

Safety Sheet 21 – Cryogenics

Consult the *Ontario Occupational Health and Safety Act* and its regulations for additional information on the duties of workplace parties.

A cryogen is a liquid existing at a temperature of -66°C to -266°C . Typical cryogenics at uOttawa include nitrogen and argon. Cryogenics are typically supplied by the uOttawa compressed gas supplier (in bulk) in dewars – a specialized wheeled pressure vessel – in volumes of up to 230 litres. Requirements for smaller, laboratory use volumes may be coordinated via the respective Faculty support personnel (i.e. decanted from larger dewars).

It should be noted that these substances (i.e. nitrogen, argon, oxygen and carbon dioxide) have high expansion ratios – thereby producing more gas than the liquid volume. Common cryogenic liquids are listed below. For example, nitrogen expands at a ratio of 696:1 in normal atmospheric conditions; therefore, displacement of oxygen can occur in confined areas with little ventilation.

Cryogenic Liquid	Expansion Ratio (Liquid to Gas)
Argon	1:841
Helium	1:754
Nitrogen	1:696
Oxygen	1:861

Applications for the cryogenic material will vary; however, the bulk dewars in which they are contained share relatively similar design, with dual walled construction and high vacuum maintained between wall layers. The dual wall provides good thermal insulation, which reduces the rate at which the cryogen will evaporate. Nevertheless, the cryogen will evaporate and build pressure within the vessel.

Both liquid and gas phases are available in a 230 litre dewar, with the gas stored above the liquid phase. As the liquid cryogen boils, gas is created and builds pressure within the vessel – this excess pressure must be vented via the built-in pressure relief valve. As a result, 230 litre vessels may suddenly “hiss” when internal pressures reach 350 psig, which is part of their normal operating conditions. A dewar venting continuously means that there may be a problem; the most common of which is the pressure relief valve frozen open due to the temperature of the cryogen meeting the temperature of the ambient air. In this case, a warm water solution may be carefully poured on the pressure relief valve to melt a small accumulation of ice. Alternatively (and in rare cases), the thermal lining of the vessel may be compromised; in this situation, contact the uOttawa compressed gas and cryogen supplier for assistance.

Dewar Transportation on Campus

Dewar vessels are generally equipped with a wheeled base, which allows easy movement of the dewar to its use location. Dewar vessels are normally delivered to the loading zone, accepted by a uOttawa representative and the user notified to pick-up their material. It should be noted that a full dewar can be

heavy – up to 667 lbs – when full; assistance may be required when transporting the dewar to avoid excessive exertion or when transporting a dewar on a slight incline/decline. The transportation of a full dewar – even up a slight incline of 5% – can increase the force required to move the container by as much as 50%¹. It is recommended to push dewars, with arms slight bent rather than pulling a dewar toward you.

When transporting dewars to another level of the building – and due to the unlikely, yet hazardous asphyxiation hazard – it is recommended to use a freight elevator and/or buddy system to send the dewar – unescorted – to the desired location. If a public elevator is required, the elevator should be put in service and the dewar transported in a similar fashion. If the elevator cannot be placed in service, persons meeting an unescorted dewar in an elevator should not enter the elevator.

General Filling / Decanting Procedure

Dewars (230 litre) will be supplied and filled by the uOttawa compressed gas and cryogen supplier; consequently, no uOttawa user will fill a 230 litre dewar. For instances in which a lesser volume of liquid nitrogen is required, procedures exist at both the Faculties of Science and Medicine for the safe decanting of the desired material. In all cases, personal protective equipment – including lab coat, protective eyewear and gloves – are required.

The Lab Supervisor and/or Manager is responsible for demonstrating the proper decanting procedures for their respective cryogen source; assistance is available from the local Health, Safety and Risk Manager or – in the case of the Faculty of Science – from the Faculty of Science Store.

Emergency

If a dewar fails (i.e. ruptures, tips over during transport or handling, etc.), do not attempt to try and catch or otherwise brace the dewar – let it go. Warn others in the immediate vicinity of the hazard, if safe to do so attempt to establish a perimeter and immediately contact Protection Services at ext. 5411. Advise them what occurred and have them meet you nearby.

Additional Resources

For additional information on cryogens and/or dewars, please contact your local [Health, Safety and Risk Manager](#), or the [Office of Risk Management](#).

¹ Air Products; Safetygram 27 – [Cryogenic Liquid Containers](#) – Accessed January 2018.