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1.0 Introduction

1.1 Purpose

This purpose of these guidelines is to provide instruction for the safe handling and use of compressed gas cylinders as prescribed in the Occupational Safety and Health Administration (OSHA) Standard – 29 CFR 1910.101 Compressed Gas Cylinders. These cylinders and their contents pose unique risks and if handled improperly can have devastating consequences. Contact your gas supplier or the Environmental Health and Safety Office (EHSO) for additional information or if you are unfamiliar with the hazards associated with a particular compressed gas.

1.2 Scope

These guidelines are inclusive of Emory employees, including Emory Healthcare (EHC), faculty, staff, students, contractors, and other people who work with or in close proximity to compressed gas cylinders.

1.3 Definitions

Compressed Gas. Any material or mixture that is a gas at 20°C (68°F) or less at an absolute pressure of 101 kPa (14.7 psia) and that has a boiling point of 20°C (68°F) or less at an absolute pressure of 101 kPa (14.7 psia) and that is liquefied, non-liquefied, or in solution, including those gases that have no other health or physical hazard properties and exerts in the packaging an absolute pressure of 280 kPa (40.6 psia) at 20°C (68°F).

Compressed Gas Cylinder. A compressed gas container having a maximum water capacity of 454 kg (1000lb.).

Corrosion or Pitting. Loss of wall thickness in a cylinder by corrosive media.

Dents. Deformations in a cylinder caused by its coming in contact with a blunt object. The thickness of the wall is not reduced.

kPa. Kilopascal.

Liquefied Petroleum Gas (LPG or LP-Gas). Liquid petroleum gas; any material which is composed predominantly of any of the following hydrocarbons, or mixtures of them; propane, propylene, butanes (normal butane or iso-butane), and butylenes.

Manifold. Gas distribution system that transfers product through multiple outlets/inlets to compressed gas containers.

Regulator. Mechanical device used to control the discharge pressure of a compressed gas from a container.

Pressure Relief Device. Pressure and/or temperature-activated device used to prevent the pressure from rising above a predetermined maximum.

PSI. Pounds per square inch.

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PSIA. Pounds per square inch absolute, where the pressure is relative to a vacuum rather than the ambient atmospheric pressure.

PSIG. Pounds per square inch gauge, where the pressure is relative to atmospheric pressure.

Safety Data Sheets (SDS). Written or printed information concerning a hazardous material prepared in accordance with the provisions of Title 29 of the U.S. Code of Federal Regulations (29 CFR) Part 1910.1200.

Ventilation (adequate). When specified for the prevention of fire during normal operation, ventilation shall be considered adequate when the concentration of the gas in a gas-air mixture does not exceed 25 percent of the lower flammable limit.

Valve. A type of device used to control the flow of gases and liquids.

Valve Protection Cap. Rigid removable cover provided for container valve protection during handling, transportation, and storage.

1.4 Training Requirements

Only properly trained personnel are allowed to handle and use compressed gases. Training includes a review of the following information, as well as any manufacturer information or required training related to the equipment being used.

2.0 General Safety

2.1 Personal Protective Equipment (PPE)

Ensure that personnel handling or using compressed gas cylinders wear PPE appropriate for the specific hazards of the cylinder or its contents, including:

- Eye protection – safety glasses or goggles
- Foot protection – close-toe or steel-toe shoes or boots
- Face protection – face shield
- Hand protection – gloves

2.2 Safety Data Sheets (SDS)

Always review the SDS prior to using any compressed gas. SDSs can be accessed through the Safety Data Sheet (SDS) link on the EHSO website.

2.3 Labeling

- Ensure all compressed gas cylinders are clearly labeled with the container contents and physical and health hazards.
- Do not use color to identify the cylinder contents.
- Maintain all prescribed markings in legible condition.
- If labels or markings become worn, contact the supplier for replacement labeling or purchase correct labeling from an approved vendor such as Grainger, Fisher Scientific, etc.

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3.0 Compressed Gas Cylinder Use

- Only use compressed gas cylinders in well-ventilated areas to avoid gas accumulation.
- Do not expose compressed gas containers to temperature extremes.
 - Never apply a flame or heat directly to any part of a compressed gas cylinder.
 - If ice or snow accumulates on a container, thaw at room temperature or with water at a temperature not exceeding 125°F (51.7°C).
- Do not use gas cylinders in locations where they might become part of an electrical circuit.
- If a cylinder is designed to accept a cap, it must be securely in place, unless the cylinder is in use or connected for use.
- When connecting a compressed gas container to a manifold, or its related equipment (regulators, safety devices, etc.), ensure:
 - The threads on the container valve outlet match the threads on the regulator connection or other auxiliary equipment.
 - Never force valve connections that do not fit properly.
 - The pressure gauges on the regulators are correct for the specific gas cylinder being used.
 - The inlet connections, including piping, regulators and manifolds, are gas-tight before use.
 - The integrity of the connection can be confirmed using a mild soap solution, a compatible commercial leak test solution, or a leak detection instrument.
- Clear the valve to prevent dust or dirt from entering the regulator before connecting a regulator.
 - Stand to the side of the cylinder away from the valve outlet, and “crack” the valve by momentarily opening the valve, then closing it immediately.
 - Do not “crack” the valve of a cylinder that contains toxic gases.
- Open valves slowly and always point the outlet away from personnel.
 - Valves with hand-wheels can be opened with torque wrenches designed for such use.
 - Valves without hand-wheels can be opened with the wrench provided or recommended by the gas supplier.
 - In order to quickly close the valve in the event of an emergency, keep wrenches and other recommended tools on the valve while the container is in use.
- Maintain a safe position when opening a regulator.
 - Stand to the side of the regulator face with the valve between you and the regulator.
 - Do not reach in front of or stand in front of the regulator face when opening the valve.
 - Ensure that the regulator is angled slightly upward, but not directed towards other personnel.
- Before removing a regulator:
 - Close the container valve;
 - Relieve the regulator of gas pressure by turning (i.e. opening) the adjusting screw; and

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- Reclose the adjusting screw.
- Properly install check valves and/or traps to prevent backflow and regularly inspect these devices to ensure proper operation.
- Ensure that a suitable pressure-regulating device is installed when the following conditions exist:
 - Gas is admitted to a system of lower pressure rating than the supply pressure, or
 - The system rating can be exceeded due to the gas capacity of the supply source. **NOTE: Provided one of the conditions is met above, a pressure-regulating device is still required, regardless of the existence of a pressure relief device (PRD) protecting the lower pressure system.**
- When using a cylinder containing a non-liquefied compressed gas (except acetylene):
 - Do not reduce the pressure below the operating pressure of the system.
 - Do not reduce the pressure less than 20 psig to prevent the backflow of contaminants into the container.
- Follow all federal, state and local regulations pertaining to the storage, use, and disposal of compressed gas cylinders (whether they are full or empty), including but not limited to:
 - The National Fire Protection Association (NFPA) and the Department of Transportation (DOT) labeling requirements;
 - The Occupational Health and Safety Administration (OSHA) hazard communication requirements;
 - The Compressed Gas Association (CGA) pamphlets for safe use, proper storage and conducting inspections; and
 - The adopted codes of the State of Georgia.

4.0 Compressed Gas Cylinder Storage

- Ensure that compressed gas storage areas are appropriately labeled.
- Label rooms or cabinets as “Compressed Gas”.
 - Identify storage areas with the hazard class or the name of the gases stored.
 - Placard storage buildings according to the hazard class using the NFPA fire diamond.
 - Post “*No Smoking*” signage around the storage area of buildings, or at entrances, where flammable gases are stored.
- Do not store cylinders near exit routes, elevators, walkways, unprotected platform edges, or in locations where heavy moving objects can strike or fall on them.
- Store cylinders in dry, well-ventilated areas with adequate room to accommodate the various containers of gases.
- Group cylinders according to hazard class.
- Separate full and empty containers.
- Label empty cylinders with the words “Empty” or “MT”.
- Ensure that outdoor storage locations of cylinders are:
 - At least 5 feet from any doorway or opening in a building that has two means of egress.

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- At least 10 feet from any doorway or opening for any building that has only one means of egress.
- At least 20 feet from any automotive service station fuel dispenser.
- Ensure that cylinders are stored upright and are secured to stationary building supports, using appropriate methods such as straps, chains or racks.
 - When cylinders are secured by a chain or strap, the preferable method is to secure them in two locations – one strap or chain 1/3 from the top of the shoulder of the cylinder and one strap or chain 1/3 up from the bottom of the cylinder.
 - At a minimum, cylinders must be secured at approximately 2/3 the height of the cylinder – secured above the midpoint, but below the shoulder.

5.0 Compressed Gas Cylinder Transportation

- Use caution when transporting cylinders to prevent them from striking against each other or against other hard surfaces.
- Use a freight elevator, when possible, to transport a filled gas cylinder between multilevel buildings.
 - If there is no freight elevator, use the common or staff elevator, and
 - Never allow other people to enter the elevator when transporting cylinders.
- Before moving a cylinder, ensure that the regulator is removed, the valve is closed, and the valve protection caps are in place. **NOTE: If the cylinder is on a vehicle or cart intended for the purpose of transporting the cylinder, the regulators do not have to be removed, provided the vehicle or cart is designed to hold the cylinders in an erect or nearly erect position and protect the cylinder valves and regulators.**
- Use an appropriate hand truck, preferably equipped with a chain or strap for securing the cylinder.
 - Never drag cylinders or roll them in the horizontal position.
 - Never lift a cylinder using the valve cover or by using a magnet.
- For moving a cylinder short distances, it is acceptable to tilt and roll the cylinder on its bottom edge.
- If appropriate lifting attachments were provided on containers at the time of manufacture, ropes, chains or slings may be used to suspend containers. **NOTE: Do not weld lifting attachments or other attachments to cylinders.**

6.0 Compressed Gas Cylinder Disposal

- Never dispose of compressed gas cylinders as conventional waste.
- Return empty, damaged or leaking gas cylinders to the gas supplier or distributor, as soon as possible.
 - Keep valves closed and have cylinder caps securely in place.
 - Properly label cylinders as “Empty” or “MT”, “Damaged”, etc.
 - Follow proper storage segregation.
- Contact EHSO at chemwaste@emory.edu to coordinate the disposal of non-returnable lecture bottles, calibration gas cylinders or other non-returnable compressed gas cylinders.

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7.0 Inspection and Maintenance

- Only qualified persons can repair manifolds, valves and other related equipment. NOTE: Emory employees are not qualified to conduct repairs on compressed gas cylinders or related equipment.
- Consult the equipment supplier for recommended maintenance schedules.
- Conduct periodic inspections of valves and regulators, and maintain documentation.
- Conduct visual inspections/examinations of compressed gas cylinders before each use for the following:
 - Corrosion and pitting
 - Dents
 - Cuts, digs and gouges
 - Bulges
 - Leaks
 - Thread or neck defects

8.0 Flammable Gases

- Use and store flammable gases in well-ventilated areas, away from oxidizers, open flames, sparks, and other sources of heat or ignition.
- Ensure that all lines and equipment associated with flammable gas systems are grounded and bonded.
- Store acetylene containers with the valve end up.
- Do not use acetylene in its free state at pressures exceeding 15 psig.
- To reduce the risk of explosion, do not open acetylene or other flammable gas cylinder valves more than ½ turn of the spindle.
- Do not take cylinders containing oxygen, acetylene, or other fuel gas into confined spaces.
- Maintain portable fire extinguishers (carbon dioxide or dry chemical types) or other fire protection or suppression systems at storage locations.
- Post “No Smoking” signage around the storage area of buildings or at entrances to storage locations.
- Use non-sparking tools.
- Proper storage outdoors or in unoccupied buildings.
 - Do not exceed 22,500 pounds of liquefied petroleum gas (LPG) in one storage area.
 - Maintain at least 20 feet of separation between storage areas of flammable gases.
 - For determination of quantity, consider full or partially full cylinders as full cylinders.
 - Separate LPG and acetylene by at least 20 feet. NOTE: No separation is required if the storage quantity of LPG is less than 1000 pounds.
- Proper storage inside occupied buildings.
 - Do not store near arcing electrical equipment, open flames, or other sources of ignition.
 - Separate flammable gas containers at least 20 feet from flammable liquids, highly combustible materials, and oxidizers.
 - If separation is not possible, isolate the flammable gas containers by a

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non-combustible barrier that has a fire resistance rating of at least ½ hour extending:

- At least 18 inches above the tallest container.
- Laterally at least 18 inches beyond the sides of the containers.

9.0 Asphyxiant and Inert Gases

- Do not store asphyxiant gases in areas without proper ventilation. NOTE: Any gas that has the potential to displace oxygen in sufficient quantities can cause asphyxiation.
- Inert gases are chemically inactive, odorless, tasteless, and colorless. This includes argon, helium, and the rare atmospheric gases. Nitrogen is also considered an inert gas because it only becomes reactive at high temperatures and pressures with catalysts.

10.0 Corrosive and Toxic Gases

- Wear appropriate personal protective equipment (PPE).
- Avoid contact with the skin or eyes or inhaling any corrosive gases.
- Store corrosive and toxic gases in accordance with local and/or building fire protection codes.
- Ensure emergency showers and eyewash fountains are available in areas where corrosive gases are used.

11.0 Oxidizing Gases

- Oxidizing gases, including oxygen, are non-flammable but can support and accelerate combustion in the presence of an ignition source and a fuel.
- Ensure equipment is free from grease, oils and other contaminants.
 - Do not handle cylinders with oily hands or gloves.
 - Use an oxygen-compatible material to clean all equipment that has been used with oxidizing gases.
- Store oxidizers separately from flammable or combustible materials.
 - Maintain a minimum distance of 20 feet, or
 - Establish a non-combustible barrier at least 5 feet high, having a fire rating of at least ½ hour.

12.0 References

Occupational Health and Safety Administration [OSHA], 1910 Subpart H, Hazardous Materials – *Compressed gases (general requirements)*, 29 CFR 1910.101.

Occupational Health and Safety Administration [OSHA], 1910 Subpart H, Hazardous Materials – *Acetylene*, 29 CFR 1910.102.

Occupational Health and Safety Administration [OSHA], 1910 Subpart H, Hazardous Materials – *Oxygen*, 29 CFR 1910.104.

Occupational Health and Safety Administration [OSHA], 1910 Subpart H, Hazardous Materials – *Storage and handling of liquefied petroleum gases*, 29 CFR 1910.110.



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Occupational Health and Safety Administration [OSHA], 1910 Subpart Q, Welding, Cutting, and Brazing – *Oxygen-fuel gas welding and cutting*, 29 CFR 1910.253.

Compressed Gas Association [CGA] (2008). P-1 OSHA – *Safe Handling of Compressed Gases in Container*.

National Fire Prevention Association [NFPA] – Liquefied Petroleum Gas Code, NFPA 58 (current).

National Fire Prevention Association [NFPA] – Standard for the Storage, Use, and Handling of Compressed and Liquefied Gases in Portable Cylinders, NFPA 55 (current).