refuelling Facilities
C4	Gas Installations for Motive Power on Mechanical Handling and Maintenance Equipment
	<u>GROUP D - ANCILLARY EQUIPMENT</u>
D1	Hoses for the Transfer of LPG in Bulk: Installation, Inspection, Testing & Maintenance
D2	Safety Valves
D3	Valves for Transportable LPG Containers
D4	Flow rates up to 80 litres/min in Installations dispensing Road Vehicle Fuel
D5	Flow rates above 80 litres/min between Mobile Equipment and Fixed LPG Storage
D6	LPG Piping Systems: Design & Installation
	<u>GROUP E - LPG CYLINDER USAGE AT DIFFERENT PREMISES</u>
E1	The Use & Storage of LPG in Cylinders at Residential Premises
E2	The Storage and Use of LPG on Construction Sites
E3	Use of LPG in Cylinders at Commercial and Industrial Premises