

2. HAZARDOUS CHEMICAL(S)/CLASS OF HAZARDOUS CHEMICAL(S)

Cryogenic liquids are defined as liquids with a normal boiling point below -150 °C (-240 °F). Some examples include: liquid N₂, O₂, He, etc, which have typical gas:liquid expansion volumes of 650-1500:1. Cryogenic solids are defined as solids with a sublimation range of -78.5 °C to -109.3 °C (-109.3 °F to -164.7 °F). An example of this would be solid CO₂ (dry ice). Finally, some mixtures of Cryogenic materials and a solvent (*e.g.*, dry ice/acetone) may have flammability or other hazards in addition to Cryogenic hazards.

REQUIRED - List (or attach) the applicable chemical(s) for your laboratory, and describe important properties and signs/symptoms of exposure.

Liquid Nitrogen - Cold Burns, Frostbite, Dizziness, Loss of Consciousness

Liquid Helium - Cold Burns, Frostbite, High pitched voice, Dizziness, Loss of Consciousness

3. ENGINEERING/VENTILATION CONTROLS

Cryogens should only be used in well-ventilated areas. Use within small rooms or unventilated areas (*e.g.*, cold rooms) may cause a buildup of gas as the Cryogen evaporates or sublimates, displacing oxygen creating an asphyxiation hazard. If the use of Cryogens are required in a small or unventilated room contact the Chemical Hygiene Officer or healthandsafety@ucdavis.edu for alternative respiratory and/or ventilation options.

How not to do it: [Texas Dewar Accident Summary](#)

REQUIRED - Insert descriptions of lab-specific ventilation controls and equipment safety features utilized to reduce the risk of Cryogen hazards.

Lab Ventilation is at least 15 air changes per hour in all rooms and thus considered adequate. An oxygen measurement should be performed before going into the pit in room 25.

4. ADMINISTRATIVE CONTROLS

The following elements are required:

1. Complete the [UC Laboratory Safety Fundamentals](#) (or approved equivalent) training prior to working in the laboratory;
2. Complete laboratory-specific safety orientation and training on laboratory-specific safety equipment, procedures, and techniques to be used, including any applicable laboratory-specific Laboratory Safety Plan(s), prior to receiving unescorted access to the laboratory;
3. Demonstrate competency to perform the procedures to the Principal Investigator (PI), Laboratory Supervisor, laboratory-specific Safety Officer, and/or trainer;
4. Be familiar with the location and content of any applicable Safety Data Sheets (SDSs) for the chemicals to be used (online SDSs can be accessed from [UC SDS](#));
5. Implement good laboratory practices, including good workspace hygiene;
6. Inspect all equipment and experimental setups prior to use;
7. Follow best practices for the movement, handling, and storage of hazardous chemicals (see Chapters 5 and 6 of [Prudent Practices in the Laboratory](#) for more detail). An appropriate spill cleanup kit must be located in the laboratory. Chemical and hazardous waste storage must follow an appropriate segregation scheme and include appropriate labeling. Hazardous

chemical waste must be properly labelled, stored in closed containers, in secondary containment, and in a designated location;

8. Do not deviate from the instructions described in this SOP without prior discussion and approval from the PI and/or Laboratory Supervisor.
9. Notify the PI and/or Laboratory Supervisor of any accidents, incidents, near-misses, or upset condition (*e.g.*, unexpected rise or drop in temperature, color or phase change, evolution of gas) involving Cryogenics described in this SOP; and
10. Abide by the laboratory-specific working alone SOP, if applicable.

For Cryogenics, the following are also required:

11. Successful completion of the [Cryogen Safety training course](#);
12. Have read [SafetyNet #58 - Safety Precautions for Cryogenic Liquids](#);
13. Do not alter or disable the pressure-relief mechanisms/valves as installed by the manufacturer;
14. Do not alter/modify the Cryogen containers as received from the vendor;
15. Use tongs or similar tools to immerse and remove objects from liquid Cryogenics;
16. Do not touch Cryogenic materials, or tools in contact with Cryogenics, with bare skin or disposable gloves (see PPE requirements below);
17. Do not lubricate equipment for Cryogenic oxygen use; and
18. Cryogenic dewars and/or delivery lines should be inspected for leaks and must be composed of compatible materials.

INSERT IF APPLICABLE - Describe any additional administrative controls (*e.g.*, restrictions on procedure/work equipment/work locations/unattended operations). Include any chemical-specific administrative controls (*e.g.*, peroxide formers).

NA

REQUIRED - Descriptions of lab-specific handling, storage and transport procedures. This includes bulk materials and samples Cryogenically preserved.

Dewars should be pulled by the handles meant for transport and not by the top ring or the fittings on top.

5. PERSONAL PROTECTIVE EQUIPMENT (PPE)

At a minimum, long pants (covered legs) and closed toe/closed heel shoes (covered feet) are required to enter a laboratory or technical area where hazardous chemicals are used or stored.

In addition to the minimum attire required upon entering a laboratory, the following PPE are required for work with Cryogenics:

- A. Eye Protection: Eye protection is required for all work with Cryogenics.
 - i. At a minimum ANSI Z87.1-compliant safety glasses are necessary.
 - ii. Splash goggles may be substituted for safety glasses, and are required for processes where splashes are foreseeable or when generating aerosols.
 - iii. In addition to safety glasses/goggles, a face shield, in good condition, is **required** for transferring from any pressurized container, and should be considered for large volume transfers.
 - iv. Ordinary prescription glasses will NOT provide adequate protection unless they also meet the Z87.1 standard and have compliant side shields.

- B. **Body Protection:** At a minimum a chemically-compatible laboratory coat that fully extends to the wrist is necessary.
- If a risk of fire exists, a flame-resistant laboratory coat that is NFPA 2112-compliant should be worn.
 - For chemicals that are corrosive and/or toxic by skin contact/absorption additional protective clothing (*e.g.*, face shield, chemically-resistant apron, disposable sleeves, etc.) are required where splashes or skin contact is foreseeable.
 - Pants should not have cuffs, which could catch the liquid Cryogen causing dermal burns.
 - Shoes should be made of non-porous materials or have impermeable uppers.
- C. **Hand Protection:** When hand protection is needed for the activities described in this SOP define the type of glove to be used based on: A) the chemical(s) being used, B) the anticipated chemical contact (*e.g.*, incidental, immersion, etc.), C) the manufacturers' permeation/compatibility data, and D) whether a combination of different gloves is needed for any specific procedural step or task.
- Loose-fitting, thermal-insulated gloves (not intended for full immersion purposes) that are meant for incidental contact **must** be available to all personnel using Cryogenics. No metal jewelry, watches, or rings should be worn while handling Cryogenics.

REQUIRED - Insert descriptions of PPE and hygiene practices used with each process, hazardous chemical(s), or hazardous chemical class, including any specialized PPE needed for a procedural step/task.

The above PPE precautions are sufficient for LN₂ and LHe transfers from storage dewars to magnets. For LN₂ transfers to small dewars used for temperature control faceshields should be used. Lab coats are OPTIONAL if the labcoat does not contain a wrist tight fit on the sleeves. If the sleeves are loose fitting, the lab coat can trap cryogenics and cause worse injuries than if no lab coat is worn.

6. SPILL AND EMERGENCY PROCEDURES

Follow the guidance for chemical spill cleanup from [SafetyNet #13](#) and/or the [UC Davis Laboratory Safety Manual](#), unless specialized cleanup procedures are described below. Emergency procedure instructions for the UC Davis campus and UCD Medical Center are contained in the [UC Davis Laboratory Safety Manual](#), [campus Emergency Response Guide \(ERG\)](#), and [UCD Health System ERG](#). The applicable ERG must be posted in the laboratory. All other locations must describe detailed emergency procedure instructions below.

REQUIRED - Insert lab-specific definition of a small and large spill of Cryogenic material.

Small spills are less than 5 liters.

For a small spill of Cryogenic liquid:

- Evacuate the area;
- Allow ventilation to dissipate the gas; and
- Contact EH&S at (530) 752-1493 for oxygen deficiency monitoring prior to reentry.

For large spills, delivery line failures, tank/dewar failures, or any other uncontrolled release immediately evacuate the room and pull the fire alarm to evacuate building.

If a leak is suspected from a Cryogen dewar or delivery line/system discontinue use. If it is safe and feasible to do so, move the leaking dewar to a safe location. Contact the vendor immediately.

Care should be taken to prevent the accidental accumulation of liquid Oxygen. Laboratory activities where liquid Nitrogen or Helium are used for cooling (*e.g.*, vacuum traps) have increased potential for liquid oxygen enrichment or entrapment.

INSERT IF APPLICABLE - Descriptions of any specialized emergency procedures for locations outside of the UC Davis main campus and the UCD Medical Center campus.

In the case a storage dewar falling over,

- a. open the vent valve to bypass the pressure relief
- b. open the doors to the rooms and evacuate
- c. contact EH&S to monitor for Oxygen deficiency monitoring prior to re-entry

Contaminated clothing or PPE should not be worn outside the lab. Soiled lab coats should be sent for professional laundering. Grossly contaminated clothing/PPE and disposable gloves must not be reused.

7. WASTE MANAGEMENT

Specific waste concerns for Cryogens:

- A. Do not put unneeded Cryogens into a sealed container. Ensure good ventilation while the unneeded Cryogen evaporates/sublimates;
- B. If Cryogen has been mixed with a liquid (*e.g.*, dry ice/acetone) that would normally be disposed as hazardous waste, follow waste disposal procedures for that liquid once the Cryogen has completely dissipated; and
- C. Do not dispose of Cryogens into sinks, as thermal shock or gaseous expansion may damage the sink and/or plumbing.

INSERT IF APPLICABLE - Descriptions of laboratory-specific information on the waste streams generated, storage location, and any special handling/storage requirements.

NA

INSERT IF APPLICABLE - Descriptions of decontamination procedures for equipment, glassware, and controlled areas (*e.g.*, glove boxes, restricted access hoods, perchloric/hot acid fume hoods, or designated portions of the laboratory).

NA

8. DESIGNATED AREA

INSERT IF APPLICABLE - Description(s) of the designated area(s) in your laboratory. Designated areas are required for "Particularly Hazardous Substances". The entire laboratory, a portion of the laboratory, a fume hood, etc. can be designated.

Entire Lab

9. DETAILED PROTOCOL

REQUIRED - Insert or attach detailed laboratory-specific procedures for the process, hazardous chemical(s), or hazard class. You may also include any relevant supporting resources such as SafetyNets, journal citations, etc. that are applicable.

Cryogen transfers to magnets will be performed with a steel braided hose. Outlet hoses may be rubber. For transfers to LN2 temperature control Dewars (or other open Dewars), Steel braided hose with a diffuser on the end shall be used.

TEMPLATE REVISION HISTORY

Version	Date Approved	Author	Revision Notes:
1.0	4/14/2015	CLSC Task Force	New template
1.1	7/10/2015	Chris Jakober	Updated safety training name/hyperlink
1.2	3/10/2016	Chris Jakober	Updated URLs following website redesign, added URL to UCDHS ERG

LAB-SPECIFIC REVISION HISTORY

Version	Date Approved	Author	Revision Notes:
1	10/16/19	Jeffrey Walton	SOP Generated
2	9/2/22	Derrick Kaseman	Revision on PPE made and updated contact information

Documentation of Standard Operating Procedure Training

(Signature of all users is required)

- ✓ Prior to using **Cryogens**, laboratory personnel must be trained on the hazards described in this SOP, how to protect themselves from these hazards, and emergency procedures.
- ✓ Ready access to this SOP and to a Safety Data Sheet for each hazardous material described in the SOP must be made available.
- ✓ The Principal Investigator (PI), or the Laboratory Supervisor if the activity does not involve a PI, must ensure that their laboratory personnel have attended appropriate laboratory safety training or refresher training within the last three years.
- ✓ Training must be repeated following any revision to the content of this SOP.

Designated Trainer: *(signature is required)*

I have read and acknowledge the contents, requirements, and responsibilities outlined in this SOP:

Name	Signature	Trainer Initials	Date