
Cryogen & Dry-Ice Safety Fact Sheet

Definitions

Cryogen: A liquefied gas with a boiling point typically below 77 K (-196°C). The most commonly cryogen used at the Penn are liquid nitrogen and liquid helium.



Dewar: an insulated container used to store and transport liquefied gases. It is insulated by a vacuum between its two walls and is equipped with pressure relief device(s).

Dry Ice: Frozen carbon dioxide. Dry ice sublimates from a solid to a gas at room temperature.

Pressure-relief devices: Devices on cryogenic systems in place to relieve pressure build up. These devices may be: (1) valves which open to relieve pressure, (2) bursting discs that break to relieve pressure and must be replaced or (3) loose-fitting lids on Dewar flasks.



(1)



(2)



(3)

Hazards Associated with Cryogenics & Dry Ice

1. **Burns:** 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.
2. **Asphyxiation:** NMR magnet quenching (the loss of superconductivity followed by the rapid release of gaseous cryogenics) can result in an oxygen deficient atmosphere. The volumetric expansion rate from the liquid to gaseous phase ranges between 690 to 750 times.

The use of dry ice in cold rooms can cause increased breathing, headache, dizziness, nausea and visual disturbances due to elevated carbon dioxide concentrations in the air. Dry ice can also cause asphyxiation in confined spaces.

Remember: You can not detect oxygen deficiency or over exposure to Carbon Dioxide.

Always work with cryogenics and dry ice in well ventilated spaces especially when filling dewars. If you are working in a small space, open a door to increase ventilation. Do not work with or store large quantities of dry ice in cold rooms.

3. **Fire and Explosion Hazards:** Liquid nitrogen and helium are not flammable. However they are capable of condensing oxygen out of the air creating an oxygen-rich environment. Flammable materials can ignite in the presence of condensed oxygen.
4. **Vacuum System and Over-pressurization Hazards:** Cryogenic systems must be equipped with pressure-relief devices. Never use a system that does not have pressure-relief devices in

place. **If you purchase a new Dewar that will be filled at Penn's liquid nitrogen filling station in the Anatomy-Chemistry building purchase a high pressure tank (235 psi) equipped with a dual pressure (22/150 psig) relief valve system.**

5. Dewars have an insulating vacuum space in between its 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, 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.

6. **Cyrotubes stored in liquid nitrogen may "explode" when removed from the dewar:** Cyrotubes are not guaranteed to be leak tight if stored in liquid nitrogen. Because of the "super fluidity" of liquid nitrogen it can leak into sealed cyrotubes. When removed from the dewar the liquid nitrogen that leaked into the cryotube expands causing the tube to "explode". If you must store samples in liquid nitrogen wear cryogloves, face shield and safety glasses when removing samples.



7. **Property Damage: Cryogenics can damage rubber tubing and crack floor tiles if spilled.** Special care should be taken to avoid spilling any cryogenics. Cracked floor tiles may also present a tripping hazard to other workers. Notify your Building Administrator of any floor tiles that require repair.

Personal Protective Equipment (PPE)

Laboratory personnel must always wear safety glasses and lab coats when working with cryogenics, dry ice or around dispensing lines where cold burns may occur.

The following PPE must be worn when filling dewars or removing specimens or samples from a dewar

1. Cryo-gloves
2. Face Shield
3. Safety goggles
4. Lab coat
5. Long pants



The following must be worn when handling dry ice:

1. Cryo gloves
2. Lab Coat
3. Long Pants

Filling Dewars or Other Storage Vessels



- Dewars and other storage vessels (e.g. cylinders) are available in a variety of shapes and sizes. Always use a dewar or storage vessel rated for the cryogen you are refilling or transporting. (Do not use styrofoam containers or thermos bottles for holding and transporting liquid nitrogen).



- Remove all metal jewelry from wrists and hands (a spill/splash could freeze the jewelry to your skin).
- Always wear cryo-gloves when dispensing a cryogenic liquid. Available from Fisher Scientific; Catalog # 11-394-305. *Note: Cryo-gloves only provide short-term protection against accidental skin exposures and are not designed to protect skin against prolonged contact.*
- Only fill a dewar from a transfer line that has a phase separator attached to the end of the line. Phase separators separate gas from liquid preventing an overabundance of gas from surrounding the end of the transfer line and allow only liquid nitrogen to fall into the dewar.
- When filling a dewar flask at a filling station, place the phase separator so that it rests on the bottom of the dewar. Do not allow the cryogen to splash into the dewar.
- Dispense directly into the dewar. Never use a funnel in the dispensing process. The funnel can freeze creating a splash hazard.



- Use stainless steel tubing to transfer cryogenics. Never use rubber or plastic tubing. The temperature can cause rubber or plastic tubing to become brittle and crack, spraying the liquid onto surrounding surfaces. Never fill a dewar or storage vessel if the tubing is damaged. (Liquid helium must be transferred through a vacuum insulated tube because of its extremely low heat of



vaporization.)

- Never overfill a dewar. This may cause liquid nitrogen to leak into the cryotubes stored in the dewar. Upon removal from the dewar, cryotubes may explode when the liquid nitrogen inside is warmed and expands.
- Never leave a filling process unattended.

Additional Safety Precautions

- When cooling objects with liquid nitrogen lower them very slowly into the liquid using tongs to prevent boiling and splashing.
- Always use a CryoClaw to retrieve samples that have fallen into a dewar. (*CryoClaw available from Fisher Scientific; Catalog # 11-675-95*).
- Be sure that all cryogen containers are clearly labeled with a cryogen warning and the cryogen's name.
- Always use appropriate glassware rated for use with cryogenics.
- Do not overfill the dewar. Where possible only store cryogenic vials in the vapor phase of liquid nitrogen (above the liquefied gas). Do not store vials in the liquid phase.
- Always use an appropriate wheeled cart to transport a dewar or storage vessel. Never pull, push or roll a dewar or storage vessel.
- For more information on using dry ice for shipping laboratory specimens see the EHRS Manual for the [Shipment of Biological Products, Diagnostic Specimens, Infectious Substances, Genetically-modified Materials & Dry Ice](#).
- Training and special packaging is required when shipping samples on dry ice. See [Shipping Dangerous Goods](#).



- Always read the Material Safety Data Sheet (MSDS) for a cryogenic substance prior to working with it. Employees can request a copy of an MSDS at http://www.ehrs.upenn.edu/resources/msds/msds_request.html
- If you work in an NMR laboratory and would like to receive more information on cryogenics and high field magnet systems, please contact our office: 215-898-4453 or ehrs@ehrs.upenn.edu

Injuries

- If skin comes in contact with a cryogen or dry ice, run the area of skin under cool or warm water for fifteen minutes (do not use hot or cold water).
- If your finger is burned do not place it in your mouth. This could burn your mouth.
- Do not rub the area; rubbing can cause further tissue damage.
- Notify your supervisor and proceed immediately to Occupational Medicine or Student Health, accordingly.

Emergencies

Spill: Do not attempt to clean up a spilled cryogen. If a large volume of gas is released, leave the area immediately and call EHRS @ 215-898-4453. (After hours call Penn Police 511 (from a University Phone) or 215-573-3333.)

Fire: In the case of fire, leave the area immediately and dial 511.