Compressed Gas Cylinder – Use, Handling and Storage Standard

Section:	Laboratory Safety Manual	Date of Issue:	2009.01.12
		Issued By:	Environment, Health &Safety
Part:	Rules and Procedures	Revision #:	1
		Revision Date:	2010.01.27
Pages:	**6**	Revised By:	FD

SCOPE

Laboratories and other workplaces at the University of Calgary using compressed gas cylinders need to be aware of the safe use, handling and storage requirements of the compressed gases they work with. As a minimum, this guiding document needs to be reviewed by all staff prior to commencing work with compressed gas cylinders.

Some compressed gases used alone or in combination present an extreme toxic, corrosive and/or flammability hazard (see table 1) that will require health and safety precautions above and beyond what is presented here. Workplaces using these gases will require additional controls such specific exhaust requirements, gas detection systems and written site specific standard operating procedures and training. EH&S must be consulted prior to conducting research with these gases.

PURPOSE

Compressed gases have the potential for creating hazardous working environments. This Standard contains information on the safe use, handling, and storage of compressed gas cylinders at the University of Calgary.

Although laboratories are the main users of compressed gas cylinders, they are also used by a wide variety of faculties and departments. Uses include:

- Chemical processes;
- Medical;
- Welding, cutting and soldering operations;
- Carbonated beverages; and
- Outdoor cooking.

Compressed gases are Class 2 dangerous goods as defined by the Transportation of Dangerous Goods (TDG) Act and Class B Controlled Products as defined by the Controlled Products Regulation (WHMIS). Hazards of working with compressed gas include:

- **Specific Chemical Properties of the Gas** – Gases may be combustible, explosive, corrosive, toxic, inert, or a combination of these properties.
- **Asphyxiation** – Gases escaping from a cylinder can expand, rapidly displacing the oxygen in the area to below what is required to support life.
- **Extreme Cold – Frostbite –** Gases escaping from a cylinder may be very cold (e.g. propane) and can cause frostbite. Severe frostbite can lead to serious permanent skin damage.
- **High Pressure** – Damaged cylinders can become projectiles or spin out of control with the rapid uncontrolled release of gas.
- **Injection** - Gas from pinhole leaks in lines can be injected into skin in direct contact with the leak.
- **Manual Handling** – Cylinders are heavy and have been known to cause crush and musculoskeletal injuries.

RESPONSIBILITIES

Environment, Health & Safety

- Provide information to users on appropriate legislation, codes, standards and best practices for use handling and storage of compressed gas cylinders.
- Assist departments with interpretation and methods of compliance with this standard.
- Periodic formal and informal inspections of areas containing compressed gas cylinders to monitor compliance with this standard.

Campus Infrastructure

- Develop and implement design guidelines compliant with appropriate legislation, codes, standards and best practices affecting construction and renovations in areas where compressed gas will be used or stored.

Supervisors

- Implement a Hazard Assessment and Control plan to identify and communicate hazards related to the tasks being performed. Where compressed gas is used or stored, the assessment and control of hazards related to it must take into consideration:
    1. the general hazards of working with compressed gas,
    2. the hazards related to the usage, specific to the gas or gases, in the area (reference the applicable Material Safety Data Sheet (MSDS)),
    3. movement of gas cylinders through the facility,
    4. safe storage of cylinders,
    5. the method of communicating the hazards to workers in the area,
    6. and training of staff.
- Develop a written Standard Operating Procedure detailing the specific procedures for use, handling, and storage of extremely toxic, corrosive and/or pyrophoric gases used in their laboratory or workspace. Table one provides a partial list of gases requiring a Standard Operating Procedure. If uncertain contact EH&S.
- Ensure that safe work practices for compressed gas cylinders are followed in their area.

Workers

- Review this standard prior to working with compressed gas.
- Follow the requirements set out in this standard and any additional requirements determined by the area supervisor in regard to compressed gas cylinder handling, use, and storage for their area.
- Report hazardous conditions immediately to their supervisor.
- Wear and properly maintain the required Personal Protective Equipment.

USEAGE

Cylinders

- Compressed gas cylinders present in a laboratory or workspace must be:
    1. in a dry well ventilated area,
    2. not exposed to temperatures exceeding 52°C or open flame,
    3. in an upright position, and secured individually to a wall or an immovable object by a strap or chain above the midpoint and below the shoulder, or in a holder designed for that purpose (never secured to utilities),

4. located so that the point of use valve is away from immediate hazards and within immediate reach (where the cylinder valve is located within immediate reach, a separate point-of-use shutoff valve is not required),
5. and not located in any exit or corridor providing access to exits, under a fire escape, outside exit stair, passage, ramp or within 1 metre of any exit.

- Only cylinders that are in use may be kept in a laboratory or workspace. A gas cylinder is considered to be **in use** if it meets one of the following conditions:
  a) is connected through a regulator to deliver gas to a laboratory operation,
  b) is connected to a manifold being used to deliver gas to a laboratory operation,
  c) and is a single reserve cylinder secured alongside a cylinder that is connected through a regulator to deliver gas to a laboratory operation (this applies only if operationally required and does not apply to gases listed in Table 1 of the Appendix).
- The main cylinder valve should be closed as soon as it is no longer necessary that it be open (i.e. it should be closed when the equipment is not operating).
- A cylinder should never be emptied to below 25 psig. This will maintain a slight positive pressure in the cylinder and keep contaminants out.
- Cylinders are not to be refilled by anyone except the gas supplier.
- Cylinders not attached to a device must have the regulator removed and the safety cap firmly secured.
- For flammable gases in a piped or manifold system there must be an identified manual shut-off valve at each point of use.

Identification

- The contents of cylinders must be clearly labelled. Colour is not an accurate indicator of contents. Cylinders received that are not properly labelled must be returned to the vendor immediately.
- Identify the gas with a label at each point of use when gases are being provided through a manifold or piped system.

Regulators

For complete instructions on removing and attaching regulators see the Compressed Gas Cylinder Regulator Installation – Standard Operating Procedure.

- Never use a compressed gas without a pressure reducing regulator marked for its maximum cylinder pressure, designed for the specific gas that will reduce the pressure to the design of your system.
- Regulators should have a gauge to measure the cylinder pressure and another to monitor the outlet pressure.
- Use only regulators compatible to the valve connector of the gas being used. NEVER USE AN ADAPTOR BETWEEN A CYLINDER AND A PRESSURE-REDUCING REGULATOR.
- Use backflow check valves and flame arrestors on each hose whenever both flammable and oxidizing gases are attached to the same system or device and backflow check valves when high pressure and low pressure gases are connected to the same system.
- Wear safety glasses when connecting or disconnecting regulators.
- Never use grease, lubricating materials or an aid (e.g. pipe dope or Teflon tape) between the threads of the cylinder and pressure reducing regulator.
- Leak test using soap and water or SNOOP™ after making a connection.

HANDLING

Movement and transportation of gas cylinders have been reported as immediate causes of numerous incidents resulting in injuries and property damage. Because of the potential for incidents/accidents, the following rules for transporting cylinders must be adhered to, in addition to the requirements of the EH&S **Safety Bulletin - Movement Of Hazardous Materials Within Buildings.**

Movement within a facility:

- Only move a cylinder, even for short distances, with the regulator removed, the cylinder valve closed, and the safety cap screwed in place.
- Do not drop or strike cylinders.
- Do not lift or move cylinders by the cap.
- Transport cylinders in an upright position using a cart designed for that purpose and only with the retaining chain or strap in place.
- Restrict movement of cylinders without a cart within the work area to distances of less than 2 metres.
- Only freight elevators or elevators designated for moving hazardous goods are to be used to move cylinders between floors within a building.

Transport on road

- Transportation of a gas cylinder by vehicle on a public road is subject to TDG legislation. Private vehicles should not be used to transport dangerous goods. Contact Supply Chain Management, Hazardous Materials Services for more information on TDG requirements.
- If a gas cylinder needs to be transported by vehicle between buildings on the main campus, or from the main campus to South Campus, contact the vendor or Supply Chain Management Goods and Services Procurement for assistance.

STORAGE

All users of compressed gas cylinders must maintain their on-site inventory of gas cylinders to as low as reasonably practical and adhere to the requirements of this Standard and best practices for storage of compressed gas. Through good ordering practices and inventory control, the reduction of on-site inventory can be achieved.

- Laboratories must not be used for the storage of gas cylinders. Cylinders not **in use** are considered to be in storage and must be located in a designated area designed for that purpose and that are compliant with the ***Alberta Building Code*** and the ***Alberta Fire Code***.
- Storage areas must be clearly identified. Full cylinders must be stored separate from empty cylinders.
- Quantities of stored compressed gas cylinders must be in compliance with Part 3 of the Alberta Fire Code 2006. Contact EH&S for assistance.
- Separate stored cylinders by compatibility group.
    - Corrosives from flammables
    - Flammables from oxidizers
    - Oxygen cylinders a minimum of twenty feet from flammable gas cylinders or separated by a non-combustible barrier at least five feet high.
- Empty cylinders must be identified with tape or other method of tagging and labelled **“empty”** or **“MT”.**

- Cylinders must be stored so that they are properly secured with a chain or strap to prevent them from falling. Multiple cylinders should be stored in a racking system or individually secured.
- Storage of multiple cylinders, outside a racking system, with a single chain should be avoided. If a number of cylinders must be stored with one retaining chain then they should be nested to always provide three points of contact with other cylinders and/or the chain.
- Cylinders must be stored in an upright position unless specifically designed to be on their side.
- Store cylinders so that they are used in the order received. Gas in cylinders can degrade over time and, therefore, unless a shorter maximum retention time is suggested by the manufacturer cylinders should be returned to the vendor within 36 months of receipt. Documentation from the supplier stating an expiry date greater than 36 months from date of receipt is also acceptable.

REFERENCES

Alberta Fire Code 2006
Alberta Building Code 2006
NFPA 45 Standard on Fire Protection for Laboratories Using Chemicals 2004 Ed.
NFPA 55 Standard for the Use, and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders and Tanks 2005 Ed.
Alberta Occupational Health and Safety Code July 1, 2009
Safety Bulletin Movement of Hazardous Materials Within Buildings
Compressed Gas Cylinder Regulator Installation – Standard Operating Procedure
Hydrogen Sulfide (H_2S) Code of Practice

Appendix

Table 1 –List of toxic, corrosive and pyrophoric gases requiring continual mechanical exhaust		
ammonia	**dimethylamine, anhydrous**	**nitrogen trioxide**
arsenic pentafluoride	**dinitrogen tetroxide**	**nitrosyl chloride**
arsine	**ethylene oxide**	**oil gas**
boron trichloride	**fluorine**	**oxygen difluoride**
boron trifluoride	**formaldehyde**	**perchloryl fluoride**
bromine chloride	**germane**	**phosgene**
carbon monoxide	**hexaethyl tetraphosphate**	**phosphine**
carbonyl fluoride	**hexafluoroacetone**	**phosphorus pentafluoride**
carbonyl sulfide	**1,3-hexafluorobutadiene**	**selenium hexafluoride**
chlorine	**hydrogen bromide**	**silane**
chlorine pentafluoride	**hydrogen chloride**	**silicon tetrafluoride**
chlorine trifluoride	**hydrogen cyanide**	**stibine (antimony hydride)**
coal gas	**hydrogen fluoride**	**sulfur dioxide**
cyanogen	**hydrogen iodide**	**sulfur tetrafluoride**
cyanogen chloride	**hydrogen selenide**	**sulfuryl fluoride**
diborane	**hydrogen sulfide**	**tellurium hexafluoride**
deuterium chloride	**methyl bromide**	**trifluoroacetyl chloride**
deuterium iodide	**methyl mercaptan**	**trifluorochloroethylene**
deuterium sulfide	**methylchlorosilane**	**tungsten hexafluoride**
dichlorosilane	**nitric oxide (nitrogen monoxide)**	

This is a partial list that will be reviewed and updated as new information is obtained. Check material Safety Data Sheets and consult EH&S if unsure of the properties of any gas prior to use.