

## Nitrogen Hazards in Cryosaunas

### Introduction

EIGA has received reports that there could be unacceptable asphyxiation risks to occupants of **cryosaunas** used in **cryotherapy** where they are cooled by the direct injection of liquid nitrogen and if appropriate precautions are not taken.

This Safety Information is intended to raise awareness of the risks associated with the properties of the liquid and gaseous nitrogen used in cryogenic nitrogen therapy. The Safety Information focuses on the main risks of asphyxiation; however, it also highlights other potential risks related to this application of liquid nitrogen.

Gas companies, as suppliers of liquid nitrogen should ensure, that their own organisations as well as their customers (cryotherapy providers) are aware of this Safety Information (and the EIGA documents referenced at the end of this publication on asphyxiation risks and the hazards of nitrogen) in order to determine and implement appropriate safety measures.

### Cryotherapy and Cryosauna

Cryotherapy is used to define several techniques and procedures that utilise low temperatures for the removal of heat from a body part to decrease pain and promote circulation. It is being promoted as a medical/fitness/wellness application. Certain suppliers and retailers in the fitness industry and some hospitals offer cryotherapy.

Cryosauna is a device used to deliver full body cryotherapy treatment. It is usually composed of a cryocabin and auxiliary equipment necessary for the optimal and safe operation.

Cryo-cabin is a part of the cryosauna where the session of cryotherapy is conducted with the low temperature (cryogenic) nitrogen gas in an open, one-person unit at temperatures from -100°C to -150°C.

NOTE: Open cryo-cabins should not be confused with enclosed cryo-chambers where the cooling effect is achieved by other means and nitrogen does not come into direct contact with the occupants. This safety information does not apply to cryo-chambers.

### Risks associated with open cryo-cabins cooled by the direct injection of liquid nitrogen

If properly designed and installed, cryo-cabins can be operated safely. However, there are a number of hazards related to cryogenic nitrogen that must be considered. The main hazards are:

- hazard of oxygen depletion and potential asphyxiation;
- hazard of cold burns (frostbites);
- hazard of falling due to low visibility conditions created by fog.

### Hazard of oxygen depletion

The hazard of oxygen depletion can result in a danger to the occupant and to the cryosauna operator.

Open cryo-cabins are cooled by injecting liquid nitrogen via a cold gas generator or directly into the open cryo-cabin. Inside the cabin, the oxygen concentration then decreases drastically. The low oxygen concentrations could endanger the life of the occupant due to the risk of asphyxiation. If not properly extracted from the cabin and from the room with the cryosauna, the cold gaseous nitrogen can result in a depletion of the oxygen concentration in and around the cryo-cabin.

The cold gaseous nitrogen and vapour is heavier than air and will accumulate from the bottom of the cabin upwards. Nitrogen has no odour, therefore if an occupant slips, submerges or faints while in the cabin the risk will be not recognized by the occupant or anybody who goes to his aid. The occupant can feel well in this oxygen depleted atmosphere, but can quickly lose consciousness and could die.

Within 15 cm of the occupant's face, the device produces depleted oxygen levels. There is no barrier to prevent the occupant dipping down further into the low oxygen atmosphere.

If there is no monitoring of the oxygen levels anywhere in the device and should something go wrong there will be no warnings that oxygen levels have dropped near the occupants' face.

The systems normally operate with an extract fan to ensure that the occupant is breathing normal air. Should the fan fail, then the extract will stop and the nitrogen gas could possibly engulf the occupant's head.

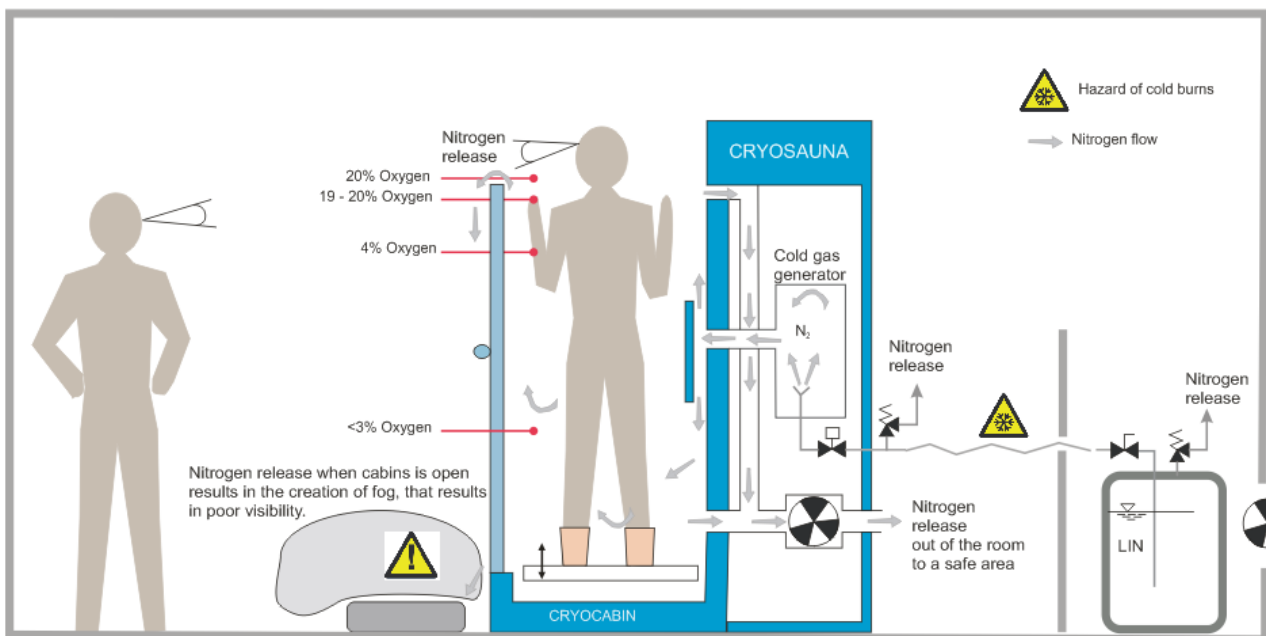


Figure: 1: Example of Oxygen concentrations measured in an open cryo-cabin and potential hazards (drawing is symbolic)

For these reasons, it is necessary that there is close and uninterrupted visual observation of the occupant by personnel who are properly trained to safely operate the equipment and to respond correctly to any emergencies that may occur.

The likely locations for these units are within enclosed buildings. The location of the unit within the confines of a building may well cause reduced oxygen levels in the surrounding area if the area is not designed with proper ventilation. Nitrogen may enter the area if the cryosauna is not equipped with an extract fan, by each opening of the cryo-cabin door and through incorrect location, operation and maintenance of safety valves.

## Effects of oxygen depleted atmospheres

The normal concentration of oxygen in the air we breathe is approximately 21%. Any depletion of oxygen below 21% must be treated as hazardous and relevant precautions taken.

It is not unusual for the person suffering from asphyxia to be totally unaware of the symptoms and they may even feel euphoric. It can take as little as two breaths in an oxygen deficient atmosphere to cause unconsciousness –

death can occur within minutes.

Asphyxia – Effects and Symptoms of Reduced O<sub>2</sub> Concentration (Vol %)\*

18-21%	No discernible symptoms can be detected by the individual.
11-18%	Reduction of physical and intellectual performance without the sufferer being aware.
8-11%	Possibility of fainting within a few minutes without prior warning. Risk of death below 11%.
6-8%	Fainting occurs after a short time. Resuscitation possible if carried out immediately.
0-6%	Fainting almost immediate. - Brain damage, even if rescued.

\* Reference EIGA Safety Newsletter NL 77/03 Campaign Against Asphyxiation

## Hazard of cold burns (frostbites)

Hazard of cold burns can occur to the occupant if they come into direct contact with the cold nitrogen. The cryosauna operator can come into contact with cold parts of the equipment e.g. flexible hose.

## Precautionary measures

Cryosaunas can be supplied with liquid nitrogen in cryogenic vessels manufactured by various companies, with different designs of construction. The instructions and piping and instrumentation diagram for the vessel shall be posted on the vessel. The nitrogen supplier should provide training to the customer (cryosauna operator) on how to use the nitrogen vessel. Emergency procedures shall be defined.

The cryotherapy provider shall check the cryogenic installation to detect any potential leakage each time the manual outlet valve for liquid nitrogen on the vessel is opened.

Oxygen concentration detection shall be in place for both the cryocabin and the room where the equipment is installed.

## Further Information

EIGA Safety Leaflet SL 01, *Dangers of Asphyxiation*. [www.eiga.eu](http://www.eiga.eu)

EIGA Doc. 44, *Hazards of inert gases and oxygen depletion*. [www.eiga.eu](http://www.eiga.eu)

EIGA Safety Newsletter NL 77/03, *Campaign Against Asphyxiation*. [www.eiga.eu](http://www.eiga.eu)

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