



BRITISH COMPRESSED GASES ASSOCIATION

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CODE OF PRACTICE 44

The storage of gas cylinders

Revision 1: 2022

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PREFACE

The British Compressed Gases Association (BCGA) was established in 1971, formed out of the British Acetylene Association, which existed since 1901. 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 promote safe practice and to prioritise environmental protection in the supply, use, storage, transportation and handling of industrial, food and medical 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 Code of Practice 44, *The storage of gas cylinders*, 2016. It was approved for publication at BCGA Technical Committee 166. This document was first published on 17/06/2022. For comments on this document contact the Association via the website www.bcgga.co.uk.

JOIN US: BECOME A BCGA MEMBER

The *British Compressed Gases Association* (**BCGA**) is the leading UK Trade Association representing the interests the industrial, food and medical gases industries, whose members include manufacturers and suppliers of bulk liquid and cylinder gases, cylinders, vessels, tanks, pipework, systems, related equipment and providers of specialist safety, health, quality, inspection and training services.

There are currently three categories of BCGA Membership designed to reflect the needs of the gases industry. These are:

Full Membership

For companies or individuals who have any practical involvement in the manufacture, mixing, handling, sales, distribution, storage or transportation of industrial, food and medical related gases or equipment.

Associate Membership

For companies or individuals who have no practical involvement (as noted in Full Membership), and is therefore for designers, consultants, training providers, academics, interested individuals involved with the industry, other associations or simply those that regularly use gases in their work environment.

Start-up Scheme

The Start-Up Scheme is designed to support young companies, who are in the early years of their business, working in the gases industry.

As a member you'll have access to a wide variety of benefits and services to help you develop your company including:

- Certificate of Membership;
- Information about all the latest news and updates in our industry;
- The opportunity to influence oncoming regulation and guidance produced by Government;
- The opportunity to be involved in developing standards (BS EN ISO) for our industry;
- The opportunity to shape the future direction of our industry;
- Technical advice;
- Interaction with other members;
- The right to attend any of our Technical Sub-Committees;
- Access to all BCGA publications;
- The opportunity to be involved in writing BCGA publications;
- Being able to attend the BCGA Conference at Member rates;
- Appropriate listings on the BCGA website;
- Use of BCGA logo.

Becoming a BCGA member couldn't be easier. Simply download and fill in the membership application and turnover declaration forms on our website, under '**Membership**'.

If you have any questions email: admin@bcga.co.uk

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* Throughout this publication the numbers in ^[1] brackets refer to references in Section 12. Documents referenced are the edition current at the time of publication, unless otherwise stated.

TERMINOLOGY AND DEFINITIONS

Bundle (of cylinders)	<p>An assembly of cylinders that are fastened together and which are interconnected by a manifold and carried as a unit. The total water capacity shall not exceed 3000 litres except that bundles intended for the carriage of toxic gases of Class 2 shall be limited to 1000 litres water capacity.</p> <p>Also known as a Manifolded Cylinder Pallet (MCP) or pack.</p> <p>A bundle is designed for movement by a fork lift truck.</p>
Gas cylinder	<p>A transportable pressure receptacle of a water capacity not exceeding 150 litres.</p>
May	<p>Indicates an option available to the user of this Code of Practice</p>
Site	<p>The premises of the organisation.</p>
Store	<p>A specific area or part of a site dedicated to the storage of gas cylinders in line with the requirements of this document.</p>
Shall	<p>Indicates a mandatory requirement for compliance with this Code of Practice and may also indicate a mandatory requirement within UK law.</p>
Should	<p>Indicates a preferred requirement but is not mandatory for compliance with this Code of Practice.</p>
Supply pipework	<p>Where cylinders are connected and in use (as a gas source), the supply pipework connects the cylinder to the gas supply and distribution system.</p>

CODE OF PRACTICE 44

THE STORAGE OF GAS CYLINDERS

1. INTRODUCTION

This Code of Practice provides advice and guidance for the safe storage of gas cylinders. It gives guidance on the construction and management of gas cylinder stores and provides information on the hazards likely to be encountered.

It shall be used when siting and constructing storage facilities or when reviewing the safety and suitability of existing storage facilities. It does not preclude the use of alternative designs, materials and methods, when they provide equivalent standards of safety.

Where gas cylinders are stored in conjunction with other packaged dangerous substances additional guidance should be sought, for example, in *Health and Safety Executive (HSE) HSG 71* ^[21], *Chemical warehousing. The storage of packaged dangerous substances*.

Cylinders containing gases are classed as hazardous substances and consequently gas cylinder stores will require relevant land use permission and may require planning permission and other consents from local authorities. Refer to Section 5.

All parties should ensure they have adequate insurance to cover their activities. All parties shall ensure that they use their gases and look after their gas cylinders and associated equipment in a safe and responsible way.

This code of practice is intended for use in conjunction with current guidance and information produced by the HSE and other related bodies and trade associations.

2. SCOPE

This document defines the principles of safe practice for the storage of gas cylinders and gas cylinder bundles and outlines the relevant legal requirements in the UK.

Throughout this document any reference to a cylinder applies equally to the storage of bundles (of cylinders).

Gas cylinders shall be stored, used and handled as if they are full of gas, refer to Section 4.

This Code of Practice is applicable to:

- the storage of cylinders whilst not in use;
- cylinders connected (through the supply pipework) and in use as the gas source for a gas supply and distribution system. For example, refer to BCGA Code of Practice (CP) 4 ^[33], *Gas supply and distribution systems (excluding acetylene)*.

NOTE: Where a cylinder(s) is connected and in-use there is often a need for a spare cylinder(s) to be ready on stand-by. Both the in-use and the spare cylinder(s) should meet the same principles of storage as detailed in this Code of Practice.

- the storage of a mobile gas supply system, for example, an oxy-fuel gas welding set mounted on a trolley, whilst not in use. Each mobile gas supply system shall be stored in a dedicated space, ensuring each gas cylinder has the valve in the closed position.

Additional requirements for the storage of speciality gases, for example, toxic or pyrophoric gases, are detailed in BCGA CP 18 ^[34], *The safe storage, handling and use of special gases*.

This Code shall be followed when storing gas cylinders and their associated gases regardless of their hazard categories which are located within a common store(s). Where only liquefied petroleum gas (LPG) cylinders are stored in a dedicated LPG store refer to Liquid Gas UK, CP 7 ^[59], *Storage of full and empty LPG cylinders and cartridges*. Where a mixture of LPG (>400 kg) and other gas cylinders are stored then the applicable sections of Liquid Gas UK, CP 7 ^[59], and this Code of Practice should be applied.

Exclusions from the scope of this Code of Practice are:

- (i) cylinders being processed for filling or for periodic inspection and test, at a suitably secured, dedicated filling centre or an inspection and test centre;
- (ii) medical cylinders in domiciliary use, refer to BCGA Guidance Note (GN) 29 ^[47], *Medical gases. The management of medical oxygen in domiciliary use*;
- (iii) gas cylinders during carriage, when they are regulated by the appropriate transport legislation, including the various modal transport Regulations;
- (iv) the storage and connection for use of tubes and tube trailers, for example, battery-vehicles and multi-element gas containers (MEGC), refer to BCGA CP 29 ^[37], *Battery-vehicles and multiple-element gas containers. Design and operation*, and BCGA 33 ^[38], *The bulk storage of compressed flammable gases at users' premises*;
- (v) a bulk fixed gas supply and distribution system which includes the permanent connection of cylinders which remain connected on site and are not disconnected and removed for the purpose of filling. An example is a bulk gaseous hydrogen installation, refer to BCGA CP 33 ^[38];
- (vi) transportable vacuum insulated containers, refer to BCGA CP 27 ^[36], *Transportable vacuum insulated containers of not more than 1000 litres volume*;
- (vii) cryogenic storage tanks. Refer to BCGA CP 26 ^[35], *Bulk liquid carbon dioxide storage at users' premises*, BCGA CP 36 ^[39], *Cryogenic liquid storage at users' premises*, and BCGA CP 46 ^[41], *Bulk storage of cryogenic flammable gases*;
- (viii) cylinders present off-shore, including working platforms and maritime assets.

3. GAS CYLINDER IDENTIFICATION

The cylinder label shall always be used as the primary means of identifying the contents of gas cylinders. The label will identify the product name and the class of hazard (diamond hazard label(s)). Some gas cylinders may have this information stencilled on the body of the cylinder.

Colour coding is a secondary method of identifying certain gases or the properties of others. Colour coding is typically applied to the shoulder, or curved part, at the top of the cylinder.

However, colour coding is not mandatory for most gases and not every gas supplier uses the same colour conventions.

BCGA Technical Information Sheet (TIS) 6 ^[50], *Gas cylinder identification. Label and colour code requirements*, provides comprehensive information on UK practices for cylinder labelling and colour coding.

Where the contents of a gas cylinder cannot be positively identified, the gas cylinder shall be quarantined (within a gas store) and the cylinder owner contacted for further advice. Refer to Section 10 for information on the return and disposal of cylinders.

4. POTENTIAL HAZARDS

Gas cylinders and their contents present a number of hazards:

- size, shape and weight, refer to Section 4.1;
- pressure hazards, refer to Section 4.2;
- product hazards, refer to Section 4.3.

Gas cylinders shall be stored and handled as if they are full of gas. Always treat gas cylinders as having hazardous properties from both the pressure and the content.

NOTE: Even a nominally empty cylinder will still contain residue gases and some pressure, therefore retaining its hazardous properties. Some cylinders are fitted with residual pressure devices which are designed to maintain some gas under pressure inside the cylinder (this prevents the ingress of contaminants into the cylinder).

Gas cylinders are capable of withstanding normal UK weather conditions, including temperatures between -20 °C to +55 °C. As such, they may not require protection from the weather when in storage.

4.1 Size, shape and weight

Gas cylinders are available in a variety of sizes, shapes and weights. Some are heavy and may weigh over 100 kg when full. Some are relatively unstable due to the base diameter to height ratio. Cylinders, which are tall and thin, are more susceptible to falling over. Most cylinders have flat bases, these should be stored in a vertical position, some cylinders have convex (round bottom) bases and these require their own storage arrangements (refer to Section 6.2). All cylinders require appropriate safety devices to hold them in a secure position (to minimise movement and to prevent them from falling over).

Gas cylinders can be awkward objects to move safely.

4.2 Pressure hazards

Cylinders contain gases stored under pressure and have significant stored energy.

Any pressure above atmospheric released from a cylinder has the potential to cause injury to personnel, or damage to plant or property.

A dangerous pressure release could occur, for example, by:

- inadvertent operation of the outlet valve;
- incorrect operation of the outlet valve, including tampering;
- a cylinder toppling or falling;
- application of heat (such as a cylinder impacted by a fire);
- mechanical impact;
- a leaking valve;
- operation of pressure relief devices (where fitted, certain cylinder types only);
- unauthorised modification of the cylinder assembly;
- failure of the cylinder wall (such as a consequence of excessive internal and / or external corrosion, through the reduction of wall thickness).

4.3 Product hazards

Different gases may have different properties and each may have its own associated hazards.

The majority of gases, if released in an uncontrolled manner, may be harmful to life and the environment. This is of particular concern if there is a gas release in a poorly ventilated or an enclosed space. Refer to Section 4.2 for potential hazardous release events.

Gas containers require marking and labelling to identify their individual hazards. There are two principle Regulations:

- for transportation, the *Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations* ^[12] sets the legal framework for the transport of dangerous goods in Great Britain (GB) for work purposes, implementing the *Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR)* ^[17], which details the standards for the packaging and labelling of the dangerous goods. Under ADR ^[17] gases are classified as Class 2 dangerous goods.
- substances and mixtures placed on the GB market shall be classified and labelled in line with the *GB Classification, Labelling and Packaging of Substances and Mixtures (CLP) Regulation* ^[16].

NOTE: From 1 January 2021, the classification, labelling and packaging of chemicals placed on the market in Great Britain (England, Scotland and Wales) is regulated by the 'Retained CLP Regulation (EU) No. 1272/2008 as amended for Great Britain', and is known as GB CLP Regulation.

The classification of each gas is shown on the cylinder contents label, refer to Section 3.















Category	Hazard pictograms		Signal word	Hazard statement Precautionary statement for storage	Notes
	Transport	GB CLP			
Class 2 Division 2.1 Flammable <i>Example:</i> <i>Hydrogen (UN 1049)</i>		 	Danger	Extremely flammable gas. Contains gas under pressure; may explode if heated. Store in a well-ventilated place.	Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Leaking gas fire: Do not extinguish, unless leak can be stopped safely. In case of leakage, eliminate all ignition sources.
Class 2 Division 2.2 Non-flammable Non-toxic Oxidizing <i>Example:</i> <i>Oxygen (UN 1072)</i>	 	 	Danger	May cause or intensify fire; oxidizer. Contains gas under pressure; may explode if heated. Store in a well-ventilated place.	Keep away from clothing and other combustible materials. Keep valves and fittings free from oil and grease. In case of fire: Stop leak if safe to do so.
Class 2 Division 2.2 Non-flammable Non-toxic Asphyxiant <i>Example:</i> <i>Nitrogen (UN 1066)</i>			Warning	Asphyxiant in high concentrations. Contains gas under pressure; may explode if heated. Store in a well-ventilated place.	
Class 2 Division 2.3 Toxic Corrosive <i>Example:</i> <i>Sulphur dioxide (UN 1079)</i>	 	  	Danger	Contains gas under pressure; may explode if heated. Causes severe skin burns and eye damage. Toxic if inhaled. Causes serious eye damage Corrosive to the respiratory tract. Store in a well-ventilated place. Store locked up.	Wear protective gloves, protective clothing, eye protection, face protection. Do not breathe gas, vapours. IF INHALED: Remove person to fresh air and keep comfortable for breathing. Liquid - IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water or shower. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get immediate medical advice.

Table 1: Examples of gases classification.

Examples of some common gases and their classifications is shown in Table 1. Detailed information is available in ADR ^[17] and the *European Industrial Gases Association (EIGA) 169* ^[31], *Classification and labelling guide*.

Full information will be shown in the individual product Safety Data Sheet. Before a gas cylinder is placed into storage or is used any additional marking and labelling requirements required by the GB CLP Regulation ^[16] shall be assessed during the risk assessment process.

5. OUTDOOR CYLINDER STORE – CONSTRUCTION AND GENERAL PRINCIPLES

All gas cylinder stores should follow these basic principles:

- be well ventilated;
- be outdoors (if a store is in any location other than outdoors, then additional controls are required);
- have adequate security (to manage access to the store);
- meet the required separation distances.

When deciding on the location, design and subsequent construction of an outdoor gas cylinder store, a site specific risk assessment shall be carried out, refer to Section 5.1, and each store shall comply with the relevant legal and permit requirements, refer to Section 5.2. During the risk assessment all the following points shall be taken into account:

- the location of the outdoor store, refer to Section 5.3;
- separation distances, refer to Section 5.4;
- ventilation and store side requirements, refer to Section 5.5;
- the design and construction of the floor, refer to Section 5.6;
- the design and construction of a roof (if required), refer to Section 5.7;
- the store layout, including provision to secure cylinders (to prevent toppling), refer to Section 5.8;
- access requirements, refer to Section 5.9;
- lighting requirements, refer to Section 5.10;
- electrical equipment requirements, refer to Section 5.11;
- fire safety requirements, refer to Section 5.12;
- safety sign and warning notice requirements, refer to Section 5.13;
- storage in a cage, refer to Section 5.14;

- general security, refer to Section 11.

Some schematics showing examples of store designs are displayed in Appendix 2.

5.1 Risk assessments

Gas cylinders and their contents have a number of hazards, refer to Section 4, as such, they require arrangements to control health and safety risks, refer to *The Management of Health and Safety at Work Regulations* ^[7] and *The Dangerous Substances and Explosive Atmospheres Regulations* (DSEAR) ^[10]. A site specific risk assessment shall be carried out to identify a suitable location for each gas cylinder store, taking into account any local health, safety and environment requirements. Every storage situation shall be assessed on its merits and special circumstances may necessitate variations on the recommended requirements.

Where there is a requirement to store medical gases, additional requirements may be necessary, refer to Section 6.3.

Guidance on the preparation of Risk Assessments under DSEAR ^[10] is contained in BCGA GN 13 ^[44], *DSEAR Risk Assessment guidance for compressed gases*.

To ensure local security requirements are managed a security vulnerability risk assessment shall be carried out, with the appropriate security controls implemented, refer to Section 11.

Each location should be subject to an environmental risk assessment. This should take into account the effects of gas leakage as well as risks from potential extreme weather conditions, for example, flooding.

NOTE: Incidents have occurred where stored containers have floated away on flooded water courses!

Where the risk assessment determines the hazard classification and properties of the gases within the store can have an immediate impact in the event of a leak, for example, toxic gases, then additional control measures (such as the use of atmospheric monitoring equipment, personal protective equipment, etc.) may need to be implemented. Further advice is available in BCGA CP 18 ^[34] and BCGA GN 11 ^[43].

Gas cylinder storage areas should be segregated from other stores. The risk assessment shall take due regard of the potential hazards of the gases being stored and the risk from other hazardous processes or storage sites that may impact on a cylinder store, including those on neighbouring sites. For information on separation distances refer to Section 5.4.

As a minimum, the risk assessment shall take into account:

- the hazard classification and properties of each of the gases;
- leak paths, from valves or safety relief devices;
- ventilation requirements, including ventilation intakes and exhausts;
- other activities / processes taking place in the area;
- other hazardous goods stored or used in the area;

- vehicle movements (including the potential for impact);
- underground and over-ground services;
- the impact to and from building services, for example, ventilation, heating, etc.

The risk assessment shall be reviewed from time to time, following construction and commissioning of the store. The review shall ensure that existing and emerging risks are managed, for example, due to inventory changes, changes to the site or surroundings, shortfalls in management controls, updates to codes and best practice documents, etc.

The HSE provide a wide range of guidance on carrying out risk assessments on their website - www.hse.gov.uk/risk.

Guidance that can be used in the assessment of risk associated with gases in enclosed workplaces is provided in BCGA GN 11 ^[43], *The management of risk when using gases in enclosed workplaces*.

5.2 Legal and permit requirements

Operators should ensure that their proposed operation takes into account:

- any tenancy and land-use constraints;
- landlord permissions;
- hazardous substances consent and planning constraints;
- insurance requirements.

The *Planning (Hazardous Substances) Regulations* ^[15] requires that hazardous substance consent is obtained from the local authority to store quantities of hazardous substances at or above defined thresholds. The regulations contain thresholds for both named substances, such as oxygen and hydrogen, and for generic categories of substances (flammable, toxic). For example, the threshold for oxygen storage is 200 tonnes, for flammables 50 tonnes, but for hydrogen only 2 tonnes. In some cases, the percentage / partial fraction of thresholds (for example, flammables and oxidants) are additive when determining if consent is required.

It is unlikely that small quantities of cylinder gas storage will trigger these thresholds and there is a 'de minimus' rule for small quantities (<2 % of the threshold). However, as the thresholds include all dangerous substances held on the site, for example product, raw material or water treatment chemicals in bulk tanks, and as thresholds for toxic gases are lower, it is recommended that an evaluation is carried out to determine if the site needs consent. For sites that currently have consent the addition of cylinder gases storage may require modification of the existing consent.

NOTE: Planning guidance can be found at:
<http://planningguidance.planningportal.gov.uk/blog/guidance/hazardous-substances/when-is-consent-needed-for-the-storage-or-use-of-hazardous-substances/>

Planning permission may be required for significant cylinder storage facilities under the *Town and Country Planning Act* ^[1]. Contact the relevant local authority for advice.

The *Dangerous Substances (Notification and Marking of Sites) Regulations* ^[3] requires notification to the authorities where a total quantity of dangerous substances of 25 tonnes or more is stored. Specific exemptions may apply.

The *Control of Major Accident Hazards Regulations (COMAH)* ^[14] requires notification to the COMAH Competent Authority where a quantity of dangerous substances is stored above certain thresholds.

The storage, the location of the store and the use of gas cylinders may affect your insurance requirements for the site. Ensure you have adequate cover for your needs.

5.3 Selection of the cylinder storage area

The cylinder storage area shall have adequate ventilation (refer to Section 5.5) and should be located outdoors.

A store is considered to be outdoors if the following conditions are met:

- a minimum of 30 % of the perimeter is open (naturally ventilated), with no roof installed;
- a minimum of 50 % of the perimeter is open (naturally ventilated), with a roof installed.

Where these conditions are not achieved the store is not outdoors. A specific risk assessment shall be conducted to identify the necessary controls to achieve safe conditions for a store which is not outdoors. Advice is available in Appendix 1.

NOTE: Gas cylinders are designed so that they can be stored outdoors and, as such, they will not be adversely affected by inclement weather conditions in the UK.

The storage location shall take account of separation distances, refer to Section 5.4.

The storage location should be in an area which can be managed to provide an appropriate level of security, refer to Section 11.

Unless thoroughly risk assessed, storage locations shall always be sited at ground level. Where it is not possible for a store to be located at ground level, the risk assessment shall additionally take into account:

- delivery arrangements, including a suitable location for delivery vehicle access and the loading and unloading of cylinders;
- access requirements (to the store) for personnel and general day-to-day cylinder movements;
- requirements for safe cylinder movements between levels;
- requirements for incident management, for example, proximity to people, gas leakage, fire, access for emergency services, etc.

The storage location shall be chosen so that it is not directly beneath overhead power or other electrical cables.

The store shall not be located above underground services. If there is a leak of a dense gas, for example, LPG, it may enter an underground system, which will then act as a conduit, transporting the gas to other locations. If water drainage is required, refer to Section 5.6.

The storage location shall be chosen so that there is appropriate access to the site for delivery vehicles (including for loading operations) and the emergency services, refer to Section 5.9.

The storage location shall be located away from site designated emergency exits, escape routes and muster points.

5.4 Separation distances

For separation distances refer to BCGA GN 41 ^[49], *Separation distances in the gases industry*.

5.5 Ventilation and store sides

In all cases, in all storage areas, there shall be adequate, through and thorough ventilation. Ventilation is required to ensure that any small leakage of gas is adequately dispersed. Adequate ventilation will prevent or minimise the likelihood of a hazardous atmosphere being created.

An outdoor store with open sides and without a roof is generally considered to provide adequate ventilation. This is the preferred option.

NOTE: To be 'open', a side shall present no significant obstruction to natural airflow.

Adjacent buildings, structures and geographical features (including natural features and site topography) may adversely affect natural airflow.

Specific factors to consider include:

- the effect of barriers to natural airflow, for example, walls, a roof, etc.;
- the requirements for additional high and low level openings, for example, within solid walls.

The effect of inclusion of openings on hazardous areas and separation distances, refer to Section 5.4, shall be taken into account.

Sides shall be installed where there is a requirement, for example, to provide security and restrict access. Security requirements are detailed in Section 11.

Where required, sides shall be permanently attached to the floor (refer to Section 5.6) and, as appropriate, any adjoining walls.

The sides may be constructed of a mixture of solid materials (sheets of metal, bricks, concrete, etc.), industrial metal fencing, bars or mesh.

Where a mesh is used the recommended size is a maximum 50 mm x 50 mm aperture, minimum thickness 3 mm (\approx 10 swg), welded mesh. This should be small enough to prevent any tampering, for example, being able to operate a valve. Advice is available in BCGA TIS 48 ^[55], *Gas equipment. Security cages*.

The use of fire storage cabinets is not recommended, for example, as referenced in BS EN 14470 ^[26], Part 2, *Fire safety storage cabinets. Safety cabinets for pressurised gas cylinders*. These cabinets do not meet the ventilation and fire safety requirements of this Code of Practice.

The materials used in the construction of sides shall be suitable, for example, fire resistant, non-flammable, providing security from malicious attack, etc. They shall be of sufficient strength to support any mechanical loads, for example, supporting segregation by partitions, supporting roofs, mountings for the lashing of cylinders, etc.

For fire safety requirements, refer to Section 5.12.

The sides shall have suitable arrangements for access, refer to Section 5.9.

Where a security cage is to be installed, refer to Section 5.14.

5.6 Floor

The floor should be constructed of concrete or other rigid, permanent, non-combustible, non-porous material. The floor should not be constructed of bricks, slabs, flags, asphalt, tarmacadam, etc. The operator shall ensure the floor is free of loose gravel, damaged concrete, aggregates, etc. A smooth concrete finish is preferred; it is likely to have a long life, is practical for manual handling operations and is easy to maintain and clean.

Items such as expansion joints, steps and drainage systems, shall not present hazards, for example, shall not impede cylinder handling operations.

The floor shall be of sufficient strength to support the weight of any structural loads (for example, from walls, gates, cage, etc.), (all) the gas cylinders' / gas cylinder pallets, plus any loads associated with mechanical handling aids (including fork lift trucks) which may operate on the floor.

The floor shall be of sufficient depth and strength to provide adequate security. This may include protection from deliberate damage and penetration by thieves. The floor shall be of sufficient depth for cage ground-anchors, the insertion and securing of ground security bolts and other relevant items, such as security panels.

The floor should be generally level, but laid at a slight gradient to prevent the accumulation of water (but which will not affect the stability of a cylinder). In this way, cylinders (especially steel) shall not remain in standing water, with the attendant risk of corrosion.

Water drainage. Water drainage systems should not be installed under the store floor. If underground drainage systems are required, take into account the properties of the gases being stored. Underground drainage systems shall be designed to prevent dense gases or cryogenic or liquefied gases entering, for example, by the use of a water trap.

5.7 Roof

Cylinders are designed for outdoor storage, however some applications require protected storage conditions for quality, hygiene and security reasons, for example, the storage of analytical and medical gases. Cylinders may also need additional protection from local environmental conditions.

The effect of installing a roof will affect the natural airflow. If a roof is installed, the roofing shall be designed to prevent gas pockets accumulating (for example, by trapping lighter than air gases) and to allow natural airflow, for example, gaps between the wall and sloping roof, ventilation in a pitched roof apex, etc.

The materials used in the construction shall be suitable, for example, fire resistant, non-flammable, able to be fastened, etc.

Where increased security is required, incorporate anti-climb features and use suitable roofing materials, for example, barred, mesh or sheet (steel) roof. If weather protection is required, use a non-apertured roof.

5.8 Storage area layout

The physical dimensions of the storage area shall take into account the requirements for managing a store and its contents, refer to Section 6.

When designing the gas cylinder storage facility, provide adequate space for cylinder segregation, quantity and the size of the cylinders. Be aware that cylinder sizes may vary between gas suppliers.

The design of the storage area shall allow safe access and egress, safe manual handling operations, the use of mechanical handling equipment, for example, gas cylinder handling trolleys and, where required, for fork lift trucks and any other powered vehicles. Refer to Section 6 and Section 8.

The layout shall take account of the separation of personnel and vehicles with appropriate traffic routes defined. Refer to HSE L24 ^[18], *Workplace health, safety and welfare. Workplace (Health, Safety and Welfare) Regulations 1992. Approved Code of Practice and guidance.*

Appropriate arrangements shall be provided to enable individual cylinders to be secured so as to prevent them falling over, for example, pallets, tie-downs, chains, straps, lashings, etc. These restraints shall be of a design which will not cause damage to the cylinder or its accessories.

NOTES:

1. Where there are cylinders of differing sizes, separate restraints may be required for individual cylinders.
2. Some cylinders are fitted with a guard to protect the valve. The design of the valve will determine if an additional guard is required. The owner of the cylinder is responsible for the construction of the cylinder and valve package, including the fitting of a valve guard where this is appropriate.

Within the store, aisles should be provided to allow safe access to cylinders, to facilitate good housekeeping, stock control and for the ease of manual handling. Aisles should be a minimum of 1 metre wide.

5.9 Access

Vehicles. There shall be a designated loading area as part of, or adjacent to each store. Where the designated loading area is within the minimum recommended separation distance from the store, refer to Section 5.4, only authorised vehicles shall be permitted to enter. A risk assessment for each relevant activity may be required.

The designated loading area shall provide sufficient space to allow the delivery vehicle to manoeuvre, for the safe movement of people and for the loading and unloading operations to take place, including the use of manual handling equipment, for example, gas cylinder handling trolleys, fork lift trucks, etc. Refer to HSE HSG 136 ^[22], *A guide to workplace transport safety*.

Vehicle accesses to the designated loading area and the storage area(s) shall be kept clear.

Personnel. The store shall be designed to allow ease of access and egress for (authorised) personnel and to facilitate safe cylinder movements. The distances over which manual handling operations take place shall be kept to a minimum.

Access to the installation shall only be allowed for authorised persons. Suitable security arrangements shall be in place, refer to Section 11.

The requirement for an emergency exit(s) shall be determined by risk assessment. The risk assessment (refer to Section 5.1) shall determine the number of exits required.

Where installed, all designated emergency exits shall open easily in the direction of escape. Ensure that they are immediately operable using a single action device that does not require a key, card, or code to open. Emergency exits shall provide an unobstructed means of escape and in operation shall not obstruct any other escape route. The use of the exits shall be described and incorporated in the site emergency plan. All site occupants shall be familiar with the emergency arrangements, and the site operator may supplement this familiarity with appropriate local signage. Where identified by risk assessment, emergency lighting and / or direction indicators may be installed on and around the emergency exits. Ensure that emergency exits are secure and cannot be opened from the outside of the store (whilst still allowing emergency escape from the inside).

For electrical safety, refer to Section 5.11.

5.10 Lighting

The area should have adequate lighting to assist in providing a safe work environment, for example, to allow the identification of the cylinder contents, signage and where necessary to assist with security. Artificial lighting shall give suitable colour rendering to enable colour labelling to be easily recognised by operators.

Where required, emergency lighting shall be to the requirements of BS 5266 ^[24], *Emergency lighting. Code of practice for the emergency escape lighting of premises*.

For electrical safety refer to Section 5.11.

5.11 Electrical equipment

Only electrical equipment that is necessary for the safe and practical operation of the gas cylinder store shall be installed. All electrical installations shall comply with *The*

Electricity at Work Regulations [2]. BS 7671 [25], *Requirements for electrical installations. IET wiring regulations*, details many of the standards to be applied.

Where flammable or oxidising gases are stored the DSEAR [10] risk assessment (refer to Section 5.1) shall determine whether protected electrical equipment is required, if so guidance is available in BCGA GN 13 [44].

5.12 Fire safety requirements

The site fire safety risk assessment shall include each individual gas cylinder storage area. Refer to The *Regulatory Reform (Fire Safety) Order* [11].

For additional information on managing the fire risk associated with gases, refer to BCGA GN 41 [49].

Fire risk assessors shall be aware of:

- gas cylinder quantities and the gas hazard classifications, based on a maximum numbers of cylinders;
- the release of (many different types of) gases, with various hazards, refer to BCGA GN 11 [43];
- the potential for release of toxic and corrosive substances as a consequence of a fire;
- the hazards of mixing substances, for example, a combination from flammable and oxidising gases;
- potential for jet flame from flammable gas cylinders;
- the tendency of some gases to burn with a low visibility flame, for example, hydrogen;
- rupture and the potential for projectiles from cylinders exposed to heat from a fire;
- dissolved acetylene, which is particularly sensitive to heat from a fire. Refer also to BCGA Leaflet 6 [56], *Cylinders in fires*;
- external fire hazards relevant to the gas store, for example, chemicals, hazardous substances, services, etc.;
- the potential of vegetation to become an unacceptable fire risk;
- the need to be able to deluge the cylinders with cooling water in the event of an incident, including giving the Fire & Rescue Service line of sight to, and visibility of, the cylinder(s).

The conclusions of the fire safety risk assessment shall be incorporated into the Site Fire Safety Management Plan, or other emergency plan. The plan shall be in writing, shall be implemented and shall be regularly reviewed and maintained.

Advice may be sought from the *Fire and Rescue Service*. It is good practice, especially where larger quantities of gas cylinders are stored, to invite the local *Fire and Rescue*

Service to site so they are familiar with the location and the inventory in the event of an incident.

The location of each gas cylinder store shall be recorded within a hazardous locations record (a site plan). This record should include information on the products stored, their maximum quantities and their hazardous classification. This should be updated on a regular basis. Each site's emergency plan shall include arrangements for making this (or the relevant aspects of it) available to the emergency services in the event of an incident. Refer to The *Regulatory Reform (Fire Safety) Order*^[11].

Adequate means of providing an alarm in the event of a fire shall be established. Where physical alarms are installed these should be clearly marked and suitably located, including at all emergency exit points. For electrical safety refer to Section 5.11.

Each gas cylinder store area shall be designated a '**NO SMOKING AREA**'. For separation distances, refer to Section 5.4. Suitable safety signs and warning notices shall be displayed, refer to Section 5.13.

Where a cylinder store is attached to one or more building walls, the walls shall be constructed of fire-resistant materials. Fire controls shall be determined by risk assessment. The wall area 2 m either side of the store and 9 m above the store floor should be imperforate and of a minimum of 30 or 60 minutes' fire resisting construction, as determined by the risk assessment. The fire-resistant materials shall comply with the requirements of BS 476^[23], Parts 20 to 23. No doors, windows or other apertures are acceptable within this space. Until the required safety standards are complied with, gas cylinders shall not be introduced into the store.

Cabinets to BS EN 14470^[26], Part 2, *Fire safety storage cabinets. Safety cabinets for pressurised gas cylinders*, do not allow direct access for cooling water in the event of an incident and do not meet the fire safety and ventilation requirements of this Code of Practice.

The risk control measures identified shall be incorporated into the design of the gas cylinder store(s).

5.13 Safety signs and warning notices

Individual gas cylinder stores shall have adequate signage to provide safety information and warnings on the hazardous products being stored.

The filler of the gas cylinder will have determined the classification and therefore the hazardous properties of the gas inside a cylinder. This will be displayed on the cylinder contents label, refer to Section 3. The information on the cylinder contents label will assist when locating a cylinder in a store.

Signage shall comply with:

- The *Health and Safety (Safety Signs and Signals) Regulations*^[5].
- BS ISO 7010^[27], *Graphical symbols. Safety colours and safety signs. Registered safety signs*.
- BCGA CP 40^[40], *Security requirements for the industrial, medical and food gases industry*, from a security perspective.

For additional advice refer to HSE L64 ^[20], *Safety signs and signals. The Health and Safety (Safety Signs and Signals) guidance on regulations.*

All signs shall be in the English language. Bilingual / multilingual signs may also be necessary.

Subject to the security requirements of BCGA CP 40 ^[40], signage shall be clearly visible from all angles of approach, preferably sited with the centre of the sign at the average eye level (between 1.5 m and 1.7 m above the ground).

If, following a DSEAR ^[10] risk assessment, there is scope for a potentially explosive atmosphere to exist, display the explosive atmosphere 'Ex' sign and any necessary zone demarcation signage or marking.

Risk assessment (refer to Section 5.1) may determine a requirement to display the following signs:

- NO SMOKING
- NO NAKED LIGHTS
- NO SOURCES OF IGNITION
- NO ACCESS FOR UNAUTHORISED PERSONS
- NO MOBILE PHONES OR OTHER ELECTRONIC DEVICES
- NO STORAGE OF OIL, GREASE OR COMBUSTIBLE MATERIALS

Appropriate personal protective equipment signage, refer to Section 8.1.

For inert gases:

- ASPHYXIATION HAZARD

For flammable gases:

- FLAMMABLE GAS
- ASPHYXIATION HAZARD

For oxidising gases:

- OXIDISING GAS

For toxic gases:

- TOXIC GAS
- ASPHYXIATION HAZARD

For corrosive gases:

- CORROSIVE GAS

- ASPHYXIATION HAZARD

For cylinders which are under quarantine:

- GAS CYLINDER QUARANTINE AREA

NOTE: This may require additional signage, dependant on the reason a cylinder(s) is in quarantine and the hazard it may present.

In addition, a notice should be displayed showing:

- (i) actions to take in the event of an emergency;
- (ii) the site operator's routine contact details;
- (iii) emergency contact information including an emergency phone number, for example of the gas supplier and / or the site operator;
- (iv) the emergency services phone number.

This information should also be available at a control point, for example the site control room or at the site security office.

Examples of signs are provided in Appendix 3. Information and suggestions on the actions to take in an emergency are detailed in Section 9.

5.13.1 Signage inside a gas cylinder store

Storage locations within the gas cylinder store shall be clearly identified by signage to show the condition and hazard classification of the gas cylinders. Refer to Section 6.2.

Consideration should be given to using the appropriate hazard 'diamond' label(s) for the gases stored.

Examples of signs are provided in Appendix 3.

5.14 Storage in a cage

Often cylinders are stored in a dedicated cage. Such storage shall meet the requirements of this code.

NOTE: There are a range of proprietary cages available which are off-the-shelf.

The security requirements for cages are included in BCGA TIS 48 ^[55].

An example of a cage is shown in Appendix 2.

6. CYLINDER STORE MANAGEMENT

The site organisation shall appoint a competent person, to manage cylinder storage and operations on site.

Access to each store shall be restricted to authorised personnel, refer to Section 11.

Routine management checks shall be carried out on each cylinder store, refer to Section 6.1.

Gas cylinder stores shall be arranged to enable the safe storage and management of the gas cylinders, refer to Section 6.2.

There are specific requirements for medical gases, refer to Section 6.3.

For the delivery and collection of cylinders, refer to Section 6.4.

6.1 Routine management checks

The person appointed to manage each cylinder store shall periodically check that:

- the store has adequate ventilation, there have been no changes which may affect the ventilation, refer to Section 5.5;
- separation distances are maintained, refer to Section 5.4;
- the fire control measures identified in the Site Fire Safety Management Plan have been implemented correctly and maintained, refer to Section 5.12.
- vegetation is being managed, for example, the clearing of long grass, excessive weeds, overhanging branches, etc. Check which chemicals are used for the management of vegetation, for example, sodium chlorate and other oxidising agents (due to the increased flammability hazard) should not be used as a weed killer;
- safety signs and warning notices are in place and legible, refer to Section 5.13;
- physical security arrangements are effective and there are appropriate management controls in place to manage access into the store, with only authorised personnel allowed access to the store, refer to Section 11;
- all cylinders are stored in accordance with Section 6.2;
- all personnel accessing the store(s) have received suitable information, instruction and training and are deemed competent, refer to Section 7;
- if there are changes made to the inventory or range of products being stored, that a competent person reviews and updates the risk assessment for the store, refer to Section 5.1, and personnel receive any additional information, instruction and training that may be necessary, refer to Section 7;
- all personnel handle and move gas cylinders safely, refer to Section 8;
- all emergency procedures are in place, refer to Section 9;
- cylinders are not being subjected to adverse conditions;
- stores are kept clean and are subjected to regular housekeeping, including the prevention of the accumulation of debris;
- the store is not used as a lay-apart store or as a convenient storage area for other items. The only items to be stored in a gas cylinder storage compound

are gas cylinders; their associated fittings, such as cylinder keys, valve caps, etc.; and associated mechanical handling aids, such as gas cylinder trolleys. Combustible stores of any description, for example, oils, greases, paints, fuels; excess packaging; other classes of dangerous goods; salt, corrosive chemicals, weed killer, etc., shall not be stored in the same store as gas cylinders.

WARNING: Contact with oils, grease, hydrocarbons, tarry substances and many plastics carries the risk of spontaneous combustion, particularly with some high pressure gases.

6.2 Gas cylinder storage arrangements

The gas cylinder store shall be arranged to balance the requirements for the grouping of cylinders by their hazard categories, for access and handling.

Cylinders containing gases with the same hazard category shall be grouped together. The location of each hazard category group shall be identified with suitable signage, refer to Section 5.13. The exception to this is a mobile gas supply system, for example, an oxy-fuel set on a trolley, which should be located in its own designated area.

Whether a cylinder is full (including part-used) or empty of a gas shall be identified with suitable signage.

Unserviceable cylinders, or those under quarantine, should be labelled as such and stored in a segregated and designated area which shall be identified with suitable signage. If an unserviceable cylinder presents a hazard which requires action to make it safe for storage, then this should be carried out before being placed into a store. As required, seek advice from the owner or gas supplier. Unserviceable cylinders should be returned to the owner or gas supplier as soon as practicable, refer to Section 10.

Where gas cylinders have been involved in a fire or been impacted by high temperatures, refer to BCGA Leaflet 6 ^[56].

Some gases may require to be kept in a controlled temperature environment.

The store should be arranged such that there is adequate access to the cylinders, taking into account the use of mechanical handling equipment, and that escape routes remain clear and allow unimpeded escape in the event of an incident. Refer to Section 5.9.

Where a gas cylinder is supplied with a valve outlet plug, for example, cylinders containing toxic gases, the plug shall remain fitted whilst the cylinder is in the store. For additional information on toxic gases refer to BCGA CP 18 ^[34].

Where cylinders are supplied with a valve guard or cap, these shall remain in place at all times when the cylinder is in storage. If removed for use, valve guard or caps shall be replaced, for example, once they are disconnected, before handling and when returned to storage.

Tamper evident seals (as fitted by the gas supplier following filling) should remain in place until a cylinder is required for use.

NOTE: Caps and covers help protect the valve and prevent contaminants, such as moisture and dirt, from gathering in the valve port(s).

Certain gas cylinders can contain gases that have a defined shelf life, for example breathing air, medical gases, calibration gases, etc. These cylinders shall only be issued for use when within their shelf life. Once this shelf life has expired, the cylinder should be withdrawn from service and as appropriate, disposed or returned to the gas supplier.

Fluorinated gases, such as refrigerants, are subject to *The Fluorinated Greenhouse Gases Regulations* ^[13]. EIGA 192 ^[32], *Fluorinated gases management*, provides additional information.

There are certain gases with particularly hazardous properties, for example, those that are pyrophoric, toxic or corrosive, advice is available in BCGA CP 18 ^[34]. These shall only be stored in an outdoor store.

Cylinders shall not be left freestanding. Where gas cylinders are not stored in specially designed pallets, racking or trolleys, the cylinders should be stored upright (where the design allows) and shall be secured to prevent toppling, refer to Section 5.8.

For round-bottomed cylinders, special arrangements will be required to secure them. They may be stored horizontally provided they do not rest directly on the floor and they are suitably restrained to prevent movement.

Cylinders containing liquefied gases should be stored in an upright position. This will ensure that in the event of a leak, it will be of vapour or gas, rather than a liquid. Some liquefied gases incorporate a pressure relief device, for example, LPG. Storage in a vertical position will allow the relief device to function correctly by connecting to the vapour space inside the cylinder.

NOTE: There are some cylinders containing liquefied gases that are designed to operate in a horizontal position, for example, LPG cylinders used as a fuel on fork lift trucks. Cylinders designed this way should be stored in a horizontal position.

Cylinders containing a dissolved gas, such as acetylene, should always be stored in a vertical position. This prevents the escape of the liquid (acetone) (from the valve area) in the event of a leak. A lack of acetone can lead to pressure build up and decomposition.

Gas cylinders stored in a vertical position are to be stored no more than one cylinder high unless specifically designed for this purpose, for example, some LPG cylinders.

Whilst in the store the valves on all cylinders (as they are not in use) are to be closed.

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 may be prudent to use those with the shortest life first, 'First-Expired, First-Out' (FEFO).

Excess stock of gas cylinders, empty gas cylinders or gas cylinders that are no longer required are to be returned promptly to the owner (normally the gas supplier).

NOTE: All refillable cylinders are required by law to have a periodic inspection and test to ensure their continued safety. After expiry of the periodic inspection and test, a cylinder can continue to be used until nominally empty (but it cannot be filled or transported on the public highway, unless being returned to the owner).

Gas cylinders are not to be repainted, to have any markings obscured, labels removed or added. If the contents of a gas cylinder cannot be identified the gas cylinder is to be declared unserviceable and the advice of the owner sought. Refer to Section 3 and Section 10.

Stored cylinders shall be periodically checked for general condition and leakage. Written operating procedures should be in place to manage any leaks. Any leaks, damage or faults discovered on a cylinder shall be reported to the owner of the cylinder as soon as possible and action taken to manage any additional hazard(s) created.

Gas cylinders stores provide a safe space for storing cylinders. No other work activity shall be carried out in or around the cylinder store unless permitted following a risk assessment process and controlled by a safety work permit system, for example, refer to EIGA 40 ^[29], *Work permit systems*.

6.3 Management of stores containing medical gas cylinders

Stores for medical gas cylinders shall comply with Section 6.2, but may require additional measures to be taken. Reference should be made to:

- the National Health Service (NHS) Protect document, *Guidance on the security and storage of medical gas cylinders* ^[61];
- HTM 02-01 ^[60], Part B, Section 8, *Medical gas pipeline systems*;
- BCGA GN 32 ^[48], *Medical gases. Good distribution practice*.

All medical gases are highly regulated by 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.

Medical gases can only be stored in the regulated supply chain such as at sites with a *Medicines and Healthcare products Regulatory Agency* (MHRA) wholesale distribution authorisation (WDA) or NHS facilities such as hospitals, medical sites and pharmacies.

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*.

As with all medicines, medical gases have a defined shelf life. Each cylinder will have a label that will show the expiry date as well as the batch number.

The following additional measures shall be taken:

- medical gas cylinders shall be segregated from all other cylinders;

NOTE: Pathology gases are not classified as medical gases.

- 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 Leaflet 7 ^[57], *The dangers of misusing gases*, and the NHS Protect document, *Guidance on the security and storage of medical gas cylinders* ^[61];

- medical gas cylinders shall be stored in accordance with the Marketing Authorisation. This may include:

- storage under a suitable cover;
- kept dry;
- not subjected to extremes of temperature. This will maintain the quality of the product, for example by controlling temperature (for example, for gas mixtures where phase separation occurs on freezing) and / or humidity;
- 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, i.e. they should be maintained in a condition for safe use in a medical environment.

- special storage conditions, where required these should be checked and monitored.

Before a medical gas cylinder is returned back to the store following use, the user of the cylinder is responsible for ensuring that it is in a suitably clean condition and free from contamination (which it may have come into contact with during use), refer to BCGA TIS 37 ^[52], *Medical gases. Gas cylinder cleanliness standards*.

6.4 Delivery and collection of cylinders

All delivery and collection of cylinders shall be managed and conducted by competent persons, with appropriate supervision, to ensure:

- security of the store is maintained, including control of access keys, cards or codes and entry only for authorised persons, refer to Section 11;
- vehicle movements onto the site are controlled. Some sites may require a specific delivery and collection point;
- all delivery vehicles are parked safely in the designated area, for example, with their engines turned off, auxiliary electrical equipment switched off and with the handbrake applied;
- there is clear access to and within the store, refer to Section 5.9;
- the movement of cylinders is conducted safely. Refer to Section 7 and Section 8;
- the inventory account is managed. There are records of receipt into the store and issues from the store;
- each cylinder product is identified and there is adequate information available to manage any hazards, for example, a Safety Data Sheet;
- each cylinder is positioned and secured in its designated area;

- all persons collecting a gas cylinder are authorised to do so and are aware of their duties with regard to the carriage, handling, storage and safe use of the cylinder and its contents.

BCGA Leaflet 17 ^[58], *Information for customers collecting gas cylinders*, provides useful safety information for those collecting gas cylinders.

BCGA GN 27 ^[46], *Guidance for the carriage of gas cylinders on vehicles*, provides advice on the transportation of gas cylinders.

BCGA TIS 41 ^[54], *Cylinders provided for the return of waste ozone depleting substances, fluorinated gases and anhydrous ammonia*, provides specific advice for cylinders used for the recovery of ozone depleting substances, fluorinated gases and anhydrous ammonia.

7. COMPETENCE

All persons shall have the necessary competence (including knowledge, skills and experience) to carry out their job safely. They shall receive appropriate information, instruction, training and supervision. This should include induction and refresher sessions, as required. It is the duty of the Employer to ensure their persons are competent. It is recommended that a training programme with a competency assessment is carried out under a formalised system. Records shall be kept of the information, instruction, training and supervision provided and of the competence level achieved.

General recommendations for the training of personnel are described in EIGA 23 ^[28], *Safety training of employees*. BCGA GN 23 ^[45], *Gas safety. Information, instruction and training*, provides guidance on the minimum knowledge required for the safe interaction of personnel with industrial, food and medical gases.

NOTE: For ozone depleting substances, fluorinated gases and anhydrous ammonia refer to BCGA TIS 41 ^[54].

8. SAFE MOVEMENT

Safe movement is defined as moving in-scope inventory, for example, a gas cylinder(s), a bundle or gas cylinders in a package (for example, cylinders in a rack or pallet, etc.). This may be carried out preferably using appropriate handling equipment or manually. This Code of Practice does not cover the use of, or the connection or disconnection of cylinders, refer to TIS 22 ^[51], *Connecting gas cylinders*.

Users shall, wherever possible, eliminate the requirement for cylinder movements. Where this is impracticable, cylinder movements should be minimised.

Before any movement activities are undertaken a work activity risk assessment shall be carried out. This shall identify any necessary methods and safety controls required for the tasks. Comply with the requirements of *The Manual Handling Operations Regulations* ^[4]. For guidance on the manual handling of gas cylinders refer to BCGA GN 3 ^[42], *Gas cylinder. Manual handling operations*.

Throughout movement activities, cylinders shall be secured to prevent toppling.

The minimum recommended safe movement requirements are:

- that there is adequate space to allow safe movement;
- that the cylinder is in a safe condition to be moved:
 - the cylinder valve is closed;
 - where provided, the valve protection caps are fitted;
 - cylinder(s) within a pallet or trolley are secured.
- that any mechanical equipment is serviceable and fit for purpose;
- that gas cylinders shall not be lifted and moved directly on the forks of fork lift or pallet trucks;
- for moving cylinders using the 'churning' method, the distance is restricted to less than 5 m and is not used on uneven or sloping floors;
- not to roll cylinders along the ground, as this may damage the cylinder.

Suspension lifting has additional hazards and the following points shall apply:

- do not use ropes, chains, or slings wrapped around the cylinder body, valve or valve guard to lift individual cylinders. Do not use magnets or scissor clamps. This is because cylinder walls and valves may be damaged, and valve guards, which are designed to protect the valve, may become detached;
- individual cylinders are secured within appropriate lifting frames, cradles, platforms or trolleys that are suitable for the combined load. Care shall be taken to ensure lifting accessories are not trapped or snagged on the valve or valve guard. Refer to BCGA TIS 38 ^[53], *Moving gas cylinders and bundles within the workplace*.
- do not suspension lift bundles unless you have confirmed with the owner that they are suitable for suspension lifting;

NOTE: Not all bundles are designed to be suspension lifted, many may only be lifted by fork lift truck using fork pockets;

- pallets and racks, shall only be lifted using fork lift trucks using fork pockets. If you are not sure check with the asset owner.

A work activity risk assessment shall determine the requirement for the use of hazard controls, including, where necessary, for personal protective equipment (PPE).

Only after all other levels of control have been determined to be ineffective in controlling risks to a reasonably practicable level, should PPE be considered as a control.

Even with PPE, if the risk is not reduced to as low a level as is reasonably practicable, then the activity should not proceed.

HSE L25 ^[19], *Personal Protective Equipment at Work*, provides guidance on the *Personal Protective Equipment Regulations* ^[8]. EIGA 136 ^[30], *Selection of personal protective equipment*, provides guidance for selecting and using PPE at work.

Where PPE is required, a PPE assessment shall be carried out in accordance with the *Personal Protective Equipment Regulations* ^[8]. This shall be carried out by competent persons.

The selection of PPE shall be appropriate for the hazard, task, location and individuals.

PPE shall be provided by the employer, along with the necessary information, instruction, training and supervision for its use. The employer shall ensure that employees wear any PPE required.

Cleaning and maintenance (including its replacement) shall be included in the PPE management system. Suitable storage shall be provided for PPE when it is not in use.

The effectiveness of the PPE shall be reviewed periodically.

Emergency situations may require different or additional PPE.

Users shall take into account the requirements of other applicable Regulations, such as the *Control of Substances Hazardous to Health (COSHH) Regulations* ^[9], in relation to assessing risks, along with any relevant equipment publications, manufacturers information and the product(s) safety data sheet.

NOTE: Any equipment that has a personal protective function is classified as PPE, for example, a personal atmospheric monitor.

In the gases industry it is common for safety footwear to include boots with metatarsal protection.

9. EMERGENCY PLANS

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, such as a fire or a gas leak.

As part of the site specific risk assessment (refer to Section 5.1) local management shall determine any foreseeable emergency scenarios. Emergency plans shall then be established.

The emergency plan shall include:

- identification of potential foreseeable emergency situations;
- identification of all gases held, approximate stock holdings and their hazard categories;
- the location of hazards and potential receptors (a person, object or a sensitive environment that could be affected by a hazard source);

- emergency operating procedures, including activation and escalation;
- responsibilities of key personnel, for example, the appointment of an incident controller;
- minimum training and familiarisation requirements;
- access to and availability of emergency equipment and PPE;
- integration requirements for the emergency services;
- contact details for all foreseeably involved persons;
- the means and the communication of the emergency plan to all relevant parties.

Emergency plans shall be reviewed on the following occasions:

- on a routine basis; at least annually;
- whenever significant changes are made to the site;
- when there is a significant change in the quantity of gases held;
- when there is an introduction of a different hazard category of gas, or the removal of a particular hazard category;
- an incident has occurred.

Any lessons learnt shall be incorporated back into the emergency plan.

The emergency plan should be tested. This may include tests, drills, evacuations, etc., as required.

9.1 Gas specific considerations

The emergency plan should include the actions to take in the event of:

- a gas leak;
- a fire involving or affecting a gas cylinder.

Typically, the emergency response will be:

- (i) raise the alarm;
- (ii) evacuate the immediate area;
- (iii) instigate the emergency plan.

Actions in the event of a leakage

Only people who have knowledge of gas properties, the hazards from the gas, who understand the risks involved and who have been trained to deal with gas emergencies in line with the emergency plan, should approach or handle leaking cylinders.

Typically, the emergency response will be:

- identify the gas concerned;
- identify the source of the leak;
- undertake the appropriate actions to make the gas cylinder safe. As necessary, consult the gas supplier for advice.

NOTE: Never attempt to dismantle or repair cylinder valves.

Actions in the event of a fire

Keep away. Do not approach or attempt to move the cylinder or operate the valve.

For a fire which involves or affects a gas cylinder you are likely to require the *Fire and Rescue Service*.

The *Fire and Rescue Service* will need to know the location, the type of gases (by hazard classification) being stored and the quantities of gas cylinders involved in the fire, as well as any other gas cylinder stores located on the site. The *Fire and Rescue Service* have operational procedures in place for dealing with gas cylinders in a fire. Following a fire, the *Fire and Rescue Service* will inform you when it is safe to approach or handle a cylinder.

Contact the gas supplier for advice on the gases or the gas cylinders involved in a fire. The gas supplier shall **ALWAYS** be notified of any cylinder affected by excessive heat or that has been involved in a fire.

Do not use any cylinder which has been exposed to fire or excessive heat. Quarantine any such cylinders in a safe place. Mark or label the cylinders to clearly show that they have been in a fire. After the area has been declared safe by the *Fire and Rescue Service*, arrange collection of the gas cylinders with the gas supplier, at a convenient date.

Further information, including useful contacts, is available in BCGA Leaflet 6 ^[56].

10. CYLINDER RETURN AND DISPOSAL

Before taking any return or disposal action, identify the owner of the gas cylinder. Ensure that the cylinder owner has given permission for the actions being taken.

The details of the cylinder owner will be printed on the cylinder contents label (refer to Section 3) or other visual identification marks, such as stamp-marking around the shoulder of the cylinder.

The vast majority of gas cylinders in circulation in the UK are refillable cylinders which remain the property of the gas suppliers. These refillable cylinders are supplied to gas users under a rental agreement, which requires the user to pay rental on the cylinder until its return. The simplest and best way to deal with these cylinders, when they are empty or no longer required, is to identify the owner (usually the gas supplier) and request that they are collected. Even if the cylinders were not originally supplied to the premises where they are discovered, the gas supplier will make arrangements to collect them.

Detailed advice on the recovery and disposal of all types of gas cylinders is available on the BCGA website under [‘Cylinder Recovery and Disposal’](#).

11. SECURITY

The gases stored in gas cylinders are hazardous and therefore all stores containing gas cylinders shall be secure with access restricted to authorised personnel.

The security at each store shall be determined by carrying out a security vulnerability risk assessment (SVRA) complying with BCGA CP 40 ^[40].

The security arrangements shall take into consideration:

- the classification of the gases and the quantities being stored;
- appropriate physical and management security controls to prevent unauthorised access, theft, tampering, arson, vandalism, etc.;
- effective monitoring of the usage of gases;
- specific local factors.

An appropriate level of security may be achieved by securing the site with a boundary fence or by securing individual stores. Dependant on the site security risk both conditions may be required.

Access keys, cards or codes for each store shall be kept in a secure location and only issued to authorised persons; a log should be kept. Arrangements shall be in place to allow the store to be unlocked in the event of an incident, for example, to allow access for the emergency services.

Where electrical or electronic security systems, for example, alarms, are installed comply with the electrical requirements of Section 5.11.

A security perimeter shall meet the ventilation requirements of Section 5.5 and have a minimum height of 1.8 metres.

All persons handling gas cylinders shall be aware of and comply with the security arrangements.

ADR ^[17] may have relevant security requirements, refer to ADR ^[17], Chapter 1.3 and 1.10.

Advice on security can be obtained from the Gas Supplier and from BCGA.

12. REFERENCES

Document Number	Title
1.	Town and Country Planning Act 1990.
2. SI 1989 No. 635	The Electricity at Work Regulations 1989.
3. SI 1990 No. 304	The Dangerous Substances (Notification and Marking of Sites) Regulations 1990.
4. SI 1992 No. 2793	The Manual Handling Operations Regulations 1992.
5. SI 1996 No. 341	The Health and Safety (Safety Signs and Signals) Regulations 1996.
6. SI 1997 No. 1713	The Confined Spaces Regulations 1997.
7. SI 1999 No. 3242	The Management of Health and Safety at Work Regulations 1999.
8. SI 2002 No. 1144	Personal Protective Equipment Regulations 2002.
9. SI 2002 No. 2677	Control of Substances Hazardous to Health Regulations 2002 (COSHH).
10. SI 2002 No. 2776	Dangerous Substances and Explosives Atmospheres Regulations 2002 - (DSEAR).
11. SI 2005 No. 1541	The Regulatory Reform (Fire Safety) Order 2005 (as amended).
12. SI 2009 No. 1348	The Carriage of Dangerous Goods and use of Transportable Pressure Equipment Regulations 2009 (as amended).
13. SI 2015 No. 310	The Fluorinated Greenhouse Gases Regulations 2015 (as amended).
14. SI 2015 No. 483	The Control of Major Accident Hazards Regulations 2015 (COMAH).
15. SI 2015 No. 627	The Planning (Hazardous Substances) Regulations 2015.
16. GB CLP Regulation	Classification, Labelling and Packaging of Substances and Mixtures (CLP Regulation) (as amended). From 1 January 2021, the classification, labelling and packaging of chemicals placed on the market in Great Britain (England, Scotland and Wales) is regulated by the 'Retained CLP Regulation (EU) No. 1272/2008 as amended for Great Britain', and is known as GB CLP Regulation.
17. ECE/TRANS/300	Agreement concerning the international carriage of dangerous goods by road (ADR) (as amended).

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| 18. | HSE L24 | Workplace health, safety and welfare. Workplace (Health, Safety and Welfare) Regulations 1992. Approved Code of Practice and guidance. |
| 19. | HSE L25 | Personal Protective Equipment at Work. |
| 20. | HSE L64 | Safety signs and signals. The Health and Safety (Safety Signs and Signals) guidance on regulations. |
| 21. | HSE HS(G) 71 | Chemical warehousing. The storage of packaged dangerous substances. |
| 22. | HSE HS(G) 136 | A guide to workplace transport safety. |
| 23. | BS 476 | Fire tests on building materials and structures. |
| | Parts 20 to 23 | |
| 24. | BS 5266 | Emergency lighting. Code of practice for the emergency escape lighting of premises. |
| 25. | BS 7671 | Requirements for electrical installations. IET wiring regulations. |
| 26. | BS EN 14470 | Fire safety storage cabinets. |
| | Part 2 | Safety cabinets for pressurised gas cylinders. |
| 27. | BS ISO 7010 | Graphical symbols. Safety colours and safety signs. Registered safety signs. |
| 28. | EIGA 23 | Safety training of employees. |
| 29. | EIGA 40 | Work permit systems. |
| 30. | EIGA 136 | Selection of personal protective equipment. |
| 31. | EIGA 169 | Classification, and labelling guide, in accordance with EC Regulation 1272/2008 (CLP Regulation). |
| 32. | EIGA 192 | Fluorinated gases management. |
| 33. | BCGA Code of Practice 4 | Gas supply and distribution systems (excluding acetylene). |
| 34. | BCGA Code of Practice 18 | The safe storage, handling and use of special gases. |
| 35. | BCGA Code of Practice 26 | Bulk liquid carbon dioxide storage at users' premises. |
| 36. | BCGA Code of Practice 27 | Transportable vacuum insulated containers of not more than 1000 litres volume. |
| 37. | BCGA Code of Practice 29 | Battery-vehicles and multiple-element gas containers. Design and operation. |

38.	BCGA Code of Practice 33	The bulk storage of compressed flammable gases at users' premises.
39.	BCGA Code of Practice 36	Cryogenic liquid storage at users' premises.
40.	BCGA Code of Practice 40	Security requirements for the industrial, medical and food gases industry.
41.	BCGA Code of Practice 46	Bulk storage of cryogenic flammable gases.
42.	BCGA Guidance Note 3	Gas cylinder. Manual handling operations.
43.	BCGA Guidance Note 11	The management of risk when using gases in enclosed workplaces.
44.	BCGA Guidance Note 13	DSEAR Risk Assessment guidance for compressed gases.
45.	BCGA Guidance Note 23	Identifying gas safety training requirements in the workplace.
46.	BCGA Guidance Note 27	Guidance for the carriage of gas cylinders on vehicles.
47.	BCGA Guidance Note 29	Medical gases. The management of medical oxygen in domiciliary use.
48.	BCGA Guidance Note 32	Medical gases. Good distribution practice.
49.	BCGA Guidance Note 41	Separation distances in the gases industry.
50.	BCGA Technical Information Sheet 6	Gas cylinder identification. Label and colour code requirements.
51.	BCGA Technical Information Sheet 22	Connecting gas cylinders.
52.	BCGA Technical Information Sheet 37	Medical gases. Gas cylinder cleanliness standards.
53.	BCGA Technical Information Sheet 38	Moving gas cylinders and bundles within the workplace.

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| 54. | BCGA Technical Information Sheet 41 | Cylinders provided for the return of waste ozone depleting substances, fluorinated gases and anhydrous ammonia. |
| 55. | BCGA Technical Information Sheet 48 | Gas equipment. Security cages. |
| 56. | BCGA Leaflet 6 | Cylinders in fires. |
| 57. | BCGA Leaflet 7 | The dangers of misusing gases. |
| 58. | BCGA Leaflet 17 | Information for customers collecting gas cylinders. |
| 59. | Liquid Gas UK Code of Practice 7 | Storage of full and empty LPG cylinders and cartridges. |
| 60. | DHSC. Health Technical Memorandum 02-01 Part B | Medical gas pipeline systems.
Part B: Operational management. |
| 61. | NHS Protect | Guidance on the security and storage of medical gas cylinders. |

Further information can be obtained from:

UK Legislation	www.legislation.gov.uk
Health and Safety Executive (HSE)	www.hse.gov.uk
Department of Health and Social Care (DHSC)	www.gov.uk/government/organisations/department-of-health-and-social-care
The Medicines and Healthcare products Regulatory Agency (MHRA)	www.gov.uk/mhra
British Standards Institute (BSI)	www.bsigroup.co.uk
British Compressed Gases Association (BCGA)	www.bcga.co.uk
European Industrial Gases Association (EIGA)	www.eiga.eu
Liquid Gas UK - The UK LPG trade association	www.liquidgasuk.org
National Association for Healthcare Security (NAHS)	www.nahs.org.uk

STORAGE OF GAS CYLINDERS WHERE NOT OUTDOORS

BCGA recommend an outdoor storage area, refer to Section 5.3. A non-outdoor store is less satisfactory, presents additional hazards to people and meets the definition of a Confined Space within the *Confined Spaces Regulations* ^[6]. A suitable and sufficient, documented risk assessment shall be conducted for all non-outdoor stores. The risk assessment may determine that a non-outdoor storage area may not be feasible or that, if feasible, it will require increased controls to maintain safety.

Examples of non-outdoor applications include:

- a standalone building, with solid sides and a roof;
- a cellar in a hospitality venue;
- a converted shipping container;
- a room in a building, with an external door with louvered vents and air bricks;
- a room inside a building (with no external access).

The following topics shall be included within the risk assessment:

- the proposed location of a store in a non-outdoor area and the infrastructure requirements necessary;
- an assessment of the ventilation and any associated atmospheric monitoring requirements, to ensure there is adequate ventilation (to prevent a hazardous atmosphere being created, for example, from leakage from a cylinder) in accordance with the requirements of BCGA GN 11 ^[43];
- an assessment to determine an appropriate level of fire and building safety. For example, including a review of the building fire risk assessment, the building fabric, suitability and integrity, including compliance with building regulations;
- a determination of which people may be at risk from the hazards of the store and associated operations;
- the impact on the store from other unrelated activities and hazards;
- the logistics of moving cylinders;
- the hazardous properties of the gases and the quantity.

An appropriate documented and quality controlled management system shall be established to manage the risks identified in the risk assessment.

EXAMPLES OF STORE DESIGNS



Figure A3-1: Example of an outdoor store.

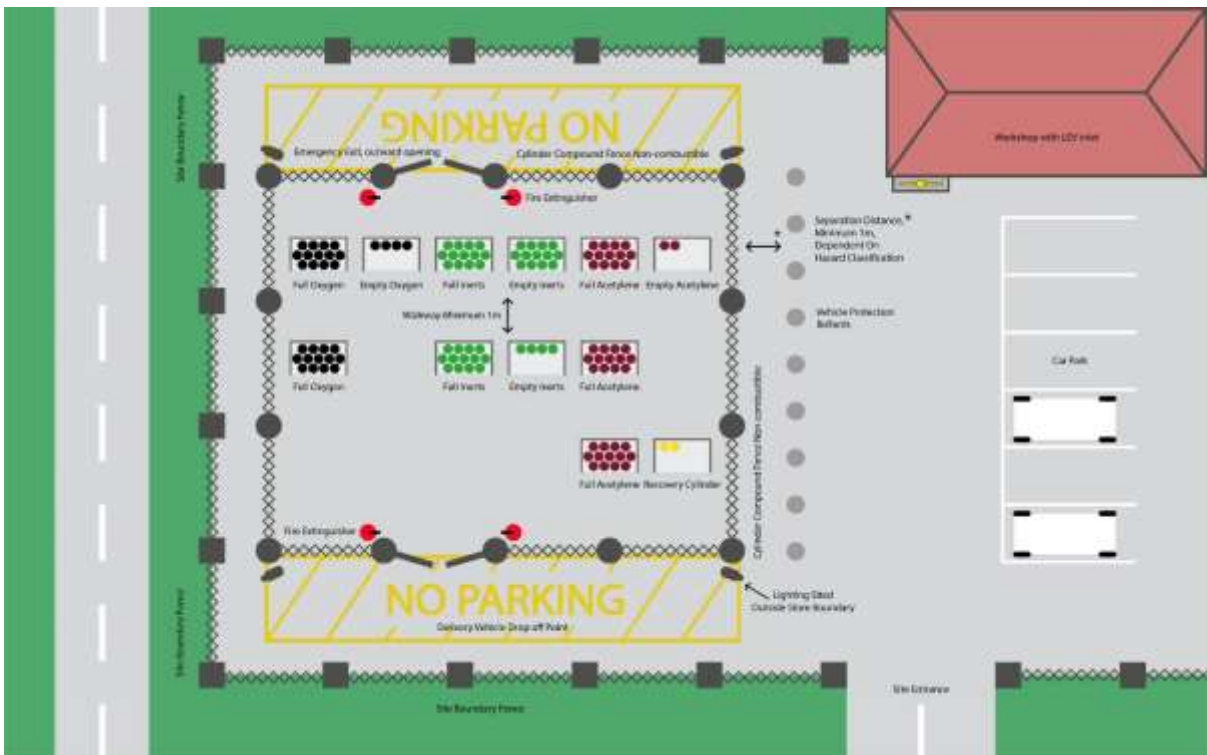


Figure A3-2: Example of an outdoor store. Plan view.

EXAMPLES OF SIGNAGE

Section 5.13 provides information on safety signs and warning notices

These are examples of signage that may be used on the site and the external area of a gas cylinder store.

General:



No source of ignition



No smoking



No unauthorised access



No mobile phones



Danger
Gas cylinder store

Gas cylinder store



Danger
Risk of asphyxiation

Potential asphyxiating atmosphere



Danger
Explosive atmosphere

Explosive Atmosphere



No oil or grease



Safety gloves shall be worn



Safety boots shall be worn



Eye protection shall be worn



Industrial vehicles

Gases:



WARNING
Flammable gas

Flammable gas



ACETYLENE

Acetylene



WARNING
Oxidising gas

Oxidising gas



WARNING
Corrosive gas

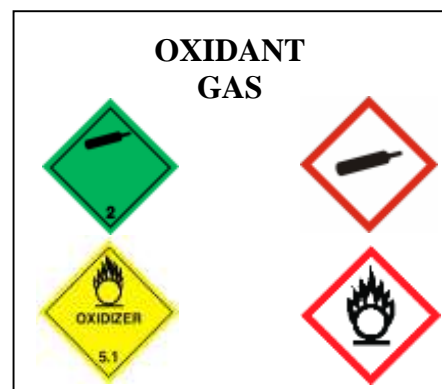
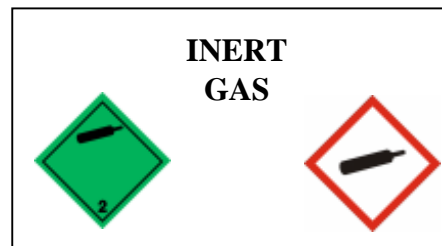
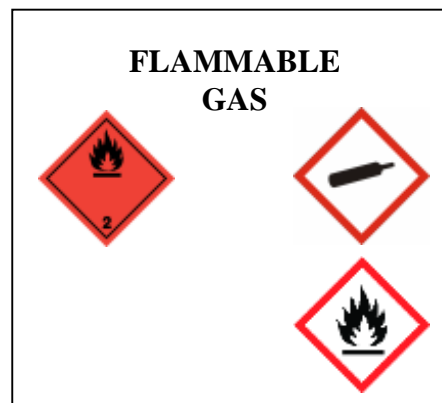
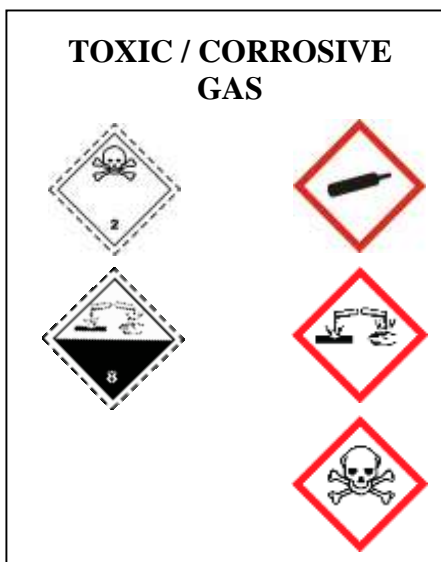
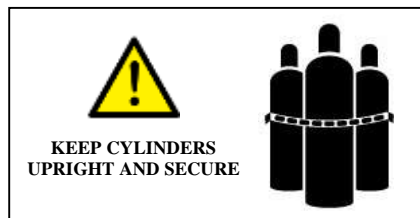
Corrosive gas



WARNING
Toxic gas

Toxic gas

Examples of signage for the inside of a gas cylinder store:





British Compressed Gases Association

www.bcga.co.uk