

<b>Environmental Health &amp; Safety Policy Manual</b>		
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<b>Cryogenic Liquid Policy</b>		

**1.0 PURPOSE:**

Working with cryogenic liquids involves significant health and safety hazards. This policy identifies health hazards, safe work methods, safe handling, transport, storage, and emergency spill response information to assist personnel with reducing the risk of working with cryogenic liquids.

**2.0 SCOPE:**

All personnel who use cryogenic liquids. This policy and EHS-200.3a (Compressed Gas Policy) supersede EHS-200.3, Compressed and Liquefied Gas Cylinder Policy.

**3.0 RESPONSIBILITIES:**

**Environmental Health & Safety (EH&S) shall:**

- Provide technical assistance when necessary.

**Principal Investigators/Supervisors shall:**

- Ensure that employees understand the contents of this policy, are instructed on the means of implementation, and are provided with equipment and controls.
- Ensure that appropriate personal protective equipment (PPE) supplies are maintained.

**Employees shall:**

- Handle cryogenic liquids only if properly trained.
- Review hazard information detailed on Material Data Sheets (MSDS, also known as Safety Data Sheets (SDS)) before beginning work with cryogenics.

**4.0 HAZARDS ASSOCIATED WITH CRYOGENS AND DRY ICE:**

Consider the following hazards during the handling, transportation and storage of cryogenics and dry ice.

- **Burns and Frostbite:** Skin contact with a cryogen, dry ice or non-insulated equipment parts can cause cold burn and frostbite. Eye contact with a cryogen or dry ice can cause permanent damage. Always wear the proper PPE when working with or around cryogenics and dry ice.
- **Asphyxiation:** When cryogenic liquids form a gas, the gas is very cold and usually heavier than air. Small amounts of liquid can evaporate into very large volumes of gas. This gas can accumulate near the floor and displace air, resulting in the threat of

asphyxiation. This potential for oxygen deficiency is an especially serious hazard in enclosed or confined spaces.

- **Fire and Explosion Hazards:** Liquid nitrogen and helium are not flammable. However, they can condense oxygen out of the air by evaporation creating an oxygen-rich environment. Flammable materials can ignite in the presence of condensed oxygen.
- **Over-pressurization Hazards:** Cryogenic systems must be equipped with pressure-relief devices that must be kept clear of blockages.
- **Dewars** have an insulating vacuum space in between their double walls. If a dewar becomes damaged, air or liquid can leak into the vacuum space. This will reduce its insulating properties and can greatly increase the pressure inside the dewar. Dewars and storage vessels are equipped with pressure-relief devices that prevent high pressure from developing (liquid nitrogen dewars have one valve and one bursting disc, liquid helium dewars have two valves and one disc, and dewar flasks are equipped with loose-fitting lids or specially vented stoppers.) Air or liquid that leaks into a vacuum space can freeze. If the space is rapidly warmed after starting a transfer, the pressure-relief valve will vent the gas that is generated, preventing an explosion. Never cover a pressure relief valve that is venting.

## 5.0 PERSONNEL PROTECTIVE EQUIPMENT (PPE):

Perform a hazard assessment to determine appropriate PPE when working with cryogenic liquids. Potential PPE for use when filling dewars or when removing specimens or samples from a dewar include:

- Cryo-gloves
- Face shield
- Safety goggles
- Lab coat
- Long pants

The following should be worn when handling dry ice:

- Cryo-gloves
- Lab coat
- Long pants

Cryogenic Gas Material Data Sheets below additionally assist in PPE selection:

- [MSDS for Carbon Dioxide – Dry Ice \(Airgas, Inc.\)](#)
- [MSDS for Liquid Nitrogen \(Airgas, Inc.\)](#)

## 6.0 SPECIAL HANDLING PROCEDURES:

- Always work with cryogenics and dry ice in well ventilated spaces, especially when filling dewars. Adequate ventilation is essential since a small amount of liquid can rapidly convert to a large volume of gas that can displace air.

- Remove metal jewelry on your hands and wrists before working with cryogenics. If exposed to cryogenic liquids or boil-off gases, jewelry can freeze to the skin.
- Cryogenic containers are designed and made of materials that can withstand rapid changes and extreme temperature differences encountered in working with cryogenics. However, fill containers slowly to minimize internal stresses.
- If feasible, use chemical fume hoods when working with cryogenics.
- Never allow any unprotected part of the body to touch exposed pipes/vessels containing cryogenic liquids; skin coming in contact with the cold metal may adhere to it and tear when attempting to withdraw. Wear long sleeve shirt and pants.
- Exercise caution when adding a cryogenic liquid to a dewar at room temperature or when adding an object at room temperature to a cryogenic liquid. Both will cause the liquid to boil and splash vigorously.
- Always employ a retrieval device or tongs to recover items submerged in liquid nitrogen. Cryo gloves do not protect against liquid nitrogen penetration; only against exposure to cold surfaces.
- Report any leaks or improperly set relief valves immediately to the supplier (Airgas) at 568-6543 or <mailto:gas@lsuhsc.edu>.
- Periodically inspect equipment and remove ice and frost blockages from openings to prevent over pressurization.

**Special precautions for the Use of Cryotubes:**

- Cryotubes containing samples stored under liquid nitrogen may explode without warning. Tube explosions are caused by liquid nitrogen entering the tube through minute cracks and then expanding rapidly as the tube thaws after removal from dewars.
- Cryotubes are designed for vapor phase storage in the extremely cold nitrogen gas that sits just above the reservoir of liquid nitrogen in the bottom of the freezer or dewar. If the freezer/dewar is overfilled with liquid nitrogen and the vials are immersed, leakage of liquid nitrogen into the vial occurs. To avoid this problem, do not overfill the freezer/dewar with liquid nitrogen and visually check each cryotube prior to filling to ensure there are no defects around the rim.
- PPE for thawing cryotubes should include safety glasses, face shield, insulated heavy gloves, a buttoned lab coat, closed toe shoes and pants.
- As a precaution, slowly remove vials from the dewar, holding the vial in the neck of the dewar for a moment before bringing them into room atmosphere. A tube that is going to explode will usually do so early in the warm-up process.
- Keep cryotubes in a heavy, walled container or behind a safety shield while warming.
- Cryotubes should never be re-used.

**7.0 STORAGE AND TRANSPORTATION:**

- Never store cryogenic liquids in walk-in cold rooms as they are confined spaces.

- Use and store liquid hydrogen and helium away from flammable materials and ignition sources. (These gases can condense oxygen out of the air by evaporation, creating localized oxygen enriched environment.)
- For liquid helium and hydrogen storage systems, check the pressure relief and inspect the system for leaks regularly.
- Periodic equipment inspections, removal of ice blockages, and replacement of damaged or old storage units will reduce the probability of the catastrophic failure of a storage unit. Ice blockages that prevent the container from venting properly can cause an explosion hazard. Contact the supplier Airgas immediately at 568-6543 if ice blockages are observed.
- Store and transport cryogenic materials only in dewars or cryogenic liquid cylinders designed for that particular cryogen.
- Post a “No Open Flames” sign in liquid oxygen storage areas.
- **LSUHSC personnel may transport cryogenics in freight elevators only if no Passengers travel in the elevator.**

There are two ways to accomplish this:

1. Contact Facility Services and request the elevator be moved, via the Liftnet software, from the originating floor to the destination floor without stopping at any interim floor. Load the car with dewars and send to the destination floor where a coworker waits to remove them. Due to operating demands, schedule the move in advance with Facility services, especially if moving the dewars to rally points in advance of a hurricane.
2. Station co-workers at each elevator floor (prior to moving the elevator) to prevent personnel from entering the elevator on an interim floor.

## **8.0 EMERGENCY PROCEDURES:**

Liquid nitrogen is the most commonly used cryogenic liquid. The failure of a large cryogenic liquid cylinder could spill 165 to 180 Liters of liquid nitrogen gas. This will completely displace all oxygen in a 21x21x10 ft. room. A much smaller spill in the same room could still create a safety hazard. Simply reducing the oxygen content in a room below 19.5 percent is considered an oxygen deficient environment. Oxygen depletion resulting from nitrogen gas (odorless, colorless and tasteless) may occur rapidly with no warning. A person entering an oxygen deficient environment may become disoriented and unable to respond properly.

### **Should a spill occur:**

- If a spill occurs *immediately exit* the area. With adequate ventilation it may be appropriate to return to the area after thirty minutes. For large spills contact University Police immediately; University Police will contact Environmental Health and Safety to respond to monitor oxygen levels in the area and determine when it is safe to re-enter.

- If experiencing symptoms such as lightheadedness, dizziness, or confusion, immediately seek fresh air and receive medical attention.
- If an individual becomes unconscious in a cryogenic liquid storage area, contact 911 immediately; they should only be retrieved by personnel using proper protective equipment. Over half of the deaths associated with asphyxiation in confined spaces occur to would-be rescuers.

**In the event of contact with cryogenic gases or liquid:**

- Immediately remove any clothing that has been contaminated. In the event of clothing contamination with oxygen, hydrogen, or carbon monoxide, it is important to remove clothing, evacuate personnel from the facility, and keep away from ignition sources.
- Flush or soak the area with warm water (no greater than 105 F).
- Do not apply dry heat or rub damaged flesh or eyes.
- Employees should notify their supervisor of injuries and seek medical attention.

**9.0 DEFINITIONS:**

**Cryogenic liquid:** Liquid with a normal boiling point below -130 F. Common industrial gases transported, handled and stored in the liquid state at cryogenic temperatures are Argon, Helium, Hydrogen, Nitrogen, and Oxygen.

**Cryotubes:** Plastic biological sample tubes able to stand very low temperatures.

**Dewars:** Liquid dewar flasks are non-pressurized, vacuum-jacketed vessels, similar to a Thermos bottle. Dewars are designed with either loose-fitting caps or pressure relief valves, that prevents air and moisture from entering, yet allows excess pressure to vent.

**Dry Ice:** Dry ice is the solid form of carbon dioxide, non-combustible, available in flakes, pellets or block form. Dry ice will vaporize directly to the gas state at a temperature of -78.5C (-109.3 F) or higher.