Cryogenic Materials

Standard Operating Procedure

Revision Date: 05/17/22

This standard operating procedure (SOP) outlines the handling and use of cryogenic materials. Review this document and supply the information required in order to make it specific to your laboratory. In accordance with this document, laboratories should use appropriate controls, personal protective equipment, and disposal techniques when handling cryogenic materials.

# Description [Provide additional information as it pertains to your research protocol]

Cryogenic liquids have various uses in the laboratory including sample preservation, cooling of equipment, and handling and storage of biological samples.

## Process [Write the steps for using the chemical in your research protocol]

# Potential Hazards [Provide additional information as it pertains to your research protocol]

Cryogenic materials are liquefied gases with boiling points less than -73°C (-100°F). They can cause tissue damage (frostbite) and asphyxiation due to oxygen displacement. They also pose a fire hazard if oxygen is condensed out of the atmosphere during the use of cryogenic liquids that have boiling points that are lower than oxygen – e.g. nitrogen, helium or hydrogen. There is a potential for explosion due to pressure buildup in closed containers. Materials intended for use with cryogenic liquids must be selected carefully as they can be weakened or fail due to embrittlement.

# Engineering Controls [Provide additional information as it pertains to your research protocol]

Use and store cryogens in well-ventilated areas with a minimum of 6 air changes per hour. Closets, small rooms, and walk-in cold rooms (or similar small/unvented spaces) should be avoided to prevent buildup of the gas as the cryogen evaporates/sublimes**. If using large quantities of cryogens or if there are concerns about the adequacy of ventilation, consult Environment, Health & Safety (EHS) Research Health and Safety (734) 647-1143 to determine if additional ventilation or an oxygen sensor/alarm is needed***.*

Each part of a cryogenic system must have its own pressure relief system.

# Work Practice Controls [Provide additional information as it pertains to your research protocol]

* Cryogenic gases can condense oxygen out of the air, creating a localized oxygen enriched environment. Therefore, they must be used and stored in well-ventilated areas, away from flammable materials, open flames and ignition sources.
* Do not put your head inside a liquid nitrogen freezer or other enclosed space containing a cryogen. Never allow people to travel in an elevator with cryogenic liquids.
* Do not use hollow rods or tubes as dipsticks. (When a warm tube is inserted into a cryogen, liquid will spout from the top of the tube.)
* When retrieving cryopreservation vials that have been stored in liquid nitrogen:
  + Raise the vials out of the liquid phase and store them in the gas above the liquid for 24 hours to allow any trapped liquid nitrogen to escape. After this period, the vials may be removed. Retrieving these vials directly from the liquid phase may cause the vials to rupture if liquid nitrogen has become trapped inside. This may expose the employee to flying bits of plastic, biological specimens or cryoprotective agents (such as dimethyl sulfoxide) that were in the vial.
  + Alternatively, 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.
* Check the liquid levels of Dewars regularly. If the liquid evaporates more rapidly than normal, the Dewar may be losing its vacuum.
* Also follow the [SOP for asphyxiants.](https://ehs.umich.edu/research-clinical/chemical/)

# Personal Protective Equipment [Provide additional information as it pertains to your research protocol]

* Wear loose fitting cryogenic gloves, safety goggles, face shield, lab coat, long pants and closed toe shoes when handling and transporting cryogenic materials.
* Lab coats should be knee length and have no pockets or cuffs to catch the liquid.
* Pants should not have cuffs and should be long enough to go over the shoe or boot.

# Transportation and Storage [Provide additional information as it pertains to your research protocol]

* Never store cryogenic liquids or dry ice in walk-in cold rooms.
* Use and store liquid hydrogen and helium away from flammable materials and ignition sources. (These gases can condense oxygen out of the air, creating a localized oxygen enriched environment.)
* For liquid helium and hydrogen storage systems, check the pressure relief and inspect the system for leaks regularly.
* These gases are cold enough to solidify atmospheric air; leaks in storage systems for these gases may become plugged with solidified air. If the pressure relief device becomes plugged, the container may over-pressurize and fail.
* Use and store liquid oxygen away from open flames. Post a “No Open Flames” sign in liquid oxygen storage areas.
* Store and transport cryogenic materials only in Dewars or cryogenic liquid cylinders designed for that particular cryogen. Inspect Dewars daily to insure that no air or ice plugs exist in the neck openings.
* Cryogens may be transported in elevators only in containers certified to leak at less than or equal to 1 liter of liquid (or 1 kilogram of solid) per day. Never allow passengers to travel in an elevator with cryogenic liquids.

# Waste Disposal [Provide additional information as it pertains to your research protocol]

If a cryogen (such as dry ice) has been mixed with a liquid that would normally be disposed of as hazardous waste (such as alcohol, as in a cold trap), follow disposal procedures for that liquid. Cryogens must not be dumped into sinks, as the thermal shock is likely to damage the sink and/or the plumbing.

As the unneeded cryogen is evaporating, good ventilation is essential to prevent hazardous air concentrations of the gas.

Do not put unneeded cryogen in a sealed container, as the build-up of pressure could cause an explosion.

# Exposures/Unintended Contact [Provide additional information as it pertains to your research protocol]

If the employee is in need of emergency medical attention, call 911 immediately.

For a chemical exposure/injury:

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| injury type | action | notes |
| Exposure-Eyes | 1. Refer to SDS. 2. Flush exposed eyes with water with warm water for at least 15 minutes. 3. Seek medical attention (see below). | Do not rub affected area. |
| Exposure-Skin | 1. Refer to SDS. 2. Flush exposed eyes or skin with water with warm water for at least 15 minutes. 3. Seek medical attention (see below). | Do not rub affected area. |
| Inhalation (including spills of powder outside of a chemical fume hood) | 1. Remove from the contaminated area. 2. If the patient is not breathing spontaneously, administer rescue breathing. 3. If the patient does not have a pulse, administer CPR. 4. Monitor the breathing and pulse continuously. 5. Seek medical attention (see below). | If medical oxygen and appropriately trained personnel are available, administer 100% oxygen. |
| Ingestion | 1. Not a normal route of entry. Seek medical attention (see below). |  |
| **NOTE**: If an ambulance is needed, call the University of Michigan Division of Public Safety and Security (DPSS) at 911 to request assistance. | | |

Contact EHS for advice on symptoms of chemical exposure, or assistance in performing an exposure assessment.

Report all work related accidents, injuries, illnesses or exposures to Work Connections within 24 hours by completing and submitting the [Illness and Injury Report Form](http://www.workconnections.umich.edu/employees/work-related-illness-injury/step-one/). Follow the directions on the Work Connections website [Where to go for treatment](http://www.workconnections.umich.edu/treatment.html) to obtain proper medical treatment and follow-up.

Complete the [Incident and Near-Miss Report](https://ehsa.oseh.umich.edu/EHSA/public/injuryillnesssubmit/injuryillnessinitialedit) form.

## Treatment Facilities

**U-M Occupational Health Services -- Campus Employees**Mon-Fri 7:00 am - 4:30 pm  
C380 Med Inn building  
1500 East Medical Center Drive, Ann Arbor (734) 764-8021

**University Health Services -- University students (non-life threatening conditions)**  
Mon-Fri 8 am - 4:30 pm, Sat 9 am - 12 pm  
Contact for current hours, as they may vary  
207 Fletcher Street, Ann Arbor (734) 764 - 8320

**UMHS Emergency Department -- after clinic hours or on weekends**  
1500 East Medical Center Drive, Ann Arbor (734) 936-6666

# Spill Procedure [Provide additional information as it pertains to your research protocol]

* When a spill occurs, personal safety should always come first.
* Alert and clear everyone in the immediate area where the spill occurred.

Spills of cryogenic liquid can cause depletion of oxygen in the area. For spills over 1 liter (or smaller amounts in very small rooms), leave the area immediately and call the University of Michigan Division of Public Safety and Security (DPSS) at 911.

For additional information regarding spill response procedures, refer to the EHS [Hazardous Waste Spill Response](http://ehs.umich.edu/hazardous-waste/spill-response/) Web page.

# Emergency Reporting

Report all emergencies, suspicious activity, injuries, spills, and fires to the University of Michigan Police (DPSS) by calling 911 or texting 377911. Register with the [University of Michigan Emergency Alert System](http://dpss.umich.edu/emergency-management/alert/) via Wolverine Access.

# Training of Personnel

All personnel shall read and fully adhere to this SOP when handling cryogenic materials.

# Certification

I have read and understand the above SOP. I agree to contact my Lab Director if I plan to modify this procedure.

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| Name | Signature | UMID # | Date |
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| Laboratory Director | Revision Date |

### Major Revisions (Tracking purposes only -- Do not print as part of SOP)

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| Date | Revision |
| 09-13-18 | EHS name and logo were added, updated the formatting, and revised the content under Exposure/Unintended Content (AKJ). |
| 03-04-19 | Reviewed and updated. |
| 05-17-22 | Reviewed and updated links (LGS) |