

FactSheet Cryogenics & Dry Ice

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 to increase the rate of heat transfer; tissue preparation; research.

WHAT ARE THE HAZARDS?

Cryogenic liquids expand 700 to 900 times their volume upon evaporation/boiling. This can cause:

- *Explosion.* A cryogenic liquid (or dry ice) in a closed vessel will produce an irresistible rise of pressure on 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.



The extreme cold of cryogenic liquids may cause:

- *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.
 - 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 since 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 wide 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. Cold rooms 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 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?**

- 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.
- Place metal hose directly into recipient dewar. Make sure that dewar is stabilized so that it does not tip over during filling.

- 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.
- Dewar is filled when LN₂ begins to overflow. Turn off valve and remove flex transfer line carefully.
- 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 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 [Cryogenic Liquids 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](#)

