

STANDARD OPERATING PROCEDURE: Cryogenic Liquids

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1.0 PURPOSE

The purpose of this standard is to provide guidelines for the safe handling of cryogenic liquids. Consult the MSDS (or SOP) for specific information about a particular cryogen before working with it.

2.0 DEFINITIONS

A **Cryogenic Liquid** is a liquid that has a boiling point at or below -150°C (123 K).

Frostbite is damage to the skin and underlying tissues caused by extreme cold. Frozen tissue is painless and appears waxy with a pallid yellowish color.

3.0 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.

4.0 EXPOSURE HAZARDS

4.1 Contact/Absorption

Cryogenic liquids are extremely cold at atmospheric pressure. Contact with skin may lead to burns and/or severe frostbite.

4.2 Inhalation

Inhalation may cause respiratory tract discomfort or irritation. Prolonged exposure may lead to asphyxiation.

5.0 PERSONAL PROTECTIVE EQUIPMENT

Use chemical splash goggles for eye protection in combination with a full-length face shield for operations that

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present splash hazards. Hand protection requires thick leather gloves or other gloves developed for protection from extreme temperatures (cold). Check glove manufacturer for recommendations on a suitable glove.

Wear a lab coat (100% cotton) and closed-toe shoes (non-fabric) with non-slip soles.

If a respirator is needed, then user must follow guidelines of the Respiratory Protection Program.

6.0 ENGINEERING AND VENTILATION CONTROLS

Adequate ventilation is essential when working with cryogenics because a small amount of liquid can rapidly convert to a large volume of gas. Do not use in confined spaces for the threat of asphyxiation.

7.0 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.

8.0 LABELING REQUIREMENTS

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

9.0 STORAGE REQUIREMENTS

Store full cryogenic containers in a dry, ventilated area.

10.0 FIRST AID

Recovery from frostbite may be complete if only the skin and underlying tissues are damaged. If blood vessels are damaged, gangrene may ensue which may require amputation of the affected area. Contact DPS and request medical assistance.

If medical assistance is not immediately available, re-warming first aid may be given:

1. Immerse the affected area(s) in warm (never HOT) water, or apply warm cloths repeatedly for 20 to 30 minutes. The recommended water temperature is 104 to 108 degrees Fahrenheit. Keep circulating the water to aid the warming process. Severe burning pain, swelling, and color change may occur during warming. Warming is complete when the skin is soft and sensation returns.
2. Apply dry, sterile dressing to the frostbitten areas. Put dressings between frostbitten fingers or toes to keep them separated.
3. Move thawed areas as little as possible.

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11.0 SPILL AND ACCIDENT PROCEDURES

In the event of a small spill, evacuation may not be necessary if the area is well-ventilated.

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. Notify DPS and/or EH&S.

12.0 PROGRAM APPROVAL AND REVIEW

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