monroe one
EDUCATIONAL SERVICES

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District Superintendent

Compressed & Liquefied Gas Cylinder Safety Plan

I. OVERVIEW

A. Some tasks assigned to Monroe One BOCES employees involve the use of compressed or liquefied gas cylinders. These have the potential to be physically hazardous and/or a health hazard. Therefore, all staff are charged to:

1. Use administrative controls to avoid having to use compressed and liquefied gas cylinders.
2. Follow the procedures and requirements of this plan when the use of compressed and liquefied gas cylinders is unavoidable.

B. This safety plan intends to detail requirements for employees to properly store, handle, use, label, and dispose of gas cylinders.

C. Monroe One BOCES does not own any compressed gas cylinders, all those in use are leased from compressed or liquefied gas vendor(s).

D. Updating this Safety Plan

1. The Director of Sustainability shall solicit comment from the appointed Chemical Hygiene Officers and from the O&M Foreman for this plan's updates, concurrent with solicited comments to the Chemical Hygiene Plan.
2. The Director of Sustainability shall send this updated plan to The Genesee Valley Educational Partnership Health, Safety and Risk Management Office (GV BOCES HSRM) to have it reviewed for compliance with current state regulations.
3. The updated plan shall be sent to the Chair of the Monroe One BOCES Health and Safety Committee for approval, so that the updated plan will be ready for the start of the next school year.

II. TRAINING REQUIRED

A. Only trained employees may handle and/or use compressed and liquefied gases.

B. Qualified training for the use of gas cylinders must include review of :

1. Associated hazards of the material contained in gas cylinders used by Monroe One BOCES, including access to the appropriate safety data sheets (SDSs)
2. Necessary safety precautions
3. Personal protective equipment (PPE)
4. Emergency response procedures.
5. The contents of this plan.

III. STORAGE OF COMPRESSED AND LIQUEFIED GAS CYLINDERS

A. Cylinder storage areas should be prominently posted with hazard information regarding the gases stored.

B. 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.

C. Compressed and liquefied gas cylinders shall be stored:

1. Away from exits or egress routes.
2. Within a well-ventilated area.
3. In a dry area, away from salt or corrosive chemicals, fumes, or heat; and not exposed to the weather.
4. Kept at least 20 feet away from all flammable, combustible or incompatible substances.
5. Protected from physical damage by striking or falling objects, or public tampering.
6. In an upright position.
7. Secured with a chain or appropriate belt above the cylinder midpoint, but below its shoulder. Laboratory cylinders less than 18" tall may be secured in approved stands or wall brackets designed for that purpose.
8. Capped when not in use or attached to a system, if the cylinder will accept a cap.
9. Segregated from gases of different hazard classes, separated by not less than noncombustible walls not less than 5 ft. high, with a fire resistance rating of at least 30 minutes. However, inert gases may be mixed in with any hazard class.
10. To be used on a first in, first out basis.
11. Dated, and used within one year.
12. Sorted so that full cylinders are separated from empty cylinders.

IV. HANDLING COMPRESSED AND LIQUEFIED GAS CYLINDERS

A. Cylinders must be transported with a hand truck designed for the transport of cylinders. Cylinder caps shall be secured during transport. Cylinders may not be dragged or physically carried.

B. Cylinders shall not be used for any other purpose than holding the contents as received. No person on Monroe One BOCES property shall attempt to mix gases within a cylinder.

C. Cylinders shall not be subjected to low temperatures without approval from the supplier.

D. Damaged or leaking cylinders must be reported to Operations & Maintenance immediately for return to the vendor.

E. Cylinders shall not be picked up by the cap.

F. Ropes, chains and slings shall not be used to suspend cylinders, unless the cylinder was designed for such.

G. Magnets may not be used for lifting cylinders.

H. Where appropriate lifting attachments have not been provided on the cylinder, lift using only suitable cradles or platforms that properly hold and constrain the cylinder.

I. Painting cylinders is not permitted.

J. Leaking, defective, fire burned and corroded containers shall not be shipped without the approval of the supplier.

V. USING COMPRESSED AND LIQUEFIED GAS CYLINDERS

A. Perform a visual inspection before each usage to detect any damage, cracks, corrosion or other defects. Long term maintenance or replacement periods vary with the types of gases used, the length of use, and conditions of usage. Consult the cylinder, regulator or gas supplier for recommended valve and regulator maintenance schedules.

B. Maintenance of gas cylinders and their valves and regulators connections is to be only by the gas cylinder supplier vendor. Monroe One BOCES employees are not authorized to repair gas cylinders, valves or regulators.

C. Use only equipment, valves and containers designed for the intended product and service pressure and temperature.

D. Do NOT:

1. Allow flames or heat sources to come in contact with a gas cylinder.
2. Allow a gas cylinder to become part of an electrical circuit.
3. Use cylinder gas as compressed air.
4. Use Teflon™, polytetrafluoroethylene (PTFE), tape on CGA (Compressed Gas Association) fittings where the seal is made by metal-to-metal contact. Use of Teflon™ tape causes the threads to spread and weaken*, increasing* the likelihood of leaks.

E. If a wrench is required to open the main valve, the proper wrench shall be left in place on the cylinder valve while it is open.

F. Use a cylinder cap hook to loosen tight cylinder caps. Never apply excessive force or pry off caps. Return to supplier to remove “stuck” caps.

G. Keep piping, regulators and other apparatus gas tight to prevent gas leakage. Confirm gas tightness by using compatible leak test solutions (e.g., soap and water) or leak test instruments.

H. Release pressure from systems before connections are tightened or loosened.

I. Fluorescent light may be used to check for grease or oil in regulators and valves.

J. Use only approved valves, regulators, manifolds, piping and other associated equipment in any system that requires compressed gas. Care must be taken to ensure that pressure gauges on regulators are correct for the pressure of the gas cylinder used.

K. Valve Use

1. Close valves on gas cylinders when not in use.
2. With the exception of lecture bottles, threads, configurations and valve outlets are different for each class of gases to prevent mixing of incompatible gases.
3. Valves that pass visual inspection are still subject to failure, therefore it is critical that toxic or poisonous gases (see Appendix C) are used in ventilated enclosures with local exhaust ventilation in place for downstream pressure relief valves, etc.
4. Use adequately sized wrenches (12" long) to minimize ergonomic stress when turning tight tank valves. Never apply excessive force when trying to open valves.
5. Do NOT install shut-off valves between pressure relief devices and the equipment to be protected
6. 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.
7. Relief valves should be vented to prevent potential buildup of explosive or toxic gases.
8. Never partially open a tank valve to remove dust or debris from the cylinder inlet.
9. De-pressurize pressure control valve regulator when not in use; open equipment valves downstream after the regulators are closed.
10. Do not attempt to open a corroded valve; it may be impossible to reseal.
11. Cylinders with "stuck" valves must be returned to suppliers to have valves repaired.
12. Valves should only be opened to the point where gas can flow into the system at the necessary pressure. This will allow for quicker shutoff in the event of a failure or emergency.

L. Manifold Use:

1. Where compressed gas cylinders are connected to a manifold, the manifold and its related equipment, such as regulators, shall be of proper design for the

product(s) they are to contain at the appropriate temperatures, pressures and flows.

2. Manifold systems shall be designed and constructed by competent personnel who are thoroughly familiar with the requirements for piping of flammable gases. Manifolds should comply with the standards of a recognized safety authority such as Underwriters Laboratories. Federal, state, local or insurance company specifications must be identified before starting design and construction. Consultation with the gas supplier before installation of manifolds is recommended.

M. Regulator Use

1. Pressurize regulators slowly and ensure that valve outlets and regulators are pointed away from all personnel when cylinder valves are opened.
2. Never use adapters or exchange fittings between tanks and regulators.
3. Ensure that the regulator pressure control valve is closed before attaching to a cylinder.

VI. LABELING

A. Return unlabeled cylinders to the vendor.

B. Use only the vendor's label for positive identification of contents of the cylinder. Be aware that color-coding may be inconsistent from vendor to vendor.

C. Empty cylinders shall be labeled with the word empty or the abbreviation MT.

D. Vendor's proper labels must include the identity of the material, statement of hazard and the associated signal word. For example, the preferred label for nitrogen would be:

Nitrogen

CAUTION: HIGH PRESSURE GAS
CAN CAUSE RAPID SUFFOCATION

VII. DISPOSAL OF GAS CYLINDERS

A. Monroe One BOCES does not own refillable cylinders, all cylinders ae the property of the vendor and must be returned to directly to the vendor.

B. If a refillable cylinder is encountered that does not have a manufacturer label, contact O&M who will try to identify the vendor through cylinder stamp marks.

C. Write work orders to O&M to have empty lecture-size cylinders picked up for proper disposal. Disposal fees for cylinders is a departmental expense.

D. Maintain vendor and manufacturer labels, label the cylinder with an "Empty" or "MT" tag.

VIII. EMERGENCY RESPONSES TO COMPRESSED GAS CYLINDER LEAKS

A. Preplanning

1. Despite strict adherence to laboratory safety practices, accidents involving gases may occur in the laboratory. The amount of damage sustained by personnel and property from these accidents will be directly related to the quality of the laboratory's emergency plan and procedures.
2. Standard Operating Procedures (SOPs) for experiments using compressed gases shall include a discussion of possible accident scenarios, appropriate employee responses and should take into account the following factors:
    - The layout and equipment used
    - Types of possible injuries
    - The potential location of a release or spill (e.g., outdoors, in a laboratory, corridor or storage area, on a table)
    - The quantities of material that might be released and the type of containment
    - The chemical and physical properties of the compressed gas
    - The hazardous properties of the compressed gas (e.g., its toxicity, corrosiveness, and flammability).
    - The availability and locations of emergency supplies and equipment.
    - Building evacuation routes, emergency telephone numbers, chemical containment procedures, fire extinguisher usage, etc., should be posted in the classroom.

B. Minor Leaks

1. Occasionally a gas cylinder or one of its component parts may develop a leak. Most of these leaks occur at the top of the cylinder in areas such as the valve threads, pressure safety device, valve stem and valve outlet.
2. If possible, verify suspected leaks using a flammable gas detector or soapy water solution (a flame should not be used for detection). If the leak cannot be stopped by tightening a valve gland or packing nut, emergency action procedures should be initiated and O&M's office X2991 should be notified.

3. For flammable, inert or oxidizing gases, move the cylinder to an isolated, well-ventilated area away from combustible materials. Post signs that describe the hazard.
4. For corrosive and toxic gases, move the cylinder to an isolated, well-ventilated area and use suitable means to direct the gas into an appropriate chemical neutralizer. Post signs that describe the hazards.
5. If it is necessary to move a leaking cylinder through populated portions of the building, place a plastic bag, rubber shroud or similar device over the top and tape it (duct tape preferred) to the cylinder to confine the leaking gas.

C. Major Leaks

In the event of a large gas release or if an accident takes place in which readily available personal protective equipment (PPE) is inadequate:

- Call 911 and report the incident.
- Activate building fire alarms using the nearest pull station.
- Evacuate the area, securing entrances and provide assistance to others on the way out.
- Provide emergency response officials with details of the problem upon their arrival.

D. Accidents Involving Personnel Injury

1. Call 911 and report the incident.
2. Assist persons involved and administer immediate first aid which may include:
3. Washing under a safety shower.
4. Removing contaminated clothing.
5. Irrigating the eyes at an eyewash.
6. Administering CPR.
7. Notify personnel in adjacent areas of any potential hazards (e.g., activate building or area alarms).
8. Move injured personnel only if necessary to prevent their exposure to further harm.

E. Fire and Fire-Related Emergencies

1. Call 911 to report the fire.
2. Activate building and area alarms.
3. Evacuate the building, shutting doors and providing assistance to others on the way out.
4. Provide fire or police officials with the details of the problem upon their arrival.

APPENDIX: GASES WITH SPECIFIC HAZARD CLASSES

A. Corrosive Gases

1. Examples of corrosive gases include chlorine, hydrogen chloride, fluorine, hydrogen fluoride, hydrogen sulfide, carbon monoxide and carbon dioxide.
2. Metals become brittle when used in corrosive gas service, check equipment and lines frequently for leaks.
3. A diaphragm gauge should be used with corrosive gases that would destroy a steel or bronze gauge. Check with gas supplier for recommended equipment.
4. Remove regulators after use and flush with dry air or nitrogen.

B. Cryogenic Liquids and Gases

1. Cryogenic liquids and gases are hazardous. Their boil-off vapors rapidly freeze human tissue and cause embrittlement of many common materials which may crack or fracture under stress. All cryogenic liquids produce large volumes of gas when they vaporize (at gas to liquid ratios of 600:1 to 1440:1) and may create oxygen-deficient conditions. Examples of common cryogenic liquids include liquid oxygen, hydrogen, helium, and liquid neon.
2. Use appropriate personal protective equipment (PPE) including insulated gloves and eye protection (goggles and a face shield) during any transfer of cryogenic liquid.
3. 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 105°F.
4. Inspect containers for loss of insulating vacuum. If the outside jacket on a container is cold or has frost spots, some vacuum has been lost. Remove the unit from service and return it to the vendor for appropriate service and or repairs.
5. Ice or other foreign matter should 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.
6. 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.
7. Do not tamper with pressure relief valves or the settings for the valves.
8. Hot air, steam or hot water should be used to thaw frozen equipment. DO NOT USE water to thaw liquid helium equipment.

C. Flammable Gases

1. Common examples of flammable gases include acetylene, hydrogen, methane, propane and iso-butane.

2. Flammable gases, except for protected fuel gases, shall not be used near ignition sources. Ignition sources include open flames and sparks, sources of heat, oxidizing agents and ungrounded or non-intrinsically safe electrical or electronic equipment.
3. Portable fire extinguishers shall be available for fire emergencies. The fire extinguisher must be compatible with the apparatus and the materials in use.
4. Flames shall not be used for detecting leaks. A compatible leak detection solution shall be used for leak detection.
5. Spark proof tools shall be used when working with or on a flammable compressed gas cylinder or system.
6. Access doors to areas which use or store flammable gases shall be posted "No Open Flames."

D. Fuel, High Pressure, and Oxidizing Gases

1. Fuel gases often use a combination of flammable and oxidizing gases. Use of fuel gases must comply with OSHA 29 CFR1910.253--Oxygen-Fuel Gas Welding and Cutting, 29 CFR1910.102—Acetylene, and 29 CFR1910.103--Hydrogen. Additionally, adherence is required to the requirements of the Compressed Gas Association as defined in Pamphlet G-1: Acetylene, Pamphlet SB-8: Use of Oxy-fuel Gas Welding and Cutting Apparatus, and the requirements of the National Fire Protection Association Standard 51: Standard for the Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting and Allied Processes.
2. Oxidizing gases are non-flammable gases (e.g., oxygen chlorine, fluorine and nitrous oxide), but in the presence of an ignition source and fuel can support and vigorously accelerate combustion. Do not use oil in any apparatus where oxygen will be used. Gauges and regulators for oxygen shall bear the warning “OXYGEN - USE NO OIL.”
3. High pressure gases can be rated up to 3,000 pounds per square inch (psi). Typical uses include MIG welding gas mixtures, cryogenics, non-toxic gas distribution, medical gas distribution, and emergency oxygen services. In addition to any gas specific hazards, high pressure gases should carry the following hazard label:

CAUTION: HIGH PRESSURE GAS

E. Toxic and Highly Toxic Gases

The following table lists toxic and highly toxic gases with a NFPA Health Hazard rating of 3 or 4. **These gases may not be used in the Monroe One BOCES.**

Gas	State	Health Rating		Gas	State	Health Rating
Ammonia	Liquid	3		Hydrogen Bromide	Gas	3
Arsine	Liquid	4		Hydrogen Chloride	Gas	3
Boron Trichloride	Gas	3		Hydrogen Cyanide	Liquid	4
Boron Triflouride	Gas	3		Hydrogen Fluoride	Gas	4
Carbon Monoxide	Gas	3		Hydrogen Selenide	Liquid	3
Carbonyl Chloride*	Gas	4		Hydrogen Sulfide	Liquid	4
Carbonyl Fluoride	Gas	4		Methylamine	Liquid	3
Carbonyl Sulfide	Liquid	3		Methylbromide	Liquid	3
Chlorine	Gas	3		Methyl Mercaptan	Liquid	4
Chlorine Dioxide	Gas	4		Nitric Oxide	Gas	3
Chlorine Monoxide	Gas	3		Nitrogen Dioxide	Gas	3
Chlorine Triflouride	Gas	4		Nitrogen Trioxide	Gas	3
Cyanogen	Liquid	4		Nitrogen Trifluoride	Gas	3
Cyanogen Chloride	Liquid	4		Nitrosyl Chloride	Gas	3
Diazomethane	Gas	3		Oxygen Difluoride	Gas	4
Diborane	Gas	3		Ozone	Gas	4
1,1-Difluoroethylene	Liquid	3		Pentaborane	Liquid	4
Dimethylamine	Gas	3		Phosphine	Gas	4
Ethylamine	Liquid	3		Selenium Hexafluoride	Gas	3
Ethylene Oxide	Liquid	3		Silicon Tetrafluoride	Gas	4
Fluorine	Gas	4		Stibine	Gas	4
Formaldehyde	Gas	3		Sulfur Tetrafluoride	Gas	4
Hexafluoroacetone	Gas	3		Trimethylamine	Liquid	3

*Phosgene

1. NFPA definition of a HEALTH HAZARD 4 includes materials that can be lethal.
   - Materials with LD50 for acute dermal toxicity is £ 40 mg/kg.
   - Materials with LD50 for acute oral toxicity £ 5 mg/kg.
   - Gases whose LC50 for acute inhalation toxicity is £ 1000 ppm.
   - Any liquid whose saturated vapor concentration at 20°C is equal to or 10 times its LC50 for acute inhalation toxicity, if its LC50 is £ 1000 ppm.
   - Dusts and mists whose LC50 for acute inhalation toxicity is £ 0.5 mg/L.

2. NFPA Health Hazard 3 includes materials that can cause serious or permanent injury.
    - Materials that are corrosive to the respiratory tract
    - Materials that are corrosive to the eye or cause irreversible corneal opacity
    - Materials that are severely irritating and/or corrosive to the skin.
    - Materials with LD50 for acute dermal toxicity >40 mg/kg but £ 200 mg/kg.
    - Materials with LD50 for acute oral toxicity >5 mg/kg but £ 50 mg/kg.
    - Gases with LC50 for acute inhalation toxicity >1000 ppm but £ 3000 ppm.
    - Any liquid whose saturated vapor concentration at 20°C is equal to or greater than its LC50 for acute inhalation toxicity or if its LC50 is £ 3000 ppm and does not meet the criteria for hazard 4.
    - Dusts and mists whose LC50 for acute inhalation toxicity is > 0.5 mg/L but £ 2mg/L.
3. NFPA Health Hazard 2 includes materials that can cause temporary incapacitation or residual injury.
    - Materials that are respiratory irritants
    - Materials that cause irritating but reversible injury to the eyes
    - Materials that are primary skin irritants or sensitizers.
    - Materials with LD50 for acute dermal toxicity is > 200 mg/kg but £ 1000mg/kg.
    - Materials with LD50 for acute oral toxicity is > 50 mg/kg but £ 500 mg/kg.
    - Gases whose LC50 for acute inhalation toxicity is > 3000 ppm but £ 5000 ppm.
    - Any liquid whose saturated vapor concentration at 20°C is equal to or greater than 1/5 its LC50 for acute inhalation toxicity, if its LC50 is £ 5000 ppm and that does not meet the criteria for either hazard 3 or hazard 4.
    - Dusts and mists whose LC50 for acute inhalation toxicity is > 2 mg/L but £ 10 mg/L.
4. NFPA Health Hazard 1 includes materials that can cause significant irritation.
    - Materials that are slightly irritating to the respiratory tract, eyes and skin.
    - Materials with LD50 for dermal toxicity is > 1000 mg/kg but £ 2000 mg/kg.
    - Materials with LD50 for oral toxicity is > 500 mg/kg but £ 2000mg/kg.
    - Gases and vapors with LC50 for acute inhalation toxicity is > 5000 ppm but £ 10,000 ppm.

- Dusts and mists whose LC50 for acute inhalation toxicity is > 10 mg/L but £200 mg/L.

5. The definition of LD50 is the quantity of material that causes death in 50% of test subjects, usually mice or rats. The value is associated with a dose received through injection, ingestion or dermal contact and is quantified by body weight of a specific animal.
6. LC50 Quantity of toxic material in air which is necessary to cause death in 50% of the test subjects (usually mouse or rat). This value is associated with inhalation risks.