Guidelines for Working Safely with gases

1. Hazards associated with gases in cylinders

Hazards due to the chemical properties of gas cylinders include:

- fire or explosion from the release of flammable gases near ignition sources (e.g. acetylene or liquid petroleum gas);
- spontaneous combustion from oxidising gases (e.g. oxygen or nitrous oxide);
- exposure to toxic or corrosive gases (e.g. anhydrous ammonia); or
- asphyxiation from some non-toxic, non-flammable gases by displacement of oxygen (e.g. nitrogen, carbon dioxide or argon).

Compressed gas cylinders contain gas stored under hundreds of atmospheres of pressure. A valve seals the gas in the cylinder. The pressure related hazards include:

- damage to a valve or regulator, causing failure and leakage of the gas;
- low boiling point, cryogenic or liquefied gases may cause frostbite on release;
- heating of the cylinder (e.g. from fire) or impact to the pressure vessel, resulting in explosion and shrapnel.

Some gases are also denser than air (e.g. LPG, carbon dioxide). On release, these gases will tend to collect in low lying areas such as pits, depressions and basements. Depending on the chemical properties of the heavier than air gas, people working in low lying areas may be exposed to the risk of fire or explosion, asphyxiation, or exposure to toxic or corrosive gases.

When gases are released and expand a drop in temperature occurs. In some cases (e.g. carbon dioxide) the rapid release and expansion of gas can cause a cold hazard (e.g. frostbite) to exposed persons.

Large gas cylinders (e.g. G or F sized cylinders) can also be bulky, heavy, awkward objects that could cause severe strain and sprain injuries from inappropriate handling practices

2. Legislation relating to the use and storage of gases in cylinders

The storage and handling of gases in cylinders is regulated by the provisions of AS4332-2004: The storage and handling of gases in cylinders and is called up under the Dangerous Goods Safety Management Regulations.

AS4332 sets out requirements and recommendations for the safe storage and handling in cylinders, of gases that are classified as Class 2 substances in the ADG Code (i.e. gases that are compressed, liquefied or dissolved under pressure).

For further information of specific gases, the following Australian Standards should be read:

- Non-flammable cryogenic and refrigerated liquids: AS1894
- Liquefied chlorine gas: AS2927
Liquefied petroleum gas

AS1596

3. Storage of gases in cylinders

In most laboratories or settings within the University, minor storage quantity rules will apply. Storage of gases in cylinders, in quantities not exceeding those in the table below, shall be classified as minor storage.

<table>
<thead>
<tr>
<th>Class of gas</th>
<th>Examples</th>
<th>Maximum aggregate water capacity, L</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 (flammable gas)</td>
<td>LPG, hydrogen, acetylene</td>
<td>500</td>
</tr>
<tr>
<td>2.2 (non-flammable, non-toxic gas)</td>
<td>compressed air, nitrogen, argon, carbon dioxide, helium</td>
<td>2000</td>
</tr>
<tr>
<td>2.2, with Class 5.1 subsidiary risk (oxidising gas)</td>
<td>oxygen, nitrous oxide</td>
<td>1000</td>
</tr>
<tr>
<td>2.3 (toxic gas)</td>
<td>methyl bromide, anhydrous ammonia, chlorine</td>
<td>50</td>
</tr>
</tbody>
</table>

Where gases of mixed classes are kept in minor storage, the aggregate quantity of all gases shall not exceed 2000L and the quantity of each subclass shall not exceed that in the above table.

For further information relating to electrical installations near flammable gas supplies, contact the Electrical Safety Officer.

3.1 Securing cylinders in the upright position

- Cylinders should always be stored in the upright position. Some gases (e.g. LPG and acetylene) contain a gaseous and liquid phase. Some flammable gas cylinders contain a pressure relief valve which must be in contact with the vapour phase if the cylinder is to function properly during an emergency.
- Ensure that cylinders are prevented from falling or being knocked over by securing cylinders using a racking system or using a non abrasive, coated chain that will not be abrasive to the cylinder markings and paint work.
- If cylinders have been lying on their side, place the cylinder in the upright position and wait 30 minutes before using.

Note: Some cylinders are designed to be stored on their side. Consult the MSDS or contact your supplier for additional information.

3.2 Location of gas stores

Gas stores should be located outdoors, preferably in a secure, tamperproof cage protected from sunlight. Gas storage areas should also provide adequate space to store used or spare cylinders. Storage indoors is not recommended unless the building has been designed for that purpose with appropriate fire rated walls and ventilation. Where gases are stored indoors, additional safety considerations and control measures need to be given consideration.

3.2.1 Outdoor minor storage
Outdoor minor stores of class 2 gases in cylinders shall be separated from other dangerous goods stores by a minimum distance of 3m. They shall be located not less than 1m from any door, window, air vent or duct.

As far as practical, compressed gas cylinders should be stored outside of buildings and the gas reticulated to points of use. These external stores should be secured against damage and tampering and be clear of combustible materials. Gases should not be reticulated at full cylinder pressure and the system should be provided with regulators at the cylinder. The need for high and low pressure cut-off devices should be considered to protect against disconnection of equipment or failure of the regulator.

3.2.2 Indoor minor storage

The indoor use and storage of gas cylinders should be avoided wherever possible. Where it is impractical to provide an outdoor cylinder store, the keeping of cylinders indoors shall be restricted as follows:

(a) The total capacity of gas in cylinders allowed for any particular indoor location shall include cylinders in use, spare cylinders in use, and used cylinders awaiting removal.
(b) The total capacity of the gases kept shall not exceed one minor storage quantity per 200m² of floor area. Where the floor area exceeds 200m² any arrangements that could result in an undue concentration of cylinders shall be avoided.
(c) Indoor minor stores of gases in cylinders shall be separated from other minor stores of gases or other dangerous goods stores by a minimum distance of 5m.
(d) Except for class 2.2 gases having no subsidiary risks, there shall be no minor storage in basements.
(e) Where cylinders are kept inside a building or a confined area, e.g. a shipping container, that building or area shall be adequately ventilated. Such ventilation shall be achieved by natural air movement or equivalent.

For further information on the design and construction of stores, refer to section 4 of AS4332-2004: The Storage and Handling of gases in cylinders.

3.3 Ventilation

- Store gas cylinders in well ventilated areas to prevent build up of escaped gases.
- Where possible gases should be stored outside in a cage.
- Where gases are stored inside a building, a mechanical ventilation system may be required if the natural ventilation is inadequate. Expert advice should be obtained if you are unsure.
- The mechanical ventilation system must be designed so as to capture escaped gases, not ignite flammable gases, ensure workers are not placed at risk of asphyxiation, or exposed to gases above the relevant National Exposure Standard (NES). National Standards are those stated in the NOHSC publication Exposure Standards for Atmospheric Contaminants in the Occupational Environment (PDF, 580 KB) (non-Queensland Government link).
- AS 4332 The storage and handling of gases in cylinders is recommended for guidance.

3.4 Personal protective equipment

Eye protection, safety shoes and gloves should be worn in gas cylinder storage and handling areas.

3.5 Segregation of DG gases in cylinders (less than 500L)
Corrosive liquids can damage gas cylinders on contact. Flammable liquids can spread a fire across a workplace floor and allow flames to come into contact with gas cylinders. Other dangerous goods may also be adversely affected by gas cylinders in an emergency.

For this reason, gas cylinders are kept separately from other dangerous goods and combustible liquids by at least 5m or by using appropriate fire rated barriers. Segregation of incompatible goods also allows fire fighters to safely use appropriate fire fighting media for each type of goods present.

Gas cylinders must also be segregated from other incompatible gases by at least 3m or more. The following is recommended:

- Class 2.3 "Toxic gas" and corrosive gases (those with a subsidiary risk of Class 8 "Corrosive") are stored away from all other gas cylinders.
- Class 2.1 "Flammable gas" must be segregated during storage from all oxidising gases.

<table>
<thead>
<tr>
<th>Class</th>
<th>2.1</th>
<th>2.2</th>
<th>2.2 (5.1)</th>
<th>2.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>C</td>
<td>C</td>
<td>R</td>
<td>I</td>
</tr>
<tr>
<td>2.2</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>I</td>
</tr>
<tr>
<td>2.2 (5.1)</td>
<td>R</td>
<td>C</td>
<td>C</td>
<td>I</td>
</tr>
<tr>
<td>2.3</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>C</td>
</tr>
</tbody>
</table>

C = Compatible
I = Incompatible and should be segregated by at least 3m
R = Reactive and should be segregated by at least 5m

3.6 Safe handling practices

- Avoid knocking cylinders about. Prevent damage to cylinders from impact from other objects (e.g. crashing into other cylinders). Some cylinders (e.g. acetylene) may react violently after being excessively shaken, heated, or knocked about.
- Cylinders should never be used as rollers to move other objects.
- When moving cylinders avoid rolling them. Ensure that an appropriate mechanical handling device (e.g. cylinder trolley with a restraining strap). Workcover Victoria has advice on manual handling of gas cylinders can be found within the Victorian Government publication, Delivering large gas cylinders - a guide to manual handling (non-Queensland Government link).
- Eye protection, safety shoes and gloves should be worn in gas cylinder storage and handling areas.

3.7 Placarding storage areas

Where gases are stored in excess of the quantities shown in Table 1 (an extract of Schedule 1 of the Dangerous Goods Safety Management Regulation 2001), placarding is required to be erected.

<table>
<thead>
<tr>
<th>Gas class</th>
<th>Quantity (water capacity in litres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 2.1</td>
<td>500 (e.g. 10 G size cylinders)</td>
</tr>
<tr>
<td>Class 2.2, sub-risk 5.1</td>
<td>2,000 (e.g. 40 G size cylinders)</td>
</tr>
<tr>
<td>Class 2.2 (without sub-risk)</td>
<td>5,000 (e.g. 100 G size cylinders)</td>
</tr>
<tr>
<td>Class 2.3</td>
<td>50 (e.g. 1 G size cylinders)</td>
</tr>
</tbody>
</table>

Refer to the UQ OH&S Guideline on Placarding for further information.
3.8  Medical oxygen cylinders

After the 1st August 2010, medical cylinders will only be supplied with pin index valve outlets.

What you need to do:

• arrange for a replacement medical oxygen regulator in order to be able to connect to the new valve outlet. It is recommended you contact your regulator supplier or medical gas supplier for assistance with your requirements.

• medical oxygen with manifold systems will need to have their manifold connections and/or flexible connections changed. Ensure that the new pin-index cylinders have been ordered and are at your site when the conversion occurs to ensure you have continuity of supply.

4.0  Internet links