



COMPRESSED GASSES HAZARDS

Introduction

A compressed gas is a substance that is a gas at normal room temperature and pressure, and is contained under pressure, usually in a cylinder. Some compressed gases (e.g. acetylene) are stabilized in the cylinder by dissolving the gas in a liquid or solid matrix.

There are three major groups of compressed gases stored in cylinders:

Liquefied Gases

Liquefied gases are gases which can become liquids at normal temperatures when they are inside cylinders under pressure. They exist inside the cylinder in a liquid-vapor balance or equilibrium. Initially the cylinder is almost full of liquid, and gas fills the space above the liquid. As gas is removed from the cylinder, enough liquid evaporates to replace it, keeping the pressure in the cylinder constant. Anhydrous ammonia, chlorine, propane, nitrous oxide and carbon dioxide are examples of liquefied gases.

Non-Liquefied Gases

Non-liquefied gases are also known as compressed, pressurized or permanent gases. These gases do not become liquid when they are compressed at normal temperatures, even at very high pressures. Common examples of these are oxygen, nitrogen, helium and argon.

Dissolved Gases

Acetylene is the only common dissolved gas. Acetylene is chemically very unstable. Even at atmospheric pressure, acetylene gas can explode. Nevertheless, acetylene is routinely stored and used safely in cylinders at high pressures (up to 250 psig at 21°C). This is possible because acetylene cylinders are fully packed with an inert, porous filler. The filler is saturated with acetone or other suitable solvent. When acetylene gas is added to the cylinder, the gas dissolves in the acetone. Acetylene in solution is stable.

However, nitrogen is frequently used in aircraft maintenance activities. The effective choice of compressed gas usually used in oleo struts charging and the refilling of the gas is an essential part of the maintenance process. For inflation systems, escape slides and life-rafts use nitrogen gas due to its inert, non-explosive properties.



Hazards of Compressed Gases

Sudden, uncontrolled release of cylinder contents – damaged cylinders can rocket or spin out of control causing significant injury and damage. Knocking over an uncapped cylinder breaking the cylinder valve can cause this type of incident.

Suffocation – a compressed gas cylinder contains a huge volume of the chemical. For example, a litre of liquid nitrogen forms 700 litres of nitrogen gas at room temperature. A leak in a confined area could displace air and cause people to suffocate.

Frostbite – gases escaping from a cylinder may be very cold and cause frostbite. Severe frostbite can lead to serious permanent skin damage.

Other hazards – compressed gases may have other hazards such as health, fire or reactivity. Look for other WHMIS hazard symbols on the container.

Fire and Explosion Hazards Associated with Compressed Gases

Flammable Gases

Flammable gases, such as acetylene, butane, ethylene, hydrogen, methylamine and vinyl chloride, can burn or explode under certain conditions. Gas Concentration within the Flammable Range: The concentration of the gas in air (or in contact with an oxidizing gas) must be between its lower flammable limit (LFL) and upper flammable limit (UFL) [sometimes called the lower and upper explosive limits (LEL and UEL)]. For example, the LFL of hydrogen gas in air is 4 percent and its UFL is 75 percent (at atmospheric pressure and temperature). This means that hydrogen can be ignited when its concentration in the air is between 4 and 75 percent. A concentration of hydrogen below 4 percent is too "lean" to burn. Hydrogen gas levels above 75 percent are too "rich" to burn.

Oxidizing Gases

Oxidizing gases include any gases containing oxygen at higher than atmospheric concentrations (above 23-25 percent), nitrogen oxides, and halogen gases such as chlorine and fluorine. These gases can react rapidly and violently with combustible materials. Normal oxygen content in air is 21 percent. At slightly higher oxygen concentrations, for example 25 percent, combustible materials, including clothing fabrics, ignite more easily and burn much faster. Fires in atmospheres enriched with oxidizing gases are very hard to extinguish and can spread rapidly.

Dangerously Reactive Gases

Some pure compressed gases are chemically unstable. If exposed to slight temperature or pressure increases, or mechanical shock, they can readily undergo certain types of chemical reactions such as polymerization or decomposition. These reactions may become violent, resulting in fire or explosion. Some dangerously reactive gases have other chemicals, called inhibitors, added to prevent these hazardous reactions.

Common dangerously reactive gases are acetylene, 1,3-butadiene, methyl acetylene, vinyl chloride, tetrafluoroethylene and vinyl fluoride.

Industrial Standard Gas Cylinder Colour Code and Identification



- A** Name of Product, **B** Material identification number, **C** Hazard diamond,
- D** Hazards and precautions, **E** Contact information

NEVER *ASSUME* CYLINDER CONTENT
***ALWAYS* CHECK THE LABEL**

COMPRESSED GAS CYLINDERS – SAFE STORAGE & HANDLING

1. When receiving, storing and handling all compressed gas cylinders, observe the following precautions. From the safety standpoint, all cylinders should be considered "full", although some of the contents may have been released in use.
2. Cylinders received from suppliers shall be in good condition and contents clearly identified.
3. Valve protection caps shall always be in place, hand tight, except when cylinders are in used or connected for use.
4. Cylinders in storage and in service shall be securely held in substantial racks or secured to other rigid structures in a vertical position so that they will not fall or be knocked over. Cylinders of flammable gases shall not be stored near electrical conductors or other sources of electricity.
5. Cylinders shall be stored in a well ventilate area where temperature is below 125°F/51.6°C. to prevent the accumulation of flammable gases in the atmosphere.
6. Non compatible gases shall be separated. Flammable gases shall be separated for non-flammable gases. Oxygen cylinders in storage shall be separated from fuel- gas cylinders or combustible materials by a minimum distance of 20 feet or by a non-combustible barrier at least 5 feet high having a fire resistance rating of at least one-half hour.
7. Acetylene cylinders shall never be stored or transported horizontally. Flammable gas cylinder shall be stored with extreme care to prevent fires or explosion.
8. No one shall tamper with the valves or safety devices on cylinders.
9. Empty cylinders shall be separated from full cylinders and clearly marked/identified (M.T).
10. Cylinders stored in the open shall be adequately protected from extreme heat or cold, accidental damage or where they shall be subjected to corrosive chemicals or similar materials.
11. Adequate warning signs shall be posted to indicate that all sources of ignition, smoking, carrying of matches is prohibited within 50 ft.
12. Compressed gas cylinders shall be stored on end on a smoother floor. All cylinders shall be chained or otherwise fastened firmly against a wall, post, or other solid object. Different kinds of gases shall be either separated by aisles or stored in separate sections of the building or storage yard.
13. Cylinders shall not be dropped or struck or permitted to strike each other violently.
14. Valve protection caps shall not be used for lifting cylinders, nor shall ropes, chain slings, or magnets be used.
15. To transport cylinders, use a carrier that does not allow excessive movement, sudden and violent contacts, and upsets. Except for acetylene, compressed gas cylinder shall be transported in a horizontal or vertical position. Acetylene cylinders shall be loaded only in the vertical position.

16. Suitable trucks or dollies shall be used to convey cylinders to which they are securely fastened. Acetylene cylinders shall not be transported in a horizontal position. When a two-wheeled truck with rounded back is used, chain the cylinder upright.
17. No person, other than the gas supplier shall attempt to mix gases in a cylinder. No one except the owner (supplier) of the cylinder or person authorized by him shall refill a cylinder.
18. Do not use cylinders as roller or support.
19. Never drag a cylinder when moving it.
20. Valves shall be closed when cylinders are not in use.
21. Flammable gas cylinders must be handled with care to minimize the danger of fire or explosion. Valves covers shall be installed when cylinders are not in use.
22. When in doubt as to how to handle a compressed gas cylinder, or how to control a gas once it is released from the cylinder or other sources, consult the Safety Department.
23. Cylinder valves will be opened by hand unless it is equipped with a wrench key. Jammed valves shall not be freed by forcing or hammering as this causes damage to the equipment, gas leaks or create sources of possible ignition.

