Safety and Cryogenic Liquids

Helium, Nitrogen, Oxygen

Safe handling of cryogenic liquids requires a knowledge of their properties and common-sense procedures based on that knowledge.

Three things to think about:

a) Temperature

b) Pressure

c) Vapour

Handling

Handle liquids slowly

Effect on skin similar to a burn

Spread and cool wide areas

Vapour produces burns

Cornea of the eye is *extremely* delicate

Do not allow any unprotected part of your body to come into contact with uninsulated pipes or cold objects particularly metal.

Many materials that are soft and pliable at room temperature become hard and brittle and can shatter when cold, including mains cables.

Clothing

Always wear eye protection

Use loose fitting dry leather gloves when at risk of touching anything cold

Overalls should not have pockets, trousers should be worn outside shoes and boots

Skilled personnel who are aware of the hazards and experienced in the procedure being carried out may exercise some discretion in the application of the clothing recommendations.

In exercising such judgement you must bear in mind that other people learn by example and a procedure that is safe in expert hands can be a hazard to the inexperienced.

Ventilation

Always handle cryogens in a well ventilated area

The white clouds are water vapour

Rule of thumb: 1 litre liquid cryogen $\mapsto$ 1m^3 gas

1 Sudden and accute asphyxiation

e.g. Inhale pure nitrogen. Immediate unconciousness, victim falls as if struck by a blow on the head and may die within a few minutes.

2 Gradual asphyxiation

When the oxygen content of the air is slowly reduced the victim has almost no warning.

Oxygen reduced from 21vol% to 14vol%
First perceptible signs of anoxemia. Increased breathing volume and accelerated pulse. Ability to maintain attention and think clearly is diminished. muscular coordination somewhat disturbed.
Oxygen reduced to range 14vol%—10vol%
Conciousness continues, but judgement becomes faulty. Severe injuries are painless. Muscular efforts lead to rapid fatigue. Emotions, particularly ill temper are easily aroused.

Oxygen reduced to range 10vol%—6vol%
Nausea and vomiting may appear. Loss of ability to perform any vigorous muscular movements, or even move at all. To this stage, or even in it, he may be wholly unaware that anything is wrong. Then his legs give way leaving him unable to stand, walk or even crawl. This is often the first and only warning, and it is too late. He may realise he is dying, but he does not greatly care, it is all quite painless. Even if resuscitation is possible, permanent brain damage may result.

Oxygen reduced below 6vol%
Respiration consists of gasps, separated by periods of increased duration. Convulsive movements may occur. Breathing then stops but the heart may continue to beat for a few minutes.

Equipment and storage

Use only containers specifically designed to store cryogens and correctly labelled

Beware thermal shock

Do not block vents; Use the correct stopper

Do not improvise

Oxygen will condense into nitrogen, argon, etc

Liquid oxygen is *very* dangerous

Use the correct equipment when transferring

Nitrogen from a self pressurising storage tank is warm

Dewars have long necks

Trenches and tanks