NEW YORK STRUCTURAL BIOLOGY CNETER

Standard Operating Procedure For Work with Cryogens	Created: 04/26/2017 Reviewed: 07/06/2017

Chemical name/class: **Cryogens (Nitrogen, Helium, Carbon dioxide)** **CAS #:**

1. **Circumstances of Use:**

Cryogens are liquefied or solid gases at low temperatures. These materials may be used for cooling, sample storage, or a ready source of pressurized gas. Cryogen exposure may result in tissue damage or asphyxiation due to displaced oxygen. Cryogenic materials stored in pressurized containers must contain safety pressure release valves in order to avoid rapid expansion and container failure.

2. **Potential Hazards:**

General:

- Cryogenic liquids are defined as liquids with a normal boiling point below -150 ^{o}C (-240 ^{o}F). Some examples include: liquid N_2, He, etc, which have typical gas:liquid expansion volumes of ~700:1.
- Cryogenic solids are defined as solids with a sublimation range of -78.5 ^{o}C to -109.3 ^{o}C (-109.3 °F to -164.7 °F). An example of this would be solid CO_2 (dry ice).
- Asphyxiation; Generation of gas as the Cryogen evaporates or sublimes can quickly displace atmospheric oxygen creating and asphyxiation hazard.
- Frostbite/cryoburns; Because of the extreme low temperatures even very short exposures of unprotected skin or eyes can cause severe frostbite or loss of vision.
- Pressure buildup; Boiling of liquefied gases within a closed system increases pressure. Users must make certain that cryogenic liquids are never contained in a closed system.
- Oxygen enrichment; Liquid nitrogen and liquid helium may fractionally distill air, causing liquid oxygen to collect in the cryogenic container. Liquid oxygen increases the combustibility of many materials, creating potentially explosive conditions.
- Embrittlement**;** Ordinary materials such as metal, rubber, and plastics (polyethylene, PVC, etc.) exposed to cryogenic temperatures for long periods may become very brittle and prone to shatter. OR materials that have undergone periodic warming and freezing must be examined regularly for cracks and warping. Do not dispose of cryogenic liquids down the drain!
- Cryotube Explosions**;** Cryotubes used to contain samples stored under liquid nitrogen may explode without warning. Tube explosions are caused by liquid nitrogen entering the tube through minute cracks or cap threads and then expanding rapidly as the tube thaws. 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.
- Consult the Safety Data Sheet (SDS) and

Toxicity:

- N/A

Reactivity:

- N/A

3. **Engineering Controls:**

- Use cryogens in well ventilated areas.
- When appropriate install or use oxygen monitors.
- For small rooms; oxygen monitors will be integrated with HVAC fans so than upon a low oxygen condition fans will automatically switch to “exhaust mode”.
- Safety pressure relieve valves will be installed on piping or containers between two valves or any other location where liquid cryogen may become trapped.

4. **Work Practice Controls:**

- Do not touch Cryogenic materials, or tools in contact with Cryogens, with bare skin or disposable gloves (see PPE requirements below)
- Use tongs or similar tools to immerse and remove objects from liquid Cryogens.
- Do not alter or disable the pressure-relief mechanisms/valves as installed by the manufacturer.
  How not to do it: Texas Dewar Accident Summary
- Do not alter/modify the Cryogen containers as received from the vendor.
- Do not ride in elevators with Cryogen containers.
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5. **Personal protective equipment (PPE):**

- Loose-fitting, thermal-insulated gloves (not intended for full immersion purposes) that are meant for incidental contact **must** be available to all personnel using Cryogens. No metal jewelry, watches, or rings should be worn while handing Cryogens.
- Wear standard laboratory safety glasses and a face shield.
- In cases where the arms or torso may be exposed to liquid suspensions or dry particles, wear a chemically-compatible laboratory coat that fully extends to the wrist.

6. **Transportation and Storage:**

- Cryogen dewars should be moved at a walking speed with container under control at all times.
- If a Cryogen container does not have wheels, use appropriately designed dollies or carts.
- For Cryogen containers with wheels, rotate the container as it goes over thresholds or transitions. Rotation helps to prevent tipping.
- Cryogen containers should be stored in well ventilated areas.

7. **Waste Disposal:**

- Excess Cryogens can be allowed to evaporate in well ventilated areas.
- Do not dump or pour excess Cryogens on the floor, this will cause rapid evaporation potentially displacing oxygen and/or damage flooring.
- Do not dispose of Cryogens into sinks or plumbing as this may cause damage.
- Do not put excess Cryogens into a sealed container, this may result in an explosion hazard.
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8. **Exposures/Unintended contact:**

- For symptoms of asphyxia such as headache, drowsiness, dizziness, excitation, excess salivation, vomiting or unconsciousness remove personnel to fresh air. Seek medical attention.
- If breathing is difficult, call 911 from any phone to request assistance. In the event breathing has stopped administer CPR. Seek medical attention.
- In the event of exposure to cryogen liquids or gases warm body part as quickly as possible with tepid water. Do not use hot water or dry heat. Under no circumstances should the frozen body part be rubbed, even after rewarming. Flush eyes with tepid water for at least 15 minutes. Seek medical attention.
- When safe to do so, inform LSO of exposure.
- An incident report found at: http://www.nysbc.net/twiki/bin/view/Staff/IncidentReports should be completed within 24 hours. Follow-up medical attention should be sought.

9. **Spill Procedure:**

- For small spills of cryogens; evacuate the immediate area and allow cryogen to evaporate and dissipate.
- For large spills, vacuum jacketed pipe failures, tank/dewar failures or any uncontrolled release of Cryogens; evacuate the building and call FDNY.
- Consult SOP for Liquid Nitrogen Bulk Tank Operation.
- Consult SOP for Activation of Oxygen Monitor.
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10. **SEMC Specific Instructions**

a. Before dispensing nitrogen, wear appropriate personal protection: cryo gloves and a face mask or goggles. Wear appropriate lab footwear: no open-toed shoes.

b. Insert the tube from the 240L tank into the 4L or 10L dewar. If it does not fit inside the dewar, use an appropriate funnel to prevent spillage. Do not fill containers smaller than 4L from a 240L tank.

c. Open liquid valve to start dispensing liquid. Be careful that flow is not so quick that much spills over or flies back. This is particularly important for the 4L dewar.

d. Fill until dewar is full then close liquid valve. Be sure it is completely closed, but do not over-tighten. Ask staff for assistance if unsure.

e. If a loud whistling sound is heard during filling, this means 240L tank is empty. Stop filling, wait for tank to cool, then move hose to a fresh tank. Mark empty tank as “empty” with sign. Mark full tank as “in use” with sign.

11. **Training of personnel:**

All personnel are required to complete the online General Lab Safety session thru the OESO website. This session includes an introduction to general chemical safety. All personnel shall read and fully adhere to this SOP for safe handling of Cryogens, the SDS, and shall document that they have read these documents by signing and dating the SOP.

"I have read and understand this SOP. I agree to fully adhere to its requirements."

Last	First	Signature	Date

