

Laboratory Standard Operating Procedure: Cryogenic Liquids

I.	THIS STANDARD OPERATING PROCEDURE (SOP) IS FOR A:
☐ Specific laboratory procedure or experiment <u>Examples:</u> synthesis of chemiluminescent esters, folate functionalization of polymeric micelles, etc. ☐ Generic laboratory procedure that covers several chemicals <u>Examples:</u> distillation, chromatography, etc. ☒ Generic use of specific chemical or class of chemicals with similar hazards <u>Examples:</u> organic azides, mineral acids, etc.	
This standard operating procedure (SOP) is intended to provide general guidance on how to safely work with cryogenic liquids. This general use SOP only addresses safety issues specific to cryogenic liquids. If you have questions concerning the applicability of any item listed in this procedure contact the Principal Investigator/Laboratory Supervisor of your laboratory or the Chemical Environmental Health and Safety Coordinator [CEHSC] at (813) 842-3528.	
II.	CLASS OF HAZARDOUS CHEMICALS
A cryogenic liquid has extremely low boiling points (i.e. less than – 150 °F). One special property of both cryogenic liquids and dry ice is that they undergo substantial volume expansion when converted to a gas phase, which can potentially lead to an oxygen deficient atmosphere where ventilation is limited. Few cryogenic liquids can also pose additional hazards including toxicity and flammability (i.e. liquid carbon monoxide). Examples of cryogenic liquids include: liquid nitrogen, helium, and argon. Dry ice is the common term for frozen carbon dioxide.	
III.	GENERAL HAZARD CONTROL
1. Only work with cryogenic liquids in well-ventilated areas to avoid localized oxygen depletion or buildup of flammable or toxic gas. 2. Handle objects that are in contact with cryogenic liquids with tongs or proper gloves. 3. Transfers or pouring of cryogenic liquids should be done carefully to avoid splashing. 4. Containers and systems containing cryogenic liquids should have pressure relief mechanisms.	

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5. Cryogenic liquid cylinders and other containers (such as Dewar flasks) should be filled no more than 80% of capacity to protect against thermal expansion.
6. Cryogenic liquid/dry ice baths should be open to the atmosphere to avoid pressure build up.
7. Keep liquid oxygen away from organic materials and ignition sources.
8. Transfer of liquid hydrogen in an air atmosphere can condense oxygen in the liquid hydrogen, creating an explosion risk.
9. Cryotube thawing - In addition to wearing proper safety equipment, when thawing cryotubes, place the cryotube in a heavy-walled container (e.g., a desiccator) or behind a safety shield to protect yourself in the event that the tube shatters.
10. Shield or wrap fiber tape around glass Dewars to minimize flying glass and fragments should an explosion occur. Note: Plastic mesh will not stop small glass fragments.
11. Check connections and hoses regularly for leaks using a specific monitoring instrument or soapy water (or equivalent).
12. Remove damaged or defective cylinders from service (contact the cylinder vendor for assistance).

IV.

ENGINEERING & VENTILATION CONTROLS

Lab ventilation should have a minimum of 6 air changes per hour. Contact the CEHSC at (813) 842-3528 for reviewing the adequacy of room ventilation standards or to determine if an oxygen-deficiency monitor or other alarm devices is necessary

V.

PERSONAL PROTECTIVE EQUIPMENT

- ☒ Lab Coat ☒ Long pants ☒ Close-toed shoes
☒ Safety goggles with Face Shield ☒ Cryogenic Gloves [*heavy duty thermal capacity*]

The above listed personal protective equipment should be worn when handling cryogenic substances. Additional protection may be required based upon each chemical agent. Check all personal protective equipment [PPE] prior to use to ensure good undamaged condition. At a minimum:

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1. When handling chemicals or contacting potentially contaminated surfaces, protective gloves are to be worn. For proper selection of glove material, review [chemical Safety Data Sheet \[SDS\]](#) and [glove selection guidance](#).
2. Goggles (not safety glasses) are appropriate for general processes, but where a splash or spray potential exists a face shield is also recommended.
3. Additional protective clothing (i.e., face shield, apron, and oversleeves) is appropriate for chemicals that are toxic via skin contact and the potential for contact is possible.

VI.

SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

1. Cryogenic liquid Dewars are to be stored in well-ventilated areas. Storage in unventilated closets, environmental rooms, and stairwells is prohibited.
2. Large Dewars must be tethered/ anchored to a wall.
3. Segregate and clearly mark full and empty ("MT") Dewars.
4. Store flammable cryogenic liquids and liquid oxygen away from combustible materials and sources of ignition.
5. Segregate according to hazard class and chemical compatibility. Ensure to separate flammable and oxidizing gases.
6. Store flammable gases away from flammable solvents, combustible material, ignition sources (including unprotected electrical connections), and oxygen gas cylinders and liquid oxygen (at least 20 feet if possible).
4. Consult MSDS for compressed gas specific storage requirements. Also, follow any substance-specific storage guidance provided in SDS documentation.

VII

DESIGNATED AREA

Establish a designated area if working with a cryogenic liquid where limited access, special procedures, knowledge, and work skills are required. A designated area can be the entire laboratory, a specific laboratory workbench, or a laboratory hood. Designated areas must be clearly marked with signs that identify the chemical hazard and include an appropriate warning; for example: **WARNING! CRYOGENIC LIQUID WORK AREA.**

VIII.

EMERGENCY SPILL AND ACCIDENT PROCEDURES

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Health-Threatening Emergencies Examples: Fire, explosion, health-threatening hazardous material spill or other Immediate Danger.	1. Call 911 2. Alert people in the vicinity to evacuate 3. Activate the local alarm systems 4. Call Campus Security at 813-257-7777 or xtn. 7777 5. Remain nearby to provide arriving emergency responders information about chemicals 6. Once personal safety is established, call the CEHSC at (813) 842-3528
Personnel Injury or Exposure	1. Remove the injured/exposed individual from the area if it is safe to do so because of the medical condition of the victim or the potential hazard to rescuers. 2. Call 911 3. Administer first aid as appropriate. 4. If skin or eye contact occurs run cool or warm water over surface for at least 15 minutes. 5. Do NOT rub affected area. 6. Give medical responders copies of MSDSs for all chemicals the victim was exposed to. 7. Report the exposure to the CESHC
Non-Health Threatening Emergencies	Call Security at 813-257-7777 or xtn. 7777 to report incident
Small Spill Clean-Up	Do Not Attempt to clean up any spill of cryogenic liquid. Call Security at (813) 251-5133 or xtn. 3333 for assistance 1. Notify your supervisor. 2. Submit waste pickup request to the CEHSC.
Incident Reporting	1. Report all occupational injuries or illness to laboratory supervisor as soon as practical. 2. Laboratory personnel are encouraged to report "near misses" as they are considered a precursor to actual incidents. 3. Laboratory supervisor is to conduct (or coordinate) an investigation of all incidents and "near misses." The goal of the investigation is to identify and address any deficiencies that may have contributed to the incident.
Medical Consultation	Laboratory personnel who work with hazardous chemicals are to be provided the opportunity to receive medical attention/consultation when: 1. A spill, leak, explosion or other occurrence results

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	in a hazardous exposure (potential overexposure). 2. Symptoms or signs of exposure to a hazardous chemical develop.
IX.	WASTE DISPOSAL
Please call the CEHSC at (813) 842-3528 to coordinate with the return of all dewars and include any special handling or storage requirements for your waste.	
X.	DECONTAMINATION PROCEDURES
EQUIPMENT	Decontaminate laboratory apparatus or other contaminated equipment (glassware) before removing them from the designated area.
XI.	TRAINING REQUIREMENTS
General Training (<i>check all that apply</i>): ☒ General Safety & Emergency Preparedness – Annual Orientation Training ☒ Review of MSDS for other chemicals involved in process/experiment ☒ Compressed gas safety ☒ Review of this SOP ☐ Other: _____ The University may require additional safety training depending on the hazardous materials and laboratory-specific processes – consult the PI for more information.	