CRYOGENS (LIQUID NITROGEN, LIQUID HELIUM, DRY ICE)

STANDARD OPERATING PROCEDURE

Type of SOP: ☐ Process ☐ Hazardous Chemical ☐ Hazard Class

Department: _____ **Building:** _____ **Room #:**_____

Principal Investigator: _____ **Phone #:**_____

Prepared By: _____ **Email:** _____ **Date:** _____

1. HAZARD OVERVIEW

Cryogenic Injury: These materials – liquid nitrogen, liquid helium and dry ice - are extremely cold (-100°C to -270°C), and upon contact can instantly freeze other materials. Thus, potentially causing serious tissue damage such as **cryogenic burns or injury** like frostbite upon exposure.

Asphyxiation: Evaporating liquid nitrogen or sublimating dry ice (carbon dioxide) will displace the air within a non-ventilated space possibly leading to **suffocation**. Generally, labs have adequate ventilation to prevent this. However, non-laboratory areas and confined spaces will not provide adequate ventilation/air exchanges to work with these materials. NOTE: Individuals have died when working in a non-ventilated lab "cold room" where large quantities of dry ice were stored. The OSHA ceiling *Permissible Exposure Limit* for carbon dioxide is 30,000 ppm.

Gas Under Pressure: The expansion of gas in a receptacle, like a Dewar of liquid nitrogen or liquid helium, will cause pressure to buildup potentially leading to a rupture in the receptacle if the pressure is not released. Please review the Gas Under Pressure SOP for additional guidance. Be aware of ice that can plug or disable pressure-relief devices. Ensure adequate pressure relief mechanisms are functional, i.e., never use tight-fitting stoppers or closures without pressure-relief devices.

2. PERSONAL PROTECTIVE EQUIPMENT (PPE)

Given the severe and immediate effects of cryogens, it is essential that proper PPE is always worn when handling cryogenic materials. Cryogenic or special insulated gloves for working with cryogens should be employed. At minimum, cuff-less pants, lab coats, safety glasses, and closed foot shoes are required. Additional or more protective PPE may be required pending the volume, source, process, and splash potential. Please refer to the NJIT Chemical Hygiene Guide and Hazard Assessment Form to determine the proper PPE for handling corrosive materials.

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Reference: University of California, Santa Barbara - Environmental Health & Safety

3. ENGINEERING/VENTILATION CONTROLS

Always work in a well-ventilated area with cryogens to prevent oxygen displacement. Even with dry ice, there was a lab fatality as a result of an individual working in a "cold room" containing dry ice without any ventilation. For this reason, **liquid cryogens should also not be transported on an occupied pubic elevator, or handled, used or stored in a cold or warm room, or any areas where the ventilation is restricted, recirculated, or nonexistent.** Please review the NJIT Chemical Hygiene Guide and the Safe Chemical Fume Hood Use Guide for information on the proper use of a chemical fume hood and criteria for implementing engineering controls.

☐ Chemical Fume Hood ☐ Glovebox ☐ Biological Safety Cabinet ☐ Other _____

Room Location of Unit(s): _____

4. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Follow any substance-specific storage guidance provided in Safety Data Sheet (SDS).

- Do not move an over-pressurized container. Evacuate and seal area, call EHS or dial 911.
- Do not fill Dewar or secondary containers more than 80% capacity; leave room for expansion of gases.
- Avoid trapping cryogenic liquids between closed sections of an apparatus.
- Dewar flasks or other glassware devices should be taped on the outside or provided with shatterproof protection to minimize flying glass particles in case of implosion. Dewar flasks should be vented with a bored or notched stopper.
- Cool cryogenic containers slowly to reduce thermal shock and flashing of the material. Cryotubes used to store samples under liquid nitrogen may explode without warning when handling and thawing.
- Wear a face shield and safety goggles when there is a potential for splash or explosion such as dispensing or transferring liquid cryogens or thawing cryotubes.
- Open valves slowly to minimize thermal effects and control gas escape.
- Transfer liquids slowly to prevent thermal sock, pressure buildup, and splashing. Use specialized withdrawal devices instead of pouring to prevent splash hazard.
- When utilizing cold baths (cryogen + organic solvent), use in a hood with a catch pan. Be aware of increased fire hazard. Be prepared for vigorous solvent boiling upon initial addition of solvent.
- Avoid condensing oxygen (blue in color) and/or its contact with organic material when using liquid nitrogen. Flush cold traps with nitrogen or keep under vacuum to avoid condensation of oxygen from air within the trap. Condensed oxygen when contacted with organic materials can cause a powerful explosion.
- To avoid condensing oxygen from the air with liquid nitrogen/helium, check glassware and valves for cracks and other defects before beginning experimental work. Verify that systems assumed to be under vacuum are so by checking vacuum gauges regularly. You should be on the lookout for the possibility of condensed air within the apparatus.

Reference: University of California, Santa Barbara - Environmental Health & Safety

- Storage of cryogens: **use only approved low temperature containers**. Make sure cryogen containers are vented to prevent pressure buildup. Use and store cryogen materials in well-ventilated areas.
- Use extreme care when working with cryogen materials. They should not be stored in sealed containers, as tremendous pressure could result potentially causing an explosion. Ice or frost buildup on pressure relief valves should be removed with a damp cloth.
- Never allow any unprotected part of the body to touch uninsulated pipes or vessels that contain cryogenic liquids.

5. INCIDENTS AND ACCIDENTS

Contact Exposure: Flood the area *(skin and eyes)* immediately with large quantities of cool/warm water or place exposed area in a warm water bath. Do not rub the area as it may damage the tissue. See a doctor immediately if the skin is blistered or if the liquid nitrogen came in contact with your eyes.

Laboratory personnel are to report all occupational injuries or illnesses to Faculty/PI as soon as practical. The Faculty/PI and laboratory personnel must submit the required paperwork to NJIT EHS Department. See the the Emergency Response Guidelines posted in the laboratory or Emergency Procedures section of the NJIT CHG for proper procedures involving an injury, exposure, fire, or release/spill of a hazardous material.

In the event of an emergency, DIAL 9-1-1 to activate emergency response personnel.

6. SPILL AND DECONTAMINATION

Spill/Release: Evacuate surrounding areas. Keep unnecessary and unprotected individuals from entering the area. Do not touch or walk through spilled material. Avoid breathing gas.

Decon: Wear proper PPE. Decontaminate equipment and work surfaces using sodium bicarbonate and water, or other appropriate decontamination/cleaning solution. Dispose of all used contaminated disposables in the appropriate waste stream following the Waste Disposal Section of the NJIT CHG.

Decontamination Solution(s): _____

Additional Spill / Decontamination Requirements:

7. WASTE DISPOSAL

Not applicable to cryogens – let materials evaporate. However, low-temperature baths, such as those made from dry ice and acetone, requires proper disposal of solvent. Follow the practices and procedures in accordance with the NJIT Laboratory Waste Management Program to properly dispose of waste.

Additional Waste Disposal Requirements:

Reference: University of California, Santa Barbara - Environmental Health & Safety

8. PRIOR APPROVAL/REVIEW

9. DESIGNATED USE AREA

Designated Use Area Location(s): _____

10. SAFETY DATA SHEETS

Location of SDS: _____

11. LAB-SPECIFIC INFORMATION (required) (*Examples* *of appropriate content)*

Reference: University of California, Santa Barbara - Environmental Health & Safety