	<b>Compressed Gas Cylinder Policy</b>	<b>Responsible Administrative Unit:</b> Finance and Administration
	<b>Issued: April 26, 2012</b>  <b>Revised: June 19, 2012</b>	<b>Policy Contact:</b> Director of Environmental Health and Safety <a href="mailto:TSweitze@mines.edu">TSweitze@mines.edu</a>

## 1.0 BACKGROUND AND PURPOSE

Compressed gas cylinders represent physical and gas-specific chemical hazards as well as an asphyxiation hazard due to oxygen displacement. The gases contained in cylinders display chemical hazards that include toxic, flammable, corrosive, pyrophoric, and oxidizing properties. Physical damage or exposure to high temperatures can result in a sudden release of pressure from a compressed gas cylinder and pose a serious threat to life and property. To minimize risk to employees and students, this policy was created to provide information and guidance in the safe handling, storage, and usage of compressed gas cylinders.


## 2.0 POLICY

Colorado School of Mines (“Mines” or “the School”) is committed to the safe handling, use and storage of portable compressed gas cylinders. All faculty, staff and students who use compressed gas cylinders are required to adhere to the handling, storage, and usage requirements outlined below. This policy is applicable school-wide including all research and teaching laboratories, all academic department shops, the Edgar Mine property, and all Facilities Management shops where compressed and liquefied gas cylinders are handled, used or stored.

## 3.0 PROCEDURES

**3.1 Storage Requirements:** Proper storage of compressed and liquefied gas cylinders is critical to protect the health and safety of all campus personnel and prevent property damage. All gas cylinders must be stored as follows:

- In a well-ventilated area.
- In an upright position. Lecture bottles may be stored on their side but stored in a way to prevent damage to the product label.
- In a free standing gas cylinder storage rack, a wall mounted cylinder rack, anchored to a fixed bench top, vented gas cabinet, or other fixed location. Free standing cylinders, storing gas cylinders in a cylinder cart, or strapping a cylinder to movable furniture or equipment is not permitted.
- In a way that the cylinder is secured to a fixed location using a substantial chain, belt or strap prior to removing the cylinder cap and attaching a regulator. The chain, belt or strap must be located halfway to approximately three quarters of the way up the height of the cylinder.
- So that the cylinder label is easily viewed.
- On a dry surface allowing no contact with corrosive fumes and chemicals, including salt.
- Away from sources of heat and open flames.
- At least 20 feet away from incompatible gas cylinders or separated by a physical barrier. Ensure this distance is maintained between oxidizing and flammable gases.
- So that gases with the same hazard class are stored in the same area. Inert gases are compatible with all other gases so this requirement does not apply.

	<b>Compressed Gas Cylinder Policy</b>	<b>Responsible Administrative Unit:</b> Finance and Administration
	<b>Issued: April 26, 2012</b>  <b>Revised: June 19, 2012</b>	<b>Policy Contact:</b> Director of Environmental Health and Safety <a href="mailto:TSweitze@mines.edu">TSweitze@mines.edu</a>

- So that full cylinders are separate from empty cylinders. Empty cylinders must be removed from a laboratory as soon as possible.
- With their caps in place.
- Away from exits or emergency egress routes.
- In a location where they will not be subject to mechanical or physical damage, heat, or electrical circuits.


Flammable gas cylinders must be stored in the building's gas cylinder storage cage until needed for research.

**3.2 Cylinder Handling Requirements:** The following requirements apply to the movement and handling of compressed and liquefied gas cylinders to or from the point of delivery and the location where the cylinder will be used.

- Always ensure the safety cap or valve protection device is in place prior to moving any cylinder.
- Never drag, slide or roll a gas cylinder.
- Use a gas cylinder cart to transport gas cylinders to and from a designated work area. Use the chain to secure the cylinder to the cylinder cart.
- Avoid dropping or striking cylinders together.
- Never lift a cylinder by the cap. If a cylinder needs to be hoisted, use a cradle. Never use a sling or lifting magnet.
- Remove the regulator and replace the cap prior to moving a cylinder.
- Empty cylinders and cylinders that are no longer needed must be returned to the delivery area and returned to the vendor. Partial lecture bottles may be returned to the Chemical Storage and Distribution Facility for storage and use. Empty lecture bottles must be submitted to EHS for waste pick up and proper disposal.

**3.3 Usage Requirements:** The following requirements apply to the use and storage of compressed and liquefied gas cylinders in laboratories and job locations.

- Wear safety equipment appropriate for the hazard potential for the gas.
- Read the material safety data sheet (MSDS) and become familiar with the health and physical hazards of the gas, gas mixture, or liquefied gas prior to dispensing the cylinder contents.
- Prior to removing the cylinder cap for use, ensure the cylinder is secured to a fixed location with a substantial chain or appropriate belt or strap. The chain, belt or strap must be located halfway to approximately three quarters of the way up the height of the cylinder.
- Do not remove the cylinder cap while the cylinder is secured to the cart.
- Use a pressure-reducing regulator or separate control valve to safely discharge gas from a cylinder.
- Use only regulators approved for the specific gas.
- Open cylinder valve slowly.

	<b>Compressed Gas Cylinder Policy</b>	<b>Responsible Administrative Unit:</b> Finance and Administration
	<b>Issued: April 26, 2012</b>  <b>Revised: June 19, 2012</b>	<b>Policy Contact:</b> Director of Environmental Health and Safety <a href="mailto:TSweitze@mines.edu">TSweitze@mines.edu</a>

- Stand clear from the regulator and valve outlet while opening the cylinder valve.
- Do not use a cylinder if the valve is difficult to operate.
- Close the cylinder valve anytime the gas cylinder is not in use.
- Leak-test lines and connections with soap and inert gas prior to using.
- Use compatible tubing to deliver gas to research apparatus.
- Do not use plastic tubing to deliver flammable, toxic or pyrophoric gas to a research apparatus.

**3.4 Maximum Allowable Storage Quantities:** International Building Code (IBC) and International Fire Code (IFC) regulate the maximum allowable storage quantity of flammable gas in campus buildings. The IBC and IFC maximum allowable storage limits for compressed gas cylinders is based on building control areas and not individual laboratory locations. Maximum allowable storage limits for flammable gases decreases significantly for each increase in building level above the ground floor.

Appendix 1 can be used as a general guideline to identify the maximum allowable storage limit for flammable gas. EHS is required to conduct a preliminary evaluation for IBC and IFC compliance for the use of flammable gas cylinders on the third or fourth floor of a building.

## 4.0 RESPONSIBILITIES

### 4.1 Responsibility of the Users:

- Compressed gas cylinders must be handled only by experienced and properly trained personnel. Training is available through EHS. Please contact EHS for Compressed Gas Cylinder Training program. This includes familiarity with hazard communication information on the cylinder label and the product's MSDS.
- Users must ensure they are obtaining the correct gas for their application. Please read the label to ensure you are using the correct gas, gas mixture and concentration. The color of the cylinder or cap does not identify the gas contained inside.
- Users must inspect the cylinder to ensure the label is intact and legible, the cap or valve protection device is in place, the cylinder is not damaged in any way, and the hydrostatic test date is less than 5 years old on steel and aluminum cylinders. Cylinders with a five point star stamped next to the test date meet certain cylinder specifications and qualify for a 10 year test interval.
- Cylinders failing this inspection should be returned to the vendor or turned into EHS for disposal.
- Users must not modify, tamper or deface any part of the cylinder, pressure relief valve, cylinder valve, or regulator.
- A leaking cylinder should be removed or isolated in a well-ventilated area. Please call EHS to report a leaking compressed gas cylinder.

	<b>Compressed Gas Cylinder Policy</b>	<b>Responsible Administrative Unit:</b> Finance and Administration
	<b>Issued: April 26, 2012</b>  <b>Revised: June 19, 2012</b>	<b>Policy Contact:</b> Director of Environmental Health and Safety <a href="mailto:TSweitze@mines.edu">TSweitze@mines.edu</a>

- Lecture bottles may be ordered through the [Chemical Storage and Distribution Facility](#). Full and half sized cylinders are ordered by departments through local vendors.

#### 4.2 Responsibility of EHS:

- EHS will maintain a compressed gas cylinder training program to identify the procedures to safely store, handle and use compressed gas cylinders on the Mines campus.
- EHS will maintain and update this compressed gas cylinder policy following changes in OSHA regulations, applicable building codes; or as needed following an accident or incident involving a compressed gas cylinder.
- EHS will maintain the Chemical Storage and Distribution Facility to purchase, store and inventory lecture bottles.
- EHS will conduct inspections to insure compliance with these procedures.

## 5.0 DEFINITIONS

Note: Many gases exhibit more than one hazard. In the examples quoted in this section, to provide the best protection to the user, most severe hazard of a gas has been designated with a (P) for Primary. Any additional hazards for which additional precautions are recommended have been designated with an (S) for Secondary.

**5.1 Asphyxiating gas:** Is usually inert, that may cause suffocation by displacing the oxygen in the air necessary to sustain life.


Examples: Acetylene (S), Argon (P), Carbon Dioxide (P), Ethane (S), Helium (P), Hydrogen (S), Liquid Nitrogen (P), Methane (S), Nitrous Oxide (P), Propane (S), Sulfur Hexafluoride (P)

**5.2 Compressed gas:** A gas or mixture of gases having an absolute pressure exceeding 40 psi at 70 degrees F (21.1 degrees C) or, a gas or mixture of gases having an absolute pressure exceeding 104 psi at 130 degrees F (54.4 degrees C) regardless of the pressure at 70 degrees F, or, a liquid having a vapor pressure exceeding 40 psi at 100 degrees F (37.8 degrees C).

**5.3 Corrosive Gas:** A gas that causes visible destruction of, or irreversible alterations in living tissues by chemical action at the point of contact or which requires a DOT Corrosive label.

Examples: Ammonia (P), Chlorine (S)

**5.4 Cryogenic fluid:** A refrigerated liquefied gas having a boiling point colder than - 90 deg C (- 130 deg F) at 14.7 psi absolute, or which DOT requires the label of non-flammable,

	<b>Compressed Gas Cylinder Policy</b>	<b>Responsible Administrative Unit:</b> Finance and Administration
	<b>Issued: April 26, 2012</b>  <b>Revised: June 19, 2012</b>	<b>Policy Contact:</b> Director of Environmental Health and Safety <a href="mailto:TSweitze@mines.edu">TSweitze@mines.edu</a>

nonpoisonous compressed gas including - compressed gas, liquefied gas, pressurized cryogenic gas, compressed gas in solution, asphyxiating gas, and oxidizing gas.

Examples: Ammonia (S), Ethane (S), Liquid Nitrogen (S), Propane (S).

**5.5 Flammable gas:** A gas which, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of 13 percent by volume or less, or a gas which at ambient temperature and pressure, forms a range of flammable mixtures with air wider than 12 percent by volume, regardless of the lower limit, or one that requires a red Flammable gas label.

Examples: Acetylene (P), Ammonia (S), Arsine (S), Carbon Monoxide (S), Ethane (P), Germane (S), Hydrogen (P), Methane (P), Propane (P), Silane (P).

**5.6 Oxidizer gas:** A gas that is nonflammable but can support and vigorously accelerate combustion in the presence of an ignition source and fuel or requires a yellow DOT oxidizer label.

Examples: Compressed air (S), Chlorine (S), Nitric Oxide (S), Nitrous Oxide (S), Oxygen (P).

**5.7 Toxic gas:** a gas that has a lethal concentration (LC 50) in air of 2000 ppm or less by volume of gas (Highly Toxic has an LC 50 of 200 ppm or less) or gas that requires a DOT poison label.

Examples: Arsine (P), Carbon Monoxide (P), Chlorine (P), Germane (P), Nitric Oxide (P).

## 6.0 REFERENCES

Occupational Safety and Health Administration (OSHA) 29 CFR 1910.101 Compressed Gases.  
 OSHA 29 CFR 1910.1450 – Occupational Exposure to Hazardous Chemical in Laboratories.  
 OSHA 29 CFR 1910.1200 – Hazard Communication.  
 Compressed Gas Association Pamphlet P-1-1965  
 2009 International Fire Code (IFC)  
 2009 International Building Code (IBC)

## 7.0 ATTACHMENTS

Please see Appendix 1 below.

## Appendix 1

### 2009 IBC Maximum Allowable Storage Quantity Flammable Gas

Building Floor Location	Base Maximum Allowable Quantity Per Control Area (Cubic Feet @NTP)	Maximum Allowable Quantity In Vented Gas Cabinets Per Control Area (Cubic Feet @NTP)	Maximum Number of Control Areas Per Floor	Maximum Number of Full Sized Cylinders Per Control Area <sup>1</sup>	Maximum Number of Full Sized Cylinders per Control Area In Vented Gas Cabinets <sup>1</sup>
Basement	1500	3000	3	6	12
First Floor	2000	4000	4	8	16
Second Floor	1500	3000	3	6	12
Third Floor	1000	2000	2	4	8
Fourth Floor	250	500	2	1	2

Maximum allowable storage volumes identified includes IBC allowance to increase storage volumes in buildings protected by a sprinkler system.

1 - Maximum number of cylinders is an estimate using an average of 250 cubic feet of gas per standard sized cylinders. Please see the following for actual flammable gas volumes for standard sized cylinders of hydrogen, methane, and carbon monoxide.

Hydrogen – Matheson Tri Gas/General Air 1A Cylinder - 213 Cubic Feet

Methane – Matheson Tri Gas/General Air 1A Cylinder - 286 Cubic Feet

Carbon Monoxide – Matheson Tri Gas/General Air 1A Cylinder - 175 Cubic Feet