



# Safe Work Practice ("SWP") Protocol

## Working Safely with Liquid Nitrogen

9/1/2015

Print a copy and insert into your *Lab Group Safe Work Practice Binder*.

### Section 1 – Lab-Specific Information

Department:	UBC - Chemistry
Date SWP was approved by the UBC Department of Chemistry Safety Committee:	10/29/2021

### Section 2 – Material Safety Data Sheet (MSDS) and Hazards

A current copy of the MSDS for the liquid nitrogen can be found at this link:

<https://www.lindecana.ca/-/media/corporate/praxair-canada/documents-en/safety-data-sheet-linde-canada/e-4630-nitrogen-refrigerated-liquid-safety-data-sheet-sds.pdf>

There are several physical properties of nitrogen which can combine to create dangerous hazards. The important physical properties and their associated hazards are:

1. Liquid Nitrogen's temperature is approximately -200C, cold enough to cause severe burns to exposed skin
2. Liquid oxygen is created when normal room air is exposed to liquid nitrogen for some period of time, creating a high risk of explosion.
3. 1 litre of liquid nitrogen expands to 700 litres of nitrogen gas, resulting in oxygen deficient room air, which can lead to risk of asphyxiation.

### Section 3 – Storage and Transport within UBC Chemistry Buildings

#### Elevator safety

Because of the small volume in an elevator, the risk of asphyxiation after a nitrogen spill in an elevator is much higher than elsewhere. The risk is small, but the results could be deadly. Never travel in an elevator with a full or partly full dewar. In the Chemistry buildings, safety bands are installed on all the elevators to warn people to stay out of the elevator when it is being used to transport liquid nitrogen. Two people are always required (one to send, one to receive) to move nitrogen dewars in an elevator.

An additional consideration is that if an earthquake were to occur while one was in an elevator with an N<sub>2</sub> dewar, even an empty dewar could cause a serious injury.

### Other transportation safety

The department recommends that dewars of 100L and larger sizes be moved by 2 persons, but a single person, with care and attention, can safely move full and empty dewars on level floors within the Chemistry complex.

Avoid taking dewars on ramps (e.g. 3<sup>rd</sup> floor between D and E wing), close to storm sewer grates (the basement entrance between D and E) or on rough terrain (anywhere outside the buildings). At least 2 persons must be present and able to help when a dewar has to be moved through one of these areas.

Some dewars are mounted on wooden bases which can degrade over time. Wooden bases should be inspected periodically to confirm that the wood hasn't rotted or weakened.

### Handling the dewars

The ring around the top of the dewar is intended to guard the controls; it is not intended as a handle for pulling or pushing the dewar. Using it to move the dewar can cause the dewar to tip over.

Most dewars have a handle located at chest height that is intended for use to propel the dewar.

## Section 4 – Spill and Accident Procedures

Small Spills (1 litre or less)	Immediately ensure that plenty of fresh air can get into the room, and then just allow the nitrogen liquid to evaporate. Once the liquid has evaporated, inspect any flooring, equipment, or furniture that came in contact with the liquid for damage.
Spills (more than one litre)	Shut off all sources of ignition, evacuate area of all personnel and call Campus Security at 604.822.2222. DO NOT return to the area until it has been declared safe by knowledgeable staff.
Accidental contact	Treat as you would a burn.

## Section 5 – Waste Disposal Procedures

Excess LN2 should be left in the dewar to evaporate with the appropriate lid on the dewar.

Do not leave the liquid in a dewar with an open top, as oxygen will condense in a layer on top of the nitrogen. By putting a lid loosely on the dewar, you can ensure that the dewar will be lightly pressurized and that oxygen won't be in contact with the liquid nitrogen.

## Section 6 – Protocol/Procedure

### Preparation

No protection is adequate in the absence of thoughtful planning. Think about possible problems that could occur before you start working with LN2, and take steps to ensure that unplanned events don't lead to unpleasant outcomes.

### O<sub>2</sub> sensors, ventilation

Areas in which large quantities of nitrogen gas or liquid are regularly handled should be well ventilated and equipped with oxygen sensors and alarms to notify occupants of low oxygen levels. Typical locations requiring these measures include LN<sub>2</sub> dispensing rooms, areas around helium liquefiers, and in rooms housing NMR spectrometers with superconducting magnets.

### Personal Protective Equipment


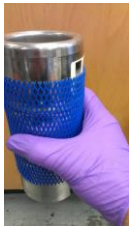
Based on the hazards listed above, the personal protective equipment required to safely handle liquid nitrogen includes:

#### Eye and face protection

Use a full face shield when transferring large (> 1 L ) quantities between containers. Use glasses with side shields for smaller quantities.

#### Hand protection

Consider both protection from cold and dexterity when choosing gloves. The department recommends:

Recommended Hand Protection	Example	Uses
Cryogenic gloves		Use cryogenic gloves to handle transfer tubes, valves and dewar handles which get extremely cold during LN <sub>2</sub> transfers. Cryogenic gloves are not suitable for handling small flasks or beakers. These gloves are somewhat absorbent; do not immerse them in liquid nitrogen.
Nitrile gloves		Use when transferring small volumes in the lab. Small quantities of liquid nitrogen spilled on a gloved hand will simply roll harmlessly off the hand.

Improper Hand Protection	Example	Why these should never be used
Oven mitts (even fuzzy ones )		These gloves absorb spilled liquid and wick the liquid to the wearer's skin.
Dry ice gloves Or Silicone oven mitts		These gloves become brittle at LN2 temperature.

### Protective clothing

Ensure that no skin is exposed, and that liquid will shed off of any clothing it falls on. Use an apron to cover pants. Sandals and open toed shoes must not be worn when handling liquid nitrogen. Fabric shoes can absorb liquid or trap liquid against skin.

### Ear protection

Use plugs or ear muffs you are working close to a venting dewar.

### Safety in the lab – transferring small volumes

Even the most careful user will spill some liquid when transferring LN2 from small dewars. Before you start pouring, figure out where the spilled liquid will go and make sure that it won't fall onto your clothing or skin. Think about what would happen if you dropped the dewar, and if the answer is that you'd be splashed with liquid, find another method to do the transfer.

- Wear nitrile gloves and eye protection
- Position the work so that the transfer occurs below eye level
- Pour the liquid slowly and steadily, to avoid trapping warm air in the liquid
- Be prepared for the liquid to splash and boil during the transfer.
  - If spilled liquid will fall on a table top, it will energetically spread across the table, so don't lean against the edge of the table
  - Keep your knees off the floor to avoid liquid that's spilled on the floor.



### Filling dewars smaller than 10 litres in the dispensing room

- Put on cryogloves, apron, and face shield
- Use the dispensing dewar, not the automated dispensers
- Watch out for splash back and spitting, especially if the receiving dewar is warm
- The hose may freeze up during dispensing...be careful not to knock the dewar over when withdrawing the filling wand from the dewar.
- Use cryogenic gloves to handle the dispensing wand.

### Filling medium sized and large unpressurized dewars



Safe filling practice:

- **Wearing gloves, apron, face shield**
- Staying clear of the top of the dewar in case liquid splashes out
- Dewar is flat on the floor
- No distractions



#### Dangerous filling practices:

- **No gloves, apron, or face shield**
- Looking directly into dewar
- Tipping dewar
- Dispensing rod not being held in place
- Filling 2 containers at once
- Small container is not appropriate for cryogenics
- Distracted by phone and coffee during fill
- Improper footwear.

#### Filling pressurized dewars

- Wear cryogloves when handling valves and dispensing lines
- Wear ear protection while dewar is venting
- Install the auto-shutoff sensor on the outlet of the dewar