Description
This standard is to provide guidelines for the safe handling of cryogenic liquids. Cryogenic liquid is a liquid that has a boiling point at or below -150 °C. Consult the M/SDS for specific information about a particular cryogen liquid before working with it.

Potential Hazards
1. Fire. The use of cryogenic liquids such as nitrogen, argon, helium, or hydrogen will condense oxygen from the atmosphere. Exposure of combustible materials to oxygen-enriched cryogenic liquids enhances the combustibility of the material.

2. Explosion. A cryogenic liquid expands by orders of magnitude upon vaporization. For example, one liter of liquid nitrogen becomes 24.6 cubic feet of nitrogen gas. This can cause an explosion of a sealed container.

3. Asphyxiation. A poorly or non-ventilated room will be quickly enveloped by the expanding gas from a cryogenic liquid. This will lead to displacement of oxygen and potential asphyxiation of the user.

4. Contact. Cryogenic liquids cause frostbite on contact with exposed skin.

Process or Experiment Description
This standard operating procedure (SOP) is intended to provide general guidance on how to safely work with cryogenic liquids and dry ice. This general use SOP only addresses safety issues specific to cryogenic hazards of chemicals. In some instances, several general use SOPs may be applicable for a specific chemical (i.e., for liquid hydrogen, both this general use SOP and the general use SOP for flammable liquids would apply). If you have questions concerning the applicability of any item listed in this procedure contact Environmental Health and Safety (509) 963-2338.

Hazardous Chemicals/Class of Hazardous Chemicals
Cryogenic liquids are materials with extremely low boiling points (i.e. less than −150 °C). Common examples of cryogenic liquids are liquid nitrogen, helium, and argon. Dry ice is the common term for frozen carbon dioxide. 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).

Control of Hazards – General
- Only work with cryogenic liquids in well-ventilated areas to avoid localized oxygen depletion or buildup of flammable or toxic gas.
- Handle objects that are in contact with cryogenic liquids with tongs or proper gloves.
- Transfers or pouring of cryogenic liquids should be done carefully to avoid splashing.
- Containers and systems containing cryogenic liquids should have pressure relief mechanisms.
• Cryogenic liquid cylinders and other containers (such as Dewar flasks) should be filled no more than 80% of capacity to protect against thermal expansion.

• Cryogenic liquid/dry ice baths should be open to the atmosphere to avoid pressure build up.

• Keep liquid oxygen away from organic materials and ignition sources.

• Transfer of liquid hydrogen in an air atmosphere can condense oxygen in the liquid hydrogen, creating an explosion risk.

• 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.

• 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.

**Engineering/Ventilation Controls**

If the process does not permit the handling of cryogenic liquids in well-ventilated areas (i.e., lab ventilation having a minimum of 6 air changes per hour).

**Personal Protective Equipment**

At minimum, chemical splash goggles, long pants, and closed toed shoes are to be worn when entering laboratories having hazardous chemicals. Additionally, when handling cryogenic liquids, heavy gloves (e.g., cryogenic gloves) are appropriate.

**Special Handling Procedures**

1. Never allow any unprotected part of the body to touch exposed pipes/vessels containing cryogenic liquids; skin coming in contact with the cold metal may adhere to it and tear when attempting to withdraw.

2. Exercise caution when adding a cryogenic liquid to a Dewar at room temperature or an object at room temperature to a cryogenic liquid. Both will cause the liquid to boil and splash vigorously.

3. Keep ignition sources away when handling cryogenic liquids especially liquid oxygen. Combustible materials (including the user) may become oxygen-enriched or saturated through exposure and, in the presence of an ignition source, will ignite rapidly and burn fiercely.

4. Only use containers or equipment specified for cryogenic use.

5. Never plug containers holding cryogenic liquid; cover them when not in use to prevent an accumulation of moisture and ice.

6. Inspect pressure relief valves on equipment (e.g. 150-L Dewar) for ice build-up.

**Storage Requirements**

• Cryogenic liquid Dewars are to be stored in well-ventilated areas. Storage in unventilated closets, environmental rooms, and stairwells is prohibited.

• Large Dewar must be tethered/ anchored to a wall.
• Store flammable cryogenic liquids and liquid oxygen away from combustible materials and sources of ignition.

• Additionally, follow all substance-specific storage guidance provided in M/SDS documentation.

**Spill and Accident Procedures**

In the event of a small spill, evacuation may not be necessary if the area is well-ventilated. Small spills will evaporate in time. In the event of a large chemical spill, follow these guidelines:

1. Notify everyone in the immediate area and the supervisor.
2. Evacuate personnel from the spill area.
3. Deny entry.
4. Alert other building occupants. NOTE: Evacuation of the building and its occupants may be necessary depending on the volume of cryogen spilled and its relative hazard.
5. Call 911

**Labeling Requirements**

Identify containers with the name of the cryogenic liquid e.g. liquid nitrogen. Label storage areas appropriately as well.

**Dewar Disposal**

Coordinate w/ vendor for return of Dewar(s).

**Minimum Training Requirements**

• Laboratory-specific training

**First Aid and Decontamination Procedures**

Unprotected skin contact with cryogenic liquids will cause frostbite. Contact 911 and request medical assistance.

Personnel: If skin or eye(s) comes in contact with a cryogenic liquid, run the area of skin under cool or warm water for fifteen minutes (do not use hot or cold water). DO NOT RUB OR MASSAGE AFFECTED AREAS—this can cause further tissue damage. Refer to M/SDS for any specific instructions. Where medical attention is required, ensure to bring along M/SDS(s) of chemical(s) to aid medical staff in proper diagnosis and treatment.

**Designated Area**

For cryogens that are also considered particularly hazardous substances, a designated area shall be established per the other applicable SOP(s).
Certification

I have read and understand the above SOP. I agree to contact my Supervisor or Principal Investigator (PI) if I plan to modify this procedure.

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Principal Investigator ______________________________ Date ___________