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Cryogenic Materials – Operating Procedure and Safety Requirements

UNC CHARLOTTE
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Cryogenic Materials – Operating Procedure and Safety Requirements

I. Overview of Liquid Nitrogen and other Cryogenic Materials

A. Liquid nitrogen is inert, colorless, odorless, noncorrosive, nonflammable, and extremely cold. Nitrogen makes up the major portion of the atmosphere (78.03% by volume, 75.5% by weight). Liquid nitrogen has a boiling point of –320°F (–196°C).

B. Cryogenic liquids are liquefied gases that have a normal boiling point below –130°F (–90°C).

C. Complete the training sign in sheet at the end of this document and send a copy to the EHS office.

Expansion Ratio at 20° Celsius for Common Cryogenic Fluids (Liquid to Gas)

Cryogenic Liquid	Liters of Liquid	Liters of Gas Produced	Cubic Feet of Gas Produced
Nitrogen	1	696	24.6
Oxygen	1	861	30.4
Helium	1	754	26.6

II. Personal Protective Equipment for Liquid Nitrogen or Cryogenic Materials

A. Eye protection

a. When pouring liquid nitrogen from a Dewar, use non-vented chemical goggles.

b. When working with liquid nitrogen in an open container or when transferring liquid nitrogen from a pressurized device, use safety glasses and a full-face shield.

B. Hand Protection

a. When working on piping systems with exposed components at cryogenic temperatures, wear loose-fitting gloves made for cryogenic work to assure that skin will not freeze to cold pipes or metal parts. Loose-fitting gloves can be thrown off readily if cryogen is spilled into them. Small spills of liquid nitrogen, if not trapped against the skin, will usually evaporate without causing damage.

C. Body Protection

a. Wear long-sleeved clothing made of non-absorbent material, long pants worn outside boots or over shoes, and an apron when handling large quantities of cryogens.

b. Always wear closed toe shoes.

III. Health Effects of Liquid Nitrogen

A. Asphyxiation

Nitrogen is not poisonous; the air is already about 78% nitrogen (oxygen makes up about 21%, and trace gases the remaining 1%). However, if sufficient liquid nitrogen or other Cryogenic Material vaporizes from a pressurized container into a poorly ventilated space, it can reduce the oxygen concentration to below 20%. Personnel in that space are in critical jeopardy due to rapid oxygen deprivation. Rapid venting of Cryogenic Material can cause rapid displacement of normal air, leading to a local concentration of nearly 100% nitrogen or other Cryogenic Material.

B. Burns

Direct contact between skin and Cryogenic Material can cause cold burns and frostbite. Prolonged contact may result in blood clots.

C. Pressure and Explosions

Large liquid-to-gas ratios can lead to rapid pressure changes as cryogens vaporize. All Cryogenic Materials can condense sufficient moisture from the air, subsequently freezing and blocking the opening of storage Dewars. This can lead to an explosion from the buildup of trapped gases in the container. For example, cryotubes stored in liquid nitrogen may explode when removed from the Dewar.

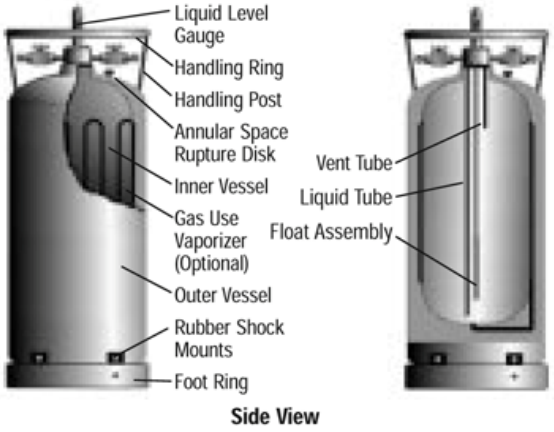
IV. Container Types for Liquid Nitrogen or Cryogenic Materials

A. Dewars

A loose-fitting dust cap over the outlet of the neck tubes prevents atmospheric moisture from plugging the neck while allowing gas produced from vaporized liquid to escape. This type of container is normally a non-pressurized container. The unit of measure for the capacity of a Dewar is typically the liter. Five- to 200-liter Dewars are available. Product may be removed from small Dewars by pouring, while larger sizes will require a transfer tube.

B. Cryogenic Liquid Cylinders

Cryogenic liquid cylinders are insulated, vacuum-jacketed pressure cylinders. They come equipped with safety relief valves and rupture discs to protect the cylinders from pressure buildup. These containers operate at pressures up to 350 psi and have capacities between 80 and 450 liters of liquid.



V. Dispensing Liquid Nitrogen and other Cryogenic Materials:

A. DO NOT transfer liquid nitrogen from the high pressure outside bulk storage containers to low pressure cryogen cylinders or Dewars, unless the low-pressure container is designed and designated to accept high-pressure material. Transferring high-pressure liquid nitrogen to incompatible containers is very dangerous.

B. Liquid Nitrogen and other Cryogenic Materials are to be dispensed only into smaller Dewars, which either have carrying handles or are on wheels, and have pressure relief valves or pressure venting lids. A wide-base Dewar that is stable on a wheeled cart qualifies as "on wheels".

C. To prevent splashing, place the filling hose at or below the mouth of the receiving vessel.

VI. Transporting Cryogenic Materials by hand/cart through or between building(s)

A. Large mobile Dewars or cylinders used for transporting cryogens within a building or between buildings should be equipped with a braking mechanism. Do not use one's feet to "brake" wheels. Take care to avoid crushing hands or fingers between the Dewars and walls or doorframes. Do not transport Liquid Nitrogen or other Cryogenic Materials in open containers.

B. Outside transport of wheeled Dewars should be undertaken by no less than two persons. Care must be taken to stay completely clear of sewer grates, large cracks in the pavement, or any other hazards which could catch the wheels and cause tipping.

C. Inside buildings the best transport from room to room is by using a Dewar that is equipped with carrying handles or is on wheels. The Dewar must have pressure relief valves or pressure venting lids.

Note: A wide-base Dewar that is stable on a wheeled cart qualifies as "on wheels".

D. For short distances in hallways, it is acceptable to hand-carry a quart or smaller Dewar of liquid nitrogen or other Cryogenic Materials, which have no handles, as long as:

- The Dewar is your only load (no books, beverages, or other items);
- The Dewar has a venting lid (a cork or loose stopper is fine);
- You are carefully watching for people who will run into you;
- You are wearing appropriate PPE;
- The Dewar is carried with both hands and as far away from your face as comfortably possible.

VII. Transport of Nitrogen and other Cryogenic Materials on an Elevator:

A. Care must be exercised when transporting pressurized cryogenic containers on an elevator. Due to the confined nature of an elevator, a nitrogen gas or other cryogenic material leak from a pressurized container could produce an oxygen deficient atmosphere in a very small amount of time by displacing oxygen.

B. When a cryogenic liquid cylinder has been placed on an elevator, the elevator must travel between floors unoccupied. All elevator doors must be manned to prevent entry by person/s. Person/s must be stationed at all "in-between" floors to prevent riders from entering elevator. The sender should remain outside the elevator and

activate it to the desired floor. Another person should be available on the receiving floor to take the liquid container off the elevator at its destination.

C. DO NOT transport a pressurized container of Liquid Nitrogen or Cryogenic Material at any time in an elevator with any other person/s in the elevator car.

VIII. Storage of Liquid Nitrogen and Cryogenic Materials

A. Store Cryogenic Materials in well-ventilated areas to prevent oxygen deficiency.

B. Use only approved storage Dewars that have pressure relief valves.

C. Never adjust, block, or plug a pressure relief valve.

D. Avoid contact of moisture with storage containers to prevent ice plugs in relief devices.

E. Periodically check container necks for ice plugs. If present, core out ice plugs.

F. Keep all heat sources away from cryogenic liquids.

G. Do not use cryogenic materials in walk-in cold rooms, because they may not have sufficient air exchange and could become hazardously oxygen deficient.

IX. Training

The undersigned personnel have read the contents of this document, understand the requirements for safe Nitrogen and Cryogenic handling on the UNC Charlotte campus, AND agree to handle these products in accordance with this procedure.

Last	First	UNC Charlotte ID	Signature
