

C06 Safe Handling of Compressed Gas Cylinders

1. Introduction

The use of compressed gas cylinders in the laboratories is very common. Compressed gas cylinders supply laboratory gases for different purposes such as controlling experimental conditions or operating laboratory equipment. Gas cylinders should be handled with great care as a number of potential dangers are associated with the use and storage of compressed gas cylinders. The purpose of this document is to provide laboratory personnel at the Science Park with general guidelines for safe handling, use and storage of compressed gas cylinder in compliance with corporate and statutory requirements.

2. Definition

A compressed gas is a material which is a gas at normal room temperature and pressure, but is packaged as a pressurized gas, pressurized liquid or refrigerated liquid and is contained usually in a cylinder. The compressed gases may be inert, toxic, flammable or explosive. The hazards associated with compressed gas cylinders arise from their pressure and contents. They must be stored and handled very carefully.

3. Type of Compressed Gases

There are three main types of compressed gases stored in cylinders:

3.1 Non-liquefied Gas

Non-liquefied gases are gases that remain gases at room temperature even at high pressure. Examples include oxygen, nitrogen, argon, air, methane and hydrogen.

3.2 Liquefied Gas

Liquefied gases are gases that become liquid at room temperature when compressed at high pressure in a cylinder. Examples include carbon dioxide, nitrogen, chlorine and ammonia.

3.3 Dissolved Gas

Dissolved gases are gases that are dissolved in a volatile solvent for stabilizing. Example include acetylene.

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4. Gas Cylinder Information

Color coding is the common practice for gas cylinder manufacturer to verify the type of compressed gas in the container. However, this color coding system is not standardized. Instead, it is required to label the cylinder to identify the gases contained. Cylinders are made in a wide variety of sizes and shapes. They range from small lecture bottles to large cylinders over 3 meters long. The materials made for the cylinder can be steel and aluminium.

5. Hazards Associated with Compressed Gas Cylinder

The hazards associated with handling, use and storage of compressed gases are summarized as follows:

5.1 Asphyxiation

Asphyxiation is the main hazard associated with inert gases such as helium, nitrogen and argon. If gas leakage happens, it will reduce the atmosphere oxygen concentration below concentration necessary to support consciousness and life.

5.2 Physical

Compressed gas cylinders are usually large, heavy and awkward to handle. Improper handling or not properly securing can cause cylinders falling which results in injury to workers.

5.3 Fire and Explosion

Flammable gases such as acetylene and hydrogen can burn and explode if leakage occurred under certain conditions.

5.4 Health

Some compressed gases are toxic which cause serious health problems depending on the specific gas, its concentration and length of exposure.

5.5 Chemical Burn

Some compressed gases are corrosive which cause skin burn or damage when contact, eyes or lung burn when inhaled.

5.6 Pressure

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All compressed gases are hazardous due to the high pressure inside the cylinder. Damage to the cylinder valve or container can result in rapid release of high pressure gas causing personal injury and damage to property.

6. Use, Handling and Storage of Gas Cylinders

Laboratory operators at the Science Park are required to comply with the Dangerous Goods Ordinance (CAP. 295) on handling and storage of gas cylinders. Compressed gas are classified as Category 2 in the Ordinance. Compressed gas suppliers are responsible for ensuring the safety of the container by performing the pressure tests on the container for every five years as required by the Ordinance. Appropriate gas detectors should be installed in the laboratory areas where necessary for monitoring gas leakage.

6.1 Use of Gas Cylinder

Some general practices of using gas cylinders are described below:

- a) Laboratory personnel working with gas cylinders are well trained.
- b) Regulator installation with leakage test must be done by trained personnel.
- c) Ensure equipment is compatible with the cylinder pressure and contents.
- d) Identify the chemical hazards of the particular gas in cylinder and wear appropriate personal protective equipment accordingly.
- e) Ensure adequate regulator and fittings are used for the particular gas in the cylinder. Each cylinder and regular fitting has connection fitting that is designated by a Compressed Gas Association (CGA) number.
- f) Visual inspect on regulator and connection for any damage or disrepair each time before using.
- g) Gas cylinders should always be used in a vertical and secured position.
- h) Open the main valve with an adequate sized wrench if required and slowly adjust the regulator control to the desired pressure on the regulator delivery gauge.
- i) Always use gas cylinders in a well-ventilated area to prevent asphyxia.
- j) Prevent sparks and flames from contacting gas cylinders.
- k) Release the pressure from regulators and close all the valves after using.
- l) Use a flashback arrestor for flammable and oxidizing gases. It will stop gas flow in the event of a reverse flow or flash back.
- m) Discontinue use and contact the supplier if a cylinder valve is difficult to operate.
- n) Never use copper fitting or tubing on acetylene gas cylinder as an explosion may result.

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6.2 Transport of Gas Cylinder

Some general practices for transport of gas cylinder are described below:

- a) Cylinders must not be transported with regulator attached.
- b) Close the main valve with valve cap protection during transportation.
- c) Use cylinder trolley when moving gas cylinders. Ensure the cylinder is secured to the cart during transport with a chain. Cylinder should not be dragged, rolled or manually carried.
- d) Never drop cylinders or allow them to strike each other violently.
- e) Use the proper personal protective equipment for cylinder handling.
- f) Never attempt to catch a falling cylinder.
- g) Move cylinder trolley on clean, smooth and level surface to the greatest extent.

6.3 Storage of Gas Cylinder

Gas cylinders shall not be stored in the laboratories in excess of their respective exempt quantities or the aggregated quantities specified in the Ordinance. Laboratory Person In-Charge should apply to store those excessive quantity of gas cylinders in the Central Dangerous Goods Stores of HKSTP wherever necessary. The following safety measures should be adhered to regarding storage of gas cylinders:

- a) Store gas cylinders in cool and well ventilated designated areas, away from incompatible materials and ignition sources.
- b) Gas cylinders with toxic or highly flammable gases should be kept in proper gas cabinets whenever necessary.
- c) Cylinders shall not be stored at temperature above 52°C or in direct sunlight or outside of the temperature range specified by the supplier.
- d) Cylinders shall be secured by chains or straps at a point approximately 2/3 of the height of the cylinder to a wall or bench in an upright position.
- e) Cylinders shall be protected against tampering and damage.
- f) Cylinders containing oxygen should be kept away from flammable gases or large quantities of flammable liquid.
- g) Flammable gases shall be separated from nonflammable gases.
- h) Dirt, oil or water should be prevented from entering cylinder valves.
- i) Empty cylinder should be separated from full cylinder within storage area and returned to supplier as soon as possible.
- j) Provide adequate access for cylinder handling.
- k) Visually inspect stored cylinders on a routine basis for any indication of leakage or damage.

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7. Commonly Used Gases

Additional precautionary measures for some commonly used gases in the laboratories are described as follows:

7.1 Acetylene

Acetylene is an extremely flammable gas usually dissolved in acetone in the cylinder. Mixture of acetylene and oxygen or air will explode in a confined area in the presence of spark. Appropriate regulator for acetylene cylinder (CGA connection: 510) should be used and a flashback arrestor should be connected to the pipe line. Acetylene can form explosive compounds with copper, silver and mercury under certain conditions. Copper fittings are not allowed to connect with acetylene gas cylinder.

7.2 Hydrogen

Hydrogen is a flammable gas and is lighter than air. A mixture of hydrogen and oxygen or air will explode in the presence of spark. Appropriate regulator for hydrogen cylinder (CGA connection: 350) should be used and a flashback arrestor should be connected to the pipe line. Personnel should take every precaution against hydrogen leakage which cannot be detected by sight, smell or taste. Leaked hydrogen may accumulate at the ceilings of the premises. The installation of detectors or carrying personal sensing devices for leak detection is strongly recommended.

7.3 Nitrogen, Argon and Helium

These inert gases can cause asphyxiation in release of large quantities in confined area. Liquefied gases may cause frostbite to eyes or skin. Do not touch the frosted pipes or valves. The regulator of CGA connection number is 580.

7.4 Oxygen

Oxygen can support and accelerate combustion of flammable materials. Segregate the storage of oxygen cylinder with flammable gas cylinder. Never use oil or grease on oxygen cylinders and their valves, fittings or regulators as it may cause fire or explosion. The regulator of CGA connection number is 540.

8. Emergency

Laboratory Persons In-Charge should address the potential hazards of individual gases and their corresponding safety measures to all concerned laboratory

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personnel. Suitable preparedness and arrangements should be in place to ensure that all laboratory personnel take appropriate actions in case of emergency. In the event of uncontrolled gas leaking from cylinder:

- a) Alert other people and evacuate the area immediately.
- b) Ventilate the area by opening the windows or activate the emergency ventilation system. If the leaked gas is flammable, do not switch on or off any electrical appliances including the mobile phone.
- c) Leave the laboratory and close the door.
- d) Report the incident to HKSTP following the “General Laboratory Emergency Procedures” in the SHE Handbook.
- e) Stay away from the laboratory and wait for assistance. Do not allow people to enter the laboratory or go to the nearby areas.