



Compressed Gas and Cryogenics Safety Procedure

Category: Health and Safety;

Established on: January 1, 2006;

Amendments: Date of Approval 2023

Preamble

This policy was created to outline appropriate safety precautions when working with or around compressed gases and cryogenic liquids. Compressed gas cylinders and cryogenic liquids present several safety hazards:

- A falling cylinder may cause injuries.
- The cylinder may become a dangerous projectile, if the valve is sheared off.
- Damaged or faulty valves may cause the release of dangerous gases.
- Elevated temperatures, i.e. if in a fire, may cause sudden release of the compressed contents.
- Pure oxygen or other oxidizing gases can present fire or explosion hazards if mishandled or improperly stored.
- Toxic and corrosive gases can cause serious, irreversible respiratory injuries that may result in fatality.
- Cryogenic liquids can cause serious burns.

Policy

Laboratories using compressed gasses and cryogenic liquids must use utmost care and best practices to ensure that the hazards of these materials are mitigated. Laboratory personnel must be trained by their Supervisor on the safe use of the materials in use in the lab and this training will be recorded and retained. All equipment used must be in good condition and used as intended by the manufacturer. Compressed gasses and cryogenic liquids are regulated by the Workplace Hazardous Materials Information System (WHMIS) Regulation and are hazardous materials. This

policy will be reviewed by the Health and Safety Office and the Joint Occupational Health and Safety Committee every five years, or as needed following an incident.

General Handling Rules

- Compressed gases may only be purchased in cylinders that are returnable to the supplier or in disposable cylinders.
- Never use a gas cylinder unless the contents are clearly identified with a supplier label. Do not rely on colour to identify the gas inside.
- Any area where compressed gases and cryogenics are stored/used must have signage on the doors depicting the hazard, type of gases, and contact information of the Person in Authority.
- Safety data sheets (SDS) for compressed gases and cryogenic liquids shall be available in the areas that the gases are used.
- Cylinders must be individually secured to a wall, cylinder rack, post or laboratory bench top with a chain or strap at 2/3 the height of the cylinder at all times regardless of whether they are full or empty. A chain must be used in addition to straps to meet fire code requirements.
- Never ground a compressed gas cylinder or place it near an electrical conductor, including plumbing.
- Appropriate personal protective equipment must be worn when using cryogenics and compressed gases.
- Cylinders must be positioned so that the cylinder valve is accessible at all times.
- Transfilling of compressed gas cylinders is prohibited. Once a tank is empty it should be marked "MT" and left for pickup by the supplier in the approved cylinder pick-up zone.
- Persons using compressed gases and cryogenic liquids must have current WHMIS training and be trained on safe use and handling.
- Compressed gasses and cryogenic liquids must be recorded in the chemical inventory system.
- If a valve will not open by hand, contact the distributor. Do not try to open using other means.
- Several styles of valves are available on compressed gas cylinders, users must be familiar with the one in use and default to the manufacturer's instructions.
- Never remove identifying labels from gas cylinders or dewars.

Valves and Regulators – Compressed Gasses

- Compressed gas cylinders may only be used with a pressure reduction regulator attached to the valve. The regulator must be appropriate for the gas cylinder. Regulator adaptors are not allowed.

- Always inspect the regulator prior to attaching it to a cylinder. Never use cylinders or regulators that are corroded. If the connections do not fit together readily, the wrong regulator is being used. Damaged threads on the connecting nut or valve outlet can cause a leak.
- When changing the regulator, pressure should be set low when the main valve is open and then brought up to desired pressure.
- When opening the main valve, stand facing the dials on the regulator. Do not allow anyone to stand behind or to the sides of the regulator.
- Wear appropriate PPE including face and hand protection when opening the main valve.
- When changing the regulator, hand tighten the nut and then tighten the fitting with a tool for a ¼ turn. Damage to regulator components can lead to mechanical failure. Use a cylinder wrench of appropriate size wrench (max handle length of 10 inches). Adjustable wrenches are not to be used.
- Manifold and piped systems using bulk compressed gas tanks or those without a pressure regulator for compressed gases require consultation by a professional engineer.
- Regulators and associated piping should be checked regularly for leaks, using a soap solution, and every time the tank is changed.
- The regulator should never be used as the shut off valve, and should be decompressed once the cylinder valve has been closed.
- Oil, grease or Teflon tape should never be used on the regulator or valve fittings. Oil and grease can become explosive when they come in contact with oxygen gas or other oxidizers.
- Manufacturers recommend regulators being serviced once every 5 years. Users must ensure that they are following maintenance schedules for their regulators.

Cylinder Storage

- Flammable, toxic and corrosive gas cylinders must be kept to a minimum number necessary to support ongoing work.
- When not in use, cylinders must be stored with safety valve caps and stored in an area where the ambient temperature does not exceed 52°C.
- Cylinders must be stored in a secure location, and not, under any circumstances be stored in aisles, hallways, doorways, stairwells or exits.
- Storage of compressed gas cylinders must conform to the *Ontario Fire Code O.Reg.388/97, section 5.6* and shall only be stored in areas that are designated for the storage of compressed gases.
- Do not store cylinders with their regulators attached.
- Do not store cylinders on their sides.
- Gases denser than air must not be stored in the basement.
- Indoor storage of propane cylinders greater than 10 pounds and other liquified petroleum gasses (LPG) is prohibited by the Technical Standards and Safety Authority (TSSA). Special

permission from Office of Human Resources – Health and Safety is required to store less than 5 pounds per laboratory.

Cylinder Transport

- When moving cylinders **any distance**, the safety cap must be on the cylinder protecting the valve.
- When moving cylinders, a distance greater than 1 metre, an approved cylinder dolly must be used with the cylinder restrained to the cart.
- When repositioning cylinders a short distance (<1m), ensure safety cap is on the cylinder and move by tilting onto the bottom edge and rolling to the desired position. Do not drag across the floor.
- When transporting cylinders between floors use an elevator

General Handling Rules – Cryogenic Liquids

- All open-flame equipment requiring flammable gas delivery systems (ie. Atomic absorption units) shall incorporate flash arrestors in the gas lines.
- Cryogenics may only be stored in a secure area and only in vacuum-jacketed dewar flasks designed for that purpose. All such dewars must be properly vented to accommodate the release of pressure.
- Personal protective equipment including face shield, loose fitting cryogenic gloves, trousers, closed toe shoes or boots should be worn when pouring cryogenics liquids.
- Cryogenic liquids must be stored in a secure location, and not, under any circumstances be stored in aisles, hallways, doorways, stairwells or exits.
- When transporting dewars, use a rubber carry bucket for small dewars and a cart for larger ones. Use of an elevator between floors is required.

Appendix 1 Table of Common Compressed Gasses

Transport Classification	Examples
Flammable	Hydrogen, acetylene, propane, methane, butane, ethane, ethylene, isobutane, silane, vinyl chloride
Inert	Helium, neon, nitrogen, carbon dioxide, air, nitrous oxide, sulphur hexafluoride, argon
Toxic	Carbon monoxide, phosgene, nitric oxide, arsine, chlorine trifluoride, cyanogen, methyl bromide, nitrogen trioxide
Corrosive	Hydrogen chloride, boron trifluoride, ammonia, chlorine

Appendix 2: Table of Common Cryogenic Liquids

Gas	Normal Boiling Point °C	Volume expansion to gas
Helium	-268.9	757 to 1
Hydrogen	-252.7	851 to 1
Nitrogen	-195.8	696 to 1
Argon	-183.7	847 to 1
Oxygen	-183.0	860 to 1
Carbon dioxide	-78.5 (sublimes)	553 to 1

Appendix 3: Regulator Attachment Procedure (General)

The following is a general sequence for attaching a regulator to a compressed gas cylinder.

Manufacturer's procedure must be followed even when it contradicts the procedure below.

- Wipe the cylinder outlet with a dry, lint free cloth. The threads and mating surfaces of the regulator and hose connections should also be cleaned before the regulator is attached.
- Always use a cylinder wrench or other tightly fitting wrench to tighten the regulator nut and hose connections. Using an oversized wrench, adjustable wrench, pliers or a pipe wrench may damage the fittings and make it impossible to tighten them properly. A connection problem caused by dirty or damaged threads will result in leaks when the cylinder is used.
- Attach the regulator securely and ensure the valve on the regulator's pressure gauge is opened slightly before opening the main cylinder valve. This will ensure that the regulator's diaphragm seats properly once the main cylinder valve is opened.
- When opening the main cylinder valve stand to the side away from the regulator, crack the valve open slightly at first, to verify that the regulator's diaphragm is working, before opening the valve wide. Note: cylinder regulators have a relief device to prevent excessive pressure from developing. High- pressure cylinder regulator gauges have solid-front, safety-back construction. When subject to excessively high pressure, the light-metal safety back will blow off to relieve the pressure.
- Check with 'snoop' for leaks.

Review Period: 7 Years, by the Associate Vice-President (Human Resources);

Next Review Period: 2030;

Related Policies and Procedures: Health and Safety Policy; WHMIS Procedure; Laboratory Safety Operating Procedures

Policy Superseded by this Policy: None.

The University Secretariat manages the development of policies through an impartial, fair governance process. Please contact the University Secretariat for additional information on University policies and procedures and/or if you require this information in another format:

Open: Monday through Friday from 8:30am to 4:30pm;

Location: University Centre, Thunder Bay Campus, Room UC2002;

Phone: 807-343-8010 Ext. 7929 or Email: univsec@lakeheadu.ca