## Document Revision Log

Document: **Cryogenic Liquid Safety Guidelines**

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Issued: January 4, 2021
# Cryogenic Liquid Safety Guidelines

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Cryogenic liquids are materials with extremely low boiling points (i.e. less than -150 °F/-101 °C). Common examples of cryogenic liquids are liquid nitrogen, liquid helium, and liquid argon. One special property of both cryogenic liquids and dry ice (frozen carbon dioxide) is that they undergo substantial volume expansion upon evaporation or sublimation, which can potentially lead to an oxygen deficient atmosphere where ventilation is limited. Some cryogenic liquids can also pose additional hazards including toxicity and flammability (i.e. liquid carbon monoxide).

1. Scope

This safety program applies to all occupational or research use of cryogenic liquids at the University of New Mexico (UNM) campuses or properties and by UNM employees or contractors completing scopes of work for UNM.

2. Responsibilities

2.1. Environmental Health & Safety (EHS) is responsible for:

- Preparing, reviewing and periodically revising this program
- Monitoring compliance with this program
- Providing general cryogenic liquid safety training
- Consultation on procedures for all highly toxic or highly hazardous gases.
- Determining health hazard classifications for previously unlisted gases, including acute and chronic toxicity, carcinogenicity, flammability, pyrophoricity and corrosivity
- Investigating accidents

2.2. Deans, Directors, and Department Heads are responsible for:

- Ensuring departmental compliance with all the procedures outlined in this program

2.3. Supervisors and/or PI’s are responsible for:

- Ensuring compliance with this program in their work area(s)
- Developing Standard Operating Procedures (SOPs) that address the specific safety measures to be implemented when using cryogenic liquids.
- Ensuring employees working around cryogenic liquids receive the appropriate training before handling or working with cryogenic liquids.
- Coordinating the provision of medical examinations, exposure monitoring and record keeping.
• Arranging for immediate emergency response, if necessary, for chemical spills, injuries and overexposures
• Maintaining a Safety Data Sheet (SDS) for all cryogenic liquids used in the work area.

2.4. **Employees and Researchers are responsible for:**

• Knowing the provisions of the cryogenic liquid safety program
• Reporting accidents, possible exposures or unsafe conditions to their supervisor
• Following proper safety protocols when using cryogenic liquids
• Utilizing engineering controls, administrative controls, and PPE

3. **HAZARD DATA**

3.1. **Physical Hazards**

• Inhalation: Inhalation can cause suffocation due to oxygen deprivation.
• Ingestion: Ingestion of liquid can cause burns similar to frostbite.
• Skin contact: Extremely cold material. Dermal contact with rapidly evaporating liquid could result in freezing of the tissues or frostbite.
• Eye contact: Extremely cold material. Liquid can cause burns similar to frostbite.

3.2. **Over-exposure signs/symptoms**

• Inhalation: Fainting/Loss of consciousness
• Eye contact: Frostbite

3.3. **Additional hazards**

• Fire and explosion from evaporation of flammable gases or condensation of oxygen
• Shattering of materials may shatter upon contact with cryogenic fluids.

4. **GENERAL SAFETY PROCEDURES**

EHS uses the hierarchy of controls to reduce exposure to hazards. The hierarchy of controls methods are listed below in the order in which they should be implemented to reduce exposure. PPE is used as a last resort, in an emergency, or as an extra layer of protection. PPE alone is not sufficient protection for employees.

4.1. **Engineering Controls**

In addition to the information below, follow procedures as specified in the lab-specific section of this SOP.
• **Room Ventilation**  
  o Liquid containers must be stored in well-ventilated areas or areas with forced ventilation  
  o Containers should be stored from the air intakes, high traffic areas, floor drains and other underground openings

• **Oxygen Deficiency Monitor**  
  o Oxygen monitor is required in rooms with poor ventilation system to monitor the oxygen level or concentration

• **Pressure relief Valve**  
  o Containers must be equipped with pressure relief valve which protects the container from over-pressurization

### 4.2. Administrative Controls

Administrative controls and workplace-specific rules should be in place to address any hazards in the lab. Common administrative controls that may be necessary include, but are not limited to:

- Maximum quantity limits for room space;  
- Written safe working procedures;  
- A 2-person rule requirement;  
- Limited access to hazardous areas;  
- Emergency response procedures.

### 4.3. Personal Protective Equipment (PPE)

In addition to proper street clothing (long pants (or equivalent) that covers legs and ankles, and close-toed non-perforated shoes that completely cover the feet), wear the following Personal Protective Equipment (PPE) when performing lab operations/tasks involving cryogenic liquids:

- Safety glasses (If splash potential exists, use goggles + face shield instead)  
- Lab coat  
- Insulated cryogenic gloves

### 5. Special Handling Procedures:

1. Only work with cryogenic liquids in well-ventilated areas to avoid localized oxygen depletion or build-up of flammable or toxic gas.

2. Handle objects that are in contact with cryogenic liquids with tongs or proper gloves.
3. Containers and systems containing cryogenic liquids should have pressure relief mechanisms.

4. Cryogenic liquid cylinders and other containers (such as Dewar flasks) should be filled no more than 80% of capacity to protect against thermal expansion.

5. Cryogenic liquid/dry ice baths should be open to the atmosphere to avoid pressure buildup.

6. Keep liquid oxygen away from organic materials and ignition sources.

7. Transfer of liquid hydrogen in an air atmosphere can condense oxygen in the liquid hydrogen, creating an explosion risk.

8. Cryotube thawing – In addition to wearing proper safety equipment, when thawing cryotubes, place the cryotube in a heavy-walled container (e.g., a desiccator) or behind a safety shield to protect yourself in the event that the tube shatters.

9. Shield or wrap fiber tape around glass dewars to minimize flying glass and fragments should an explosion occur. Note: Plastic mesh will not stop small glass fragments.

6. STORAGE

Cryogenic liquid dewars are to be stored in well-ventilated areas. Storage in unventilated closets, environmental rooms, and stairwells is prohibited.

- Large dewars must be tethered/anchored to a wall.
- Store flammable cryogenic liquids and liquid oxygen away from combustible materials and sources of ignition.
- Follow all substance-specific storage guidance provided in MSDS documentation.

7. EMPLOYEE INFORMATION AND TRAINING

Supervisors are responsible for ensuring that employees with potential exposure to cryogenic liquid have the appropriate training before working with it. Further, on-the-job training must be done. Supervisors should review this information with employees annually.

- Live in person cryogenic liquids safety training is available upon request through through UNM Learning Central - Cryogenics Safety Training (COURSE SRS 9909)
- An online module is available through UNM Learning Central - Liquid Nitrogen Safety (ONLINE COURSE SRS WB 001)
8. **EXPOSURE PROCEDURES (IN CASE OF EMERGENCY)**

If skin or eye(s) comes in contact with a cryogenic liquid, run the area of skin under cool or warm water for fifteen minutes (do not use hot or cold water). DO NOT RUB OR MASSAGE AFFECTED AREAS—this can cause further tissue damage. Refer to SDS for any specific instructions. Where medical attention is required, ensure to bring along SDS(s) of chemical(s) to aid medical staff in proper diagnosis and treatment.

In cases of prolonged contact with cryogenic liquids call 911 immediately. Prolonged contact may cause serious burns requiring more sophisticated medical treatment or blood clots.

Report all cases of contact or splashing to the supervisor.

9. **SPILLS**

9.1. **Spill Cleanup Procedures**

- In the event of a large spill, the employee should restrict access to the work area and dial 911.
- A small spill or splash will rapidly evaporate into the atmosphere requiring no cleanup.
- Report all spills to the lab supervisor and large spills UNM Environmental Health & Safety (EHS)

9.2. **Report Incident to Environmental Health & Safety (EHS)**

As soon as possible report the spill by notifying EH&S (during business hours (M-F/8-5) (505) 277-2753, outside business hours (505) 951-0194); tell them that a spill has occurred, and that you need help managing the spill. Notify supervisor.

Be prepared to provide the following information:

a. Name and phone number of knowledgeable person that can be contacted
b. Name of chemical spilled, concentration and amount spilled (if known)
c. Number of injured, if any
d. Location of spill

10. **REFERENCES**

Stanford – General Use SOP for Cryogenic Liquids

University of Wisconsin – Cryogenic Liquids Policy

MIT – PSFC Cryogenic Liquids SOP
Airgas – Liquid Nitrogen SDS