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1. INTRODUCTION

Cryogenic liquids have boiling points less than -73°C (-100°F). Liquid nitrogen, liquid oxygen and carbon dioxide are the most common cryogenic materials used in the laboratory. Hazards may include fire, explosion, embrittlement, pressure buildup, frostbite and asphyxiation.

Many of the safety precautions observed for compressed gases also apply to cryogenic liquids. Two additional hazards are created from the unique properties of cryogenic liquids:

Extremely Low Temperatures –The cold boil-off vapor of cryogenic liquids rapidly freezes human tissue. Most metals become stronger upon exposure to cold temperatures, but materials such as carbon steel, plastics and rubber become brittle or even fracture under stress at these temperatures. Proper material selection is important. Cold burns and frostbite caused by cryogenic liquids can result in extensive tissue damage.


Vaporization - All cryogenic liquids produce large volumes of gas when they vaporize. Liquid nitrogen will expand 696 times as it vaporizes. The expansion ratio of argon is 847:1, hydrogen is 851:1 and oxygen is 862:1. If these liquids vaporize in a sealed container, they can produce enormous pressures that could rupture the vessel. For this reason, pressurized cryogenic containers are usually protected with multiple pressure relief devices.

Vaporization of cryogenic liquids (except oxygen) in an enclosed area can cause asphyxiation. Vaporization of liquid oxygen can produce an oxygen-rich atmosphere, which will support and accelerate the combustion of other materials. Vaporization of liquid hydrogen can form an extremely flammable mixture with air.

2. Handling Cryogenic Liquids

Most cryogenic liquids are odorless, colorless, and tasteless when vaporized. When cryogenic liquids are exposed to the atmosphere, the cold boil-off gases condense the moisture in the air, creating a highly visible fog.

- a. Always handle these liquids carefully to avoid skin burns and frostbite. Exposure that may be too brief to affect the skin of the face or hands may damage delicate tissues, such as the eyes.
- b. Boiling and splashing always occur when charging or filling a warm container with cryogenic liquid or when inserting objects into these liquids. Perform these tasks slowly to minimize boiling and splashing. Use tongs to withdraw objects immersed in a cryogenic liquid.
- c. Never touch un-insulated pipes or vessels containing cryogenic liquids. Flesh will stick to extremely cold materials. Even nonmetallic materials are dangerous to touch at low temperatures.

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- d. Use wooden or rubber tongs to remove small items from cryogenic liquid baths. Cryogenic gloves are for indirect or splash protection only, they are not designed to protect against immersion into cryogenic liquids.
- e. Cylinders and dewars should not be filled to more than 80% of capacity, since expansion of gases during warming may cause excessive pressure buildup.
- f. Check cold baths frequently to ensure they are not plugged with frozen material.
- g. Keep liquid oxygen away from organic materials and ignition sources.
- h. Transfer of liquid hydrogen in an air atmosphere can condense oxygen in the liquid hydrogen, creating an explosion risk.
- i. Shield or wrap fiber tape around glass Dewar's to minimize flying glass and fragments should an explosion occur.
- j. Engineering Controls

Local exhaust ventilation is required. In some cases, gas detection may be required. Consult the individual chemical hazard properties to determine the proper engineering controls. Bulk tanks shall be sited in appropriate locations outside of the building. Smaller tanks and dewars should not be stored inside unless adequate ventilation and detection are present to prevent the development of an undetected asphyxiation hazard.

- k. Administrative Controls

Personnel working with the materials must receive detailed training on the hazards, safe use, and emergency procedures.

3. Protective Clothing

Face shields worn with safety glasses or chemical splash goggles are recommended during transfer and handling of cryogenic liquids.

Wear loose fitting, dry, insulated cryogenic gloves when handling objects that come into contact with cryogenic liquids and vapor. Trousers should be worn on the outside of boots or work shoes.

4. Cooling Baths and Dry Ice

Neither liquid nitrogen nor liquid air should be used to cool a flammable mixture in the presence of air, because oxygen can condense from the air, leading to an explosion hazard.

Wear insulated, dry gloves and a face shield when handling dry ice.

Add dry ice slowly to the liquid portion of the cooling bath to avoid foaming over. Do not lower your head into a dry ice chest, since suffocation can result from carbon dioxide buildup.