

# The Newcastle Upon Tyne Hospitals NHS Foundation Trust

## Safe use and storage of liquid nitrogen and solid carbon dioxide (dry ice) Guidance and information

Effective: February 2010

Review February 2012

### 1. Scope

This document provides guidelines for the storage and handling of Cryogenic gases, mainly Liquid Nitrogen and Solid Carbon Dioxide (dry Ice).

### 2. General Information

All departments that use or store any Cryogenic gas or solids should carry out a risk assessment. All staff that use liquid nitrogen/cryogenic gases must receive appropriate training in its safe handling and use. Cryogenic gases/solids are only to be used in well-ventilated areas where this is not possible static Oxygen depletion monitors must be present.

### 3. Hazards

Hazards of liquid nitrogen include:

- Asphyxiation due to reduced oxygen levels
- Localised oxygen enrichment
- Cryogenic (cold) burns by contact with liquid nitrogen or associated cold surfaces.

**3.1 Asphyxiation:** Liquid Nitrogen rapidly vaporises to gas with about 700 times the liquid volume. By displacing air the gas may kill by asphyxiation. When the oxygen concentration in air is sufficiently low, a person can become unconscious without any warning symptoms.

**3.2 Cold Burns:** Extremely low temperatures can freeze flesh rapidly. When spilled on a surface the liquid tends to cover it completely. The gas issuing from the liquid is also extremely cold. Delicate tissue, such as eyes, can be damaged by exposure to cold gas alone. Unprotected body parts contacting objects cooled by liquid nitrogen may stick fast. This may result in injuries by flesh being torn whilst attempting to withdraw from the object. Prolonged inhalation of cold vapour or gas can damage the lungs. Cryogenic liquids and vapour can damage the eyes.

**3.3 Use of Lifts:** There is a small risk that should a person remain in a closed lift for a prolonged time any venting gases may reduce the oxygen levels sufficiently to cause harm. However to eliminate these risks the following practice should be followed when transporting dewars.

- No one should accompany the dewar inside a lift.

- One person should send the dewar and another should be waiting to receive the dewar from the lift.
- Use controlled goods lifts whenever possible. Do not use public use lifts.

#### 4. Storage

The location for the storage and use of liquid nitrogen must be chosen in the following order of preference:

- i. in a ventilated room sealed from other areas of normal occupancy, or
- ii. at, or above, ground level adjacent to an outside wall as far as possible from normal workstations, or
- iii. at above, ground level, as far as possible from normal workstations

Liquid nitrogen must not be stored or used below ground level or in corridors. All pipe-work and valves must be labelled or marked for functions. All vessels and equipment must be commissioned and handed over by a competent person.

**4.1 Workplace:** All vessels, work equipment, furniture and other items must be organised in such away as to allow staff, and other users of the space, adequate means of access and egress.

**4.2 Storage of Dewars in Rooms:** Storing single dewars of up to 25L in rooms is considered acceptable with adequate ventilation. However the storage of large numbers of small dewars or dewars over 25 litre capacity may require additional precautions to be taken. In these circumstances consideration should be given to: the size of the room; the storage conditions: ventilation levels: and, the possible use of low oxygen level alarms. Dewars must not be stored in sealed rooms (e.g. Walk in refrigerated rooms) because the reduced ventilation may be inadequate to mitigate against spillage and general evaporation.

**4.3 Containers:** Use only containers designed for low-temperature liquids. Cryogenic containers (e.g. Dewar flasks) are specifically designed and made of materials that can withstand the rapid changes and extreme temperature differences encountered in working with liquid nitrogen. Even so, these special containers should be filled slowly to minimise the internal stresses that occur when any material is cooled.

- Do not cover or plug the entrance opening of any liquid nitrogen refrigerator or dewar.
- Do not use any stopper or other device that would interfere with venting gas.

Cryogenic liquid containers are generally designed to operate with little or no internal pressure inadequate venting can result in excessive gas pressure which could damage or burst the container. Check the unit periodically to be sure that the venting is not restricted by accumulated ice or frost.

## 5. Labelling

Liquid nitrogen dewars shall be clearly and adequately labelled. The Label includes:

- Basic safety information
- Transport labelling information
- Gas supplier contacts

## 6. Maintenance of equipment

All large capacity storage equipment (25 litres or larger) should be subject to annual maintenance checks. Smaller dewars should be visually inspected

## 7. Protective Clothing

When using or decanting liquid nitrogen a face visor must be worn.

Always wear appropriate gloves when handling anything that is, or may have been, in immediate contact with liquid nitrogen. Use tongs to withdraw objects immersed in the liquid, and handle the object carefully. **Never put hands (even in the best gloves) into liquid nitrogen.**

Appropriate gloves are thermal protective gloves which are specifically designed for cryogenic use, with close fitting ribbed cuffs to prevent liquid nitrogen from spilling inside the glove.

When decanting liquid nitrogen, a splash resistant apron may be appropriate.

## 8. Transport

Only use closed 'onion' dewars and transport dewars when moving liquid nitrogen. When transporting large quantities of liquid nitrogen / solid carbon dioxide and when using lifts this task should be undertaken by 2 members of staff.

Keep the unit upright at all times. Tipping the container or laying it on its side can cause spillage of liquid nitrogen. It may also damage the container and any materials stored in it.

Rough handling can cause serious damage to dewars. Dropping the container allowing it to fall over on its side, or subjecting it to sharp impact or severe vibration can result in partial or complete loss of vacuum. To protect the vacuum insulation system, handle containers carefully.

Do not 'walk', roll or drag Dewars across a floor. Large units are heavy enough to cause personal injury or damage to equipment if proper lifting and handling techniques are not used.

Avoid transport on vehicles where the load space is not separated from the driver's compartment. Ensure vehicle driver is aware of the potential hazards of the load and knows what to do in the event of an accident or an emergency.

Before transporting product containers, ensure that they are firmly secured.

## 9. Disposal

Never dispose of cryogenic liquids down the drain. Ordinary materials may not be able to withstand cryogenic temperatures without failure. Laboratory plumbing is a common example.

Allow waste liquid nitrogen to evaporate naturally in a fume hood or, preferably, pour the liquid slowly on gravel or bare earth, from which other people are excluded, where it can evaporate without causing damage. Do not pour the liquid on the pavement.

## 10. First Aid

### 10.1 Skin / Eye Contact

- i. Immediately flush thoroughly with copious quantities of tepid water (the water must not be hotter than 44C).
- ii. **DO NOT** apply any form of direct heat.
- iii. **DO NOT** rub affected parts either before or after warming.
- iv. Move patient to a warm place (22C).

The aim is to slowly raise the temperature of the affected area back to normal. For minor injuries make the injured person comfortable and loosen any clothing that may restrict blood circulation. **Do not pull clothes away from burned or frozen area.**

Use a sterile burn dressing to protect the injury and to get the patient to the Hospital casualty department.

**DO NOT** permit smoking or alcohol consumption or give analgesics (aspirin, paracetamol etc).

**10.2 Anoxia:** If a person seems to become dizzy or loses consciousness while working with liquid nitrogen, move to a well ventilated area immediately. In contained areas self-contained breathing apparatus should be worn unless atmosphere is proved to be safe.

## 11. Dry Ice: Carbon Dioxide (Solid) CO<sub>2</sub>

Dry ice is frozen carbon dioxide (CO<sub>2</sub>). It is denser and colder than traditional ice. In addition, Dry Ice does not melt-it sublimates. Sublimation is the process of going directly from a solid to a gas.

**11.1 Hazard:** Contact with product may cause cold burns or frostbite. In high concentrations sublimed vapour may cause asphyxiation.

**11.2 General Precautions:** All staff who use Dry Ice must receive appropriate training in its safe handling and use.

**11.3 Handling and Use Precautions:**

- Do not handle Dry Ice with bare hands always wear suitable insulated gloves.
- Use only specified equipment which is suitable for the storage or transportation of Dry Ice.

#### **11.4 First aid Measures**

##### **Skin / Eye contact with Dry Ice**

Immediately flush eyes thoroughly with water for at least 15 minutes. In case of cold burns/frost bite, apply a sterile dressing and seek medical assistance.

#### **12. Summary of Recommendations**

- Carry out a risk-assessment in accordance with the Management of Health & Safety at work Regulations (8) and, where necessary, the confined Spaces Regulations (1).
- Ensure that all employees are adequately trained in the handling of dewars and are aware of the hazards of liquid nitrogen and that proper operating procedures are in place.
- Ensure that adequate ventilation is provided in areas dewars are used or stored.
- Ensure that adequate procedures are in place for the transportation of dewars within the premises particularly in respect to the use of lifts and stairs.
- Ensure that manual handling assessments have been carried out on all activities involving dewars.
- Ensure that labelling meets all regulatory requirements.
- Ensure that dewars are adequately maintained and that they are in good condition.
- Ensure that adequate emergency procedures are in place in the event of a liquid spillage.
- Ensure that a sufficient number of personnel are trained in the treatment of asphyxia and cold burns.
- Carry out actions resulting from risk assessments.

All personnel involved in the filling, handling, use or transportation of liquid nitrogen dewars shall:

- Be aware of, and trained in, the hazards of liquid nitrogen

- Wear appropriate hand, eye, feet and body protection when handling full or empty dewars
- Not fill, use or transport any dewar with a damaged neck, wall trunnion support, base support or wheels
- Ensure that dewars are correctly and clearly labelled for nitrogen service before filling
- Only use dewars which are correctly and clearly labelled
- Only transport dewars which are correctly labelled for transport
- Be adequately trained in the handling of liquid nitrogen dewars
- Know what actions to take in the event of a liquid spillage
- Know what actions to take if an incident results in a cold burn or asphyxia casualty

### **13. Advice and Guidance**

If you require any further advice and guidance please contact a member of the Health and Safety department.

### **14. Monitoring and Guidance**

The effectiveness of this guidance will be monitored through the Trust Health and Safety inspection programme, and the Trust Health and Safety committee.

**Policy compiled by the Health and Safety Department**

**THE NEWCASTLE UPON TYNE HOSPITALS NHS FOUNDATION TRUST**  
**IMPACT ASSESSMENT – SCREENING FORM A**

This form must be completed and attached to any procedural document when submitted to the appropriate committee for consideration and approval.

Policy Title:	Safe use and storage of Liquid Nitrogen and solid carbon dioxide	Policy Author:	Health and Safety Advisor
		Yes/No?	You must provide evidence to support your response:
1.	Does the policy/guidance affect one group less or more favourably than another on the basis of:		This policy applies to all employees of the Trust and is underpinned by the trusts overriding policy on equal opportunities
	• Race	no	
	• Ethnic origins (including gypsies and travellers)	no	
	• Nationality	no	
	• Gender	no	
	• Culture	no	
	• Religion or belief	no	
	• Sexual orientation including lesbian, gay and bisexual people	no	
	• Age	no	
	• Disability – learning difficulties, physical disability, sensory impairment and mental health problems.	no	
2.	Is there any evidence that some groups are affected differently?	no	
3.	If you have identified potential discrimination, are any exceptions valid, legal and/or justifiable?	no	
4(a).	Is the impact of the policy/guidance likely to be negative? <i>(If “yes”, please answer sections 4(b) to 4(d)).</i>	no	
4(b).	If so can the impact be avoided?		
4(c).	What alternatives are there to achieving the policy/guidance without the impact?		
4(d)	Can we reduce the impact by taking different action?		

<b>Comments:</b>	<b>Action Plan due (or Not Applicable):</b>

Name and Designation of Person responsible for completion of this form: Paul Clancy Date: 21/04/2010

Names & Designations of those involved in the impact assessment screening process: Paul Clancy, Health and Safety Advisor

(If any reader of this procedural document identifies a potential discriminatory impact that has not been identified on this form, please refer to the Policy Author identified above, together with any suggestions for the actions required to avoid/reduce this impact.)

*For advice on answering the above questions please contact Helen Lamont, Director of Nursing, or, Christine Holland, Senior HR Manager. On completion this form must be forwarded electronically to Steven Stoker, Clinical Effectiveness Manager, (Ext. 24963) [steven.stoker@nuth.nhs.uk](mailto:steven.stoker@nuth.nhs.uk) together with the procedural document. If you have identified a potential discriminatory impact of this procedural document, please ensure that you arrange for a full consultation, with relevant stakeholders, to complete a Full Impact Assessment (Form B) and to develop an Action Plan to avoid/reduce this impact; both Form B and the Action Plan should also be sent electronically to Steven Stoker within six weeks of the completion of this form.*