Safety advice.

Gas in cylinders.

Properties

**Compressed gases**
Gases which remain in gaseous state during normal filling pressures and temperatures are called compressed gases. Some examples of pure gases are: Oxygen, Nitrogen, Argon, Hydrogen, Helium and Carbon monoxide. Compressed gases are usually filled in cylinders at 200 bar, in some cases up to 300 bar.

**Liquefied gases**
Gases that exist in liquid state at normal filling pressures and temperatures are called liquefied gases. Some examples of pure gases are: Carbon dioxide, Nitrous oxide, Ammonia and Propane. Liquefied gases may be stored in either high pressure cylinders – for example Carbon dioxide, at about 50 bar – or in low pressure cylinders – for example Ammonia or Propane, at about 7 bar.

**Dissolved gases**
Acetylene cylinders are filled with a porous mass in which a solution of Acetylene in Acetone or DMF (dimethylformamide) is under pressure, typically 15 bar.

Gas cylinders are designed to safely contain their contents and are tested typically up to 1.5 times of normal working pressure. The testing period is defined by the relevant transport regulations. Cylinders can be combined in bundles in a number of usually 12 or 16.

Important information about cylinders e.g. maximum filling pressure, testing data etc. are stamped on the cylinder shoulder.

<table>
<thead>
<tr>
<th>Gas / Product</th>
<th>Acetylene</th>
<th>Oxygen</th>
<th>Carbon Dioxide</th>
<th>LPG</th>
</tr>
</thead>
<tbody>
<tr>
<td>State of product</td>
<td>Dissolved in Acetone or DMF in a porous mass</td>
<td>Gaseous</td>
<td>Liquid</td>
<td>Liquid</td>
</tr>
<tr>
<td>Gas pressure at ambient temperature (bar)</td>
<td>T5</td>
<td>Up to 300</td>
<td>50</td>
<td>5</td>
</tr>
<tr>
<td>Protection against excess pressure</td>
<td>No</td>
<td>No</td>
<td>Bursting disc</td>
<td>Safety valve</td>
</tr>
<tr>
<td>Density compared to air</td>
<td>0.9</td>
<td>1.1</td>
<td>1.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>
Hazards

Pressure release
Gases in cylinders are stored under pressure. This represents high energy; the hazard is therefore a sudden release of this pressure that could harm personnel and/or damage assets, especially if the cylinder itself is projected at a high velocity due to the sudden release of the stored energy.

Containment rupture
When a cylinder that contains a liquefied gas (fitted with a protective device) is heated, the gas inside starts to increase in pressure; this can cause the protective device to operate in order to relieve the pressure. Additionally, if cylinders are exposed to extreme heat sources such as a fire, the pressure inside can build up rapidly or up to a point where the cylinder itself will rupture catastrophically.

Cylinders toppling
Many gases are supplied in heavy metal cylinders that can weigh up to 70 kg and the simple act of manual handling could involve hazards to personnel in case of cylinders toppling. Cylinders should always be restrained unless they are designed to be free-standing i.e. propane cylinders with a wide flat bottom. As an example some cutting and welding systems such as arc welding machines carry gas cylinder on board. Big cylinders may effect stability of the machine especially when moving around. In this case the selection of the proper cylinder size is critical.

Hazards related to the nature of the gases contained in the cylinder
Gases may be classified as asphyxiant, flammable, oxidising, toxic, corrosive, hazardous for human health, hazardous for the environment or a combination of these. The classification of the gas is given on the cylinder label and on the safety data sheet.
Precautions

Identification
• The cylinder must always have a label that clearly identifies the contents and the relevant hazards

Storage
• Store gas cylinders upright and below 50°C, in a well-ventilated place
• Cylinders must be restrained from falling with safety caps in place
• Protect gas cylinders from corrosion, mechanical damage or access by unauthorized persons
• Ensure a safety distance of approx. 2 m between gas cylinders containing flammable gases and oxidisers (e.g. Acetylene/Oxygen).
• Do not store gas cylinders along with other flammable materials
• Do not store gas cylinders in underground rooms, on or next to stairs, in corridors, passages or garages, escape routes
• Empty cylinders must be kept separately from full cylinders

Cylinder handling
• While moving cylinders, the pressure regulator must be removed with the safety cap in place
• Cylinders should be transported using wheeled trolleys designed for this purpose
• During transport, cylinders must be properly secured
• Do not drag, roll, slide or drop gas cylinders

Use
• Cylinders must be adequately restrained
• Only a pressure regulator suitable for the product and pressure must be used
• When not in use, remove the regulator and install safety caps
• Store cylinders which are not required for current operations outside the working place
• Prevent sucking back of water or any other liquid into the cylinder

Return
• Always return cylinders with a positive residual pressure, as recommended by the supplier

General recommendations
• Only experienced and properly trained persons should handle gases
• Do not smoke while handling a gas cylinder or using the product
• Never attempt to transfer gases from one container to another
• Implement the necessary measures in relation to the nature of the hazards, e.g. gas detection systems, gas cabinets, ventilation systems, flammable zones etc. Such measures must be defined as the outcome of a proper risk assessment

Emergency
For spill or leak and first aid consult specific instruction related to the content of the gas cylinder and the related hazards.

Fire
1. Use an extinguishing medium suitable for the type of fire
2. Remove containers to safe area, if safe to do so
3. Cool containers with water from a protected position. Exposure to a fire may cause containers to rupture
4. Do not direct water at the source of a leak or any protective devices
5. Advise the Fire Services of the location of the containers and their contents

Refer to the relevant safety data sheet for further information. Contact your local Linde supplier for specific questions.