

CRYOGENIC EQUIPMENT SAFETY and HANDLING GUIDE



INSTRUCTIONS FOR SAFE USE OF YOUR CRYOGENIC TRANSFER EQUIPMENT

For your safety and the safety of others, read and understand this booklet in its entirety. Keep this information readily available for reference at all times. Contact Technifab if you require additional copies.

* The precautions and safe practices mentioned throughout this guide are for the protection and well being of any person handling Cryogenic Fluids. Do not attempt to handle cryogenic fluids until you fully understand the hazards and safety issues. Always consult the MSDS (Material Safety Data Sheets) for information on the liquids, gases and equipment you will be using.

Properties of cryogenic fluids:

1. Liquid Nitrogen: At atmospheric pressure liquid nitrogen boils at -320°F (-196°C). A small volume of liquid nitrogen vaporizes into a relatively large volume of nitrogen gas. One liter of liquid nitrogen becomes 24.6 cu. ft. (0.7 cu. meters) of gas.
2. Liquid Argon: At atmospheric pressure liquid argon boils at -302°F (-186°C).
3. Liquid Oxygen: At atmospheric pressure liquid oxygen boils at -297°F (-183°C).
4. Liquid Helium: At atmospheric pressure liquid helium boils at -452°F (-269°C).
5. Liquid Hydrogen: At atmospheric pressure liquid hydrogen boils at -423°F (-253°C).

****Abide by any Caution, Warning or Danger labels attached to the equipment****

GENERAL PRECAUTIONS

Contact with cryogenic fluids or cold gases may cause severe frostbite.

The extremely low temperatures of cryogenic fluids can freeze human flesh very quickly. The gas issuing from the liquid is also extremely cold. Delicate tissue, such as the eyes, can be damaged by exposure to the cold gas, which would be too brief to affect the skin of the hands or face.

Wear prescribed protective equipment.

Objects cooled by cryogenic fluids are extremely cold and may quickly stick to unprotected skin. Always use tongs to withdraw objects immersed in liquid nitrogen, and handle the objects with care. Always wear protective clothing when handling cryogenic fluids.

Protect your eyes with a face shield or, at minimum, safety glasses with side shields. Wear insulated gloves when handling anything that is or has been in contact with a cryogenic fluid. (Heavy leather gloves are an acceptable alternative.) The gloves should fit loosely, so they can be thrown off quickly should liquid nitrogen spill into them.

Do not wear canvas-topped shoes, as they will absorb the cryogenic fluid during a spill, resulting in a far more severe burn. The recommended footwear is high-top shoes to prevent the cryogenic fluid from splashing into the shoe.

In the event of emergency situations pertaining to hydrogen, a fire resistant suit and gloves should be worn and a self-contained breathing apparatus (SCBA) is advised.

Nitrogen, argon, helium and hydrogen gas can displace air, thereby causing suffocation. Store and use liquid only in well ventilated areas.

When liquid nitrogen, argon, helium or hydrogen evaporates the resulting gas tends to displace normal air from the area. In an enclosed space, excessive amounts of these gases reduce the concentration of oxygen, which can lead to asphyxiation. Atmospheres that are oxygen deficient are within the flammable range and should not be entered. (This is not true of atmospheres with nitrogen concentrations.)

The visible cloud that appears when a cryogenic liquid is exposed to air is caused by the sudden condensation of the moisture in the air. Nitrogen and hydrogen gases are colorless, odorless and tasteless. These gases cannot be detected by human senses. Breathing atmosphere that contains less than 18 percent oxygen can cause dizziness and quickly result in loss of consciousness and death. An oxygen monitor should be installed in any areas where cryogenic fluids are being transferred in enclosed spaces.

Dispose of liquid nitrogen outdoors.

To dispose of liquid nitrogen, pour the liquid slowly on gravel or bare ground where it can evaporate without causing damage. Do not pour liquid nitrogen on pavement or in confined areas or areas people may enter.

Expansion Rate of Cryogenic Fluids

Due to the high expansion rate of cryogenic fluids, the possibility of a pressure burst exists. If a cryogenic fluid is trapped between two valves, without a properly working pressure relief valve in place, a violent rupture of the pipe may occur. Bodily injury may result if a person is in the area during the rupture of the pipe. It is critical that a pressure relief valve is installed wherever the potential of liquid trapped in a closed line exists. Do not plug, remove or tamper with any pressure relief valves in a system.

Rough handling can cause damage to Technifab Equipment.

Subjecting the equipment to excessive bending, heat, vibrations and /or impacts can result in loss of vacuum and leaks in the lines, possibly causing injury, also possibly voiding the warranty. To protect the integrity of the equipment and to protect the people using it, handle the equipment carefully.

Never remove the Evacuation Valve Plug.

Removal of the evacuation valve plug may damage the insulation and getter in the vacuum space of cryogenic transfer equipment and will void the warranty.

Venting Cryogenic Equipment

Technifab requires that products or systems with relief valves or vent outlets have outlet locations that do not injure people or damage any facility/equipment in case liquid cryogen is ever expelled through the vent.

Oxygen Warning

Liquid oxygen is non-flammable but is a highly reactive element that accelerates combustion. Combustibles that come in contact with liquid oxygen may explode on ignition or impact. If liquid oxygen comes in contact with hydrocarbons like oil, grease or asphalt, it may ignite. If liquid oxygen is spilled in an area, do not walk or roll equipment in the area for at least 30 minutes after all frost or fog has dissipated. Some materials that are non-combustible in air will burn in the presence of an oxygen-enriched atmosphere. The fire potential increases when the concentration of oxygen increases to as little as 23%. Normal air contains approximately 21% oxygen. Materials will burn with added violence in the presence of increased oxygen percentages.

Any clothing that has been soaked with liquid oxygen or exposed to high concentrations of oxygen needs to be removed immediately and aired out for at least 1 hour. Clothing that is saturated with oxygen will ignite quickly and burn vigorously. Cotton clothing is recommended for use to prevent static buildup and discharge.

Breathing 80% or more pure oxygen at atmospheric pressure for more than a few hours may cause nasal stuffiness, coughing, sore throat, chest pain and breathing difficulty. Breathing oxygen at higher pressures increases the likelihood of adverse effects within a shorter time. Breathing pure oxygen under pressure may cause lung damage and central nervous system effects resulting in dizziness, poor coordination, tingling sensation, visual and hearing disturbances, muscular twitching, unconsciousness, convulsions, and reduced peripheral vision.

Handling and Storage

- Use only Oxygen compatible grease.
- Only use sealing components compatible with Liquid Oxygen.
- Use only transfer lines and equipment designed and labeled for Liquid Oxygen use.
- Do not remove or interchange connections.
- Always use the proper connections.
- It is recommended all vents be piped to the exterior of the building.
- Make sure all connection fittings are clean, free from dirt and foreign materials.
- Always have adequate ventilation; do not store liquid oxygen in a confined space.

Hydrogen Warning

The hazards associated with handling liquid hydrogen are fire, explosion, asphyxiation and frostbite. The amount of hydrogen gas necessary to produce an oxygen deficient atmosphere is well within the flammable range. Hydrogen has a wide flammability range —4% to 74% in air — and requires only a small amount of energy for ignition.

The withdrawal of liquid from a tanker, tank or liquid cylinder requires the use of a closed system. Proper safety relief devices, which can be evacuated and/or purged, must be used to eliminate the possibility of creating a flammable atmosphere or explosive mixture of liquid air and liquid hydrogen. All equipment **MUST** be electrically grounded and bonded before transferring liquid.

Gaseous and liquid hydrogen systems must be purged of air, oxygen and other oxidizers prior to admitting hydrogen into the systems. Likewise, hydrogen systems must be purged to remove hydrogen before opening the system to the atmosphere. The purging of a liquid hydrogen device should be performed using liquid helium. Liquid hydrogen can solidify other gases, such as liquid nitrogen, causing the device to become plugged, resulting in possible rupturing of the device. Follow prescribed procedures when purging systems for hydrogen use. Repeat the appropriate purge procedures as many times as needed to assure the system is ready for the introduction of hydrogen.

Hydrogen, when ignited, will burn with a pale blue, almost invisible flame with the characteristics of a torch or jet. The most effective way to fight a hydrogen fire is to shut off the flow of gas. If it is necessary to extinguish the fire first, use a dry powder extinguisher. If the fire is extinguished without stopping the flow of gas, an explosive mixture may form that may create a more serious hazard than the fire itself should re-ignition of the hydrogen occur. Dry powder fire extinguishers should be located for adequate coverage, and a fire blanket should be conveniently located for use. An adequate water supply should be available to keep surrounding equipment cool in the event of a hydrogen fire.

First Aid

If a person becomes dizzy or loses consciousness while working with cryogenic fluids, move him or her to a well-ventilated area. Keep the person warm and immediately seek medical attention.

For persons exposed to liquid or cold gas, restore tissue to normal body temperature (98.6° F or 37° C) as rapidly as possible. Remove or loosen clothing that may restrict blood flow to the frozen area. Protect injured areas from further damage or infection. Seek medical attention immediately.