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# GAS CYLINDER SAFETY

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# Introduction

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Certain specific properties of compressed gases make them highly useful in various research activities.

These gases, however, can be dangerous if not handled in an appropriate manner.

Many of the odourless and colourless gases are highly toxic and flammable and this calls for utmost care while handling them.



## Types of gases

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- **Flammable gas** burns or explodes if it is mixed with air, oxygen or other oxidant, in the presence of a source of ignition.

Please note that flammable and inflammable are synonyms & non-inflammable is their antonym.

- **Inert gas** is resistant to chemical action under normal temperature and pressure conditions.



# Types of gases

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- **Oxidising gas** supports combustion.
- **Pyrophoric gas** spontaneously ignites upon exposure to air.
- **Corrosive gas** can burn and destroy body tissues on contact. Corrosive gases can also attack and corrode metals.
- **Poisonous (Toxic) gas** is harmful to humans when it exceeds the maximum allowable concentration in air.



# Gases used routinely in our Institute

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Inert gases - Argon, Helium, Neon and Nitrogen

Flammable gases- Hydrogen, Methane, Ethylene, Ethane, Propylene, Acetylene, Isobutylene, LPG and Deuterium

Toxic gases- Carbon monoxide, Sulphur dioxide, Phosgene, Boron trichloride, Germane, Diborane, Chlorine and Ammonia

Pyrophoric gases - Silane and Phosphine

Oxidisers - Oxygen and Nitrous oxide



# Hazards in gas cylinder usage

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- Oxygen deficient atmosphere resulting in asphyxiation.
- Formation of flammable gas air mixtures in case of leakage of flammable gas.
- Oxygen enriched atmosphere in case of leakage of oxygen gas.
- Injury caused by fall of gas cylinders during handling.



## Hazards in gas cylinder usage (contd.)

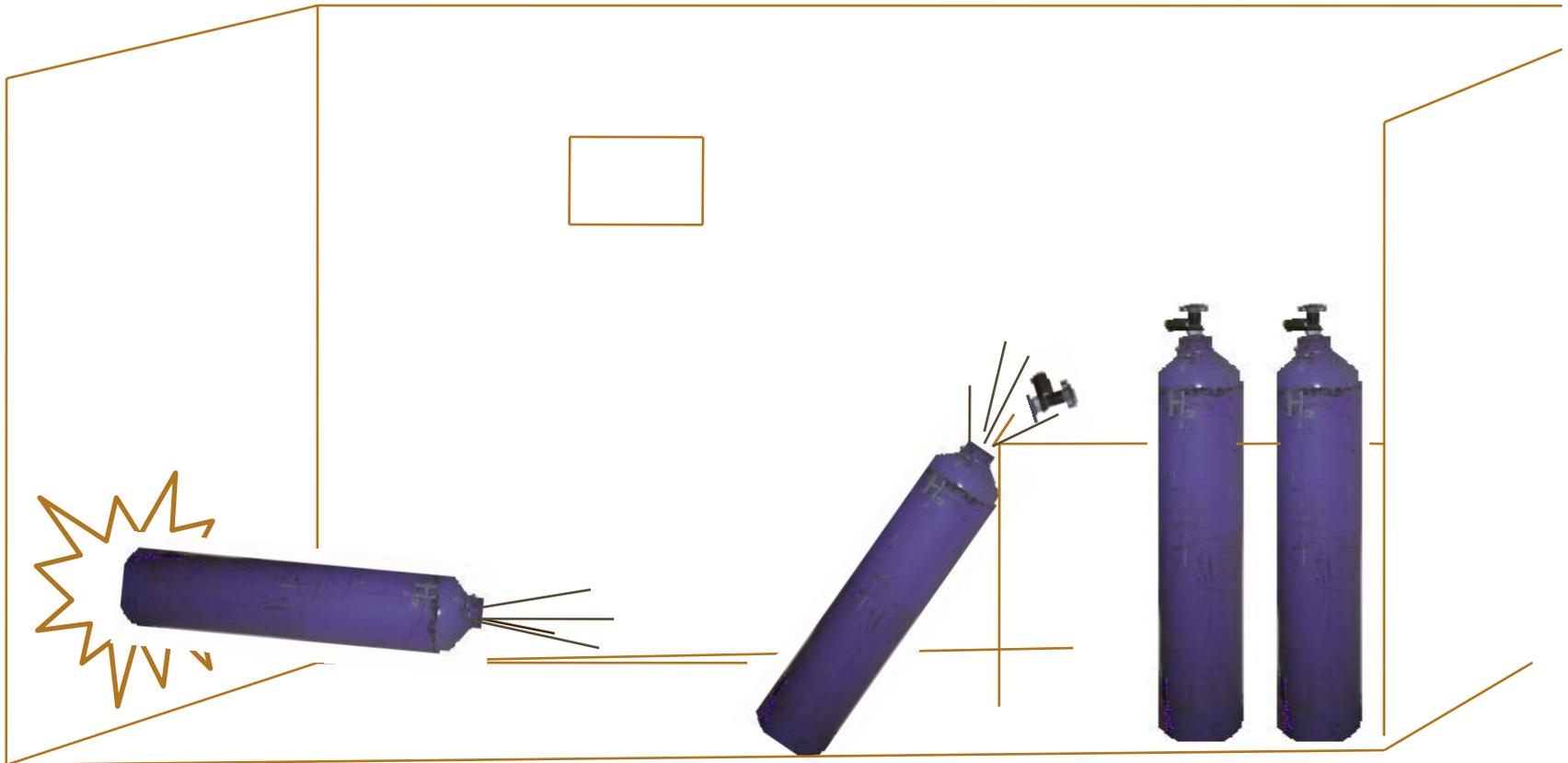
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- Exposure to high concentrations of toxic or corrosive gases in case of leakage.
- Gas cylinders can explode when exposed to high temperatures, e.g., in case of fire.
- If the valve breaks, the sudden release of compressed gas can turn it into a lethal projectile.



# Breakage of valve can turn the cylinder into a projectile

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Gas cylinders should be capped when they are not connected to the system.



# Oxygen deficiency

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- Leakage of any gas (except oxygen) inside a confined/enclosed space can cause displacement of oxygen resulting in an oxygen deficient atmosphere.

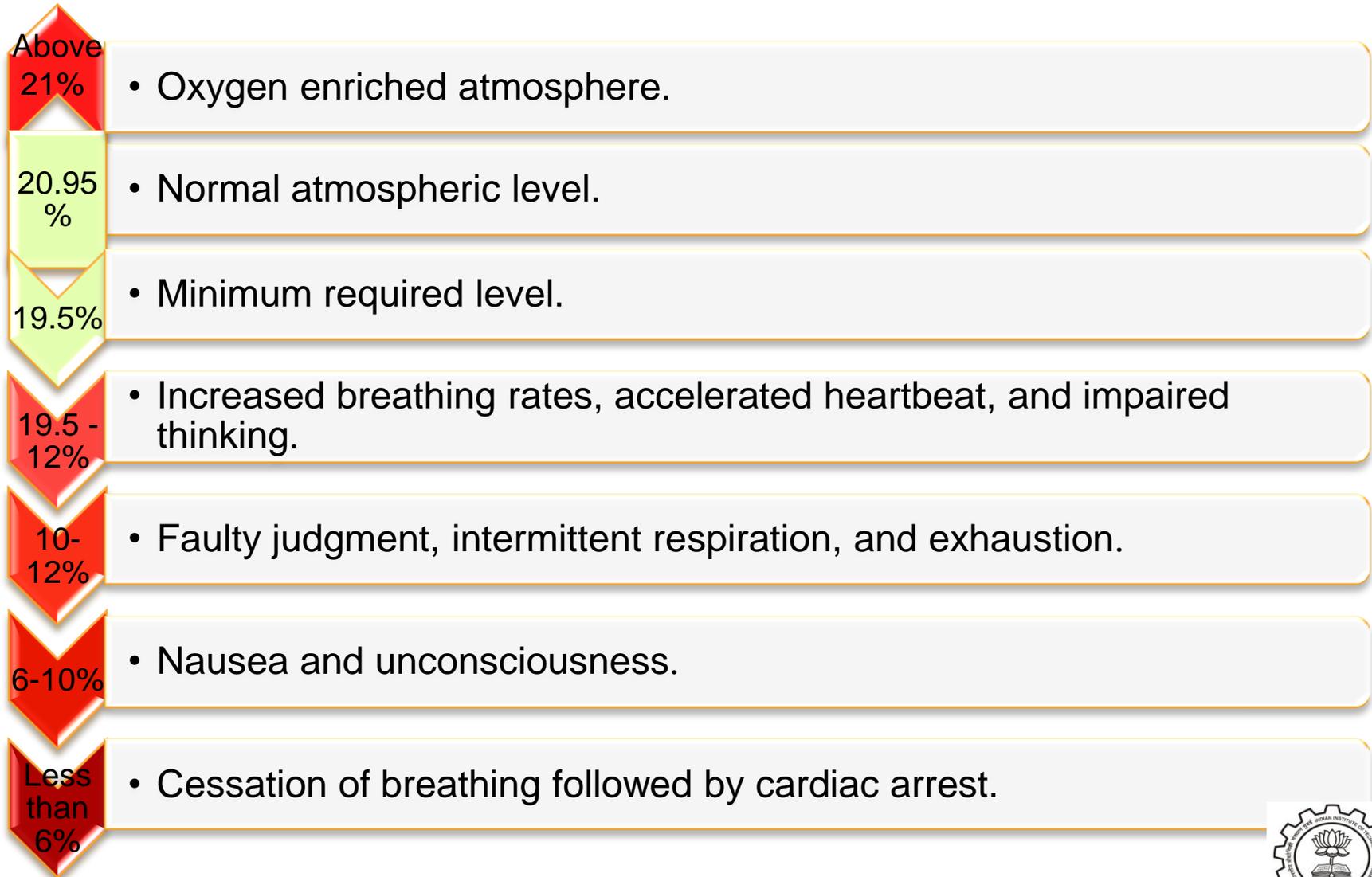


- Entry into a workspace with oxygen level below 19.5% is unsafe and not permitted.



# Oxygen levels and effects

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# Oxygen enrichment

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- An atmosphere having more than 21% of oxygen is considered as an oxygen enriched atmosphere and is not safe for entry/working.
- A leakage of oxygen gas in an enclosed space can result in an oxygen enriched atmosphere.
- An excess of oxygen in the air can be a fire hazard, as oxygen is a supporter of combustion and it causes materials to burn violently.



# Flammable vapour air mixtures

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- 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.



# Flammability limits

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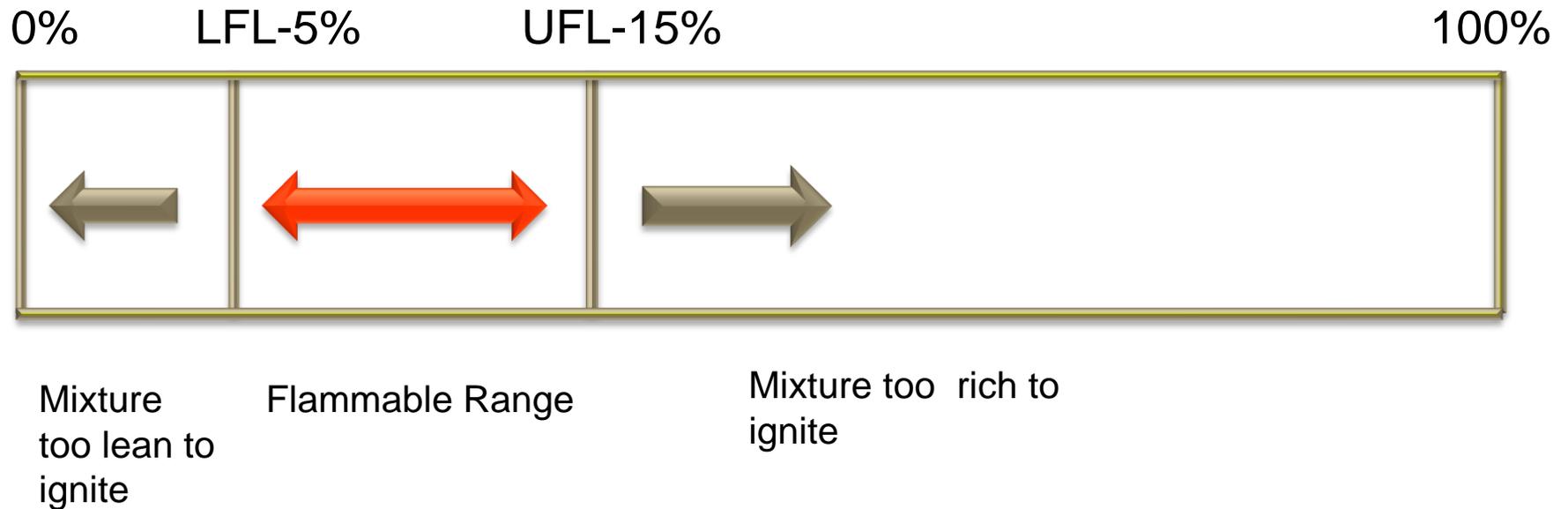
- Vapour air mixtures will only ignite within a well-specified range of composition.
- The lower flammable limit (LFL) is the leanest mixture that can ignite, i.e., the mixture with the smallest fraction of combustible gas.
- The upper flammable limit (UFL) is the richest fraction of combustible gas mixture that can ignite.



# Flammability limits

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Flammable limits for methane gas.



# Flammability limits examples

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



# Toxicity

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- Toxicity is the ability of a substance to produce an unwanted physiological effect when the substance has reached a sufficient concentration at a certain site in the body.



# Toxicity- Threshold Limit Value( TLV)

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- The concentration of an airborne substance to which an average person can be repeatedly exposed without adverse effects.

Toxic gas

TLV

Carbon  
monoxide

29 mg/m<sup>3</sup>

Phosgene

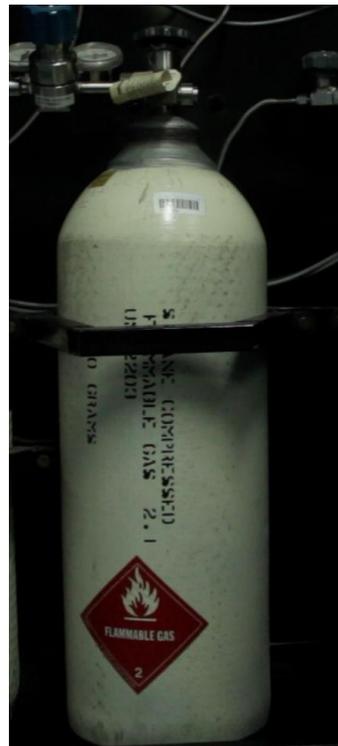
0.4 mg/m<sup>3</sup>



# Purchasing/ Receiving gas cylinders

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- Purchase smallest quantities wherever and whenever possible.



# Purchasing/ Receiving gas cylinders

When receiving gas cylinders:

- Ensure that they are properly labelled.



- Do not accept cylinders without label of the content.



## Purchasing/ Receiving gas cylinders (contd.)

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- The colour of the cylinder alone must not be depended upon.
- Visually inspect for damage.
- Ensure that the gas cylinders are received with valve caps.



# Storage of gas cylinders

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- Gas cylinders must be stored in a separate storage area outside the building.
- The storage area must be protected from weather.



# Storage of gas cylinders

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- Flammable gas cylinders must be separated from oxygen cylinders by a distance of 6m or by a wall of 30 minutes fire resistance.
- Empty cylinders must be marked /tagged and stored separately.



# Storage of gas cylinders inside labs

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- Only gas cylinders for immediate use must be stored inside the laboratory.
- Materials must not be stored in front or on top of gas cylinders.
- All cylinders in the laboratories must be clearly labeled.



# Storage of gas cylinders inside labs

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- Gas cylinders must not be stored near exits and passages.
- Gas cylinders must be stored away from heat sources.
- Place the valve cap on the cylinder whenever the regulator is removed.



# Storage of gas cylinders inside labs

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



# Transportation of gas cylinders inside labs

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Before moving gas cylinder

- Valve must be closed.
- Regulator must be removed.
- Cylinder must be capped.
- Secure the cylinder in a cylinder cart (with chain).



# Safe use of gas cylinders

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- Refer the Material Safety Data Sheet(MSDS) for the gas before usage, to know about the hazards and precautions to be taken.
- Do not tamper with the cylinder valves.
- Always use the correct regulator for the cylinder.
- Inspect the regulator for damage before use.



# Safe use of gas cylinders

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- Never use damaged regulators, piping, etc.
- After the regulator is attached, the cylinder valve must be opened just enough to indicate pressure on the regulator gauge and all connections must be checked with a compatible solution for leaks.



# Safe use of gas cylinders

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- Do not stand in front of the regulator gauge or the valve outlet side, while opening the valve.
- Use safety glasses while working with gas cylinders.



# Safe use of gas cylinders

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- Before a regulator is removed from a cylinder, the cylinder valve must be closed and the regulator relieved of gas pressure.
- Ensure proper ventilation in the area where gas cylinders are stored.



# Safe use of gas cylinders

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- Spindle key must always be placed at an easily accessible location, for closing the valve in case of emergency.



# Safe use of gas cylinders

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- 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



# Safe use of gas cylinders

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- Store toxic/pyrophoric gases in gas cabinets.
- Gas detectors must be installed for detecting gas leaks.
- The cylinder valve and other fittings used with gas cylinders must be compatible with the type of gas used. Incompatible materials can cause gas leak.



## Safe use of gas cylinders

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- Greasy and oily materials must never be used on oxygen cylinders or fittings as it can cause explosion.
- Regulators for oxygen service must never be used with flammable gases. Cross contamination of internal parts may result in rapid oxidation and fire.



# Emergency measures

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- If a gas leak occurs from the cylinder inside the gas cabinet it must not be removed from the cabinet.



# Emergency measures

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- No attempt must be made to repair a leak from the base of the valve.
- Personal protective equipment must be used while dealing with toxic/corrosive gas leaks.



# Emergency measures

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- The building must be evacuated immediately if a gas (flammable/pyrophoric/toxic/corrosive) leak becomes uncontrollable.
- Emergency measures must be undertaken only by trained personnel.
- The gas supplier must be intimated immediately.



# Emergency measures

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- Self Contained Breathing Apparatus(SCBA) must be used while dealing with toxic/corrosive gas leaks or if an oxygen deficient atmosphere exists.



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THANK YOU

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