

## Liquid Nitrogen Handling Procedures

### Purpose

The purpose of this document is to provide information on handling as well as the hazards of working with liquid nitrogen.

### Training requirements

Only trained and qualified personnel should handle liquid nitrogen. This training includes, but is not limited to, reading and understanding all available and relevant literature (Material Safety Data Sheets, Liquid Nitrogen Handling Procedures), standard operating procedures and/or protocols and participating in all related site specific training.

### Liquid Nitrogen

Liquid nitrogen is a common cryogenic liquid used in research and analytical labs. Cryogenic liquids are liquefied gases that are kept in the liquid state at very low temperatures. The boiling points of cryogenic liquids are below  $-150\text{ }^{\circ}\text{C}$ , with liquid nitrogen having a boiling point of approximately  $-196\text{ }^{\circ}\text{C}$  ( $-195.79\text{ }^{\circ}\text{C}$ ). As a result, liquid nitrogen is extremely cold as well as the vapours released from it. Anyone working with liquid nitrogen must be aware of its associated hazards and know how to work safely with it.

### Health Hazards

- Extreme Cold: Liquid nitrogen, and its associated cold vapours, upon contact with exposed skin will produce effects similar to a thermal burn. Prolonged exposure of the skin or contact with cold surfaces can cause frostbite to these affected areas and prolonged breathing of the cold vapours can damage the lungs. Brief exposures to the eyes can cause serious damage. Unprotected skin can stick to metal surfaces cooled by liquid nitrogen causing skin to tear when pulled away.
- Asphyxiation Hazard: With all cryogenic liquids, small quantities of liquid can evaporate into very large volumes of gas, displacing breathable air. One litre of liquid nitrogen will evaporate, at room temperature, to 695 litres of gaseous nitrogen. When working in enclosed or confined spaces this could result in an oxygen deficiency and subsequent asphyxiation.
- Over pressurization: Without proper venting on containers or operating systems, enormous pressures can build up resulting in an explosion called a boiling liquid expanding vapour explosion (BLEVE).
- Oxygen Enrichment: Cryogenic liquids with boiling points below that of liquid oxygen can condense oxygen from the atmosphere. Liquid nitrogen has a lower boiling point than oxygen's and can condense oxygen from the atmosphere. There is a risk that the liquid oxygen could react violently with organic materials.

### Handling Precautions

- Storage of liquid nitrogen:
  1. Store liquid containers upright and in a well ventilated area.
  2. Ensure containers are secure.

3. Do not store containers where they may come in contact with moisture. Valves and pressure relief devices can malfunction due to external ice buildup.
  4. Restrict access to storage areas to authorized personnel only.
  5. Clearly post warning signs and 24 hour emergency contact information.
- Personal Protective Equipment (PPE): When handling liquid nitrogen the proper PPE must be worn at all times.
    1. Loose fitting insulated gloves are to be worn when handling liquid nitrogen or objects that have come in contact with liquid nitrogen. Gloves need to be loose fitting so that they can be easily and quickly removed in the event that liquid enters into them. Insulated welding gloves are one type of glove that has been found useful (Canadian Centre for Occupational Health and Safety. [How Do I Work Safely With Cryogenic Liquids?](#)).
    2. Protect exposed skin by wearing a lab coat, long pants that cover down to the top of footwear and non-porous closed toed and closed heeled footwear.
    3. Eye protection is required at all times when working with liquid nitrogen and safety goggles are the preferred means of protection. Where there is the possibility of splashing of liquid nitrogen onto the face (pouring, filling Dewars), a face shield must be worn.
  - Transport Vessels: The proper vessels must be used for storage and transport of liquid nitrogen. These vessels are commonly referred to as Dewars and are specially designed for use with cryogenic liquids. The common Thermos style insulated container available for keeping foods cold or hot are not designed for use with cryogenic liquids and should not be used as such. Dewar's are covered with a loose fitting cap or plug that is designed to keep air or moisture from entering the flask but allows any pressure to escape. Ensure that openings in the Dewars or pressure relief valves do not ice up. This can cause a pressure build up and a rupture of the container. As well, the formation of ice can damage moving parts such as pressure relief valves. If using glass Dewars, wrap them in tape to minimize hazards from flying glass in the event that the container fractures (never use glass Dewars for storage of combustible or oxidizing cryogenic liquids).
  - Transferring Liquid Nitrogen: When transferring liquid nitrogen to a receiving Dewar flask, cool the receiving flask by filling slowly to allow the vaporization to chill the receiving flask. Once the vapourization and boiling has decreased, filling can continue at a normal rate. This will help minimize the vapourization and boiling that occurs during this type of transfer thereby reducing splash and cold contact injuries to personnel. Only fill containers to 80 % capacity to prevent splashing or spillage during transport.
  - Transporting Liquid Nitrogen: Always transport tanks or large Dewars using the appropriate hand truck or cart. Do not move a tank by rolling it on its lower rim. Always push cryogenic containers to reduce the risk of the container falling on you or a co-worker. If liquid nitrogen tanks need to be transported via elevator, ensure no passenger rides the

elevator with the liquid nitrogen. In the event of a power failure vapourization of the liquid nitrogen could reduce the breathable oxygen to dangerous levels. Dewars being transported by hand should be transported using secondary containment (bucket).

• Working with Liquid Nitrogen:

1. Choose equipment that will not break or shrink. Many materials become brittle at very low temperatures and crack or break such as rubber or plastic (i.e. do not pour liquid nitrogen down a sink).
2. Do not wear any type of jewelry that could freeze to your skin (i.e. watches, rings, bracelets, etc.).
3. When inserting objects in liquid nitrogen (i.e. traps, vials) do so slowly, and use tongs if applicable to the situation. This will minimize the boiling and splashing that occurs when warm objects are added rapidly. Never insert a hollow tube or rod into liquid nitrogen. The gasification and expansion process will force liquid to spurt from the top of the tube.
4. Always inspect equipment and storage vessels to ensure that pressure relief valves are functional.
5. Always work with liquid nitrogen in a well ventilated area.

• First Aid Measures:

1. Eye contact: Remove person from source of contamination. Flush eyes with warm water for 15 minutes. Seek medical attention immediately.
2. Skin contact: Run warm water over exposed area to restore tissues to normal body temperature. Do not rub the area. Seek medical attention immediately.
3. Inhalation: If person becomes disorientated or overcome remove person to fresh air, only if safe for rescuer to do so. Artificial respiration should be applied if breathing has stopped. If person is having trouble breathing, provide oxygen. Seek medical help immediately.

References:

1. Canadian Centre for Occupational Health and Safety: Cryogenic Liquids and Their Hazards.
2. Canadian Centre for Occupational Health and Safety: How Do I Work Safely with Cryogenic Liquids?