



# Safety Instruction

## Cryogenic Liquids Safety

### General

Cryogenic liquids are liquefied gases that are kept in their liquid state at very low temperatures. These liquids have boiling points below  $-238^{\circ}\text{F}$  ( $-150^{\circ}\text{C}$ ) and are gases at normal temperatures and pressures. Different cryogenics become liquids under different conditions of temperature and pressure, but all have two common properties: they are extremely cold and small amounts of the liquid can expand into very large volumes of gas.



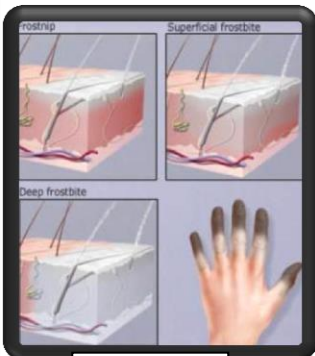
Most cryogenic liquids and the gases they produce can be placed into three groups:

- Inert gases – These gases do not react chemically to any great extent and do not burn or support combustion.
- Flammable gases – Produce a gas that can burn in air when ignited.
- Oxygen – Reacts explosively with organic materials; supports combustion.

Cryogen	Type of gas
Argon (Ar)	Inert
Helium (He)	Inert
Hydrogen gas ( $\text{H}_2$ )	Flammable
Nitrogen gas ( $\text{N}_2$ )	Inert
Oxygen ( $\text{O}_2$ )	Oxygen
Methane ( $\text{CH}_4$ )	Flammable
Carbon Monoxide (CO)	Flammable

### Hazards

Cryogenics can present one or more of the following hazards:



Frostbite

- **Extreme Cold:** Cryogenic liquids and their associated cold vapors and gases can produce effects on the skin similar to a thermal burn. Brief exposures can damage delicate tissues, such as the eyes. Prolonged exposure of the skin can cause a cold burn and frostbite.
- **Asphyxiation:** When cryogenic liquids form a gas, the gas is very cold and usually heavier than air; even if the gas is non-toxic, it displaces air. Oxygen deficiency (i.e. asphyxiation) can cause death and is a serious hazard in confined spaces.
- **Toxicity:** Each gas can cause specific health effects. See MSDSs/SDSs for information about the toxic hazards of a particular cryogen.
- **Adhesion:** Plastic, carbon steel, and rubber can become brittle and break if using them with a cryogenic material.
- **Physical Hazard:** Without adequate venting or pressure-relief devices, pressure can build up and cause serious physical hazards including an explosion.
- **Flammability:** Flammable gases such as hydrogen, methane, carbon monoxide, and liquefied natural gas can burn or explode so therefore should be kept away from possible ignition sources.

### Personal Protective Equipment

- **Eye & Face Protection:** Full-face shields and splash resistance goggles provide the best protection for the eyes and face. Safety glasses will not protect the entirety of your face and contact lenses should not be worn.
- **Hand Protection (Gloves):** Always wear appropriate cryogen gloves, such as insulated or leather gloves. Rubber gloves should not be used because they could harden instantly. Avoid wearing metal jewelry or watches.
- **Proper Clothing & Shoes:** Wear closed-toe shoes, along with long sleeve shirts, when handling cryogenics.
- **Respiratory Protection:** When there is a chance of an oxygen-deficient atmosphere, ensure to use a respirator for handling such cryogenic liquids.

### Safe Use and Handling

- Cryogenic systems must be equipped with pressure-relief devices; never use a system that does not have a pressure-relief device in place.
- Conduct operations involving cryogenics in well ventilated areas to prevent the possible gas or vapor accumulation.
- Ensure all equipment and containers are free of oil, grease, dirt, or other materials which may lead to a flammability hazard.

#### Contact EHS:

safety@oregonstate.edu  
oregonstate.edu/ehs/  
541 • 737 • 2273

- Never allow any unprotected part of the body to touch on-insulated pipes or vessels which contain cryogenic fluids.
- Do not drop, tip, or roll containers on their sides.
- Always use proper connections; do not remove or interchange connections.

### Storage

- Store cryogenics in a wall-ventilated area to prevent oxygen deficiency.
- Avoid contact of moisture with storage containers to prevent ice plugs in relief devices.
- Use only approved storage vessels that have pressure relief valves.
- Keep all heat sources away from cryogenic liquids.
- Do not store on a cart or on a shelf where they could fall or get knocked over.
- Do not store in a confined space.
- Store in an upright position.
- Do not store cryogenic liquids with corrosive or flammable liquids.
- Storage units should be placed so that vents and openings are orientated away from personnel and lab equipment.



### Transfer

- Use only fitted transfer tubes designed for use with container.
- When transferring to a secondary container, do not fill the secondary container to more than 80% of capacity (60% is the temperatures is likely to be above 30°C).
- Transfer operations involving open cryogenic containers, such as dewars, must be conducted slowly to minimize boiling and splashing of the fluid.
- Transfer of cryogenic fluids from open containers must occur below chest level.
- Use a suitable hand truck for container movement.
- If cryogenics must be transported by elevator, ensure that no passengers get on the elevator while the cryogen is being transported.

### Emergency Procedures



- If the pressure relief valve fails, allowing improper or frequent venting, safely move the damaged container to a well-ventilated area, post a warning sign, and contact the manufacturer/distributor.
- If the skin comes into contact with a cryogen, run the affected area under cool or warm water for fifteen minutes; never use cold or hot water (above 40°C) or dry heat, the re-warming of the affected area(s) should be done gradually.
- Do not rub burned area, rubbing can cause further tissue damage.
- Seek medical attention as soon as possible after contact with cryogenic liquids.
- If a spill occurs, immediately exit the area and contact appropriate emergency personnel, including

EH&S. Do not re-enter until cleared to do so.

### Disposal

- Do not pour cryogenic liquids down the sink.
- Do not allow cryogenics to vaporize in a fume hood as a means of disposal.
- Do not allow cryogenic substances to vaporize in enclosed areas, including: fridges, cold rooms, sealed rooms and basements.
- Contact the distributor/manufacturer for refill and/or disposal.