



## Guidance Document

### Cryogenic Liquids

[This is a brief and general summary. Read the full MSDS for more details before handling.]

**Introduction:** All cryogenic liquids are gases at normal temperature and pressure. The liquids are formed by cooling the gases below room temperature, followed by compression which liquefies them. Cryogenic liquids are kept in the liquid state at very low temperatures. Cryogenic liquids have boiling points below  $-73^{\circ}\text{C}$  ( $-100^{\circ}\text{F}$ ). The most common cryogenic liquids currently on campus are liquid nitrogen, liquid argon and liquid helium.

The different cryogens become liquids under different conditions of temperature and pressure. But all have two very important properties in common. First, the liquids and their vapors are extremely cold. The risk of destructive freezing of tissues is always present. In addition, when they vaporize the liquids expand to enormous volumes. For example, liquid nitrogen will expand 696 times as it vaporizes. Vaporization in a sealed container could rupture the vessel. Vaporization in an enclosed workspace could cause asphyxiation by displacing air needed to support life.

All of the cryogenic liquids on campus are inert, colorless, odorless, non-corrosive and non-flammable. Not all cryogens fit this description. Special permission would be required to use other cryogenic liquids. Liquid oxygen could produce an oxygen-rich atmosphere which could accelerate combustion of other materials. Liquid hydrogen, liquid methane or liquefied natural gas could form an extremely flammable mixture with air. Liquid carbon monoxide is extremely toxic and extremely flammable.

Cryogenic liquids are received from the vendor in special vacuum jacketed cylinders, which allows for storage of the liquefied gas for a long time. The cylinders are sometimes incorrectly referred to as "dewars," a term for the smaller containers used in the lab. The cylinders are equipped with special transfer piping to allow withdrawal of liquid or vapor. The cylinders have various pressure relief devices to guard against excessive pressure buildup. The cylinders are designed to vent the unavoidable pressure increase resulting from heat gained from the surroundings. Slight hissing or occasional relief bursts from the cylinders is a normal occurrence. Do not plug, remove or tamper with any relief device.

### **Use and Storage Guidelines**

1. Use only in well ventilated areas following the manufacturer's instructions.
2. Store cylinders in upright position only.
3. Protect valves, relief devices and piping on the top of the cylinder.
4. Do not drag, slide or roll cylinders. Use a suitable hand truck to move cylinders.
5. Use pressure reducing regulator when connecting cylinder to lower pressure piping or systems.
6. Use a check valve or trap in the discharge line to prevent hazardous backflow into the cylinder.
7. If you experience any difficulty operating a valve, do not use. Contact the supplier.
8. Do not try to repair, adjust or modify the cylinder apparatus.
9. Always wear appropriate personal protective equipment for the task at hand. Wear face shields with safety glasses or chemical splash goggles during transfers. Wear loose fitting, dry, insulated or leather gloves when handling cold objects. Wear long pants on the outside of boots or shoes.
10. Insulated gloves are for splash protection only. Do not put any part of the body in the liquid.
11. Never allow any unprotected part of the body to touch uninsulated pipes or vessels containing cryogenic liquid. The extreme cold may cause flesh to stick and tear when you try to remove it.
12. Most metals are suitable for handling cryogenic liquid. But materials such as carbon steel, plastic and rubber become brittle and may fracture at these temperatures
13. Boiling and splashing will occur when filling a warm container with cryogenic liquid or when inserting warmer objects into the liquid. Perform these tasks slowly to minimize the danger. Use tongs to place objects in or remove objects from a cryogenic liquid.

14. Liquefied inert gases, such as liquid nitrogen (b.p.  $-196^{\circ}\text{C}$ ) or liquid helium b.p.  $-269^{\circ}\text{C}$  , can condense atmospheric oxygen (b.p.  $-183^{\circ}\text{C}$ ). This could cause unexpected oxygen enriched atmospheres. Condensation on uninsulated metal surfaces can produce a similar effect. Cryogenic liquids should not be used to cool a flammable material in the presence of air. Oxygen could condense from the air, leading to an explosion hazard.
15. Because most cryogenic liquids will condense liquid air, only sealed or evacuated equipment should use cryogenic liquid cooled traps. For open systems one should use traps cooled with dry ice instead of with cryogenic liquid.