Liquid Nitrogen Safety Meeting Kit

WHAT'S AT STAKE

Nitrogen gas is inert, meaning it does not form chemical compounds with other molecules. It is odorless, colorless, and tasteless. This makes it safe to add nitrogen to food or for industrial processes. In addition, Nitrogen, in its liquid form, is easy to transport in tanks or cylinders.

USES OF LIQUID NITROGEN

The most useful property is that liquid nitrogen is cold. Liquid nitrogen has a boiling point of -320°F (-196°C). At any temperature above this is becomes a gas. By piping LN (liquid nitrogen) around or into other gases or objects, it can be used to cool them. This makes it useful as both a coolant or for freezing materials.

- Doctors use it for cryosurgery to remove skin lesions or moles. It is used for the storage and transportation of blood, body parts, and foods.
- Bottlers use it to remove oxygen from the headspace of bottles before capping.
- Scientists use it for cooling in experiments or to cool CCD cameras for astronomy.
- It is used in industry to temporarily shrink metal parts for precision fitting.
- It is used to freeze scrap rubber and plastic so it can be efficiently ground for recycling.

WHAT'S THE DANGER

PRIMARY RISK/DANGERS OF LIQUID NITROGEN

1. **Liquid Nitrogen Inhalation.** Asphyxiation is the primary

risk. A person exposed to high levels of nitrogen gas should be removed from the source of the gas and administered rescue breathing if required.

2. **Liquid Nitrogen Exposure.** Proper handling. storage, and use of LN is critical to worker safety. Liquid nitrogen can cause burns equivalent to frostbite.
3. **Extreme Cold Hazard.** Direct skin or eye contact with cryogenic fluids (liquid or cold gas) can cause severe damage, including cryogenic burns, frostbite, and eye damage. Wet skin is particularly vulnerable to freezing. Delicate tissues such as the eyes can be permanently damaged even after very brief exposures that would not affect skin on the face or hands. There is often no initial pain when tissue freezes, but there is intense pain when frozen tissue thaws. Damage can occur very quickly with only brief contact.
4. **High-Pressure Gas.** Working with or storing cryogenic fluids presents hazards from high-pressure gas. Due to the large expansion ratio (700:1) from liquid to gas, a build-up of high pressure can occur when the liquid evaporates. This can cause explosion of a sealed or insufficiently vented container.
5. **Displacement of Oxygen/Asphyxiation.** Due to the large liquid to gas expansion that takes place upon evaporation, liquid nitrogen is capable of displacing sufficient oxygen to create an oxygen deficient environment in a small or insufficiently ventilated space, leading to the risk of asphyxiation. Working in or entering an oxygen deficient atmosphere may cause unconsciousness without warning and death without regaining consciousness.
6. **Fire and Explosion Hazards.** Liquid nitrogen is not flammable. However, the boiling point of nitrogen is lower than that of oxygen, allowing oxygen to condense from the air and be concentrated. If dewars and insulated flasks containing liquid nitrogen are left uncovered and exposed to air for an extended period of time, liquid oxygen can build up to levels which may cause violent reactions with organic materials (i.e. a severe clothing fire could result).

7. **Boiling and Splashing.** Cryogenic liquids can boil and splash when first added to a warm container.

HOW TO PROTECT YOURSELF

SAFETY PRECAUTIONS WITH LIQUID NITROGEN

Wear protective clothing. Protect your eyes with a face shield or safety goggles (safety glasses without side shields do not give adequate protection). Always wear cryo gloves when handling anything that is, or may have been, in immediate contact with liquid nitrogen. The gloves should fit loosely, so that they can be thrown off quickly if liquid should splash into them. When handling liquid in open containers, it is advisable to wear high-top shoes. Trousers (which should be cuffless if possible) should be worn outside the shoes. Any kind of canvas shoes should be avoided because a liquid nitrogen spill can be taken up by the canvas resulting in a far more severe burn, in fact that would occur if the feet were essentially open or bare!

Handle liquid nitrogen carefully. The extremely low temperature can freeze human flesh very rapidly. When spilled on a surface the liquid tends to cover it completely and intimately, cooling a large area. The gas issuing from the liquid is also extremely cold. Delicate tissue, such as that of the eyes, can be damaged by an exposure to the cold gas which would be too brief to affect the skin of the hands or face. Never allow any unprotected part of your body to touch objects cooled by liquid nitrogen. Such objects may stick fast to the skin and tear the flesh when you attempt to free yourself.

Training

Training should be directly documented in the researcher’s lab notebook. On each day of training, both trainer and trainee should sign the lab notebook. Review the reagent-specific safety data sheets (SDSs). Evaluate the hazards associated with the chemical procedure and experimental setup.

LIQUID NITROGEN PRUDENT PRACTICES

- Liquid nitrogen should be handled in well-ventilated areas.
- Handle the liquid slowly to minimize boiling and splashing.
- Do not transport liquid nitrogen in wide-mouthed glass Dewars or Dewars not protected with safety tape.
- Use only approved containers. Impact resistant containers that can withstand the extremely low temperatures should be used.
- Only store liquid nitrogen in containers with loose fitting lids (Never seal liquid nitrogen in a container).
- Never touch non-insulated vessels containing cryogenic liquids. Flesh sticks to cold materials.
- Never tamper or modify safety devices such as cylinder valve or regulator of the tank.
- Liquid nitrogen should only be stored in well-ventilated areas (do not store in a confined space).
- Do not store liquid nitrogen for long periods in an uncovered container.
- Cylinders and Dewars should not be filled to more than 80% of capacity since expansion of gases during warming may cause excessive pressure buildup.

FINAL WORD

Since liquid nitrogen is so volatile, workplace safety precautions are essential for workers who handle it or are around it in a work environment. Although liquid nitrogen is non-toxic, it can cause severe burn injuries to the skin, as well as respiratory problems and internal damage to organs.