



Northern Illinois
University

Compressed Gas Cylinder Policy

Table of Contents

Purpose	2
Policy.....	2
Training Requirements.....	2
Labeling.....	3
Valves and Regulators.....	4
Piping Connections and Tubing.....	5
Storage.....	5
Proper Use	8
Transporting Gas Cylinders.....	9
Specific Hazard Classes	11

Purpose

Compressed gas cylinders can present a variety of hazards due to their pressure and/or contents. Improper use, handling, storage, or transportation can cause injury, death, or physical damage to property. The purpose of the Compressed Gas Cylinder Policy (Policy) is to outline safe practices and procedures to ensure compressed gas cylinders are safely used to support campus operations.

Policy

Expectations pertaining to implementation of this Policy are in accordance with polices, codes, and regulations as referenced below. As such, all members of the NIU community are expected to comply with the content outlined in this Policy.

Policies

- NIU Health and Safety Policy
- NIU Facilities Management and Campus Services Safety Policy

Codes and Regulations

- 56 IL Admin Code Part 350 Health and Safety Code
- OSHA 29 CFR 1910.101 General requirements (Compressed Gases)
- OSHA 29 CFR 1910.102 Acetylene
- OSHA 29 CFR 1910.103 Hydrogen/Liquid hydrogen
- OSHA 29 CFR 1910.104 Oxygen/Liquid oxygen
- OSHA 29 CFR 1910.105 Nitrous oxide
- OSHA 29 CFR 1910.253 Oxygen-fuel gas welding and cutting
- OSHA 29 CFR 1926.350 Gas welding and cutting
- DOT 49 CFR 171-179 Hazardous Materials Regulations
- NFPA 55 Compressed gases and Cryogenic Fluids Code

Note:

OSHA – Occupational Safety and Health Administration

DOT – Department of Transportation

NFPA – National Fire Protection Association

The Office of Research Compliance, Integrity, and Safety (ORCIS) and the Environmental Health and Safety Department (EH&S) reserve the right to conduct periodic audits of campus operations to ensure compliance with the Policy. ORCIS and EH&S will also periodically update the Policy as needed to reflect changes to campus operations and/or updates to applicable rules, regulations, and consensus standards.

Training Requirements

All NIU employees (including faculty, staff, researchers, and students) who transport, store, or use compressed gas cylinders at NIU must receive compressed gas cylinder training and will be required to provide proof of training upon request. Initial compressed gas cylinder training can be found here: <https://www.niu.edu/divresearch/compliance/safety/training.shtml> Academic personnel are required to complete this training in addition to laboratory specific training.

Periodic refresher training, as scheduled by a supervisor, is required and retraining will be mandatory under the following conditions:

- Employees who display unsafe workplace practices or violate safety regulations involving the use of compressed gas cylinders or equipment.
- Employees involved in a near miss or accident in which compressed gas cylinders were used.
- Changes in processes or procedures which may alter the way in which compressed gas cylinders are used, handled, or stored.

Labeling

All compressed gases received, used or stored must be labeled according to the United States Department of Transportation (DOT) and the Occupational Safety and Health Agency (OSHA) Hazard Communication regulations.

Compressed gas cylinders must be legibly marked for the purpose of identifying the gas content with either the chemical or the trade name of the gas. Such marking shall be by means of stenciling, stamping, or labeling, and shall not be readily removable. The marking shall be located on the shoulder of the cylinder.

As depicted in the photo for Nitrogen, labeling must list contents, concentrations, hazards classes, safety precautions and the manufacturer or supplier:



- A** Name of Product, **B** Material identification number, **C** Hazard diamond,
D Hazards and precautions, **E** Contact information

If the labeling on the gas cylinder becomes unclear or defaced so that the contents cannot be identified, the cylinder should be marked “contents unknown” and the manufacturer must be contacted regarding appropriate procedures for removal.

Color-coding is not a reliable means of identification. Cylinder colors vary by supplier and labels on caps have no identification value because many caps are interchangeable.

Cylinders must bear an identification tag stating the name of the gas or mixture and illustrating one of three conditions: Empty, In-Use or Full.

Mixed gases must be clearly labeled with the contents of the cylinder. Know the contents of each cylinder that you are using. Preferred labeling includes the identity of the material, statement of hazard, and the associated signal word.

All gas lines leading from a compressed gas supply shall be clearly labeled to identify the gas. Storage areas shall be prominently posted with the hazard class or the name of the gases stored.

Valves and Regulators

The gas cylinder valve shall never be opened without a regulator attached. Regulators reduce high pressure gas on a cylinder or process line to a lower usable level. Regulators come as single stage for short term applications and two stages for long term applications.

The application will define the required regulator. If unsure which kind of regulator to use, consult the gas supplier. Regulators are designed to be fitted directly to the cylinder valve. No other fitting, connections, or lubricants shall be used to connect a regulator to a gas cylinder valve.

The following rules for cylinder valves and regulators shall be followed at all times:

- Use regulators approved for the specific gas.
- Tampering with safety relief devices in cylinder valves is not permitted
- Repair or alter of cylinders, valves, or other safety relief devices is strictly prohibited.
- All cylinder valves shall be kept closed at all times, except when the cylinder is in use.
- Approved pressure regulating devices must be used in all cases when gas pressure in a system is lower than cylinder pressure.
- All cylinder valves shall be opened slowly to prevent ice formation. Appropriate tools shall be used to tighten or loosen tank valves. If the valve will not readily open, return the cylinder to the vendor.
- Before a regulator is removed from a cylinder, the cylinder valve shall be closed, and all pressure released from the regulator and system.
- Be sure the regulator pressure control valve is relieved (or closed) before attaching to the cylinder.
- Remove all pressure from regulators that are not currently used.
- Use pressure relief valves in downstream lines to prevent high pressure buildup in the event that a regulator valve does not seat properly, and a tank valve is left on.
- Pressurize regulators slowly and ensure that valve outlets and regulators are pointed away from all personnel when cylinder valves are opened.
- Leave the wrench in place on the cylinder valve, when needed, to open the main valve. Use adequately sized wrenches (12 inches long) to minimize ergonomic stress when turning tight tank valves. Cylinders with “stuck” valves need to be returned to the vendor for repair.
- Fully open valves during cylinder use. A fully open valve improves the internal seal and helps prevent packing leaks.

- Use a cylinder cap hook to loosen tight cylinder caps. Never apply excessive force to pry off caps.
- Regulators, gauges, hoses, and other appliances used with a particular gas or group of gases must not be used on cylinders containing gases having different chemical properties unless approved in writing by the vendor.

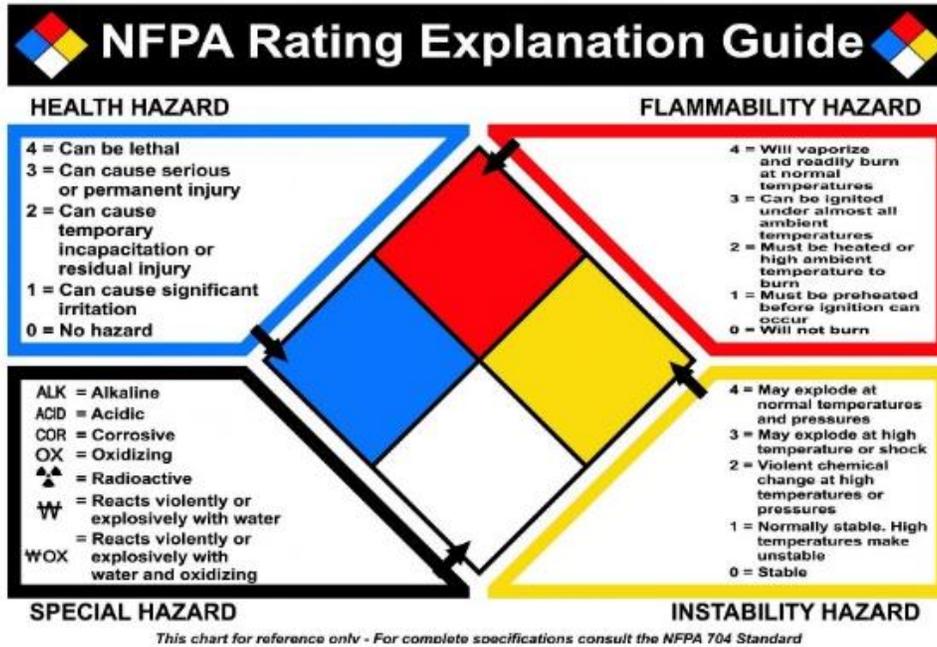
Piping Connections and Tubing

Hazardous gases must be dispensed using systems that are properly cleaned and compatible with the gas in use. “Burst pressure” of tubing and piping must be twice the maximum pressure on the second stage regulator. Exceptions to this requirement may be made for short sections of tubing when it and the compressed gas cylinder are completely enclosed in a fume hood and low pressures and flow rates are used. It is recommended to:

- Select tubing compatible with the chemical and pressure properties of the gas being used in the system. Avoid the use of flexible tubing for highly toxic gases. Flexible tubing should only be used within "line of sight." Do not run flexible tubing through walls, ceiling spaces, doorways, or other non-visible pathways if chafing is likely to occur.
- Never use Teflon tape on cylinder connections or tube-fitting connections
- Always clamp flexible tubing connections. Use a clamp approved for the maximum allowable pressure that the connection is subject to. Never use wire, which may cut the flexible tubing.
- Understand most flexible tubing deteriorates with age or exposure to chemicals or UV light. Replace old flexible tubing before it deteriorates.
- Always leak-check (leak-test) tubing or piping connections when using hazardous gases.
- Secure and support tubing or piping to keep it in place and to prevent "whipping" if a connection fails under pressure.
- Use appropriately rated flexible lines are suitable for manifold/cylinder connections.

Storage

Proper storage is critical for the safe usage of compressed and liquefied gases. Cylinder storage areas should be prominently posted with hazard information regarding the gases stored. The NFPA 704 diamond with a cylinder indicated in the “specific hazard” (white) section of the diamond and the corresponding flammability, health and reactivity hazard sections also marked is an accepted method of signage.

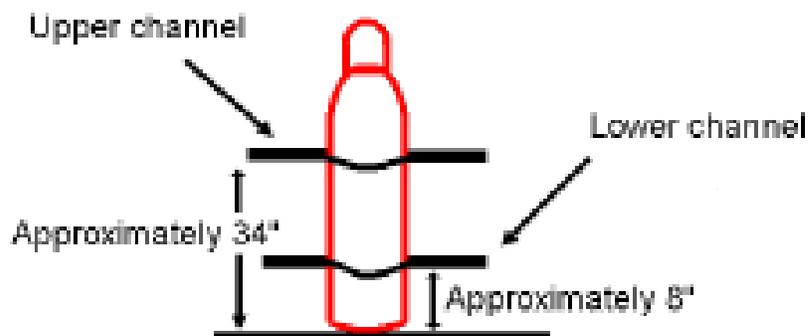
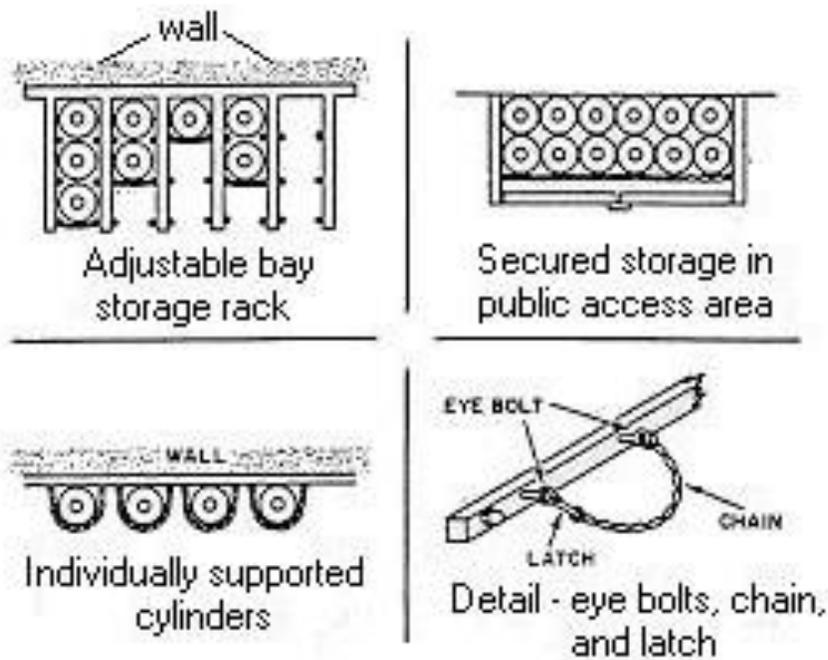


The following precautions must be taken for the storage of compressed gas cylinders:

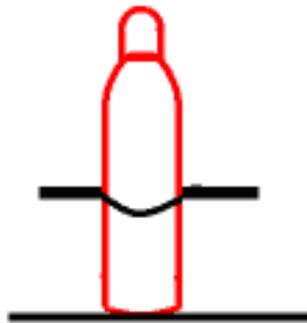
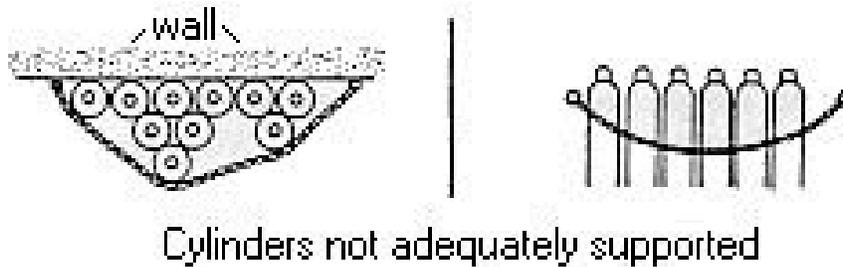
- Store cylinders in a clearly identified, dry, well-ventilated storage area away from doorways, aisles, elevators, and stairs.
- Protect cylinders from contact with ground, ice, snow, water, salt, corrosion, and high temperatures.
- Compressed gas storage area temperatures shall not exceed 125 degrees F (52 C).
- Always store cylinders in an upright position.
- Cylinders shall be capped when not in use or attached to a system (if the cylinder will accept a cap).
- Store cylinders of the same hazard class in the same area (i.e., poison/highly toxic, flammable, inert, corrosive, oxidizer, and cryogenic gas).
- Cylinders must be segregated into “FULL” or “EMPTY” groups at locations or in racks for each category.
- All cylinders, whether full or empty, must comply with NFPA and DOT labeling requirements and OSHA hazard communication requirements. Contents of cylinders should be readily identifiable during inspection. A safety data sheet (SDS) must be available for all gases and gas mixtures.
- Cylinders less than 18 inches tall may be secured by approved stands or wall brackets.
- Inert gases are compatible with all other gases and may be stored together.
- Oxidizers and fuel gases must be separated by at least 20 feet, or a noncombustible wall at least 5 feet high with at least a half-hour fire rating.
- Cylinders, especially oxygen, must be kept at least 20 feet from highly combustible or flammable materials and all sources of ignition.
- Store cylinders so that they are used in the order in which they were received (i.e., first in, first out).
- Do not store cylinders longer than one year without use. Return them to the supplier or give them to another laboratory or shop on campus.

- Secure with a chain or appropriate belt above the midpoint, but below the shoulder. Best practice is having both an upper and lower chain. This will reduce the potential of the cylinder falling over. See the following diagrams for reference:

Best Practice (Recommended)



Poor Practice (Not-Recommended)



Proper Use

Gas cylinders can be hazardous due to both their physical (size and weight) and chemical characteristics. Each compressed gas cylinder has unique hazards based on its contents. Read, understand, and follow the markings on the cylinder, the label(s) on the cylinder, and the SDS to avoid misuse.

Take the following precautions to prevent injuries caused by the improper use of compressed gases:

- Know and understand the gases associated with the equipment being used.
- Do not permit cylinders to become part of an electrical circuit.
- Use non-sparking tools (brass) when working with flammable/explosive materials.
- Prevent sparks and flames from contacting cylinders.
- Never strike an arc on a cylinder. Never introduce another product into the cylinder.
- Do not discharge the contents from any gas cylinder directly towards any person.

- Do not force cylinder valves connections that do not fit. If the threads do not match, return the cylinder to the vendor. Teflon tapes can never be used on cylinder or regulator connections.
- Open cylinder valve slowly and carefully after the cylinder has been connected to the process. Use check valves to prevent reverse flow into the cylinder.
- Close the cylinder valve and release all pressure from the downstream equipment. Disconnect the cylinder anytime there an extended non-use period is expected. Cap the cylinder when not in use.
- Never use a compressed gas in any confined space.
- Never work alone when using compressed gas.
- 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 chemically saturated and burst into flames if touched by an ignition source such as a spark or cigarette.
- If the cylinder's valve does not operate properly, do not attempt to force the valve to turn. The cylinder should be returned to the vendor or the Material Distribution Center. Employees must not attempt to repair cylinders or cylinder valves or to force stuck or frozen cylinder valves.

Transporting Gas Cylinders

Most accidents or injuries involving cylinders happen when moving or handling the gas cylinders. Large gas cylinders (e.g., G or F sized cylinders) can be bulky, heavy, and awkward to handle. They require special care and equipment in handling and securing so they don't fall or tip over and cause injury. Anyone involved in the handling of gas cylinders should undertake some basic introduction training.

Building Transport

When transporting compressed gas cylinders internal to buildings, the following shall be followed at all times:

- Valves must be closed with protective caps in place.
- Regulators must be removed.
- Inspect the cylinder for existing damage prior to attempting transport.
- Secure cylinders in a cylinder cart with a chain to move to new location.
- Do not drag or roll cylinders horizontally or "walk" at an angle.
- Use platforms or cradles that keep cylinders upright and secured when lifting with mechanical equipment. Do not lift cylinders by their valve cap.
- Once the cylinder is placed on a cylinder hand truck, ensure it is secured by a strap rack, heavy gauge chain or clamp to prevent falling.

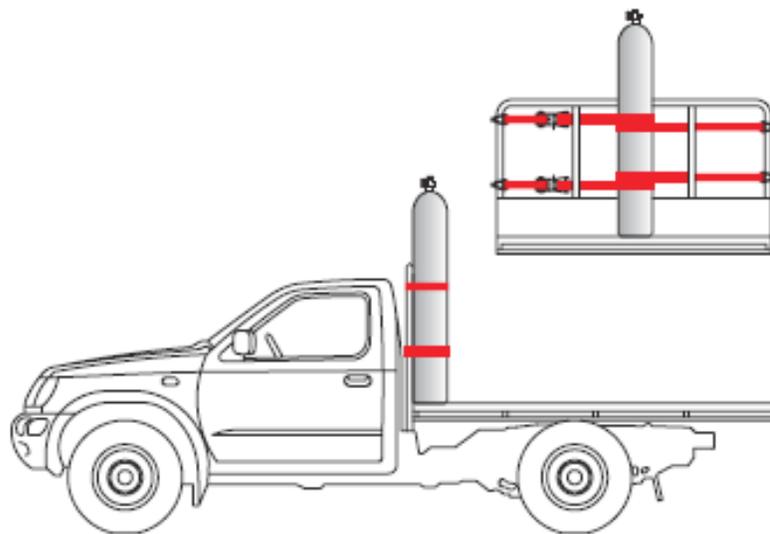


Transporting cylinders between floors of a building shall be done by elevator. The elevator car is a small, enclosed space. Should the cylinder leak, gas could quickly fill the car, potentially overcoming passengers with toxic or oxygen-displacing gas. Therefore, no person shall travel in the elevator with the gas cylinder. The cylinder trolley shall be secured to the elevator hand-rail to prevent it from falling over. Ideally a sign should be used across the entrance of the elevator to prevent others from entering while the cylinder is in transit. A second employee must be at the receiving floor to collect the cylinder. Secure the cylinder immediately once arriving at the usage location.

Vehicle Transport

Gas cylinders used in the field may require the use of a vehicle to get them to the field site. Where possible, have the gas supplier deliver the cylinders directly to the field site. If a vehicle is required to transport cylinders, then it shall be done as follows:

- Applicable DOT requirements must be met when transporting gas cylinders.
- A safety data sheet must be kept in the vehicle if cylinders are transported off campus.
- Do not carry gas cylinders of any kind in the passenger compartment of a vehicle. Should a gas leak develop the occupants could be overcome by toxic or oxygen-displacing gas, resulting in serious injury or death. Direct sunlight or excessive temperatures can result in a release of the cylinder contents.
- Always transport gas cylinders in vehicles where the cargo section is separate from the passenger section (i.e., not one continuous space).
- Inspect the cylinder for existing damage prior to attempting transport.
- The protective valve cap must be on the cylinder to protect the valve stem.
- The cylinder must be secured in an upright position in the back of the vehicle to prevent cylinder damage, particularly to the valve stem, during transport.
- Take a direct route to the destination. Do not make any intermediate stops. Avoid heavy traffic.
- Remove the cylinder from the vehicle upon arrival to the destination. Place it in proper storage.
- Treat “empty” tanks the same as full tanks since residual gas may still remain.



Cylinders Transported in Upright Position

Specific Hazard Classes

Compressed gas cylinders should be handled only by those familiar with the hazards and who can demonstrate safety precautions working with cylinders. Consult the SDS for all gases. Wear the appropriate personal protective equipment when handling cylinders. If you are unsure how to control the dangerous properties of a particular compressed gas, contact ORCIS or EH&S.

Inert/Non-hazardous gases

- Inert or Non-Hazardous gases are non-flammable, non-toxic and non-reactive under most conditions, however, otherwise harmless gases can kill. Inert gases are odorless and tasteless. Inert gases such as argon, helium, carbon dioxide, and nitrogen also displace oxygen and can create an oxygen-deficient atmosphere.
- Inert gases should only be used in well ventilated areas to assure the availability of air suitable for breathing. Care should be taken to ensure connections and tubing are secure. Always check for leaks to ensure the system is operating correctly.

- Asphyxiation occurs rapidly and without warning. Gases should only be used and stored in well ventilated areas. All possible precautions should be taken to ensure that an adequate oxygen supply is available.
Respirators do not supply oxygen. They only filter or purify the air. If asphyxiation is possible, workers should be equipped with supplied air respirators.

Flammable Gases

Flammable gases can be extremely hazardous in the workplace. All flammable gases are potentially hazardous and will burn or explode when mixed with air or oxygen.

No cylinders are to be stored near highly flammable solvents, combustible waste material, unprotected electrical connections, gas flames, or other sources of ignition. Common examples of flammable gases include acetylene, hydrogen, methane, propane, carbon monoxide, and isobutane.

- Cylinders containing flammable gases (empty or full) should be separated from oxidizing gases by a minimum distance of 20 feet or by a barrier at least 5 feet high that has a fire-resistance rating of at least one-half hour.
- Always keep flammable gas cylinders upright. Never use them on their sides.
- Use only regulators and other equipment designed for the gas being used and always follow the manufacturer's instructions.
- All lines and equipment associated with flammable gas systems must be grounded and bonded.
- 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 without risk.

Acetylene

Special care is needed when working with acetylene since it is highly unstable. Acetylene is an extremely volatile gas which has a high risk of decomposition, a spontaneous reaction that can cause high energy explosions. In order to stabilize the gas against decomposition, acetylene is mixed with a liquid solvent and stored in a special cylinder. The following guidelines must be followed when using or handling acetylene cylinders:

- Never use acetylene at a pressure above 15 psig. Acetylene is highly flammable under pressure and is spontaneously combustible in air at pressures above 15 psig.
- Never open the cylinder valve more than one turn. 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 fire or accident.
- Never use an acetylene cylinder on its side. Keep it upright and chained to a cylinder truck, wall or other safe, stable object so that it cannot be knocked over or otherwise damaged.

- Acetylene cylinders are not designed for use in environments where the temperatures may exceed 125 degrees F (52 degrees C).
- Avoid storing the cylinder in below-freezing point temperatures.

Toxic Gases

Toxic compressed gases present a unique set of hazards for their safe storage and use. These gases may require specialized ventilation or detection equipment for their safe use. Any compressed gas with a NFPA health rating of 2, 3 or 4 requires approval from ORCIS or EH&S before it is delivered to campus. In addition to the general guidelines, the following measures shall be taken when handling toxic gases:

- Before using a poison gas, all label information and SDS's associated with the use of the particular toxic gas shall be read. Users shall be familiar with the hazards and health effects of the gas which they are using and procedures to be followed in the event of an emergency.
- Toxic gases shall only be used in force-ventilated areas, preferably in gas cabinets or hoods with forced ventilation.
- Toxic gas cylinders shall be of a size that will ensure the complete usage of the cylinder within a reasonable period of time.

Corrosive Gases

Corrosive gases can cause visible destruction of or irreversible alterations in living tissue by chemical action at the site of contact. The following information is provided for corrosive gases:

- An emergency shower and eyewash must be installed within 10 seconds where corrosive gases are used.
- Cylinders containing corrosive gases shall not be stored for more than six months.
- Remove regulators after use and flush with dry air or nitrogen.
- Metals become brittle when used in corrosive gas service. Check equipment and lines frequently for leaks.
- Use a diaphragm gauge with corrosive gases that would destroy a steel or bronze gauge. Check with the gas supplier for recommended equipment.

Oxidizing Gases

Oxidizing gases may promote combustion of materials, which will not normally burn in air. Oxidizing gases are non-flammable but in the presence of an ignition source and fuel can support and vigorously accelerate combustion. Oxidizer-promoted combustion is frequently more vigorous and violent than combustion in air. The following precautions shall be followed:

- Do not use oil in any apparatus where oxygen will be used.
- Never oil or grease torches, regulators, hoses, cylinder valves, or anything that may come into contact with oxygen.
- Do not place oxygen cylinders or equipment in locations where they may encounter oil or grease from machinery.

- Never allow anyone to dust his or herself with an oxygen line. Clothes can become oxygen saturated and therefore extremely flammable.
- Never allow a jet of oxygen to contact an oily surface, a greasy cloth or to enter a fuel-oil or other storage tank unless it has been thoroughly cleaned according to approved procedures.
- Never use oxygen to run air tools. Oxygen and other gases should be used only for their intended purposes.
- Never use oxygen to blow out pipelines or to provide ventilation. The oxygen may cool the operator, but it also increases the oxygen content of the room. A spark that is inconsequential in air can be extremely hazardous in an oxygen enriched environment.

Cryogenic Liquids and Gases

Cryogenic liquids are liquids maintained at very low temperatures below -130 F (-90 C). thus, keeping them in a liquid state. Cryogenic Liquids can cause significant damage to tissue on contact. Cryogenic liquids produce large volumes of gas when they vaporize and may create oxygen-deficient conditions. Common examples of common cryogenic liquids include liquid nitrogen, oxygen, hydrogen, and helium. The following information applies to the use and handling of cryogenics



- Use appropriate personal protective equipment, including insulated gloves, lab coat, and eye protection (goggles and face shield) during any transfer of cryogenic liquid.
- In the event of skin contact with a cryogenic liquid, do not rub skin. Place the affected part of the body in a warm water bath (not to exceed 40°C [105°F]). If a burn is significant, seek medical attention.
- Use only equipment, valves, and containers designed for the intended product, service pressure, and temperature.
- Inspect containers for loss of insulating vacuum. If the outside jacket on a container is cold or has frost, some vacuum has been lost. Empty the contents into another cryogenic container and remove the damaged unit from service. Repairs shall be made by the manufacturer or an authorized company.

- Transfer operations involving open cryogenic containers must be conducted slowly to minimize boiling and splashing of the cryogenic fluid.
- Ice or other foreign matter shall not be allowed to accumulate beneath the vaporizer or the tank. Excessive ice buildup could result in the discharge of excessively cold gas or structural damage to the cryogenic container or surroundings.
- All cryogenic systems, including piping, must be equipped with pressure relief devices to prevent excessive pressure build-up. Pressure reliefs must be directed to a safe location. Do not tamper with pressure relief valves or the settings for the valves.
- Elevators should not be used to transport cryogenic liquids. If transport by elevator is unavoidable, the cryogenic liquid must be transported by itself. Steps should be taken to ensure the elevator does not stop on other floors.

Date	Reviewed by	Changes
4/22/2022	Lab Safety Committee	Major Update