

# Liquid Nitrogen Handling and Use



## Overview

Liquid nitrogen (LN<sub>2</sub>) is inert, colorless, odorless, non-corrosive, non-flammable, tasteless, extremely cold, and has no warning properties. It poses a risk of explosion if stored in unvented containers and asphyxiation if not used in well-ventilated areas. Special care must be taken by personnel who handle or work in areas where liquid nitrogen is used. Additionally, the New York City Fire Department has specific requirements and restrictions associated with the safe storage, handling, and use of liquid nitrogen.

## Applicability

This Update includes information from the updated New York City Fire Code, which implemented new regulations regarding the storage and use of cryogenic liquids (including LN<sub>2</sub>). All labs that store or use liquid nitrogen must comply with the Handling and Storage requirements listed in this Update. In addition, this Update provides general hazard warning and safety precaution information to users of LN<sub>2</sub>. Laboratory personnel who work with or in areas where LN<sub>2</sub> is used must know and understand these guidelines.

## Responsibilities

**Personnel working with LN<sub>2</sub>** must follow this Update and contact EHS for assistance and training as needed. Formerly the G-97, the G-79 Certificate of Fitness (CoF) for the "Supervision of Storage, Handling and Use of Commercial Cryogenic Systems" applies to cryogenic liquids NOT stored or used in an FDNY-permitted laboratory. If cryogenic liquids are stored or used in an FDNY-permitted laboratory, only the C-14 "Supervising Non-Production Chemical Laboratories" CoF is required.

**Environmental Health and Safety (EHS)** provides assistance and training on the safe handling and use of LN<sub>2</sub> upon request and provides assistance to personnel applying for the C-14 or G-79 CoF.

## Health Hazards

- Humans cannot reliably detect the presence of nitrogen.
- Asphyxiation may result from the displacement of oxygen in the air with nitrogen to levels where there is insufficient oxygen to support life. Inhalation of oxygen-deficient air can cause dizziness, nausea, vomiting, loss of consciousness, and death.
- Liquid nitrogen has a 700x expansion ratio which may create physical hazards and injuries from the explosion of unvented containers (e.g., cryovials), equipment, or other devices.
- Extensive tissue damage or burns can result from exposure to LN<sub>2</sub> or cold nitrogen vapors.

## First Aid

Personnel who have been exposed to LN<sub>2</sub> must seek immediate medical assistance from Workforce Health and Safety (WHS), Student Health Services (SHS), or the Emergency Department (ED), depending on the severity of the exposure.

**Frostbite Exposure:** In the event of frostbite from skin contact with LN<sub>2</sub>, follow the procedures below:

- Remove any clothing that may restrict circulation to the frozen area.
- Do not rub frozen parts, as tissue damage may result.
- Place the affected area in a warm-water bath with a temperature that does not exceed 105°F (40°C). Never use dry heat.
- Seek medical attention from Workforce Health & Safety, Student Health Services, or NewYork-Presbyterian Emergency Department.

## Personal Protective Equipment

The following personal protective equipment is required when handling or using LN<sub>2</sub>:

- Waterproof thermal insulated gloves (e.g., cryo gloves).
- Lab coat.
- Safety goggles and/or face shields.



**Figure 1** Goggles (North Safety Products at VWR)



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**Hands** must be protected with waterproof thermal insulated gloves that can be quickly removed if LN<sub>2</sub> is spilled on them. Insulated gloves are not intended for submersing hands into LN<sub>2</sub>.

**Eyes** are most sensitive to the extreme cold of LN<sub>2</sub> and its vapors. Over-pressurization may result in the explosion of improperly vented equipment. Chemical splash goggles must be utilized when handling LN<sub>2</sub> and when handling sealed containers that have been stored in LN<sub>2</sub> (e.g., cryovials). Face shields offer additional protection.

**Body** must be protected with pants, lab coats, and closed-toe shoes. Thermal insulated aprons are available.

## Handling and Storage

- The storage and dispensing of LN<sub>2</sub> in public corridors are strictly prohibited. Contact EHS for clarification on corridor designations.
- LN<sub>2</sub> containers/tanks must be kept at least three (3) feet from all room or area exits and ten (10) feet from building exits.

**Store and use LN<sub>2</sub> only in well-ventilated areas.** Do not store in confined spaces or non-ventilated areas (e.g., cold rooms or closets).

- **Store containers in an upright position.** Do not drop, tip, or roll containers on their sides.
- **Use only approved containers** with lids to store and transport LN<sub>2</sub> (e.g., Thermolyne Thermo-Flask®). Lids must be vented to allow the off-gassing of over-pressurized nitrogen gas.
- **Never vapor-seal** LN<sub>2</sub> storage containers.
- **Never plug, remove, or tamper with any pressure relief device.** Under normal conditions, these containers are designed to vent gas periodically.
- **The FDNY requires** the installation of an oxygen monitor in labs where greater than 60 gallons of liquid Nitrogen is stored/dispensed. Contact EHS to assess if an oxygen monitor is required and to obtain an oxygen monitor.



**Figure 2** Gloves (Tempshield, Inc. at VWR)



**Figure 3** Thermo-Flask® containers pictured are manufactured by Fisher Scientific.

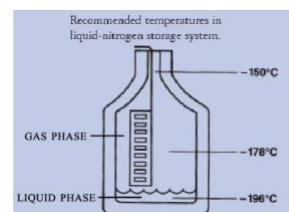
## Sample Storage Precautions

**WARNING** - Do not store cryovials in the liquid phase of LN<sub>2</sub> unless specifically approved by the manufacturer for liquid phase storage. Liquid can still enter closed screw-top cryovials with o-rings and explode when removed from storage.

Laboratory personnel must use **extreme** caution when preserving samples in LN<sub>2</sub>. LN<sub>2</sub> storage consists of a **liquid phase** and a **gaseous phase**, as illustrated. If cryovials are immersed in the liquid phase, LN<sub>2</sub> can still enter the closed screw-top cryovials with o-rings during storage. The cryovial may then explode when removed from storage due to the vaporization and expansion (700x expansion ratio) of the liquid nitrogen inside the cryovial.

### Safety Precautions:

- Use only manufacturer-approved containers (e.g., cryovials) for storage in LN<sub>2</sub>.
- If storage in the LN<sub>2</sub> liquid phase is required, utilize either:
  - Manufacturer-approved cryovials specifically designed for liquid phase storage; or
  - Gaseous phase-approved screw-top cryovials that are then hermetically sealed in an outer protective envelope designed for use in LN<sub>2</sub>. Nalge Nunc International manufactures CryoFlex™ tubing specifically for hermetically sealing cryovials for liquid phase storage.
- Where feasible, the risk of explosion of cryovials stored in the LN<sub>2</sub> liquid phase can be further reduced by moving cryovials to the gaseous phase in the LN<sub>2</sub> container for at least 24 hours before moving to room temperature.
- Where feasible, the handling of containers (e.g., cryovials) inside of Biological Safety Cabinets or Chemical Hoods (with the sash lowered) will further reduce the risk of injury from explosions caused by excess pressure within containers.



**Figure 4** Image courtesy of Nalge Nunc International



## Certificate of Fitness

The storage, handling, and use of 60 or more gallons (the sum of tanks and dewars) **in non-FDNY laboratory permitted spaces** must be under the direct supervision of a G-79 CoF holder.

If cryogenic liquids are stored or used **in an FDNY-permitted laboratory**, only a C-14 CoF is required. EHS is available to assist qualifying personnel in obtaining a C-14 CoF through an Alternate Issuance Application program. More information, including the list of qualifications, is listed on the [EHS website](#) and the [C-14 Application Overview & Checklist](#).

EHS is available to assist personnel in obtaining the G-79 CoF by providing training on campus and by submitting the associated applications and documentation to the FDNY. Please contact EHS to arrange a group training session. Personnel may also apply directly to the FDNY. For information about how to apply, visit the FDNY CoF website at: <https://www1.nyc.gov/site/fdny/business/all-certifications/certificates-of-fitness.page>.

## References

- [EHS C-14 Application Overview & Checklist](#)
- [Air Products and Chemicals, Inc., "Safetygram-7: Liquid Nitrogen"](#)
- [Nalge Nunc International, "Nunc Cryopreservation Manual"](#)
- [Personal Protective Equipment Tempshield, Inc.](#)
- [New York City Fire Code](#)
- [FDNY G-79 Certificate of Fitness](#)



**Figure 5** Example DOT 180 L LN<sub>2</sub> Tank