



Cryogenics

Cryogenics are liquefied gases that are kept in their liquid state by very low temperatures and high pressure. They are used to reduce temperatures below -153°C (-243°F).

TYPES OF CRYOGENIC LIQUIDS

- **Inert Gases:** Do not react chemically, burn, or support combustion.
 - Nitrogen, Helium, Neon, Argon, Krypton
- **Flammable Gases:** Produce a gas that can burn in air.
 - Hydrogen, Methane, Liquefied Natural Gas
- **Oxygen:** Can allow normally non-combustible materials to burn; Organic materials can react explosively.
 - Due to its unique hazards, liquid oxygen must be considered separately from other cryogenics.

HEALTH & PHYSICAL HAZARDS

Asphyxiation (suffocation)	<ul style="list-style-type: none"> • Displacement of air by expanding cryogenic vapors.
Thermal Burns (frostbite)	<ul style="list-style-type: none"> • Prolonged exposure can damage skin. • Brief exposure can damage delicate tissues (eg. eyes). • Skin can adhere to metal cooled by cryogenics. • Breathing of extremely cold air can damage lungs.
Toxic Hazards	<ul style="list-style-type: none"> • Materials can have specific health effects. • Refer to the SDS of the material for specific information.
Fire Hazard	<ul style="list-style-type: none"> • Flammable gasses can burn or explode.
Liquid Oxygen	<ul style="list-style-type: none"> • Some cryogenics (eg. liquid hydrogen or helium) are cold enough to condense oxygen out of the air. Flammable materials can ignite in the presence of condensed oxygen.
Explosion	<ul style="list-style-type: none"> • Risk from pressure buildup (due to the large expansion ratio of cryogenic liquids) in containers where ventilation is blocked.

CONTROLS

Work Practices

- Only work with cryogenics in well ventilated rooms (**minimum 6-10 air changes per hour**).
- Avoid direct contact with cryogenic liquids and un-insulated cryogenic piping systems and reservoirs.
- Use loose-fitting cryogenic gloves and personal attire so that they do not collect cryogenic liquids and can be readily removed if a cryogen does splash into them.
- Do not tuck pants into shoes/socks.
- Do not overfill containers, leave a large head space to account for expansion.
- Examine container condition before filling (check for cracks, suitability for material, functional pressure relief, etc.).

Cryogenics (cont.)

Personal Protective Equipment (PPE)

Eyes	<ul style="list-style-type: none"> When pouring, use non-vented chemical goggles or safety glasses with side shields. When working with cryogenics in an open container or when transferring from a pressurized device, use safety glasses and a full-face shield.
Hands	<ul style="list-style-type: none"> When working on piping systems with exposed components at cryogenic temperatures, wear loose-fitting gloves made for cryogenic work (or leather welding type without gauntlets).
Feet	<ul style="list-style-type: none"> Wear closed-toe shoes that cover the top of the foot or boots with trouser legs extended over the top of the boot.
Body	<ul style="list-style-type: none"> Wear long-sleeved clothing made of non-absorbent material, cuff-less long trousers worn outside boots or over shoes, and an apron made of leather (or other appropriate material) when handling large quantities of cryogenics.
Ears	<ul style="list-style-type: none"> Ear plugs or earmuffs may be required where excessive noise levels occur near filling and venting operations.

STORAGE & TRANSPORT

- Do not store cryogenics in:

Confined spaces	Corridors	Stairways
Walk-in Refrigerators	Environmental Chambers	Rooms With Inadequate Ventilation

- Floor surfaces in areas where splashes are likely should be of durable material. Tile and laminate are likely to crack and need frequent repair. Plywood panels can be used to protect the floor, but are not appropriate where liquid oxygen is used.
- Conduct periodic inspection of equipment. Remove ice and frost blockages, inspect pressure relief valves and gauges, replace old and damaged equipment.
- Transport containers must have pressure relief or vented lid.
- Elevators do not have adequate ventilation for cryogenics. If you need to use an elevator for large volumes of cryogenics, send the cryogen on the elevator by itself and have someone waiting to take it off at the correct floor.

EMERGENCY/SPILL RESPONSE

- Spilled cryogenic liquid evaporates quickly and generally does not need to be cleaned up.

General Rules:

- If more than 4L, everyone should leave the area for a few minutes until the gas dissipates.
- If more than 16L or the rupture disk on a pressurized dewar breaks, everyone should evacuate the area and call 911.

FIRST AID

- Do NOT rub frozen body parts because tissue damage may result.
- Place the affected part of the body in a warm (not hot) water bath.
- Consult a medical professional as soon as possible.
- If the victim is experiencing symptoms of hypothermia, burn area is extensive, or pain is significant, call 911.