

**UNIVERSITY OF ROCHESTER
ENVIRONMENTAL HEALTH & SAFETY**

Policy No.: LS004	Approved by: Mike Liberty
Title: Compressed Gas Safety Policy	Date: 3/18/2022
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Prepared by: Carolyn M. Place	
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I. PURPOSE

It is a requirement that all University of Rochester employees who handle compressed gases understand the health and safety hazards of the compressed gas cylinders, including proper handling, use, storage, and emergency procedures. Failure to follow these requirements may result in injury or death. All employees must also abide by all local, state, and federal laws.

The gas contents in a cylinder can present physical and/or health hazards to users. The gas may be classified as flammable, toxic, corrosive, pyrophoric, oxidative, an asphyxiant, and/or may present a combination of these hazards. Because gas cylinder contents are under high pressure, any uncontrolled release can create a hazardous situation in the area in a very short period of time. Therefore, personnel must follow all established operating procedures when using gas cylinders to ensure the cylinders are properly utilized, transported, and stored.

Additional information is available by contacting Environmental Health & Safety.

This document does not cover cryogenic cylinders. The appropriate documentation for cryogenics can be found at:

<https://www.safety.rochester.edu/labsafety/guidelines/cryogenicsafety.html>.

II. PERSONNEL AFFECTED

This policy establishes requirements for all competent personnel to safely handle and use compressed gas cylinders. A competent user is defined as someone who is authorized to use compressed gases after completing a University of Rochester sanctioned online training course with a knowledge-based test, as well as a hands-on practical training that is site-specific and overseen by their Supervisor. Training must be completed BEFORE an employee is allowed to handle compressed gases.

The online training courses can be found through the University of Rochester's MyPath website. There are several training courses for compressed gases depending on the type of work with compressed gases. Please note that **ALL** EH&S Laboratory Safety Training courses contain both compressed gas and cryogenic liquids training.

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III. DEFINITIONS

Asphyxiant Gas: A gas, or mixture of gases that displaces oxygen in the ambient atmosphere, and can thus cause oxygen deprivation in those in the environment, leading to unconsciousness and potentially death.

Compressed Gas: Any contained material or mixture having either an absolute pressure exceeding 40 pounds per square inch at 70°F (21.1°C), or an absolute pressure exceeding 104 pounds per square inch at 130°F (54.4°C), regardless of the pressure at 70°F (21.1°C); or, a liquid having a vapor pressure exceeding 40 psi at 100°F (37.8 °C) as determined by ASTM D-323-72.

Cryogenic Liquid: A cryogenic liquid is any liquid with a boiling point less than -238°F (-150°C). The most common cryogenic liquids at the University of Rochester include oxygen and nitrogen.

Flammable Gas: Any material which has a boiling point of 68°F (20°C) or less at 14.7 psia (101.3 kPa, abs) which is ignitable at 14.7 psia (101.3 kPa, abs) when in a mixture of 13% or less by volume with air and has flammable range at 14.7 psia (101.3 kPa, abs) with air of at least 12%, regardless of the lower limit. These limits shall be determined in accordance with ASTM E681 Standard Test Method for Concentration Limits of Flammability of Chemicals, or an approved equivalent.

Compressed Medical Gas: Medical liquefied or vaporized gas alone, or in combination with other gases, that is a drug as defined by the Federal *Food, Drug, and Cosmetic Act*; 21 USC Section 321 (2)(g)(1). NOTE- compressed medical gases include the following: Gas(es) recognized in the current USP-NF and its supplements, and gas(es) intended for direct use in the diagnosis, cure, mitigation, treatment, or prevention of diseases in a man or animals that achieve its intended purpose through chemical rather than physical means.

Toxic Gas: Any Material which has a boiling point of 68°F (20°C) or less at 14.7psia (101.3 kPa, abs) that is known to be so toxic to humans as to pose a hazard to health, and in the absence of adequate data on human toxicity, is presumed to be toxic to humans because when tested in laboratory animals it has an LC₅₀ not more than 5000ml/m³.

IV. RESPONSIBILITIES

It is the responsibility of all Supervisors, Managers, and trainers, to ensure that all employees who work with compressed gases are properly trained in their knowledge, duties, and the

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standard operating procedures surrounding compressed gases. It is the responsibility of those approved and deemed competent by their Supervisors to transport, store, and use gas cylinders utilizing the standard operating procedures established for their location.

V. PROCEDURES

A. General Requirements

- 1. Before** using any cylinder for any purpose, check the label for the proper contents. Contents of the gas cylinder must be clearly identified. **DO NOT** rely upon color-coding as a reliable means of identification. Do not deface or remove any markings, tags, or stencil marks used by the vendor for identification of the contents. Cylinders that do not have stamped, stenciled, or written identification of the contents should not be accepted or used; these cylinders need to be segregated and returned to the vendor as soon as possible.
2. Protective caps must be kept on cylinders when the cylinders are **NOT** in use. The cap needs to be hand tightened all the way down on the cylinder neck. The term “in use” is defined as being connected to a piece of equipment or is actively in use.
3. Cylinders must be properly secured at all times to prevent falling.
4. Cylinders or valves that have any visible damage that might impair the integrity of the cylinder, including corrosion, should be called to the attention of the vendor before the cylinder is returned.
5. Do not order lecture bottles from a company unless you can return the cylinder to the company at minimal or no charge. Consult with others in your department to see if a lecture bottle containing the gas needed for a project is already available.
6. Never transfer the contents of a compressed gas cylinder from one cylinder to another.
7. Ensure that a current Safety Data Sheet (SDS) is on hand in all locations and for every type of compressed gas that is being used.
8. Do not use compressed gas, including compressed air, to blow away dust or dirt.
9. **If any cylinder is suspected of leaking, evacuate the room and contact Public Safety (x13, 275-3333). For emergencies at any off-site location, not serviced by the University’s Public Safety Department, contact 911.** When able, notify the supplier of the defective cylinder.
 - For a leaking cylinder containing a **poisonous gas**: Immediately leave the room, close the door(s), pull the nearest fire alarm, evacuate the area and call Public Safety at 275-3333 from a safe location to report the emergency. Be sure to meet the emergency responders to provide any additional information that might be useful.

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- For a cylinder containing **flammable or oxidizing gas**: Follow the same steps as above. Prior to leaving the area, shut off all ignition sources if the shut offs are accessible and can be done safely.

B. Moving and Transporting Cylinders

1. Protective valve caps must be secured when moving cylinders. Never lift or move the cylinder by the cap.
2. Use a hand truck or similar device to move gas cylinders. Never roll or drag a cylinder to move it, or allow a cylinder to strike another tank or any other surface violently.
3. Always wear gloves and eye protection when moving/placing any cylinder.
4. Never use ropes or slings to suspend cylinders unless the attachment points are provided on the cylinder by the vendor.

C. Storing Cylinders

1. Cylinder storage areas must be prominently marked with the hazard class or the name of the gases to be stored. An example includes "Flammable Gas Storage Area". Additional signs such as "No Smoking" need to be posted as well.
2. Secure gas cylinders upright, with valve end up, to a wall, cylinder hand truck, or cylinder rack or post. The gas cylinder should be secured at 2/3 height of the tank if secured with a chain or strap.
3. Never store cylinders in elevator lobbies, stair towers, corridors, or any other location which could obstruct the safe exit pathway of the building occupants.
4. If gases of different types are stored at the same location, the "full" cylinders must be segregated from "empties". Additional segregation includes grouping cylinders by the type of gas, e.g., flammable, oxidizer, or corrosive. Inert gases can be stored with any other type of gas.
5. Cylinders should be used by the "first in, first out" guideline.
6. Cylinders must be stored in a well-ventilated area away from sparks, flames, or any source of heat or ignition. Cylinders may be stored outside on a slab, provided they are protected from the direct rays of the sun and from extreme temperature fluctuations. Do not expose cylinders to temperatures above 125°F. A well-ventilated area is an outside storage location, a gas cabinet (for hazardous gases), or a laboratory with at least 10 air changes per hour (ACH).
7. Cylinders must not be exposed to continuous dampness or stored near salt or other corrosive chemicals. Corrosion may damage cylinder valves. Cylinders containing

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corrosive chemicals must be periodically checked to ensure that the valve has not corroded.

8. Only certain linear equipment areas are deemed suitable for cylinder storage. Contact EH&S to verify if gas cylinders can be stored in linear equipment areas within your location.

D. General Use Precautions

1. Wrenches must not be used on any cylinder valve equipped with a hand wheel. If the valve is faulty (leaking or does not properly seal), tag the cylinder and contact the supplier.
2. Never tamper with or attempt to repair/alter cylinders, valves, or any safety relief devices. Notify and return cylinders to the vendor for all repairs.
3. Do not attempt to remove a stuck cap by using a lever in the cap ports. The lever may accidentally open the valve when the cap turns.
4. Do not place cylinders where they might become part of an electric circuit or allow them to come into contact with an electrically energized system.
5. Use "Snoops", soapy water, or leak detection equipment to ascertain that there are no leaks in the gas transport system. "Snoops" is **NOT** recommended for checking oxygen connections.
6. Use pressure regulators equipped with pressure relief devices.
7. Never permit oil, grease, or other combustible substances to come in contact with cylinders and their valves, particularly oxygen cylinders.
8. All gas lines leading from a gas cylinder must be labeled clearly to identify the gas carried.
9. If a gas cylinder has a Pressure Relief Device (PRD) and it is discovered to be faulty, place a cap on the cylinder (if possible and it is safe to do so) and isolate the cylinder away from personnel and equipment. Call the gas supplier to inform them of the problem. NEVER attempt to tighten the PRD: they are under full cylinder pressure.

E. Utilizing Compressed Gases

1. Before using the gas, read all label information and the Safety Data Sheet associated with the gas.
2. Ensure that the tank has been properly secured to the appropriate stand or structure.
3. Always use the proper regulator for the gas in the cylinder. Always check the regulator before attaching it to a cylinder. If the connections do not fit together readily, the wrong regulator is being used.

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4. Before attaching cylinders to a connection, be sure that the threads on the cylinder and the connection mate, and are of a type intended for gas service.
5. The threads and mating surfaces of the regulator and hose connections must be cleaned before the regulator is attached. Wipe the outlet with a clean, dry, lint-free cloth.
6. Attach the regulator securely with the secondary valve closed and with the regulator flow to the off position (counterclockwise) before opening the cylinder valve wide.
7. To tighten the regulator nut and tube connections, always use a cylinder wrench. Use a second wrench to minimize stress on tubing and fittings where appropriate.
8. **Teflon tape must never be used on cylinder connections or tube-fitting connections.**
9. Open cylinder valves **SLOWLY**. Point the valve opening away from yourself and other persons. Never use a wrench or hammer to open or close a hand wheel type cylinder valve. If the valve is frozen and cannot be operated by hand, return the cylinder to the vendor.
10. Before a regulator is removed from a cylinder, close the cylinder valve and release all pressure from the regulator.
11. Never completely empty a gas cylinder. Discontinue use of the cylinder when it has at least 30 psi remaining. Close the valve and secure the cylinder valve protective cap/outlet cap/plug. Mark the cylinder so that others know that it is empty, e.g., write "EMPTY" on a piece of tape and stick it on the cylinder.

E. Special Precautions for Using Flammable Gases

In addition to the above requirements, the following measures must be taken when handling flammable gases:

1. Cylinders containing flammable gases (empty or full) must be separated from cylinders containing oxidizing gases by a minimum distance of 20 feet or by a barrier at least 5 feet high which has a fire-resistance rating of at least one-half hour (e.g., a concrete block wall).
2. Do not store flammable or oxidizing gases near highly flammable solvents, combustible materials, unprotected electrical connections, gas flames, or any other source of ignition.
3. All flammable gas systems must be grounded and bonded to properly prevent static electricity buildup. Bonded refers to an electrical bond between all pieces. Therefore, it is crucial to ensure that there is no static electricity created or present while using a flammable gas.
4. Non-sparking tools must be used when working with or on flammable compressed gas cylinders/systems.

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5. The quantity of flammable gases in an area must be kept to a minimum. **You must contact EH&S before purchasing and using flammable gases**, as there are limits to the number of cylinders allowed per control area and per floor. Ventilated gas cabinets and other safety devices may be required.
6. Never use compressed oxygen to run air tools. Oxygen and other gases must only be used for their intended purposes.
7. When using acetylene:
 - Never open the cylinder valve more than one complete revolution. Leave the valve key or wrench on the valve whenever the valve is open so that the valve can be closed quickly in case of a fire or accident.
 - Never use acetylene at a pressure greater than 15 psig. The pressure at which the gas is released must not exceed the manufacturer's recommendations.

F. Special Precautions for Using Poison Gases

In addition to the general requirements, the following measures must be taken when handling toxic gases:

1. Acutely toxic gases (with a health hazard warning of 1 or 2 in the GHS rating system) must be stored in a ventilated enclosure: e.g., an approved ventilated gas cabinet or within a fume hood.
2. Gas detection systems may be required in laboratories utilizing poison gases. Contact the Laboratory Safety Unit or the Occupational Safety Unit within EH&S for more information.
3. The quantity of poison gas in a laboratory must be kept to a minimum, as there are limits to the number of cylinders allowed per control area and per floor
4. Properly label and identify areas that utilize poisonous or toxic gases.

G. Special Precautions for Using Oxygen and Oxidizing Gases

In addition to the general requirements, the following measures must be taken when handling oxidizing gases:

1. Do not permit oil or grease to come in contact with cylinders or their valves, especially cylinders containing oxidizing gases. Regulators and tubing used with oxidizing gases must be specially cleaned to remove oil and other reducing agents. Explosions may occur when a pressurized oxidizer (e.g. oxygen) comes into contact with grease or oil.
2. "Snoops" is **NOT** recommended for checking oxygen connections.

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3. Always open an oxygen tank **SLOWLY**. If the cylinder is opened too quickly, the rapid pressurization may create enough heat to start a fire.
4. Cylinders containing oxygen or oxidizing gases, e.g., chlorine (empty or full), must be separated from cylinders containing flammable gases by a minimum distance of 20 feet, or by a barrier at least 5 feet high having a fire-resistance rating of at least one-half hour (e.g., a concrete block wall).
5. Do not store oxidizing gases near flammable solvents, combustible materials, unprotected electrical connections, gas flames, or other sources of ignition.
6. Do not exceed more than two full H size (9"x51") tanks or more than twenty full E size (4 3/16" x 26 1/2") portable tanks, containing an oxidizing gas, including oxygen, in any given area.

I. Instructions for Medical Professionals:

1. Store cylinders in approved areas with labeled signs. Do not store cylinders in public areas, such as corridors or stair wells.
2. Properly secure cylinders when "in storage" in racks or stands.
3. Secure cylinders when "in use". Whether attended or not, a cylinder is "in use" when in a wheelchair, stretcher, gurney, or bed. Ensure that it is properly secured at all times, and that the gauges can be read on the cylinder.
4. Do not lay oxygen cylinders on top of patients or on stretchers.
5. Smoking, open flames, or heat sources are prohibited in oxygen and flammable gas storage/use areas.
6. Unnecessary medical gases must not be stored in an operating room.
7. Separate empty and full cylinders, and label them accordingly. Segregate cylinders according to contents.
8. Ensure that cylinders are always kept in an upright and secured position.
9. Ensure that the correct regulator is being used for the specific type of gas.
10. If the gas to be used is flammable, make sure the entire gas system is grounded and bonded. Bonded refers to an electrical bond between all pieces. Therefore, it is crucial to ensure that there is no static electricity created or present while using a flammable gas.
11. Always open an oxygen tank **SLOWLY**. If the cylinder is opened too quickly, the rapid pressurization may create enough heat to start a fire.
12. Never lift a cylinder by its cap.
13. Do not change cylinders located in the SMH Gas Cylinder Storage Room (G-1219). These are only to be maintained by AirGas personnel.
14. Use of anesthetic gas is only to be used by specifically trained staff. The staff member must have documented training and be certified by their Supervisor.

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J. Instructions for Facilities:

1. Always wear gloves and eye protection when moving/placing any cylinder.
2. Move cylinders into the use location and secure tank to a wall or stand before removing the protective cap.
3. Use a spark-free wrench to connect a regulator to a flammable gas cylinder
4. Always open a gas cylinder **SLOWLY** to prevent rapid pressurization and compressive heat that can cause an explosion.
5. If a gas cylinder has a Pressure Relief Device (PRD) and it is discovered to be faulty, place a cap on the cylinder (if possible and it is safe to do so) and isolate the cylinder away from personnel and equipment. Call the gas supplier to inform them of the problem. NEVER attempt to tighten the PRD: they are under full cylinder pressure.
6. Spark producing tools such as drills, grinders, etc. must not be used in flammable gas storage areas.

VI. REFERENCES

Compressed Gas Association. Handbook of Compressed Gases. 5th ed. Chantilly: Compressed Gas Association, Inc., 2013. Print.

Environmental Health & Safety. Compressed Gas Safety Guidelines. University of Rochester. 2004. Print.

VII. APPENDICES/FORMS

VIII. REVISION HISTORY

Date	Revision No.	Description
10/4/2018	New	
3/18/2022	1	Triennial Review – minor updates