Purpose
The purpose of this SOP is to provide guidance for the safe handling of cryogenic liquids in general. Consult the Safety Data Sheet (SDS) for specific information about a particular cryogenic liquid before working with it.

Definitions
_Cryogenic Liquid:_ a liquid that has a boiling point at or below -150ºC (123K).

_Frostbite:_ damage to the skin and underlying tissues caused by extreme cold. Frozen tissue is painless and appear waxy with a pallid yellowish color.

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 explosions in sealed containers.
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. **Tissue Damage:** Cryogenic liquids are extremely cold at atmospheric pressure. Contact with skin may lead to burns and/or severe frostbite.

Personal Protective Equipment
- Use chemical splash goggles for eye protection, in combination with a full-length face shield, for operations that present splash hazards.
- Use thick leather or other gloves designed for protection from extreme cold. Check glove manufacturer for recommendations on suitable gloves.
- In addition to long pants, wear a lab coat (100% cotton) and closed-toed shoes (non-fabric) with non-slip soles.
- If a respirator is needed, the user must follow the guidelines of the Respiratory Protection Program.

Hazard Controls
- Adequate ventilation is essential when working with cryogens because small amounts of liquid can rapidly convert to a large volume of gas.
- Do not use in confined spaces for threat of asphyxiation.
- Handle objects that are in contact with cryogenic liquids with tongs or proper gloves.
- Containers and systems containing cryogenic liquids should have pressure relief mechanisms.
- Cryogenic liquid containers should be no more than 80% full to allow room for gas expansion.
- Cryogenic liquid/dry ice baths should be open to the atmosphere to avoid pressure build-up, cover loosely to prevent accumulation of moisture and ice.
- When thawing tubes removed from cryogenic liquids, place the tube in a heavy-walled container or behind a safety shield to contain the tube in case it shatters.

Special Handling Procedures
- Never allow unprotected skin to touch exposed pipes/vessels containing cryogenic liquids. Skin coming into contact with the cold metal may adhere to it and tear when attempting to withdraw.
- Exercise caution when adding a cryogenic liquid to a dewar at room temperature, or placing an object at room temperature into a cryogenic liquid. Both will cause the liquid to boil and splash vigorously.
- Transfer or pouring of cryogenic liquids should be done carefully to avoid splashing.
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.

- Only use containers or equipment specified for cryogenic use.
- Do not use hollow rods or tubes with cryogenic liquids. When a room temperature tube is inserted into a cryogenic liquid the liquid will quickly spout from the top of the tube.
- Follow all substance-specific guidance provided in the SDS.

**Emergency Procedures**

- In the event of an exposure or spill, submit an incident report to EH&S as soon as possible after the resolution of the incident.

**First Aid**

For skin and eye exposure to cryogenic liquids follow first aid procedures after calling 911

- Remove any clothing that has been contaminated
  - In the event of clothing contamination with oxygen, hydrogen, or carbon monoxide; it is important to remove clothing, evacuate personnel from the facility, and keep away from ignition sources.
- Flush or soak the area with warm water (Do not use hot water! Water should be less than 108°F)
- Apply dry, sterile dressing to the affected areas. Put dressing between fingers or toes to keep them separated.
- Do not apply dry heat or heat lamps to damaged area
- Do not rub affected area
- Make sure emergency responders know exactly what the injured person was exposed to and provide them with a copy of the SDS.

**Spill/Release Procedures**

If the spill is small (less than one liter), AND the area is well ventilated:

- Notify everyone in the area, and supervisor, that a spill has happened
- Turn off any ignition sources in the room
- Evacuate the room/area
- Wait 30 minutes for the liquid to evaporate and for the gas to dissipate in the air
- Contact EH&S to make sure it is safe to reenter room

For a larger spill:

- Notify everyone in the area, and supervisor, that a spill has happened
- Evacuate everyone from spill area
- Deny entry to area
  - Post warning signs and put up barriers, or post personnel
- Alert other building occupants.
  - Evacuation of the building and all occupants may be necessary depending on the volume of cryogen spilled and its hazard
- Notify the fire department and EH&S
  - Cheney Fire Department: 498-9291
  - EH&S: 359-6497 or 290-3510
Labeling Requirements
- Identify containers with the name of the cryogenic liquid (e.g. Liquid Nitrogen).
- Label storage areas with warning signs about the presence of cryogenic liquids.
- Post a “No Open Flames” sign in areas storing liquid oxygen.

Storage Requirements
- Store full cryogenic containers in dry, ventilated areas.
- Inspect pressure relief valves on equipment (e.g. 150L dewars) for ice build-up.
- Never store cryogenic liquid in a walk-in cold room.

Waste Disposal
- If a cryogenic liquid has been mixed with a liquid that would normally be disposed of as hazardous waste, follow disposal for that liquid
- As the unneeded cryogenic liquid is evaporating, good ventilation is essential to prevent hazardous concentrations of the gas
- Do not put unneeded cryogenic liquids in a sealed container, the pressure could cause an explosion
- Cryogenic liquids must never be dumped into sinks. The thermal shock is likely to damage the sink and/or pipes.