

Cryogenic Gas Safe Handling Guideline

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URL: <http://www-group.slac.stanford.edu/esh/eshmanual/references/chemsafetyGuideCryo.pdf>

Synonyms

Cryogens, liquefied gas, cryogenic liquids

Reactivity and Physical Concerns

Cryogenic liquids are liquefied gases that are kept in their liquid state at very low temperatures. Each cryogenic liquid has its own specific properties but the most commonly used cryogenic liquids can be placed into one of three groups: inert gases (e.g., helium, nitrogen), flammable gases (e.g., hydrogen) and oxidizer (e.g., oxygen). Different cryogens become liquids under different conditions of temperature and pressure, but all have two properties in common: they are extremely cold and small amounts of liquid can expand into very large volumes of gas. The vapors and gases released from cryogenic liquids also remain very cold. They often condense the moisture in air, creating a highly visible fog.

Without adequate venting or pressure-relief devices on the containers, enormous pressures can build up. The pressure can cause an explosion called a "boiling liquid expanding vapor explosion". Because of the temperature at which these liquefied gases exist, they can cause other gases to fractionally condense from the atmosphere. For example, liquid helium has a boiling point below that of oxygen (-183°C), which could result in oxygen being condensed out of air, which in some circumstances can pose a fire risk.

Exposure Hazards

Routes of Exposure

Inhalation, ingestion, skin contact, eye contact

The primary health hazards associated with cryogenic liquids are extreme cold and asphyxiation. Prolonged exposure of the skin or contact with cold surfaces can cause frostbite, which may cause the skin to appear waxy and yellow. Eyes can be damaged by short exposures that may not damage surrounding skin. Intense pain will occur when frozen tissue thaws. Prolonged breathing of extremely cold air may damage the lungs. Cold, heavy gas does not disperse readily and can accumulate near the floor, displacing air: asphyxiation and death may result. Because of the significant expansion ratio of these materials (e.g., LN₂ has a liquid-to-gas expansion ratio of 710 times), a small amount of spilled cryogenic liquid can displace a large amount of air, especially in relatively small rooms.

Chronic Exposure

NA

First Aid

First aid measures will vary based on the individual chemical's hazard properties. In general, the following steps should be taken. Move victim to fresh air. Call 911. Apply artificial respiration if victim is not breathing. Remove and isolate contaminated clothing and shoes. Clothing frozen to the skin should be thawed before being removed. In case of contact with liquefied gas, thaw frosted parts with lukewarm water. Keep victim warm and quiet. Obtain medical attention

immediately. (See [Chemical Safety: Accidental Exposure Requirements](#) [SLAC-I-730-0A09S-041].)

Exposure Limits

Exposure limits will vary based on individual chemical hazards; consult the manufacturer's [SDS](#) for established exposure limits. The primary risk is from oxygen deficiency.

Exposure Controls

Engineering Controls

Local exhaust ventilation is required. In some cases, gas detection may be required. Consult the individual chemical hazard properties to determine the proper engineering controls. Bulk tanks must be sited in appropriate locations outside of the building. Smaller tanks and dewars should not be stored inside unless adequate ventilation and detection are present to prevent the development of an undetected asphyxiation hazard.

Administrative Controls

Personnel working with the materials must receive detailed training on the hazards, safe use, and emergency procedures.

Personal Protective Equipment

Avoid contact with body parts. Always wear thermal protective clothing when handling refrigerated/cryogenic liquids. Follow SDS recommendations for PPE. In general, prevent skin/eye contact through the use of impervious gloves, clothing, boots, apron, and eye goggles or full face shield. In the event of a possible asphyxiation hazard, only self-contained breathing apparatus may be used for entry.

Disposal

Contact the CMS representative or the chemical lifecycle management program manager for the return of empty or damaged cylinders or dewars to the supplier.

Medical Monitoring (if applicable)

NA

Emergency Response

In the event of a spill that poses a threat to health and/or the environment, immediately evacuate the area and call 911. Then call SLAC Site Security (ext. 5555 or 650-926-5555 from a cell phone) and notify your supervisor.

For other spills, notify your supervisor then SLAC Site Security; these may be cleaned up with appropriate spill response supplies by trained personnel who have been authorized via work planning and control. (See [Spills: Response, Cleanup, and Reporting Procedure](#) [SLAC-I-750-0A16C-006].)

Standards and Regulations

- OSHA. PEL: [29 CFR 1910.1000 Table Z-1](#); Respiratory Protection: [29 CFR 1910.134](#)
- EPA. Release: [40 CFR 355.40](#); Waste: [40 CFR 261.21-261.24](#)
- *California Fire Code*, Chapters 27 through 41 ([24 CCR Part 9](#))

Other References

- CCOSH. [OSH Answers: Cryogenic Liquids and Their Hazards](#)