

Liquid CO₂ and Snow Horn Operation

1. Definition:

- a. The snow horn is a device for making dry-ice snow using liquid carbon dioxide.

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 use the snow horn.
 - 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 the snow horn is in good condition before use - report any defects or missing equipment.
 - Wear appropriate PPE as required.

3. Precautions:

- 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. Whenever cryogenics are in use, appropriate controls must be implemented and proper PPE worn.
- b. On liquid cryogen exposure:
 - When skin is wet, for instance from sweat, frostbite occurs almost instantly.
 - 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.
 - When skin is dry, longer exposure can lead to frostbite.
 - 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 the snowhorn equipment safely.
 - How to ensure proper functioning of “fail safe” devices,
 - Safe handling of the cryogen both as a liquid and as a gas.
 - Materials that are and are not compatible with cryogenics.
 - Use and care of personal protective equipment (PPE).
- b. Before using the snow horn, 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 to arrange a training session.

5. Personal Protective Equipment:

- a. Loose fitting cryogen rated gloves - when handling materials that have come in contact with cryogenics and for other cryogen handling tasks.
- b. Face shield and ear plugs
- c. Goggles plus a full face shield must be worn when pouring cryogenics or using an open vessel that may boil and splash. As per Canadian Standards Association (CSA) Standard Z94.3-02 and the U of T Protective Eye and Face wear Standard. The face shield protects the face and neck, while the goggles ensure that no splashes can enter the eyes.
[\[https://ehs.utoronto.ca/wp-content/uploads/2015/10/Eye-Protection-Standard.pdf\]](https://ehs.utoronto.ca/wp-content/uploads/2015/10/Eye-Protection-Standard.pdf)
- d. 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 cryogenics close to the body.
- e. 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.
- f. No watches, rings or other jewelry should be worn, as a splash can freeze these objects to the skin.

6. Procedure: Liquid CO₂ Dewar Use:

- a. The reading on the pressure gauge must be 320 psig as a minimum before collecting liquid CO₂.



- b. In the event that the pressure has dropped below 320 psig, gently open the Pressure Control valve to allow the pressure to increase. Close the Pressure Control valve once adequate pressure has been reached.



- c. Ideally, two people are required to operate the snow horn: One for operating it and one for verifying the pressure at the dewar.
- d. Verify that the ball valve at the snow horn is closed. The black handle should be perpendicular to the direction of the flow.



- e. Fully open the liquid valve at the Dewar.



- f. Carefully unhook the snow horn. Hold it and direct it to the snow container. The hose should have no loops, keep it straight.
- g. Fully open the snow horn valve in a quick fashion. If the valve is throttled by opening it slowly, the formation of a dry ice plug is very likely, so throttling the valve should be avoided.
 - During the first few seconds of operation, only gas comes out from the snow horn, but it should take no more than about 5 seconds for the snow to appear. Otherwise, close the snow horn valve and verify the pressure and the content level of the dewar. The pressure might not be high enough or the dewar is empty.
 - If the snow horn valve was throttled, a dry ice plug could potentially be formed, blocking the hose or the horn. If this is suspected, close the snow horn valve and the liquid valve at the Dewar. Wait for the snow horn to warm up, so the dry ice plug will melt. Depending on the ambient temperature this could take between 15 to 30 min. Go back to the previous step.
- h. Keep the snow horn valve fully open until enough snow has been generated for your needs. The pressure at the dewar will decrease as snow is generated. Do not let the pressure at the dewar decrease to less than 250 psig.
- i. Once done with the snow generation, close the valve at the snow horn.
- j. Close the liquid valve at the dewar.
- k. Open the snow horn valve, so the hose is drained. A small amount of snow will come off the snow horn.
- l. Hang the snow horn back on the metal hook at the cylinder.
- m. Close the pressure builder valve at the dewar if you know there are no plans for generating more snow for the day.

Linde Canada has a 24 hour emergency response number 905.501.0802

- Uninterrupted phone assistance in the unlikely event that a Linde gas product be involved in an incident or emergency. We can provide immediate technical assistance to callers and have the ability to connect a caller with Linde trained emergency response personnel or action a Linde emergency response if required.
- This number is intended to be used for emergency purposes only. It is not intended for technical assistance regarding Linde gas products nor for product ordering.
- If you have an emergency involving non-Linde products or any other types of dangerous goods you can contact Canutec at 613.996.6666

7. 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

8. 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>