

Standard Operating Procedure

Liquid Nitrogen

Section 1 – Lab-Specific Information

Department:	College of Engineering – Discovery Learning Labs
Date SOP was written:	10/29/2018
Date SOP was approved by PI/lab supervisor:	Click here to enter a date.
Principal Investigator:	Thomas Silman
Internal Lab Safety Coordinator/Lab Manager:	Thomas Silman
Lab Phone:	414-288-4602
Office Phone:	414-288-5423
Emergency Contact:	Thomas Silman 414-350-5432
Location(s) covered by this SOP:	<i>Engineering Hall – Discovery Learning Labs Complex</i>

Section 2 – Type of SOP:

Process Hazardous Chemical Hazardous Class

Section 3 – Physical / Chemical Properties and Uses

Physical / Chemical Properties:

CAS#: 7727-37-9

GHS Classification: Gas under pressure, cryogenic liquid

Molecular Formula: N₂

Form (physical state): Liquid

Boiling Point: -196°C (-320°F)

Relative Vapor Density: 0.97 (air = 1)

Section 4 – Potential Hazards

Liquid nitrogen is a cryogenic liquid that may cause severe frostbite or eye damage upon contact. Extremely cold liquid and gas under pressure. Expands by a factor of 700 upon vaporization. Can cause rapid suffocation due to displacement of oxygen. Avoid breathing gas. Substances may become brittle upon contact and shatter. May cause an explosion of a sealed container. Symptoms to exposure included frostbite, dizziness, salivation, nausea, vomiting, or loss of mobility and/or consciousness.



Section 5 – Personal Protective Equipment (PPE)

For quantities less than 100 mL, safety glasses, lab gloves, long pants, and close-toe shoes are adequate (Figure 1). For intermediate quantities (100 mL – 1 L), also use splash goggles, face shield, and cryogenic gloves (Figure 2). For quantities greater than 1 L or filling a secondary Dewar, a cryogenic apron should be used in addition to the general use intermediate requirements (Figure 3).



Figure 1 – Small quantity PPE requirements



Figure 2 – Intermediate quantity PPE requirements



Figure 3 – Large quantity PPE requirements

Section 6 – Engineering Controls

Liquid nitrogen must only be used in a well-ventilated area or in a properly functioning chemical fume hood whenever possible. Liquid nitrogen should never be used in a poorly ventilated enclosed area where oxygen displacement is a possibility.

Section 7 – Liquid Nitrogen Containers

Vacuum Insulated Containers:

Vacuum insulated containers are used for storing and dispensing liquid nitrogen. They are either sealed (capable of holding 20 psig – 240 psig with pressure relief valve) or ambient pressure (covered loosely with a cap, cork, or stopper and are referred to as Dewars (due'-werz)). There are two primary types of Dewars, benchtop and large Dewars. Benchtop Dewars (Figure 4) are typically for small-scale laboratory use and the lid is the only pressure-relief device. Large Dewars (Figure 5) are typically used for storage of lab samples, movement of samples between campus locations, or to fill other secondary containers. Large Dewars may have a secure seal and pressure relief vent. Liquid nitrogen exposure is a risk when handling Dewars. Therefore, the PPE illustrated in Figure 2 should be worn when working with a Dewar.



Figure 4 – Benchtop Dewar



Figure 5 – Large Dewar

Cryogenic tubes are typically used for storage samples, movement of samples between campus locations, or for shipments off campus for collaborative research (Figure 6). There is no pressure-relief device on a cryogenic tube other than the lid. Consequently, cryogenic tubes can explode without warning. Explosions are likely caused by trapped nitrogen expanding inside of the tube during the thawing process. As the temperature increases, the tube may become over-pressurized and explode and may result in serious injuries. Because of this risk, the PPE illustrated in Figure 2 should be worn when directly handling a sealed cryogenic tube.



Figure 6 – Cryo Tubes

Self-Pressurizing Tanks

Self-pressurizing tanks (Figure 7) are generally a 140 – 260 L double wall, stainless steel tank used to fill other liquid nitrogen containers such as Dewars. These tanks are equipped with pressure relief valves and a backup rupture disk. A loud hissing sound is commonly heard when the pressure relief valve opens. Exposure to liquid nitrogen can occur when connecting and disconnecting equipment, during the filling process, from a leaking valve, or from condensate ice buildup on valves and hoses. Because of these risks, the PPE illustrated in Figure 3 should always be worn when working with a self-pressurized tank.



Figure 7 – Self-Pressurizing Tank

Section 8 – General Safe Handling Practices and Storage Requirements

- Only trained personnel should work with liquid nitrogen.
- Use only in well ventilated and low traffic areas.
- Caution signs should be posted in the area warning others that liquid nitrogen is being stored and used.
- Always wear the appropriate PPE.
- Liquid nitrogen should only be stored in approved containers.
- All liquid nitrogen containers must be labeled. Large containers (e.g., Dewars, Self-Pressurizing Tanks) must be labeled. Smaller containers such as cryogenic tubes should be labeled “Liquid Nitrogen, Cryogenic Hazard” or with similar words that convey the hazards.
- Avoid breathing liquid nitrogen vapors.
- Carry containers away from body and face.
- Never drop a liquid nitrogen container. Damage to a container may result in over-pressurization or container failure.
- Dewars more than 100 pounds require two people to move safely.
- Always use a specially designed cylinder cart to transport liquid nitrogen containers that are too heavy to be hand carried.
- Use the freight elevator whenever possible.
- Do not leave open containers unattended.
- Liquid nitrogen containers should be stored in cool, dry, and well ventilated areas.
- Do not store in a cold room or other controlled environment without air supply.
- Liquid nitrogen containers should be stored out of direct sunlight.

Section 9 – Spill and Accident Procedures

In the event of a large liquid nitrogen spill or release, immediately evacuate the area and ensure others are aware of the spill. Remember that frostbite and asphyxiation are the primary hazards so ensure people are protected from these hazards. If there is an imminent threat, pull the nearest fire alarm station to evacuate the building and **dial 8-1911**. If the spill is minor and does not pose a threat to personnel, contact EH&S at 8-8411 during normal business hours (7 AM – 4 PM) for spill cleanup assistance (**dial 8-1911** if spill occurs after hours and assistance is needed).

Section 7 – First Aid Procedures

If inhaled:

Over exposure of liquid nitrogen may cause rapid suffocation due to displacement of oxygen. With asphyxiation, unconsciousness may happen without warning. If person becomes dizzy, move them to a well-ventilated area and seek immediate medical attention (**dial 8-1911**).

In case of skin contact:

Skin contact with liquid nitrogen may cause severe cold burns and frostbite. Flesh freezes very rapidly and may be torn when attempting to be withdrawn from object. If frostbite or freezing occurs, the following steps should be taken:

1. Flush the area thoroughly with tepid water. Do not apply heat or rub the affected area.
2. Protect the area with bulky, dry, and sterile dressings.
3. Seek immediate medical attention (**dial 8-1911**).

In case of eye contact:

Eye exposure to liquid nitrogen can cause permanent and irreversible damage. Delicate eye tissue can be damaged by exposure to the cold gas alone. If liquid nitrogen is splashed into the eyes, the following steps should be taken, flush the eyes with water for 15 minutes and seek immediate medical attention (**dial 8-1911**).

Section 10 – Medical Emergency

Life Threatening Emergency, After Hours, Weekends and Holidays:

Dial 8-1911

Non-Life Threatening Emergency:

Immediately report injury to supervisor and complete the First Report of Injury.

http://www.marquette.edu/riskunit/riskmanagement/documents/Employee_First_Report_of_Incident.pdf

Section 11 – Waste Disposal Procedures

There is typically no waste generation involved with the use of liquid nitrogen. However, if waste disposal questions arise please contact dennis.daye@marquette.edu or visit the EH&S webpage for questions.

Section 12 – Safety Data Sheet (SDS)

A current copy of the SDS for liquid nitrogen must be made available to all personnel working in the laboratory at all times. To obtain a copy of the SDS, refer to Marquette's MSDS library.

http://www.marquette.edu/riskunit/environmental/documents/waste_disposal_form.pdf Many manufacturers' SDSs can be found online on websites such as Sigma-Aldrich (<http://www.sigmaaldrich.com/united-states.html>) or Siri MSDS Index (<http://hazard.com/msds/>).

Section 13 – Protocol/Procedure

Not applicable at this time.

NOTE: Any deviation from this SOP requires approval from PI.

Section 14 – Documentation of Training (signature of all users is required)

- Prior to conducting any work with liquid nitrogen, designated personnel must provide training to his/her laboratory personnel specific to the hazards involved in working with this substance, work area decontamination, and emergency procedures.
- The Principal Investigator must provide his/her laboratory personnel with a copy of this SOP and a copy of the SDS provided by the manufacturer.
- The Principal Investigator must ensure that his/her laboratory personnel have attended appropriate laboratory safety training or refresher training within the last one year.

I have read and understand the content of this SOP:

Name	Signature	Date
Click here to enter text.		Click here to enter a date.
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