Filling non-pressurized open dewars in the Faculty of Sciences

General instructions and operating procedure – Oct 2022 version

Gases that can be liquefied at room temperature through an increase in air pressure are classified as cryogenic fluids.

All cryogenic fluids are hazardous, and carry the following risks in particular :

- Various mechanical risks that come with the handling of compressed gases (especially the risk of explosion of the container) ;
- The risk of an object becoming a projectile when a pressurized container is opened ;
- The risk of asphyxiation when the concentration of oxygen in the air falls below 19% ;
- The risks of cold-burns and frostbite when a very cold liquid is touched by someone, or splashed on them.

It is therefore a strict requirement for you to know what the operating procedures and safety rules are before you can be authorised to work with cryogenic fluids.

1. Accessing the dewar filling station – Service Hélium ("Helium Service"), 2nd basement level of the Sciences 2 building

Access to the filling area is only allowed when there is no active fire alarm (during which the elevator/lift on the ground floor is immobilised, with its doors open), no active evacuation alarm (which is a recorded voice message played on the public address system), and no gas alarm (please refer to section 5 of this document for information about this type of alarm).

Access to the filling station is limited to the following operating hours : Monday to Friday from 7.30 am to 12 noon.

Outside of the building's opening hours (in other words: in the evening, on weekends, and on public holidays), anyone wishing to fill a dewar must make arrangements to be accompanied by a colleague, or must inform the security guard (by calling 9 60 21 from a fixed telephone in the building).

2. Training

Decanting or transporting cryogenic liquids must only be done by staff who have been assigned these duties by their group leader (or the leader's representative), and who have been properly trained for these tasks.

Group leaders, or their representatives (for example the technician in charge of the laboratory), must ensure that the individuals they have assigned to these tasks have received proper training (in particular on how to use all of the equipment). If required, the Service Hélium and STEPS can be called upon to provide assistance with this training.

3. General safety rules

Before any use of the station :

- Carefully read the dewar's user instructions (manual) as well as the instructions displayed on the walls around the liquid nitrogen filling station.
- Seek help from the staff of the Service Hélium to receive rapid training on how to use the station.

If you are uncertain of anything : seek help from the staff of the Service Hélium.

During each filling procedure you must wear :

- Full coverage safety goggles (that include protection from exposure via the sides of the face) or a face shield ;
- Cryogenic gloves (when handling equipment);
- Suitable clothing and protection : lab coat with long sleeves, trousers / long pants, and closed shoes.

Please note : personal protective equipment is not provided by the Service Hélium.

4. Safety advice for specific risks

The risk	How to avoid the risk
➢ <u>The safety systems do not work</u>	- Get to know (through the dewar user manual) the safety systems of the dewar and the filling station (e.g. pressure gauge, safety cable restraint, etc.) – know their location and how they work ; - Report anything unusual about the safety equipment to your superior or to the staff of the Service Hélium.
➢ <u>A projectile object, when opening a dewar</u> Injury to the face 	- Before opening : ✓ Check that the dewar is not pressurized (e.g. look at the pressure gauge) ;  ✓ Expose the dewar to the ambient air by opening the vent valve, then check that the pressure gauge shows that the dewar is not pressurized ; - Never stand in front of an opening or a moving part of the dewar.

The risk	How to avoid the risk
➢ <u>Liquid nitrogen splash</u> Cold burns 	You must wear personal protective equipment (PPI) : - Cryogenic gloves ;  - Clothing covering all parts of your body / lab coat ;  - Facial protection / safety goggles ;  - Closed shoes
➢ <u>Asphyxiation through lack of oxygen</u> 	- Position the local extraction arm as close as possible to the dewar ;  - Follow the relevant instructions if the oxygen alarm is triggered ; - Never remain in the car (cab) of a goods lift (freight elevator) or passenger lift (passenger elevator) after placing a dewar in it for transportation. Stand outside and leave the dewar to be transported unaccompanied. 

➢ <u>Explosion</u> Increased internal pressure due to nitrogen evaporation. 	- Never use an airtight cap ; - Never use a household thermos bottle ; - Never allow ice to form through condensation – this ice can act as an airtight seal at the dewar's opening. Use a plug with vent holes (these allow the nitrogen vapours to vent out of the dewar). 
➢ <u>Fire</u> Oxygen enriched atmosphere resulting from the liquefaction of air by the cryogenic fluid. 	- Keep the dewar away from any flame ; - It may be necessary to leave the dewar open at room temperature in order to vent out oxygen and moisture from inside the dewar ; - If an unused dewar will be stored for a prolonged period of time, follow the dewar supplier's instructions (low-pressure storage may, for example, be recommended); - Air can condense on non-insulated parts (e.g. piping), and the condensate that drips from these parts is enriched with oxygen. Be careful with flooring : if the condensate drips onto the flooring, oxygen can penetrate it and this can lead to a high risk of fire (especially if there is contact with organic material).

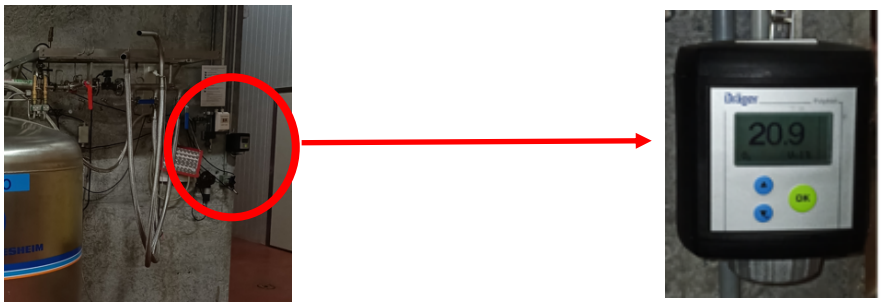
5. Responding to gas alarms – Oxygen depletion alarm

If there is an accidental release of liquid nitrogen, oxygen levels can fall below 19% in the ambient air at the filling area.

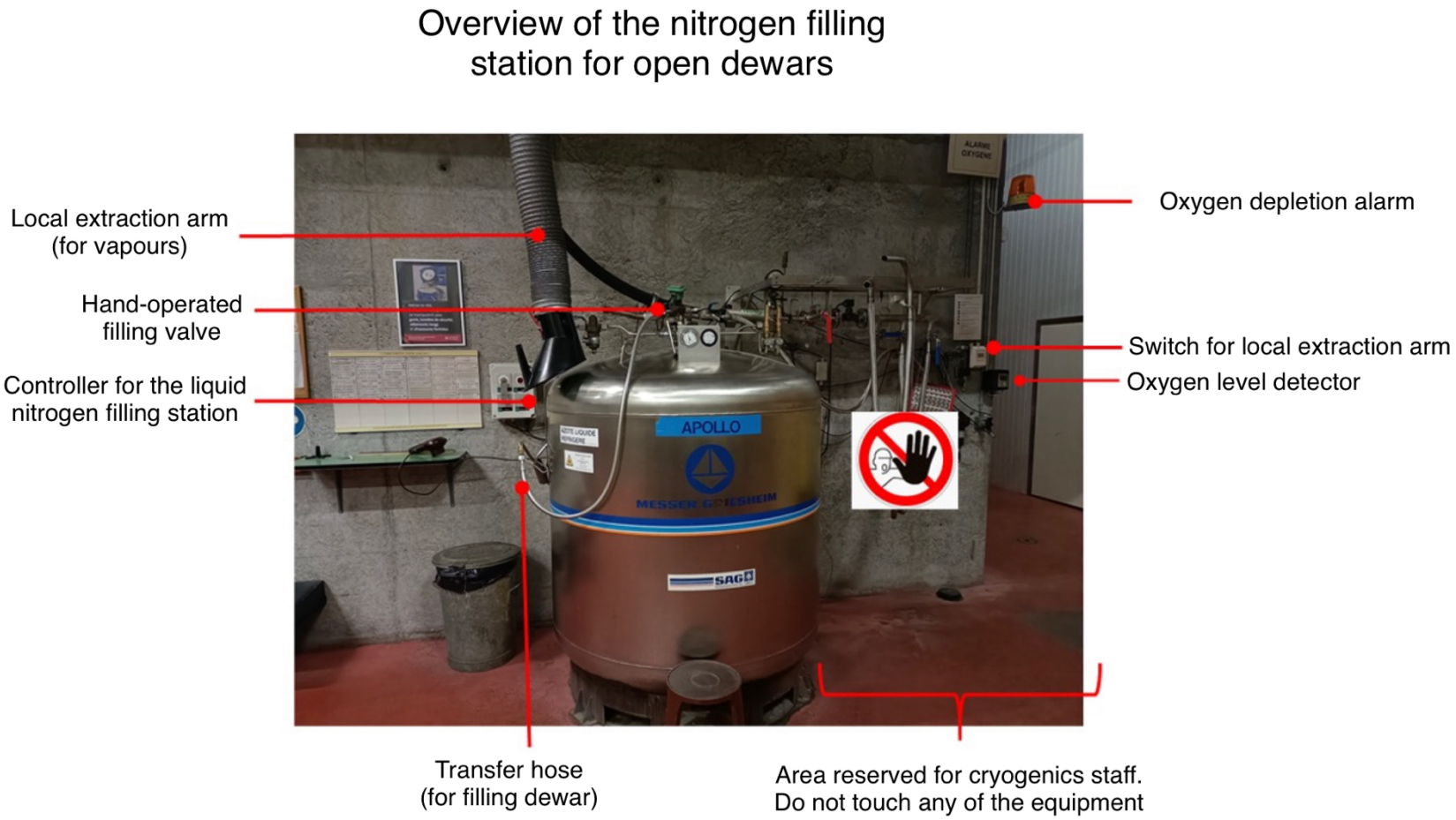
This would be an emergency and would trigger an oxygen depletion alarm in two stages :

Level 1 alarm Visual (light) alarm -> 19% 0_2
Level 2 alarm Visual (light) alarm + sound alarm -> 17% 0_2

What to do if the alarm is active :

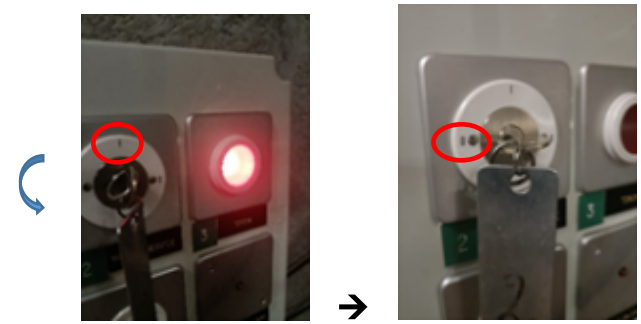
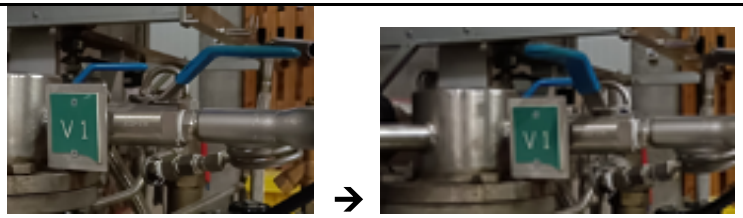
Situation 1	If the user is on the basement level and the alarm involves Visual (light) alarm only ➔ Check the % O_2 level on the sensor  - If > 20 % 0_2 → there is no risk ; - If < 19 % 0_2 ➔ Close the liquid nitrogen fill valve on the filling station (this is the valve labeled V1) ; ➔ Move away from the filling area ; ➔ Call the cryogenics service on 96065 or 96066. If the Service Hélium ("Helium Service") is closed, evacuate the basement level and call 1222.
Situation 2	If the user is on the basement level and the alarm involves Visual (light) alarm + sound alarm - Immediately evacuate the basement level ; - Call 118 and 1222.

6. Liquid nitrogen filling station - operating procedure



Action	Detail	Safety instructions
Open the hand-operated fill valve labelled V1 (turn the valve's handle to the right)	 →  Valve is closed Valve is open	Cryogenic gloves must be worn 
Starting up the station Start up the station by turning the key switch labelled "2 MISE EN SERVICE" with Key number 2 to position 1. The indicator light labelled "3 TÉMOIN" will light up.	 → 	
Opening a dewar		✓ Before touching the dewar, check that it is not pressurized (e.g. by looking at the pressure gauge) ✓ PPE must be worn (cryogenic gloves, face shield, closed shoes, clothing covering the whole body) 

Action	Detail	Safety instructions
Insert the fill hose into the empty dewar		
Turn on the vapour extraction arm By flipping the switch to ON		
Fill dewar with nitrogen Activate the transfer button n°4, labelled "4 TRANSFERT" The indicator light labelled "5 TRANSF. EN COURS" ("5 Transfer in progress") will light up	 	Risk of overflow – if there is no liquid level gauge on the dewar → you must constantly monitor the filling operation
Extraction of nitrogen vapours		Place the local extraction arm as close as possible to the opening of the dewar.

Action	Detail	Safety instructions
DEWAR FULL **Stopping the station's fill operation** Turn Key No. 2 in the key switch to position 0. The indicator light will turn off.		
Close the valve labelled V1 (turn the handle towards the left)	 Valve is open → Valve is closed	
Put the fill hose back in its original place.		
Turn off the vapour extraction arm by flipping the extraction switch to off.