

Contents

About Compressed Gas..... 2

Hazards Associated with Compressed Gas..... 2

Pressure Hazards..... 2

Asphyxiation Hazards..... 2

Physical Hazards..... 3

Fire and Explosion Hazards..... 3

Health Hazards..... 3

Chemical Burn Hazards..... 3

Precautions to Prevent Injuries and Accidents..... 3

Cylinders Storage..... 4

Cylinders Storage Area..... 4

Storage Area Conditions..... 4

Securing Cylinders in Storage 4

Cylinders Temperature Exposure..... 5

Storing Empty Cylinders..... 5

Safe Handling..... 5

Usage and Installation..... 6

Visual Inspection..... 6

Labeling..... 6

Securing Cylinders during Use..... 6

Initiating Service of Cylinder..... 6

Valve Outlet Connections and Fittings..... 7

Terminating Service of Cylinders..... 7

Cylinder Transport and Restraint..... 7

Hand Transportation..... 7

Vehicle Transport..... 7-8

What is compressed gas?

In general, a compressed gas is a material contained under pressure which is either permanent gas or liquified gas by compression, refrigeration or dissolved. Compressed gases are hazardous by their nature, they are capable of creating environments that are either flammable, oxygen enriched, or oxygen deficient.

For example: A common Gas (Nitrogen) comprises almost 79% of the earth's atmosphere, can displace breathable oxygen in an enclosed space and cause asphyxiation because of undetected escape.

What are the main hazards associated with compressed gas?

A Cylinder containing compressed, liquefied or dissolved gas can create a dangerous situation in the event of a fire, as they may explode as a result of the heat generation. Cylinders should be considered as a pressure vessel and need to be handled accordingly to prevent:

Pressure Hazards: All compressed gases are hazardous due to high pressure inside the cylinder.

If the things go wrong and the valve is broken off, a pressurized cylinder can:

- Become a high-speed projectiles and flow over a half mile and harming those in their path.
- Penetrate a concrete-block wall.
- Displace Oxygen from the environment.
- Spin and ricochet completely out of control.
- Immediately freeze the exposed skin.
- Explode with tremendous force.
- Virtually unstoppable.

Asphyxiation Hazards: Asphyxiation is an extreme hazard associated with inert gases or Cryogenic Liquid while working in enclosed spaces.

An undetected escape of inert gas into the atmosphere can quickly reduce the oxygen levels below than the concentrations necessary to support consciousness and life.

Cryogenic liquid generates a large volume of cold inert gas (e.g. 1 liter of liquid nitrogen will produce 680 liters gaseous product) that will displace ambient air, causing oxygen deficiency. Cryogenic Liquid can cause serious cold burns also on contact with the skin.

The most common oxygen displacing gases are:

- **Nitrogen**
- **Argon**
- **Carbon Dioxide**
- **Helium**

Physical Hazards: Compressed gas cylinders are large, heavy and awkward to handle. Improper handling, or not properly securing cylinders while in use, can cause cylinders to fall or roll. Their weight alone can trigger a disaster, do damage, causing injury or even kill workers.

Fire and Explosion Hazards: Flammable gases such as acetylene, butane and hydrogen can burn or explode under certain conditions. If flammable gases are allowed to accumulate until their concentration is between their defined Lower Explosion Limit (LEL) and Upper Explosion Limit (UEL), an explosion may occur if there is an ignition source present.

Health Hazards: Many gases are toxic that can cause serious health problems dependent upon the specific gas concentration, length of exposure, and route of entry. Health symptoms of exposure to gases can be immediate or delayed.

Chemical Burn Hazards: Some compressed gases are corrosive and can attack chemically various materials including fire resistance clothing. They can burn or damage skin on contact, burn the eyes or lungs if inhaled.

What are the precautions to prevent injuries and accidents?

A safe work practice always helps to prevent injuries and property damage when working with or around compressed gas cylinders. Users should review this procedure and implement the applicable hazard control measures according to Material Safety Data Sheet (MSDS), as almost all accidents involving compressed gases initially result from not following established methods for the safe handling, use, lifting, transport, and storage of compressed gas cylinders. The main causes of accidents are:

- Poor Storage & Handling.
- Poor Examination.
- Faulty Equipment and/or Design (e.g. badly fitted valves and regulators).
- Unplanned Releases of Gas.
- Hidden Damage of Cylinders.
- Inadequate Training and Supervision for Handling the Cylinders.

Remember, your safety depends on you while using compressed gas cylinders. Follow the following procedures to prevent injuries & accidents:

Cylinders Storage:

It's a huge area of concern, as many possible hazards can arise as a result of incorrect handling combined with unsecured storage. The key point to remember about gas cylinders is that they are unstable and can turn into veritable projectiles with the escape of high-pressure gas. Specific requirements are found in:

Cylinders Storage Area:

- Store gas cylinders in a ventilated and well illuminated area away from combustible materials.
- Separate gases by type, and store them in assigned locations that can be readily identified.
- Store cylinders "containing flammable Gases" at least 20 feet (6.1 meters) away from those cylinders containing oxygen or other oxidants, or it should be separated by a fire-resistant wall with a rating of at least 30 minutes.
- Stored Toxic/Poison gases in a chemical fume hood or in a properly ventilated gas cabinet.
- Do not remove or alter the content identification of cylinders i.e. Label, Decals.
- Store cylinders in place where they can be protected from tampering by unauthorized person.

Storage Area Conditions:

Cylinders storage location should be away from the source of:

- Excess Heat
- Open Flame or Ignition
- Corrosive Chemicals
- Chemical Vapors
- Direct Sunlight
- Damp or Salt

The storage area should be dry cool and well ventilated.

Securing Cylinders in Storage:

Securing cylinders is one of the major concerns of safety in order to avoid risk of cylinders falling over, and possibly shearing off its valve. The assigned storage places should be located in the area where cylinders will not be knocked over or damaged by passing or falling objects.

- To prevent falling, cylinders must be secured upright and in place by using approved chains, straps, stands or carts.
- To protect the withdrawal valve of cylinders, the valve protection caps must be firmly in place and tightened.

Cylinders Temperature Exposure:

The integrity of gas cylinders can be compromised if stored at high temperatures or exposed to excessive heat under direct sunlight.

- Cylinders should never be exposed to above 52°C, as excessive heat above 65°C results in an increase in internal pressure.
- Avoid storing cylinders below 0°C especially if the gas is mixture, as some mixtures may separate below this temperature.
- A cylinder if become frozen to a surface, can be freed by using warm water (less than 52°C), but never apply direct heat to a cylinder.

Storing Empty cylinders:

- Cylinder below than 25psi should be considered as empty in order to prevent air suck-back that may allow moisture and contaminants to enter the cylinder.
- Use first-in first-out inventory control method in order to use old stock first and segregate them with clear identified marking of "Full & Empty".
- Do not keep gas cylinders for extended period, as this may cause cylinders damage.

Safe Handling:

Never avoid safety measure while handling compressed gas cylinders, as improper use may result explosion, killing workers, and destroying equipment and damage the property. Safe handling guidelines include:

- Compressed gas cylinders should be handled only by those familiar with the hazards and who can demonstrate safety precautions while working with cylinders.
- Eye protection and appropriate footwear should be always used when transporting compressed gas cylinders even for short distance.
- Use suitable cradles, slings, clamps or other effective means when lifting cylinders with a hoist or crane.
- Gas cylinders should not be raised or lowered on the forks of lift trucks unless adequate precautions are taken to prevent them from falling.
- Cylinders must not be allowed to stand or lie in water.
- Always wear personal protective equipment (PPE) appropriate for the hazard potential of the material being worked with. Refer to the MSDS of concerned gas for details on the safe handling of the material.

Usage and Installation:

Cylinders internal pressure and their toxic and/or flammable properties are the main hazards during usage and Installation. The following precautionary steps should be taken:

Visual Inspection:

Compressed gas cylinders must be initially inspected before being placed into service to ensure that they are in safe condition. Cylinders can be visually condemned for any of the following reasons:

- Dent Cuts, Gouges or Digs.
- Evidence of Physical Abuse.
- Bulges Attachment.
- Neck Defects, Crevice Pitting.
- Defective Valves.
- Fire Damage, Arc or Torch Burns.
- Rusting or Corrosion.

Labeling:

- If a cylinder's content is not clearly identified by proper labels, it should not be accepted for use.
- Do not rely on the color of cylinders for identification.
- Ensure that equipment is used only with those gases for which it is designed.
- Gases should not be used for any propose other than their use has been authorized.

Securing Cylinders during Use:

- Cylinder must be secured with a fastener while in use.
- Never leave a cylinder standing unrestrained, even temporarily while it's being replaced or installed.

Initiating Service of Cylinder:

- Secure the cylinder before removing valve protection cap.
- Inspect the cylinders valve before use, and do not open if appears to be damaged or corroded, as it may not reseal properly if opened.
- Use clean cloth to remove any dust or dirt from the valve if found.
- Cleanliness and material requirements for oxygen or another oxidant service must be observed strictly.
- Do not attempt to use If oil or grease found on the valve of cylinders, as such substances in contact with an oxidant are explosive.
- Do not use copper fittings on acetylene cylinders, as it reacts with copper to form explosive acetylide compounds.

Valve Outlet Connections and Fittings:

- Ensure all fittings and connections, and never force to fit if the connections do not fit together readily. Seek additional information before proceeding.
- Stay aside from the regulator face when opening valve first time, as regulator may explode under pressure if fail.
- Teflon tape should never be used on cylinder connection or tube fitting connections, as it may become powdered and get caught on the regulator poppet, causing full pressure downstream.

Terminating Service of Cylinders:

- Before a regulator is removed from a cylinder, close the cylinder valve and release all pressure from the regulator.
- Always disconnect equipment from the cylinder when not in use and return the valve protection cap to the cylinder.

Cylinder Transport and Restraint:

Most cylinder accidents occur during transport are due to improper restraint. By taking a few simple precautions and following some guidelines, operators can prevent all accidents of this type.

Hand Transportation:

- When preparing to move a cylinder, even for just a short distance, make sure the protective cap is in place and tightened.
- Use hand truck, cart or dolly, especially designed for the propose to move a heavy compressed gas cylinder.
- Do not use the valve cover to lift cylinders, as they could be damaged and become unattached.
- **REMEMBER**, If the cylinder is dropped on a hard surface it can cause an explosion.

Vehicle Transport:

- Make sure cylinders are properly restrained to avoid moving during transport, even in the event of a minor collision.
- Limit the number of cylinders to be transported according to Vehicle capacity.
- Use open vehicles or trailers in preference to any enclosed vehicles or trailers.
- Do not cover your vehicle with a tarpaulin.
- Use leather protective gloves when handling cylinders in order to keep your hands clean as well as protected from minor injuries such as getting fingers stuck between two cylinders or getting a cut from a sharp metallic edge on a pressure fitting or cylinder cap.

Vehicle Transport (Continued):

- Wear safety shoes or boots, and safety glasses or goggles.
- Never Transport Dissolved Acetylene and liquified gases (such as CO₂) horizontally. These cylinders must be transported upright.
- Ensure cylinders cap in place, as cylinder caps are designed to protect the cylinder valve and prevent sudden decompression in the event that the cylinder falls or is hit by something.

Important Note:

Firefighting cylinders with personnel safety and first aid equipment should be always available for emergency. Ensure adequate personnel are trained in the use of this equipment.

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