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Compressed gases are widely used in both teaching and research laboratories across UTM. The pressure at which gases are contained in gas cylinders can be extremely high, which makes it hazardous if improperly handled. The main hazard from gas cylinders arises from the large amount of stored energy they contain due to the pressure of the compressed gas within them. If the pressurised gas is released in an uncontrolled manner, this can cause considerable damage. Uncontrolled release and flying particles (including the cylinder itself) can occur from failure of the cylinder or its fittings and may arise if it is involved in a fire or it suffers damage in a collision. Gas cylinders also present a hazard from their contents which, even if not directly hazardous by nature of their flammable, toxic, corrosive or oxidising properties, can still cause an asphyxiant hazard by displacing oxygen. The inherent weight and size of cylinders may also present a physical hazard during transport and manual handling or if they topple.

The main causes of accidents from gas cylinders are:

- Poor storage
- Poor handling
- Poor installation
- Faulty equipment and / or design (e.g. Faulty or incorrectly fitted/specified valves and regulators)
- Poor examination and maintenance
- Unplanned releases of gas
- Hidden damage
- Inadequate training and supervision.

This Guidelines provide basic safety precautions to be taken when handling and storing compressed gas cylinders. The Safety Data Sheet must always be referred to for detailed explanations of these safety aspects. LPG usage is not covered in this Guidelines.

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Good Practices:

- Store compressed gases in a well-ventilated and open area.
- Gas tanks must be protected from the weather (rain, sunlight).
- Gas storage area must be well-drained, to prevent corrosion of cylinder bases.
- Storage area must be free from the sources and risk of fire.
- Within the storage area, oxidizing gases should be stored at 3-5 meters away from flammable gases. Fire-rated wall can also be used for separation. The wall must be minimum of 1 meter higher than the tallest cylinders.
- Signage of hazard is mandatory.
- Cylinders must be chained individually (using heavy metal chain).
- Full and empty cylinders should be kept separately, and according to its hazard classes (refer to Safety Data Sheet).
- The following scheme can be used for isolation of cylinders:
Full cylinder- Flammable, Oxidizing, Non-oxidizing.
Empty cylinder-Flammable, Oxidizing, Non-oxidizing.
- DO NOT smoke near gas storage facilities.

The size and number of gas cylinders in use or storage should be kept as small as practicable, having regard to the task(s) being performed and the need to maintain supply. An alternative approach is to dispense with gas cylinders altogether and use gas generators. These are commonly and successfully used to produce hydrogen for gas chromatography and nitrogen for mass spectrometry. Acetylene generators are also available.

Where none of the above is reasonably practicable, the gas cylinder should be secured in a safe place close to the point of use and removed to storage in one of the above locations as soon as possible after use. It may not be possible or desirable for storage of cylinders of medical gases or breathing air to be stored in

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the open air but nevertheless the aim should be to minimise the number and size of cylinders stored within buildings, allowing adequate ventilation and protection from fire or other damage.

General Storage Issues

Cylinders should be inspected on receipt as placed in storage and on removal from storage prior to installation for signs of obvious damage. They should not be accepted or installed if there are obvious signs of damage (e.g. bent valves) but returned to the supplier.

Rotation of stores of gas cylinders to ensure that the first purchased gas cylinders are used before the last purchased should be encouraged. Gas cylinders should not be kept for extended periods. The size and number of the gas cylinders purchased should be matched to the anticipated usage.

Where gas cylinders containing toxic or flammable gases are brought into buildings, they must be removed to safe storage when not in use. When stored outside, gas cylinders should be in a safe, dry, well-ventilated and secure location. The storage area should ideally be provided with simple protection (see Good Practices above) to protect the gas cylinders from the weather and direct sunlight. Storage areas and approaches, e.g. where unloading of cylinders occurs, should be as flat and level as possible to ease mechanical handling issues.

Gas cylinders must not be allowed to stand or lie in water.

Seals or covers should be kept in place on the valves of cylinders that are not in use to help prevent dirt or dust or other contaminants entering, which may affect gas quality, cause corrosion and prevent a good seal being obtained once connected to a supply. 'Empty' cylinders should always have their valve shut although gas cylinders should never be run to zero pressure and left totally empty.

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The hazardous properties of the gas (including factors such as if it is unstable or susceptible to decomposition if subject to heat or shock as is acetylene) will also need to be considered when determining storage requirements / locations and may include enhanced requirements for ventilation, separation or keeping them cool.

When storage and use of gas cylinders inside a building is unavoidable, due consideration must be given to the:

- Separation/segregation from other activities and incompatible materials
- Provision of adequate ventilation
- Detection of leaks
- Protection from involvement in fire
- Materials handling aspects and safe access routes to bring gas cylinders into the building, avoiding the need to manually lift or accompany them in lifts
- Supporting/securing gas cylinders upright
- Maintenance of safe means of escape
- Possible need for explosion relief/prevention and for protected electrical equipment appropriate to any hazardous area classification when flammable gases are being stored / used.

All storage areas, laboratories, rooms or cabinets where gas cylinders are located should have warning signs displayed to indicate the presence of gas cylinders, hazards (e.g. flammable or toxic) posed by the gases together with any precautions that must be taken (e.g. ‘No naked lights/sources of ignition’). Gas cylinders should not be taken into or stored in unventilated rooms, which would include most cold-rooms.

Gas cylinders must be kept away from sources of heat e.g. direct sunlight that could cause an uncontrolled rise in the temperature of the contents leading to over-pressurisation and possible catastrophic failure of the gas cylinder.

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Full and empty gas cylinders should be segregated and clearly labelled (see Good Practices).

Gas cylinders should be secured upright and restrained at all times to prevent them falling over with consequent possible damage to persons, facilities, equipment or the gas cylinder and its fittings. They must also be protected from violent contact with other objects such as vehicles.

Gas cylinders should not be allowed to come into contact with electrical apparatus. A separation distance of at least 50 mm between gas cylinders/gas pipework and electrical services should be ensured, except where electrical apparatus is purpose designed and installed for gas pipework applications e.g. auto-shut off, changeover systems and heaters on CO₂ supplies.

Cylinders of oxidant gases (e.g. oxygen and nitrous oxide) must be kept separated from cylinders of flammable gases or other flammable material, either by a distance of at least 3 m or by a 30-minute fire-resisting wall.

References

1. Occupational Safety and Health Act 1994 [Act 514]; Occupational Safety and Health (Use and Standards of Exposure of Chemicals Hazardous to Health) Regulations (USECHH) 2000.
2. Occupational Safety and Health Act 1994 [Act 514]; Occupational Safety and Health (Classification, Labelling and Safety Data Sheet of Hazardous Chemicals) Regulation (CLASS) 2013.
3. US Department of Labor. Occupational Safety and Health Administration.
4. Guidelines for Gas Cylinder Safety. 2012. BOC Australia.
5. Guidance on Safe Storage and Installation of Gas Cylinders. 2013. Natural Environment Research Council (NERC) UK.
6. Storage and Handling of Gas Cylinders Guidelines. 2015. University of

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	Wollongong. 7. CGA P-1 1965 Safe Handling of Compressed Gases. Fifth Edition. 1965. Compressed Gas Association, Inc.
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