

# Liquid Nitrogen Code of Practice

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## Document control

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## **LIQUID NITROGEN - CODE OF PRACTICE FOR HANDLING**

Dewar = The silver flask that holds the liquid nitrogen (N<sub>2</sub>).

**1. STATUS OF THIS CODE.** Compliance with this code of practice is mandatory for all staff and patients.

**2. RISK ASSESSMENT.** A current COSHH risk assessment must be in existence for all work with liquid nitrogen. (Appendix 1)

**3. COLD BURNS.** Liquid N<sub>2</sub> can cause severe frostbite and cold burns. Safety glasses and appropriate gloves must be worn when handling liquid N<sub>2</sub>. Never put any part of your body in front of a liquid N<sub>2</sub> supply. Never touch an un-insulated pipe or vessel. The cold metal may stick fast and tear the flesh when you attempt to withdraw from it.

**4. VENTILATION.** Always handle liquid N<sub>2</sub> in well-ventilated areas to prevent excessive concentrations of gas. If such are not available then oxygen monitoring should be fitted and great care exercised to avoid spills. Note: The cloudy vapour that appears when liquid N<sub>2</sub> is exposed to the air is condensed atmospheric moisture; not the gas itself.

**5. ASPHYXIATION.** Liquid N<sub>2</sub> can rapidly be converted into gas at 700 times the liquid volume. It may then kill by asphyxiation. When the oxygen concentration in the air is sufficiently low, a person can become unconscious without sensing any warning symptoms, such as dizziness. See Appendix 2 'the physiology of asphyxiation'.

**6. PRESSURE.** Liquid N<sub>2</sub> boils off very quickly. Do not put liquid N<sub>2</sub> in closed vessels that cannot withstand the pressure. Do not put into thermos flasks. Do not punch holes in cryovials. ONLY ever use the Dewar provided.

**7. SIGNAGE.** The presence of liquid N<sub>2</sub> must be indicated by a suitable sign

**8. TRANSPORTATION.**

Only use Dewar 1 litre universal flask when moving liquid N<sub>2</sub>. Lid must be secured and locked whenever transportation is necessary.

Always place Dewar into transportation box when transporting.

The Dewar should only be transported unaccompanied by lift. It should never be taken via the stairs or across the shop floor.

**9. USE OF LIFTS.** It is extremely unlikely that a well-maintained and properly handled Dewar will spill its contents whilst being transported in a lift and so place an accompanying handler at risk of injury or death. However, to eliminate such risk altogether the Dewar should only be transported in the lift unaccompanied and the lift called from the destination. No personnel should ever travel with the Dewar in the lift.

**10. MAINTENANCE OF DEWARs.** The Dewar must be visually inspected each time it is refilled and any defects must be reported to a member of the Management team.

**11. DECANTING OF LIQUID N<sub>2</sub>.** Never overfill Dewars. Spillage damages flooring and could cause injury. Insert pipes and funnels slowly to avoid splashing. Great care should be exercised to ensure that space is left to replace lids/tops on Dewars especially those that insert a considerable distance into the vessel.

**12. APPROPRIATE GLOVES -** Spills when wearing gauntlets or other loose-fitting gloves can result in liquid N<sub>2</sub> running inside the glove and causing severe burns. Always use thermal protective gloves specifically designed for cryogenic use with close-fitting ribbed cuffs that will prevent this from happening. They also protect the hands from cold burns from materials that have been in contact with cryogenic

liquids. These can be as much of a problem as the liquid itself. The surface of the glove is textured to provide a sure grip on cold slippery surfaces thus helping to prevent other associated accidents.

**13. FIRST AID MEASURES FOR SKIN/EYE CONTACT** - Immediately flush thoroughly with water for 15 minutes. In case of frostbite, spray with water for at least 15 minutes, apply a sterile dressing obtain medical assistance.

**14. SIZE OF ROOMS TO ACCOMMODATE DEWARs WITHOUT OXYGEN MONITORING**  
Liquid Nitrogen expands around 700 – fold when it vaporises at room temperature (e.g. 1 litre of Liquid Nitrogen produces 700 litres of gas).

Closed vessels containing LN may explode because of build up in pressure caused by the evaporation.

In poorly ventilated rooms there is a danger that air will be displaced by the nitrogen, leading to an oxygen deficient atmosphere and death by asphyxiation.

Table: Effects on a person in an Oxygen deficient atmosphere.

Oxygen Content (vol. %)	Effects and symptoms (at atmospheric pressure)
20 - 14	Diminution of physical and intellectual performance without person's knowledge.
14 - 10	Judgement becomes faulty. Severe injuries may cause no pain. Ill temper easily aroused. Rapid fatigue on exertion.
10 - 6	Nausea and vomiting may appear. Loss of ability to move vigorously or at all. Inability to walk, stand or crawl is often first warning and it comes too late. Person may realise they are dying but does not care. Resuscitation possible if carried out immediately.
0 - 6	Fainting almost immediate, painless death ensues, brain damage even if rescued.

## PROCEDURE

Dewar to be delivered by Pathology with pathology run on alt Wednesday around 12:30.

Driver will ring to say that he is in the basement.

2 members of staff to go out to lift with transportation box and 1 member of staff proceeds to basement with box in the lift.

Driver will put the dewar into the transportation box for the member of staff.

Transportation box to be closed and locked.

Box to be placed into lift and doors closed. Staff member does not enter the lift with the box.

Staff member upstairs to call lift.

Transportation box to be removed from lift and placed in second floor stock room. Dewar to remain in transportation box until needed.

Doctor to be informed of arrival.

Doctor to wear protective clothing to decant from Dewar into Cry-Ac (application flask) prior to clinic starting. Decanting to only take place in consulting room. Stock Room is too small to perform this task safely.

Procedures to be performed in consulting rooms with door open.

Empty flask to returned to pathology when next delivery.

## FURTHER READING

- a) BOC (Cryospeed) G4521 - Siting of liquid cylinders or vessels in buildings.
- b) BOC Gases - Liquid Nitrogen Safety Data Sheet.
- c) BOC - Prevention of oxygen enrichment or deficiency accidents
- d) BOC - Care with Cryogenics
- e) Queen Mary College, London - Liquid Nitrogen, Code of Practice
- f) J.A.G. Collinson, Safety in the Laboratory, The Medical Technologist, February 1990
- g) British Cryogenics Council, Cryogenics Safety Manual, Oxford, 1991
- h) National Physics Laboratory, Safety Measures in Chemical Laboratories, London, 1964

## CHANGE REGISTER

Date	Author	Change
12.9.2011	Dixine Douis	Updated staff details
March 2019	Dixine Douis	updated procedure and staff details
22.9.2021	Dixine Douis	Routine review and update staff details

## APPENDIX ONE

### COSHH. Risk Assessment Form - use of Liquid Nitrogen

**N.B. All risk assessments - must be reviewed at least once per year to ensure they are up-to-date. For example - check for changes in personnel, method, materials, lab and risk levels.**

I, the UNDERSIGNED, have identified the health and safety hazards and have assessed the levels of risk to persons and property which might arise from the use of Liquid Nitrogen

**The work involves: (circle relevant letter/s)**

**A.** Laboratory hazards not in categories B-E below and not requiring controls or precautions beyond the requirements of the general departmental/school safety codes of practice that will be issued to relevant workers/students and adhered to.

**B.** Biological substances hazardous to health - i.e. viruses, micro-organisms, GM material etc above bio-hazard group 1.

**C.** Chemical substances hazardous to health - i.e. known or suspected irritants, toxins, carcinogens plus highly flammables and explosives.

**D.** Physical hazards to health - i.e. ionizing radiation, high voltage equipment, noise >80dB(A), ultrasonics, lasers and other non-ionising radiations.

**E.** Environmental or other hazard stated here: .....

If the work is in **category A.** above - state **OVERLEAF** the titles of the school/dept. safety code that covers the work involved and that will be issued to relevant workers/students.

If the work is in **categories B-E** above - state **OVERLEAF** your full assessment of the risks involved and the particular codes of practice and/or control measures that will be taken to protect persons and property beyond those specified in a general safety code of practice.

**Note:** If **HEALTH SURVEILLANCE** is required e.g. work with allergens, certain chemicals or involving expectant or breastfeeding mothers, the names of the relevant workers must be notified to the Human Resource department who will initiate a further risk assessment.

**DECLARATION:** I (member of staff overseeing the work) ..... confirm that all who will be involved in the work are listed overleaf and have read and understood this assessment

**SIGNATURE:** ..... **DATE:** .....

Staff members involved in task

Clinical Staff

Dr Catherine Maytum - Procedure

Dr Jackie Belbeck - Procedure

Reception staff

All reception staff – transportation

Megan Jocelynn – Transportation

Dixine Douis – Transportation

Jane Glydon - Transportation

Hazard	Control	Persons involved
<p>Cold burns</p> <p>Liquid N2 boils off very quickly</p>	<p>Safety glasses and appropriate gloves must be worn when handling. Only put in Dewar flask and Cry-Ac-3 and wear protective clothing (see below)</p>	<p>Doctor</p>
<p>Ventilation</p> <p>Excessive build up of gas can occur in unventilated rooms or rooms without sufficient capacity.</p>	<p>Always use in well ventilated area and take great care to avoid spills. Size of flask to be minimum size necessary for task (1 litre). Due to size of room (approx 34m<sup>3</sup> CR3/4) the Oxygen content in the room should remain above 20% (20.6%). At this level no discernible symptoms can be detected by the individual. Advisable to keep door open when performing cryotherapy.</p> <p>All rooms have internal ventilation systems which supply clean air from ventilators on the roof and take 'bad' air from the room to the outside air.</p>	<p>Doctor</p>
<p>Asphyxiation</p> <p>Liquid N2 can be converted into gas at 700 times the liquid volume. Can kill by asphyxiation.</p>	<p>Due to size of room (approx 34m<sup>3</sup> CR3/4) the Oxygen content in the room should remain above 20% (20.6%). At this level no discernible symptoms can be detected by the individual.</p>	<p>Doctor</p>
<p>Transporting</p> <p>Risk of spills</p>	<p>Spills could cause all of the above hazards. Spills are unlikely if transported in the Dewar flask.</p> <p>Flask must be checked for faults every time the unit is transported and filled.</p> <p>Dewar must only be transported in lift unaccompanied. NO personnel must travel in the lift with the Dewar.</p> <p>The Dewar must not be carried via the stairs in case of spills. Always place in lift unaccompanied and call lift from destination.</p> <p>Dewar to be placed in transportation box supplied and lid closed and locked. Dewar must never be carried without being in transportation box.</p>	<p>Transporter</p> <p>Patients</p> <p>Boots staff and shoppers</p>
<p>Spills</p> <p>Spills damage floors and can cause injury</p>	<p>Never over fill Dewars. Insert pipes and funnels slowly to avoid splashing. Exercise great care when replacing lids and tops. Always wear</p>	<p>Doctor</p> <p>Transporter</p> <p>Patients</p>

	<p>protective clothing supplied (see below)</p> <p>Open toed shoes and sandals not suitable. If boots are worn, trousers should be worn outside the boots to prevent liquid running into top of boot.</p>	Boots staff and shoppers
Decanting	<p>Decanting should always be performed on a room larger than 25m<sup>3</sup> in order to ensure safety from spills. (See table 3)</p> <p>The dirty room, clean room or Triage room should not be used for decanting purposes. Decanting should be performed in the consulting room with the door open.</p>	Doctor
Storage	The Dewar can be stored in the dirty room, within the transportation box. (see Table 2)	Transporter Doctor

Room sizes

- Stock Room = 21m<sup>3</sup>
- Consulting Room 4 = 34m<sup>3</sup>
- Room 8 =
- Volume liquid Nitrogen = 1 Litre

Table 2: Oxygen concentration, % effect of evaporation – 0.4 air changes per hour

	Volume of Liquid Nitrogen, litres		
Room Volume (m <sup>3</sup> )	<u>10</u>	<u>25</u>	<u>50</u>
<u>15</u>	21	21	20.9
<u>25</u>	21	21	20.9
<u>50</u>	21	21	21

Table 3: Oxygen concentration, % effect of spillage.

	Volume of Liquid Nitrogen spilled, litres		
Room Volume (m <sup>3</sup> )	<u>1</u>	<u>2</u>	<u>3</u>
<u>10</u>	19.6	18.1	16.7
<u>25</u>	20.4	19.9	19.3
<u>50</u>	20.7	20.4	20.1

These charts show that both rooms are a suitable size for the management of liquid nitrogen but decanting and procedure would be best performed in the consulting room



Protective clothing:

Face: Plastic shield

Hands: Gloves with ribbed wrist, do not use latex type gloves for fear of LN running into cuff.

Body: PVE apron

Feet: Open toed shoes and sandals not suitable. If boots are worn, trousers should be worn outside the boots to prevent liquid running into top of boot.

FIRST AID

If any of the following symptoms appear in situations where asphyxia is possible:

- Rapid and gasping breath
- Rapid fatigue
- Nausea
- Vomiting
- Collapse or inability to move
- Unusual behaviour

Immediately move the affected person to the open air. Keep victim warm and rested. Call an ambulance. Apply artificial respiration if necessary.

However, attempts to rescue affected persons from confined spaces or where Oxygen deficient atmospheres may be present should only be made by those trained in the use of breathing apparatus and confined space entry procedures. This excludes all practice personnel. The Fire Brigade should be called in all instances where a person requires rescue.

Skin/Eye Contact.

- Immediately flush thoroughly with copious quantities of tepid water (the water must not be hotter than 44 C). In case of frostbite spray with water.
- DO NOT apply any form of direct heat.
- DO NOT rub affected parts either before or after warming.
- Move the patient to a warm place (22 C).
- Arrange for the casualty to be transported to hospital without delay.
- While waiting for transport :
- Remove or loosen restrictive clothing.
- Continue to flush the affected area with copious quantities of tepid water.
- Protect any frozen parts with bulky, dry, sterile dressings. Do not apply to tightly.
- Keep patient warm and at rest.
- Ensure ambulance crew/hospital is advised of details of accident and first aid treatment already administered.
- The patient should neither smoke, nor drink alcohol.

## APPENDIX 2

### Physiology of Asphyxiation

Large leaks of nitrogen may produce local oxygen deficient atmospheres that will result in asphyxia if breathed. This is especially true in confined spaces. Atmospheres containing less than 18% oxygen are potentially dangerous and entry into atmospheres containing less than 20% is not recommended.

Asphyxia due to oxygen deficiency (anoxia) is often rapid with no prior warning to the victim. A general indication of what is liable to happen in oxygen deficient atmospheres is given in the Table: Effects on a person in an Oxygen deficient atmosphere above.

It should be appreciated that the reactions of some individuals may be very different from those shown.

**Sudden asphyxia.** In sudden and acute asphyxia, such as that from inhalation of a gas containing practically no oxygen, unconsciousness is immediate. The person falls as if struck down by a blow on the head and may die in a few minutes, unless immediate remedial action is taken.

**Gradual asphyxia.** Degrees of asphyxia will occur when the atmosphere contains less than 20.9% oxygen by volume.

If any of the following symptoms appear in situations where asphyxia is possible:

- i) Rapid and gasping breath.
- ii) Rapid fatigue.
- iii) Nausea.
- iv) Vomiting
- v) Collapse or inability to move.
- vi) Unusual behaviour

Immediately move the affected person to the open air. Keep victim warm and rested. Call an ambulance. Apply artificial respiration if necessary.

However, attempts to rescue affected persons from confined spaces or where oxygen deficient atmospheres may be present should only be made by those trained in the use of breathing apparatus and confined space entry procedures. **This excludes all Practice personnel.** The Fire Brigade should be called in all instances where a trapped person requires rescue.