



Information for employees and students working at the Faculty of Science (W&N)

This AMD information sheet describes the precautions involved when working with Cryogenics

1 Introduction

Cryogenics are liquid or gaseous with temperatures down to $-273\text{ }^{\circ}\text{C}$. A literal translation of the term cryogen is “making/-creating cold”. These substances boil at this temperature, which causes continuous evaporation. Well-known cryogenics are liquid nitrogen and liquid helium. In the Faculty of Science these are frequently used to perform experiments at low temperatures (e.g. for superconduction), or to “freeze” molecules for measurements. Dry ice (carbon dioxide in solid form) is a cryogen as well, and has a temperature of $-78\text{ }^{\circ}\text{C}$.

2 Risks

Coming into contact with the cryogen or with materials cooled by it, may cause harm: freezing, which resembles burns. In addition, cryogenics may lead to suffocation in small or insufficiently ventilated rooms, by displacing the oxygen that is present, by evaporating. The risks are discussed below.



2.1 Burns/harm

Cryogenic liquids are usually used as a coolant. Cryogenic liquids have temperatures below $-130\text{ }^{\circ}\text{C}$. Dry ice has a temperature of $-78\text{ }^{\circ}\text{C}$. Contact with the skin may lead to severe burns.

Contact with the eyes may result in severe damage.

2.2 Suffocation

Cryogenics may displace the oxygen in the air by evaporating. This way, quick evaporation (for example when a reservoir tumbles) may lead to suffocation. (To give an example: 1 litre liquid nitrogen produces about 700 litre gaseous nitrogen after evaporating.)



2.3 Boiling

Under atmospheric pressure, cryogenic liquids are usually in a state of boiling at their surface; There is a continuous formation of vapour bubbles rising to the surface of the liquid. When the liquid is poured over into reservoirs, the liquid will boil until the reservoir is cooled down. At that moment the boiling will decrease in intensity. When a warm object is placed in the liquid, the liquid will start to boil violently until the object is cooled down to the temperature of the cryogenic liquid. Exposed skin may be exposed to extreme cold drops of liquid. Therefore, it is important to wear protective clothing.



2.4 Pressure build-up

When storing cryogenics in a closed reservoir, one should take into account that, under the influence of heat supplied by the environment, the pressure will build up. Liquids evaporate. The transport/storage reservoirs should have a safeguard against pressure build-up. During transport, the valve of the transport reservoir should be open at all times.

2.5 Embrittlement

Please make sure that the materials that come into contact with cryogenics, are cryogenic resistant. This means that they should not become brittle due to the low temperatures. It is important that the materials used are suited for this application.

2.6 Shrinking

Every material shrinks upon lowering its temperature. However, the amount of shrinkage varies per material, which may lead to leakage.

2.7 Fire and explosion hazards

If the temperature of the cryogenic gas is lower than the boiling point of oxygen (-183°C), the oxygen from the surrounding air condenses. The formation of liquid oxygen may lead locally to heightened oxygen concentrations which in turn create a fire hazard. Liquid oxygen is very dangerous, because it is capable of violent and often explosive reactions with many materials.

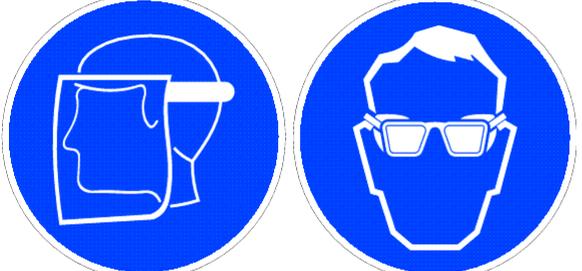
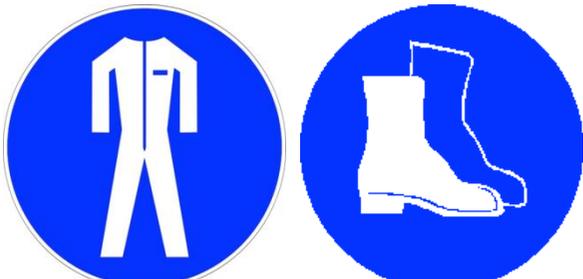
2.8 Spattering dry ice

During the processing of dry ice, dry ice may fly about. Therefore, please work slowly and carefully.

3 Safety precautions

3.1 Personal protection equipment

The substances named are extremely cold. Helium is the coldest of all substances. Coming into contact with cold substances or materials cooled by them, causes severe freezing damage (burns). This is why, when working with cryogenic substances, the following prescribed personal protection equipment must be worn:

Full-face shield or safety glasses with side shields against spattering	
Cryogenic gloves that are sufficiently loose-fitting to enable quick removal in case splashes of liquid accidentally enter them.	
Wear suitable protective clothing (long sleeves and long trousers). Wear closed shoes.	

3.2 Ventilation

Please make sure the room is sufficiently ventilated. Humans function normally at oxygen levels in the air of 21%. As a result of heat supplied by the environment, the cryogen will start to evaporate and ultimately, at large quantities, it will displace the oxygen in the air. At oxygen levels below 16% humans start to become ill. At 6% death will occur within seconds.

3.3 Storage/transport

Cryogens may only be stored in dedicated suitable reservoirs. Air-tight storage is never an option because of the possibility of gas formation when heat is supplied. Liquid cryogens (such as nitrogen) may be stored and transported only in specially designed transport reservoirs. When transporting reservoirs in a lift, no people are allowed in the lift. This also means that one has to prevent anyone else entering the lift during this transport. Dry ice must be stored in dedicated suitable boxes and be kept close to ground level.

4 First aid

In case of incidents with cryogens involving humans, the following rules apply:

- Leave the room in which the incident/accident happened.
- Flush body parts that have been affected as soon as possible with water at a temperature not exceeding 25°C. At least 10 minutes.
- **NEVER** pull away clothing that is frozen to the body.
- Avoid touching the frozen body part as much as possible and do not rub.
- Sound the alarm. (Please refer to AMD introduction sheet A040 *Calamities and accidents*).

5 Handling cryogens at the workplace

5.1 General guidelines are:

- Before you start working with a cryogen, please first consult the MSDS of the substance (hazardous substance). Please refer to material safety data sheets for cryogenic gasses. [MSDS](#)
- Please consult the Cryogenics department on how to handle helium and nitrogen.
- Check the MSDS (section 1.2) for the relevant identified use of the substance as well as the uses that are advised against. If the intended use is unknown, the risk assessment is considered to be incomplete, and use of this substance for this purpose is not allowed without further steps. In this case, please contact the AMD.
- Wear the prescribed personal protection equipment.



- Wear long trousers and closed shoes.
- Store dry ice close to ground level.