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PURPOSE

This Cryogenic Materials Standard contains information on the safe use, handling and storage of cryogenic materials at the University of Calgary to protect people, assets and the environment. This Standard may be used in the development of site-specific Standard Operating Procedures (SOPs). As a minimum, this guiding document needs to be reviewed by all staff prior to commencing work with cryogenic materials. This Standard addresses the Occupational Health and Safety Code requirements for safety equipment and emergency response when working with cryogenic materials.

SCOPE

This Standard applies to all persons that are handling, using, storing and/or disposing of cryogenic materials under the auspices of the University of Calgary. This standard addresses the use of cryogenic materials in low pressure or non-pressurized containers commonly called Dewars. Some sources refer to low pressure containers as liquid containers to differentiate them from non-pressurized containers. Cryogenic materials, when under pressure in a liquid cylinder, are classified and labelled as “compressed gases” according to WHMIS 1988 and WHMIS 2015. The symbols for compressed gases are as follows:



WHMIS 1988



WHMIS 2015

PROPERTIES

- Cryogenic materials are liquefied gases that are kept in their liquid state at very low temperatures.
- Cryogenic materials have boiling points below -150°C (-238°F).
- Carbon dioxide and nitrous oxide, which have slightly higher boiling points are sometimes included in this category.
- Cryogenic vapours can rapidly freeze human tissue.
- All cryogenic materials are gases at normal temperature and pressure. These gases must be cooled below room temperature before an increase in pressure can liquefy them.
- Cryogenics expand at an average ratio of about 1:1000 when heated. Vaporization of a cryogenic liquid in an enclosed area can cause asphyxiation by displacing air.

- The vapours and gases released from cryogenic liquids as they boil remain very cold. They can condense the moisture in air, creating a highly visible fog.
- In poorly insulated containers, some cryogenic liquids condense the surrounding air, resulting in a liquid oxygen condensate on the exterior of cryogenic piping. Violent reactions may occur if other, easily oxidized materials make contact with the liquid oxygen.
- Some elastomers and metals, such as carbon steel may become brittle at extremely low temperatures and may easily fracture. These materials must be avoided in cryogenic service.
- Cryogenic materials in liquid containers are **Class 2** Gases dangerous goods as defined by the Transportation of Dangerous Goods (TDG) Act.
- Cryogenic materials under **WHMIS 1988** legislation are classified as **Class A** Compressed Gases.
- Cryogenic materials under **WHMIS 2015** legislation are classified in **Part 7** Physical Hazard Classes: Gases Under Pressure Category 3.

RESPONSIBILITIES

Supervisors

- Complete a Hazard Assessment and Control Form (HACF) that identifies the hazards of working with cryogenic materials and the controls used to mitigate the hazards.
- Communicate the hazards and appropriate controls to workers.
- Provide appropriate Personal Protective Equipment (PPE).
- Develop a Standard Operating Procedure (SOP) for the use, handling, storage and movement of cryogenic materials in your work area including how to properly:
 - transfer from a liquid cylinder
 - transfer from a storage Dewar into a working container
 - dispensing into a storage Dewar
 - transferring into a cold finger (condensing chamber)
 - filling an NMR
 - tissue preparation for long term storage
- Train staff in accordance to this Standard and any laboratory specific procedures involving cryogenic materials and ensure compliance.
- Maintain an inventory of cryogenic materials.
- Follow the UofC EHS Fixed Gas Detection Systems Standard when the volume of cryogenic liquid could pose an asphyxiation hazard as a result of an accidental release.

Workers

- Review this Standard and the applicable Safety Data Sheet (SDS) prior to working with cryogenic materials.
- Follow the requirements set out in this Standard, the HACF for your laboratory, and any laboratory specific SOPs.
- Report hazardous conditions immediately to their supervisor.
- Know the location of emergency equipment and how to respond to an emergency.
- Wear and properly maintain the required Personal Protective Equipment (PPE).
- Wear appropriate laboratory attire including long pants and closed-toe shoes.

Facilities

- Develop and implement University of Calgary Design Standards compliant with appropriate legislation, codes, standards and best practices affecting construction and renovations in areas where cryogenic materials will be used or stored.
- Follow the UofC EHS Fixed Gas Detection Systems Standard when the volume of cryogenic liquid could pose an asphyxiation hazard as a result of an accidental release.

Environmental Health and Safety

- The development and review of this Standard.
- Advise users on appropriate legislation, codes, standards and best practices for use, handling and storage of cryogenic materials.
- Assist departments with interpretation and methods of compliance with this Standard.

USAGE

- Industry best practice is to purchase cryogenic materials in the smallest quantity practical for the application.
- Always wear appropriate personal protective equipment (PPE) and appropriate laboratory attire when working with cryogenic materials.
- Use chemical splash goggles, face shield and cryogenic gloves (oven mitts do not provide adequate protection) when there is a risk of splash from cryogenic materials.
- If a respirator is required, the user must follow the UofC EHS Respiratory Protection Program.
- Adequate pressure relief must be provided to all parts of a cryogenic containment system to permit routine off-gassing and prevent possible explosion. Do not tamper with or alter safety valves.
- Only fill Dewars if properly trained.
- Replace damaged or obsolete product labels as appropriate.
- Prior to use, ensure the fittings on the Dewar match the fittings on the transfer hose.
- Use only transfer lines and equipment including containers designed for cryogenic materials.
- Continually monitor the filling process. Do not leave unattended.
- Fill Dewars or secondary containers to no more than 80% of capacity or to the level specified by the manufacturer. Expansion of gases may cause pressure build-up.
- Removal of ice build-up on the control valves is to be done according to supplier's instructions.
- Perform regular visual inspections of storage Dewars; be alert for excessive frost formation on the outside of the Dewar.

HANDLING

Movement within a facility

- Movement of cryogenic materials must adhere to the UofC EHS Movement of Hazardous Materials Within Buildings document.
- Carts used to transport small Dewars preferably have integral secondary containment or have side rails and the cryogen inside a secondary container to capture spills.
- Transport Dewars, containers and cylinders are heavy and may cause crush or musculoskeletal injuries.
- All transport carts and Dewars should be inspected before use to ensure safe operation.
- Do not transport Dewars through small, confined or unventilated spaces (such as elevators and air locks) while Dewars are actively venting.
- Large transport Dewars should be accompanied by two lab personnel.
- To transport a large Dewar down a ramp, there should be two people to brace the Dewar on the “downside” to allow very slow, controlled movement down the ramp. One person should hold onto the handle during this process so a third person may be required.
- To transport a large Dewar up a ramp, one person should pull from in front and a second person should push from behind.
- Always keep containers upright.
- Movement of cryogenic materials must adhere to the EHS Movement of Hazardous Materials Within Buildings document.



Primary Dispensing Locations

- Primary dispensing stations are located in Chemistry Stores, Main Campus and Distribution Services and Foothills Campus.
- Where primary dispensing stations are located;
 - A written, site-specific Standard Operating Procedure must be posted.
 - Site-specific training must be provided and documented prior to dispensing in these areas.
 - An appropriate gas detection system and alarm to monitor for low oxygen levels must be in place, properly maintained and tested with documentation in accordance with the Fixed Gas Detection System Standard.

Transport on Road

- Transportation of hazardous materials is subject to Transportation of Dangerous Goods (TDG) legislation and University of Calgary procedures. Private vehicles must not be used to transport dangerous goods. Contact Supply Chain Management for assistance when transport of cryogenic materials between buildings or between campuses is required.

Waste/Disposal

- Never pour cryogenic materials down any plumbing system.
- Excess cryogenic materials should be evaporated in a fume hood.

STORAGE

Users of cryogenic materials must maintain their inventory as low as reasonably practical adhering to the requirements of this Standard for storage of cryogenic materials.

- Containers with cryogenic materials and pressure relief valves will periodically vent product.
- Containers with cryogenic materials should be stored in an upright position in well-ventilated areas.
- Containers with cryogenic materials should be stored away from air intakes, high traffic areas, floor drains, and other underground openings.
- The presence of Dewars with pressure relief valves should be listed on the Laboratory Placard under the heading "Special Hazards or Requirements".
- Areas where cryogenic materials are stored shall have appropriate signage as per the Fixed Gas Detection Systems Standard.
- Never store cryogenic materials or dry ice in a walk-in fridges, freezers or environmental chambers.

EMERGENCY PROCEDURES

Annual review of emergency procedures is required as per the UofC EHS Fixed Gas Detection Systems Standard

First Aid

- Provide first aid in accordance with the Safety Data Sheet.
- Contact Campus Security 403-220-5333, if additional first aid treatment is needed.
- Contact supervisor and follow the University of Calgary Incident Reporting and Investigation instructions on the EHS website.

Spill Procedures

- In case of a spill, evacuate the area, cordon off and ventilate well. Allow ample time for evaporation.

REFERENCES

Alberta Occupational Health and Safety Act, Regulations and Code
UofC EHS Compressed Gas Cylinder - Use, Handling and Storage Standard
UofC EHS Compressed Gas Cylinder Regulator Installation Safe Operating Procedure
UofC EHS Fixed Gas Detection Systems Standard
UofC EHS Movement of Hazardous Materials Within Buildings
UofC EHS Respiratory Protection Program
UofC EHS Spill Kit Information
UofC EHS Spill Response Procedures
University of Calgary Design Standards