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| STANDARD OPERATING PROCEDURE | | | |
| Title: Handling, Using and Storing Compressed Gases | | | |
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| Institution: York University | | Effective Date: 01-12-08 | |

Standard Operating Procedure (SOP) for
HANDLING, USING AND STORING COMPRESSED GASES
SOP# FSE-01-08

Creation Date: November 2008
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Prepared By: Brad Sheeller
Reviewed By: DOHS

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1. Introduction/Purpose

Compressed gases are used in many teaching and research laboratories. Handled improperly the container that holds the compressed gas can cause a great deal of damage. This danger is compounded by the contents of the container which can be cryogenic, flammable, or toxic.

The following procedures have been established to ensure faculty, staff and students know the necessary protective measures.

2. Scope

These guidelines are for all faculty, staff and students within the Faculty of Science and Engineering that handle, use or store compressed gases.

3. Definitions, Abbreviations

DOHS: Department of Occupational Health and Safety

PPE: Personal protective equipment

PI: Principal Investigator

WHMIS: Workplace Hazardous Materials Information System

4. Responsibilities and Training

The Principal Investigator and/or the lab supervisor play a key role in the health and safety of staff and students working in their research or teaching facilities. Laboratory training (including orientation, familiarity with lab rules and lab protocols) may be delegated by the PI to other experienced staff members. Lab staff and students will also attend relevant DOHS safety training (i.e. WHMIS II, Compressed Gas), and all such training will be documented.

5. Equipment, Materials and Facilities Required

- Training must be provided on how to properly use all equipment or instruments needed to perform any lab experiments. A complete list of all equipment required is beyond the scope of this SOP. An equipment inventory (including usage, maintenance and repair records) is recommended.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

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| FOOTWEAR | <ul style="list-style-type: none"> • Wear shoes that fully cover feet • Footwear should have good traction to avoid slipping while moving cylinders |
| SAFETY GLASSES Prevent exposure by protecting your eyes and face | <ul style="list-style-type: none"> • Wear safety glasses if there is a danger of pressurized gas that may propel dust, etc. • If there is a chance of chemical exposure use goggles |

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| GLOVES Prevent exposure of hands from extreme cold or damage by the chemical | <ul style="list-style-type: none"> Wear insulated gauntlet gloves (longgloves that provide some arm protection) when dispensing or handling cryogenic liquids When using gasses that are harmful by skin contact wear protective gloves suitable for the chemical in use |
| RESPIRATOR Prevent inhalation exposure of toxic gases | <ul style="list-style-type: none"> When using gases that are harmful by inhalation and engineering controls are not effective in controlling exposure (i.e cylinder is not within an enclosed, exhausted gas cabinet) a respirator should be worn |

Equipment

- Cylinder cart
- Cylinder clamp
- Safety glasses/goggles
- Proper regulator
- Wrench
- Insulated gloves (for cryogenics)

Facilities

- Temporary storage area for cylinders not in use (G101 Farquharson, 023 & 030A Petrie)
- Exhausted enclosed area within laboratory for toxic gases

6. Storing Compressed Gases

General Gas Cylinders Storage

- In accordance with WHMIS and TDG regulations, each cylinder must be clearly labeled with the name of the gas and its UN number. A tag showing the principle investigator's name and account number should be clearly visible.
- Protect the valve from damage. Attach the protective cap when not in use or put the cylinder in a location where it can't be easily damaged.
- All gas cylinders must be secured (i.e. with a chain, sturdy strap or non-tip base).
- When storing multiple cylinders, they should be packed together and touching each other so that the chain can be pulled tightly and securely around the "nest" of cylinders. Ensure to tighten the chain around cylinders such that cylinders are not free standing.
- Gas cylinders stored outdoors should be located on a raised platform and protected from the weather (i.e. kept dry, no direct sun exposure).
- Gas cylinders stored indoors should be in a ventilated area and away from sources of heat.
- When adding a gas cylinder to one of the storage areas, verify that an updated MSDS is in the binder.
- As outlined in the National Fire Code of Canada, gas cylinders that supply and are directly connected to appliances, equipment or apparatus are consider to be 'in use' rather than 'in storage'. Attaching a regulator to the cylinder doesn't suffice; it has to be attached to an appliance, equipment or apparatus to be considered in use.

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Storing Gas Cylinders containing Non-toxic, Non-flammable Gases

- The Ontario Fire Code states that the amount of compressed gas stored in a lab/room must not exceed 150 kg of non-flammable compressed gas. This is the absolute upper limit set by the Ontario Fire Code and the overruling legislation is the National Fire Code of Canada which instructs that the quantity of compressed gas kept in a laboratory shall be minimized and shall not exceed the supply necessary for normal operation.
- Non-toxic, non-flammable gas cylinders not in use should be stored in 030A Petrie or G101 Farquharson.
- Within the caged storage area, keep full cylinders separate from empty cylinders.
- The gas cylinder cages must be closed and locked up upon leaving.

Storing Gas Cylinders containing Toxic Gases

- Toxic gases must be located in a gas cabinet, fumehood or other exhausted enclosures, even when in use.
- Toxic gas cylinders not in use should be stored in 023 Petrie.

Storing Gas Cylinders containing Flammable Gases

- The Ontario Fire Code states that the amount of compressed gas stored in a lab/room must not exceed 25 kg of flammable compressed gas. This is the absolute upper limit set by the Ontario Fire Code and the overruling legislation is the National Fire Code of Canada which instructs that the quantity of compressed gas kept in a laboratory shall be minimized and shall not exceed the supply necessary for normal operation.
- Flammable gas cylinders not in use should be stored in 023 Petrie.
- Keep away from sources of ignition or excessive heat.
- Do not store near oxidizers.

Storing Large Dewars with Compressed Cryogenic Liquids

- Large Dewars with compressed cryogenic liquids should be stored in a protected area. This may be a locked laboratory or the caged cylinder storage areas (G101 Farquharson and 030A Petrie).
- Cylinders waiting to be filled by the supplier should be stored in the caged cylinder storage areas.

7. Handling Compressed Gases

- Users of these gas cylinder cages must have received WHMIS II training and Gas Cylinder training.

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01-12-08Transporting Gas Cylinders

- Approved gas cylinder carts must be used to transport gas cylinders. Cylinders must be chained to the cart for safe transport.
- During transportation or storage, all cylinders must have a tightly secured protective cap in place. Do not lift the cylinder by its cap.
- Cylinders should never be rolled, dragged, slid or spun across the floor.
- Before transporting gas cylinders containing toxic or flammable gas (and the cylinder does not contain a water reactive gas) check the cylinder for leaks with a commercial product ('Big Blu' or 'Snoop') or a mixture of water:isopropanol:soap (100:100:1).
- When transporting toxic gases between floors, do not transport with passengers in the elevator. Send the elevator with the cylinder by itself and have a second person waiting on the desired floor. Post a sign on the cylinder (facing the elevator doorway) advising others not to use the elevator while the cylinder is being transported.

Transporting Large Dewars with Compressed Cryogenic Liquids

- Do not transport compressed cryogenic liquids with passengers in the elevator.
- Send the elevator with the dewar by itself and have a second person waiting on the desired floor. Post a sign on the dewar (facing the elevator doorway) advising others not to use the elevator while the dewar is being transported.
- If a service/freight elevator is available, then send the container using that elevator instead.

Filling Small Dewars from a Large (Compressed Cryogenic Liquid) Dewar

- Don the required PPE (safety glasses, insulated gloves).
- Use a dewar that is rated to store cryogenic liquids.
- Ensure there is plenty of ventilation. If you are in a small room, open the door.
- When filling the smaller dewar, place the filling hose within the mouth of the smaller receiving dewar to prevent splashing or spillage.
- When transfer is complete, ensure the dewar is sealed before transporting.
- If the dewar is larger than 20 litres, two people should lift it.

8. Using Compressed Gases and Spill Response

- Users of these gas cylinder cages must have received WHMIS II training and Gas Cylinder training.
- Consult MSDS before using the compressed gas and know how to handle appropriately, including spill and accident procedures.

Attaching a Regulator

- Choose the right regulator with the correct pressure output range for the intended application. If unsure, ask the lab coordinator or supervisor.
- Make sure the threads are clean (free of obstacles or dust) and in good condition. The use of Teflon tape is not recommended.

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- Make sure the regulator is in good condition (all valves/knobs move freely). Never modify a regulator, use one that has been altered nor use adapters.
- Line up the regulator with the cylinder head and thread the nut until finger-tight. Use a wrench to tighten the nut with a maximum of one turn.
- Never use excessive force or over-tighten the connection.
- Check for leaks with a commercial product ('Big Blu' or 'Snoop') or a mixture of water:isopropanol:soap (100:100:1). If a leak is discovered, tighten the connection. If the leak persists remove the regulator and re-attach. If a leak is still present, remove the regulator from usage and get a new regulator.
- For further information on Regulator Maintenance refer to DOHS's website:
<http://www.yorku.ca/dohs/doc/GuidelinesNotices/CompressedGasRegulator.htm>

Damaged/Leaking Gas Cylinders with Non-Toxic, Non-Flammable Gases

- 1) Stop any leaks if it can be done without risk to yourself or others. If the cylinder is still leaking and it is possible to safely move it to an area to drain (i.e. outside), do so. Otherwise leave the cylinder where it is located and evacuate the area. Place a sign to keep others out of the area.
- 2) Contact the supplier's customer service and let them know you have a bad gas cylinder and need a replacement cylinder.
- 3) Contact York Security (ext. 58000 or 416-650-8000). Tell them the location of the cylinder, the cylinder's supplier, the type of gas in the cylinder and the situation (i.e. *non-toxic & non-flammable* gas cylinder that is leaking and has been left to drain), as well as any other relevant information.
- 4) Contact the Health and Safety Officer (ext. 20770) for the Faculty of Science and Engineering.

Damaged/Leaking Gas Cylinders with Toxic or Flammable Gases

- 1) Stop any leaks if it can be done without risk to yourself or others.
 - a) If the cylinder contains a flammable gas, eliminate all sources of ignition.
 - b) If the cylinder is in a lab or an area occupied by others, evacuate the area. Place a sign to keep others out of the area.
 - c) If necessary (i.e. a significant amount of gas is leaking or it is located in a common area, like a hallway) pull the fire alarm to evacuate the building.
 - d) If it can be done safely, move the cylinder to an area in the room that is well ventilated (i.e. close to a fumehood). Only do this if you can move the cylinder without compromising your own health and safety! Toxic gas leaks may require the use of a self-contained breathing apparatus and protective clothing.
- 2) Contact the supplier's Emergency Response number
 - Air Liquide: 514-878-1667
 - BOC/Linde: 905-501-0802
 - Praxair: 1-800-363-0042
- 3) Contact York Security immediately (ext. 33333 or 416-736-5333). Tell them the location of the cylinder, the cylinder's supplier, the type of gas in the cylinder and the situation (i.e. leaking gas cylinder), as well as any other relevant information.
- 4) Contact the Health and Safety Officer (ext. 20770) for the Faculty of Science and Engineering.

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9. Removal of Empty Cylinders

The cylinder account holder or delegate must contact the compressed gas distributor to advise that empty cylinders are ready to be picked up.

10. Related References, Standards, Guidelines

- i) Ontario Fire Code (O. Reg 213/07):
http://www.e-laws.gov.on.ca/html/source/regs/english/2007/elaws_src_regs_r07213_e.htm
- ii) National Fire Code of Canada
- iii) NFPA 55 – Standards for the storage, use and handling of compressed and liquefied gases in portable cylinders
- iv) Occupational Health and Safety Act, R.S.O. 1990, c. O.1, Regulation 851 & Regulation 860
- v) Transportation of Dangerous Goods Act
- vi) Canadian Centre for Occupational Health and Safety: <http://www.ccohs.ca/>