BCGA GUIDANCE NOTE GN2

GUIDANCE FOR THE STORAGE OF GAS CYLINDERS IN THE WORKPLACE

Revision 5: 2012

British Compressed Gases Association

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BRITISH COMPRESSED GASES ASSOCIATION

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PREFACE

The British Compressed Gases Association (BCGA) was established in l971, formed out of the British Acetylene Association, which existed since l901. BCGA members include gas producers, suppliers of gas handling equipment and users operating in the compressed gas field.

The main objectives of the Association are to further technology, to enhance safe practice, and to prioritise environmental protection in the supply and use of industrial gases, and we produce a host of publications to this end. BCGA also provides advice and makes representations on behalf of its Members to regulatory bodies, including the UK Government.

Policy is determined by a Council elected from Member Companies, with detailed technical studies being undertaken by a Technical Committee and its specialist Sub-Committees appointed for this purpose.

BCGA makes strenuous efforts to ensure the accuracy and current relevance of its publications, which are intended for use by technically competent persons. However this does not remove the need for technical and managerial judgement in practical situations. Nor do they confer any immunity or exemption from relevant legal requirements, including by-laws.

For the assistance of users, references are given, either in the text or Appendices, to publications such as British, European and International Standards and Codes of Practice, and current legislation that may be applicable but no representation or warranty can be given that these references are complete or current.

BCGA publications are reviewed, and revised if necessary, at five-yearly intervals, or sooner where the need is recognised. Readers are advised to check the Association's website to ensure that the copy in their possession is the current version.

This document has been prepared by BCGA Technical Sub-Committee 6. This document replaces BCGA Guidance Note 2: Revision 4. It was approved for publication at BCGA Technical Committee 145. This document was first published on 18/12/2012. For comments on this document contact the Association via the website www.bcga.co.uk.

CONTENTS

* Throughout this publication the numbers in brackets refer to references in Section 7. Documents referenced are the edition current at the time of publication of this Guidance Note.

BCGA GUIDANCE NOTE 2

GUIDANCE FOR THE STORAGE OF GAS CYLINDERS IN THE WORKPLACE

1. INTRODUCTION

This Guidance Note has been prepared by producers, processors and distributors of cylinder gases.

It is aimed primarily at users of gas cylinders in the workplace. Sites operated under the direct control of the gases supplier or manufacturer of gases will be governed by guidelines drawn up on the basis of a site risk assessment.

The guidance given is based on extensive knowledge and experience of cylinder storage practices, which have been proved to be safe in practical situations for over half a century. Substantial quantities of industrial gases are produced, distributed and stored each year and, although many organisations have developed their own Codes of Practice and Engineering Standards, it is considered that this Guidance Note will be of benefit to users generally.

A risk assessment is required at all times under *The Management of Health and Safety at Work Regulations* (5) and may also be required under *The Dangerous Substances and Explosive Atmospheres Regulations* (DSEAR) (6). Guidance on the preparation of Risk Assessments under DSEAR is contained in BCGA Guidance Note (GN) 13 (32). DSEAR is a set of regulations concerned with protection against risks from fire, explosion and similar events arising from dangerous substances used or present in the workplace. These Regulations apply to employers and the self-employed and are supported by a number of Health and Safety Executive (HSE) Approved Codes of Practice (ACOPs) (References 10 to 14). See also HSE INDG370 (16), *Fire & Explosion. How safe is your workplace?*

The aim of this Guidance Note is to provide information on the hazards of gas cylinder storage, and on what is good practice for controlling the risks to assist the user of gases to conduct a risk assessment.

Every storage situation must be considered on its merits and special circumstances may necessitate variations on the recommended requirements. This guidance is intended as an aid to designing new storage areas; it may also be used for reviewing the safety and suitability of existing gas cylinder storage facilities. It does not preclude the use of alternative designs, materials and methods, when they provide equivalent standards of safety.

This Guidance Note has been written in consultation with the HSE and takes full account of its publication HS(G)71 (15), *Chemical warehousing. The storage of packaged dangerous substances*. Where gas cylinders are stored in conjunction with other packaged dangerous substances reference should be made to HS(G)71 (15).

2. SCOPE

This document defines the principles of safe practice for the storage of gases in cylinders and cylinder bundles. This Guidance Note is intended for users, distributors and stockists of these gases.

Exclusions from this Guidance Note are:

(i) Cylinders in use, i.e. connected to user equipment, or permanently connected for use; e.g. fire protection systems.

(ii) Cylinder storage situations that are covered by specialised published guidance, from Government Agencies.

(iii) Hydrogen trailer exchange installations and static cylinder storage systems permanently connected for use, e.g. hydrogen storage installations – refer to BCGA Code of Practice (CP) 33 (27) -*The bulk storage of gaseous hydrogen at users' premises*.

(iv) Storage of radioactive gases.

(v) Very toxic or pyrophoric gases – refer to BCGA CP 18 (26) - *The safe storage, handling and use of special gases in the micro-electronics and other industries*, for further information.

(vi) Gas cylinders during conveyance by road, rail, air and sea.

(vii) Containers for cryogenic liquids. Refer to BCGA CP 36 (28).

NOTES:
1. Cylinders are never fully empty so even though the contents may be less than a full cylinder the hazards of the gases contained remain. Cylinders in this state are considered as 'nominally empty'.
2. Where reference is made to oxidants, throughout this publication, this means oxygen, nitrous oxide and their mixtures.

3. POTENTIAL HAZARDS

The contents of the gas cylinders should be identified from the cylinder precautionary labels.

As an aid to identification of cylinders, within the UK the cylinder shoulders are usually colour coded according to BS EN 1089, Part 3 (21), introduced in 1997 or previously BS 349 (now withdrawn) (18). ISO 32 (17) specifies a colour coding system for the identification of the contents of medical gas cylinders. Shoulder colours are not mandatory and should not be relied upon as the only means of identification. Refer to BCGA's Technical Information Sheet (TIS) 6 (33).

3.1 Product hazards

All gases are classified by the gas manufacturer according to legislation (8 and 9). The classification is shown on the precautionary label within the hazard diamond label(s). Table 1 indicates the main categories of gas:

Category	Hazard Diamond(s)	Hazard statement on label	Notes
Oxidant	Green and Yellow	Contact with combustible material may cause fire	Strongly support combustion but do not, themselves burn, e.g. oxygen.
Inert	Green	Asphyxiant in high concentrations	Do not in general react with other materials, but can cause asphyxiation by replacement of the oxygen in the atmosphere, e.g. nitrogen, argon, helium and carbon dioxide.
Toxic	White	Toxic by inhalation	Gases which, when inhaled, are known to produce injurious or fatal effects, e.g. carbon monoxide and hydrogen sulphide.
Very Toxic	White	Very toxic by inhalation	Gases which are toxic at lower concentrations than gases classified as toxic and which can produce injurious or fatal effects with less exposure, e.g. arsine, boron trichloride and phosphine.
Flammable	Red	Extremely flammable	Will burn if a source of ignition is present, e.g. propane, hydrogen and acetylene. In addition, acetylene may decompose explosively if the cylinder is subjected to excessive heat or severe impact.
Pyrophoric	Red	Spontaneously flammable in air	Ignite spontaneously in contact with air and, therefore, should be stored separately (refer to BCGA CP 18 (26)), e.g. silane and phosphine.
Corrosive	White with hand symbol	Cause severe burns and are irritating to the eyes and respiratory system	Can cause severe burns to the skin and irritation to eyes and respiratory system, e.g. hydrogen chloride, chlorine.

Table 1: Gas categories.

3.1.1 All gases, with the exception of oxygen and air, are asphyxiant.

3.1.2 Some gases exhibit more than one of the above properties, e.g. carbon monoxide and hydrogen sulphide are both toxic and flammable. All these properties need to be taken into account when designing storage for such gases.

3.1.3 Some gases also have subsidiary properties such as corrosive, harmful, irritant. These do not significantly influence the storage of gas cylinders, but need to be taken into account. Further details are given in each product Safety Data Sheet provided by the supplier.

3.1.4 Acetylene in cylinders may react differently to other gases in cylinders after exposure to fire. The fire and rescue services have operational procedures in place for dealing with gas cylinders, including acetylene cylinders, involved in fires. It is advisable to put appropriate signs outside of any storage areas containing acetylene cylinders, particularly where the cylinders are obscured from view, in order to alert

the fire and rescue services of their presence. See Figure 1. Refer also to BCGA Leaflet 6, Cylinders in fires (36).

Figure 1: Example of an acetylene warning sign.

3.2 Pressure hazards

Cylinders are pressure vessels, which may fail if over-pressurised or weakened by the application of heat. Heating causes the internal pressure to rise and could, in extreme conditions, result in the failure of the cylinder with an uncontrolled pressure release (reportable under the *Reportable Injuries, Diseases and Dangerous Occurrences Regulations* (RIDDOR) (2)).

Most gas cylinders are not fitted with pressure relief devices.

However some cylinders do incorporate such devices including:

(i) Propane, butane and other LPG cylinders, which are protected by pressure relief valves.

(ii) Some older acetylene cylinders, which are protected by fusible plugs or a bursting disc in the fitted valve.

(iii) Carbon dioxide cylinders, which are protected by bursting discs.

(iv) Transportable vacuum-insulated cryogenic gas containers: these storage vessels are fitted with pressure relief devices, which, during normal operation, are designed to lift and vent any excess pressure.

These cylinders should always be stored and transported in an upright condition to ensure that the relief device can operate correctly to relieve pressure from the gas phase.

Fusible plugs operate when direct or indirect excessive heat is applied to the device. Pressure relief valves or bursting discs can operate when heat raises the pressure in the cylinders. It should be noted, that whilst these devices should protect the cylinders against rupture, their operation might give rise to a localised hazardous atmosphere. Refer to the Confined Spaces Regulations (4).

4. GENERAL PRINCIPLES OF CYLINDER STORAGE

4.1 Storage area layout and separation distances

4.1.1 Minimum recommended separation distances

Table 2 shows the minimum recommended separation distances from cylinders. It should be noted that no separation distances are needed between individual cylinders. For guidelines on storage of multiple cylinders refer to Section 4.11.

TYPICAL TYPE OF EXPOSURE (Note 1)		**MINIMUM SEPARATION DISTANCE** (Metres) (Note 2)				
		Inerts including CO_2	**Oxidants**	**Flammable(s)** Compressed or dissolved gases only – e.g. H_2 and Acetylene	**LPG and other liquefied flammables** (Note 3)	**Toxics** (Note 4)
Between gas cylinders and other gas storage						
Bulk storage of flammable gases and liquids (Note 6)		1	3	3	3	3
Bulk storage of cryogenic liquids –- (Notes 6 and 7)	**Oxidants** <2000 litres capacity	1	1	5	5	1
	>2000 litres up to 200 Tonnes			8 (>70 m^3 flammable gas – 7 large cylinders)	7.5 (above 50 kg total capacity LPG)	
	Inerts <2000 litres	1	1	3	3	1
	Inerts >2000 litres	1	1	3	3	1
Transportable cryogenic containers	**Oxidants**	1	1	5	5	1
	Others	1	1	1	3	1
Between gas cylinders and other features						
Site boundaries		1	1	3	1 <400 kg 3 >400 kg (Note 8)	3
Building openings. Ref. Section 5.2		1	1	1	3	3
Smoking, naked flames, sources of ignition and heat sources		1	1	3	1 <400 kg 3 >400 kg	3
Unprotected electrical equipment		0	0	3 (Note 9)	1 <400 kg 3 >400 kg	0
Air compressors and ventilator intakes (Note 10)		3	3	3 (Note 11)	3	3
Combustible materials e.g. paper, wood etc.		0	3	3	3	3

Table 2: Minimum recommended separation distances.

NOTES:

1. When siting cylinders near another hazard, check that there is no specific legislation concerning that hazard which requires measures beyond those stated above.

2. In some cases physical partitions or barriers may be used to reduce the required separation distances. A suitably constructed firewall may eliminate the need for separation distances. See section 4.1.2 – Fire Walls.

3. This guidance refers to quantities of LPG between 50 - 1000 kg. Below 50 kg no specific separation is defined. For quantities above 1000 kg, and for additional information on the storage of LPG cylinders in other circumstances, e.g. domestic and retail, refer to UKLPG CP 7 (38) and CP 24 (39).

4. Where flammable toxics are concerned the greater distance (from the "Flammables" column) shall apply. Where pure toxic / corrosive cylinders are stored as an adjacent group, no separation is required within the same product type, as there would be no immediate domino effect resulting from a leak or spill.

5. Reference shall be made to BCGA CP 18 (26) for the requirements for the storage of pyrophoric gases.

6. Bulk storage is defined as static vessels of a capacity greater than 2000 litres into which product is delivered.

7. The distances from bulk storage are to be taken from the nearest point of the tank including the filling line or vaporiser.

8. A separation distance of 8 m should be applied where the site boundary forms the boundary with vulnerable populations. See Section 4.1.2 for the definition of vulnerable populations.

9. A documented risk assessment will identify if there is a need for protected electrical equipment or may justify the reduction or removal of a separation distance for un-protected electrical equipment. See Section 4.5.

10. Storage area shall not be directly below an air intake.

11. Generally the separation distance is 3 metres but special consideration should be given to the density of gas, e.g. if the gas is lighter than air, consider windows, air intakes and openings above the storage area.

12. Additional information on the minimum separation distances associated with drains, gulleys, basements etc. is available in BCGA CP 4 (25).

4.1.2 Fire walls

In some cases physical partitions or barriers may be used to reduce the required separation distances. Such partitions / barriers should be of at least 30 minutes' fire-resisting construction (refer to BS 476 (19)), imperforate

and constructed of materials such as solid masonry or concrete. They should be not less than 2 metres high, See also HSE L136 (12), *DSEAR ACOP and Guidance. Control & Mitigation Measures*.

Where the wall separates vulnerable populations from the cylinders (not inerts), the fire resistance provided should be a minimum of 60 minutes. Vulnerable populations include those in schools, hospitals, old people's homes and other residential accommodation.

4.2 Siting the storage area

Storage areas should be well defined and located in the open air where there is good natural ventilation. Storage within a building is not recommended and should not be considered for new locations for cylinder stores.

Storage areas should be segregated and located with due regard to the potential hazards of the particular gases. See Table 2.

Storage locations for vessels containing cryogenic, liquefied and heavier-than-air compressed gases, e.g. argon, carbon dioxide, LPG, liquid nitrogen etc. should be sited at ground level. Consideration should be given to the effects of any leakage, with no immediate pathways available to underground facilities and due regard given to the dangers of seepage into drains, basements, cable ducts, etc. The minimum separation distances given in Table 2 may need to be increased.

Consideration should be given to the proximity of the site boundary, other process equipment or buildings containing process plant where there is a potential fire or explosion hazard. Precautions such as increased minimum separation distances or properly designed fire or radiation barriers may be necessary in such cases. Refer to Sections 3 and 4 and see Table 2 for minimum separation distances.

Cylinder stores should not be located next to other stores containing combustible materials or products.

Stores are to be located away from any source of excessive heat or ignition. Where significant quantities are present or there is uncertainty about arrangements it is recommended that the Fire and Rescue Service is consulted.

Cylinder stores are to be located away from site designated emergency exits and escape routes.

Where significant quantities are present or there is uncertainty about arrangements it is recommended that the Fire and Rescue Service is consulted.

The location of the storage area should consider the security of cylinders to avoid theft. Refer to Section 4.8.

4.3 Ventilation

Good ventilation is required to ensure that any small leakage of gas is adequately dispersed. An ideal outdoor storage structure should be well ventilated, with no roof and up to two solid walls. High walls (>2 m high) or thin corridor style storage is

not conducive to good ventilation, and in general, no more than 50 % of the perimeter wall should be obstructed.

However, a typical storage structure for non-flammable cylinders or for small quantities of flammable cylinders may consist of three adjacent walls, provided that at least 25 % of the perimeter is constructed to ensure that ventilation is not impaired, e.g. meshed fencing.

If overhead weather protection is required, then roofing designed to prevent potential gas pockets should be considered, e.g. gaps between the wall and sloping roof, natural ventilation in the roof apex etc.

The properties of all the gases being stored should be considered; refer to the appropriate Safety Data Sheet(s).

4.4 Access

The storage area should be located so that it is readily accessible for cylinder movements with manual handling distances kept to a minimum and clear access maintained at all times for deliveries and the emergency services.

No parking should be permitted within the delivery and storage area other than for loading and unloading cylinders.

For safe access to cylinders and to facilitate housekeeping and stock control, aisles should be provided. They should be a minimum of 0.6 metres wide.

The layout of the area should be such as to prevent damage to cylinders, consideration is to be given to the use of, and access for, manual handling trolleys, fork lift trucks or other vehicles.

Where installed, all emergency exits are to open in the direction of escape and are to be fitted with panic furniture of a type not requiring a key, card, or code to open. They are to provide an unobstructed means of escape and in operation are not to obstruct any other escape route. These exits are to be properly identified by signage, and maintained in a serviceable condition at all times.

4.5 Lighting and other electrical equipment

The area should have adequate lighting to assist in the identification of the cylinder contents, and where necessary to assist with security. Where flammable gases are involved a risk assessment is required to determine whether protected electrical equipment is required. For the standard regarding electrical equipment refer to BS EN 60079, Part 14 (23), *Explosive atmospheres. Electrical installations, design, selection and erection*.

4.6 Fire safety

A Fire Safety Risk Assessment is to be carried out on all storage sites and is to be incorporated into the Site Fire Safety Management Plan. Each site should keep a record of the location of its hazardous store(s), this is to be made available to the emergency services in the event of an incident. Refer to The Regulatory Reform (Fire Safety) Order (7).

The cylinder storage area shall be designated a "**NO SMOKING AREA**". Suitable signs are to be displayed. See Figure 2.

Wherever practicable, the cylinder storage infrastructure should be constructed of non-combustible materials.

Adequate fire fighting facilities as identified in the risk assessment of the storage facility should be provided. Refer to BS 5306, Part 3 (20), *Fire extinguishing installations and equipment on premises. Commissioning and maintenance of portable fire extinguishers. Code of practice.* Materials of construction should be non-combustible.

For emergency procedures in the event of an incident – see Section 6.

4.7 Signage

All areas within the gas cylinders storage facility are to be clearly identified by signage to show the condition and contents of gas cylinders.

Warning notices should be displayed. Refer to:

(i) The Dangerous Substances (Notification and Marking of Sites) Regulations (1) (where more than 25 tonnes of dangerous substances are stored).

(ii) The Health and Safety (Safety Signs and Signals) Regulations (3).

(iii) BS ISO 7010, Graphical symbols. Safety colours and safety signs. Registered safety signs (24).

As a minimum the signs in Figure 2 should be displayed:

Smoking and naked flames forbidden

Figure 2: Examples of warning signs.

Consideration should be given to using the appropriate Hazard "diamond" label(s) for the gases stored, particularly when they are not in clear view (see Section 3.1). If there is a risk of the development of an explosive atmosphere (DSEAR, 6, 10 to 14), then it may be necessary to display the EX-sign. See Figure 3.

Figure 3: Example of an explosive atmosphere sign.

4.8 Security

Access to the storage area should be restricted to authorised personnel only.

Consideration should be given to site security, to prevent the unauthorised access to or tampering with cylinders. Appropriate management controls should be implemented to prevent the theft of gas cylinders and to monitor the usage of gases.

If the site conditions so require it, the storage area should be enclosed by an industrial-type fence or equivalent, not less than 1.8 metres high with suitable emergency exits. A firewall (see Section 4.1.2) may be considered as part of the enclosure. The storage site is to be secured by locked gates or doors appropriate to the location of the site.

Security for small quantities of cylinders may be achieved by the use of a suitably ventilated, lockable cabinet or wire mesh enclosure.

NOTE: The use of fire resistant cabinets for storing cylinders is the subject of a BCGA statement included as Appendix 1.

4.9 Floor

The floor should be essentially level and constructed of concrete or other non-combustible, non-porous material. A concrete finish is preferred and is likely to have a longer life. The floor should be laid to a fall to prevent the accumulation of water.

NOTE: Adequate drainage is required so that stored cylinders do not stand in trapped water and risk being subjected to corrosion. Care should be taken when storing cold gases and those denser than air such that any gas leakage cannot collect in low lying areas in dangerous quantities.

4.10 Indoor storage

Internal storage is not recommended.

Where indoor storage of **small numbers** of cylinders cannot be avoided, a risk assessment shall be carried out to cover quantity of cylinders and proposed location.

Consideration shall be given to:

(i) Fire, impacting on the cylinder store.

(ii) The densities of gases stored.

(iii) Risk of explosion from flammable gas release.

(iv) Leakage from valves or safety relief devices.

(v) Ventilation requirements.

(vii) Access to and egress from the cylinder store.

(viii) Movement and handling of cylinders to and from the store.

(ix) Detection equipment.

(x) Exposure of personnel to gas / gases.

Guidance on risk assessment is provided by:

BCGA GN 9 (30), *The application of the confined spaces regulations to the drinks dispense industry*, and

BCGA GN 11 (31), *The management of risks associated with reduced oxygen atmospheres resulting from the use of gases in the workplace*.

Some general principles that apply are:

a) The number of cylinders shall be kept to a minimum.

b) Where practicable the store shall be constructed of non-combustible materials, by making the walls, floor and ceiling from materials complying with BS 476, Parts 20 to 23 (19), *Fire tests on building materials and structures*. If the wall of a cylinder store forms part of a building, it should be of at least 30 minutes fire-resisting construction, preferably made of brick or concrete.

c) The store shall be adequately ventilated as determined by the risk assessment.

d) Any forced ventilation system shall be linked to a suitable visual and audible alarm system to warn of failure.

e) Consideration should be given to atmospheric monitoring within the store depending upon the assessed risk.

4.11 Management of cylinder stores

Layouts which meet with the minimum separation distances, as given in Table 2, should be used. Consideration should be given to reducing the manual handling of cylinders. Refer to BCGA GN 03 (29) and TIS 17 (35).

4.11.1 Cylinders should be stored upright, when designed for this, and suitable measures implemented to prevent them toppling over, e.g. secured by chains or lashings. Alternatively, they may be stored in specially designed pallets. Special arrangements may be required to secure small or round-bottomed cylinders. Gas cylinders, which are mounted within a gas cylinder manual handling trolley, are to be secured to an appropriate strong point to prevent the combined trolley and gas cylinder falling over.

NOTE: Care is to be taken to prevent the onset of external corrosion (e.g. by ensuring gas cylinders do not rest in pools of water). In particular horizontally stored gas cylinders are not to rest directly on the floor.

4.11.2 Full (including part-used) and empty cylinders should be stored separately and the areas properly identified. See Figure 4.

Figure 4: Examples of full and empty signs.

4.11.3 Generally gases with the same hazard category should be grouped together and the areas properly identified according to the gas being stored.

4.11.4 Unserviceable cylinders, or those under quarantine, should be stored separately from serviceable cylinders and the areas properly identified. Such cylinders should be returned to the gas supplier as soon as practicable.

4.11.5 Toxic gases. By storing toxics separately from other gases there will be less activity in the area, reducing risk of an accident and exposure of personnel, should an incident occur. It is also important to have good access to toxic gas cylinders for routine checking and control.

4.11.6 Corrosive gases. Some corrosive products will be subject to a “return by” date. These products will be highlighted with a separate label specifying the return date. Contact the supplier if this date is due or has passed. Refer to BCGA TIS 16 (34).

4.11.7 Avoid excessive levels of stock. Stock rotation should generally be controlled on a First in First Out (FIFO) basis. However, some gases are given a shelf life. It is not recommended that these gases are used once this shelf life has expired; upon expiry the cylinder should be replaced.

NOTE: All cylinders are required by law to have periodic inspection and test procedures carried out to ensure the total safety of the cylinder. Cylinders are generally inspected every 5 or 10 years dependent upon service. Stamps on the shoulder identify the test date and the approved test authority. These cylinders can continue to be used until nominally empty, but not refilled, if the due date for inspection and re-test has passed. Where fitted, the use of cylinder test date rings between the cylinder and valve provides a quick visual reference to the next test date.

4.11.8 Cylinder storage areas should be inspected regularly to check that the cylinders are not being subjected to adverse conditions.

4.11.9 The local management should prepare a procedure for dealing with any likely incidents within a store. This is to include leaking cylinders based on the extent of the leak and the risks associated with the leaking product.

4.11.10 Stores are to be kept clean and subjected to regular housekeeping. Contamination of cylinders is to be prevented. Ensure all excess packaging, and other combustible material is removed.

NOTE: Contact with oils, grease, hydrocarbons, tarry substances and many plastics carries the risk of spontaneous combustion, particularly with high pressure gases, and especially oxidizing ones.

4.11.11 Gas cylinders are not to be repainted, to have any markings obscured, labels removed or added, without the explicit consent of the owner. If the contents of a gas cylinder cannot be identified the gas cylinder is to be declared unserviceable and returned to the owner as soon as practicable. Refer to BCGA TIS 6 (33).

4.12 Management of stores for medical gas cylinders

As well as complying with Section 4.11, medical gas cylinders require additional measures to be taken when in storage. Reference should be made to HTM 02-01 Part B, Section 8 (40).

All medical gases are highly regulated by European Directives and UK legislation. The gases are classified as medicinal products for administration to a patient. As with all medicines they should be stored securely and out of the reach and sight of children.

The storage requirements of medicinal gases are covered within their individual Marketing Authorisation – product licence – and these have to be complied with. Each Marketing Authorisation will have agreed details for each company but the storage conditions will be summarised in the Summary of Product Characteristics.

The following additional measures are to be taken:

4.12.1 Medical gas cylinders are to be segregated from all other cylinders.

NOTE: Pathology gases are not classified as medical gases and therefore are to be segregated from medical gases.

4.12.2 Appropriate management controls should be implemented to prevent the theft of gas cylinders and to monitor the usage of gases. Particular care may be required for certain gases that are misused, for example as "recreational drugs". Refer to BCGA L 7 (37).

4.12.3 Medical gas cylinders should be stored under a weatherproof cover. They are to be kept dry and are not to be subjected to extremes of temperature.

4.12.4 Specific storage conditions can be required by the Marketing Authorisation to maintain the quality of the product, for example by controlling temperature (e.g. for gas mixtures where phase separation occurs on freezing) and/or humidity. Where special storage conditions are required these should be provided, checked and monitored.

4.12.5 All storage areas containing medical gas cylinders are to be kept clean. Particular care is required to prevent the spread of disease from contamination by animals, such as birds and rodents.

NOTE: It is a requirement that medical gas cylinders are stored and managed in a manner that ensures that they will be delivered in a clean state, compatible with the environment in which they will be used.

4.12.6 As with all medicines, medical gases have a defined shelf life which is specified within the relevant Marketing Authorisation. Each cylinder will have a label that will show the expiry date as well as the batch number of the medicinal product.

It is not recommended that Medical Gases are used once this shelf life has expired; upon expiry the cylinder should be replaced.

Medical gas cylinders should be used in strict rotation so that cylinders with the earliest filling date are used first.

NOTE: Some gas cylinders may be stored, but used only infrequently e.g. specifically for use in an emergency situation. Regular checks should be carried out to ensure these remain within their shelf life.

5. TRAINING

All people engaged in the storage and handling of gases in cylinders shall receive suitable training.

Training should be carried out regularly under a formalised system and records kept.

Training should be reviewed and / or up-dated following:

a) A related accident or incident.

b) The purchase of gases which have not previously been used on site.

c) Changes to guidance or information previously provided.

d) The appointment of new and/or transferred employees.

Training should include, but not be necessarily confined to the following subjects:

5.1 Identification of the cylinder contents

(i) Cylinder labels, tags, stencilling.

(ii) Colour coding.

5.2 Properties of gases

(i) Meaning of flammable, toxic and non-flammable non-toxic gases classification.

(ii) Potential hazards as given in Section 3.

(iii) Contents of each product safety data sheet.

(iv) Fire triangle.

(v) The different properties and hazards of compressed and liquefied gases.

5.3 Construction of cylinders

(i) Materials of construction.

(ii) Difference between welded and seamless cylinders.

(iii) Valve operation and valve types.

(iv) Cylinder information on data plate or stamped into cylinder shoulder.

(v) Use of guards, caps on valves where fitted.

(vi) Checks on cylinder condition.

(vii) The importance and operation of relief devices.

5.4 Handling of cylinders

(i) Cylinder weights full and empty.

(ii) Safe handling techniques for individual cylinders.

(iii) Safe movement of cylinders into or out of pallets.

(iv) Safe movement of palletised cylinders.

(v) Use of trolleys or other handling devices.

(vi) Use of mechanical handling devices e.g. Fork Lift Truck.

(vii) Operation and maintenance of securing devices for cylinders.

(vii) Personal protective equipment as identified by the risk assessment.

5.5 Stock management

(i) Examination of cylinder storage conditions.

(ii) Separation of different categories of cylinders e.g. full and empty cylinders.

(iii) Stock rotation of cylinders.

(iv) Reporting of cylinder defects to line management/supplier.

5.6 Storage compound

(i) Need for removal of debris and good housekeeping.

(ii) Need for security.

(iii) Identification by the appropriate signage.

5.7 Emergency situations

(i) Action to be taken in cases of:

- Leaking cylinder valve.
- Fire.
- Fire impact on cylinders in storage.

(ii) Emergency contact details for supplier.

(iii) Location of emergency equipment.

(iv) Links to emergency services.

6. EMERGENCY PROCEDURES

Cylinders handled and stored in a safe manner, as described in this document, should not give rise to an emergency situation. It is recognised, however, that they may occasionally become involved in an incident. This section is included to provide guidance on what action should be considered on such occasions.

Risk assessments should identify potential emergency situations. Control measures and emergency plans should be established through liaison with the Fire and Rescue Service.

The following items should be considered in the preparation of documented emergency procedures.

6.1 Incident controller

The need for and appointment of a trained person with adequate local site knowledge to take charge of the emergency and assist the emergency services as necessary.

6.2 Action in the event of a serious leakage

(i) Identify the source of the leak.

(ii) Identify the gas concerned.

(iii) Undertake actions as based on the properties of the gas concerned.

(iv) Consult gas supplier for advice.

Only people who have knowledge of gas properties and hazards and who have been trained to deal with gas emergencies should handle leaking cylinders.

NOTE: Never attempt to dismantle or repair cylinder valves.

6.3 Action in the event of a fire

(i) KEEP AWAY, do not approach or attempt to move the cylinder or open the valve.

(ii) Sound the alarm.

(iii) Evacuate the danger area.

(iv) Call the Fire and Rescue Service.

NOTE: The Fire and Rescue Services have operational procedures in place for dealing with gas cylinders in a fire. The Fire and Rescue Service will inform you when it is safe to handle a cylinder.

Further advice on fire fighting equipment and fire precautions may be obtained from either the enforcing or fire authorities. Additional information is available in the product Safety Data Sheet, also refer to BCGA L 6, Cylinders in fires (36).

6.4 Information required by the emergency services

Inform the fire and rescue service immediately of the location and type of any gas cylinders involved in the fire as well as any others located on the site. Refer to Section 4.6.

It is good practice where larger quantities of cylinder gases are stored to invite the Fire and Rescue Service to site so they are familiar with the location in the event of a fire.

6.5 Gas supplier

Contact the gas supplier for further information regarding the gases involved. The gas supplier should **ALWAYS** be notified of any cylinder involved in a fire. Further information, including contact numbers, is available in BCGA L 6 (36).

7. REFERENCES *

	Document Number	Title
1	SI 1990 No. 304	The Dangerous Substances (Notification and Marking of Sites) Regulations 1990.
2	SI 1995 No. 3163	Reportable Injuries, Diseases and Dangerous Occurrences Regulations 1995. (RIDDOR).
3	SI 1996 No. 341	The Health and Safety (Safety Signs and Signals) Regulations 1996.
4	SI 1997 No. 1713	Confined Spaces Regulations 1997.
5	SI 1999 No. 3242	The Management of Health and Safety at Work Regulations 1999.
6	SI 2002 No. 2776	Dangerous Substances and Explosives Atmospheres Regulations 2002 - (DSEAR).
7	SI 2005 No. 1541	The Regulatory Reform (Fire Safety) Order 2005

	Document Number	Title
8	SI 2009 No. 716	The Chemicals (Hazard Information and Packaging for Supply) Regulations 2009. (CHIP 4). CHIP 4 brings national legislation into line with the transitional arrangements set out in European Regulation (EC) No 1272/2008 on Classification, Labelling and Packaging of Substances and Mixtures – known as the CLP Regulation.
9	SI 2009 No. 1348	The Carriage of Dangerous Goods and use of Transportable Pressure Equipment Regulations 2009 (as amended).
10	Health and Safety Executive – L134	Dangerous Substances and Explosives Atmospheres Regulations 2002. Approved Code of Practice and Guidance. Design of plant, equipment and workplaces.
11	Health and Safety Executive – L135	Dangerous Substances and Explosives Atmospheres Regulations 2002. Approved Code of Practice and Guidance. Storage of Dangerous Substances.
12	Health and Safety Executive – L136	Dangerous Substances and Explosives Atmospheres Regulations 2002. Approved Code of Practice and Guidance. Control and Mitigation Measures.
13	Health and Safety Executive – L137	Dangerous Substances and Explosives Atmospheres Regulations 2002. Approved Code of Practice and Guidance. Safe maintenance, repair and cleaning procedures.
14	Health and Safety Executive – L138	Dangerous Substances and Explosives Atmospheres Regulations 2002. Approved Code of Practice and Guidance.
15	Health and Safety Executive - HS(G) 71	Chemical warehousing. The storage of packaged dangerous substances.
16	Health and Safety Executive – INDG 370	Fire & Explosion. How safe is your workplace?
17	ISO 32	Gas cylinders for medical use - Marking for identification of content.

	Document Number	Title
18	BS 349 (Withdrawn)	Specification for identification of the contents of industrial gas containers.
19	BS 476 - Parts 20 to 23	Fire tests on building materials and structures.
20	BS 5306 - Part 3	Fire extinguishing installations and equipment on premises. Commissioning and maintenance of portable fire extinguishers. Code of practice.
21	BS EN 1089 - Part 3	Transportable gas cylinders. Gas cylinders Identification (excluding LPG). Colour coding.
22	BS EN 14470 – Part 2	Fire safety storage cabinets. Safety cabinets for pressurised gas cylinders.
23	BS EN 60079 - Part 14	Explosive atmospheres. Electrical installations, design, selection and erection.
24	BS ISO 7010	Graphical symbols. Safety colours and safety signs. Registered safety signs.
25	BCGA Code of Practice 4	Industrial gas cylinder manifolds and gas distribution pipework (excluding acetylene).
26	BCGA Code of Practice 18	The safe storage, handling and use of special gases in the micro-electronics and other industries.
27	BCGA Code of Practice 33	The bulk storage of gaseous hydrogen at users' premises.
28	BCGA Code of Practice 36	Cryogenic liquid storage at users' premises.
29	BCGA Guidance Note 3	Safe cylinder handling and the application of the manual handling operations regulations to gas cylinders.
30	BCGA Guidance Note 9	The application of the confined spaces regulations to the drinks dispense industry.
31	BCGA Guidance Note 11	Reduced oxygen atmospheres. The management of risks associated with reduced oxygen atmospheres resulting from the use of gases in the workplace.
32	BCGA Guidance Note 13	DSEAR Risk Assessment.
33	BCGA Technical Information Sheet 6	Cylinder identification colour coding and labelling requirements.

	Document Number	Title
34	BCGA Technical Information Sheet 16	Customer information leaflet for storage of cylinders containing corrosive gas.
35	BCGA Technical Information Sheet 17	Model risk assessment for manual handling activities in the industrial gas industry.
36	BCGA Leaflet 6	Cylinders in fires.
37	BCGA Leaflet 7	The dangers of industrial gas abuse.
38	UKLPG Code of Practice 7	Storage of full and empty LPG cylinders and cartridges.
39	UKLPG Code of Practice 24	Use of LPG cylinders. Part 1: Use of LPG cylinders at residential and similar premises. Part 5: The storage and use of LPG on construction sites.
40	Department of Health. Health Technical Memorandum 02-01 Part B	Medical gas pipeline systems. Part B: Operational management.

Further information can be obtained from:

Health and Safety Executive	www.hse.gov.uk
HSE Books	www.hsebooks.co.uk
UK Legislation	www.legislation.gov.uk
International Organization for Standardization (ISO)	www.iso.org
British Standards Institute (BSI)	www.bsigroup.co.uk
European Industrial Gases Association (EIGA)	www.eiga.eu
British Compressed Gases Association (BCGA)	www.bcga.co.uk
The UK LPG trade association (UKLPG)	www.uklpg.org

BCGA POSITION REGARDING THE USE OF GAS CYLINDER STORAGE CABINETS

A European standard, BS EN 14470, Part 2 (22), exists for gas cylinder storage cabinets, though BCGA was not involved in the creation of that standard.

BCGA advice generally is to recommend external (outdoor) storage of gas cylinders in well secured compounds or cages and piping into buildings where needed. But we acknowledge that internal storage is sometimes necessary where the above is not suitable / practicable or does not suit the gas product or process (see below). In that case our recommendation is a well signed dedicated store room.

The Fire & Rescue Service view is unambiguous. They do not like to encounter gas cylinders in cabinets at all, regardless of the nature of hazard of the gas, or its potential contribution to fire load (all gas cylinders, even those containing inert gases will ultimately rupture if exposed to fire). If the contents are a fuel gas or oxygen then the fire load will be significantly increased.

Firefighters want to be able to see and apply cooling water to cylinders from a distance in a fire, but they also want cylinders secured against theft, so external storage in locked cages is very much their preference.

Whether a cabinet has 30 or 90 minutes fire resistance makes little difference to Firefighters, since they won't likely know where they are on that timescale in a real fire scenario. But even with the higher fire rating it is questionable whether such cabinets would keep cylinders below the 60 °C temperature norm, which guides the maximum developed pressure most cylinders are designed for.

HOWEVER, we also recognise that in some specialised gas uses, storage in suitable extraction cabinets may have merit:

a) Where there is a personal safety or process quality consideration, e.g. toxic or ultra high purity gases are needed, for example in the electronics industry.

b) Where gases / mixtures require to be temperature controlled for process reasons.

In such cases cabinets should only be used for cylinders which are connected and in current use and not for storage of full inventory or ‘empty’ cylinders awaiting return, both of which should be held in secure external storage.

Where cylinders are held in cabinets, prominent and fire resistant signage should be visible on the outside of storage cabinets and on the buildings/rooms which house them and consideration should be given to notifying the local fire service of the existence and whereabouts of gas cylinders in buildings.

The placing of cylinders into cabinets and their removal also presents manual handling risks, for which suitable training should be given. BCGA GN 3 (29) refers.

British Compressed Gases Association
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