

Cryogenics are substances used to obtain very low temperatures and are extensively employed in teaching and research at USC. Dry ice (solid carbon dioxide), though not categorized as a cryogen, is also frequently used at USC for low temperature applications. It sublimates directly to a gas at -78.5°C .

There are potential health hazards common to both cryogenics and dry ice that include asphyxiation, frostbite, and injury from sudden expansion/explosion.

WHAT ARE THE USES OF CRYOGENICS AND DRY ICE AT USC?

- Liquid nitrogen (LN_2 ; bp: -196°C) – Cold trap/distillation; tissue preparation; LN_2 freezers; research.
- Liquid helium (bp: -269°C) – Superconducting magnet cooling/NMR; ultra low temperature research.
- Dry ice – Alcohol or acetone cold bath, tissue preparation, and research.

WHAT ARE THE HAZARDS?

- *Explosion.* A cryogenic liquid (or dry ice) in a closed vessel will produce a substantial rise in pressure upon warming, usually causing the vessel to burst explosively.
- *Asphyxiation.* The boil-off gas may displace sufficient air to cause a hazardous or even lethal, reduced-oxygen atmosphere.
- *Cold Burns (frostbite).* A painful condition caused by damage or death of frozen tissue. Extreme cases can result in loss of fingers or toes.
- *Oxygen/Air Condensation*
 - Liquid helium is cold enough to freeze air into a solid which may render liquid helium equipment inoperative. Follow the manufacturer's operating instructions and safety precautions when using this equipment.
 - LN_2 -cooled surfaces (e.g., metal filling hose, a trap on a Schlenk line) may condense oxygen-enriched air. The liquid is easily recognized as all other likely substances freeze at that temperature.



WHAT I NEED TO KNOW...

- NEVER store liquid nitrogen or dry ice in cold rooms. Cold rooms are non-ventilated.
- For uncontrolled release of LN_2 , evacuate area immediately. Close doors behind last person to exit. Contact DPS at (213) 740-4321.
- NEVER immerse hands in LN_2 , even with cryogenic gloves. This will result in **SEVERE** injury!
- Only use vials and glassware designed and approved for cryogenic work.
- Remove all metal jewelry from wrists and hands. A spill/splash may freeze the jewelry to the skin.
- Contact labsafety@usc.edu for more information.

- *Liquefied Air* presents a fire or explosion hazard if it contacts combustible materials in the presence of an ignition source. If liquid air is present or suspected:
 1. Open the system to the atmosphere.
 2. Remove the cooling bath.
 3. Allow to evaporate. Liquid air that boils in a closed or narrowly-vented system will cause extreme pressurization and may result in an explosion.

Dry Ice

Carbon dioxide (CO_2) is both an asphyxiant and actively toxic at high concentrations.¹ At room temperature, it is denser than air and even more so when cold.

Bulk dry ice is stored in large, top-opening containers (chests) around campus that fill to the top with CO_2 . Do NOT place head into container when reaching for last blocks of dry ice.

NOTE: Use tongs to remove dry ice blocks.

Inhalation of CO_2 in high concentration may lead to headache, nausea, tremors, and suffocation. Consult the [SDS](#) for more information.

¹ [Asphyxiation Due to Dry Ice in a Walk-in Freezer](#)



WHAT ARE THE STORAGE REQUIREMENTS FOR CRYOGENS AND DRY ICE?

- Store cryogenics and dry ice in well-ventilated locations. **NEVER** store liquid nitrogen or dry ice in cold rooms as they are non-ventilated.
- Restrain large dewars (e.g., 20 L) and all pressurized dewars for seismic safety per guidelines in [Compressed Gas Cylinder Storage Fact Sheet](#).
- An oxygen deficiency monitor is recommended for all rooms containing large amounts of LN₂ and/or dry ice.
- Place appropriate internal and external signage where cryogenics are being used and stored.



WHAT PPE IS NEEDED?

- *Hand protection.* Cryogenic gloves - thermally-insulated, loose-fitting gloves to protect against contact with cold surfaces. They are not liquid-tight and DO NOT protect against immersion in liquid nitrogen. Remove immediately if they become soaked. Nitrile gloves may be used if dexterity is needed and cold surfaces are absent.
- *Face protection.* Splash goggles to guard against incidental splashes; face shield is used in combination with safety glasses or splash goggles for higher-hazard operations (e.g., dispensing from a pressurized dewar).
- *Body protection.* Lab coat (100% cotton) and closed-toe/closed-heel/non-absorbent shoes (required). Avoid wearing pants with cuffs since they can retain liquid nitrogen.



WHAT ARE THE STEPS FOR FILLING CRYOGEN DEWARS?

1. Wear appropriate PPE before filling. Also, ensure that:
 - 160-L LN₂ dewar is in well-ventilated area. 3000-L LN₂ tanks at USC are located outside buildings (e.g., CEM and SSC).
 - All valves on 160-L dewar are closed.
 - Flex metal transfer line is attached to liquid port on 160-L dewar.
2. Place metal hose directly into recipient dewar. Make sure that dewar is stabilized so that it does not tip over during filling.

3. Slowly open liquid port valve to initiate flow. A jet of cold vapor will continuously exit the recipient dewar as it fills. **REMEMBER:** Do not leave dewar unattended.
4. Dewar is filled when LN₂ begins to overflow. Turn off valve and remove flex transfer line carefully.
5. Remove recipient dewar and transport to lab safely (see below).

WHAT IS NEEDED TO TRANSPORT CRYOGENS AND DRY ICE?

- Use a wheeled utility cart to transport LN₂ dewars within and between buildings. Place dewars on the bottom shelf. **NEVER** push, pull, or roll a dewar.
- Do NOT transport LN₂ or dry ice in passenger or service elevators with occupants. Use passenger elevators only during off-hours.
 1. Place dewar/utility cart in empty service elevator. If no service elevator available, use an empty passenger elevator with caution.
 2. Have a co-worker place caution tape across elevator portal at every floor the elevator will travel past to discourage passenger entry.
 3. Attach a conspicuous "Do Not Enter" sign to dewar/utility cart and send to destination floor.
 4. Direct co-worker to wait at destination floor to receive dewar/utility cart. Remove caution tape from elevator portal at each floor.

REMEMBER: NEVER store or transport cryogenics and dry ice in an enclosed vehicle (e.g., passenger car or SUV).



First Aid (OSHA QuickFacts)

- In case of exposure to cryogenics or dry ice, remove any clothing that is not frozen to the skin. Do NOT rub frozen body parts because tissue damage may result. Obtain medical assistance as soon as possible.
- Place the affected part of the body in a warm water bath (not above 40°C). Never use dry heat.

REFERENCES

USC EH&S [Cryogenics and Dry Ice SOP](#)
 University of Florida EH&S [Cryogen Safety](#)
 Grainger Catalog [Cryogenic gloves](#)
 OSHA QuickFacts Laboratory Safety [Cryogenics and Dry Ice](#)
 Northwestern University video [Filling and Maintenance of Liquid Nitrogen Tanks](#)

