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# Safe Use of Industrial Compressed Gas Cylinder

**Dr. S. B. Mishra, Dr. Arkaprabha Sau, Bhupendra Chakradhari**
Director (Industrial Hygiene), Regional Labour Institute, Kolkata, India
Deputy Director (Medical), Regional Labour Institute, Kolkata, India
Deputy Director (Safety), Regional Labour Institute, Kolkata, India

***Abstract:*** Compressed gas cylinders are widely used in manufacturing industries, construction sites, hospitals, and laboratories for applications such as welding, cutting, chemical processing, medical treatment, and research. Although essential for many operations, they can pose serious safety hazards if not handled, stored, or transported properly. Compressed gases are stored under high pressure and may present both physical and chemical hazards. The major hazards include fire, explosion, toxicity, corrosiveness, oxidation, and asphyxiation. More than 200 different gases are commonly supplied in cylinders, including atmospheric gases (oxygen, nitrogen, argon), fuel gases (acetylene, hydrogen, propane), refrigerants, medical gases, and toxic gases such as chlorine and ammonia. One of the most significant dangers associated with compressed gas cylinders is the accidental release of gas due to valve damage, improper handling, or exposure to excessive heat. Such a release can generate tremendous force, turning a cylinder into a missile-like projectile capable of causing severe injuries, fatalities, and extensive property damage. In extreme cases, cylinders have been known to penetrate concrete walls. Additionally, leaks of flammable gases can result in fires or explosions, while toxic gases may cause serious health effects. To minimize these risks, strict safety practices must be followed during the storage, handling, transportation, and use of compressed gas cylinders. Proper training, regular inspection, secure storage, use of suitable personal protective equipment, and adherence to established safety procedures are essential to ensure the safety of personnel, equipment, and the workplace environment.

*Index Terms* - Compressed Gas Cylinders, Hazardous Gases, Storage and Handling, Occupational Safety.

## I. INTRODUCTION

Compressed gas cylinders are widely used in industrial facilities, laboratories, healthcare institutions, and construction sites for applications such as welding, cutting, chemical processing, refrigeration, and scientific research. Although indispensable in modern industry, compressed gases present significant safety hazards owing to their physical and chemical properties. Since these gases are stored under high pressure, improper storage, handling, or transportation can result in serious accidents causing injury, loss of life, and damage to property [1,2].

The hazards associated with compressed gases include fire, explosion, toxicity, corrosiveness, oxidation, and asphyxiation. In addition to these chemical hazards, the stored pressure itself constitutes a major physical hazard. More than 200 different gases are commercially supplied in cylinders, including

atmospheric gases, fuel gases, refrigerants, toxic gases, oxidizers, and specialty gases used in industrial and laboratory settings [3]. Based on their hazardous characteristics, compressed gases are generally classified into categories such as flammable, oxidizing, toxic, corrosive, inert, and cryogenic gases, with some gases exhibiting multiple hazard classes [4].

One of the most severe risks associated with compressed gas cylinders is the sudden and uncontrolled release of gas resulting from valve failure, mechanical damage, excessive heat exposure, or improper handling. Such incidents can transform a cylinder into a high-velocity projectile capable of causing catastrophic damage. Reports have documented cases where propelled cylinders penetrated concrete-block walls and caused fatal injuries [2,5]. Therefore, strict adherence to established procedures for the storage, handling, transportation, and use of compressed gas cylinders is essential to ensure workplace safety and prevent potentially devastating accidents.

## II. Identification of Contents in Compressed Gas Cylinders

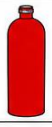
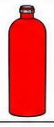
Proper identification of the contents of compressed gas cylinders is essential for ensuring safe handling and use. Cylinders whose contents cannot be clearly identified or whose labels are missing, damaged, or illegible should never be used, transported, or shipped. Labels and markings on cylinders must be durable and securely affixed so that they remain legible throughout handling, storage, and transportation. If the identification label becomes unclear or unreadable, the cylinder should be immediately removed from service, marked as “Contents Unknown,” and the manufacturer or supplier should be contacted for guidance. Gas cylinders should be accepted only when they are properly labeled and colour-coded in accordance with the applicable national or international standards. In addition, identification tags should be attached to cylinders to record important information such as the name of the user, date of issue, and date of use. Maintaining proper identification and usage records helps prevent accidental misuse of gases and enhances overall workplace safety.

### Colour Coding of Non-Medical Gas Cylinders

In addition to labels and markings, non-medical gas cylinders should be colour coded in accordance with IS 4379:2021, Identification of the Contents of Industrial Gas Cylinders, to facilitate rapid visual identification of their contents [6]. The colour identification consists of a ground colour and one or more colour bands painted on the cylinder body and shoulder. Common examples include oxygen cylinders painted black with a white shoulder, acetylene cylinders maroon, hydrogen cylinders red, nitrogen cylinders grey with a black shoulder, and argon cylinders peacock blue. Colour coding serves as an important supplementary means of identification; however, it should never be used as the sole method for determining cylinder contents. Users must always verify the gas name, chemical formula, and hazard labels affixed to the cylinder before use. Cylinders with damaged, faded, or incorrect colour markings should be withdrawn from service until proper identification is restored. A representative colour-coding scheme for industrial gas cylinders as per IS 4379 is shown in Figure 1.

**COLOUR SPECIFICATIONS FOR SELECTED INDUSTRIAL GAS CYLINDERS (NON-MEDICAL)**

| Name of the Gas | | Oxygen ($O_2$) | Nitrogen ($N_2$) | Carbon Dioxide ($CO_2$) | Ammonia ($NH_3$) | Freon 12 ($CCl_2F_2$) |
|---|---|---|---|---|---|---|
| Visual Identification | |  |  |  |  |  |
| Distinctive Colour: | Body | Black | Grey | Black | Black | Bottom Grey, Neck and Violet |
| | Band | None | Black | White | Red & Yellow | None |
| Pressure when fully charged at 30 °C (approx.) | Kg/sq.cm | 139 | 139 | 18 | 11 | 8 |
| | Lbs/sq.cm | 1980 | 1980 | 260 | 155 | 115 |

| Name of the Gas | | Argon (A) | Chlorine ($Cl_2$) | Hydrogen ($H_2$) | Acetylene ($C_2H_2$) | L.P.G. Commercial Butane ($C_4H_{10}$) (80%) | Air |
|---|---|---|---|---|---|---|---|
| Visual Identification | |  |  |  |  |  |  |
| Distinctive Colour: | Body | Blue | Yellow | Red | Maroon | Red | Grey |
| | Band | None | None | None | None | None | None |
| Pressure when fully charged at 30 °C (approx.) | Kg/sq.cm | 139 | 8 | 139 | 18 | 3 | 139 |
| | Lbs/sq.cm | 1980 | 114 | 1980 | 250 | 45 | 1980 |

**NOTE:** The colour of the cylinder refers to the body and shoulder (neck) of the cylinder. Bands, if required, shall be painted on the shoulder.

Source: IS 4379:1981 – Identification of the Contents of Industrial Gas Cylinders.

Figure-1: Colour identification of selected industrial gas cylinders as specified in IS 4379:2021. The colour coding comprises a ground colour and shoulder colour band(s) to aid visual identification of cylinder contents.

## TRANSPORTING GAS CYLINDERS

Compressed gas cylinders should be transported with utmost care to prevent damage, leakage, or accidental release of gas. Before transportation, all cylinders must be fitted with valve protection caps, which should be securely screwed onto the cylinder neck to protect the valve from impact. Cylinders should never be lifted, carried, or suspended by their protective caps, as these are designed solely to protect the valve and are not intended to support the cylinder's weight.

When transported by trucks or other vehicles, cylinders should be secured in an upright position using appropriate restraints to prevent them from falling, rolling, or striking one another during transit. Regulators and other attached equipment should be removed before transportation to minimize the risk of damage to the cylinder valve. For manual movement within the workplace, suitable cylinder trolleys or carts should always be used [Figure-2]. Cylinders should never be dragged, slid, rolled horizontally, or dropped, as such practices can damage the cylinder, valve, or safety devices and may lead to hazardous incidents. Adhering to these safe transportation practices helps ensure the protection of personnel, equipment, and the workplace environment.

Figure-2: Cylinder trolley used for the safe handling and transportation of compressed gas cylinders.

## STORING COMPRESSED GAS CYLINDERS

Compressed gas cylinders should be stored in accordance with applicable standards such as ISO 11625 to ensure safety and regulatory compliance. Cylinders should be segregated based on the compatibility of their hazards. For example, flammable gas cylinders should not be stored together with oxygen or other oxidizing gases, as such combinations can significantly increase the risk of fire and explosion. Liquefied flammable gas cylinders should always be stored in an upright position, or in a manner that ensures the pressure relief device remains in direct communication with the vapor space of the cylinder [Figure-3].

Oxygen cylinders, whether full or empty, should be separated from fuel-gas cylinders and combustible materials by a minimum distance of 6 m (20 ft) or by a non-combustible barrier at least 1.5 m (5 ft) high with a fire-resistance rating of not less than 30 minutes. Valve protection caps should remain in place at all times except when cylinders are being used or refilled. Cylinders should be stored in a well-ventilated area away from open flames, sparks, hot surfaces, electrical circuits, and other potential sources of ignition.

To avoid confusion and facilitate inventory management, full and empty cylinders should be stored separately and clearly identified using appropriate signs or markings. Storage areas should be kept dry and free from corrosive substances. Cylinders should not be exposed to prolonged dampness, salt spray, or corrosive chemicals and fumes, as corrosion can weaken the cylinder structure and cause valve protection caps and fittings to seize, creating additional safety hazards.

Figure-3: Representative compressed gas cylinder storage area showing cylinders stored upright in dedicated racks with chain restraints

## III. DO'S AND DON'TS FOR SAFE HANDLING, STORAGE, AND USE OF COMPRESSED GAS CYLINDERS

### HANDLING OF COMPRESSED GAS CYLINDERS

**Do Not**

- Drag, slide, roll, or drop gas cylinders, even for short distances.
- Carry or lift cylinders by the valve or valve protection cap.
- Use an open flame to detect gas leaks.
- Attempt to mix gases inside a cylinder.
- Allow cylinders to strike each other violently.
- Force incompatible regulators, fittings, or attachments onto a cylinder.
- Subject cylinders to mechanical shocks that may damage valves or pressure-relief devices.
- Use cylinders as rollers for moving materials or equipment.
- Tamper with pressure-relief devices.
- Allow oil, grease, or other combustible materials to come into contact with oxygen or oxidizer cylinders and associated equipment.
- Remove product labels, hazard labels, or identification markings.
- Lift cylinders using magnets, ropes, or slings attached to the protective cap [7,12].

**Do**

- Move cylinders using approved cylinder trolleys, hand trucks, or carts.
- Keep valve protection caps and outlet seals in place until the cylinder is secured and ready for use.
- Use a cylinder cage, cradle, or approved lifting device when lifting cylinders mechanically.
- Wear appropriate PPE.
- Use at least two persons when manually moving portable cylinder banks [7,12].

## STORAGE OF COMPRESSED GAS CYLINDERS

**Do Not**

- Allow storage temperatures to exceed 52°C (125°F).
- Permit smoking, open flames, or ignition sources in storage areas.
- Store cylinders in corrosive environments.
- Store incompatible gases together.
- Block emergency exits with stored cylinders [7,10–12].

**Do**

- Store cylinders upright with valve protection caps in place.
- Store cylinders in designated, secure, cool, dry, and well-ventilated areas.
- Segregate cylinders according to hazard classification.
- Store full and empty cylinders separately.
- Maintain separation between oxygen and fuel-gas cylinders.
- Conduct routine inspections for leakage, corrosion, or damage [7,10–12].

## PROPER USE OF COMPRESSED GAS CYLINDERS

**Do Not**

- Use oxygen as a substitute for compressed air.
- Attempt to mix gases within a cylinder.
- Expose cylinders to temperatures above 52°C (125°F).
- Strike welding arcs on cylinders.
- Use cylinder colour alone to identify cylinder contents.
- Refill non-refillable cylinders.
- Force incompatible valve connections [7,8,12].

**Do**

- Use approved pressure regulators and pressure-relief devices.
- Leak-test systems before use.
- Install check valves to prevent reverse flow.
- Open cylinder valves slowly.
- Verify cylinder contents using the cylinder label before use.
- Follow manufacturer instructions and site-specific safety procedures [7,8,12].

## Conclusion

The Compressed gas cylinders are indispensable in industrial, healthcare, laboratory, and construction environments; however, they present significant physical and chemical hazards due to their high-pressure contents and the properties of the gases they contain. Fires, explosions, toxic exposures, asphyxiation, and projectile hazards resulting from improper handling or storage can lead to severe injuries, fatalities, and extensive property damage. Therefore, ensuring the safe identification, transportation, handling, storage, and use of compressed gas cylinders is a critical component of workplace safety management. Compliance with applicable regulations, standards, and recommended practices, including proper cylinder identification and colour coding, segregation of incompatible gases, secure storage arrangements, routine inspection, and the use of appropriate handling equipment, can substantially reduce the risk of accidents. Equally important are employee training, adherence to established operating procedures, and the consistent application of safe work practices. Organizations should foster a strong safety culture in which compressed gas hazards are recognized, assessed, and controlled through engineering measures, administrative controls, and the use of

appropriate personal protective equipment. By following the recommended do's and don'ts outlined in this article and complying with relevant statutory requirements and standards, workplaces can ensure the safe management of compressed gases, thereby protecting workers, equipment, property, and the environment.

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