A. POLICY


B. PURPOSE

This policy provides hazard warning and safety precaution information to users of compressed gas cylinders. This policy applies to all Alvernia University personnel and contractors working with compressed gas cylinders. The City of Reading Fire Department is the authority having jurisdiction established to enforce laws, regulations, and standards pertaining to the storage and handling of compressed gas cylinders.

Compressed gas cylinders are used in many workplaces to store gases that vary from extremely flammable (acetylene) to extremely inert (helium). Many compressed gas cylinders are stored at extremely high pressures (up to 2,500 pounds per square inch gauge or PSIG). A sudden release of these gases can cause a cylinder to become a missile-like projectile. Cylinders have been known to penetrate concrete-block walls. If handled properly, compressed gas cylinders are safe. If handled improperly, the same cylinders can present a severe hazard to Alvernia University employees and property.

C. DEFINITIONS

“Combustible material” means any liquid, solid mixture, substance, or compound that emits a flammable vapor at temperatures between 100 degrees Fahrenheit and 300 degrees Fahrenheit when tested in a Tagliabue open cup tester (i.e. fuel oil).

“Compressed gas” means a material in a container with an absolute pressure greater than 276 kilopascals (kPa), or 40 psi (pounds per square inch) at 21 degrees Celsius or an absolute pressure greater than 717 kPa (104 psi) at 54 degrees Celsius, or both, or any liquid flammable material having a Reid vapor pressure greater than 276 kPa (40 psi) at 38 degrees Celsius.

“Corrosive gas” means a gas that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the point of contact or is labeled by the DOT as Division 2.3 and Division 8 (Corrosive).

“DOT” means the U.S. Department of Transportation which oversees federal highway, air, railroad, and maritime and other transportation functions.

“Fire” means a chemical reaction known as combustion. It involves the rapid oxidation of a combustible material and the release of energy in the form of heat and light. Oxygen, heat, and fuel in proper proportions create a fire.

“Flammable gas” means a gas which may be ignited when mixed with air in certain concentrations (i.e. acetylene, methane, hydrogen).

“Ignition Source” means that for a flammable gas within its flammable limits (or oxidizing gas to ignite), an ignition source must be present. There are many possible ignition sources including open flames, sparks, and hot surfaces.
“Oxidizer gas” means a gas that is nonflammable but can support and vigorously accelerate combustion in the presence of an ignition source and a fuel or is labeled by the DOT as Division 2.2 and Division 5.1 (Oxidizer).

“psi” means a measurement unit used when describing the pressure of a gas inside a cylinder. The letters psi stand for pounds per square inch.

“Toxic gas” means a gas that has a median lethal concentration (LC50) in air of 2,000 parts per million or less by volume of gas (Highly Toxic has an LC50 of 200 ppm or less); or, a gas which the DOT requires the white poison label or is labeled as Division 2.3 “Gas poisonous by inhalation” because it is known to be so toxic to humans as to pose a hazard to health during transportation; or a gas that has an NFPA Health Hazard Rating of 3 (Toxic) or 4 (Highly Toxic).

D. RESPONSIBILITIES
1. Alvernia University Safety Technician is responsible for:
   a. Developing and maintaining the Alvernia University Compressed Gas Safety Policy
   b. Providing guidance and information on the use, storage, and transportation of compressed gas cylinders
   c. Perform quarterly inspections of all gas cylinders on campus

2. Alvernia University personnel who use compressed gas cylinders are responsible for:
   a. Reading, understanding, and following the markings and label(s) on the cylinder and the material safety data sheets (MSDS).
   b. Wearing appropriate personal protective equipment.

3. Vendors are responsible for:
   a. Delivering properly labeled gas cylinders with safety caps in place.

4. Outside Contractors are responsible for:

E. GAS CYLINDER IDENTIFICATION
1. All compressed gas cylinders must bear labels that clearly identify the contents.
2. Always read the cylinder label. The contents of any compressed gas cylinder must be clearly identified. Gas identification should be stenciled or stamped on the cylinder or a label.
3. No compressed gas cylinder should be accepted for use that does not legibly identify its contents by name. If the labeling on a cylinder becomes unclear, the cylinder should be marked “contents unknown” and returned to the supplier.
4. Do not rely on the color of the cylinder for identification. Color-coding is not reliable because cylinder colors may vary with supplier. Also, never rely on labels on caps because they are interchangeable.
5. Signs should be posted in areas where flammable compressed gases are stored or used, identifying the substance and appropriate precautions.
F. GAS CYLINDER HANDLING

Before cylinders are first used, the following precautions should be taken:

a. Make sure the cylinder is equipped with the correct regulator
b. Inspect the regulator and cylinder valves for grease, oil, dirt, and solvent. Never use grease or oil to lubricate regulators or cylinder valves because they can cause an explosion
c. The cylinder should be placed so that the valve handle at the top is easily accessible
d. Only use wrenches or tools that are provided by the cylinder supplier to open or close a valve. Pliers should never be used to open a cylinder valve. Some regulators require washers; this should be checked before the regulator is fitted.
e. Refer to Material Safety Data Sheet (MSDS) for the gas being used for information regarding use and toxicity
f. Fire extinguishing equipment should be readily available when combustible materials can be exposed to welding or cutting operations using compressed cylinder gases.

G. GAS CYLINDER STORAGE

1. Gas cylinders must be secured at all times to prevent tipping.
2. Use appropriate material, such as chain, plastic coated wire cable, commercial straps, etc., to secure cylinders.
3. Gas cylinders may not be stored in public hallways or other unprotected areas.
4. Cylinders must be segregated in hazard classes while in storage. Oxidizers (such as oxygen) must be separated from flammable gases, and empty cylinders must be isolated from filled cylinders.
5. The proper storage for oxygen cylinders requires that a minimum of 20 feet is maintained between flammable gas (ie. acetylene) cylinders and oxygen cylinders or the storage area be separated, at a minimum, by a firewall five (5) feet high with a fire rating of 30 minutes.
6. Store out of direct sunlight and away from sources of heat and ignition; temperatures must not exceed 125° F.
7. Acetylene cylinders must never be stored on their sides.
8. Always place valve protectors on gas cylinders when the cylinders are not connected for use.
9. Cylinders must be protected from damage. Do not store cylinders near elevators, gangways, or in locations where heavy-moving objects may strike or fall on them.
10. Cylinders must be stored where they are protected from the ground to prevent rusting.
11. Cylinders should be protected against tampering by unauthorized individuals.
12. Storage areas must be well-ventilated, cool, dry, and free from corrosive materials.

H. MOVING GAS CYLINDERS

1. Never drag, slide or roll a cylinder; use a cylinder cart or dolly.
2. Cylinders must be transported upright (with the valve up), and must be securely fastened to prevent them from falling or being knocked over.
3. Always have the protective cap covering the valve when transporting the cylinder.
4. Never transport the cylinder with the regulator in place.
5. Make sure the cylinder is secured to the cart or dolly before moving it.
6. Do not drop cylinders or strike them against each other or against other surfaces violently.
7. Do not use the valve cover to lift cylinders; they could be damaged and become
unattached. If the cylinder is dropped on a hard surface, it can cause an explosion.

I. GENERAL GAS CYLINDER USE AND OPERATION
1. Only properly trained personal should handle compressed gas cylinders.
2. Open the valve slowly and only with the proper regulator in place. Stand with the cylinder between yourself and the regulator (cylinder valve outlet facing away) when opening the cylinder valve.
3. Never heat a cylinder to raise the pressure of the gas (this can defeat the safety mechanisms built in by the supplier).
4. Keep the cylinder clear of all electrical circuits, flame, and sparks.
5. Never leave the valve open when equipment is not in use, even when empty; air and moisture may diffuse through an open valve, causing contamination and corrosion within the cylinder.
6. Do not refill a cylinder, mixing of residual gases in a confined area may cause a dangerous reaction.
7. Never use compressed gas to dust off clothing; this could cause injury to the eyes or body and create a fire hazard. Clothing can become saturated and burst into flames if touched off by an ignition source such as a spark or cigarette.
8. Never leave pressure in a regulator when it is not in use.
9. Valve protection caps should remain in place until ready to withdraw gas, or connect to a manifold.
10. Cylinder discharge lines should be equipped with approved check valves to prevent inadvertent contamination of cylinders connected to a closed system.
11. Do not force connections that do not fit.
12. Close the cylinder valve and release all pressure before removing the regulator from the cylinder.
13. Do not smoke when oxygen or fuel gases are present. Smoking can cause a fire or explosion.
14. Purge fuel and oxygen hoses individually before lighting up a torch tip.
15. Follow the equipment manufacturer’s operating instructions at all times.
16. If an outlet valve becomes clogged with ice, thaw it with warm water (if the gas is not water reactive), applied only to the valve.
17. Use the cylinder valve for turning gas off, not the regulator.
18. Employees should wear proper personal protective equipment (PPE) such as safety glasses and/or face shields when handling and using compressed gases, especially when connecting and disconnecting regulators and lines.
19. Oxygen is not compressed air – it is Oxygen. Never use oxygen as a substitute as a “compressed air” to run pneumatic tools, in oil heating burners, to start internal combustion engines, to blow out pipelines, or to create pressure for ventilation.
20. Oxygen cylinder valves should be opened all of the way during use.

J. SPECIFIC GAS CYLINDER PROCEDURES
1. Flammable Gases (ie. Acetylene, Propane)
   a. Not more than 100 cubic feet of flammable gas can be used and stored (combined quantity) in a fire control area. In a laboratory 500 square feet or less, not more than 6 cubic feet of flammable gas, and in larger laboratories, not more than 0.012 cubic feet per
square feet of lab work area of flammable gas can be used and stored. In addition, lecture bottle cylinders must be limited to 25 (10 in instructional laboratories).

b. Flammable gases must be stored in well-ventilated areas away from flammable liquids, combustible materials, oxidizers, open flames, sparks and other sources of heat or ignition. A distance of 20 feet or a noncombustible barrier at least 18 inches above the tallest container, but not less than 5 feet and laterally not less than 18 inches beyond the sides of the containers and having a fire rating of at least ½ hour is the minimum separation requirement.

c. Portable fire extinguishers (carbon dioxide or dry chemical type) must be available for fire emergencies where flammable gas is stored.

d. Spark-proof tools should be used when working with flammable gas cylinders.

e. "Flow" experiments with flammable gases are not to be left unattended; an explosimeter or combustible gas alarm must be used.

f. In the event of an emergency involving a flammable gas, such as a gas leak, fire or explosion, personnel must immediately evacuate the area. Do not attempt to extinguish burning gas if the flow of product cannot be shut off immediately and without risk.

g. All lines and equipment associated with flammable gas systems must be grounded and bonded.

h. Acetylene should not be utilized in lines or hoses at a pressure exceeding 15 psi.

i. Acetylene or other flammable gas cylinder valves should not be opened more than ½ turns of the spindle, and preferably no more than ¾ of a turn. This reduces the risk of explosion and allows for the cylinder valve to be closed quickly to cut off the gas flow.

j. Never use copper fittings or tubing on acetylene tanks – an explosion may result.

2. Asphyxiant Gases (ie. Nitrogen)

a. Do not store asphyxiant gases in areas without ventilation. This includes environmental chambers (e.g. cold boxes) that do not have a fresh air supply or exhaust system.

b. Any gas that has the potential to displace oxygen in sufficient quantities can cause asphyxiation. Only persons trained, qualified and using a self contained breathing apparatus (SCBA) with adequate back-up should respond to an inert gas leak or enter an area where an asphyxiant gas could be present. Shut off the source of the gas leak only if there is no risk to personnel and then ventilate the area. If a person has symptoms of asphyxiation, move the victim to fresh air then call 911.

3. Oxidizer Gas (ie. Oxygen)

a. Not more than 1500 cubic feet of oxidizing gas can be used and stored (combined quantity) in a fire control area. In a laboratory 500 square feet or less, not more than 6 cubic feet, and larger laboratories, not more than 0.012 cubic feet per square feet of lab work area can be used and stored. In addition, lecture bottle cylinders must be limited to 25 (10 in instructional laboratories).

b. All equipment used for oxidizing gases must be cleaned with oxygen-compatible materials free from oils, greases, and other contaminants (hydrocarbons and neoprene are not oxygen-compatible; PTFE Teflon is compatible. The equipment will state that it is oxygen compatible). Do not handle cylinders with oily hands or gloves.

c. Oxidizers shall be stored separately from flammable gas containers or combustible materials. A distance of 20 feet or a noncombustible barrier at least 5 feet high having a
4. Corrosive Gases (ie. Chlorine, Ammonia)
   a. Not more than 810 cubic feet of corrosive gas can be used and stored (combined quantity) in a fire control area.
   b. Keep exposure to gas as low as possible. Use in fume hood or other vented enclosure when possible. Avoid contact with skin and eyes.
   c. Wear safety goggles when handling compressed gases which are corrosive.
   d. An emergency shower and eyewash must be installed within 50 feet where corrosive materials, including corrosive gases, are used.
   e. An emergency response procedure must be in place and everyone working in the area must be trained on the procedures.
   f. Safety plugs in the valves of chlorine cylinders fuse at 157 degrees F. Care must be exercised to see that they are not exposed to steam, hot water, etc. which could produce this temperature. Chlorine leaks may be located using a cloth wet with aqueous ammonia which will produce white fumes (ammonia chloride) in the presence of chlorine.
      NOTE: This procedure may only be performed with appropriate respiratory protection. Refer to the Alvernia University Respiratory Protection Program and the Chemical Hygiene Plan.

5. Toxic and Highly Toxic Gases (ie. Phosgene, Cyanide)
   a. Not more than 1,620 cubic feet of toxic gas can be in storage and 810 cubic feet in use in a fire control area. Not more than 40 cubic feet of highly toxic gas can be in storage and 20 cubic feet in use in a fire control area. In a laboratory 500 square feet or less, not more than 0.3 cubic feet, and larger laboratories, not more than 0.0006 cubic feet per square feet of lab work area can be used and stored. In addition, lecture bottle cylinders must be limited to 25 (10 in instructional laboratories).
   b. Lecture bottle-sized cylinders for all gases that have a health hazard rating of 3 or 4 or a health hazard rating of 2 without physiological warning properties, must be kept in a continuously mechanically ventilated hood or other continuously mechanically ventilated enclosure. Larger cylinders of toxic or highly toxic gas must be stored in gas cabinets, exhausted enclosures or gas rooms.
   c. Toxic and highly toxic gases shall not be stored or used outside of academic or research laboratories.
   d. Keep exposure to gas as low as possible. Use in fume hood or other vented enclosure when possible. Avoid contact with skin and eyes.
   e. Wear safety goggles when handling compressed gases which are toxic or highly toxic.
   f. A gas detection system with visible and audible alarms to detect the presence of leaks, etc. must be installed for all toxic and highly toxic gases when the physiological warning properties for the gas are at a level below the accepted permissible exposure limit or ceiling limit for the gas.
   g. An emergency response procedure must be in place and everyone working in the area must be trained on the procedures.
6. Cryogenic Gases (ie. Liquid Nitrogen)
   a. Wear face shield and chemical safety goggles when dispensing from cylinder or dewar toxic
   b. Wear appropriate insulated gloves to protect from the extreme cold when handling cryogenic containers. Gloves need to be loose fitting so that they can be readily removed in the event liquid is splashed into them. Never allow an unprotected part of the body to touch uninsulated pipes or containers of cryogenic material.
   c. Keep liquid oxygen containers, piping, and equipment clean and free of grease, oil, and organic materials.
   d. Do not store cylinders or dewars in environmental chambers that do not have fresh air ventilation. A leak or venting from the container could cause an oxygen deficient atmosphere.
   e. Large stationary cryogenic systems and piping have additional requirements.
   f. First aid treatment for cold-contact burns:
      i. Remove any clothing not frozen to the skin that may restrict circulation to the frozen area. Do not rub frozen parts, as tissue damage may result. Obtain medical assistance as soon as possible.
      ii. Place the affected part of the body in a warm water bath (not to exceed 40°C). Never use dry heat.

7. Pyrophoric Gases (ie. Silane)
   a. Not more than 250 cubic feet of pyrophoric gas can be in a storage area.
   b. Lecture bottle-sized cylinders for pyrophoric (e.g. Silane) gases must be kept in a continuously mechanically ventilated hood or other continuously mechanically ventilated enclosure.
   c. Silane gas with a concentration of 2% or more by volume silane has additional safety requirements for flow control, exhausted enclosures or gas cabinets and emergency power.

K. GAS CYLINDERS USED FOR WELDING OR CUTTING
   1. Devices or attachments mixing air or oxygen with combustible gases prior to consumption, except at the burner or in a standard torch shall not be allowed unless approved.
   2. Storage, handling, and use of compressed gas cylinders, containers, and tanks will be in accordance with the Alvernia University Compressed Gas Cylinder policy.
   3. Cylinders, valves, regulators, hoses, and other apparatus and fittings for oxygen shall be kept free from oil or grease. Oxygen cylinders, apparatus and fittings shall not be handled with oily hands, oily gloves, or greasy tools or equipment.
   4. The torch valve shall be closed and the gas supply to the torch completely shut off when gas welding or cutting operations are discontinued for a period of one (1) hour or more.

L. CYLINDER LEAKS
   1. If the cylinder contains a flammable, inert, or oxidizing gas, remove it to an isolated area, away from possible ignition sources, if possible. Contact the Alvernia University Safety Technician and/or the Director of Science Laboratory Services & Safety immediately. In the event of an emergency involving a flammable gas, such as a gas leak, fire or explosion, personnel must immediately evacuate the area. Do not attempt to extinguish
burning gas if the flow of product cannot be shut off immediately and without risk.
2. If the gas is a corrosive, contact the Alvernia University Safety Technician and/or the Director of Science Laboratory Services & Safety immediately.
3. For toxic materials, contact the Alvernia University Safety Technician and/or the Director of Science Laboratory Services & Safety immediately.
4. If the leak is at the junction of the cylinder valve and cylinder, do not try to repair it. Contact the Alvernia University Safety Technician and/or the Director of Science Laboratory Services & Safety immediately.
5. Never use a flame to detect a gas leak. Use soapy water.

Contact the Alvernia University Safety Technician (610-796-8231) and/or the Director of Science Laboratory Services & Safety (610-790-2865) for all compressed gas cylinder leaks.

M. EMPTY CYLINDERS
1. If the cylinder is empty, replace the cap and remove it to the empty cylinder storage area.
2. Label all empty cylinders with tags so that other personnel will know their status. Mark empty cylinders with the word “Empty” or the letters “MT” and the date.
3. Handle empty cylinders as carefully as full ones; residual pressure can be dangerous.
4. Never refill a cylinder. This requires specialized equipment and techniques.
5. Never mix gases in a cylinder. The next person who draws from it may unknowingly cause an explosion.

N. HOSES AND CONNECTIONS
1. Examine hoses regularly for leaks.
2. Do not use unnecessarily long hoses.
3. Keep hoses free from kinks and away from high traffic areas.
4. Repair leaks in hoses and connections promptly and properly.
5. Store hoses in a cool place, and protect them from hot objects, and sparks.
6. Do not use a single hose having more than one gas passage.

O. INSPECTIONS
The Alvernia University Safety Technician will perform quarterly inspections to determine that compressed gas cylinders are in a safe working condition to the extent that can be determined by a visual inspection. Visual and other inspections will be conducted as prescribed in the Hazardous Materials Regulations of the Department of Transportation (49 CFR parts 171-179). Where those regulations are not applicable, visual and other inspections shall be conducted in accordance with Compressed Gas Association Pamphlets C-6-1968 and C-8-1962.

P. EMPLOYEE TRAINING
Training must be conducted:
1. For Alvernia University employees who use compressed gas cylinders
2. The video “Compressed Gases: The Correct Way to Use Acetylene and Oxygen” by the Pennsylvania Bureau of Deep Mines will be shown annually to all Alvernia University personnel authorized to perform “Hot Work” operations.
Q. OUTSIDE CONTRACTORS

R. REFERENCES
2. Compressed Gas Association Pamphlet P-1-1965
3. Compressed Gas Association Pamphlets C-6-1968 and C-8-1962
5. Code of Federal Regulations, Title 49, Parts 171-179
6. Fire Marshall Todd Iaeger, City of Reading (PA) Department of Fire & Rescue Services
7. Alvernia University Welding, Cutting and Brazing "Hot Work" Program