Code of Practice 01
Part 1 - 2017

Bulk LPG Storage at Fixed Installations
Design, Installation and Operation
of Vessels Located Above Ground
UKLPG changed its name to Liquid Gas UK as of July 2019. For the purpose of this Code of Practice please read any reference to UKLPG to mean Liquid Gas UK.
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Part 1 : 2017
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The UK LPG Industry believes that the contents of this Code demonstrate good practice in the LPG industry and commends its use.

Note: Editions of LPGA Codes of Practice published before 1st January 2008, together with any amendments incorporated before or after that date, remain valid until the Code of Practice is superseded by a new edition.

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This Code has been prepared by UKLPG in full consultation with its members.

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The Health and Safety Executive

The Health and Safety Executive provided support to UKLPG in producing this guidance, which is aimed at improvements within the LPG industry. This guidance may go further than the minimum you need to do to comply with the law with regard to health and safety.
UKLPG

UKLPG is the trade association for the LPG industry and represents producers, distributors, equipment and service providers and vehicle converters. As the voice of LPG, UKLPG works at both National and European level actively seeking to raise awareness of the benefits of LPG.

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Code of Practice 1 : 2017
Bulk LPG Storage at Fixed Installations
Part 1 : Design, Installation and Operation of Vessels Located Above Ground

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Introduction

1.1.1 Objective of this Code of Practice

This Code of Practice has been prepared for the guidance of those involved in the safe practice of storing and handling of LPG in bulk at fixed installations in the UK.
of Practice has been produced with the support of the Health and Safety Executive and supersedes the 2013 edition of Code of Practice 1 part 1 for above ground vessels.

It does not cover small vapour offtake bulk propane installations which are the subject of Code of Practice 1 part 2.

Other relevant UKLPG Codes of Practice and Standards are listed in Appendix K.

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 is a comma (e.g. one point five is represented as 1,5).

1.1.2 The use of Should, Shall and Must

In this document:

Must (is required by law) identifies a requirement by law in Great Britain (GB) at the time of publication.

Shall (is required by the Code of Practice) is used to indicate a requirement which, it is intended, will be complied with in full and without deviation.

Should (is recommended by the Code of Practice) to prescribe a requirement which, it is intended, will be complied with unless, after prior consideration, deviation is considered to be acceptable.

This does not preclude other possibilities but when an organisation is subject to the Health and Safety at Work etc. Act any deviation from the recommendation shall be the subject to a suitable and sufficient, documented risk assessment which should be made available to Consumers and Enforcing Authorities on request. See also Clause 1.3.1.

1.1.3 Definition of LPG

In this Code of Practice the term LPG means commercial butane and commercial propane in accordance with BS 4250:2014 and mixtures thereof.

LPG forms flammable mixtures with air in concentrations of between approximately 2 % and 10 %. It can, therefore, be a fire or explosion risk if stored or used incorrectly.

Other properties are given in Appendix A.
Special requirements for un-odourised LPG are given in Appendix G.
Autogas to BS EN 589 should be considered to be commercial propane for the purposes of this Code of Practice.

1.1.4 Safe Operation

The principles of safe operation of LPG installations can be summarised in the following way:

Safe operation of LPG installations is achieved by preventing loss of the LPG by proper plant selection, design, installation, commissioning and operation, including training. In recognition of the fact that releases will occur from time to time, these measures are supported by control of potential ignition sources and the provision of appropriate fire precautions and emergency procedures. The initial and continuing effectiveness of all of these factors is assured by the creation and maintenance of an appropriate safety management system covering all aspects of the safety of the installation.

HSE Guidance Note H5(G)65 gives further details on the management of health and safety.

Scope

This Code of Practice deals solely with above ground installations where LPG is stored under pressure at ambient temperatures in fixed vessels larger than 150 litres (nominally 75 kg) LPG capacity. It applies to all such installations whether or not the material is stored for use on site or transhipment and subsequent use off site, and includes guidance on the design of LPG storage vessels.

Small vapour off-take buried or mounded installations within the scope of the Gas Safety (Installation and Use) Regulations of up to three vessels each not exceeding a Propane capacity 2 tonnes are not covered by this Code of Practice. They are the subject of Code of Practice 1 part 2.

Note: UKLPG Code of Practice 1 part 2 makes extensive reference to this Code of Practice but where specific guidance is given in that Code of Practice it shall be followed.

The following are not covered by this Code of Practice:

(a) Refrigerated, or partially refrigerated storage;
(b) Buried, semi-mounded and mounded vessels, which are covered by guidance in Code of Practice No. 1 Parts 2 and 4.
Whilst the general principles and much of the more detailed information in this Code of Practice may be applicable to petrochemical storage and process facilities, dependent on the nature of the product stream, additional guidance and models may be more appropriate and detailed site specific risk assessments should be undertaken, together with consultation with the enforcing authority as necessary.

Information is also given on the precautions to be taken during loading and offloading of road tankers.

For more detailed guidance on LPG pipework refer to UKLPG Code of Practice 22, LPG Pipework System Design and Installation.

For maintenance of LPG vessels refer to UKLPG Code of Practice 1 Part 3, Periodic Inspection and Testing.

The design and installation of LPG piped supplies to multiple consumers is covered in UKLPG Code of Practice 25 which extends the requirements given in this Code of Practice.

**Application**

**1.3 Limitations**

The information in this Code of Practice gives one way of achieving a minimum standard of safety. Each case should be considered on its merits, and special circumstances backed up by risk assessment may necessitate variations from the recommendations.

The information in this Code of Practice is not intended to preclude the use of alternative designs, materials and methods where these provide equivalent safety standards. The guidance given is primarily intended for new installations, but will equally apply to modifications and alterations to existing installations.

The guidance in this Code of Practice is given without prejudice to the general requirements under the Health and Safety at Work, etc. Act 1974 that risks should be reduced to as low as is reasonably practicable.

**1.3.2 New Premises**

New installations and modifications to existing installations involving changes in layout or increased storage shall comply with the advice in this Code of Practice from the date of publication.
Note 1: The like for like exchange of installation components, such as pressure relief valves, regulators, valves, etc. is not considered a modification.

Note 2: Complying with the advice in this Code of Practice, could mean alternative designs as suggested by clause 1.3.1.

1.3.3 Existing Premises

It is not the intention that the recommendations in the Code of Practice should be applied rigidly to existing installations. When undertaking a like for like vessel exchange, such installations must meet the appropriate legal requirements such as the Gas Safety (Installation and Use) Regulations 1998.

In addition, such installations shall also be checked against the requirements contained within this Code of Practice and where reasonably practicable they should be complied with.

For a variety of reasons it may not be reasonably practicable to comply with all the requirements of this Code of Practice.

If not compliant, the installation may be deemed to be satisfactory if, either:

a) the installation met the relevant requirements of the Standards and Guidance in force at the time of its installation and the installation does not present a safety risk; or

b) a risk assessment demonstrates that the installation does not pose a significant safety risk.

Where a significant safety risk is identified the vessel shall be re-sited or other equally effective measures adopted to ensure that the vessel can be used, filled and refilled without causing a danger to any person.

1.3.4 Planning Requirements

This Code of Practice aims to provide guidance on achieving the levels of risk appropriate to compliance with health and safety legislation. The planning controls on hazardous installations and developments near them are mitigation measures that are taken even though there is full compliance with all health and safety legal requirements. For this reason, compliance with this Code of Practice may not be sufficient to ensure that consent can be obtained under hazardous substances planning legislation because lower levels of risk are still significant in that context. The larger installations are potentially the most hazardous. However, they are subject to hazardous substance planning legislation and are likely to
receive more scrutiny than installations generally. This may necessitate variations from the recommendations in order to achieve a higher standard of safety.

1.3.5 Other Legal Requirements

The storage of LPG for use at work must comply with the general duties of the Health and Safety at Work, etc. Act 1974.

Further guidance on the legal requirements that may apply to the transport, storage and handling of LPG is given in Appendix J.

In certain cases on site emergency plans may be required. HSE Guidance Note Emergency Planning for Major Accidents gives further details.

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 appendices I, J and K. 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.

For statutory provisions the reference should be taken as being to the statute quoted as amended or replaced with or without modification.
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<td>Motors</td>
</tr>
<tr>
<td>2.9.2</td>
<td>Pumps</td>
</tr>
</tbody>
</table>
2.1 Hazardous Places

2.1.1 General

The requirements of the Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) apply to bulk LPG storage installations and their surroundings.

Hazardous places are defined as places in which an explosive atmosphere may occur in such quantities as to require special precautions to protect the health and safety of the workers concerned.

Hazardous places are classified into zones on the basis of the frequency and duration of the occurrence of an explosive atmosphere. Further information is given in Appendix B.

For an LPG bulk storage installation designed, constructed and maintained in accordance with Codes of Practice a release of LPG should only occur during product transfer; any release should be small and controlled. The risk of ignition of an explosive atmosphere is low provided that appropriate precautions are taken, in accordance with this Code of Practice. The required precautions include display and observance of appropriate warning notices (2.7), control of access (2.6) and sources of ignition (2.1.2, 2.3.1.3) and selection of appropriate equipment.

The “Ex” sign described in DSEAR need not be displayed if suitable warning signs (see 2.7) are in place to warn people of the flammable nature of any release from the tank or fittings.
2.1.2 Requirements

Within the hazardous places described in Appendix B.2:

- fixed sources of ignition (i.e. pilot lights, naked flames) must be prohibited;
- smoking, including electronic cigarettes, must be prohibited;
- all other potential sources of ignition must be controlled;
- vehicles must be excluded except those associated with the product transfer and handling operations;
- equipment suitable for use in zoned areas and constructed to a recognised Standard (e.g. BS EN 60079) must be installed;

    Older equipment built to earlier Standards (e.g. BS 5501 series) remains acceptable provided it is correctly maintained and a risk assessment in accordance with DSEAR shows it is still suitable.

- electrical equipment must be suitable for the zoned area in which it is installed.

The above list is not necessarily comprehensive and in all instances a risk assessment, in accordance with DSEAR, must be carried out by the site owner / operator.

Apparatus, which may be a potential source of ignition (e.g. electrical equipment, rotating parts) and required to operate in a designated zone must be tested, approved and certified in accordance with The Equipment and Protective Systems for Use in Potentially Explosive Atmospheres Regulations 2016.

Guidance on electrical installation requirements is given in 5.1.

Accessibility and Layout of Vessels

All above ground items of LPG plant shall be easily accessible for installation, operation, maintenance, uplift and fire-fighting purposes.

The layout and grouping of vessels (as distinct from spacing) shall receive careful consideration so as to ensure:

- Adequate free ventilation;
- Accessibility for fire fighting;
- The avoidance of spillage from one vessel affecting any other vessel or adjacent facility;
- A clear line of sight for a person whilst in a position to control a product transfer to see both the receiving vessel, or remote filling facility, and the delivery vehicle.
Specific requirements for installations supplying multiple consumers through pipelines are given in UKLPG Code of Practice 25.

LPG Storage Vessels: Location, Separation and Spacing

2.3.1 General

2.3.1.1 LPG storage vessels must never be located and installed:

- in buildings;
- on roofs;
- above or below any other LPG vessel or any other tank such that their outlines overlap when viewed in plan;
- in cellars; or
- in pits.

2.3.1.2 Separation distances are intended to protect the LPG facilities from the immediate thermal radiation effects of fires involving other facilities as well as to minimise the risk of escaping LPG being ignited before it has dispersed or diluted below LFL.

2.3.1.3 Accordingly, LPG storage vessels sited above ground shall be located in the open air in a well ventilated position in accordance with the separation distances given in Tables 1, 2 and 3.

Note: further advice on ventilation is provided in 2.3.2.17

2.3.1.4 Subject to appropriate risk assessment and where necessary Enforcing Authority advice, separation distances less than those given in Tables 1, 2 and 3 may be acceptable.

2.3.1.5 Separation distances involving LPG storage vessels greater than 150 tonnes LPG capacity shall be discussed with the Enforcing Authority.

2.3.2 Separation distances

This separation distance defines an area which is not classified as being either Zone 0, 1 or 2, but where additional measures are required to minimise the risk of fire. A firewall or gas dispersion wall meeting the requirements of UKLPG Code of Practice 1 Part 1 or 4 may be used to reduce the separation distance.

2.3.2.1 The separation distance is the horizontal distance between the nearest part of an
LPG storage vessels and a specified feature, for example an adjacent building or property.

2.3.2.2 Separation distances should not be confused with the distances relating to hazardous places described in Section 2.1 and Appendix B:2 and often known as ‘zoning’.

2.3.2.3 In the event of the total capacity exceeding the figure in column 2 of Table 1 the separation distances of the next higher group applies.

2.3.2.4 The maximum number of vessels in a group shall not exceed 6.

Table 1: Separation Distances from Buildings, Boundaries and Sources of Ignition to LPG Vessel(s) Containing Propane

<table>
<thead>
<tr>
<th>Maximum Propane Capacity</th>
<th>Minimum Separation Distances</th>
</tr>
</thead>
<tbody>
<tr>
<td>Of any single vessel in a group</td>
<td>Of all vessels in a group up to a max. of 6</td>
</tr>
<tr>
<td>LPG Capacity (a)</td>
<td>Typical Water Capacity (b)</td>
</tr>
<tr>
<td>Tonnes</td>
<td>Litres</td>
</tr>
<tr>
<td>0.05 to 0.25</td>
<td>150 to 500</td>
</tr>
<tr>
<td>&gt;0.25 to 1.1</td>
<td>&gt;500 to 2 500</td>
</tr>
<tr>
<td>&gt;1.1 to 4</td>
<td>&gt;2 500 to 9 000</td>
</tr>
<tr>
<td>&gt;4 to 60</td>
<td>&gt;9 000 to 135 000</td>
</tr>
<tr>
<td>&gt;60 to 150</td>
<td>&gt;135 000 to 337 500</td>
</tr>
<tr>
<td>&gt;150</td>
<td>&gt;337 500</td>
</tr>
</tbody>
</table>
2.3.2.5 The separation distances quoted in Table 1 depend on the nominal LPG capacity of the vessel(s), columns (a) and (c). The typical water capacities given in column (b) of Table 1 are given for information as many LPG vessels quote water capacity on their data plates. The water capacity is the maximum designed internal volume of the vessel and is normally quoted in litres, gallons or m$^3$.

2.3.2.6 To convert an LPG vessel's water capacity to its nominal LPG capacity in tonnes, can be calculated by multiplying the vessel's water capacity by its maximum fill level (normally as per Table 6) and by the LPG's density at 15°C.

Table 2: Separation Distances from Other Flammable Liquids

<table>
<thead>
<tr>
<th>Flashpoint of flammable liquid</th>
<th>Minimum separation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LPG vessel up to and including 60 tonnes LPG capacity</td>
</tr>
<tr>
<td>&lt; 32 °C (e.g. Petrol)</td>
<td>6 m to bund wall or double skinned tan</td>
</tr>
<tr>
<td>32° - 65 °C (e.g. Kerosene, Diesel fuel, Gasoil)</td>
<td>Tank size up to 3 000 litres of flammable liquid</td>
</tr>
<tr>
<td></td>
<td>6 m to tank, bund wall or diversion wall lesser</td>
</tr>
<tr>
<td></td>
<td>Tank size over 3 000 litres of flammable liquid</td>
</tr>
<tr>
<td></td>
<td>15 m to tank, bund wall or diversion wall</td>
</tr>
</tbody>
</table>

**Note 1:** Where the above separation distances would exceed the boundary distances for LPG storage given in Table 1, liaison between the parties will be necessary.

**Note 2:** For LPG vessels up to 1.1 tonne above ground, and 2.2 tonne below ground located adjacent to flammable liquid storage that is either double skinned or bunded, the minimum separation distance may be reduced to 1 m (see also UKLPG Code of Practice 1: Part 2; 2012, Section 2.3. Separation distances between propane vessels and oil vessels).
Table 3: Separation Distances from Liquid Oxygen Storage

<table>
<thead>
<tr>
<th>Vessel Sizes</th>
<th>LPG (Tonnes)</th>
<th>Separation Distance (Metres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid Oxygen (Litres)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Up to 125 000</td>
<td>0 - 1,1</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>&gt;1,1 - 4</td>
<td>7,5</td>
</tr>
<tr>
<td></td>
<td>&gt;4 - 60</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>&gt;60 - 150</td>
<td>22,5</td>
</tr>
<tr>
<td></td>
<td>&gt;150 - 300</td>
<td>30</td>
</tr>
<tr>
<td>Over 125 000</td>
<td>0 - 2</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>&gt;2 - 220</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>&gt;220</td>
<td>Seek expert advice</td>
</tr>
</tbody>
</table>

2.3.2.7 Firewalls shall be sited in accordance with 2.4.2. For vessels up to 1.1 tonnes LPG capacity, the fire wall need be no higher than the top of the vessel and may form part of the site boundary. The fire wall for a vessel up to 1.1 tonnes LPG capacity may form part of a building wall in accordance with Figure 1.

2.3.2.8 Where part of the building is used for residential accommodation the wall, including overhangs but excluding the eaves, against which the LPG is stored should be imperforate and of 60 minutes fire-resisting construction (to BS 476-20).

2.3.2.9 Within the separation distance:
- fixed sources of ignition (i.e. pilot lights, naked flames at any height) shall be prohibited;
- unprotected fixed electrical equipment within the areas described by 2.3.4 shall be prohibited;
- smoking shall be prohibited, including e-cigarettes;
- all other potential sources of ignition shall be controlled;
- 2.3.4 gives guidance on electrical installations within the separation distance;
- only vehicles associated with product transfer and handling operations shall be permitted;
- 2.3.2.11 gives guidance on parking of vehicles;
- fixed electrical generators shall be prohibited.
2.3.2.10 Separation distances for above ground vessels may be reduced as shown in Table 1 above by the provision of fire walls complying with 2.4.

Alternatively, separation distances may be reduced by the provision of greater fire protection than that set out in Section 4 of this Code of Practice, Fire Precautions. However, in this case advice should be sought from the Enforcing Authority and the Fire Authority.

2.3.2.11 Powered vehicles which are under the control of the site occupier shall be parked at least 6 m or the separation distance given in column (d) of Table 1 above, whichever is the smaller, from LPG vessels. This does not apply to the loading and unloading or refuelling of vehicles. Powered vehicles not under site control, for example those belonging to members of the public, shall be parked no closer than the separation distances given in column (d) of Table 1.

Areas in which the public should not park may be indicated by marking of the ground, warning notices etc.

2.3.2.12 Buildings or structures in which cylinders are filled with LPG or other flammable gases shall be sited 10 m from bulk LPG vessels up to 60 tonnes LPG capacity and 15 m from larger vessels.

This separation distance is not necessary where only a small number of cylinders are filled, e.g. for those installations described in UKLPG Code of Practice 20.

2.3.2.13 The minimum distances of separation between an LPG storage vessel and a vessel containing a flammable liquid or liquid oxygen are set out in Tables 2 and 3. If LPG is to be stored with hazardous or other combustible materials the enforcing authority shall be consulted. LPG vessels shall not be located in a bunded area.

2.3.2.14 No part of the storage vessel shall be located directly beneath any part of the structure of the premises or extension from it, for example roof eaves, car ports, etc.

2.3.2.15 LPG storage vessels located near trees should be sited so that the trees do not present a risk to the tank, its valves or the integrity of the pipework.

Note: in practice this means that trees that are large enough to damage an LPG vessel, its valves or pipework will be managed and maintained in a healthy state, with no substantial branches overhanging the vessel.
2.3.2.16 Combustible materials shall be kept out of / controlled in the area around the LPG storage vessel(s). This means overgrown weeds, long grass, deciduous shrubs and deciduous trees, and any combustible material shall be removed from an area within the separation distance in column (d) of Table 1 (for vessels not exceeding 1.1 tonnes LPG capacity, or within 6m for larger vessels). Chemical weed killers (such as sodium chlorate) or any other method which might provide a source of ignition shall not be used in these areas.

2.3.2.17 Where a visual screen is required for above ground LPG storage vessels, this shall be located at least 1 m from the vessels and not interfere with access or ventilation. In order to achieve this it is recommended that:

The screen should not obstruct more than 50% of natural ventilation around the vessel(s) perimeter taken to the height of the vessel(s). The screen shall not prevent the free movement of air around the vessel(s). This should be achieved by ensuring there is low level ventilation on at least two sides – ideally in line with the prevailing wind direction.

Practical examples of screening which have generally proved satisfactory include:

- one side of the vessel only for evergreen shrubs or trees;
  Evergreen shrubs or trees can present a fire risk and need to be carefully positioned and maintained to ensure that they do not restrict access and that they do not grow nearer than 1m to the vessels or in an area extending vertically above such a distance to the vessels;

- no more than two sides (the third and fourth sides being left clear for ventilation and delivery hose access); for closed panel type fence or wall (including a fire wall) which obstructs more than 50% of natural ventilation around the vessel(s);

- no more than three sides (the fourth side being left clear for ventilation and delivery hose access) for fence or wall, which obstructs no more than 50% of natural ventilation around the vessel(s);

- on all four sides for a fence or wall, which obstructs no more than 50% of natural ventilation around the vessel(s) provided that at least two equivalently ventilated means of exit, situated to minimise the distance to be travelled to escape from a dead end are provided. Gates or access should open outwards and be easily and immediately openable from inside, they should not be self-locking and should provide unobstructed means of escape.

2.3.2.18 The electrical risks from aboveground electrical cables near LPG storage vessels, vaporisers, pumps, compressors, gas-air mixing plants, etc., shall be minimized. The key risks to be controlled are fallen live cables coming into contact with
LPG equipment, high voltage cables arcing onto metallic LPG equipment, and working in the vicinity of live cables.

LPG storage vessels, vaporisers, pumps, compressors, gas-air mixing plants, etc., should not be located directly beneath electrical power cables.

For cables operating at a voltage of 1.0 kV or greater the vessel(s) should be sited at least 10 m from a plane drawn vertically downwards from the power cables.

For cables operating at a voltage of between 50V and less than 1.0 kV the vessels should be sited at least 1.5 m from a plane drawn vertically downwards from the power cables.

For cables operating at a voltage of less than 50V (such as telephone cables) they provide minimal electrical risk to the LPG vessels, but should be routed in such a way as to not to impede access to the vessel or hinder installation or maintenance.

These distances may need to be increased where the presence of the overhead line could constitute a danger to users of the facility or loading tankers and personnel.

If the above requirements cannot be attained, further advice and information should be obtained from the electricity line owner or from BS EN 50110 Part I to ensure the risks from such cables are minimized.

Attention is also drawn to HSE Guidance Note GS6.

2.3.2.19 To avoid risk of damage and possible disruption of the LPG in the event of subsequent maintenance location of LPG storage vessels, vaporisers, pumps, gas-air mixing plants, etc., above other services should be avoided wherever practicable.

HSE Guidance Note HS[G]47 “Avoiding danger from underground services” gives further information.

2.3.2.20 LPG cylinders in excess of 50 kg total quantity with pressure relief valves which vent horizontally shall not be stored within 7.5 m of vessels of more than 2.2 tonnes LPG capacity or 3 m of vessels below this size. Up to 300 kg of LPG in cylinders fitted with vertically venting pressure relief valves, e.g. most fork lift truck cylinders, may be stored within the vessel security compound at least 1 m from the vessel.
2.3.2.21 Up to 300 kg of propane in cylinders may be kept within 7.5 m or 3 m of a vessel (see paragraph 2.3.1.1 above) for the purposes of pressure augmentation of a butane vessel in cold weather or to provide an emergency supply of propane in the event of a failure of the bulk supplies.

2.3.2.22 The cylinders should be positioned at least 1 m from the vessel. The pressure relief valves shall be directed away from the vessel, or a fire wall shall be built between the cylinders and vessel.

2.3.3 Vessel Spacing

The distance between LPG storage vessels shall be in accordance with Table 1, column (f).

2.3.4 Electrical Installations within the Separation Distances

This Section is in addition to and not to be confused with the requirements of Section 2.1.1 which defines hazardous places as required under Regulation 7 of DSEAR.

Unless a specific, documented, risk assessment has demonstrated the risk to be insignificant, then in addition to the requirements of DSEAR and Section 2.1.1, only equipment suitable for use in zoned areas and constructed to a recognised standard shall be installed within:

• 0.5 m of any point on the surface of the vessel;
• the area beneath the vessel;
• the area 1.5 m above ground level measured at the vessel surface and decreasing uniformly to zero at the distance set in column (d) of Table 1.

A firewall meeting the requirements of 2.4.2 may be used to truncate this area, however the truncated area should be considered to wrap around the side of the wall away from the vessel.

Guidance on electrical installation requirements is given in 5.1.

2.3.5 Multiple Vessel Installations

Multiple vessel installations should be designed and installed as follows.

2.3.5.1 Location and spacing requirements apply as for a single vessel.
2.3.5.2 Precautions shall be taken when vessels are interconnected in the liquid phase to ensure that the maximum permissible liquid level in any vessel is not exceeded for example, vessels should be of a similar cross section/diameter and at the same level.

2.3.5.3 A vapour balance line of adequate size shall be fitted to groups of vessels which are interconnected in the liquid phase.

2.3.5.4 The design of remote fill lines on multiple vessels should be carefully considered with the fitting of either separate filling lines to each vessel or a common fill line. Separate fill lines shall be readily identified with the relevant vessel as described in 2.8 and common fill lines shall have individual isolation valves to each vessel.

**Note:** The design of fill lines needs to assess the circumstances of the installation and minimize the risk associated with it. Separate fill lines will result in more connections and disconnections being made during deliveries whereas common fill lines introduce the risk of unintentionally filling vessel(s) other than that being filled.

2.3.5.5 Installations having a liquid return line to the storage vessels, e.g. from pumps or vaporisers, shall be designed to prevent overfilling by the inadvertent return of product to vessels otherwise isolated.

2.3.5.6 The number of above ground LPG storage vessels in one group should not exceed six.

2.3.5.7 Any vessel in one group should be the separation distance given in Table 1 column (d), from the nearest vessel in another group unless a fire wall is erected between the two groups.

2.3.5.8 Separate groups of vessels shall only feed a common gas supply if emergency situations can be effectively managed.

**Note:** this clause is to remind designers and operators that if two or more vessel groups feed the same supply, the design will need to clearly indicate how to isolate the gas supply in the event of an emergency. In practice this can be achieved by the vessels’ physical proximity, by the use of remotely operated shut off valves and by clear signage.
Figure 1: Small Bulk Vessel Adjacent to Building

Should be 1 metre either side of pressure relief valve

Height of top of P.R.V

30 min. fire resisting and imperforate; 60 min for residential property

LPG vessel

0.3 m for vessel up to 500 litres
1.0 m for larger vessels

2.5 m for vessels up to 250 kg Propane capacity
3.0 m for vessels 250 kg to 1.1 tonne Propane capacity
4.0 m for vessels 1.1 tonne to 2 tonne Propane capacity
Figure 2: Small Bulk Vessel at Domestic Premises

- **Vessel 1 tonne**
- **3m x 3m x 3m**
- **Hedge (one side only)**
- **Ordinary trees**
- **Driver**
- **Road tanker**
Figure 3: Vessel Compound with Fire Wall
Figure 4: Storage Vessel at an LPG Cylinder Filling Installation

Cylinder filling building

Water sprays

Pneumatically operated valves

Tanker discharge area

2 x 30 tonne vessels

Perimeter fence

Cylinder storage area (see UKLPG CoP 7 for advice on cylinder storage)

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Figure 5: Installation Supplying Gas to Houses on a Metered Supply

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Figure 6: Two 60 Tonne Vessels with Vaporisers

- Entrance
- Vaporizers
- Water sprays
- Concrete base sloping towards gravel
- Security fence
- Separation distance: 15m min. (Table 1)
- Tanker discharge area
- Evaporation area gravel surface
- Entrance
- Evaporation area gravel surface

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2.3.6 Caravan Park, Mobile Home Park or Similar Installations

The spacing between adjacent vessels should be determined by the site conditions and the needs for safe installation, testing, maintenance and removal of vessels.

Where consumers are individual residents of a caravan park, mobile home park or the like, reduced separation distances between LPG vessels and the boundary of the plots on which they are installed may be accepted. However, this is only acceptable if there are contractual agreements between the residents and the site owner to control any activities on the plots occupied by the residents that could endanger the safety of LPG on their own plots or on adjoining ones.

Such agreements should cover, among other things:

- The lighting of fires, barbecues, etc.;
- The erection of combustible buildings, sheds, fences, etc.;
- The removal of vegetation, etc., in accordance with 4.8.

Where such agreements are in force, the distance between LPG vessels to the boundaries of the individual plots may be reduced below those given in Table 1, however the following conditions shall be met:

- The distance in Table 1, column (d) between individual vessels and properties (such as mobile homes) complies with those set out in the table in each case;
- The distance between individual vessels on adjoining plots is not less than that given in Table 1, column (f) (i.e. 1 metre for vessels up to 4 tonnes LPG capacity);
- The distance in Table 1, column (d) between any of the vessels and the boundary of the site under the control of the owner is no less than that given in the table.

See Figure 7 for examples of separation distances.
Figure 7: Examples of Separation Distances

Overall site boundary

Residential home/caravan

LPG vessel

A & C - to comply with minimum distance given in Table 1 for separation of vessels from buildings (A) & boundary/property line (Column a)

B - to comply with minimum distance given in Table 1 for separation of individual vessels (Column c)
2.4 Fire Wall

2.4.1 Purpose

The purpose of a fire wall is to protect the vessel or vessels from thermal radiation from a fire nearby and to ensure an adequate dispersion distance to boundaries, buildings and sources of ignition for LPG leaking from the vessel or its fittings where normal separation distances cannot be achieved.

2.4.2 Siting

Fire walls may permit the distance from the vessel to buildings, boundaries, etc. to be reduced to the values given in column (e) of Table 1. However, this distance can be reduced only if the distance from the vessel to these features around the end of the fire wall is at least that given in column (d) of the table.

For vessels not exceeding 0.25 tonnes LPG capacity fire walls shall be sited a minimum of 0.3 m from the nearest point of the vessel. For vessels of greater than 0.25 tonnes LPG capacity fire walls shall be sited a minimum of 1.0 m from the nearest point of the vessel.

A fire wall may be built on a boundary for vessels up to 1.1 tonnes LPG capacity but in such cases it should be wholly under the control of the occupier of the LPG storage site.

Fire walls should not be provided on more than two sides and normally only on one side. In all cases the natural ventilation should not be significantly impaired. Where two fire walls are being considered the Enforcing Authority should be consulted.

Where multiple vessels are installed in a group two fire walls parallel to the longest axis of the vessels should only be considered if the distance between the vessels is as shown in Figure 8 where dimension “f” corresponds to Table 1, column (f).

Figure 8: Use of two Parallel Fire Walls
2.4.3 Size and Construction

Fire walls should be imperforate and substantially constructed from brick, concrete or solid masonry and be capable, if tested in accordance with either BS 476 part 20 and the relevant criteria of BS 476 parts 20 and 21 (formerly BS476 part 8); or BS EN 1363 in conjunction with the relevant parts of BS EN 1364 and BS EN 1365, of achieving 30 minute fire resistance or, where the fire walls form part of residential accommodation, 60 minute fire resistance (see also 2.4.4).

For vessels up to and including 1.1 tonnes LPG capacity, they should not be less than the height of the vessel. For larger vessels they should be not less than 2 metres high or the height of the vessel, whichever is the greater.

2.4.4 Use of Existing Walls

For vessels up to and including 1.1 tonnes LPG capacity the fire wall may be the wall of an existing building, in which case the following additional requirements should be met:

- There shall be no openings in the wall either to the sides or above the top of the storage vessel for distances shown by Figure 1;

- There shall be no overhanging eaves or similar projections constructed from combustible materials immediately above any storage vessel, nor any obstruction above the vessel which could interfere with the operation of pressure relief valves. No external stairway or fire escape shall be positioned above a storage vessel or be allowed to terminate in the storage areas.

2.5 Storage Areas

2.5.1 General

2.5.1.1 The ground beneath or adjacent to vessel connections or ancillary equipment shall be concreted or compacted and arranged to prevent either the accumulation of any liquid beneath them or its flow affecting other vessels or important areas. Provision shall be made for handling the run-off of cooling water applied under fire conditions.

It is not necessary to compact or concrete the ground beneath connections that are plugged or blanked off.
2.5.1.2 To prevent the formation of gas pockets the vicinity of LPG storage vessels shall be free from pits and depressions within the separation distance given in Table 1.

2.5.1.3 Open drains, gullies or ducts located within the vessel separation distances which would permit access and passage of LPG vapours shall be fitted with a water trap or be otherwise suitably sealed.

2.5.2 Provision for Spillage of LPG

2.5.2.1 Conventional bunds shall not be used around LPG storage vessels.

Note: Some installations subject to 2.5.2.2, 2.5.2.3 and 2.5.2.4 may have bunding to a height not exceeding 500mm around the LPG storage vessel. This is only permitted if the design aids the swift removal of liquid LPG spillages away from the LPG storage vessel into an evaporation area (in accordance with 2.5.2.4) which can cope with the maximum credible LPG spillage.

2.5.2.2 Vessels with connections below the liquid level with an individual capacity of:

- 25 tonnes or more Propane;
- 5 tonnes or more Butane;

shall have provision made for directing any spillage of LPG to an evaporation area. Installations of individual vessels smaller than these shall not normally require evaporation areas.

2.5.2.3 For installations requiring evaporation areas diversion kerbs with a height not exceeding 500 mm to avoid forming gas traps may be required to direct possible spillage away from vessels and sources of ignition to a safe area for evaporation or containment.

2.5.2.4 Evaporation areas shall be at least 3 m from LPG vessels, the area should be surfaced with stone chippings or similar material to increase the surface area and promote evaporation and dispersion of the gas. Depending on its location the evaporation area may be contained.

2.5.2.5 For larger installations, consideration should be given, on a case by case basis, to the need for catchment pits to contain spillage. Any assessment should include consideration of the nature of the substance being stored; the inventory which could be released; proximity of people/plant which may be at risk and other control/mitigation measures e.g. fire protection arrangements.

2.5.2.6 The American Petroleum Institute Standard 2510 describes alternative methods
2.6 Storage Compound Protection

2.6.1 Fencing and Gates

Except where the provisions of 2.6.2 and 2.6.3 below apply, the installation, its fittings and attachments shall be protected to minimise inadvertent or deliberate interference.

The area which includes above ground vessels and pumping equipment shall be enclosed by an industrial-type fence, e.g. open mesh or palisade types, which:

- Ensures adequate ventilation;
- Is at least 1.8 m high;
- Is at a distance of not less than 1.5 m from the storage installation (unless it is otherwise adequately protected, for example if the area comes within a greater fenced area or is otherwise isolated from the public).

Around the immediate vessel area, fences shall have at least two means of exit, situated to minimise the distance to be travelled to escape from a dead end. Gates or access shall open outwards and be easily and immediately openable from inside. They shall not be self locking, and shall provide unobstructed means of escape.

2.6.2 Installations with Uncontrolled Public Access

Storage installations for supply to autogas refueling sites or to multiple consumers (e.g. housing estates, or home parks) to which the public have uncontrolled access (e.g. without controlled access and a secure perimeter fence), shall be enclosed by a security fence as described in 2.6.1 above.

The fence should be at least 3 m from the vessel. Installations involving storage vessels exceeding 4 tonnes individual capacity should be subject to a specific site risk assessment.

The distance between the fence and the vessel may be reduced to 1.5 m at autogas refueling sites provided that the compound is subject to constant surveillance (i.e. where the site has attended operation 24 hours a day, 7 days a week and the vessel is visible to site staff either directly or via closed circuit television).

Combustible materials shall not be allowed to accumulate and arrangements shall be made to control the positioning of sources of ignition within the remainder of the area which is within the separation distance (7.5 m for vessels between 1.1 and 4 tonnes LPG capacity) and outside of the security fence.

Refer to UKLPG Code of Practice 25 for further guidance.
2.6.3 Relaxation of Fencing Requirements

The provisions of 2.6.1 above for a security fence may be relaxed for vessels of less than 4 tonnes LPG capacity provided that access to the valves and fittings other than pressure relief valves is denied. Examples of ways in which access could be denied are:

- By a substantial ventilated hinged cover capable of being locked in the closed position;
- By a blank flange or plug on drain connections;
- By an open wire mesh fence with lockable access between support piers of vessels with bottom connections between the supports.

Where a lockable cover is provided the key should be readily available in an emergency.

2.6.4 Precautions against Damage from Vehicular Traffic

Precautions against damage to vessel(s) and ancillary equipment e.g. pumps and dispensers from vehicular impact damage shall be taken.

The design of the protection shall take into account the vehicle types, likely speeds and proximity of adjacent roads to the installation location. Protection from impact damage can be achieved by the use of bollards, crash barriers, kerbs, mounting on a raised plinth or other means that provide a suitable level of safety.

Such protection may be immediately adjacent to the installation and associated pipework and should not impede access for the emergency services, everyday use, filling and maintenance.

Security fences or restrictions of traffic by marking of the ground, warning notices etc. are unlikely to provide adequate impact protection on their own.

2.6.5 Supplementing Perimeter Fencing

At industrial sites where there is surveillance of the installation, the site perimeter fence may suffice for security. However, where the installation is remotely located on the site, subject to infrequent surveillance, or where trespass on to the site is known, the installation should be enclosed by its own security fence to supplement that at the perimeter.
Warning Notices

Each vessel shall be clearly and boldly marked ‘Highly Flammable - Butane (or Propane)’ as appropriate.

The term ‘Extremely Flammable’ may also be used.

Prohibition of smoking or naked flames and No Unauthorised Entry (if applicable) shall be indicated by signs complying with the Health and Safety (Safety Signs and Signals) Regulations 1996. These are defined in BS 5499. The signs shall be durable, clearly visible and legible at the applicable separation distance (see Table 1), and should be firmly fixed to the fence or wall or the vessel itself.

For unodorised product refer to Appendix G.

For sites storing more than 25 tonnes, notices are required in accordance with the Dangerous Substances (Notification and Marking of Sites) Regulations 1990.

Ex signage is not required as per 2.1.1.

Location of Offloading / Reception Facilities

2.8.1 Siting of Filling Connections

Filling connections should be as close to the vessel as is practicable but shall not be directly underneath. Offset / remote fill points should be used whenever vehicle access would otherwise be difficult.

Filling connections should be located within the storage fenced area when practicable. If outside, the terminal fitting shall be secured against tampering, for example by use of a ventilated box capable of being locked.

Filling connections should be easily accessible. They shall be located so that the safe positioning of the delivery vehicle and its quick removal in an emergency are facilitated.

Connections should terminate about one metre above ground and should allow a horizontal connection to be made with the delivery hose(s).

If vessels are top-filled, safe access to filling connections shall be provided, for example by suitable steps and access platforms.
When siting offset / remote filling connections, consideration shall be given to their area classification, see Appendix B.

### 2.8.2 Labelling of Filling Connections

Filling connections that include vapour returns should be clearly labelled ‘liquid’ or ‘vapour’ as appropriate. Where butane and propane loading / unloading connections are adjacent they shall be clearly distinguished.

### 2.8.3 Storage and Use of Filling Hoses

To avoid abrasion and other damage to the hose during filling it should not pass over walls or fences or similar features likely to cause such damage. Hoses should be securely supported and stored accordingly when not in use.

### Location of Product Transfer Equipment

Pumps, compressors and their motors should be protected against accidental damage and the weather by suitable positioning and / or protection. They shall not be sited beneath vessels.

#### 2.9.1 Motors

Note that explosion protected motors are not necessarily weatherproof.

Any electrical equipment shall be appropriate for the classification of the area in which it is installed (see 2.1 and 2.3.2).

#### 2.9.2 Pumps

The location of pumps should be selected to minimise the risk of cavitation under the specified operating conditions.

Pumps should be located to facilitate ease of maintenance.
2.9.3 Compressors

If compressors are located in a building the structure shall be non-combustible with a lightweight roof, well ventilated and used for no other purpose than the compression and distribution of LPG or other gases. (See also 3.4.3).

2.9.4 Pipework

Pipework shall be adequately supported and not used as a step or path.

2.10 Location of Regulators

First stage pressure regulator(s) should be located as close as practicable to the vessel or vaporiser in a well ventilated position and shall be installed to avoid trapping re-liquefied LPG from vapour pressure pipework.

All regulator(s) shall be designed or sited to avoid the ingress of water through vent hole(s) and should also be easily accessible.

2.11 Location of Meters

Meters should be protected against accidental damage by suitable positioning and/or protection. They shall not be sited beneath vessels.

Meters should be located to facilitate installation, maintenance and use.

2.12 Location of Vaporisers

2.12.1 Distance from LPG Storage Vessels

Except for those described in 2.12.2, vaporisers shall not be installed within 1.5 m of a storage vessel.

Direct fired or non-ATEX rated electrical vaporisers (see 3.7.1) shall be installed no nearer to LPG storage vessels than the distances permitted in columns (a) and (b) of Table 1 as appropriate.

Particular care shall be taken with the location of vaporisers to facilitate their safe draining.
2.12.2 Vaporisers as Part of the Storage Vessel

Where the vaporiser design and the manufacturers installation instructions permits installation closer than 1.5 m to the storage vessel(s), it shall be considered as part of the vessel(s) for installation safety distances (see Tables 1, 2 and 3).

**Note:** When using Table 1 for this purpose, the water capacity of the LPG section of the vaporizer needs to be included when calculating the the LPG vessel’s water capacity.

2.12.3 Distance from Properties

The distance between any vaporiser and the nearest building, boundary or fixed source of ignition shall be in accordance with the distances given in Table 4 for the water capacity of the vapouriser.

**Table 4: Separation Distances between LPG Vaporisers and Buildings, Boundaries and Sources of Ignition**

<table>
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<tr>
<th>Water Capacity of the LPG Section of the Vaporiser (litres)</th>
<th>Separation Distance (m)</th>
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<tr>
<td>Up to 2 500</td>
<td>3</td>
</tr>
<tr>
<td>&gt;2 500 to 9 000</td>
<td>7.5</td>
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<td>&gt;9 000</td>
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Storage Vessels

3.1 Design Code

New vessels shall be designed and constructed to BS EN 12542, BS EN 13445, PD 5500 or an alternative, appropriate Standard meeting the conditions set out in 3.1.2 and 3.1.3 below. Alternative pressure vessel Standards may be used only if it can be shown that they will give an equivalent standard of safety.

Note: New vessels must be CE marked in accordance with the Pressure Equipment (Safety) Regulations 2016.

The design of any vessel shall be based on the application of a single recognised Standard. The mixed application of Standards to the design of a vessel should be avoided.

The designer/supplier must provide sufficient written information to the user so that the Pressure Systems Safety Regulations 2000 can be complied with. The Construction (Design and Management) Regulations 2015 also require the preparation of a health and safety file for any project within their scope.

3.1.2 Design Conditions

The design pressures and temperatures shall take into account the extreme ambient and service temperatures that the contents may reach in operation.

The design conditions for storage vessels shall not be less onerous than the service limits given in Table 5 below.
For existing vessels where the design conditions cannot be established (see Section 9) these must be determined by a competent person before the vessel is put back into service. The Pressure Systems Safety Regulations 2000 require users to establish the safe operating limits of a pressure system before it is used, and to implement a written scheme for periodic examination, which may include a requirement for examination before next use.

Table 5: LPG Service Limits

<table>
<thead>
<tr>
<th></th>
<th>Commercial Butane</th>
<th>Commercial Propane</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Liquid offtake</td>
<td>Vapour offtake</td>
</tr>
<tr>
<td>Maximum temperature</td>
<td>38 °C</td>
<td>38 °C</td>
</tr>
<tr>
<td>(See Note 1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum pressure</td>
<td>4,83 bar gauge</td>
<td>14,5 bar gauge</td>
</tr>
<tr>
<td>(See Note 1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum temperature</td>
<td>Minus 18 °C</td>
<td>Minus 20 °C</td>
</tr>
<tr>
<td></td>
<td>(See Note 4)</td>
<td>Minus 40 °C</td>
</tr>
<tr>
<td>Minimum pressure</td>
<td>480 mbar absolute</td>
<td>Zero gauge</td>
</tr>
<tr>
<td>(See Note 3)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note 1:** These developed pressure reference temperatures are for vessels finished in white. Other finishes may reduce normal reflection of solar radiation and therefore require a higher design temperature / pressure.

**Note 2:** A higher minimum temperature may only be used for dedicated service where controls are provided to limit the lowest product temperature to a higher value.

**Note 3:** A higher minimum pressure for butane storage may only be used if the system incorporates a positive means for preventing unacceptable vacuum conditions occurring in the vessel, or if local minimum ambient temperatures ensure that the product temperature will be higher than minus 18 °C. See 3.1.3 below.

**Note 4:** This temperature allows for auto refrigeration effects in the absence of a vapour balance system for vessels up to 100 tonnes LPG capacity and for offtake rates up to 30 tonnes per hour. Outside these parameters this design temperature shall be minus 40 °C unless a technical assessment for the operating conditions confirms a higher figure.
3.1.3 Vacuum Conditions in Butane Storage Vessels

Operating conditions, product composition and ambient temperatures may lead to low product temperatures, even to the extent that the stored products vapour pressure falls below atmospheric pressure. One of the following design conditions shall therefore be met:

• The vessel should be designed to withstand the vacuum;
• Alternatively, the system should incorporate positive means for preventing unacceptable vacuum conditions occurring in the vessel.

Whichever of these two design conditions is used, the design of equipment shall cover the use of commercial butane at the lowest product temperature likely to occur in service.

See also Appendix E.

3.1.4 Marking

Each vessel must be provided with visible, legible and indelible markings which must include at least the following information:

(a) the pressure vessel design code;
(b) the manufacturer’s name and vessel serial number;
(c) the maximum and minimum design pressure in bar g;
(d) the maximum and minimum safe operating temperatures;
(e) the date of the manufacture of the vessel.

It is recommended that the following additional information shall also be included:

(f) the water capacity in litres;
(g) date of test, pressure applied, inspection authorities’ identification;
(h) provision for subsequent test marking.

Note: The markings listed in (a)-(e) above are those required by the Pressure Systems Safety Regulations 2000.
3.1.5 Vessel Supports

3.1.5.1 Vessel supports shall comply with the pressure vessel Standard taking account of the vessel shell stressing and transmission of the loadings to the ground. Supports shall permit movement of the vessel due to changes in temperature.

3.1.5.2 Saddle bearing or corrosion plates shall be designed in accordance with the Standard to which the vessel is designed and shall be of steel. Where saddles are not welded to the vessel, bearing and/or corrosion plates shall be used. The latter shall also be used whenever there is likely to be severe corrosion between the vessel and the supporting structure.

3.1.5.3 Saddles or supports shall project downwards more than any other projection on the lowest part of the vessel. Where saddles are not used, the vessel supports shall be shaped to conform with the vessel shell.

3.1.5.4 For vessels above 2.2 tonnes LPG capacity and/or where piers are used as part of the vessel support, provision shall be made for securing the vessel at one end, the other being free to move as required. The end so secured shall be that to which the principal liquid and vapour lines are attached. If a choice between liquid lines and vapour lines is necessary the liquid lines shall take precedence.

3.1.5.5 Vessel supports shall be designed to prevent, or to drain, any accumulation of water and be of sufficient height to allow adequate access for installation, maintenance and use of the bottom fittings.

3.1.5.6 Vessel supports shall be designed so that drain connections are at the lowest point of the vessel.

3.1.5.7 Information on maximum permitted loads on supports shall be included in design documentation.

3.1.5.8 Supports for vertical vessels shall be constructed so as to provide adequate support to the vessel.

3.1.5.9 Where vertical vessels supports are of the “skirt” design, they shall be provided with openings of sufficient area and so sited to:

- provide adequate ventilation;
- allow unhindered flow of any spilled LPG;
- be designed to prevent any over pressure developing, likely to threaten the tank or its fitting in the event of an explosion involving LPG.
To achieve this, a minimum of two vents / inspection openings shall be provided, with at least one located at ground level. Pipes within the skirt shall have welded or welded flanged joints.

3.1.5.10 Vessels shall be properly installed on firm foundations and, where appropriate, supported on concrete, masonry or structural steel supports. These supports (excluding supporting feet 460 mm or less in height, vessel saddles, or skirts of vertical vessels) shall be so constructed or protected to ensure their load-bearing capacity is maintained for at least the same period as fire resistance is provided for the vessel. See BS 476 Part 21 and Section 4.4 of this Code of Practice.

3.1.6 Access for Internal Inspection

For vessels up to and including 1500 mm inside diameter, provision for internal inspection through vessel connections of 35 mm internal diameter are adequate for advanced optical techniques. Where such techniques are unlikely to be available, the openings should be spaced in accordance with BS EN 12542, BS EN 13445, PD 5500 or an alternative, appropriate Standard.

3.1.7 Protection against Corrosion

An adequate external protection system shall be applied to the vessel and its supports, for example by zinc metal spraying and painting.

The external surfaces of vessels shall be suitably prepared, for example by shot blasting.

The form of corrosion protection applied shall allow for any expansion / contraction of the vessel which takes place with change of temperature and internal pressure conditions.

3.1.8 Fittings

3.1.8.1 Each vessel shall be provided with at least one of each of the following fittings:

(a) Pressure relief valve connected to the vapour space. (See 3.1.10);
(b) A drain (see 3.1.18), an Occasional Liquid Withdrawal valve or other means of removing the liquid contents, as defined in EN13175;
(c) A fixed maximum liquid level device (see 3.1.14) or Maximum Level Fill Stop Valve (see 3.1.15), and preferably a contents gauge. The level device should be independent of the contents gauge;
(d) Filling connection. (See note below);
(e) Service outlet connection. (See note below);
(f) A pressure gauge connected to the vapour space if the vessel is over 2,2 tonnes LPG capacity. For vessels of 2,2 tonnes LPG capacity and below provision should be made for determining the pressure in the vessel, for example a valved tapping in the vapour space of the vessel or adjacent pipework.

**Note:** The location of connections, particularly in combination valve clusters, should ensure that liquid is not entrained in a vapour service offtake during filling operations.

3.1.8.2 New tank valves and fittings should meet the requirements of BS EN 13175. New contents gauges should meet the requirements of BS EN 13799.

New valves, fittings and gauges must comply with the Pressure Equipment (Safety) Regulations 2016.

3.1.8.3 Vessels for the storage of butane shall be provided with means of preventing excessive vacuum where necessary. (See Appendix E.)

3.1.8.4 All fittings attached to the vessel shall be suitable for LPG service over the range of temperatures and pressures that the product will reach in service.

3.1.8.5 Jointing compounds for screwed joints shall be resistant to liquid phase LPG. They shall conform to one of BS EN 751-1, 751-2 and 751-3 as appropriate. They shall be applied in accordance with the manufacturer’s instructions and to the male thread only, so that jointing material cannot enter the fitting. Red lead, hemp or Boss White shall not be used. The use of jointing compounds on materials may affect their electrical continuity: see paragraph (e) of 5.2 for further guidance.

3.1.8.6 Gaskets for flanged joints shall be resistant to liquid phase LPG. Gaskets of natural rubber; or those bonded with natural rubber; shall not be used.

3.1.8.7 The number of direct connections below the liquid level should be kept to a minimum. Wherever possible only one branch, excluding drain lines, should be provided. All other branches should terminate in the vapour space.

3.1.9 **Service Outlet Connection**

For small vapour offtake vessels with a POL left hand female outlet service valve, the recommended connection is BS EN 15202, connection G9.

**Note:** The cylinder POL to BS EN 15202, connection G7 is larger and will not fit.
3.1.10 Pressure Relief Valves

3.1.10.1 All vessels shall be fitted with a pressure relief valve or valves so that the level of accumulation is within the limits specified in the design standard of the vessel to which it is fitted.

3.1.10.2 For vessels up to 60 tonnes LPG capacity the discharge capacity shall meet the requirements of BS EN 14129. Pressure relief valves shall be set to start to discharge at a pressure not less than the service pressure given in 3.1.2, table 5 and shall not be set to discharge at a pressure higher than the vessel design pressure. For above ground vessels the rate of discharge at full flow of the relief system shall not be less than that specified in Appendix C.

For larger vessels the discharge capacity should comply with a recognised Standard such as this Code of Practice, or API 520, or API 2000, with design details to BS EN 14129.

**Note:** These rates of flow are the minimum permissible at full discharge, and apply to relief valve systems including pipework, relief valve adaptors, multiple valve manifolds etc., as installed. When determining the size or number of relief valves required, allowance therefore needs to be made for the reduction of quoted safety relief valve discharge rates arising from the flow resistance of relief valve adaptors, multiple valve manifolds or other restrictions.

3.1.10.3 Isolation valves with the exception of those described in 3.1.10.5 shall not be fitted between a single pressure relief valve and the vessel. In the case of manifolded pressure relief valves, any provision made for isolating any relief valve (e.g. for testing or servicing) should ensure that the remaining relief valves connected to the vessel provide the full capacity required at all times.

Where the removal of a relief valve would leave the vessel protected by less than full discharge capacity, a replacement relief valve should be fitted immediately.

3.1.10.4 In the case of vessels fitted with separate or single relief valves, provision may be made for their removal for testing or servicing by the use of a relief valve isolator designed to BS EN 14071, provided this valve is retained in the fully open position by the presence of the relief valve and closes before the relief valve is completely removed.

When carrying out this procedure, it is essential that the storage vessel is not left unprotected. A replacement relief valve shall be fitted immediately.

3.1.10.5 Where a vessel designed for propane is used for butane service, safety valves with a capacity not less than that specified in Appendix C, and set at the vessel design pressure (e.g. 14.5 bar gauge), may be used.
3.1.10.6 Where a vessel designed for propane is used for butane service, relief valves set at butane service pressure (e.g. 4.83 bar gauge) may be used. The safety relief capacity shall not be less than the capacity in Appendix C related to the vessel design pressure (e.g. 14.5 bar gauge).

3.1.10.7 Excess flow valves shall not be installed between the vessel and any safety relief valve. Check devices shall comply with 3.1.10.5 above.

It is also essential that the closing device in 3.1.10.4 and 3.1.10.5 above is adequately identified by marking so that the correct and safe method of the removal of the relief valve can be established. The design shall provide for the means to check that the pressure beneath the valve is relieved and that the closing device is closed before removal.

3.1.10.8 Each pressure relief valve shall be plainly and permanently marked in accordance with BS EN 14129.

3.1.10.9 For vessels exceeding 1 500 mm internal diameter, the relief valves should be fitted with vent pipes adequately supported and having outlets at least 1.8 m above the top of the vessel to which they are fitted.

Vent pipes shall meet the requirements of BS EN 14071, which specifies:

• The inside diameter of the vent pipe shall not be less than the inside diameter of the relief valve outlet;

• Vent pipes shall be designed in such a way that the required flow of fluid discharges freely away from the pressure vessel and the function of the relief valve is not impaired;

• Vent pipes shall be made from materials shall take into account fire resistance;

• If vent pipes are not self-supporting, they shall be provided with a method of support that does not cause any unacceptable load on the vessel or relief valve.

If the relief valve does not allow for the drainage of rainwater that may enter, a drainage point should be included in the vent pipes. The top of the vent pipes should be protected with a rain cap.

3.1.10.10 For vessels 1 500 mm internal diameter and less where vent pipes are not fitted, the relief valves shall be installed so that any discharged products do not impinge on any vessel, equipment or piping.

Where a relief valve is covered by a vessel fittings protective cover, a hole shall be left in the cover to allow for free discharge from the relief valve. (See 2.6.3.)
3.11 Shut-off Valves and Emergency Valves

3.11.1 With the exception of safety relief valves, internal shut-off valves or where the passageway into the vessel is 1.5 mm diameter or less, all liquid and vapour connections which permit flow out of or into a vessel shall have a shut-off valve capable of manual operation located as close as practicable to the vessel. The number of connections to a vessel should be kept to a minimum.

Where there are no mechanical joints between the shut-off valve flange and the vessel, and the intervening piping is designed, constructed, and tested in accordance with the vessel’s design code, the shut-off valve may be located at the downstream end of that length of piping.

3.11.2 Shut-off valves required by 3.11.1 for connections of greater than 1 1/4” nominal bore should be ball valves, except where such a connection is to take a proprietary combination multi-valve on vessels up to and including 4 tonnes LPG capacity. Ball valves should be designed in accordance with BS EN ISO 17292 and conform to the fire-test requirements of BS EN ISO 10497 or other recognised Standard giving at least an equivalent level of performance.

3.11.3 All connections into the vessel with passageways, with the valve fitted, greater than 3 mm diameter for liquid and 8 mm diameter for vapour (with the exception of those for relief valves) should be protected by an excess flow valve, a non-return valve or a remotely operated shut off valve. A non-return valve should only be used on a fill line or liquid return line.

3.11.4 Valves and their components should comply with 3.1.8.4, and should be made of steel, bronze or forged brass. Spheroidal graphite cast iron shall comply with BS EN 1563, with an elongation at fracture of more than 18 %. Other ductile irons or cast irons shall not be used.

3.11.5 For installations with liquid service pipework having a nominal internal diameter of greater than 25 mm and where:

   (i) The supply of liquid phase LPG requiring frequent routine making and breaking of connections, e.g. tanker filling, cylinder filling;

or

   (ii) The activity occurs where the public has uncontrolled access, or where a significant number of people who are not familiar with the relevant emergency procedures and whose number and location would make it difficult to evacuate quickly, e.g. hospitals, schools, canteens;
or

(iii) The vessel water capacity exceeds 100 tonnes LPG capacity;

the manual valve required by 3.1.11.1 shall be provided with an emergency remote actuation facility unless the connection is either:

• protected by an excess flow valve or non return valve (see 3.1.11.3) and the connection or pipework contains a device giving equivalent protection to remote actuation of the manual valve;

• or is a drain valve connection.

For vehicle filling and similar small scale installations where a remotely operated shut off valve is not a practicable proposition, the device referred to above may take the form of a pump differential valve arranged to close automatically when the pump is stopped.

Smaller pipe sizes for vessels meeting one or more of the criteria above may also require a remotely operated shut off valve if the person in control of the liquid flow (for example at a cylinder filling plant) is located some distance from the vessel, such that prompt closure of a manual valve at the vessel may not always be possible.

The shut-off valve shall be capable of remote actuation to close the valve, and shall also close automatically on loss of actuating power or fire engulfment. The valves fire performance shall meet the requirements of BS EN ISO 10497 or other recognised Standard giving at least an equivalent level of performance.

The location of the valve shall be as close as practicable to the vessel and should preferably be the primary shut-off valve on the vessel as required by 3.1.11.1. If the valve is not mounted directly on the vessel it shall be no further than 1.5 metres away from the vessel. The pipework connecting this valve to the vessel shall be as short as possible, and shall give the same degree of fire protection as the vessel itself.

Where valve actuators are fitted, they should be sized to operate the valve at the maximum pressure that may be reached in service. Pneumatically operated actuators should have a speed control on the opening cycle to avoid inadvertent operation of the excess flow valve.

Any manual override facility provided on a valve with power actuator should be capable of disconnection, designed so that it will not create a hazard to an operator in the event of unexpected closure.
3.1.11.6 The operation of all manual isolation valves should be clear. The operating points for remotely operated isolation valves should be clearly identified and the mode of operation marked.

3.1.11.7 Where necessary a suitable notice to warn of remote actuation should be placed on or near the valve.

3.1.12 Excess Flow Valves

Excess flow valves shall be designed to BS EN 13175. An excess flow valve is a valve which is held in the open position by means of a spring. When the flow of liquid or vapour exceeds the design flow rating, this causes the valve to close. The valve remains closed until the pressure on the downstream side of the valve balances that on the upstream side thereby allowing it to reopen. The balancing orifice should not have a diameter greater than 1.5 mm.

The flow rate for closure of excess flow valves should be below that likely to result from complete fracture of the line it is protecting, but should be substantially above the expected design flow rate in order to prevent premature closing.

3.1.13 Non Return Valves (also known as Back Check Valves)

Non return valves shall be designed to BS EN 13175. A non return valve shall be spring loaded which is held in the closed position. The valve remains closed against reverse flow until the pressure on the upstream side is greater than the downstream side, at which time the valve opens and allows product to flow.

3.1.14 Fixed Maximum Liquid Level Device

3.1.14.1 The device shall be of a type that allows vapour or liquid to bleed from a valve attached to an internal connection or dip-tube, or a device fixed in the vessel which signals electrically to indicate when the maximum permitted level is reached during filling. It shall be designed to shall be designed to BS EN 13799.

3.1.14.2 The design length of any dip-tube or the position of any maximum level equipment indication position should be determined according to the grade of LPG being stored, and should indicate a maximum permitted level which should not exceed the values in Table 6 below. (See also Appendix D).
### 3.1.14.3 The maximum permissible fill should be included in design documentation.

### 3.1.14.4 For bleed type devices, the orifice through the device should not be larger than 1.5 mm diameter unless it is fitted with an excess flow valve.

### 3.1.14.5 For bleed type devices, the operational bleed screw should remain captive at all times.

### 3.1.14.6 The bleed valve for the liquid should be installed so that it can be conveniently reached and is visible from the filling point, unless special precautions are taken as described in 3.3.3.

### 3.1.15 Maximum Level Fill Stop Valve

#### 3.1.15.1 As an alternative to a fixed liquid level gauge described in 3.1.14 a purpose designed automatic shut-off valve may be used which is activated by a float or other means so that it shuts positively during filling to limit the liquid level to not more than that specified in Table 6 above. They shall be designed to BS EN 13175.

#### 3.1.15.2 Fill stop valves and actuation mechanisms should be of adequate proven reliability for a life expectancy not less than the storage vessel inspection or maintenance interval.

#### 3.1.15.3 The valve and mechanism should have been subjected to a type test for endurance and effectiveness not less onerous than that specified for autogas stop fill valves in BS EN 13175.

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### Table 6: Maximum permitted fill in LPG vessels

<table>
<thead>
<tr>
<th>Product</th>
<th>Max. fill % Volume of Vessel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial Propane to BS 4250 and LPG as an automotive fuel to BS EN 589</td>
<td>86.6</td>
</tr>
<tr>
<td>Commercial Butane to BS 4250</td>
<td>89.9</td>
</tr>
</tbody>
</table>
3.1.16 Filling Connections

3.1.16.1 Where practicable, the vessel liquid fill connection shall connect directly, or via internal pipework, with the vapour space of the vessel.

Where this is not practicable (eg. larger vessels), consideration should be given to the installation of multiple non return valves to minimise the risk of vessel contents loss from failure of a tanker delivery hose.

3.1.16.2 All filling connections shall be equipped at the storage vessel with an excess flow valve or non return valve as described in 3.1.13, plus:

(a) A shut-off valve capable of manual operation as in 3.1.11 and 3.3 (see note below);

or

(b) A remotely actuated valve of the ‘fail safe’ type which is operated from a safe area and which is capable of manual operation.

**Note:** The use of a shut-off valve capable of manual operation is required at all new installations. Existing installations not complying should be modified at the first available opportunity.

3.1.16.3 During the filling operation a pressure increase may occur, and consideration should be given either to fitting internal spray pipes or to the use of vapour balancing lines for pressure equalization between the delivery tanker and the storage vessel.

3.1.16.4 Threaded Couplings

To maintain an industry standard and minimise the use of adapters, couplings for hoses intended for tank filling or discharge and for vapour return connections should be one of the types and sizes indicated below. Vehicle half couplings should be male, and suit delivery hoses with female half couplings. All couplings should be provided with suitable blanking caps or plugs.

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Table 7: Adaptors and Coupling Types and Sizes

<table>
<thead>
<tr>
<th>Liquid</th>
<th>Vapour</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>3¾&quot; ACME</td>
<td>3¼&quot; x 6 TPI ASA B1.5 class 2G. EN 13175:2014 Annex A</td>
<td></td>
</tr>
<tr>
<td>2¾&quot; ACME</td>
<td>2¼&quot; x 6 TPI ASA B1.5 class 2G. EN 13175:2014 Annex A</td>
<td></td>
</tr>
<tr>
<td>1¾&quot; ACME</td>
<td>1¾&quot; x 6 TPI ASA B1.5 class 2G. EN 15202:2012, Type G 3I</td>
<td></td>
</tr>
</tbody>
</table>

Note: Right hand threads are used for odourised product. Left hand threads should be used for couplings for unodourised products and should not be used for any other purpose.

3.1.16.5 Self-sealing Couplings - this type of coupling, also known as Dry Break Coupling, is not compatible with the ACME coupling. Where self-sealing couplings are used, the type and size shall have compatible mating halves, and to avoid the use of adapters the sizes should be restricted to those given in BS EN 13175.

3.1.16.6 Where a storage vessel is to be filled on a regular basis by one supplier the use of adapters shall be avoided.

3.1.16.7 Where the use of an adapter is unavoidable only one single adapter shall be used.

3.1.16.8 Left-hand threads shall only be used for liquid or vapour couplings for un-odourised products. (See Appendix G.)

3.1.17 Pressure Gauges

Vessels of more than 5 000 litres water capacity (2,2 tonnes) should be equipped with a suitable pressure gauge connected to the vapour space of the vessel and easily readable from ground level. Pressure gauge connections shall be protected either by a tapping reduced internally to a bleed hole not larger than 1,5 mm diameter or by a suitable excess flow valve and shut-off valve.

The pressure gauge shall conform to the appropriate requirements of BS EN 13175 and to EN 837-1 and shall be resistant to the effects of the weather:

Where fluid shock or vibration is likely to be encountered, the design shall be of a type compatible with these conditions.

The accuracy shall be in accordance with the requirements of EN 837-1, with a minimum Class 2.5.
Pressure gauges on pressure vessels for butane service shall be capable of withstanding a vacuum of at least 50 mbar absolute.

3.1.18 Drain Connections

3.1.18.1 Drain connections should be provided with a shut-off valve which is of the quick acting or spring loaded type e.g. a quarter turn ball valve.

**Important:** This valve should not be more than 50 mm nominal diameter.

The outlet of the drain valves shall be provided with a length of piping terminating with a second shut-off valve. The length of piping shall be such that the risk of simultaneous obstruction of the two valves, e.g. by freezing of any accumulated water, is minimised. The second valve should be positioned to facilitate operation of both valves by one person.

(a) The second valve and the piping shall be adequately supported and secured to prevent mechanical damage or breakage by jet forces.

(b) Both valves on the drain system shall have a means of actuation which cannot readily be removed or moved from the closed position except by intentional operation.

(c) The additional pipework and second valve may be fitted at the time of draining, but in this instance the fixed drain valve shall be protected by an excess flow valve fitted upstream.

(d) The outlet of the drain valve system shall be blank-flanged, plugged or otherwise secured against tampering when not in use.

(e) Pipework between the drain system valves, and between any valve and a blank-flange, plug, etc., shall be protected by hydrostatic relief valves. (See 3.2.4).

3.1.18.2 Drain systems used for product transfer to a second vessel shall be designed with a suitable coupling after the second valve. The coupling shall not be located beneath the vessel.

3.1.18.3 Drain systems used for other purposes such as sampling, flaring, removing water, etc., shall terminate in a safe place away from the vessel, to ensure that any discharge does not travel beneath the vessel, and any ignition of the discharge
would not impinge on the vessel. The second valve shall not be larger than 25 mm nominal diameter.

3.1.18.4 No drain or blow-off line shall discharge into, or be in the proximity of, any public or other drainage system where this would be liable to create a hazard.

3.1.19 Contents Gauges

3.1.19.1 All contents gauges shall be designed to BS EN 13799.

3.1.19.2 All contents gauges shall clearly indicate whether they read in % of water capacity, % of fractional LPG capacity, or actual contents in gallons, tonnes etc.

3.1.19.3 Any gauging device that relies on bleeding to atmosphere, such as a rotary tube, fixed tube or slip tube, shall be such that:

   (a) The bleed hole maximum opening is not larger than 1.5 mm diameter unless it is protected by an excess flow valve;

   (b) It cannot be completely withdrawn in normal gauging operations;

   (c) The gland is capable of being repacked without withdrawing the vessel from service.

3.1.19.4 Any gauge device that relies on differential pressure should be installed so that the effect of condensation in the balance line and pressure fluctuations in the storage vessel do not interfere with its satisfactory operation.

3.1.20 Temperature Gauges

Temperature gauges, when fitted, shall be installed in blind pockets. These should be in the form of blind tubes of suitable length and strength, oil filled, permanently welded to the vessel and constructed in accordance with the vessel design Code.

Distribution System

3.2 Pipework

Pipework should be in accordance with UKLPG Code of Practice 22 and, where applicable, must comply with the Pressure Systems Safety Regulations as amended. The routes of all pipework should be carefully selected so as to avoid physical damage or failure.
Where pipework handles more than one grade of LPG, it shall be designed for the most onerous duty.

The effect of any change in service on the safe operation of pipework shall be assessed before changes are implemented.

3.2.2 Shut-off Valves

3.2.2.1 System shut-off valves shall be provided at strategic points in the system to enable the supply of LPG to be cut off readily in the event of an emergency. These shall be provided at the terminals of pipelines and where pipelines enter buildings and works complexes.

These valves may be manual, remotely actuated or automatic depending on the size and complexity of the installation.

3.2.2.2 Valves and other ancillary equipment shall be suitable for LPG at pressures and temperatures that can be reached in service. They shall be installed to the manufacturer’s instructions and to such relevant Standards as apply to the installation design. All equipment shall be installed free of excessive external stress and adequately supported or secured against foreseeable forces such as valve operating torque.

3.2.2.3 Materials for valves and other ancillary equipment should be steel, bronze or forged brass and should comply with 3.2.2.2 above. Cast iron valves, fittings and other ancillary equipment (other than those of Spheroidal graphite cast iron complying with BS EN 1563, with an elongation at fracture of more than 18 %.) shall not be used for:

(a) Liquid service;
(b) Vapour service upstream of the first stage of pressure regulation;
(c) Vapour service designed to operate at 4.83 bar gauge or above;
(d) Applications where thermal shocks are likely.

3.2.2.4 Valve seats, gland packings, seals, and any polymer materials in contact with LPG shall be suitable for use with LPG for service conditions as in 3.2.2.2 above.

3.2.3 Pressure Gauges and Test Points

Consideration should be given to the provision of pressure gauges or test points to determine service pressure and for setting regulators.
3.2.4 Hydrostatic Relief Valves

3.2.4.1 Hydrostatic relief valves shall be designed in accordance with BS EN 14129.

3.2.4.2 Wherever liquid LPG may be trapped (for example between shut-off valves or blank flanges), protection against excessive pressure caused by thermal expansion of the contents shall be provided. This is normally achieved by the use of hydrostatic relief valves.

3.2.4.3 Hydrostatic relief valves shall be set to discharge above the maximum working pressure in the line but not greater than the design pressure of the pipework and components in the section to be protected. For hydrostatic relief valves which discharge to the open air, the set pressure shall not be less than the following:

- Propane: Not less than 24 bar gauge (Not less than 18 bar gauge where ASA150 or equivalent flanges are used);
- Butane: Not less than 10 bar gauge.

3.2.4.4 Hydrostatic relief valves which discharge to the open air shall be located and orientated so as not to endanger personnel, vessels or equipment, and should be fitted with rain caps where their location dictates. (Refer to UKLPG Code of Practice for further guidance).

3.2.5 Positioning of Flanges

Flanges shall be positioned in such a way that in the event of failure of the gasket resulting in a fire, flames do not impinge on the pressure vessel.

3.3 Offloading / Reception Facilities

3.3.1 Filling Facilities

3.3.1.1 Filling connections mounted directly on the vessel should comply with 3.1.16.

3.3.1.2 Extended fill, offloading, or vapour balance lines, should terminate with a manual shut-off valve and transfer hose half-coupling protected immediately upstream of the valve by a non-return valve or excess flow valve as appropriate. These should be sited in a well ventilated position.

This provision should be in addition to the requirement for valves adjacent to the vessel (as in 3.1.16), and hydrostatic relief valves (as in 3.2.4).
3.3.2 LPG Hoses

Hoses conveying LPG shall be suitable for the duty required. Liquid transfer and associated vapour balance hoses shall be to BS EN 1762, and if steel wire braiding or steel wire reinforcement is used it should be of stainless steel.

3.3.3 Prevention of Overfilling

Where the fixed liquid level device is not clearly visible from the filling point, special precautions and procedures to prevent overfilling shall be adopted, for example:

- Two person operation;
- Remote reading systems.

3.3.4 Lighting Requirements

Adequate artificial lighting must be provided where operations are to take place during the hours of darkness.

Lighting equipment located in a DSEAR Hazardous Place must comply with 5.1.

Note: Adequate artificial lighting may include portable lighting carried by the driver, or lighting from the delivery vehicle.

Pumps and Compressors

3.4.1 Design and Materials

3.4.1.1 The design of pumps, compressors, etc. and the materials of construction shall suit the grade of LPG and the range of temperatures and pressures that the product will reach in service.

3.4.1.2 Cast iron should not be used except spheroidal graphite cast iron complying with BS EN 1563, with an elongation at fracture of more than 18 %. Other ductile irons or cast irons shall not be used. (See also 3.2.2.3).

3.4.1.3 The available pressure head at the pump inlet at maximum off-take rate under the most onerous specified operating conditions shall be adequate to ensure proper operation and avoid cavitation.
3.4.1.4 Design of pump by-pass systems should minimise heating of recirculated products which could lead to cavitation. Positive displacement pumps should have a by-pass or other suitable protection against excessive pressure.

3.4.1.5 Pumps should be protected by suitable strainer / filter units.

3.4.1.6 Mechanical seals should be used. As a minimum a single seal with a throttle bush should be used.

3.4.2 Electric Motors

Electric motors and other electrical equipment must be suitable for use in areas described in 2.1 and 2.3.2. Belt drives should be of the anti-static type. (See also Section 5 of this Code of Practice, Electrical and Electrostatic Hazard Precautions).

Electric motors shall have an Ingress Protection (IP) rating that is suitable for their location.

3.4.3 Siting of Vapour Compressors

Vapour compressors should preferably be installed in the open air in a well ventilated position at least 4.5 m from any LPG vessel, buildings and boundaries.

If installed in a building, then the building shall be constructed of materials that have a ‘minimal reaction to fire’ rating and provided with a lightweight roof. Adequate natural ventilation shall 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 whichever is the greater. They shall be well dispersed at both high and low level. The building shall not be used for any purpose other than compression and distribution of LPG and other gases.

Compressors shall have at least one of the following:

- A high pressure cut-off switch, or similar device, on the discharge side of the compressor;
- A means to prevent liquid LPG entering the compressor; for example a catchpot with a liquid level sensor and where appropriate high level trip, high discharge temperature trip.

3.4.4 Use of Remote Starters

Where remote starters are installed, an explosion protected means (i.e. Exd) of isolation, with lockout, should be fitted adjacent to the pump motor to facilitate servicing. (See Section 5).
Pressure Regulators (Vapour)

3.5.1 Principles of Pressure Regulation

The pressure of vapour at the consuming appliance shall be controlled by pressure regulators within limits necessary for safe and satisfactory performance over the entire operating range.

3.5.2 Multiple Stage Regulation

3.5.2.1 Where necessary to achieve the requirements of 3.5.1 above, or to avoid problems from low vapour temperatures arising out of high pressure drops, multiple stage regulation should be employed.

3.5.2.2 The first stage pressure regulator shall be located in accordance with 2.10.

3.5.2.3 Requirements for multiple consumer installations are covered by UKLPG Code of Practice 25.

3.5.3 Design and Construction

3.5.3.1 Regulators must comply with the requirements of the Pressure Equipment (Safety) Regulations: 2016.

3.5.3.2 For regulators of capacity up to 100kg/hr, they shall comply with BS EN 16129, for regulators of capacity greater than 100kg/hr they shall comply with UKLPG Code of Practice 22.

3.5.3.3 Vent holes on regulators shall be carefully orientated or otherwise protected against the possible ingress of water or substances which could cause blockage, e.g. ice formation, and also to allow for drainage.

3.5.3.4 Regulators shall be adequately supported.

3.5.3.5 It is recommended that isolating valves are located close to regulators to facilitate maintenance.

3.5.3.6 Consideration should be given to the duplication of pressure regulators to facilitate servicing where continuity of supply is required.
3.5.4 Automatic Shut-down

For installations which are the subject of the Gas Safety (Installation and Use) Regulations, provision must be made in the regulating system to provide automatic shut-down of the supply to prevent gas at abnormally high or low pressure from entering the premises. It must require manual reset to re-establish the gas supply. Only the low pressure shut off device should be capable of being reset by the customer.

Vapour Meters

3.6.1 General

The design, materials and construction of vapour meters should comply with 3.2.2.2 and 3.2.2.3.

For guidance on liquid flow meters, refer to UKLPG Code of Practice 19.

For vapour meters up to 6m³, see BS 6400-3.

3.6.2 Flow Meter Requirements

3.6.2.1 Flow meters shall be sized to give the required accuracy of measurement over the full range of flow rates, rate of change of flow rate, and range of pressures and temperatures expected in service. The pressure drop through the meter needs to be allowed for in the system design.

3.6.2.2 Flow meters shall indicate the units of flow being measured and the pressure and temperature of the vapour for which it is calibrated. If the readout is corrected to a standard condition this should be indicated, or a correction factor determined. If the meter is automatically compensated for actual pressure and/or temperature, the standard conditions of the readout should be indicated.

Vaporisers

3.7.1 Classification

Vaporisers should be classified in four groups:

- Indirect vaporisers are those which do not constitute a source of ignition. Examples are: steam heaters, hot fluid heaters or process heaters, flameproof electrical heaters;
• Direct fired vaporisers are those in which a source of ignition may be present. Example are: fuel-fired radiant or convective heaters, fuel-fired fluid bath heaters, non-flameproof electrical heaters;

• Carrier gas heaters, although not officially classified as vaporisers, is a system to enhance the vaporisation of LPG by heating a carrier gas so that it will cause liquid LPG to vaporise when mixed with it;

• External heating devices, although not officially classed as vapourisers, is a system which, will enhance the vaporisation capacity, when directly attached to an LPG vessel. Only suitable proprietary devices shall be used and installed in line with manufacturers’ instructions. The requirements of DSEAR must be adhered to and the device must not interfere with the operation of the Vessel Pressure Relief Valve(s).

3.7.2 General

3.7.2.1 The vaporiser capacity should not be less than that required for the conversion of liquid LPG at minus 18 °C to vapour at a temperature above the dew point at the maximum inlet pressure to the vaporiser and at the maximum off-take rate.

3.7.2.2 Precautions should be taken against the accumulation of condensate in all pipelines carrying LPG vapour. These may require insulation and trace heating.

The design temperature should be at least 6 °C above the dew point of the LPG at the maximum design pressure.

3.7.2.3 Exceptionally high vapour withdrawal rates cause excessive cooling of the liquid LPG in the vaporiser. With steam and hot water heated vaporisers, precautions shall be taken to avoid freezing of the steam condensate or water.

3.7.2.4 Heating coils shall not be installed inside an LPG storage vessel as a substitute for a vaporiser.

3.7.3 Design and Construction

3.7.3.1 Vaporisers shall be designed, constructed and tested in accordance with a recognised and appropriate pressure vessel code.

3.7.3.2 If vapour is returned to the storage vessel(s), controls and / or relief devices shall be incorporated in the system to prevent inadvertent over-pressurising of the storage vessel(s) beyond its design limits.
3.7.3.3 The vaporiser shell and tubes in contact with liquid LPG shall be of steel of a grade appropriate to the operating conditions.

3.7.3.4 Vaporiser heat exchangers shall be designed for a working pressure at least equal to the sum of the maximum differential pressure of the LPG pump (if fitted) and the maximum working pressure of the systems supplying it.

3.7.3.5 The vaporiser, and all piping components and relief valves up to and including the discharge valve, shall be designed for the same conditions as the inlet pipework.

3.7.4 Valves for Vaporisers

3.7.4.1 Valves shall be installed to shut off the liquid and the vapour connections between the storage vessel and the vaporiser. Manifolded vaporisers shall have a means of individual isolation.

3.7.4.2 All liquid and vapour connections on vaporisers, other than those for relief valves, plugged openings and those where the connection through the vessel shell is not greater than 1.5 mm diameter, shall have shut-off valves capable of manual operation located as close as practicable to the vaporiser. It is recommended that ball valves designed in accordance with BS EN ISO 17292, and conforming to the fire test requirements of BS EN ISO 10497, should be used.

3.7.4.3 For vaporisers having a water capacity in excess of 6 litres, all connections into the vaporiser greater than 3 mm diameter for liquid and 8 mm diameter for vapour, with the exception of those for relief valves and drain connections, shall be protected by:

- An excess flow valve; or
- A remotely controlled valve of the ‘fail safe’ type capable of local manual operation, as described in 3.1.11.5, and which can be operated remotely from a safe area.

3.7.4.4 The flow rate for closure of excess flow valves should be below that likely to result from complete fracture of the line it is protecting, but, in order to prevent premature closing, should be substantially above the normal service flow rate expected.

3.7.5 Drain Connections for Vaporisers

3.7.5.1 Drain connections designed to permit drainage of water, oil etc, from LPG systems
to atmosphere shall be provided with a shut-off valve which is preferably not more than 50 mm nominal diameter and in accordance with 3.7.4 above. The outlet of the drain valve should be provided with a length of piping terminating with a second shut-off valve, preferably not more than 25 mm nominal diameter.

The drain valve adjacent to the vaporiser connection shall be of a quick acting or spring loaded type e.g. quarter turn ball valve, and the length of piping between the two valves should be such that the risk of their simultaneous obstruction, e.g. by the freezing of any accumulated water, is minimised.

The following provisions apply to the drain valves:

(a) The second valve and the piping shall be adequately supported and secured to prevent mechanical damage or breakage by jet forces;

(b) Both valves on the drain system should have a means of actuation which cannot readily be removed or moved from the closed position except by intentional operation;

(c) The additional pipework and second valve may be fitted at the time of draining, but in this instance the fixed drain valve shall be protected by an excess flow valve fitted upstream;

(d) The outlet of the drain valve system shall be blank-flanged, plugged or otherwise secured against tampering when not in use;

(e) Pipework between the drain system valves, and between any valve and a blank-flange or plug etc., shall be protected by a hydrostatic relief valve against excess pressure caused by thermal expansion as described in 3.2.4.

3.7.5.2 Drain systems used for product transfer shall be designed with a suitable coupling after the second valve.

3.7.5.3 Drain systems used for purposes other than product transfer (for example sampling, flaring, or removing water) shall ensure that discharge does not take place beneath the vessel, and the second valve shall not be larger than 25 mm nominal diameter.

3.7.5.4 No vessel drain outlet or blow-off line shall discharge into or be in the proximity of any water drain.

3.7.5.5 In the case of direct-fired and non-flameproof electrical vaporisers, the source of heating must be shut off prior to drainage and not restarted until the area is free from flammable vapour.
3.7.5.6 Care shall be exercised in the handling and disposal of flammable residues drained from the vaporisers. Adequate ventilation shall be ensured during this operation. Residues shall on no account be allowed to pass to drains or sewers.

3.7.6 Vaporiser Pressure Relief

3.7.6.1 Vaporiser systems shall have a pressure relief valve in direct communication with the vapour space and set to discharge and reach full flow conditions as required by the Code to which the vaporiser is designed and constructed.

3.7.6.2 The minimum required rate of discharge to protect the vaporiser alone is derived as follows:

- Add the surface area of the vaporiser shell to that of the heat exchanger directly in contact with the LPG liquid (items (d) and (e) of 3.7.9 below);
- From Appendix C, obtain the minimum requirement for the rate of discharge;
- Attention is drawn also to the requirements of 3.7.3.1 and 3.7.3.2.

3.7.6.3 The pressure relief valve(s) shall provide an effective rate of discharge which shall be directed upwards into the open air and away from the vaporiser or shell of any adjacent LPG vessel. (See also 3.1.10).

3.7.6.4 Fusible plugs and frangible discs for pressure relief shall not be fitted to vaporisers.

3.7.7 Liquid Control

3.7.7.1 For “feed out” vaporisers they shall be provided with suitable automatic means to prevent LPG liquid passing through the vaporiser to the vapour discharge piping under all operating conditions.

3.7.7.2 A liquid level control, if fitted, shall be integral with each vaporising vessel or shall be fitted immediately adjacent to it.

3.7.8 Heat Input Control

3.7.8.1 The vaporiser heat input shall be controlled to ensure that the start-to-discharge pressure of the relief valve(s) is not reached in the course of normal operation.
3.7.8.2 Vaporisers and carrier gas heaters shall be fitted with an automatic control to prevent overheating.

3.7.8.3 Direct-fired vaporisers shall be fitted with suitable flame supervision devices.

3.7.9 Marking

Each heat exchanger / vaporiser must be provided with a permanent and clearly visible corrosion resistant data plate marked with at least the following:

(a) The pressure vessel design code;
(b) The manufacturer’s name and vessel serial number;
(c) The maximum working pressure and temperature of shell and tube or the coil of a carrier gas heater;
(d) The outside surface area of the vaporiser shell in square metres;
(e) The inside heat exchange area in square metres;
(f) The vaporising fluid for which the vessel is designed;
(g) The heating medium for which the vessel is designed;
(h) Date of test, pressure applied and inspecting authorities’ symbol;
(i) Provision for subsequent test marking.

Insulation and Trace Heating of LPG Vapour Distribution Systems

3.8 General

Insulation and heating of vapour systems shall be used where, due to low ambient temperature or volume expansion of product, condensation of product or icing of valves could occur. Specialist advice should be sought regarding the application of heat tracing and particularly for electrical heating.
3.8.2 Insulation Requirements

Insulation should be:

- Impervious to the ingress of water;
- Sufficiently robust to withstand minor mechanical damage;
- Resistant to fire.

3.8.3 Heating Requirements

All pipeline heating systems shall be designed to prevent over-heating, e.g. by the use of thermostats. Electrical heating systems shall be protected against overload conditions.

3.8.4 Butane and Butane-air Lines

Where insulation and heating are employed on butane or butane-air lines, the design temperature should be at least 6 °C above the dew point of n-butane or butane-air mixtures at maximum design pressure.

3.8.5 Condensation Traps

Where insulation and heating are not provided to deal with condensation of product, condensation traps should be incorporated in the piping system to prevent liquid carry over to consumer equipment.
## Section 4: Fire Precautions

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General

4.1  Basic principles

The emergency services shall assume responsibility for any incident on arrival.

Note: For most incidents this would be the Fire and Rescue Service, however for COMAH 2015 Upper Tier sites, the Police will assume responsibility if an external emergency plan is activated.

Steps to mitigate the effects of a foreseeable incident shall be taken where it is safe to do so. In order of priority these steps shall be to:

1. protect people;
2. protect the environment; and
3. protect property.

The risk of exposing people to tackle the incident shall be balanced against the overall risk to people of doing nothing or taking only limited measures. Steps to mitigate the effects may include evacuating people who may be affected and using water monitors, e.g. to limit the extent of a gas cloud release or to protect vessels against the effects of fire.

The possibility of fire is minimised by:

- plant design and layout;
- operating practice; and
- instruction and training of personnel in routine operations and actions to be taken in an emergency.

However, such are the potential consequences of any outbreak of fire that precautions are needed to minimise the risk that any incident may escalate. These precautions include:

- Consideration of fire protection of plant;
- Water supplies;
- Fire fighting plans;
- Means of access for emergency service appliances;
- Protection of emergency service personnel;
- Arrangements to ensure an early call out to the emergency services in the event of fire.

Note: Reference should be made to UKLPG Code of Practice 3, Recommendations for Preventing or Controlling Fire Involving LPG.
4.1.2 Protection of Storage Vessels

Adequate fire protection of the storage vessels is of key importance. To achieve this, vessels may need to be buried, mounded, coated with a passive fire protective (PFP) material, or equipped with a water deluge system.

Table 8 sets out good practice for above ground installations where special circumstances do not exist.

The choice of fire protection method should be made on the basis of operational considerations and analysis of the fire hazards to be protected against. Buried vessels or those protected by mounding (refer to UKLPG Code of Practice 1 Part 4) or by a PFP material do not need the provision of on-site cooling water supplies other than for exposed surfaces.

4.1.3 Assessment of Storage Vessels Following Fire Engulfment

Following fire engulfment vessels should be withdrawn from service and re-assessed by a Competent Person.

Water Deluge Systems and Monitors

4.2 Achieving Effective Fire Protection

4.2.1 Effective fire protection can only be achieved by establishing a continuous film of water over the whole vessel surface and supports.

4.2.1.2 The means of providing the water coverage will be dictated by the size and type of installation. Table 8 sets out good practice for above ground installations where special circumstances do not exist and where alternative means of protection, such as mounding or PFP coating, are not employed.

4.2.1.3 Where special circumstances prevail, more or less stringent requirements may be appropriate: for example, a remote site with few but well trained personnel may not call for the full specification, but on a site where there is an unusual fire risk, greater precautions may be required.

Installations at commercial and industrial premises are the subject of the Regulatory Reform (Fire Safety) Order 2005 and Fire (Scotland) Act 2005 and subsidiary legislation and fire precautions must be considered in this light.
### Table 8: Fire Precautions for Above Ground Installations

<table>
<thead>
<tr>
<th>Installation Capacity Tonnes</th>
<th>Fire Precautions</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 4 Domestic Vapour Service</td>
<td>Water supply for fire brigade use</td>
</tr>
<tr>
<td>&lt; 1.1 Commercial and Industrial Vapour Service</td>
<td>Water supply for fire brigade use</td>
</tr>
<tr>
<td>&lt; 1.1 Commercial and Industrial Liquid Service</td>
<td>Water supply for fire brigade use <strong>And either:</strong> 19 mm hose reel and either 2 x 9 kg or 3 x 6 kg dry powder extinguishers <strong>Or:</strong> 4 x 9 kg or 6 x 6 kg dry powder extinguishers <strong>Or:</strong> 2 x 9 kg or 3 x 6 kg dry powder extinguishers and 2 x 9</td>
</tr>
<tr>
<td>&gt; 1.1 &lt; 25</td>
<td>Water supply for fire brigade use <strong>And:</strong> 19 mm hose reel <strong>And:</strong> 2 x 9 kg or 3 x 6 kg dry powder extinguishers</td>
</tr>
<tr>
<td>&gt; 25 &lt; 50</td>
<td>Water supply <strong>And:</strong> Fixed deluges and / or portable monitors for vessel or passive fire protection <strong>And:</strong> Fixed deluges and / or portable monitors for road vehicle bays, where vessels are not passively coated <strong>And:</strong> 19 mm hose reel <strong>And:</strong> 2 x 9 kg or 3 x 6 kg dry powder extinguishers</td>
</tr>
</tbody>
</table>

Continued overleaf
4.2.2 System Requirements

4.2.2.1 For installations as described in 4.2.2.2, 4.2.2.4 and 4.2.2.10 the site operator should consider the adequacy of water supply and equipment (e.g. hydrants, hoses, monitors, spray/jet nozzles) that may be necessary to control any foreseeable incident and consult with the fire authority on its use and compatibility with fire service equipment.

4.2.2.2 At installations with inventories of 50 tonnes LPG capacity and greater, the vessels should be provided with fixed water deluge systems or adequately protected by other means.

4.2.2.3 Fixed deluge systems shall be designed by a competent person and to an

<table>
<thead>
<tr>
<th>Installation Capacity Tonnes</th>
<th>Fire Precautions</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 50</td>
<td>Water supply</td>
</tr>
<tr>
<td></td>
<td>And:</td>
</tr>
<tr>
<td></td>
<td>Fixed deluges for vessels or passive fire protection</td>
</tr>
<tr>
<td></td>
<td>And:</td>
</tr>
<tr>
<td></td>
<td>Fixed deluges for road / rail vehicle bays</td>
</tr>
<tr>
<td></td>
<td>And:</td>
</tr>
<tr>
<td></td>
<td>19 mm hose reel</td>
</tr>
<tr>
<td></td>
<td>And:</td>
</tr>
<tr>
<td></td>
<td>2 x 9 kg or 3 x 6 kg dry powder extinguishers</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>&gt; 7 Individual vessel capacity with Liquid Offtake where 4.2.2.9 applies</th>
<th>Water supply</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>And:</td>
</tr>
<tr>
<td></td>
<td>Consideration of provision of means to apply cooling water to vessels, e.g. fixed or portable monitors or passive fire protection</td>
</tr>
<tr>
<td></td>
<td>And:</td>
</tr>
<tr>
<td></td>
<td>19 mm hose reel</td>
</tr>
<tr>
<td></td>
<td>And:</td>
</tr>
<tr>
<td></td>
<td>2 x 9 kg or 3 x 6 kg dry powder extinguishers</td>
</tr>
</tbody>
</table>

| ‘Metered’ Estates, Caravan Parks, etc. | Water supply for fire brigade use |
appropriate Code of Practice such as the Fire Offices Committee (FOC) Tentative Rules for Medium and High Velocity Spray Systems or NFPA15 – Water Spray Fixed Systems for Fire Protection.

The system shall be capable of achieving at least 9.8 l/m²/min (see note below) over the whole vessel surface and its supports. Manual control may be acceptable where continuous supervision is maintained. In other cases control should be automatic. Connection points for fire brigade appliances should be provided at safe locations in the water supply pipeline to the fixed drench systems, to be able to supplement the supply if necessary; see 4.3.1.

It is essential for "dry" systems to ensure that adequate and correctly located drainage points are provided.

**Note:** Whilst 9.8 l/m²/min has been a commonly accepted figure derived from experiments, it would appear that systems installed to FOC rules provide significantly higher rates of approximately 13.1 l/m²/min.

4.2.2.4 Installations with inventories greater than 25 tonnes, but less than 50 tonnes LPG capacity, shall have available portable or fixed monitors to be used by the Fire Brigade, or by the firm’s emergency response team until the arrival of the Fire Brigade. The monitors and water supply to these should be capable of providing a nominal water coverage over the vessel(s) of 9.8 l/m²/min. See also 4.3.1.

4.2.2.5 On-site hydrants, monitors and fixed deluge systems shall be so designed that water flow can be controlled from a position where location or distance from the storage makes it relatively safe. Manually operated fixed water-drench systems shall be clearly identified and the mode of operation marked.

4.2.2.6 For installations of 56 250 litres water capacity (25 tonnes LPG) total inventory or greater and which is not passively coated, the road tanker bay should be provided with water protection to the level appropriate to the size and type of installation of the fixed storage as set out in Table 8.

4.2.2.7 At installations where an average of more than two road tanker deliveries a week take place, or where two or more road tankers a week are filled with LPG, based on the consumption over six months (including the Winter period), consideration should be given to the provision of additional fire protection at the tanker bay.

4.2.2.8 Rail loading and unloading gantries should be provided with fixed water deluge.

4.2.2.9 Unless adequately protected by other means, fixed or portable water deluge systems shall be provided for bulk vessels at cylinder filling plant.
This requirement will not apply where the sole activity is the dispensing of automotive LPG or where a small number of cylinders are filled, e.g. for fork lift trucks.

Refer to UKLPG Code of Practice 12 and UKLPG Code of Practice 20 for guidance.

4.2.2.10 For vessels below 25 tonnes LPG capacity but which exceed 7 tonnes LPG capacity, with liquid outlets and where remotely operated shut off valves (ROSOVs) are not fitted to the liquid outlets, means should be provided for applying cooling water to the vessels. This may be by a fixed deluge system or portable monitors. Alternative methods of fire protection may also be used: see 4.1.2.

4.2.2.11 In determining the water deluge system requirement, individual vessels may be considered in isolation where they are apart by at least the separation distances given in column (a) of Table 1.

Water Supply

4.3.1 General

The water supply shall be able to maintain the required application rate for at least 60 minutes. Any supplementary supply after this period should be at the same application rate, and capable of being put in place before the primary supply is exhausted. See 4.2.2.3.

Where the water supply is provided by means of an on site pump, consideration should be given to the possibility of loss of electrical or motive power and the need for backup facilities.

Systems shall be protected against freezing.

4.3.2 Recirculating Systems

Where water is supplied via a recirculation system the reservoir shall hold at least a 30 minute supply without recirculation. The design should also ensure that any LPG spilled will not be returned with the recirculated water, by installation of suitable traps, interceptors or design of the pump suction system.
### 4.3.3 Water Supply Sources

There should be ready access to an adequate water supply for emergency service use. Table 9 describes appropriate sources.

**Table 9: Water Sources**

<table>
<thead>
<tr>
<th>Type of Installation</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic installations and small commercial or industrial installations where the</td>
<td>Mains water, hydrants, ponds, canals or rivers, may be used with the permission of the owner. These should be no more than 100 metres from the vessel(s). At remote installations it may be acceptable for the water supply to be more than 100 metres from the vessel(s), subject to consultation with the local fire authority.</td>
</tr>
<tr>
<td>storage does not exceed 1,1 tonnes LPG capacity</td>
<td></td>
</tr>
<tr>
<td>Commercial and industrial installations having a total inventory exceeding 1,1 tonnes</td>
<td>Mains water, ponds, canals or rivers. These should be no more than 100 metres from the vessel(s). Subject to consultation with the local fire authority. Public water sources more than 100 metres from the vessel(s), and hydrants may also be used.</td>
</tr>
<tr>
<td>up to 25 tonnes LPG capacity</td>
<td></td>
</tr>
<tr>
<td>Installations having a total inventory of between 25 tonnes and 50 tonnes LPG</td>
<td>The water supply for fixed deluge system and/or portable monitors should be provided from either:</td>
</tr>
<tr>
<td>capacity</td>
<td>• a water storage facility capable of supplying the deluge requirement; or</td>
</tr>
<tr>
<td></td>
<td>• subject to consultation with the local fire authority, hydrants and/or other water sources</td>
</tr>
<tr>
<td>Installations having a total inventory above 50 tonnes LPG capacity</td>
<td>The water supply for fixed deluge system shall be provided from a water storage facility capable of supplying the deluge systems requirement.</td>
</tr>
</tbody>
</table>
Passive Fire Protection (PFP) Coating

4.4.1 General

4.4.1.1 The PFP coating shall be capable of ensuring that the integrity of the vessel is fully safeguarded against the effects of a fire.

Suitable fire protection to the first-off valves and fittings shall be provided to ensure their integrity.

Unlike protection by a water deluge system (see 4.3.1), in the event of an incident, the period of fire protection provided by PFP cannot be prolonged. The period of protection needed should therefore be determined on the basis of the possible duration of the fire incident at the particular site.

The effectiveness of the PFP coating is critically dependent on the manner in which it has been applied. Therefore only competent installers shall be used for this work.

Note: Tests have shown that the integrity of a PFP coated LPG vessel is not compromised at temperatures up to 300 °C for 90 minutes.

4.4.1.2 The manufacturer/supplier of the PFP material shall be capable of demonstrating the fire performance of the material by reference to a relevant test, e.g. a jet fire test such as that described in the HSE Technology Report 'Jet Fire resistance for Passive Fire Protection Materials'.

The structural supports for the vessels should be designed and protected to maintain their load-bearing capacity (BS 476: Part 21:1987 or BS EN 1365 as relevant refers) for at least the same period of fire resistance as the vessel itself.

4.4.2 PFP Coating Considerations

The PFP coating should:

(a) Be resilient to the action of fire hoses;

(b) Prevent accumulation of water at the vessel surface, either by cellular construction of the PFP material itself or provision of an efficient vapour barrier;

(c) Be sufficiently strong so that minor mechanical damage will not destroy the vapour barrier(s) and should be durable and easily repaired;
(d) Be non-corrosive to the vessel surface;

(e) Be installed in such a manner to facilitate the checking for corrosion of the vessel;

(f) Be unaffected by environmental conditions whether natural or from local leaks, spillage or pollution;

(g) Be essentially non-combustible and in particular should not contribute to a fire by the spread of flame across its surface, or by burning droplets.

**Portable Fire Fighting Equipment**

There shall be sufficient and suitable portable firefighting equipment on the premises. This equipment should be selected and located to enable fires adjacent to the vessel to be extinguished and so prevent fire spreading to or jeopardising the LPG installation. Fire extinguishers or hose reels or an equivalent combination of the two types of equipment should be provided. Fire extinguishers and hose reels should be selected, located and maintained in accordance with BS 5306. Fire extinguishers should comply with BS EN 3-3. It is important that the equipment is properly maintained: maintenance should be entrusted to a competent person, e.g. one that is registered by British Approvals for Fire Equipment (BAFE).

Table 8 sets out good practice for above ground installations where special circumstances do not exist.

Fire extinguishers or hose reels need not be provided at metered estates and domestic installations where it is unlikely that anyone will be available who has been trained in their use. Appropriate provision and deployment of fire extinguishers is required where filling operations take place as it is a Workplace.

Additionally, under the Caravan Sites and Control of Development Act 1960 Section 5, firefighting equipment is required in accordance with the Model Standards (1989) applicable to Permanent Residential Mobile Home Sites and Holiday Caravan Sites.

**Access**

Access to and around the installation shall be provided for firefighting and should be kept free at all times.
Fire Instruction and Training

People on premises where LPG is stored shall receive adequate instructions, with training and exercises as appropriate, to enable them to understand the fire precautions and actions to be taken in the event of fire or leakage of LPG (see 7.1). The instruction and training should be appropriate to their responsibilities in the event of an emergency. Those trained to fight LPG fires should be aware that these fires should not normally be extinguished unless the source of LPG can be isolated.

At commercial and industrial sites, notices setting out the emergency procedures shall be prominently displayed near the LPG storage area.

At domestic installations and "metered" estates, the user shall be provided with full instructions which include the actions to be taken in an emergency.

Refer to UKLPG Code of Practice 1, Part 2 and UKLPG Code of Practice 25 for further guidance.

Grass and Weed Control

As stated in 2.3.11, combustible materials shall be kept out of / controlled in the area around the vessel(s) this means overgrown weeds, long grass, deciduous shrubs and deciduous trees, and any combustible material shall be removed from an area within the separation distance in column (a) of Table 1 (for vessels not exceeding 1.1 tonnes LPG capacity, or within 6m for larger vessels). Chemical weed killers (such as sodium chlorate) or any other method which might provide a source of ignition shall not be used in these areas.
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Electrical Requirements

5.1.1 Regulations and Guidelines

The Electricity at Work Regulations 1989 must be applied to these installations and the relevant HSE Guidance Notes shall be followed.

LPG installations differ from other fuel installations in several respects. The most important difference is that the LPG installation is a pressurised system with no venting system releasing flammable vapours during storage. There is only a limited release on filling and on release of the filling coupling.
Electrical installations shall conform with BS 7671 as amended.

The selection, installation and maintenance of fixed electrical apparatus for use in hazardous places or within the separation distances shall be in accordance with the recommendations of BS EN 60079 and as described in 2.1.2 and 2.3.2.

5.1.5 describes the use of portable equipment in hazardous places.

For LPG, equipment with a temperature rating of T2 is adequate. Higher T ratings imply lower maximum operating surface temperatures on equipment, and any equipment with a higher T rating will also be suitable.

Electrical equipment’s degree of protection against the ingress of solid objects and liquids is indicated by an IP rating in accordance with BS EN 60529 and as such shall be used to specify the equipment’s suitability for use in dusty or wet environments. Electrical equipment used externally within a zone 2 area shall have a minimum rating of IP 54.

Note: Electrical equipment to BS EN 60079 will not necessarily be weatherproof.

In addition to this guidance reference should also be made to:

- Energy Institute, Model Code of Practice, Part 1 - The selection, installation, inspection, and maintenance of electrical and non electrical apparatus in hazardous areas;
- EEMUA Publication No. 186; “A Practitioner’s Handbook - Electrical installation, inspection and maintenance in potentially explosive atmospheres”;
- IP/APEA publication “Guidance for the design, construction and modification of petrol filling stations” (often referred to as the “Blue Book”).

5.1.2 Competence

The object of regulation 16 of the Electricity at Work Regulations is to ensure that people are not placed at risk due to a lack of skills on their part or others in dealing with electrical equipment and installations. Electrical work within hazardous places shall only be carried out by personnel with sufficient technical knowledge or experience to prevent danger or injury during that work.

Note: further guidance is available in HSE publication HSR25.

The Provision and Use of Work Equipment Regulations require every employer to ensure that where work equipment is likely to involve a specific risk, the use
of that equipment is restricted to those persons given the task of using it and repairs, modifications, maintenance or servicing that work equipment is restricted to specifically designated persons whom the employer must ensure have received adequate related training.

For many types of work a guide would be for the Company/Organisation to be a member of an organisation providing accreditation under a third party assessment system.

Individual electricians shall have successfully completed suitable training appropriate to the tasks to be undertaken and reflecting the Electricity at Work Regulations and the Dangerous Substances and Explosive Atmospheres Regulations. (For many types of work this will mean a COMP ‘Ex’ or similar training course) and their training suitably recorded, e.g. an appropriately endorsed “Joint Industries Board” (JIB) card.

5.1.3 Electrical Supply

a) Provision of supply

The supply into a hazardous place should be on a circuit directly from a main switch isolator and not from a ring circuit feeding other parts of the site. The switch isolator must isolate all live and neutral conductors.

b) Type of supply

Electrical supplies within hazardous places or separation distances should be TN-S, or TT as described in BS 7671. Other types of supply shall not be used unless no alternative exists and then only if a competent electrician has carried out a written risk assessment before the installation is undertaken.

Should the type of supply not be established or the site has a different type of earth then the electricity supplier must be contacted before any connections are made.

c) Generators

Where electrical supplies from onsite generators are used within hazardous places or the separation distances, specialist guidance shall be sought to confirm compliance with BS 7671, suitable earthing arrangements, suitable voltage characteristics and prevention of excessive voltage.

d) Installations with Cathodic Protection

Installations with cathodic protection require special consideration. Expert advice shall be sought and there shall be full communication with the installers of the electrical and
cathodic protection systems.

e) Voltage Drop

Tests shall be carried out to confirm there are no excessive voltage drops e.g. due to length of cable and/or the relatively high power absorbed by many LPG pump motors on start up.

BS 7671 gives further guidance and specifies the permissible voltage drop at the extremity of circuits.

The available voltage at any motor contactor shall remain within the stated tolerances both on startup and during running. For example, a single-phase AC motor intended to operate at nominal voltage of 230 V AC, the voltage shall not fall below 220 V AC on start up.

f) Protection against Indirect Contact

When a different type of supply is used for the hazardous area compared with the supply to the non-hazardous area there shall be a suitable separation, typically in excess of 2.5m, between the electrical equipment in these locations to prevent inadvertent contact between the two.

g) Site Earthing

Site earthing is required for all sizes of storage vessel when fitted with electrical equipment, with the primary requirement being protection against electric shock. This is not the same as the equipotential bonding required for the dissipation of static electricity.

A main equipotential bonding conductor shall be run back to a primary earthing point at the source of energy. This is typical of a TN-S system where all metallic parts will ultimately be bonded to this point. (Typical earth figures for bonding should comply with BS 7671).

The electrical supply must have a suitable effective earth, usually TN-S or TT. TNC-S (PME) may be considered providing a competent electrician has carried out an appropriate, documented, risk assessment. TNC-S supplies are not recommended at petrol filling stations, refer to UKLPG Code of Practice 20.

Should the type of supply not be established or the site has a different type of earth then the unit supplier shall be contacted before any electrical connections are made.
Protective devices within the main distribution board (typically miniature circuit breakers) shall disconnect all poles of the supply (i.e. phase(s) and neutral). Consideration should be given, when sizing miniature circuit breakers, to the current rating of the type, its short circuit capability and earthing impedance values, which need to be evaluated on site to ensure compliance with BS 7671.

Bonding to other services should comply with BS 7671.

**Note:** Installations using cathodic protection systems for corrosion protection of vessels or pipework require special consideration and expert advice should be sought.

### 5.1.4 Testing

**a) Construction Test**

Suitable certificates shall be completed and provided to the customer on satisfactory completion and testing of the installation.

BS 7671 give guidance on the information which should be provided.

**b) Periodic Inspection**

Periodic inspection is required in accordance with BS EN 60079-17 and BS 7671 to enable the duty holder to meet obligations under the Electricity at Work Regulations 1989.

An assessment shall be made (and recorded) at the time of issuing the completion certificate of:

- the type of inspections required;
- the period between inspections (which should not exceed 12 months).

### 5.1.5 Portable Electric Equipment

Any portable electrical equipment or generators used temporarily within hazardous places should be in accordance with the recommendations of BS EN 60079 and should meet the requirements of the Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 2016 for the zone in which it is to be used or otherwise be covered by a permit to work scheme. Such equipment should be included within a planned maintenance system.

Older equipment built to earlier Standards (e.g. BS 5501 series) remains
acceptable provided it is correctly maintained and a risk assessment in accordance with DSEAR shows it is still suitable and remains unaltered.

Electrostatic Precautions

Means should be provided to ensure that no electrostatic potential exists between the tanker delivery connection and the static vessel fill connection which could cause a spark when these connections are either made or broken. The following precautions should therefore apply:

(a) Except as permitted by (b) below, vessels shall be permanently bonded to an effective earthing point to prevent the accumulation of static electricity. The earthing point shall be located so that the bulk tanker vehicle can discharge any static electricity to this earth by means of its earthing / bonding cable before delivery connections are made. (See also 7.3.3.8 and 7.3.6);

(b) For vessels not exceeding 1,1 tonne, as an alternative to (a) above, a bonding connection shall be provided on the vessel to permit direct attachment of the delivery vehicle earthing / bonding cable before delivery connections are made. A lifting lug or leg may be used for this purpose. (See also 7.3.3.8 and 7.3.6);

(c) Electrical continuity shall exist between vessel transfer couplings and the earthing point or bonding connection, through the vessel. The earthing or bonding connection shall always provide a good electrical connection, and shall therefore always be kept free of corrosion and should not be painted;

(d) BS 5958 part 1 and PD CLC/TR 60079-32-1 give guidance on the control of undesirable static electricity and should be complied with as appropriate to the installation;

(e) Pipelines, fittings and hoses conveying liquid phase LPG shall have electrical continuity and be connected to earth. This may mean the fitting of electrical bonding straps across connecting joints. Detailed information on the generation of static electricity and advice on earthing and bonding is given in BS 5958 Parts 1 and 2. In the case of ball valves attention is drawn to the need for the ball and actuating lever to have electrical continuity with the valve body and adjacent pipework. Refer to UKLPG Code of Practice 22.

LPG vessels do not normally require special lightning protection. However, assessment in accordance with BS EN 62305 should be considered for vertical vessels.
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General

6.1.1 Responsibility

The installation and commissioning of the plant shall be a responsibility only undertaken by competent personnel, and in accordance with manufacturer's instructions where applicable. Where necessary, particularly at larger installations, written procedures should be drawn up for installation and/or commissioning.

6.1.2 Site Survey

Before any storage vessel is placed on a site, the area should be surveyed for any possible hazards. Particular attention should be paid to overhead power cables etc. (see 2.3.1.12) and to the ground conditions, ensuring suitability for delivery vehicles, cranes etc.
6.1.3 Protective Clothing

Where there is a risk to personnel of exposure to LPG release during commissioning, suitable protective clothing should be worn.

See Appendix F for guidance.

6.1.4 Purging

Vessels and their ancillary equipment shall be purged until the oxygen level is reduced below that which will support combustion before commissioning.

When purging into or out of service is required this shall be carried out in accordance with UKLPG Code of Practice 1 part 3.

6.1.5 Written Scheme of Examination

A written scheme of examination must be prepared by (or certified as suitable by) a competent person as required under the Pressure Systems Safety Regulations 2000.

Guidance on the preparation of the written scheme is provided in UKLPG Code of Practice 1 Part 3.

6.2 Storage Vessels and Fittings

6.2.1 Lifting

6.2.1.1 Care should be taken when lifting vessels to avoid distortion or damage to them or their coatings.

Warning: Most LPG vessels have welded-on supports (legs). There are a few larger vessels, however, which have separate supports which will require special precautions during lifting: for example, supports may become detached during lifting. In these cases spreader bars should be used to stop sling movement.

6.2.1.2 All lifting procedures shall be carried out with due regard to safe practice, including gas freeing where necessary. Reference should be made to BS 7121 for guidance on the use of cranes etc.

Except for vessels less than 15 tonnes LPG capacity at sites where adequate facilities for gas-charging or gas-freeing are difficult to provide, vessels shall
normally be emptied and gas freed before lifting.

UKLPG Code of Practice 26 gives further guidance.

6.2.1.3 The vessel shall be free of any restraint before lifting. The slings shall be positioned so that no snagging of valves or fittings can occur when the strain is taken. The lifting operation shall be halted after the vessel has been raised a few centimetres to ensure that the vessel is securely slung and that the vessel is clear of all obstacles.

6.2.1.4 Where lifting lugs have been provided as integral parts of the vessel, these may be used, provided they are adequate for the lift required. Lifting lugs on LPG vessels are not normally designed to lift more than the empty vessel itself. Unless it can be shown that the lifting lugs have been designed to lift a vessel containing liquid product, this should not be attempted. They shall never be used to attempt to lift a vessel with an attached additional structure e.g. a skid unit, unless they have been specifically designed to do so.

6.2.1.5 Where lugs are not used, the vessel should be correctly slung so that it will not move out of the horizontal plane during the lifting operations. Slings or chains should be positioned outside the legs.

6.2.1.6 Only equipment which has been specially designed or adapted should be used to lift and move vessels.

6.2.2 Securing

If required by 3.1.5.4, above ground vessels should be secured in place.

6.2.3 Valves

Care should be taken to ensure that there is no extraneous matter present in vessels before valving. If entry is made for this or any other purpose, the necessary precautions shall be taken.

The operation of shut-off valves, emergency valves and excess flow valves (but excluding pressure relief valves) should be checked for correct operation and correct orientation. Pressure relief valves should be visually checked for their correct discharge pressure and flow rate.
6.2.4 Leak Testing (Vessels and Fittings)

6.2.4.1 Vessels delivered to site containing LPG should have had all connections leak tested prior to delivery and upon receipt on site. Any connections made on site shall be tested with a proprietary leak detection fluid to BS EN 14291 or suitably calibrated gas detection meter. Leak detection fluid shall be cleaned off the pipework following testing.

6.2.4.2 Vessels, associated fittings, and equipment containing air or an inert atmosphere shall be leak tested to a pressure not less than 3 bar gauge for butane, and 6 bar gauge for propane but no more than 90 per cent of the vessel design pressure, using one of the methods described in Table 10.

Care should be taken to ensure that the vessel is not subject to tests outside its design criteria.
Table 10: Vessel Leak Test Methods

<table>
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<th>Test Medium</th>
<th>Method</th>
<th>Advantages</th>
<th>Disadvantages</th>
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<tr>
<td>(a) Air</td>
<td>Pressurise with air; check joints with leak detection fluid to BS EN 14291 or equivalent</td>
<td>Emergency valves can be tested for operation</td>
<td>Suitable compressor equipment has to be provided</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Water may be introduced into the system with compressed air</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Necessary to purge</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Risk of unanticipated pressure release</td>
</tr>
<tr>
<td>(b) Inert Gas</td>
<td>Pressurise with gaseous nitrogen or carbon dioxide and proceed as for air; (Gaseous nitrogen is preferred)</td>
<td>No danger of condensed water or need for drying</td>
<td>Asphyxiation risk</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vessel can be filled with LPG directly into an inert atmosphere</td>
<td>Adequate supply of inert gas must be arranged</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Emergency valves can be tested for operation</td>
<td>If the source of inert gas is in liquid form, precautions should be taken to prevent undue chilling of vessel, pipework and fittings and possible static electricity generation with CO₂</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Risk of unanticipated pressure release</td>
</tr>
<tr>
<td>(c) Water</td>
<td>Fill tank completely with water; pressurise; check to ensure zero pressure drop over period of not less than 30 minutes</td>
<td>Water usually available</td>
<td>Need for complete removal of water</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Less hazard</td>
<td>Care necessary to avoid a vacuum forming whilst draining off water</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Emergency valves can be tested for correct operation</td>
<td>Plinth or base must be capable of taking total weight</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vessel can be charged with LPG directly on top of water</td>
<td></td>
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6.2.5 Initial Fill

A responsible person should be present and in control throughout the initial fill.

Care shall be taken to limit flash vaporisation on initial fill to ensure the vessel isn’t taken outside of its design envelope. This can be achieved by pressurising the vessel with vapour before introducing liquid LPG.

During initial fill, any inert gas should be safely vented from the vessel.

Refer to UKLPG Code of Practice 1 part 3.

6.2.6 Contents Gauges

Contents gauges should be checked for freedom of action / movement by internal inspection, where practicable, or otherwise by observation during initial fill.

6.3 Pipework, Valves and Fittings

Detailed requirements for pipework systems are given in UKLPG Code of Practice 22. Refer to UKLPG Code of Practice 25 for installations supplying multiple users.

6.4 Checking Offloading / Reception Facilities

All valves, couplings, threads and seals should be checked. They should be clean and undamaged.

6.5 Product Transfer Systems

6.5.1 General

Prime movers should be safely located in accordance with Section 2 of this Code of Practice, LPG Plant Location and Safety Distances.

All equipment, e.g. pumps, compressors, etc., shall be installed and maintained in accordance with the manufacturer’s instructions. The correct alignment of all prime movers should be checked.
All valves and couplings should be checked to ensure they are installed in the correct orientation / direction. They should be clean and undamaged.

6.5.2 Pump Operation

Vapour should be vented safely and pumps primed with liquid phase LPG before being put into operation. Pumps should be started with by-pass valves / liquid pressure controllers fully open and, after ensuring free flow, adjusted to required pressures in accordance with manufacturer’s instructions.

Regulators

6.6.1 Preparation

Before installation dust caps shall be removed, and the orientation and correct direction of flow determined. Regulators shall be adequately located, supported and orientated in accordance with the manufacturer’s instructions.

Note: 1st stage regulators need to be sited so there is no chance of re-liquefied LPG passing through the regulator. This is achieved by locating the regulator above pipework seeing tank pressure and the design of the vapour pressure pipework.

6.6.2 Installation and Testing

Regulators for small installations shall be installed and commissioned in accordance with UKLPG Code of Practice 1, Part 2.

Where regulators have been supplied factory set, their operating pressure shall be checked under known flow conditions. Conversely adjustable regulators that have not been factory set shall be set to their lowest outlet pressure and then adjusted to their required operating pressure under known flow conditions.

Where possible the system shall be flow tested to ensure that regulators are maintaining the required pressure control over the range of the system demand and check Lock-Up at zero flow.

Where applicable regulators should be sealed against tampering.
Meters
Prior to installation the meter data plate shall be checked to ensure that the flow capacity and pressure rating are suitable for the application.

Before installation, dust caps, packaging etc. shall be removed and the correct direction of flow determined. Meters shall be installed, adequately supported and orientated in accordance with the manufacturer’s instructions.

For liquid flow meters, Refer to UKLPG Code of Practice 19, Liquid Measuring Systems.

For vapour meters up to $6m^3$, see BS 6400-3.

Vaporisers

6.8.1 Installation and Testing

Vaporisers shall be installed in accordance with manufacturer’s instructions ensuring adequate support and without undue strain on associated pipework.

Before installation the heating system rated capacity shall be checked against design.

All necessary steps should be taken to ensure the safe and satisfactory functioning of the systems before and during commissioning, e.g. thermostats and pressure switches shall be set before start-up.

Vaporisers shall be free from leaks under test pressure and purged into service in accordance with UKLPG Code of Practice 17.

The satisfactory operation of such items as level controls, heat input controls, emergency valves (other than pressure relief valves), pressure controllers, etc. shall be established during commissioning checks.

Electrical

6.9 Electrical cabling and connections shall be made in accordance with the equipment manufacturer’s instructions and tested in accordance with BS 7671 as amended.

Flame proof glands and connections shall be correctly assembled and all access covers securely fastened. Cable glands shall be selected to take account of cold flow characteristics in cables.
Flameproof electrical fittings shall have their gaps checked to ensure they are not wholly or partially blocked e.g. paint has not covered the flameproof gap.

Electrical equipment in flammable atmospheres shall be selected and installed in accordance with BS EN 60079.

See 5.1 for further guidance.

**Earthing and Static Bonding Arrangements**

Earthing and static bonding arrangements shall be installed in accordance with Section 5.2 of this Code of Practice and the requirements of PD CLC/TR 60079-32-1.

**Fire Fighting Precautions**

**6.11.1 General**

All combustible material including overgrown weeds and grass, etc., shall be cleared from the storage area before initial fill of LPG.

Suitable portable fire fighting extinguishers shall be available during commissioning.

**6.11.2 Testing**

The satisfactory operation of water drenching systems, where fitted, shall be tested before LPG is filled. ‘Dry’ systems shall be drained after use.

Automatic actuating systems and alarms, if fitted, shall be tested.

**Corrosion Protection**

**6.12.1 Equipment Exposed to Atmosphere**

Paint coatings for vessels, pipework and other equipment exposed to the atmosphere shall be applied and tested in accordance with the manufacturer’s instructions to provide the protection required.

See 3.1.7 for further guidance.
6.12.2 Buried pipework

The corrosion protection applied to buried pipework shall be checked before backfilling/covering. If cathodic protection is employed on steel pipework the presence of sacrificial anodes shall be verified and current at installation measured. Where wrapping is used, it is essential that the correct surface preparation and the manufacturer’s instructions are followed. (See UKLPG Code of Practice 22 for further guidance).

Refer to UKLPG Industry Information Sheet 033 for guidance on deomestic LPG metallic underground pipework.
## Section 7: Operations

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</table>
7.1 Instruction of Personnel

7.1.1 Personnel responsible for and involved with the operation of plant equipment and the handling of LPG shall understand the physical characteristics of the product, be adequately instructed in the correct operation of equipment and plant and be familiar with the relevant sections of this Code of Practice.

7.1.2 In addition to the training described in 4.7, relevant site personnel shall be aware of the location of the main electrical isolation switches, vapour and liquid LPG valves, any actuating switches and, ESD systems, and understand their use.

7.1.3 Written Procedures

7.1.3.1 Written procedures should include:
(a) The transfer of LPG to or from the installation (for which checklists may prove a useful supplement);

(b) The transfer of LPG at other sites when delivery tankers operate from the site;

(c) Permit-to-work systems;

(d) Plant maintenance and modification including the maintenance of protected electrical equipment and overpressure protection, e.g. safety relief valves;

(e) Emergency procedures;

(f) Procedures for the control of contractors and mobile plant;

(g) The draining of storage vessels in service, in particular the sequence of valve operations and the action in the event of no flow.

7.1.3.2 Employees, permanent and temporary, and contractors shall only carry out tasks for which they are authorized, trained and competent to do. Any deviation from the written procedures shall only be undertaken with the written authority of the appropriate responsible person on site.

As a minimum any proposed alterations to plant shall be assessed against this Code of Practice to ensure continued compliance. Part of this assessment shall ensure operating instructions are checked and updated where necessary. All changes to plant and, operating instructions, shall be brought to the attention of those effected by them and additional training provided if necessary.

7.1.4 24 Hour Emergency Service

The LPG supplier must provide or arrange for a 24 hour service whereby appropriate action can be taken in the event of gas leakage or other emergency.

7.1.5 Consumer Instructions

7.1.5.1 Consumer instructions giving details of the action to be taken in the event of an emergency shall be provided.

7.1.5.2 Emergency instructions shall include:
• Telephone number of the Gas Supplier’s 24 hour emergency service;

• Procedure for calling the Emergency Services.

7.1.5.3 In addition, emergency instructions shall advise:

In the event of GAS LEAKAGE or SUSPECTED LEAKAGE:

• Extinguish all naked flames or ignition sources;

• Turn off all gas appliances;

• Do not turn on or off any electrical equipment;

• Turn off the gas supply at the gas emergency control and the storage tank;

• If the leak is indoors, open doors and windows to increase ventilation;

• IMMEDIATELY NOTIFY the gas supplier and / or the 24 hour emergency service in order that the installation may be tested and made safe, and any necessary repair carried out.

In the event of FIRE:

• The emergency services (Fire and Rescue Service) should be called immediately and should be informed that an LPG vessel is on the premises;

• The gas supply should be turned off, if practicable and safe to do so.

Segregation of Product

All vessels and, where necessary, pipework, filling connections and other equipment, shall be clearly marked to show the product being used.

Where more than one grade of LPG is handled, any interconnecting system shall be thoroughly checked to ensure that a grade of LPG is not charged into vessels, pipelines or other equipment not designed to handle it and that unacceptable product contamination will not occur.
Product Transfer

7.3.1 Control and Supervision

A competent person shall remain in control throughout all transfer operations, and there shall be adequate supervision throughout the transfer operation.

7.3.2 Protective Clothing

Suitable protection, e.g. gloves, eye protection, etc. shall be used whenever there is a likelihood of contact with liquid LPG. Clothing and footwear shall also be chosen to minimize the risk of generating static.

See Appendix F for further guidance.

7.3.3 Preparation for Product Transfer

Before LPG is transferred from any delivery vehicle to a fixed installation, the following procedure shall be carried out:

7.3.3.1 The receiving vessel shall be checked to ensure that it is in safe working order and that the grade of LPG to be transferred is compatible with its content and design working conditions.

7.3.3.2 The receiving vessel shall be checked to establish the quantity that can be delivered into it.

7.3.3.3 The interconnection system, i.e. pipework, fittings, valves, hoses, etc. shall be visually checked to ensure that it is in safe working condition and that the tanker hose coupling is compatible with the storage vessel fill coupling.

7.3.3.4 Any vehicle or rail tank car involved shall be located on level ground or preferably on shallow gradient and a slight camber to ensure that:

(a) Any leaks do not flow under or remain under the tanker;

(b) The vehicle is secured against movement.

7.3.3.5 The loading / unloading operation shall only be carried out when it is safe to do so, and where practicable should be separated from other traffic movement. Where vehicles or pedestrians are likely to pass by, steps should be taken to deter them from approaching the transfer operation.
7.3.3.6 The driving unit and any electrical equipment not required and not specifically designed for the transfer operation shall be stopped and isolated.

7.3.3.7 Fire extinguishers shall be located in easily accessible positions and temporary warning notices prominently displayed before product transfer commences.

7.3.3.8 The tank of the delivery vehicle, or rail tank car shall dissipate any electrostatic potential before the transfer hoses are connected.

This can be achieved by either of the following:

(a) Connecting an earth lead from the vehicle to the earthing point of the fixed installation;

or

(b) Where the installation has no earth point by connecting an earth lead from the vehicle directly to the vessel bonding point.

7.3.3.9 Drive-away protection devices on the delivery vehicle, or rail tank car or the fixed installation shall be used to ensure a hazard cannot occur if the vehicle is moved before the hose(s) is disconnected. Examples are:

(a) Self-sealing breakaway coupling connected to the flexible hose;

(b) Means to shut emergency isolation valves on both the fixed plant and the tanker automatically;

(c) An interlocked physical barrier or similar system on either the vehicle or static installation;

(d) A means to automatically actuate the vehicle braking system to lock immediately the delivery hose is taken from its normal transit stowage position until it is restored to that position;

(e) A brake flap arrangement which must be moved aside to gain access to the filling branch, the action of which actuates the braking system.

7.3.3.10 When a delivery vehicle’s engine is used to drive a pump during loading / unloading, an emergency engine cut-off device shall be installed so that the engine can be switched off from outside the cab.

Further guidance is given in UKLPG Code of Practice 2.
7.3.4 Prevention of Overfilling

During LPG transfers, a constant check shall be kept on the receiving vessel to ensure that overfilling or other hazardous condition does not occur. On completion of the transfer, the receiving vessel shall be checked to ensure that it has not been overfilled.

See 7.4 for further guidance.

7.3.5 Absence of Responsible Person

If the responsible person in charge of the operation has to leave it for any reason and no other competent person is available to take over the control, then the operation shall be stopped and the isolating valves closed.

7.3.6 Completion of Transfer

On completion of the transfer, all transfer hose connections shall be disconnected before removing the electrical bonding.

Before any vehicle involved in a transfer operation is moved, it shall be checked to ensure that it is in a safe condition.

7.3.7 Product Transfer during Hours of Darkness

Operations shall not be carried out during the hours of darkness unless adequate artificial lighting is used as required by 3.3.4.

7.3.8 Public Warning Notices

Hoses shall not run across a public footpath or pavement for unloading unless there is no alternative and where consideration of likely public activity during the time of unloading indicates that it will not constitute a significant hazard.

In such cases, before and during unloading, warning notices, legible from 6 metres shall be prominently displayed at the front and rear of the vehicle and should state:

**WARNING - FLAMMABLE GAS TRANSFER TAKING PLACE - NO SMOKING OR NAKED FLAMES**

or words to that effect.
These notices and any pictorial signs must conform with the Health and Safety (Signs and Signals) Regulations 1996. (See also HSE Guidance Note L64).

**7.4 Storage Vessels: Filling**

**7.4.1 Maximum Filling Level**

The maximum allowable filling level is normally determined by the setting of the fixed maximum liquid level device. This shall be used by a person in attendance whenever a vessel is being filled, to ensure that overfilling does not occur. Filling shall be stopped immediately the device indicates that the maximum permitted level is reached. The level set by the fixed maximum liquid level device is designed to ensure that the vessel does not become liquid full under any foreseeable circumstances.

An alternative to this method is by use of a maximum level fill stop valve as described in 3.1.15.

See also paragraphs 3.1.8.1 (c) and 3.1.14, and Appendix D.

**Important:** Fixed liquid level gauges only give effective indication of the liquid level if the transition from vapour to liquid discharge is witnessed during filling.

**7.4.2 Overfilling**

Overfilling can have extremely serious consequences. Any overfilled tanker or vessel shall have the excess LPG removed in a safe manner immediately.

**7.5 Use of Vessel Drain System**

The use of the drain system described in 3.1.18 shall only be undertaken by competent personnel under a written operational procedure or permit to work system. Suitable protective clothing should be worn.

Draining to atmosphere, e.g. to test for water, should not be necessary at consumer installations and should be discouraged.

Where for quality control purposes it is necessary to carry out draining of water it is recommended that at no time shall both valves described in 3.1.18 be open at the same time. The second valve shall be opened to drain off the contents downstream of the first valve, and
then shut. The first valve shall then be opened to charge the interconnecting system and again shut. The cycle shall be repeated until the water is cleared. The system is then left with both valves shut and the downstream valve plugged.

7.6 Sampling

Sampling of product, either vapour or liquid, should only be undertaken by a competent person such as under a written operational procedure or permit to work system, and suitable interconnecting pipework. Suitable protective clothing should be worn.

7.7 Loading / Unloading Rail Tankers

7.7.1 Transfer Point Requirements

7.7.1.1 The rail loading / offloading operation shall be separated from other rail traffic, for example on a siding. The transfer point shall be sited in a well ventilated position at least 15 m from buildings, boundaries, sources of ignition and any storage vessel forming part of the fixed installation.

7.7.1.2 In order to minimise the risk of accidental movement, the track shall be laid straight and normally level. Where a gradient is unavoidable it should be no more than 1 in 400 and for a siding ending in buffers, shall slope down towards the buffer stop.

7.7.1.3 The ground beneath a tanker shall be drained, cambered or sloped to one side to prevent any spillage from remaining under the vehicle or from flowing and collecting under any vessel or piping in the fixed installation or other rail vehicle.

7.7.2 Protection of Tankers

7.7.2.1 Rail tankers containing LPG shall not be loose shunted nor other wagons loose shunted against them.

7.7.2.2 Physical barriers shall be provided where there is a possibility that a tanker could be damaged by road vehicles, for example where a road and a rail siding are sited beside each other.

7.7.2.3 A barrier gate and other means of positive isolation shall be provided to prevent a train from being accidentally pulled away while the tankers are connected to the fixed installation. Examples of avoiding tanker movement are:
(a) Removal of the locomotive;
(b) Removal of the towing cable or isolation of the capstan motor;
(c) Locked points;
(d) Application of wagon handbrakes.

Interlocks may be provided with product transfer pumps, isolation valves, etc. to ensure that the train has been correctly positioned before transfer begins. A clearly visible identification in the form of a red flag, red disc or red light shall be displayed in a conspicuous position on or over the tankers to show that they shall not be moved while connected to the fixed installation.

7.7.2.4 A system of work shall be provided to ensure the tankers are not moved without the knowledge and approval of the plant personnel in charge of the LPG transfer operations. Traffic movements to and from the transfer point shall be controlled, where appropriate, by a written procedure. Where tankers are shunted, the closest co-operation is necessary between the locomotive driver and plant personnel. When a Train Operators drivers are used, the Train Operator requires the use of a permit system (a Certificate of Readiness) before their personnel will move any wagons. A similar system shall be used when shunting is carried out by a firm’s own locomotive.

7.7.3 Further Safety Precautions

7.7.3.1 Remotely operated emergency isolation valves shall be provided on the loading bay. In addition, manual shut-off valves shall be provided for each loading / unloading liquid LPG branch pipe. Each manual valve shall be fitted with its own key or operating handle with which it can be operated quickly in an emergency. Safeguards such as remotely operated valves shall be considered for vapour lines. Where a common manifold is used, non-return valves shall be fitted to prevent backflow of liquid into rail tankers during unloading.

7.7.3.2 Additional protection against pullaway incidents and to prevent any resultant leakages shall be provided. This may be in the form of self-sealing breakaway couplings, isolation valves interlocked with the movement of the rail wagons, or other equipment providing equivalent protection.

7.7.4 Prevention of Overfilling

Care shall be taken to prevent overfilling. To do this it may be necessary to limit the number of tankers being controlled by a single operator and to meter the delivery.
A positive way of preventing overfilling is to continuously weigh the vehicle being filled on a weighing machine with an automatic shut-off set at the predetermined quantity.

**Maintenance**

LPG vessels, pipework and associated systems shall be kept in good working order, by a combination of routine inspection, periodic examination and regular maintenance. Such work shall be carried out to written procedures describing both the scope of the work and the methods of carrying it out. Further details are in UKLPG Code of Practice 1 Part 3.
Section 8: De-Commissioning

Contents

This section of the Code of Practice covers the following topics:

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</thead>
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<td>8.2 Emptying and Purging</td>
<td>109</td>
</tr>
</tbody>
</table>

Isolation

The installation to be de-commissioned and purged free of LPG shall be isolated from any process, plant or vessels containing LPG. Normally, this is achieved by removing pieces of piping or by fitting suitably rated blanks or spades in the pipes. The closure of shut off valves is not a suitable means of isolation.

Where necessary, particularly at larger installations, written procedures and/or a permit to work shall be used.

Emptying and Purging

Further guidance is given in UKLPG Code of Practice 1 part 3, UKLPG Code of Practice 17, UKLPG Code of Practice 26 and HSE publication L138.
Before opening, an LPG vessel shall be:

(a) Emptied of liquid LPG as far as possible, by normal use or transfer to another suitable vessel, flaring or venting. Where a drainline is used for emptying the vessel it shall comply with 3.1.18. If it is necessary to vent LPG to atmosphere, only the minimum quantity of product shall be vented;

(b) Purged with an inert gas until it contains less than 4 % by volume of LPG and remains at or near that concentration of LPG, i.e. there are not heavy ends still gassing off flammable vapours;

(c) Purged by displacement with water or another suitable method. Care shall be taken to ensure no heavy ends remain which could lead to the formation of a flammable atmosphere when air is introduced into the vessel.
Record Requirements

There must be for each vessel sufficient records to establish that the vessel is fit for its duty and that the system can be operated, maintained and examined safely. These records shall be readily available and include those described below. For new installations, certification shall be available before the installation is fully commissioned.

9.1.1 Pressure Test Certificate

Manufacturer’s pressure test certificate complying with the requirements of the Standard to which it is manufactured.

9.1.2 Certification of Design Conditions

Adequate documentation certified by a competent person(s) to establish that the design
conditions were no less onerous than those set out in 3.1.

9.1.3 Documentation of Vessel History

It is recommended that vessels which are not new at the time of installation shall, in addition to the requirements of 9.1.2 above, have documented history of periodic examinations subsequent to manufacture. At least the report of the last examination shall have been endorsed by a competent person as ‘fit for further propane service’, or words to that effect, and be within the validation period.

In addition it shall be established that since the last examination the vessel has always been charged with LPG or, if out of service, with LPG or an inert gas and that at no time, other than normal servicing, has the vessel been left open, or left filled with air, water or any other corroding substance.

The LPG supplier shall not fill any vessel of unknown pedigree until records are available.

9.1.4 Electrical Certificate

Any LPG installation that has electrical equipment shall be certificated to ensure it complies with the requirements outlined in Section 5 by a suitably qualified electrician.

9.1.5 Lack of Documentation

Where compliance with clauses 9.1.1, 9.1.2 or 9.1.3 cannot be established, the vessel must be subject to a thorough examination by a Competent Person as defined by PSSR to establish its fitness for purpose for the design conditions set out in 3.1.
The two liquefied petroleum gases which are generally available in the UK are Commercial Butane and Commercial Propane as defined in BS 4250.

Butane is normally supplied in cylinders up to 15 kg capacity and has a much lower vapour (or cylinder) pressure than propane.

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 (for example 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 propane 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 and will also burn at the interface 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 odourised before distribution by the addition 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 odourised.

(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.

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. 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

All figures below are approximate, the actual figure depends on the actual composition.

All properties relate to temperatures of 15 °C unless otherwise stated.
## Property

<table>
<thead>
<tr>
<th>Property</th>
<th>Commercial Butane</th>
<th>Commercial Propane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formula of major component</td>
<td>$C_4H_{10}$</td>
<td>$C_3H_8$</td>
</tr>
<tr>
<td>Sulphur content % by weight</td>
<td>No greater than 0.02</td>
<td></td>
</tr>
<tr>
<td>Boiling point, Saturation pressure in bar gauge at selected temperatures</td>
<td>°C</td>
<td>°C</td>
</tr>
<tr>
<td>-2</td>
<td>-18</td>
<td>Negative</td>
</tr>
<tr>
<td>-18</td>
<td>0</td>
<td>2.5</td>
</tr>
<tr>
<td>0</td>
<td>15</td>
<td>4.5</td>
</tr>
<tr>
<td>15</td>
<td>38</td>
<td>7.0</td>
</tr>
<tr>
<td>Density of liquid compared to water (Specific Gravity)</td>
<td>0.57 to 0.58</td>
<td>0.50 to 0.51</td>
</tr>
<tr>
<td>Litres of liquid per kg of liquid</td>
<td>1.75</td>
<td>2.0</td>
</tr>
<tr>
<td>Coefficient of liquid thermal expansion @0°C</td>
<td>0.18 %/°C</td>
<td>0.26 %/°C</td>
</tr>
<tr>
<td>20°C (Typical figure)</td>
<td>0.20 %/°C</td>
<td>0.30 %/°C</td>
</tr>
<tr>
<td>40°C</td>
<td>0.22 %/°C</td>
<td>0.38 %/°C</td>
</tr>
<tr>
<td>Density of gas compared to air</td>
<td>2.0</td>
<td>1.5</td>
</tr>
<tr>
<td>Litres of gas at atmospheric pressure per kg of liquid</td>
<td>420</td>
<td>540</td>
</tr>
<tr>
<td>Litres of gas at atmospheric pressure per litre of liquid</td>
<td>230</td>
<td>270</td>
</tr>
<tr>
<td>$m^3$ air required to burn 1 $m^3$ gas</td>
<td>30</td>
<td>24</td>
</tr>
<tr>
<td>Net calorific value (Useful heat given off per unit of gas burnt)</td>
<td>MJ/$m^3$</td>
<td>MJ/kg</td>
</tr>
<tr>
<td>Upper (UEL)</td>
<td>113</td>
<td>45.8</td>
</tr>
<tr>
<td>Lower (LEL)</td>
<td>9.3</td>
<td>10.9</td>
</tr>
<tr>
<td>Flammability Limits (FL) i.e. percentage volume of gas in air which will support combustion (also known as Explosive Limits (EL))</td>
<td>1.4</td>
<td>1.7</td>
</tr>
<tr>
<td>Flash point</td>
<td>-60 °C</td>
<td>-104 °C</td>
</tr>
<tr>
<td>Ignition temperature, $T$ class</td>
<td>372 °CT2</td>
<td>470 °CT1</td>
</tr>
<tr>
<td>Gas subdivision</td>
<td>II A</td>
<td></td>
</tr>
<tr>
<td>Maximum experimental safe gap (MESG) mm</td>
<td>0.98</td>
<td>0.92</td>
</tr>
</tbody>
</table>

### Workplace Exposure Limits

<table>
<thead>
<tr>
<th>CAS No,</th>
<th>Long-term exposure limit</th>
<th>Short-term exposure limit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8-hour TWA reference period</td>
<td>15-minute reference period</td>
</tr>
<tr>
<td>LPG</td>
<td>68476-85-7</td>
<td>1000 ppm 0,10%</td>
</tr>
<tr>
<td>Butane</td>
<td>106-97-8</td>
<td>600 ppm 0,06%</td>
</tr>
</tbody>
</table>
British Standard for Commercial Propane and Butane

BS 4250 is more prescriptive with limiting requirements on properties and prescribes limits for residual matter and oily residue.

### Property

<table>
<thead>
<tr>
<th>Property</th>
<th>ISO 9162 Commercial Butane</th>
<th>BS 4250 Commercial Butane</th>
<th>ISO 9162 Commercial Propane</th>
<th>BS 4250 Commercial Propane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gauge vapour pressure at 40°C (measured or calculated) (kPa), max</td>
<td>520</td>
<td>505</td>
<td>1550</td>
<td>1550</td>
</tr>
<tr>
<td><strong>Hydrocarbon Content</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C4 and higher hydrocarbons content mole %, max</td>
<td>-</td>
<td>-</td>
<td>7,5</td>
<td>10,0</td>
</tr>
<tr>
<td>C4 and higher hydrocarbons content mole %, max</td>
<td>2,5</td>
<td>2,0</td>
<td>0,2</td>
<td>2,0</td>
</tr>
<tr>
<td>Ethylene content, mole %, max</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1,0</td>
</tr>
<tr>
<td>Alkynes content, mole %, max</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0,5</td>
</tr>
<tr>
<td>Dienes content, mole %, max</td>
<td>0,5</td>
<td>0,5</td>
<td>0,5</td>
<td>0,5</td>
</tr>
<tr>
<td>Residual Matter R Number</td>
<td>-</td>
<td>10 max</td>
<td>-</td>
<td>10 max</td>
</tr>
<tr>
<td>O number</td>
<td>-</td>
<td>33 max</td>
<td>-</td>
<td>33 max</td>
</tr>
<tr>
<td><strong>Impurities</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copper Corrosion 1h at 40°C</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Free Water</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Dissolved Water</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Pass - Valve Freeze Test</td>
</tr>
<tr>
<td>Total sulphur content (mg/kg), max</td>
<td>-</td>
<td>200</td>
<td>-</td>
<td>200</td>
</tr>
<tr>
<td>Mercaptan sulphur content (mg/kg), max</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Hydrogen sulphide content (mg/m³), max</td>
<td>pass</td>
<td>0,75</td>
<td>pass</td>
<td>0,75</td>
</tr>
<tr>
<td>Ammonia Content (mg/m³ in the vapour phase), max</td>
<td>-</td>
<td>2,3</td>
<td>-</td>
<td>2,3</td>
</tr>
</tbody>
</table>
Hazardous Places

The Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) apply to these installations.

Hazardous places are classified in terms of zones on the basis of the frequency and duration of the occurrence of an explosive atmosphere.

Further guidance on DSEAR may be found in L138, HSE’s Approved Code of Practice on DSEAR. (see Appendix K).

BS EN 60079-10, Classification of Hazardous Areas, provides detailed guidance.

Zone 0

A place in which an explosive atmosphere consisting of a mixture with air of dangerous substances in the form of gas, vapour or mist is present continuously or for long periods or frequently.

Zone 1

A place in which an explosive atmosphere consisting of a mixture with air of dangerous substances in the form of gas, vapour or mist is likely to occur in normal operation occasionally.

Zone 2

A place in which an explosive atmosphere consisting of a mixture with air of dangerous
substances in the form of gas, vapour or mist is not likely to occur in normal operation but, if it does occur, will persist for a short period only.

By implication, an area that is not classified Zone 0, 1 or 2 is deemed to be a non-hazardous or safe area in respect to the selection of apparatus.

Area Classification

The following values should be used unless a specific DSEAR risk assessment justifies a lower value:

Notes relating to table opposite:

**Note 1:** Any pit, trench, drain, duct entry or depression falling within or below a Zone 1 or Zone 2 location should be treated as being Zone 1 throughout, unless a suitable interceptor or water trap is installed.

**Note 2:** For electrical hazards attention is drawn to BS 60079.

**Note 3:** The term ‘outdoors in open air’ includes areas which are covered by an open sided canopy.
<table>
<thead>
<tr>
<th>Factor</th>
<th>Extent of Classified Area</th>
<th>Area Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharge orifice of liquid level detection devices (e.g. fixed liquid level gauges or rotary or slip gauges)</td>
<td>Within 0.5 m of the point of discharge</td>
<td>Zone 1</td>
</tr>
<tr>
<td>Vessel Relief Valve</td>
<td>Within direct path of discharge. Note: The circumstances under which a relief valve opens to give full discharge is considered an abnormal event, so above a relief valve is classified as a non hazardous area</td>
<td>Fixed electrical equipment should not be installed, to avoid damage or ignition in the unlikely event of a full discharge</td>
</tr>
<tr>
<td>Hydrostatic (thermal) Relief Valve</td>
<td>Within 0.5 m of the point of discharge * * Distance and zone from IP15</td>
<td>Zone 2</td>
</tr>
<tr>
<td>Tank Vehicle Loading / Unloading Connections</td>
<td>Within 0.5 m in all directions from a point where connections are made or disconnected for product transfer</td>
<td>Zone 1</td>
</tr>
<tr>
<td>Vessel Flanges</td>
<td>Within 0.5 m in all directions</td>
<td>Zone 2</td>
</tr>
<tr>
<td>Pumps</td>
<td>Within 0.5 m in all directions around any LPG wetted external pump shaft</td>
<td>Zone 1</td>
</tr>
<tr>
<td>Magnetic drive pumps</td>
<td>Within 0.5 m in all directions</td>
<td>Zone 2 (for the flange connection only)</td>
</tr>
<tr>
<td>LPG Compressors &amp; Vacuum Pumps</td>
<td>Within 0.5 m in all directions</td>
<td>Zone 2 (for the connection)</td>
</tr>
<tr>
<td>Vapouriser (excluding direct fired)</td>
<td>Within 0.5 m in all directions</td>
<td>Zone 2</td>
</tr>
<tr>
<td>Operational:</td>
<td>Within 0.5 m of the point of discharge</td>
<td>Zone 1</td>
</tr>
<tr>
<td>• bleeds;</td>
<td>In indoor locations where the entire room and any adjacent room are not separated by a vapour tight partition</td>
<td>Site specific DSEAR risk assessment</td>
</tr>
<tr>
<td>• vents;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• drips;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• drains, in pipelines containing liquid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liquid Meter</td>
<td>Within 0.5 m in all directions unless a specific DSEAR risk assessment determines a different value</td>
<td>Zone 2</td>
</tr>
</tbody>
</table>
The discharge rate of the pressure relief valve(s) should not be less than that shown in the Table of Required Flow Rates overleaf, which is based on an adequate release rate for a vessel exposed to standard fire conditions. This rate is given as the equivalent discharge at standard conditions when using air, and the required rate should be achieved before the pressure rises to 120% of the set pressure.

For vessel sizes not contained in the table the following formula may be used:

\[
\text{Discharge rate} = 10,655 \times S^{-0.82} \text{ in m}^3/\text{minute of air at } 15 \degree \text{C and 1,013 bar abs.}
\]

where \( S \) is the total exterior surface area of the storage vessel in square metres.

**Important:** The rates of flow in the Table are the minimum permissible at full discharge at 120% of the set pressure, and apply to relief systems as installed. Allowance must be made for the reduction in quoted discharge rates for valves created by the resistance of check devices, multiple valve manifolds, or other restrictions in assessing the actual installed rates.

In the Table of Required Flow Rates overleaf: Surface m\(^2\) = total exterior surface of the tank in m\(^2\);

Air flow m\(^3\)/min = cubic metres of air to be allowed to escape per minute;

Flow rates at 15 °C at atmospheric pressure.
<table>
<thead>
<tr>
<th>Surface m²</th>
<th>Air Flow m³/min</th>
<th>Surface m²</th>
<th>Air Flow m³/min</th>
<th>Surface m²</th>
<th>Air Flow m³/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10,65</td>
<td>20</td>
<td>124,22</td>
<td>130</td>
<td>576,48</td>
</tr>
<tr>
<td>1,5</td>
<td>14,86</td>
<td>21</td>
<td>129,29</td>
<td>135</td>
<td>594,58</td>
</tr>
<tr>
<td>2</td>
<td>18,81</td>
<td>22</td>
<td>134,31</td>
<td>140</td>
<td>612,58</td>
</tr>
<tr>
<td>2,5</td>
<td>22,58</td>
<td>23</td>
<td>139,30</td>
<td>145</td>
<td>630,48</td>
</tr>
<tr>
<td>3</td>
<td>26,23</td>
<td>24</td>
<td>144,25</td>
<td>150</td>
<td>648,25</td>
</tr>
<tr>
<td>3,5</td>
<td>29,77</td>
<td>25</td>
<td>149,16</td>
<td>155</td>
<td>665,91</td>
</tr>
<tr>
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</table>
LPG, in its liquid phase, has an extremely high coefficient of thermal expansion. For this reason no LPG container should be completely filled, because a rise in temperature could cause the relief valve to open and release liquid LPG to atmosphere. The maximum volume of LPG which is permissible to fill into any container should therefore be such that the hydraulically full condition will not be reached for any foreseeable range of product temperatures in normal service.

To ensure this condition is met there should always be sufficient ullage (free space above the liquid level) so that the vessel is not more than 97 % full at the 'filling reference temperature', and should not be liquid full at 5 °C above this temperature.

The filling reference temperature to be used for the UK is 38 °C.

The maximum permissible volume of liquid in LPG storage vessels can be calculated as follows:

\[
U_{\text{max}} = \frac{(0.97 \times g_i \times V)}{g_t}
\]

where:
- \( U_{\text{max}} \) = Maximum permitted liquid volume.
- \( g_t \) = Relative density of liquid at its lowest likely temperature at filling. (Usually assumed as 5 °C).
- \( g_i \) = Relative density at the filling reference temperature.
- \( V \) = Internal volume of the storage vessel.

For LPG manufactured to BS 4250 the hydraulically full condition will not be reached at 5 °C above the reference temperature if the volume does not exceed 97 % full at the reference temperature.
The fixed liquid level gauge required by 3.1.14 has a dip-tube the end of which is reached by the liquid surface as it rises to indicate the maximum permitted volume during the filling operation. The controlled vapour release from the device changes from invisible vapour to a visible white mist: at this point the filling should cease immediately.

To simplify the task of determining the length of the dip-tube, paragraph 3.1.14.2 gives the percentage of vessel volumes for maximum permissible fill for commercial propane, and commercial butane to BS 4250.
This Appendix relates to the protection of static above ground butane storage systems that have not been designed to withstand the maximum vacuum conditions that could occur in service as required by 3.1.3.

**Prevention of Unacceptable Vacuum Conditions**

Where necessary, the possible vacuum in a butane storage vessel may be limited by either of the following methods.

**E.1.1 Hot Gas Return**

Hot butane vapour from a locally vaporised source at a rate sufficient to maintain the required pressure can be returned into the vapour space of the vessel, provided:

(a) A self-operating regulator of sufficient capacity is used to govern the flow of vapour and a manual by-pass valve and automatic alarm for both high and low pressure is fitted;

or

(b) Where there is constant supervision, a manually operated flow valve may be used to control the flow of vapour:

An automatic alarm should be fitted for both high and low pressures see E.2 below.

In the case of an automatic system, ensure that it is ‘active’, i.e. the system has not been inadvertently shut off.
Where the connections made between vaporisers, storage tank, and the process run above ground, a specific risk assessment regarding the vulnerability of the pipes to vehicle impact should be made. Adequate safeguards should be put in place to prevent damage to any pipes and vaporisers that would prejudice the return supply of butane to the tanks.

E.1.2 Propane Vapour Pressurisation

Propane vapour can be fed into the vapour space from the vapour space of a local propane storage vessel or from cylinders (see 2.3.1.15 and 2.3.1.16) subject to the following:

a) A propane pressure regulator(s) of sufficient capacity is used to govern the flow of vapour to maintain a safe pressure, and an automatic alarm is fitted for both high and low pressures. See E.2 below.

(b) Where cylinders are used it is not always practicable to check their contents, and an automatic changeover system should be incorporated to provide an additional safeguard to the vapour supply.

(c) In the case of an automatic system ensure that it is 'active', i.e. the system has not been inadvertently shut off.

E.2 High and Low Pressure Alarms

E.2.1 High Pressure Alarm

This is to warn of abnormally high pressure indicating a fault in the pressure control system. It should be set above the manual controlled pressure, but below the vessel relief valve setting. Where deluges are fitted and they are operated automatically by high pressure and also sound an alarm, this is accepted as a suitable high pressure alarm.

E.2.2 Low Pressure Alarm

This is to warn of abnormally low pressure indicating a fault in the automatic pressure control system, or the need to operate the manual control valve. It should be set above the minimum safe working pressure vessel.
E.3 Other Methods of Limiting Vacuum Conditions

E.3.1 Product Composition

In certain special cases the composition of butane to BS 4250 may, by agreement with the supplier, be controlled so that the vapour pressure under the lowest service temperature will be above the minimum safe working pressure of the vessel.

E.3.2 Inert Gas Pressurisation or Vacuum Breakers

(a) Vacuum breakers will prevent a vacuum from occurring, but can introduce many operating problems and should normally be considered for emergency or interim purposes only. Specialist advice must be obtained. See also (c) below.

(b) An inert gas can be fed into the vapour space to avoid an unacceptable vacuum, but this may introduce operating problems. See also (c) below.

(c) The non-flammability and non-condensable nature of inert gas or air will give rise to problems, for the user and the supplier, if they are introduced into the storage vessel. If either method is contemplated it should be by agreement between user and supplier. It is strongly recommended that for emergency purposes the alternative use of propane vapour is considered as described in E.1.2 above.
Suitable protective clothing should be worn by personnel engaged in product transfer operations such as road / rail transfers, cylinder filling, plant commissioning, etc.

The wearing of antistatic clothing material is recommended. Fabrics such as nylon are not recommended as they are likely to increase the severity of burns in a fire situation.

Antistatic protective footwear with covered impact resistant toe caps are also recommended. There should be no steel tips on sole or heels.

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

Other than these specific items, good industrial practice should be followed.
This Appendix relates to product supplied or used for a particular application which requires the LPG to have a low odour: such LPG is therefore not in compliance with BS 4250 with regard to odour.

Because of the nature of the product, it is recommended that the following extra precautions and safety procedures be followed:

(a) Storage vessels should be clearly marked to indicate that the contents are un-odorised.

(b) Couplings used should prevent or minimise the risk of delivery of unodorised LPG into normal odorised storage.

(c) Pressure gauges should be fitted on all storage vessels.

(d) For certain applications requiring very close control of product quality, such as the aerosol market, positive means of isolation of plant sections should be provided to facilitate cleaning or renewal. For similar reasons provision of suitable sampling points and permanent drain connections should be provided.

(e) Pipework wherever practicable should be welded and flanged, and clearly identified as carrying unodorised products.

(f) An inspection for leaks, either visual or using portable gas detectors, should be undertaken regularly by a competent person familiar with the product.

(g) Where the ultimate process takes place inside a building, the provision of suitable automatic flammable gas detectors is required. The alarm setting of these and the
action to be taken in the event of an alarm needs to be determined on the basis of the process being carried out, upon which further expert advice should be sought.

Attention is also drawn to guidance issued by the British Aerosol Manufacturers Association.

(h) All enclosures within which LPG may be vented to atmosphere as part of the process should be provided with mechanical ventilation extracting at low level and discharging to atmosphere at high level. Electrical interlocks to prevent process machinery from being started before the ventilation system is in operation should be provided.

(i) To prevent inadvertent delivery of normal odourised LPG into a storage vessel, or vice versa, it is recommended that fitting connections on the fixed storage installation and the delivery vehicle hose end coupling are provided with left-hand ACME threads (see also 3.1.16.8).
Back pressure check valve
A device designed to close automatically and prevent a reverse flow of vapour or liquid.

Bonding
The means of ensuring all parts of metal structures are at the same electrical potential.

Bund
A wall surrounding a storage vessel(s), designed to retain 110% of the contents of at least one vessel in the event of failure.

Buried vessel
A vessel buried except for any manholes, safety relief valves, transfer connections and other service fittings.

Cathodic protection
A method of preventing corrosion in a metal structure by making it the cathode in an electro-chemical cell.

Deluge system
A fixed array of high/medium velocity deluge nozzles.

Emergency valve
A strategically located valve provided to enable the LPG supply to be shut off in an emergency.

Enforcing Authority
The authority with a responsibility for enforcing the Health and Safety at Work etc. Act 1974 (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.

Evaporation area
An area of ground in a safe place adjacent to the storage vessel or vessels where LPG can collect, evaporate and disperse safely.
**Excess flow valve**  
A device designed to close when the liquid or vapour passing through it exceeds a predetermined flow and pressure drop, and which reopens when the pressure differential is restored.

**Fire wall (Radiation wall)**  
A wall, screen or separation partition erected in the open air to reduce the effects from radiated heat on an LPG vessel and to ensure an adequate dispersion distance for LPG leaking from the vessel.

**Fixed maximum liquid level device**  
A small bleed valve connected to a dip-tube terminating at the maximum permitted filling level in a bulk vessel to indicate its maximum permitted level when being filled.

**Hydrant**  
A fixed water terminal with a coupling to take fire fighting hoses.

**Hydrostatic relief valve**  
A relief valve which allows release of liquid from a shut off pipeline in the event of thermal expansion of the liquid between two valves or blank flanges.

**IGEM**  
Institution of Gas Engineers and Managers

**Kerb**  
A low wall designed to contain small volumes of spillage or to direct spillage to a specific area.

**LPG-air mixing plant**  
Plant designed to accurately control the ratio of air and gas flows and their mixing to meet the demand of a distribution system.

**LFL**  
Lower flammability limit – the mixture of gas in air below which combustion is no longer possible.

**Lock-Up**  
Maximum pressure obtainable at no flow for all values of the supply pressure.

**‘Minimal reaction to fire’ rating**  
The rating of a material of construction that is either certified non-combustible according to the test specified in BS 476 : Part 4 throughout; or does not flame or cause any rise in temperature on either the centre (specimen) or furnace thermocouples according to the test specified in BS 476 : Part 11; or has achieved a classification of A1 when tested in accordance with BS ENISO 1182 and BS ENISO 1716; or has achieved a classification of A2 when tested in accordance with BS EN13823 and BS ENISO 1182 or BS ENISO 1716.
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Monitor</td>
<td>A specifically designed fire fighting water nozzle, either fixed or portable, with coupling to suit fire fighting hoses.</td>
</tr>
<tr>
<td>Mounded vessel</td>
<td>A vessel partially or entirely above ground with earth or other suitable material covering the above ground surfaces except for any entry manholes where fitted, relief valves, transfer connections and other service fittings.</td>
</tr>
<tr>
<td>Passive Fire Protection (PFP)</td>
<td>An in situ cladding to protect the vessel in the event of fire.</td>
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<tr>
<td>Pressure test point</td>
<td>A fitting provided on a pipe or appliance for temporary connection of a pressure gauge.</td>
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<tr>
<td>Reasonably practicable</td>
<td>The degree of risk in a particular job or workplace needs to be balanced against the time, trouble, cost and physical difficulty of taking measures to avoid or reduce the risk. Measures must be taken to eliminate or control the risks unless it is clear that the cost of doing so is grossly disproportionate to the level of risk. However, the ability to pay for additional control measures is not a deciding factor as to whether they are necessary.</td>
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<tr>
<td>Regulator</td>
<td>A device for automatically maintaining gas pressure at a steady value within close limits required for the application, and over a range of flow rates down to zero.</td>
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<tr>
<td>Saddle</td>
<td>Support for cylindrical vessels which is shaped to conform to the outside of the vessel.</td>
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<tr>
<td>Separation distance</td>
<td>The horizontal distance between the nearest part of a storage vessel and the specified feature.</td>
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<tr>
<td>Storage</td>
<td>Where used in this Code of Practice it should refer to a pressure storage vessel, i.e. a vessel designed to hold LPG in the liquid phase at ambient temperatures and at the vapour pressures corresponding at least to those temperatures.</td>
</tr>
<tr>
<td>Trace heating</td>
<td>Means of heating pipework etc. by electrical heating tapes as opposed to other methods such as water / steam pipes.</td>
</tr>
<tr>
<td>Vaporiser</td>
<td>A heat exchanger for vaporising liquid phase LPG to provide a vapour / gas supply.</td>
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</table>
The Planning (Hazardous Substances) Regulations 2015, the Town and Country Planning (Hazardous Substances) (Scotland) Regulations 2015 and the Planning (Hazardous Substances) (Wales) Regulations 2015

Hazardous Substances Consent is in addition to the normal planning permission required for the siting of LPG tanks and related plant / buildings.

These regulations apply when a total of 25 tonnes or more of LPG will be present on a site. Before the 25 tonnes is on site an application must be made to the local Hazardous Substances Authority (HSA) to grant Hazardous Substances Consent and approved. In most cases the Local Planning Authority (LPA) carries out the role of HSA. The HSA consult with HSE before deciding on the granting of the Consent. Consent may not be granted in all cases, or granted subject to specific conditions. Where Consent is granted, the HSE will establish a land use planning consultation distance around the LPG site (typically between 180 and 500 metres, but may be more). Subsequently, HSE will be consulted by the LPA on most developments requiring planning permission within this consultation distance.
Legal Requirements

This UKLPG Code of Practice was published taking into account of Legislation which was in force in the United Kingdom at the time of publication.

Primary Legislation

Health and Safety at Work etc. Act (HSWA)

The HSWA applies to any person connected to or involved with work activities, including employers, employees, designers, manufacturers, suppliers, owners of premises etc. The HSWA places general duties on such people to ensure so far as reasonably practicable, the health, safety and welfare of employees and the health and safety of members of the public and any other person(s) affected by the work activity.

Any person engaged in the, construction, design, operation, commissioning, testing, servicing, maintenance, alteration, disconnection or decommissioning etc must be competent to carry out the work. Competency is normally achieved through a combination of education, training, behaviour and practical experience.

It is a legal requirement under health and safety law that those responsible for work activities ensure that:

(a) Hazards are adequately identified;

(b) Risks are adequately assessed; and

(c) Suitable control measures are put into practice.
Measures should be taken to eliminate or control the risks unless it is clear that the cost of doing so is grossly disproportionate to the level of risk. However, the ability to pay for additional control measures is not a deciding factor as to whether they are necessary.

The following section outlines the health and safety law applicable to LPG, including its carriage, storage and use.

**Caravan Sites Control and Development Act 1960**

Section 5 requires fire fighting equipment in accordance with the Model Standards (1989) and is applicable to Permanent Residential Mobile Home Sites and Holiday Caravan Sites.

**Secondary Legislation**

**Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009**

“The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009 (CDG Regs) directly reference ADR which is the European agreement on transport of dangerous goods (“Accord européen relatif au transport international des marchandises dangereuses par route”, known as ADR) for the main duties, though there are some GB derogations. Amending regulations were made in 2011, mainly to reflect changes to the EU Transportable Pressure Equipment Directive”.

Further guidance can be found at: http://www.hse.gov.uk/cdg/

**The CLP Regulation**

CHIP requires the supplier of a dangerous chemical to:

- identify the hazards (dangers) of the chemical. This is known as ‘classification’;

- give information about the hazards to their customers. Suppliers usually provide this information on the package itself (e.g., a label) and, if supplied for use at work, in a safety data sheet (SDS);

- package the chemical safely.

**Confined Spaces Regulations 1997**

These Regulations place duties on those in control of work in confined spaces, as defined. This may include work inside LPG vessels.
**Construction (Design and Management) Regulations 2015**

These regulations require the preparation of a health and safety file for the “structure” of any project within the scope of the regulations. This includes pipeline works and some aspects of work on industrial plant. Requirements include the preparation by an appointed planning supervisor of a health and safety plan for the construction work and delivery of a health and safety file to the client.

Further guidance can be found at: [http://www.hse.gov.uk/construction/index.htm](http://www.hse.gov.uk/construction/index.htm)

**Control of Major Accident Hazards Regulations 2015**

The aim of these Regulations is to prevent major accidents and limit their consequences to people and the environment. A major accident includes a major emission, fire or explosion resulting from uncontrolled developments which lead to serious danger.

HSE Guidance L111 ‘A Guide to the Control of Major Accident Hazard Regulations 2015’ gives further information and is available via this link: [http://www.hse.gov.uk/pubns/priced/l111.pdf](http://www.hse.gov.uk/pubns/priced/l111.pdf)

The Regulations apply at two levels to certain premises where specified quantities of particular substances are stored, used or processed. The lower tier (LT) threshold is 50 tonnes (nett) and the upper tier (UT) threshold is 200 tonnes (nett). The Regulations also introduce notification requirements for both LT and UT sites.

Operators of COMAH UT and LT sites must prepare a major accident prevention policy (MAPP).

HSE provide guidance on the contents of a MAPP here: [http://www.hse.gov.uk/comah/sram/docs/s111.pdf](http://www.hse.gov.uk/comah/sram/docs/s111.pdf)

Operators of COMAH UT sites must also submit a safety report. Its purpose is to show that the Operator has put in place arrangements for the control of major accident hazards and to limit the consequences to people and the environment of any that do occur. The primary audience for the safety report demonstration is both the operator and the competent authority. The discipline of having to prepare the safety report can reveal shortcomings in your preventive and mitigation measures.

Much guidance on the duties of Operators and how to demonstrate compliance with them is provided here: [http://www.hse.gov.uk/comah/guidance.htm](http://www.hse.gov.uk/comah/guidance.htm)

**Dangerous Substances (Notification and Marking of Sites) Regulations 1990**

The purpose of these Regulations is to assist the fire-fighting services by the provision of advance
and on-site information on sites containing large quantities of dangerous substances. The Regulations apply to sites containing total quantities of 25 tonnes or more of dangerous substances. Dangerous substances include LPG. The Regulations require suitable signs to be erected at access points and at any locations specified by the enforcing authority, and notification to the Fire Authority and HSE / Local Authority of the presence of any dangerous substance.

HSR29 gives further guidance.

**Dangerous Substances and Explosive Atmospheres Regulations 2002**

These Regulations impose requirements for the purpose of eliminating or reducing risks to safety from fire, explosion or other events arising from the hazardous properties of a “dangerous substance” in connection with work. At domestic premises subject to the Gas Safety (Installation & Use Regulations) the Dangerous Substances and Explosive Atmospheres Regulations only apply to work activities related to the bulk storage vessel.

Further guidance on DSEAR may be found in HSE Leaflet “Fire and Explosion – How safe is your workplace?” (INDG370) and in five supporting Approved Codes of Practice (see Appendix K).

**Electricity at Work Regulations 1989**

These Regulations impose requirements for the safe use of electricity at work. They require electrical installations and equipment to be properly constructed, maintained and fit for the purpose and environment in which they are to be used. In particular, electrical equipment which is exposed (or reasonably expected to be exposed) to any flammable or explosive substance, including flammable vapours or gases, should be constructed or protected so as to prevent danger.

Advice is available in HS(R)25.

**Gas Safety (Installation and Use) Regulations 1998**

These Regulations deal with the installation, maintenance and use of gas systems and appliances in domestic and commercial premises. The regulations cover the use of LPG.

The Regulations are enforced by the HSE or by the local authorities depending on the type of premises as determined by the Health and Safety (Enforcing Authority) Regulations 1989.

**Management of Health and Safety at Work Regulations 1999**

These require employers and the self-employed to assess the risks to workers and others who may be affected by their undertakings so that they can decide what measures need to be taken to comply
with health and safety law. These Regulations require the implementation of appropriate arrangements for managing health and safety. Health surveillance (where appropriate), emergency planning, and the provision of information and training are also included.

**Pipelines Safety Regulations 1996**

These Regulations apply to all pipelines, with certain exceptions. Their aim is to secure the initial and continuing integrity of pipelines, for the purposes of health and safety.

Further information may be found in the HSE Approved Code of Practice (L81) for service pipes, and in HSE’s Guidance to the Regulations (L82).

The Regulations do NOT apply to pipelines contained wholly within a caravan site.

**Provision and Use of Work Equipment Regulations 1998**

These Regulations deal with the work equipment and machinery used everyday in workplaces: factories, offices, shops, hospitals, construction sites, farms - wherever equipment and machinery is used at work.

Further guidance can be found at: http://www.hse.gov.uk/equipment/

**Pressure Systems Safety Regulations 2000**

These Regulations require users and owners of pressure systems to demonstrate that they know the operating pressures of their pressure systems, and that the systems are actually safe at those pressures. They also need to ensure that a suitable written scheme of examination is in place. A written scheme of examination is a document containing information about selected items of plant or equipment which form a pressure system, operate under pressure and contain a 'relevant fluid'. The term 'relevant fluid' is defined in the Regulations and covers compressed or liquefied gases above 0.5 bar pressure.

A guide and an Approved Code of Practice accompany the Regulations.

**Pressure Equipment (Safety) Regulations 2016**

These regulations apply to all pressurised equipment including pipework assemblies operating at pressures greater than 0.5 bar produced after May 2002. In most cases new equipment needs to be CE marked.

Assemblies including those made on site may also require CE marking if not made under the authority of the owner of the pressure system.
Guidance on the implementation of the Regulations may be obtained from the Department for Business, Energy and Industrial Strategy.

**Regulatory Reform (Fire Safety) Order 2005 in England and Wales and the Fire (Scotland) Act 2005**

Fire safety legislation has been significantly changed by these new provisions. The objective of the new legislation is to consolidate the general fire safety precautions of a large number of pieces of legislation, which are revoked. This includes the Fire Certificate (Special Premises) Regulations 1976, thus removing the requirement for fire certificates. In general, the legislation places responsibility for enforcing general fire precautions on the local Fire Authorities.

The new legislation introduces a risk-based approach, in contrast to the prescriptive requirements associated with the prior special premises regulations. This requires the Responsible Person to carry out a risk assessment to demonstrate that the fire safety precautions are adequate.

Further guidance may be found at:

http://www.communities.gov.uk/index.asp?id=1124877,
http://www.scotland.gov.uk/Topics/Justice/Fire/19077/FireAct, or
British Standards

BS 341  Transportable Gas Container Valves
BS 476  Fire tests on building materials and structures
BS 4250 Specification for Commercial Butane and Propane
BS 5306 Fire extinguishing installations and equipment on premises BS 5351
  Specification for steel ball valves for the petroleum industry
BS 5355 Specification for filling ratios and developed pressures for liquefied and
  permanent gases
BS EN 3  Portable fire extinguishers
BS 5499 Graphical symbols and signs
PD 5500 Specification for unfired fusion welded pressure vessels
BS 5501 Electrical Apparatus for potentially explosive atmospheres
BS 5958 Code of Practice for control of undesirable static electricity
BS 6651 Code of Practice for protection of structures against lightning
BS 6956 Jointing materials and compounds
BS 7121  Code of Practice for safe use of cranes
BS 7671  Requirements for electrical installations
BS 7786  Specification for unsintered PTFE tapes for general use
BS EN 3   Portable fire extinguishers
BS ENISO 1182  Reaction to Fire Tests for Building Products – Non-Combustibility Test
BS EN 589  Automotive fuels. LPG. Requirements and test methods
BS EN 1363-1  Fire resistance tests. General requirements
BS EN 1364-1  Fire resistance tests for non-loadbearing elements. Walls
BS EN 1365-1  Fire resistance tests for loadbearing elements. Walls
BS ENISO 1716  Reaction to fire tests for building products. Determination of the heat of combustion
BS EN 1563  Founding. Spheroidal graphite cast iron
BS EN 1762  Rubber hoses and hose assemblies for liquefied petroleum gas, LPG (liquid or gaseous phase), and natural gas up to 25 bar (2,5 Mpa)
BS EN 12542  Static welded cylindrical tanks, serially produced for the storage of Liquefied petroleum gas (LPG) having a volume not greater than 13 m³ and for installation above ground. Design and manufacture
BS EN 12806  Automotive liquefied gas components other than tanks
BS EN 13175  Specification and testing for Liquefied Petroleum Gas (LPG) tank valves and fittings
BS EN 13445  Unfired pressure vessels
BS EN 13785  Regulators with a capacity of up to and including 100 kg/h, having a maximum nominal outlet pressure of up to and including 4 bar; other than those covered by EN 12864 and their associated safety devices for butane, propane or their mixtures
BS EN 13799  Contents gauges for LPG tanks
BS EN 13823  Reaction to Fire Tests for Building Products – Building Products Excluding Floorings exposed to the Thermal Attack by a Single Burning it

BS EN 50020  Electrical apparatus for potentially explosive atmospheres

BS EN 50028  Electrical apparatus for potentially explosive atmospheres

BS EN 50039  Electrical apparatus for potentially explosive atmospheres

BS EN 50110-1  Operation of electrical installations, General requirements

BS EN 60079  Electrical Apparatus for Explosive Gas Atmospheres

BS EN 60529  Specification for degrees of protection provided by enclosures (IP Code)

BS ENISO 10497  Testing of valves. Fire type-testing requirements

BS ENISO 17292  Metal ball valves for the petroleum, petrochemical and allied industries

PD CLC/TR 60079-32-1  Explosive atmospheres. Electrostatic hazards, guidance

Other Standards and Guidance

ANSI - B1.5  American National Standard for ACME screw threads  ASA¹

ANSI - B57.1  Cylinder valve outlet and inlet connections  CGA²

API 520  Recommended Practice for the design and installation of pressure relieving systems in refineries  API³

API 2000  Venting atmospheric and low pressure storage tanks  API³

EEMUA Publication  A practitioner’s handbook – Electrical installations No. 186 in potentially explosive atmospheres  EEMUA⁴

HSE Guidance Note  Avoiding danger from underground services  HS[G]47

HSE Guidance Note  Safe work in confined spaces  L101

HSE Guidance Note  Avoidance of danger from overhead power lines  GS 6

HSE Guidance Note  The storage of flammable liquids in containers  HS[G]51
HSE Guidance Note Successful Health and Safety Management HS[G]65
HSE Guidance Note Control Major Accident Hazard Regulations L111
HSE Guidance Note Gas Safety (Installation and Use) Regulations 1998 L56
HSE Guidance Note Safety Signs and Signals, the Health and Safety (Signs and Signals) Regulations (1996) L64
HSE Guidance Note The Design, Construction and Installation of Gas Service Pipes, Pipelines Safety Regulations 1996 L81
HSE Guidance Note Guide to the Pipelines Safety Regulations 1996 L82
HSE Guidance Note Safety of Pressure Systems L122
Fire Offices’ Committee Tentative Rules for Medium and High Velocity Spray System FPA
Institute of Petroleum / Association of Petroleum and Explosives Administrations Guidance for the design, construction and modification of petrol filling stations IP / APEA

1 American Standards Association
2 Compressed Gases Association (U.S.A.)
3 American Petroleum Institute
4 Engineering Equipment Manufacturers and Users Association (UK)
5 Fire Protection Association (U.K.)
Table 1(i): Separation Distances from Buildings, Boundaries and Sources of Ignition to LPG Vessel(s) Containing Butane.

Note: Appendix L contains Table 1(i), which gives the typical water capacities of LPG tanks containing butane.

### Appendix L: Conversion of Water Capacity to Nominal Tonnage

<table>
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<th>Maximum Butane Capacity</th>
<th>Minimum Separation Distances</th>
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<tbody>
<tr>
<td></td>
<td>Of any single vessel in a group</td>
</tr>
<tr>
<td>LPG Capacity (a)</td>
<td>Typical Water Capacity (b)</td>
</tr>
<tr>
<td>Tonnes</td>
<td>Litres</td>
</tr>
<tr>
<td>----------</td>
<td>--------</td>
</tr>
<tr>
<td>0,05 to 0,25</td>
<td>150 to 500</td>
</tr>
<tr>
<td>&gt;0,25 to 1,1</td>
<td>&gt;500 to 2 500</td>
</tr>
<tr>
<td>&gt;1,1 to 4</td>
<td>&gt;2 500 to 9 000</td>
</tr>
<tr>
<td>&gt;4 to 60</td>
<td>&gt;9 000 to 135 000</td>
</tr>
<tr>
<td>&gt;60 to 150</td>
<td>&gt;135 000 to 337 500</td>
</tr>
<tr>
<td>&gt;150</td>
<td>&gt;337 500</td>
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