

Safe handling of liquid nitrogen

Liquid nitrogen (LN2) is a clear, thin liquid, which is extremely cold (-196 °C) and thus belongs to the cryogenic liquids. Liquid nitrogen has no odour. The liquid is inactive (has no chemical reaction) and cannot burn.

The most common hazards when using liquid nitrogen are:

- **Freeze injuries, especially eye damage**
- **Suffocation**
- **Explosion**

Freeze injuries, especially eye injury

Serious freeze injuries may occur if liquid nitrogen get into contact with skin. With serious damage to follow, bare skin can freeze onto surfaces that have cooled with LN2. Long-term cooling of skin may cause frostbite, and inhalation of cold gas may cause injury to the lungs.

The eyes are particularly sensitive – even small splashes or sprays of liquid nitrogen can lead to an immediate freezing of tissue with permanent injury to follow.

- **Avoid skin getting into contact with LN2 or cooled surfaces**
- **Use safety goggles**
- **Because of low viscosity be aware that LN2 easily runs through material**
- **If the damage is done, rinse with plenty of *lukewarm* water and seek doctor, if necessary**

Suffocation

Even though liquid nitrogen is not poisonous, the presence of liquid nitrogen may lead to a risk of suffocation. When the liquid is converted into gas, the volume increases dramatically, e.g. 1 litre of liquid turns into 700 litres of gas that reduces the oxygen content of air. The oxygen content of air is normally 20.9%. Do not stay in a room with an oxygen content of less than 19.5%. If the oxygen content decreases further, it can lead to dizziness, nausea, vomiting, fainting and death. Please note that you do not experience any kind of warning, e.g. in the form of suffocation sensations.

It does not take much of LN2 to reduce the oxygen content of the air. If the content of a 10-litre Dewar (thermo container) evaporates in a room of $4\text{m} \times 3.6\text{m} \times 2.5\text{m} = 36\text{ m}^3$, the oxygen concentration decreases to 16.9%!

- **Avoid spilling of LN2**
- **Please note that the cold gas is concentrated at the floor of the room, the oxygen concentration is thus lower at the floor than at the ceiling.**
- **Only use LN2 in ventilated rooms**
- **Use a monitor to monitor the oxygen content of the air in small rooms where work with LN2 is done**
- **Avoid transporting LN2 together with people in lifts**
- **Avoid transporting of LN2 in closed cars**

Explosion

Because liquid nitrogen is expanding dramatically through evaporation, improper storage can lead to heavy explosions. Large containers for cryogenic gases are therefore equipped with relief valves that regulate the pressure in the container. Smaller containers are normally equipped with *loose* lids.

Ingestion of LN2, deliberately or accidentally, results with great probability in the stomach exploding.

The low viscosity of liquid nitrogen means that it easily runs through small holes and crevices. If, for example, LN2 is poured into an ordinary thermo jug, the great risk is that the nitrogen seeps between the glass container and the rubber seal. When the liquid is then converted into gas, the pressure increases, and the jug may explode.

If LN2 is stored in open containers, the fumes will condense the air moisture, and the nitrogen will then generate a content of ice crystals. More seriously, the oxygen of the air will densify on surfaces that have the temperature of the LN2, so that it is inadvertently possible to form a reservoir of liquid oxygen. With certain organic materials, the oxygen can react violently resulting in a fire/explosion.

- **Do not ever drink LN2!**
- **Only store LN2 in containers that have been approved for the purpose**
- **Avoid valves and evaporation pipes icing up and thus get blocked**
- **Never screw a cap on a container holding LN2**
- **Be aware of the risk of build-up of liquid oxygen**