

# ENVIRONMENTAL HEALTH & SAFETY

BRYN MAWR COLLEGE

## CRYOGENIC & DRY ICE SAFETY

*This guidance document provides detailed information to share with students during faculty-lead cryogenic and dry ice safety training. This document must be supplemented with faculty lead hands-on training that demonstrates specific processes such as dewar filling, charging NMR, freezing samples, etc.*

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Cryogenics such as liquid nitrogen and dry ice can be hazardous to laboratory workers if not handled properly. Depending on the situation, improperly handled liquid nitrogen can lead to oxygen deficiency, cold burns, and explosions.

### GENERAL PRECAUTIONS

- Liquid nitrogen splashes or handling of dry ice can result in cold burns. Personal Protective Equipment (PPE) requirements are designed to avoid eye and skin contact.
- Never handle cryogenics, dry ice, or items that have been in cryogenics, with bare hands.
- Use gloves that are designed specifically for working with cryogenics and dry ice.
- Do not use or store cryogenics in confined areas, walk-in refrigerators, environmental chambers, or rooms without ventilation. A leak in such an area could cause an oxygen-deficient atmosphere.
- Never store cryogenics in a sealed, airtight container at a temperature above its boiling point (-195.8°C). The pressure resulting from the production of gas may lead to an explosion.

### PERSONAL PROTECTIVE EQUIPMENT (PPE)

- **Safety goggles** and a **face shield**.
- Hands must be protected with **thermal insulated cryogenic gloves** that can quickly be removed if liquid nitrogen is spilled on them. Even with insulated gloves, hands should not be submerged in liquid nitrogen or used to scoop up or grab dry ice.
- Protect the rest of the body with **long pants**, **lab coat**, and **closed toe shoes**. It is recommended that pants cover the shoes rather than be tucked into them (to avoid liquid nitrogen spilling into the boots).
- A PPE Decision Matrix is listed on the next page (page 2) which provides recommendations for PPE based on specific operations.



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PPE Decision Matrix

| Operation   | Potential Hazard  | Face Shield and Safety Glasses (with Side Shields) | Safety Glasses (with Side Shields) | Cryogen Gloves | Closed-Toe Shoes | Long Pants (No Cuffs) | Lab Coat or Long-Sleeve Shirt with apron | Remarks   |
|---|---|--|------------------------------------|----------------|------------------|-----------------------|--|---|
| Pouring small non-pressurized (<5 liters) volume of LN <sub>2</sub> between open containers | Eye or skin injury from splashing   |  | X                                  | Recommended    | X                | X                     | Recommended                              | Avoid pouring cryogens from above chest level   |
| Work with experimental samples immersed in LN <sub>2</sub> in small (~1 L) dewar            | Frostbite and burns from cold surface contact   |  | X                                  | Recommended    | X                | X                     | Recommended                              | Thermally insulated hand tools may be an effective alternative to gloves  |
| Handling chilled metal transfer lines   | Frostbite and burns from cold surface contact   |  | X                                  | X              | X                | X                     | X  |   |
| Dispensing LN <sub>2</sub> from a pressurized line to an open dewar.                        | Frostbite and burns from cold surface contact, eye and skin injury from splashing                 | X  | X                                  | X              | X                | X                     | X  | When using a phase separator btw the pressurized LN <sub>2</sub> line and the open non-pressurized dewar, the risk of a cryogen splash is substantially reduced |
| Closed pressurized line LN <sub>2</sub> or LHe transfer                                     | Frostbite and burns from contact with the unexpected release of pressurized cryogen liquid or gas | X  | X                                  | X              | X                | X                     | X  |   |
| Transporting dewar from filling station to laboratory                                       | Frostbite and burns from cold surface contact   |  | X                                  | X              | X                | X                     | Recommended                              |   |
| Handling dry ice  | Frostbite and burns from cold surface contact   |  | X                                  | X              | X                | X                     | X  |   |

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### Emergency Procedures & First Aid

1. Emergency procedures

OSHA defines an oxygen level of 19.5% as oxygen deficient. No occupancy or entry should be permitted below this level, except by trained and properly protected emergency responders. Rooms containing cryogenics are equipped with oxygen monitoring systems or the oxygen deficiency hazard has been assessed and determined that the size of cryogenics does not affect the oxygen level of the laboratory or room. If the monitor system is alarming, no one should enter that room. They should evacuate and call Campus Safety (x7911).

2. Inhalation of oxygen-deficient atmospheres

DO NOT attempt to remove an unconscious person out of an alarming room. You must call Campus Safety (x7911).

3. Liquid Nitrogen Spills

- a. DO NOT attempt to clean up a liquid nitrogen spill.
- b. Less than 1 liter, evacuate the area and allow the liquid to evaporate and the room to ventilate for at least 30 minutes. Contact your supervisor if equipment was damaged. Contact facilities services if there was any damage to the floors, benches, or walls.
- c. Greater than 1 liter, immediately evacuate the room and DO NOT return. If the room is equipped with a purge button, activate it. Contact Campus Safety and EHS to monitor the oxygen levels before it can be determined safe to re-enter.

4. Dry Ice Spill

- a. If spilled, dry ice will sublimate to carbon dioxide. The gas is heavier than air and is extremely cold. It will briefly accumulate in low areas until it warms and equilibrates with the air. Open the room or increase ventilation by activating the lab's purge button or opening the fume hood sash, if a large amount has spilled or if the room is un-ventilated.

5. Cold burns and frostbite

Remove any clothing that is not frozen to the skin. Do NOT rub frozen body parts because tissue damage may result. Flush the affected skin with copious amounts of room temperature or lukewarm water, or place the affected part in lukewarm water, and do not apply any form of direct heat. If possible, move the person to a warm room and call Campus Safety (x7911). First aid/CPR-trained personnel must assess and/or summon medical assistance to address cold burns and associated tissue damage.

6. Liquid nitrogen splash in the eye

Flush your eyes with running water for at least 15 minutes and summon medical attention as quickly as possible.

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### Disposal

- DO NOT pour cryogenics down the sink, toilet, or garbage.
- DO NOT allow cryogenics to evaporate or sublime in enclosed areas.
- Allow cryogenics to evaporate or sublime in an open container in a well-ventilated space.
- Share excess cryogenics and dry ice with colleagues when possible.

### Transporting Cryogenics

1. Filled Dewars and Dry Ice in Elevators
  - a. Volumes greater than 1L
    - i. Passengers are NOT permitted to ride in the elevator. A warning sign (page 5) must be posted at the starting floor and destination floor indicating that the elevator is in use and passengers are not permitted. The warning sign should be taped to the wall next to the elevator not on the elevator doors. The warning sign must be removed once transport is complete.
    - ii. Cryogenic gloves must be used while carrying dewars from the filling station to a laboratory. Dry ice must be transported in an appropriate Styrofoam chest, insulated cooler, or a special cooler designed for the storage of dry ice. Dry Ice must NEVER be stored in any type of tightly sealed devices such as an ultra-low freezer or plastic/glass container.
  - b. Volumes of 1L or less
    - i. Use hallways and stairs as a primary route before elevators.
    - ii. All elevators in the Park Science Buildings can be used with a passenger and without posting the warning sign at the elevator entrance. Contact EHS (ehs@brynmawr.edu) if other buildings or vehicles need to be evaluated for transporting cryogenic materials.
    - iii. Cryogenic gloves must be used while carrying dewars from the filling station to a laboratory.
2. For information about Dry Shippers, please contact the respective faculty or EHS.
3. **Students are prohibited from transporting cryogenics in their personal vehicles.**

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**WARNING**

**Cryogenic Materials in Transit**

**DO NOT ENTER**

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### Student Training Checklist

Faculty are responsible for providing hands-on training to their students. This training should be comprised of information found within this guidance specifically covering the following topics:

- Hazards associated with cryogenics
  - Asphyxiation
  - Cryogenic Burns/Frostbite
  - Expansion
- Personal Protective Equipment (PPE)
  - Cryogenic gloves
  - Safety glasses
  - Face shield
  - Long pants with no cuffs
  - Long sleeves
  - Closed toed shoes
  - Lab coat or apron as needed
- Emergencies & First Aid
- Storage and Use
  - Dispensing process → hands-on training with faculty
  - Usage is specific experiments → hands-on training with faculty
  - Transporting

All cryogenic users shall adhere to the abovementioned when handling cryogenics. Signing below indicates your understanding of cryogenic hazards and usage.

\_\_\_\_\_  
(Name: Print and Signature)

\_\_\_\_\_  
(Date)

\_\_\_\_\_  
(Department)

\_\_\_\_\_  
(Supervisor)