Instructions for handling liquid nitrogen at Karolinska Institutet

Reference 1-1044/2024

Valid from 19 February 2025

NOTE: *This is a translation of the Swedish version (Anvisningar för hantering av flytande kväve vid Karolinska Institutet). In the event of any discrepancy between the versions, the Swedish version constitutes the official decision, and the Swedish wording will prevail.*

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Introduction

The following instruction revises and replaces previous document Anvisningar för hantering av flytande kväve (dnr 1-194/2022).

The basis for this instruction is the Work Environment Act (1977:1160) in its entirety and applicable provisions. Emphasis is placed on the Swedish Work Environment Authority's provisions Systematisk arbetsmiljöarbete – grundläggande skyldigheter för dig med arbetsgivaransvar AFS 2023:1, Risker i arbetsmiljön AFS 2023:10 and Arbetsutrustning och personlig skyddsutrustning - säker användning AFS 2023:11.

Purpose

The purpose of these instruction is to clarify that the handling of liquid nitrogen entails risks of accidents and ill health and to prevent the risks that may be associated with the handling.

The instructions are intended for KI's activities that handle liquid nitrogen. To limit the risk of injury, all affected activities are obliged to make a risk assessment and issue written handling and protection instructions specifically suited to their circumstances.

Terms and definitions

Handling
Handling is defined as manufacturing, processing, treatment, packaging, storage, transport, use, disposal, destruction, conversion and comparable procedures (AFS 2023:10).

Breathing apparatus
A breathing apparatus consists of a respirator, compressed air storage and air supply, and is used in conditions where there is not enough oxygen in the surrounding space.

Note! Training is required for the safe use of a breathing apparatus.

When handling liquid nitrogen applies

in general:

- Work with liquid nitrogen may only be carried out by those who have sufficient knowledge of the risks that may arise during handling and use and how these risks can be avoided.
- The responsible manager must ensure that documented risk assessment is carried out before handling begins, that adequate protective measures have been taken and that local handling and safety instructions have been issued.
- The responsible manager must ensure that the employees concerned fully understand the risks involved in the handling of liquid nitrogen and that they have been informed of the handling and safety instructions.

Common risks when handling liquid nitrogen

Liquid nitrogen is extremely cold, colourless, odourless and tasteless. The boiling point of nitrogen gas is -196 °C at one atmosphere of pressure.

Because of its extremely low temperature, liquid nitrogen can cause cryogenic burns/frostbite when coming into contact with unprotected body parts or skin. Moist skin can instantaneously freeze and adhere to metal objects that have been cooled with liquid nitrogen, which can lead to skin injury. Materials (e.g., plastic) that are not designed for use at low temperature can also constitute a risk.

As the liquid-to-gas expansion ratio of liquid nitrogen is 1:694 at room temperature (20 °C), there is a risk of asphyxiation when liquid nitrogen boils (evaporates) and displaces the oxygen in the air. This is especially the case in smaller enclosed spaces such as elevators (see under “Internal transportation”) and rooms where liquid nitrogen is stored or used (see under “Alarms and safety procedures”).

Due to expansion during the transition from liquid to gas, pipes and containers containing liquid nitrogen must never be completely closed as

there is a risk of explosion. This also applies to very small volumes, as liquid nitrogen in a sealed tube/container can result in excessive gas pressure. For the same reason, larger containers such as cryogenic Dewars without safety vents shall never be hermitically sealed.

If a container cannot be opened and the gas has no possibility of escaping, the emergency services must immediately be contacted. Call 112 and inform that there is a risk of explosion.

Liquid nitrogen is classed as a hazardous good, which means that it is subject to specific regulations for transit along public roads, on aircraft, etc. Any questions about the transportation of hazard goods are to be directed to KI's Safety Advisor.

Risk assessment

It is important that the risk assessment is adapted to the work performed in the specific activities and that it covers all aspects of handling and all relevant employees. What the risk assessment should contain is stated in AFS 2023:10.

The supplier's safety data sheet (SDS) shall be used for the risk assessment, which is preferably done with the help of the risk assessment tool in the KLARA product database. The risk assessment shall form the basis for the local and written handling and safety instructions, which shall state how the handling is to be carried out as well as instructions regarding the necessary protective measures, first aid and handling of spill.

In the risk assessment, particular attention must be placed to the risk of cryonic burns/frostbite and asphyxiation. Moreover, room dimensions, ventilation and alarm systems, transportation, nitrogen volume, container and solitary work must be taken into account.

Example for calculation:

In an elevator of dimensions 2x2x2 m3 (8 m3), a spill of 0.35 litres of liquid nitrogen is sufficient to reduce the oxygen content in the air to below 18% (normal 21%).

Protective equipment

When transporting, pouring and handling liquid nitrogen, users must wear a face visor as well as protective gloves, no open-topped shoes and clothing.

In the event of an actual or suspected serious leakage, the nitrogen-filled space must not be entered without adequate rescue equipment encompassing breathing apparatus.

First aid

High concentrations of nitrogen gas can cause asphyxiation, which can occur without warning. The symptoms can also include unconsciousness. In the event of breathing difficulties, the injured person must be moved immediately to a safe distance from the nitrogen gas source (this might require his/her colleagues to use a breathing apparatus) and kept warm and still. Call a doctor. Perform cardiopulmonary resuscitation if breathing stops.

In the event of splashes in the eyes, rinse immediately very thoroughly with water for at least 15 minutes. Any contact lenses are to be removed. A doctor must always be contacted.

Frostbitten body parts must be thawed slowly with lukewarm water until the feeling and normal colour returns to the skin. Injuries must not be rubbed or handled in any other way as it could aggravate the injury. A doctor must be called if the injury is more severe or extensive. The thawing process must not be interrupted during transport to the hospital.

Internal transportation

If the risk assessment declares it to be safe, small volumes (1 to 10 litres) may be carried by employees direct to the room in which the container is to be stored. However, you are not allowed to use the elevator. Such containers must be of such a size and design that the risk of spillage/accident likely to cause explosion, cryonic burns/frostbite or asphyxiation is avoided.

Liquid nitrogen in volumes greater than 10 litres must be transported using a suitable trolley, cart or wheeled tank and in such a way that the container cannot tip over. When transporting by elevator, no person is allowed to take the elevator together with liquid nitrogen and the elevator must be signed or

locked/cordoned off so that no one enters it by mistake at another level of the building.

Containers without a safety vent may never be hermetically sealed (explosion risk).

Handling of spill

In the event of a small spill, the room is to be evacuated and the need for further measures assessed. The measures to be taken depend on the space, nature of work, and air exchange.

In the event of a major spill, the area is to be sealed off and properly ventilated. Discharge into the drainage system must be avoided whenever possible.

Waste

Liquid nitrogen must not be poured down sinks or similar (can cause destruction). Smaller vessels are to be placed in fume cupboards where the nitrogen can evaporate safely.

Signs

Warning signs marked “Liquid nitrogen” and hazard pictograms “Gas under pressure” are to be posted on doors to rooms where liquid nitrogen is stored/handled.

Alarms and safety procedures

Rooms in which liquid nitrogen is stored and handled must be well ventilated and, if the risk assessment shows it, equipped with low oxygen alarms. There must be no risk of a leakage or spill causing the oxygen concentration to fall below 20 volume percent (AFS 2023:10). All employees must know where the main stopcock is located.

See also KI's regulation for solitary work.

To think of

- Conduct a risk assessment, write the handling and safety instructions and emergency procedures before work begins and keep the documents close by.
- Keep the supplier's safety data sheet close to where the work is being done.
- Make sure to have the appropriate signage.
- Make sure there is sufficient ventilation (e.g., work with the door open).
- Have a low oxygen alarm installed if necessary.
- Use adequate face visor, gloves, no open-topped shoes and clothes.
- Never work alone.
- Never store liquid nitrogen in standard freezers, refrigerators, or cold rooms, as these spaces are poorly ventilated.
- Comply with the transportation rules. Contact KI's Safety Advisor if unsure.
- Register the gas container in the KLARA product database.

Information and contact details

For more information, contact kemikaliesakerhet@ki.se .

The contact information for KI's Safety Advisor can be found on KI's Staff portal under Laboratory Waste and Contact.