

Cylinders: Safety precautions

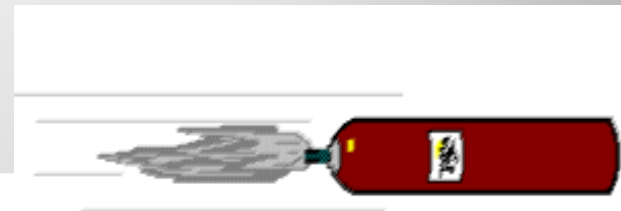


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Main Causes of Accidents



- Inadequate training and supervision
- Poor installation
- Poor maintenance
- Faulty equipment and/or design(e.g badly fitting valves or regulators)
- Poor handling
- Poor storage
- Inadequately ventilated working conditions



A **gas cylinder** is a pressure vessel for storage and containment of gases at above atmospheric pressure. Inside the cylinder the stored contents may be in a state of compressed gas, vapor over liquid, supercritical fluid, or dissolved in a substrate material, depending on the physical characteristics of the contents.

Compressed Gas

Any material or mixture with an in-container pressure exceeding 40 psia at 70°F, or a pressure exceeding 104 psia at 130°F, or any liquid flammable material having a vapor pressure exceeding 40 psia at 100°F



Types of Gases

There are three types of gases commonly supplied and used:

1. Compressed Gases – Nitrogen, Oxygen, Air, Carbon Dioxide, Helium
2. Liquefied Gases – LPG, Liquefied Nitrous Oxide
3. Dissolved Gases – Acetylene

Types of Gas Cylinders

In general, there are three types of gas cylinders:

1. High Pressure Cylinders – High pressure cylinders come in a variety of sizes.

Ex. Nitrogen, Helium, Hydrogen, Oxygen and Carbon Dioxide.

2. Low Pressure Cylinders – Low pressure cylinders come in a variety of sizes.





Ex. LPG and refrigerant gases.

3. Acetylene Cylinders – Acetylene is in a class of its own as the cylinder is filled with an aggregate material and dissolved in a liquid medium (acetone).

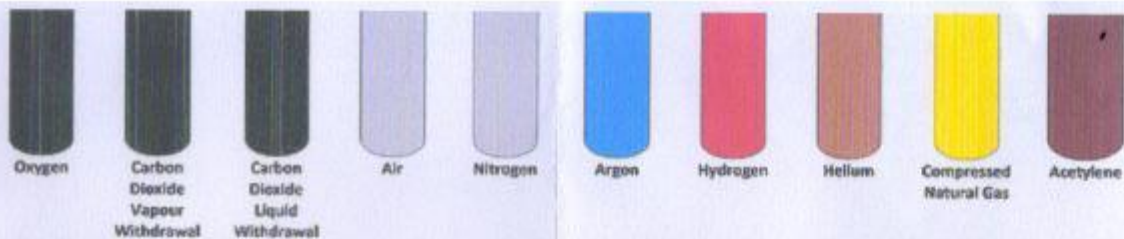
- ❖ Compressed gases used in a variety of industrial and laboratory situations
- ❖ Compressed gases present a unique hazard. Depending on the particular gas, there is a potential for simultaneous exposure to both mechanical and chemical hazards
- ❖ Gases can be:
 - Flammable or combustible
 - Explosive
 - Corrosive
 - Poisonous/toxic
 - Inert
 - Cryogenic
 - Pyrophoric(burns on contact with air)
 - or a combination of hazards

- ❖ **Oxidants** support combustion e.g. **air & oxygen**
- ❖ **Inerts** do not generally react with other materials, asphyxiants (leak displace air) e.g. **nitrogen, argon, helium**
- ❖ **Flammables** when mixed with oxidant and ignition source will burn e.g. **acetylene, hydrogen, propane**
- ❖ **Toxics** toxic in small concentrations e.g. **ammonia, chlorine, carbon dioxide**
- ❖ **Corrosives** react with materials causing reactions e.g. **chlorine, sulfur dioxide**
- ❖ **Pyrophorics** ignite spontaneously in air e.g. **silane, phosphine**

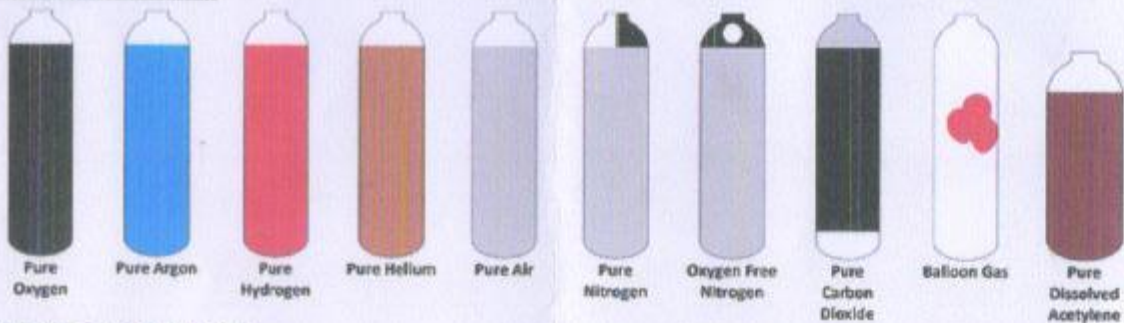
Classes of Gases

Dangerous Goods Diamond	Class	Examples
	Class 2.1 Flammable gas	LPG, hydrogen, acetylene
	Class 2.2 Non-flammable, non-toxic gases	Compressed air, nitrogen, argon, carbon dioxide, helium.
	Class 2.2, Sub-risk 5.1 Oxidizing gas	Oxygen, nitrous oxide, Entonox (50% oxygen, 50% nitrous oxide).
	Class 2.3 Toxic Gas	Methyl bromide, anhydrous ammonia, chlorine.

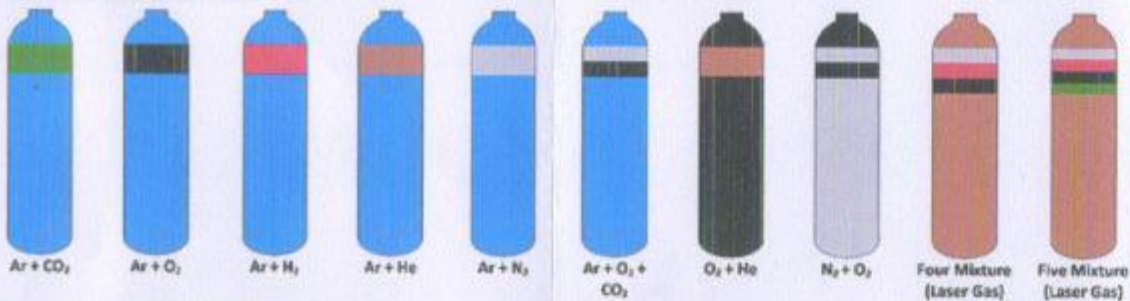




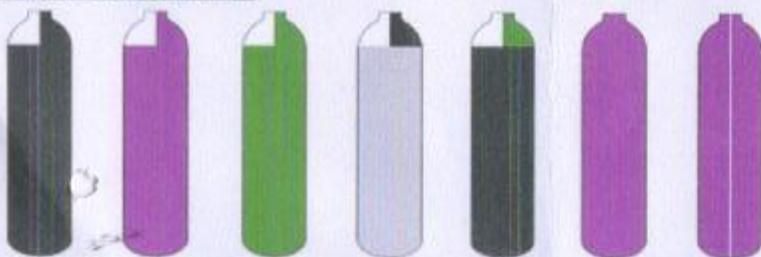
PURE GAS CYLINDER



MIXTURE GAS CYLINDER



MEDICAL GAS CYLINDER



WARNING!

Read all cylinder labels
and stenciled marks.
Do not rely on colour of
cylinder alone.

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Cylinder shoulder colours

By hazard property

Flammable	Red	
Toxic/corrosive	Yellow	
Inert	Bright green	
Oxidising	Pale blue	

Note: More than one hazard property may be shown on the cylinder shoulder e.g. red and yellow

By specific gas

Argon	Dark green	
Carbon dioxide	Dusty grey	
Helium	Brown	
Nitrogen	Black	
Nitrous oxide	Dark blue	
Oxygen	White	

Red = Flammable
 Yellow = Toxic or corrosive
 Light blue = Oxidising
 Bright green = Inert
 Red and yellow = Flammable and toxic
 Yellow and light blue = Toxic and oxidising



Flammable



Toxic or corrosive



Oxidising



Inert



Flammable and toxic



Toxic and oxidising

Oxygen
Industrial Grade
Laser Grade
High Purity Grade



Body: Black

Nitrogen
Industrial Grade
Laser Grade (Available in packs only)
High Purity Grade
VinAr



Body: Pewter

Carbon Dioxide
Industrial Grade
Laser Grade
FOGG®
High Purity Grade



Body: Green Grey

Argon
Welding Grade
High Purity Grade



Body: Peacock Blue

Helium
High Purity Grade
Laser Grade



Body: Brown

Acetylene
Industrial Grade
Instrument Grade



Bands: Green Grey
Body: Peacock Blue

Hydrogen
Industrial Grade
High Purity Grade



Bands: Black, Green Grey
Body: Peacock Blue

Air
Industrial Grade
Instrument Grade



Bands: Green Grey, Brown
Body: Peacock Blue

ARGOSHIELD® 40
STAINSHIELD®
SPECSHIELD® Copper



Bands: Black, Brown
Body: Peacock Blue



Bands: Signal Red, Green Grey
Body: Peacock Blue

ARGOPLAS® 5
ARGOPLAS® 20
ARGOPLAS® 35

ALUSHIELD® Light
ALUSHIELD® Universal



Band: Brown
Body: Peacock Blue

ALUSHIELD® Heavy



Band: Peacock Blue
Body: Brown

STAINSHIELD® Duplex



Bands: Pewter
Body: Peacock Blue

STAINSHIELD® Pipeline



Bands: Green Grey, Peacock Blue
Body: Brown

Refrigerant
R134a



Band: Aqua
Body: Galvanised or White

Refrigerant
R22



Band: Moss Green
Body: Galvanised or White

Ammonia
Refrigerant R717



Band: Slate
Body: Galvanised or White

Refrigerant (Extractor tube fitted)
R404A
R407C
R408A
R409A
R410A
R416A



Bands: Brown
Body: Galvanised or White

Refrigerant
R507

Flammable vapour air mixtures

A leakage of a flammable gas would form a flammable vapour air mixture.

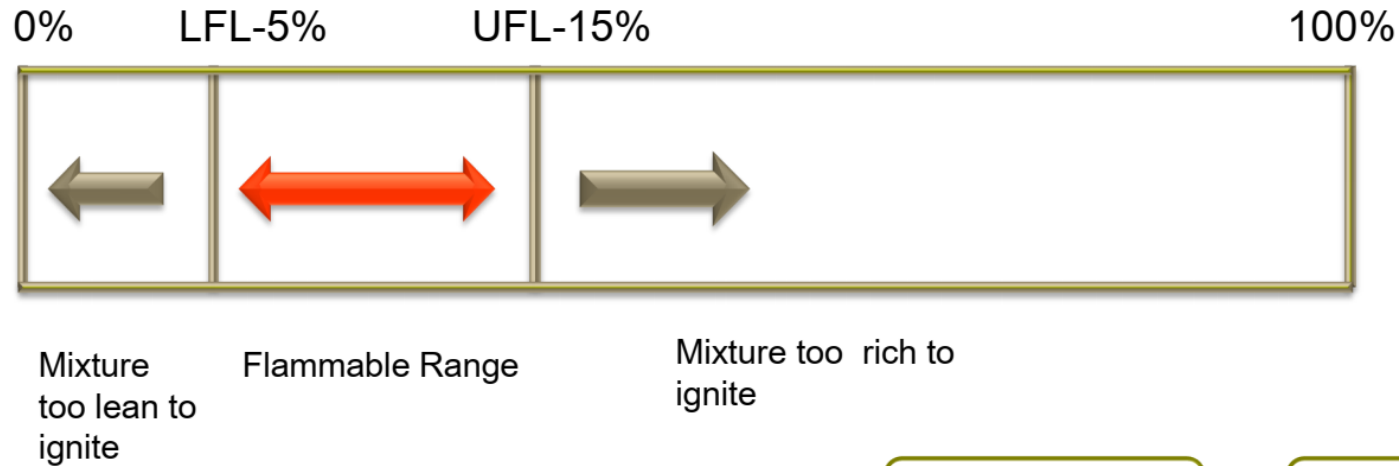
If the vapour air mixture is within the flammable range, it can explode in the presence of an ignition source.

Vapour air mixtures will only ignite within a well-specified range of composition.

The lower flammable limit (LFL) is the leanest mixture that can ignite, i.e., the mixture with the smallest fraction of combustible gas.

The upper flammable limit (UFL) is the richest fraction of combustible gas mixture that can ignite.

Flammable limits for methane gas.

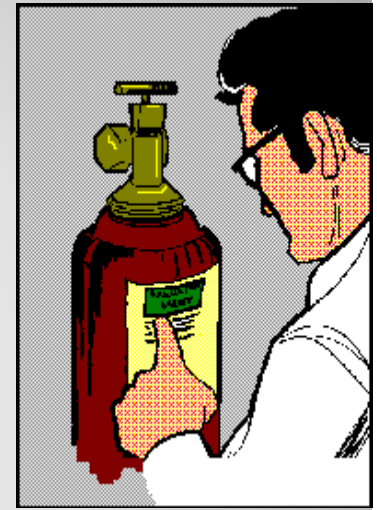


Flammable gas	LFL	UFL
Ethylene	2.7%	36%
Propane	2.4%	9.5%
Hydrogen	4.0%	75%
Carbon monoxide	12.5%	74%

Safe Working with Gas Cylinders

Daily Inspection

- Cylinders should be inspected daily and prior to each use for corrosion, leaks, cracks, etc.
- Inspection should include the cylinder, piping, safety relief devices, valves, protection caps and stems.
- Leaking regulators, cylinder valves or other equipment should be taken out of service.

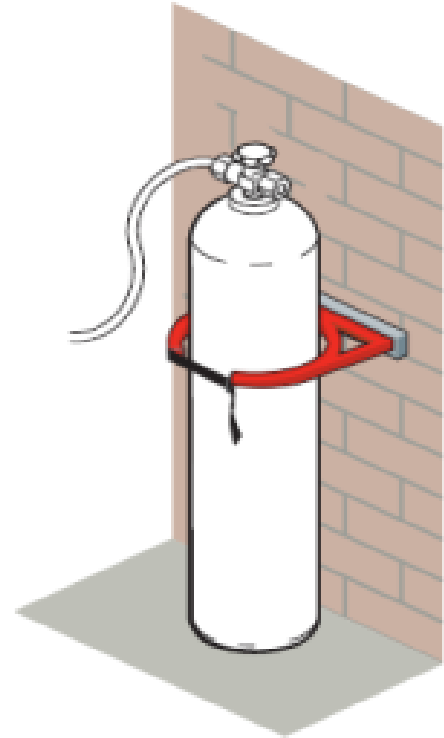




Open



Close



Do not expose gas cylinders to temperatures above 45° C. Overheating of cylinders can result in build up of pressure and explosion.

Do not store gas cylinders with other combustible materials.

Flammable substances, such as oil and other solvents, must not be stored in the same area. The floor used for storing gas cylinders must be dry, to prevent the corrosion of gas cylinders.

Never use oxygen regulator for flammable gases. An adaptor must not be used for connecting regulators. **Cross contamination of internal parts can result in rapid oxidation and fire.** Same is applicable for other oxidising gases.

The empty and full cylinders must be stored separately and clearly labelled/marked.

Do not use cylinders without a regulator.
Close the valve after usage or when the equipment is not in use.

Install gas detectors for detecting leaks.



Place the spindle key near the gas cylinder, so that the valve can be quickly closed in case of an emergency.

Cylinders must always be kept chained or supported in a manner to prevent fall.

Refer the Material Safety Data Sheet (**MSDS**) for the gas before usage, to know about the hazards and precautions to be taken.

A cylinder must never be emptied to a pressure lower than 25 psi as the residual contents may become contaminated if the valve is left open.

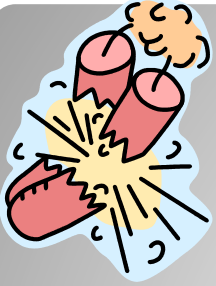
Close cylinder valve whenever:
work is finished
cylinder is empty



A regulator is a device that receives gas at a high pressure and reduces it to a much lower working pressure



❖ Acetylene gas under excess pressure becomes unstable



After the regulator is attached, the cylinder valve should be opened just enough to indicate pressure on the regulator gauge (no more than one full turn) and all the connections checked with a soap solution for leaks.



Never use oil or grease on the regulator of a cylinder valve.

- Before a regulator is removed from a cylinder, the cylinder valve shall be closed and the regulator relieved of gas pressure.
- Regulators, gauges, hoses and other apparatus shall not be used on gas cylinders having different chemical properties

First aid measures

In case of contact of corrosive/toxic gas with eyes-flush with water for at least 15 min.

In case of skin contact, remove contaminated clothing and flush the affected part with water. An emergency shower can be used for the same.

In case of inhalation of gas, remove the person to fresh air.

Get immediate medical attention. Do not give anything to drink if the person is not conscious.

Primary Governing Bodies / Safety Codes

Compressed Gas Association (CGA)

Semiconductor Equipment & Materials International (SEMI)

US Environmental Protection Agency (EPA)

Uniform Fire Code / Local City Regulatory Committee (UFC)

Uniform Building Code (UBC) / BOCA

National Fire Prevention Code (NFPC)

International Conference of Building Officials (IBOC)

Toxic Gas Ordinance (TGO)

Always Treat Gas Cylinders with Respect

**WE RISE AND
FALL AS ONE
PEOPLE, ONE
NATION.**

- BARACK OBAMA



THANK YOU