



Safety Regulations. Handling of liquid nitrogen.

Risks when handling liquid nitrogen.



Warning! $-196\text{ }^{\circ}\text{C}$.

Liquid nitrogen is extremely cold, and may cause severe frostbite in those who come into contact with it.



Danger/risk

Due to its low temperature, liquid nitrogen may cause severe frostbite when exposed to the skin and even when the skin is exposed to cooled equipment. The eyes are especially sensitive and must always be protected against splashing.

See "First aid", page 6.

Measures/requirements

- Avoid direct contact with liquid nitrogen or cooled equipment.
- Personal protection equipment must be used (**full coveralls, gloves, trousers outside of the bootlegs and protective eyewear/face shield**).
- Beware of the risk of exhaust holes re-icing and lids freezing, which may lead to a dangerous rise in pressure.
- Pipes for liquid nitrogen, which can be closed off, must be fitted with safety valves that prevent unauthorised increases in pressure when trapped liquid vaporises.
- Dewars and vessels used to hold liquid nitrogen must be marked with a label reading "Liquid nitrogen".



Warning! Suffocating.

Nitrogen displaces oxygen and reduces the oxygen content in the air. This can be extremely dangerous in small, low-lying or insufficiently ventilated areas.



Danger/risk

Nitrogen is odourless, non-toxic and invisible. High levels of nitrogen cause **suffocation**. One litre of liquid nitrogen is equivalent to around 700 litres of gaseous nitrogen at a normal pressure and temperature. The nitrogen dilutes the air, which reduces the oxygen content. Cold vaporised nitrogen is heavier than air. It is important to be aware of the risks associated with oxygen deficiency in conjunction with substantial emissions indoors, as well as less extensive emissions in small, low-lying or poorly ventilated areas.

The symptoms of oxygen deficiency present gradually and are difficult to detect. Where oxygen levels fall to 16 %, subjects will experience loss of breath, palpitations and fatigue. Extremely low levels of oxygen will result in sudden unconsciousness without prior warning. Never enter an area in which there may be an oxygen deficiency without assessing oxygen levels with the use of a gauge.

See "First aid", page 6.

Measures/requirements

- A preventive measure against oxygen deficiency is good ventilation (e.g. to have the door open) and the use of an oxygen alarm.
- According to the Swedish Work Environment Authority, oxygen levels in the workplace may ordinarily be no lower than 20 %. Where levels fall below 18 %, breathing apparatus must be used.
- During transportation of liquid nitrogen, dewars and vessels must be placed in a ventilated area that is separate from the driver and passenger compartment.
- The nitrogen dewars and vessels must always be secured so that they cannot tip over during transport.
- Premises where liquid nitrogen is being handled must include a sign reading "Warning: Liquid nitrogen".
- Written handling and safety regulations must be available at the workplace.

Risks when handling liquid nitrogen.



Warning! Embrittlement.

Due to the extremely low temperature of liquid nitrogen, several materials contract substantially and become hard and brittle, causing them to lose their strength.

Danger/risk

Due to the low temperature of liquid nitrogen, $-196\text{ }^{\circ}\text{C}$, many materials for which it is used for cooling purposes contract substantially and become hard and brittle, causing them to lose their strength. This may lead to personal injury and material damage.

Measures/requirements

- Storage and handling of liquid nitrogen may only take place using materials and equipment that retain sufficient strength at the low temperature in question.
- Never allow gas to spurt or fall onto other equipment.



Warning! Can lead to an increased oxygen content, which is oxidising.

Liquid nitrogen may, under certain circumstances, lead to an increased concentration of oxygen. This can, in turn, lead to an increased fire hazard.

Danger/risk

Nitrogen is neither oxidising nor flammable in itself. However, under certain circumstances, air may be condensed when it is exposed to uninsulated cooled equipment.

Condensed air that falls from equipment will have an elevated level of oxygen (as oxygen has a higher boiling point than nitrogen). This leads to a higher risk of fire during exposure to flammable materials.

Even materials ordinarily not considered especially flammable may become combustible under these circumstances.

Measures/requirements

- Only use equipment approved for liquid nitrogen. Equipment must be handled so as to ensure flammable materials are not exposed to condensed air.
- Equipment for handling liquid nitrogen may not be isolated with flammable materials.
- An AB Class 1 fire extinguisher must be present during transportation.

First aid.

Suffocation, oxygen deficiency

High levels may result in suffocation. Symptoms may even include paralysis and/or unconsciousness. The symptoms of oxygen deficiency present gradually and are difficult to detect. Suffocation may occur without prior warning. It is important to act quickly.

- Transfer the injured party to an area with fresh air.
- If the person is losing consciousness, ensure that he/she is breathing and that his/her airway is unrestricted, and place in the recovery position. Call 112. Keep the person warm, and watch over him/her.
- If the person exposed to a nitrogen-filled environment is unconscious and not breathing, call

112 and commence CPR (cardiopulmonary resuscitation) immediately.

Skin contact

- In case of frostbite, thaw the affected area with warm water, maximum 37 °C, for at least 15 min. until the skin returns to its normal colour. Use a sterile dressing. Seek medical assistance.
- In case of deep skin injuries, consult a doctor. Protect the wound from infection with a sterile dressing.

Eye contact

- Rinse the eyes with warm water, maximum 37 °C, for at least 15 minutes, then contact a doctor.

Transportation.

Road transport

- Liquid nitrogen is classed as hazardous goods and must be transported in accordance with the ADR-S. If more than 333 kg gross liquid nitrogen is transported, then ADR-S applies in its entirety. Goods specification forms and transport cards can be obtained from Linde Gas depots.
- When only transporting smaller volumes of liquid nitrogen (under 333 kg gross) it is sufficient that the vessel is labelled, marked and sealed, and that there is an AB Class 1 fire extinguisher (2 kg) and goods declaration accompanying the transport.
- In addition to the details of goods carried, the goods declaration must indicate the consignor and consignee as well as the gross weight of the filled vessel.
- There are two types of vessels approved for transportation of liquid nitrogen: double-walled, sealed pressure vessels with vacuum insulation and small, open thermos vessels equipped with lids.

The volume of open vessels may not exceed 100 litres.

- During transportation, dewars and vessels must be secured so as to ensure they do not tip over.
- Liquid nitrogen should not be transported in an ordinary passenger car. (AFS 1997:7)
- **Please note** that only one dl of liquid nitrogen that evaporates can lead to a hazardous low oxygen content in an area that has a volume of 2 m³ (e.g. a lift or vehicle).

Internal and lift transport

- Vessels should be transported in a basket by truck or forklift. Baskets must be fitted with rollover protection structure (ROPS).
- During transport of liquid nitrogen in a sealed lift no persons are allowed to attend. The lift must be locked. If that is not possible, the vessel must be marked with a warning sign stating that personal transportation is prohibited due to transportation of liquid nitrogen. The doors must be obstructed or secured with a chain or cones, clearly marked with warning signs.

Dewars and Vessels for liquid nitrogen.

Linde Healthcare rents out vessels for storage and transportation of liquid nitrogen. There are vessels in a range of different sizes in two main types: open thermos vessels and sealed pressurised vessels. Both vessels are double-walled, and the gap is ordinarily super-insulated and vacuum-pumped. There are also other types of insulation.



Open vessels

The vessels are frequently inspected with regard to safety, function and labelling. As Linde Healthcare handles vessels that are owned by the client, e.g. during transferral from one vessel to another, Linde Healthcare requires that these are inspected and in good condition.



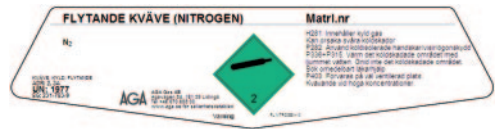
Pressurised vessels

Labelling/signage.

Vessels for liquid nitrogen must be equipped with the following:




Premises where liquid nitrogen is being handled must include a sign reading "Warning: Liquid nitrogen"




Our vessels are also equipped with the following label to point out and clarify the safety rules and risks.


Warning! Liquid Nitrogen




Handle only with protective gloves.




Warning! Suffocating.
Can be extremely dangerous in small, low-lying or insufficiently ventilated areas.




Warning! -196 °C.
May cause severe frostbite in those who come into contact with it.



Use protective eyewear or facemask.



Use only with fully covering protective clothing or apron.



Use protective shoes or boots. Pants over boot shafts.

Get in touch with us.

Linde Healthcare is committed to continually developing healthcare products and services. We provide medical gas products, equipment and training in the handling and usage.

Our medical gases are classed as medicines – they are manufactured and distributed in accordance with both European regulations and Swedish law. We were the first to receive marketing authorisation for medicinal oxygen in Sweden (2005).

Our medical equipment meets European requirements and standards applicable to medical devices.

Linde Healthcare is part of Linde plc, which is represented in over 100 countries. The Swedish organisation is legally part of Linde Gas AB.

More information about us and our products and services can be found at www.linde-healthcare.se

Security training

Linde Healthcare offers training in the safe handling of liquid nitrogen (LIN). The target group for the training are persons who handle liquid nitrogen in their daily work, but also people who are responsible for training or safety in their workplaces. We recommend that all workers who in one way or another come in contact with or handle liquid nitrogen in the workplace have undergone training in safe LIN handling to minimise the risk of an accident or incident.

Place of delivery

When purchasing, Linde Healthcare delivers vessels in a basket to the loading dock or other suitable location in direct connection to the customer.

Linde Healthcare customer centre

Phone +46 (0)8-731 18 00

healthcare.se@linde.com

Linde Gas AB

Linde Healthcare, Rättarvägen 3, SE-169 68 Solna, Sweden

Phone +46 (0)8-731 18 00, www.linde-healthcare.se