



School of Plant Biology - Liquid Nitrogen Induction

Liquid Nitrogen (LN₂) Usage Guidelines

If you wish to use LN₂, there are a few rules that have been put in place to ensure your safety and to ensure there is LN₂ available when you require it.

If you require large volumes of LN₂, (≥ 5 litres), please arrange your own collection through the School of Physics.

You must be signed off as having done the introduction 'training' to LN₂ dispensing before taking LN₂. This takes 10 minutes and must be provided by a competent person.

PLEASE TAKE A FEW MINUTES TO READ AND UNDERSTAND THE FOLLOWING:

Known or Expected Hazards

Temperature Related

These low temperature fluids have the potential to cause suffocation, lung disorders, cold-contact lesions and frostbite, therefore training in their use is important.

The extremely low temperature of the liquid can cause severe burn-like damage to the skin either by contact with the fluid, surfaces cooled by the fluid or evolving gases. The hazard level is comparable to that of handling boiling water.

The low temperature of the vapour can cause damage to softer tissues *e.g.* eyes and lungs but may not affect the skin during short exposure.

Skin can freeze and adhere to liquid nitrogen cooled surfaces causing tearing on removal.

Soft materials *e.g.* rubber and plastics become brittle when cooled by liquid nitrogen and may shatter unexpectedly.

Liquid oxygen may condense in containers of liquid nitrogen or vessels cooled by liquid nitrogen. This can be extremely hazardous because of the pressure rise on the slightest degree of warming above the boiling point of oxygen (-183°C) and the possibility of explosive reaction with oxidisable material.

Thermal stress damage can be caused to containers because of large, rapid changes of temperature.

Vapour Related

Large volumes of nitrogen gas are evolved from small volumes of liquid nitrogen (x~700) and this can easily replace normal air in poorly ventilated areas leading to the danger of asphyxiation. It should be noted that oxygen normally constitutes 21% of air. Atmospheres containing less than 10% oxygen can result in brain damage and death (the gasping reflex is triggered by excess carbon dioxide and not by shortage of oxygen), levels of 18% or less are dangerous and entry into regions with levels less than 20% is not recommended.

Oxygen condensed into leaking containers can explode on heating following resealing or blockage with ice.



Precautions

Some gases are flammable e.g. hydrogen and others such as liquefied oxygen promote rapid combustion. The more common problems are due to explosion of the containers. The cryogenic liquids evaporate to form large volumes of gas at room temperatures. During the evaporation process, water vapour can be condensed from the air forming ice which then blocks the vent on the container causing over pressurisation of the vessel.

Regular checks should be made to ensure that the venting mechanism on the container is still operable.

Transportation of containers of cryogenic liquids in confined areas such as cars or lifts should only be undertaken if a risk assessment has been undertaken and the procedure is then approved.

If flammable or poisonous cryogenic liquids are to be used in the laboratory, the container shall not exceed Five Litres and provision must be made for special ventilation and where appropriate, gas detectors put in place.

Cryogenic liquids should not be stored in non-ventilated areas such as cold rooms.

Properties: Liquid Nitrogen

Liquid Nitrogen has a boiling point of -183°C

Volume of expansion liquid to gas (at 15°C , 1 atm.) = 682.1

Sg = 0.808 (at -183°C).

Density of liquid (normal boiling point, 1 atm.) = 0.807 g/cc

Colourless, Odourless liquid similar in appearance to water.

Operation

Always use liquid nitrogen in a well-ventilated area, especially when filling a warm container or transfer tube or inserting a warm object, as large volumes of nitrogen gas are evolved. It is prohibited to travel in a lift with a Dewar of liquid nitrogen, failure of the Dewar or a large spillage could result in asphyxia in the confined area of a lift.

Use only containers or fittings (pipes, tongs *etc.*) that have been designed specifically for use with cryogenic liquids as non-specialised equipment may crack or fail. In particular, do not use food type vacuum flasks as they can implode resulting in flying glass fragments.

Protect all glass Dewars against the possibility of flying glass fragments, arising from failure by mechanical or temperature stress damage, by sealing all exposed glass either in an insulated metal can or by wrapping with adhesive tape.

Always fill warm Dewars slowly to reduce temperature shock effects and to minimise splashing. Do not overpressure the storage Dewar when filling a globular Dewar. Use the minimum pressure required to maintain a flow of liquid.

Always make sure that containers of liquid nitrogen are suitably vented and unlikely to block due to ice formation.



Beware of the formation of liquid oxygen in cold-traps that are open to air or the increase of liquid oxygen content in a flask of liquid nitrogen that has been cold for a long period. (Liquid oxygen has a blue water-like appearance). However, most liquid nitrogen containers are closed except for a small neck area and the nitrogen vapour issuing from the surface forms a barrier which keeps air away from the liquid thus preventing oxygen contamination. (An explosion at UMIST was caused apparently by overcooling of Rotaflo taps which leaked and allowed oxygen to condense into a sample tube. Subsequent warming resealed the Rotaflo but blew the tube apart as the oxygen evaporated.)

Avoid skin contact with either liquid nitrogen or items cooled by liquid nitrogen as serious burns may occur. Beware of wearing gloves, wrist-bands or bracelets which may trap liquid nitrogen close to the skin.

Always wear approved Personal Protective Equipment especially safety glasses to protect against splashes, vapour, failure of glass apparatus resulting in implosion, brittle failure of items cooled by liquid nitrogen.

When transporting LN₂ in a lift, you may NOT accompany the LN₂, it must be sent in the lift with no occupants.

Alternatively, when carrying LN₂ up or down the stairs, you MUST use a solid (closed /emergency) staircases and NOT the "open" staircase, e.g. the main staircase in the middle of Ag Central.

Personal Protective Equipment

Protective clothing suitable for handling these liquids shall be provided with particular attention given to gloves and eye/face protection. Aust Standard 1337 Eye Protectors for Industrial Applications recommends a full-face shield be worn.

Dry leather gloves (when handling equipment that has been in contact with the liquid). Gloves should be loose fitting and easily removed.

Lab coat or overalls are advisable to minimise skin contact, also, wear trousers *over* shoe/boot tops to prevent shoes filling in the event of a spillage.

A full face shield and leather glove is provided for transferring LN₂ from the Dewar to your container.

Failure to use these will result in the removal of your privileges to access this source.

Training

All staff using or handling cryogenic liquids must receive training which includes care, selection and use of protective equipment, hazards associated with its use and emergency procedures. New users of liquid nitrogen should receive instruction in its use from experienced members of the academic or technical staff.

The B.O.C. leaflet "**Recommended Safety Precautions for Handling Cryogenic Liquids.**" should be read.

Level of Risk Remaining

There remains a significant risk in using liquid nitrogen from the inadvertent condensation of oxygen into a closed system. It is recommended that whenever possible some other coolant is used *e.g.* solid carbon dioxide/liquid traps or baths - the preferred liquids for such baths are isopropanol or glycols. It is strongly recommended that such baths are used in preference to liquid nitrogen when long term storage is envisaged.



Hazards

Apart from being unable to condense oxygen, hazards associated with solid carbon dioxide are similar to those described for liquid nitrogen *i.e.* temperature related and vapour related. In operation, similar precautions should be taken against cold burns and asphyxiation.

Emergency Procedures

Temperature related

For brief, localised contact with cold material - flush the area with water. (Water is used because of its high heat capacity.) Obtain First Aid assistance.

More prolonged contact will require medical treatment. Call a First Aider.

Vapour related

Following a large spillage of liquid nitrogen, evacuate the area and call for help. Follow the procedure outlined in the School Safety Handbook for the escape of toxic material in the section "Coping with an Emergency".



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Name:		√
Please Circle:	Student / Staff / Visitor	
1. Appropriate safety equipment must be worn. Full face shield, large welding gloves, lab coat and enclosed shoes.		
2. Clearly fill out the log book with your full name, date, amount you have taken and project grant to be charged.		
3. DO NOT use both Dewar's at the same time. Use one until it is nearly empty and then move onto the 2nd. We get charged for a full refill even if a Dewar is only half empty, so if both are half full at the beginning of the week they will not get refilled and we will run out by mid-week.		
4. DO NOT empty Dewar completely. Make sure there is still a little bit of LN2 in Dewar and place an "empty" notice on that cylinder. <u>AND</u> please advise Maria (ext. 1720) that the Dewar is empty We get charged double to refill an empty Dewar; this cost is subsequently passed onto YOU the user.		
5. The 2nd Dewar is stored between the 2 -80°C freezers (eastern end, first floor). When the first Dewar is nearly empty, place an "empty" notice on it and swap it with the 2nd Dewar. <u>AND</u> advise Maria (ext. 7397). IF it's running low please let Maria know to give her adequate time to re-fill. Maria may not be able to go and fill a Dewar immediately she is informed due to her other work commitments, please give her ample notice to make this facility functions adequately.		
6. DO NOT open the Dewar in the corridor.		
7. DO NOT put LN2 back into the Dewar. You will contaminate other peoples' work.		
8. Waste LN2 disposal is to be in a well-ventilated area away from human traffic.		
9. Dispense LN2 into appropriate containers.		
10. Lock the Dewar when finished.		
11. Transporting LN2: When using a lift, ensure that you do NOT accompany LN2 in the same lift. When using stairs, ensure that you know where the SOLID (emergency) staircases are located – <u>NO</u> LN2 are allowed on open staircases.		

	Name	Signature	Date
Inducted Person			
Person conducting			
Supervisor			

Once this checklist has been completed and signed, the original is to be handed into the School Manager. A copy can be made for the records of the individual where requested.