

Fire Safety - Flammable Gases

Understanding the Risk

Flammable gases in cylinders, also often referred to as bottled gases, are used in a vast range of commercial and industrial premises and other occupancies.

Examples of flammable gases referenced in this document are LPG (liquefied petroleum gas – propane, butane or a mixture of the two), oxygen, hydrogen, acetylene, etc. This list is not exhaustive.

This document deals solely with hazards arising from flammable gases stored and used in cylinders. It is not intended to deal with bulk storage of such gases.

Flammable gases in cylinders present a number of substantial, inherent hazards. LPG is stored at sufficient pressure to liquefy the gas. Other flammable gases are held at higher pressures – normally around 15 atmospheres. Consequently, even a minor leak from a cylinder under pressure can result in a large volume of gas at room temperature and atmospheric pressure. Flammable gases form ignitable mixtures with air over an exceptionally wide range of concentrations and are liable to explode when in contact with an ignition source, such as a naked flame or electrical spark. As an example, propane forms explosive concentrations with air between its lower and upper explosive limits of 2.2% and 9.5% respectively.

Flammable gases can be heavier than air and may travel a considerable distance to an ignition source. Rapid flame propagation and flashback is possible. Cylinders containing flammable gases may vent rapidly or rupture violently as a result of pressure build-up, when involved in a fire situation.

Fires or explosions involving flammable gases can have a severe and immediate impact, even where the use of the gas is incidental to core activities. Where use of flammable gases is extensive, impact can be devastating with widespread property damage, or a complete loss of assets the norm.

Controlling the Hazard

Hazards associated with use and storage of flammable gases need to be adequately risk assessed and controlled to eliminate, reduce or control them and create a safe working environment. This is important not only to protect the financial status of your business but also to fulfill your legislative obligations under the Regulatory Reform (Fire Safety) Order 2005 or Fire Safety (Scotland) Regulations 2006.



The undernoted issues should be considered fully to create an integrated risk management programme:

General Management

- Undertake fire risk assessments to identify hazards and develop appropriate self-inspection checklists.
- In particular, all gases should be assessed for safety hazards and in relation to the Control of Substances Hazardous to Health Regulations (COSHH) for hazards to health. To comply with the Dangerous Substances and Explosive Atmospheres Regulations (DSEAR), an explosion risk assessment should be undertaken where appropriate.
- Maintain good housekeeping regimes to eliminate unnecessary combustibles, especially in close proximity to flammable gas storage areas or compounds.
- Obtain safety data sheets, user manuals and other appropriate publications from suppliers of cylinders or equipment. Provide and maintain up to date records of induction and refresher training to employees in the correct use of cylinders or equipment.
- Develop written emergency plans and have regular drills incorporating action to be taken in the event of an incident.
- Every effort should be made to prevent cylinders suffering impact damage. They should be treated with care, never rolled along the ground or floor during transportation
- During delivery, cylinders should be checked to ensure they are appropriately labeled and colour coded.
- Damaged or contaminated cylinders should not be accepted from suppliers. Never attempt to repair cylinders or their valves.

- Legislative smoking bans apply in respect of enclosed public spaces in the UK. Additionally, smoking should be specifically prohibited in all areas where cylinders are stored or used. Appropriate warning notices should be displayed.

General Storage

- For storage within a building, natural ventilation is essential, at both high and low level, to prevent accumulation of escaped gas.
- In no circumstances should storage below ground level be permitted.
- In large gas stores, where quantities of different gases may be stored, radiation barriers or baffles should be provided between banks of differing gases. Radiation barriers/baffles should be at least as tall as the largest cylinder and provide a fire resistance of at least 30 minutes.
- Storage areas should be secured against unauthorized access, to prevent theft or tampering.
- Warning notices identifying gases stored and prohibiting naked lights or other sources of ignition should be prominently displayed at storage areas.
- Storage areas should be exclusively for the storage of gas cylinders.
- Cylinders should be stored in the upright position, i.e. with valves uppermost. Protective valve covers should be retained on cylinders which are not in use. Cylinders should be securely supported either on trolleys, within racks or fixed to structural elements such as walls or pillars.
- Full, nominally empty and cylinders of different gases should be segregated from each other in the storage area.
- Nominally empty cylinders should be returned to the supplier at the earliest opportunity. A check should be made to ensure their valves are fully closed.
- As oxygen has particularly dangerous characteristics relative to fire hazard – it supports and accelerates combustion – oxygen cylinders should not be stored within 3m of any fuel gas cylinder. Similarly, acetylene cylinders should not be stored within 3m of LPG cylinders.

Storage in the Open

- When stored in the open cylinders should be secured/enclosed within a compound sited as far from buildings as reasonably practicable. Compounds should ideally be sited near the boundary of the site, though not within 4m of the boundary fence.
- The storage compound should be set on a level, compacted, surface capable of bearing the load of the cylinder stock and any transportation used. Drains, manholes, or openings to any basement area in close proximity to storage areas should not be permitted.
- Storage compounds should be enclosed by palisade security fencing at least 2.2m in height. Gates should provide commensurable security protection and be secured by a quality chain and padlock arrangement.
- A lightweight, open sided, weatherproof covering of non-combustible construction should be erected over the storage compound, to protect cylinders from direct sunlight.

- Combustible materials and vegetation should not be allowed to accumulate in close proximity to storage compounds.



Storage Within Buildings

- Ideally, the storage facility should be a detached, dedicated building, constructed of non-combustible materials and positioned as far from other buildings as reasonably practicable.
- Natural ventilation is essential and should be provided at high and low level to prevent accumulation of escaped gas.
- If cylinders are held within a non dedicated store, i.e., within part of a building used for another purpose, then:
 - The storage area should be at ground floor level, in a room having at least one wall on an external elevation and with a door or doors exiting directly to the open.
 - The storage area should be separated from the rest of the building by walls and floors having a fire resistance of 120 minutes.
 - The store should be of non-combustible construction.
- Cylinder stores should be kept cool. Cylinders should not be stored in close proximity to any heat source.
- Electrical equipment or wiring should be installed outside of environments where flammable gases are stored. Where such equipment is installed internally, it should be explosion proof or flame proof in accordance with DSEAR.
- Explosion venting – lightweight roofing or walling – should be provided. Explosion venting in walls is only acceptable where there is no risk of injury to individuals outside the structure.

- When gas cylinders are stored in a building, numbers stored should be kept to the absolute minimum required for operational purposes.

Use of Gas Cylinders

- Cylinder valves should only be opened with the appropriate key, supplied by the manufacturer. Do not attempt to open damaged valves. Always close valves when equipment is not in use.
- Transferal of gases between cylinders for mixing or other purposes should not be permitted.
- Individual cylinders should never be removed from a manifold cylinder pallet.
- When in use, cylinders should be kept well clear of all heat sources, especially oxy-fuel gas cutting torches and electric welding kits.
- Steps should be taken to ensure oil and grease are not allowed to come into contact with cylinders, valves or equipment. Jointing compounds or tape should not be used on cylinders, valves or equipment.
- In situations where a cylinder has a direct feed or connection to a manufacturing process, a non-return valve or check valve should be fitted as a precaution against back flow of gases or liquids. Installation of an automatic shut-off valve, activated when the pressure in the supply gas cylinder falls below a predetermined level, is preferable. Such systems require planned preventive maintenance.
- Where many cylinders are in use simultaneously, a pipeline supply from a manifold system of cylinders located outside the building should be considered. The pipeline system should be designed and installed by a specialist.
- LPG and acetylene cylinders should be stored and used in the upright position. Cylinders specially designed for use on lift trucks may be used horizontally.
- Designated welding and other areas where hot work may be undertaken should be considered high fire hazard areas. Combustible items and other hazards should be segregated from hot work areas by non-combustible/fire-resisting partitions or screens. Ensure that combustible building components cannot be ignited by hot work operations. Where maintenance of buildings or machinery is concerned and mobile equipment used, a dedicated hot work permit to work system should be used.
- Oxy-acetylene kits not in use should be returned to a well ventilated internal storage location, which is free from combustible storage. Oxy-acetylene kits should preferably be held in a separate store.

Equipment

- Regulators, hoses, blowpipes, etc., should be disconnected before storage or transportation.
- Good ventilation should be provided wherever cylinder gases are used.
- Only regulators specific to the gas should be used. Regulators are not interchangeable between different types of gas.

- For welding and similar applications, flashback arrestors should be fitted downstream of pressure regulators to all fuel gas supply hoses/lines and oxygen supply hoses/lines where used in conjunction with fuel gases, to prevent flames traveling back into the cylinders.
- Purpose-made hoses should be used. Only clips that are approved by the equipment manufacturer should be used to secure hoses. Worm drive clips are not suitable and should not be used under any circumstances.
- Hose connections should be checked regularly for damage or deterioration.
- Under no circumstances should copper piping or joint fittings be used in conjunction with acetylene.
- Hoses should not be coiled around cylinders or regulators – fires in coiled hoses are extremely difficult to suppress.
- Hoses which are too short or too long for their purpose should be avoided. The former could lead to operations being carried out too close to cylinders. Hoses should be positioned well clear of sparks, where they will not be subjected to damage by foot traffic or contact with sharp metal objects.
- Hose check valves should be used with oxy-fuel equipment. This will prevent backfeeding, prevent mixing of oxygen and fuel in a hose and subsequently fire within a hose.
- All cylinder valves and assembled equipment should be routinely checked for leaks. Joints, pressure regulators and equipment valves should be checked.

Maintenance

- Equipment used in conjunction with gas cylinders should be returned to the supplier or manufacturer for routine servicing, at intervals recommended by the supplier or manufacturer. Repairs should only be undertaken by the supplier or manufacturer.

Fire Protection

- Under no circumstances should an attempt be made to extinguish an outbreak of fire involving burning fuel gases, until the gas supply has been isolated. Untrained personnel should not attempt to tackle a fire involving fuel gases. Rather, the area should be evacuated and the emergency services summoned immediately.
- Provision should be made for an adequate supply of water for the fire brigade to provide hose streams for cooling cylinders that might become exposed to heat from a fire. A fire hydrant located within 150m of the premises and connected to a minimum 100mm diameter public main constitutes an adequate water supply for fire fighting purposes. Appropriate access should be provided to cylinder storage areas to facilitate firefighting.

- Fire extinguishers, approved and certificated by an independent, third-party certification body, of a type suitable for extinguishing fires in nearby materials, should be provided in all areas in which gases are used or stored. Fire extinguishers should be easily accessible and maintained in accordance with BS 5306: Parts 3 - Commissioning & maintenance of portable fire extinguishers and 8 - Fire extinguishing installations and equipment on premises (latest enforceable version).

- Automatic sprinkler or water spray systems should be considered in occupancies where large numbers of fuel gases are stored or used.

For further information please contact your local AIG risk engineer.

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