1 Introduction

Compressed gas cylinders can present a variety of hazards due to their pressure and/or contents. It is the intent of this SOP to provide information on the safe usage of compressed gases and offer staff and students protection from potential health and physical hazards associated with compressed gas cylinder usage.

2 Scope

This SOP applies to all staff and students in Department of Physics who use compressed or liquefied gases.

3 Responsibility

The Principal Investigator (PI) or supervisor shall designate and train students and staff who are required to handle and use compressed gases and ensure that compressed gases are handled in accordance with good work practices. It is the PI or supervisor's responsibility to verify that staff and students using compressed gases understand the proper procedures.

4 Types of Compressed Gases

A gas cylinder is a pressure vessel used to store gases at high pressure. The three main types of compressed gases that are stored in gas cylinders are liquefied gas, non-liquefied gas and dissolved gas.

1. Liquefied gases are gases that become liquids at room temperature when compressed at high pressure in a cylinder. Examples are carbon dioxide, ammonia, chlorine, etc.
2. Non-liquefied gases are gases that remain gases at room temperature even at high pressure. Examples are nitrogen, argon, carbon monoxide, helium, hydrogen, methane, oxygen, etc.
3. Dissolved gases are gases that are dissolved in a volatile solvent in order to stabilize them. Acetylene is a good example of a dissolved gas. It is usually dissolved in acetone.

5 Classifications of Compressed Gases

Flammable or combustible - Gases are flammable if their flashpoints (temperature above which there is not sufficient vapors given off to ignite) are lower than room temperature. In these situations there is an ever present danger of fire or explosion. Examples are acetylene, butane, ethane, ethylene, hydrogen, isobutene, methane, propane, etc.

Corrosive - A gas that causes visible destruction or permanent changes in skin tissue at the site of contact. Exposure to corrosive gas affects can be compounded due to the nature of the material. Examples are ammonia, boron trifluoride, chlorine, hydrogen chloride, methylamine and etc.

Poisonous – Exposure to poisonous gases and vapors can go unnoticed for long periods of time. Common poison or highly toxic gases include: arsine, ethylene oxide, hydrogen cyanide, nitric oxide, phosphine, etc.

Inert - An inert gas is a non-reactive gas and is usually a member of the noble gas family. Examples include helium, neon, argon, nitrogen, xenon, krypton, and radon.

6 Main Hazards Associated with Gas Cylinders

- Asphyxiation caused by gas leaks.
- Impact from the blast of a gas cylinder explosion or rapid release of compressed gas.
- Impact from parts of gas cylinders that fail, or any flying debris.
- Contact with the released gas or fluid (such as chlorine).
- Fire resulting from the escape of flammable gases or fluids.
- Impact from falling cylinders.
- Manual handling injuries.

7 Main Causes of Gas Cylinders Accidents

- Inadequate training and supervision.
- Poor installation or maintenance.
- Faulty equipment and/or design, e.g. badly fitting valves or regulators.

- Poor handling or storage.
- Inadequately ventilated working conditions.

8 Safe Practices when working with Compressed Gases

8.1 Identification of contents

- Contents of the gas cylinder should be clearly identified.
- Color coding is not a reliable means of identification. Cylinder colors vary from supplier to supplier.
- Do not deface or remove any markings, tags or stencil marks used for identification of contents attached by the gas vendor.
- Cylinders which do not bear a legibly written, stamped, or stenciled identification of the contents should not be used and the gas vendor should be contacted for removal.
- Read the MSDS and labels for all of the materials you work with.

8.2 Handling and Use

- Gas cylinders should always be used in a vertical position, unless specifically designed to be used otherwise.
- Gas cylinders should always be securely restrained to prevent them falling over.
- Ensure that the cylinder/gas is the right one for the intended use.
- Wear appropriate personal protective equipment, such as safety shoes and safety spectacles.
- Never roll, drag, or drop cylinders or permit them to strike each other.
- Close all valves when cylinders are not in use.

8.3 Lifting and Transport

- Use cylinder trolley when handling gas cylinders.
- Fit suitable protective valve caps and covers to cylinders before transporting.
- Transport cylinders with valve caps. Do not lift cylinders by the cap.
- Do not transport with the regulator attached.
- Cylinders must be fastened securely in upright position.

8.4 Storage

- Gas cylinders should not be stored for excessive periods of time. Only purchase sufficient quantities of gas to cover short-term needs.
- Properly secure the cylinder at all times: straps, belts, or chains.
- Store gas cylinders in cool, dry, well-ventilated areas, away from incompatible materials and ignition sources.
- Gas cylinders should be stored away from sources of ignition, other flammable materials or oxygen cylinders.
- Store gas cylinders securely when they are not in use and should be properly restrained.

9 Safe Use of Regulators

- A regulator is a device that receives gas at a high pressure and reduces it to a much lower working pressure.
- Regulators are gas specific. Be sure to use the proper regulator for the gas tank in the cylinder.
- Always check the regulator before attaching it to a cylinder. If the connections do not fit together readily, the wrong regulator is being used or gasket could be missing.
- Check leakage by bubble soak test.
- Before a regulator is removed from a cylinder, close the cylinder valve and release all pressure from the regulator.
- Regulators shall be removed from the cylinder during transport.

- Two stage regulators are commonly used in most labs. The gauge closest to the tank itself is the main gauge. It provides the total pressure reading of the gas in the tank. The primary stage should be kept closed whenever the gas tank is not actually in use. The second stage allows careful control and release of a lower constant pressure of gas. The reading on the second gauge provides an indication of the actual pressure of the gas being released from the tank.

10 Incidents & Near Misses

All near misses and incidents must be reported to your PI and department safety officer immediately.

A formal report must be filed to the accidents/incidents reporting site at this link https://wws.nus.edu.sg/airs/report.aspx within 24 hours.

For emergencies, please call Campus Security at 68741616

Acknowledgement

This SOP is adapted from the SOP written by Mr. H K Wong for the SSL Lab.