

## Liquid Nitrogen Use

### 1. Definition:

- a. A cryogenic liquid is defined as a liquefied gas that is stored or used at cryogenic temperatures. Cryogenic temperatures are defined by the NIST (National Institute of Standards and Technology) as being below 93.15 K (-180°C).

### 2. Responsibility:

- a. Managers, or Supervisors or Principal Investigators shall:
  - Ensure that only workers who are informed about hazards, controls, safe work and emergency procedures can conduct work with cryogenics.
  - Provide and maintain appropriate equipment and materials to work safely.
  - Ensure that all appropriate precautions are being followed and that required personal protective equipment (PPE) is being worn.
- b. Workers shall:
  - Work in accordance with the standard and emergency operating procedures.
  - Ensure equipment is in good condition before use, and report any defective or missing equipment.
  - Wear appropriate PPE as required.

### 3. Precaution:

- a. In University workplaces, the storage, handling and dispensing of cryogenic liquids can lead to serious workplace injuries due to hazards related to oxygen deficiency, contact with extremely cold materials, oxygen condensation, or pressure build-up. Appropriate controls must be implemented wherever cryogenics are in use.
- b. Frostbite occurs almost instantly when skin is wet, for instance from sweat. When skin is dry, it has been shown that a thin layer of gas forms next to the skin upon liquid cryogen exposure, insulating the skin from the cryogen for a very short exposure and very small quantities. However with longer exposure, frostbite is common.
- c. Cryogen splashed into the eye can cause immediate frostbite and severe eye damage.

### 4. Training:

- a. Managers, Supervisors, and Principal Investigators shall ensure that workers receive training in the following:
  - Specific instructions on how to use equipment safely.
  - Functioning of “fail safe” devices, and how to ensure they are working properly.
  - Safe handling of the cryogen as a liquid and as a gas.
  - Materials that are and are not compatible with cryogenics.
  - Use and care of personal protective equipment (PPE).
  - Good housekeeping practices.

- b. Before using the liquid nitrogen, new users must be trained by a Linde service technician or by a previously trained and experienced user in TBEP. Contact [admin.tbep@utoronto.ca](mailto:admin.tbep@utoronto.ca) to arrange a training session.

#### **5. Personal Protective Equipment:**

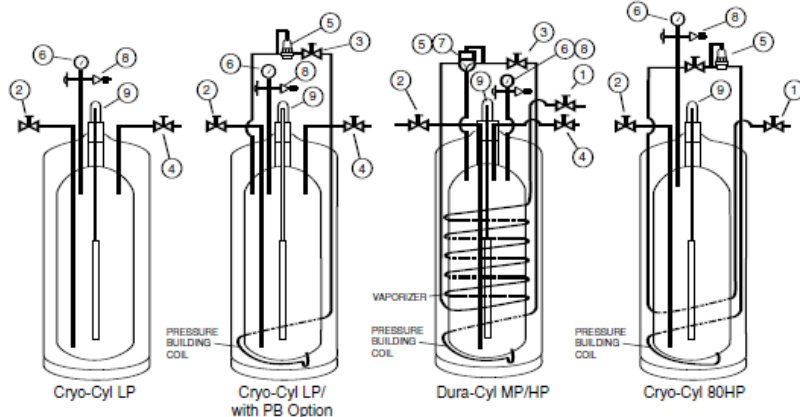
- a. Loose fitting cryogen rated gloves should be used when handling materials that have come in contact with cryogenes. They are also appropriate for other cryogen handling tasks.
- b. When pouring cryogenes or using an open vessel that may boil and splash, goggles plus a full face shield must be worn as per Canadian Standards Association (CSA) Standard Z94.3-02 and the U of T Protective Eye and Facewear Standard. The face shield protects the face and neck, while the goggles ensure that no splashes can enter the eyes.  
[<https://ehs.utoronto.ca/wp-content/uploads/2015/10/Eye-Protection-Standard.pdf>]
- c. Closed toe shoes, a non-porous lab coat, and long pants must be worn. Cuffs of any type should be avoided, as they can trap cryogenes close to the body.
- d. The bottoms of the pants should cover past the tops of the shoes to ensure that no cryogen can be inadvertently poured into the shoe.
- e. No watches, rings or other jewelry should be worn, as a splash can freeze these objects to the skin.

#### **6. Liquid Nitrogen Dewar Use:**

- a. The reading on the pressure gauge must be between 20-22 psi before collecting liquid N<sub>2</sub>. In the event that the pressure has dropped below 20 psi, gently open the Pressure Control valve to allow the pressure to increase. Close the Pressure Control valve once adequate pressure has been reached.
- b. To collect liquid nitrogen, open the Fill/Liquid valve labeled "Liquid". Turn the Fill/Liquid valve complete off once you have finished collecting liquid nitrogen.
- c. The outlet labeled "Vent" is the Vent Valve prevents pressure buildup within the tank during storage and use. Do not be alarmed if you see or hear gas being released from this valve.
- d. The Gas Use valve should remain closed at all times.

NOTE: the diagram below shows the relative positioning of all valves on the liquid nitrogen dewar.

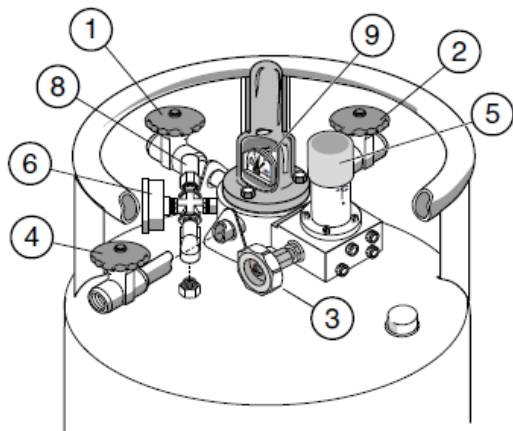
### Dura-Cyl/Cryo-Cyl Series



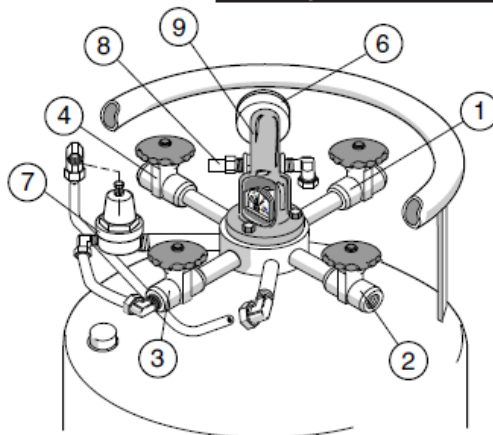
### Item Plumbing Controls and Function

1. **Gas Use Valve** – Used for gas withdrawal.
2. **Fill / Liquid Valve** – Used for filling or liquid withdrawal operations.
3. **Pressure Control Valve** – Used to isolate (on/off) the pressure control regulator.
4. **Vent Valve** – Used to vent pressure.
5. **Pressure Control Manifold** – Used to automatically maintain pressure.
6. **Pressure Gauge** – Indicates cylinder pressure.
7. **Combination Regulator MCR** – Used to automatically maintain pressure.
8. **Pressure Relief Valve** – Used to limit pressure in the liquid cylinders.
9. **Liquid Level Gauge** – Used to approximate the liquid contents of the liquid cylinder.

### Dura-Cyl MP/HP Series



### Dura-Cyl MCR MP/HP Series



## 7. Vessels for Use With Cryogenics

- a. All vessels used for cryogenics must have a pressure release system to ensure that pressure cannot build up resulting in an explosion. For example Dewar flasks should have a cover that allows for boiled off gases to escape. Vessels should meet ISO 21009-1 or equivalent.
- b. Any vessel used for containing cryogenic materials must be specifically designed for use with cryogenics. For example a “thermos” flask for food storage would not be appropriate.

## 8. In the Event of an Emergency/Spill

- a. In the case of emergency: Linde On-Alert Emergency Response 24/7 can be reached at 905.501.0802
- b. In the event of a spill: cryogenics penetrate clothing much more quickly than water, so remove any contaminated clothing immediately.
- c. For both emergencies and spills (especially large spills): leave the area immediately, and call both 911 and MaRS Tenant Services at 416.673.8200

**9. References:**

- a. <http://ehs.utoronto.ca/wp-content/uploads/2015/10/Standard-for-Inert-Cryogenic-Liquid-Usage-in-the-Laboratory-Updated.pdf>
- b. <https://ehs.utoronto.ca/wp-content/uploads/2015/10/Eye-Protection-Standard.pdf>