☐ ADMINISTRATE POLICY & PROCEDURE (APP)	☐ INSTITUTIONAL POLICY & PROCEDURE (IPP) ☐ INTERDEPARTMENTAL ☐ INTERNAL	
TITLE		**POLICY NUMBER/V#**
Mechanism of Compressed and Flammable Gases		MMC – LAB – 18 (01)
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APPLIES TO	**RESPONSIBILITY**	
Laboratory Department	All Lab Staff	

1. Policy

1.1 All compressed gas cylinders should be marked, clearly identified the type of gas contained, to be placed on upright position and mounted against a stand. All compressed gas cylinders should be marked either full in use, full not in use, or empty.

1.2 Compressed gases present a unique hazard. Depending on the particular gas, there is a potential for simultaneous exposure to both mechanical and chemical hazards.

2. Purpose

2.1 This policy provides key information on the practices and procedures that shall be implemented to maintain compliance with state, federal, and local regulations required for the mechanism of compressed and flammable gases control

3. Definition

3.1 None.

4. Affected department

4.1 LAB.

5. Procedures

5.1 **Flammable gasses** (acetylene, hydrogen, hydrocarbons, propane) cylinders are stored in a separate room or enclosure reserved exclusively for that purpose and with a fire-resistance

5.1.1 classification. The area must be well ventilated and:

Flammable gasses are not stored within 6 meters (20 feet of oxidizing gases unless separated by a firewall.

5.1.2 Flammable liquid storage cabinets are labeled and vented.

5..1.3 Highly flammable and toxic procedures are performed in a fume hood.

5.1.4 A specially constructed storage room is provided for large amounts of flammable or combustible liquids. This includes a floor seal across the door to contain liquids, explosion proof fixtures and venting of vapors to the outside.

5.2 Refrigerators and freezers approved for storage of flammable liquids are identified with a sign or label. Compressed gases present a unique hazard. Depending on the particular gas, there is a potential for simultaneous exposure to both mechanical and chemical hazards. Gases may be combustible, explosive, corrosive, poisonous, inert, or a combination of hazards. If the gas is flammable, flash points lower than room temperature compounded by high rates of diffusion (which allow for fast permeation throughout the laboratory) present a danger of fire or explosion. Additional hazards of reactivity and toxicity of the gas, as well as asphyxiation, can be caused by high concentrations of even "harmless" gases such as nitrogen. Since the gases are contained in heavy, highly pressurized metal containers, the large amount of potential energy resulting from compression of the gas makes the cylinder a potential rocket or fragmentation bomb. In summary, careful procedures are necessary for handling the various compressed gases, the cylinders containing the compressed gases, regulators or valves used to control gas glow, and the piping used to confine gases during flow.

5.3 Procedure For Handling Compressed Gases

5.3.1 Identification

5.3.2 The contents of any compressed gas cylinder shall be clearly identified for easy, quick, and complete determination by any laboratory worker.

5.3.3 Such identification should be stenciled or stamped on the cylinder or a label, provided that it cannot be removed from the cylinder. Commercially available three-part tag systems can be very useful for identification and inventory. No compressed gas cylinder shall be accepted for use that does not legibly identify its contents by name. Color coding is not a reliable means of identification; cylinder colors vary with the supplier, and labels on caps have little value as caps are interchangeable.

5.3.2 If the labeling on a cylinder becomes unclear or an attached tag is defaced to the point the contents cannot be identified, the cylinder should be marked "contents unknown" and returned directly to the manufacturer.

5.3.3 All gas lines leading from a compressed gas supply should be clearly labeled to identify the gas, the laboratory served, and the relevant emergency telephone numbers. The labels should be color coded to distinguish hazardous gases (such as flammable, toxic, or corrosive substances) (e.g., a yellow background and black letters).

5.3.4 Signs should be conspicuously posted in areas where flammable compressed gases are stored, identifying the substances and appropriate precautions (e.g., HYDROGEN - FLAMMABLE GAS - NO SMOKING - NO OPEN FLAMES).

5.4 Handling and Use

5.4.1 Since gas cylinders are tall and narrow, they shall be secured at all times to prevent tipping. Cylinders may be attached to a bench top, individually to the wall, placed in a holding cage, or have a non-tip base attached.

5.4.2 When new cylinders are received, they should be inspected. During this inspection, one should insure the proper cap is securely in place and the cylinder is not leaking. Cylinders shall have clear labels indicating the type of gas contained. If the cylinders are acceptable, they shall be stored in a proper location. If a leaking cylinder is discovered, move it to a safe place (if it is safe to do so) and inform maintenance Services and polyclinic safety officer. You should also call the vendor as soon as possible. Under no circumstances should any attempt be made to repair a cylinder or valve.

5.4.3 Cylinders containing flammable gasses such as hydrogen or acetylene shall not be stored in close proximity to open flames, areas where electrical sparks are generated,

or where other sources of ignition may be present. Cylinders containing acetylene shall never be stored on their side. An open flame shall never be used to detect leaks of flammable gasses. Hydrogen flame is invisible, so "feels" for heat. All cylinders containing flammable gasses should be stored in a well-ventilated area.

5.4.4 Oxygen cylinders, full or empty, shall not be stored in the same vicinity as flammable gasses. The proper storage for oxygen cylinders requires that a minimum of 50 feet be maintained between flammable gas cylinders and oxygen cylinders or the storage areas be separated, at a minimum, by a fire wall five feet high with a fire rating of 0.5 hours. Greasy and oily materials shall never be stored around oxygen; nor should oil or grease be applied to fittings.

5.4.5 Standard cylinder-valve outlet connections have been devised by the Compressed Gas Association (CGA) to prevent mixing of incompatible gases. The outlet threads used vary in diameter; some are internal, some are external; some are right-handed, some are left-handed. In general, right-handed threads are used for non-fuel and water-pumped gases, while left-handed threads are used for fuel and oil-pump gases. To minimize undesirable connections, only CGA standard combinations of valves and fittings should be used in compressed gas installations; the assembly of miscellaneous parts should be avoided. The threads on cylinder valves, regulators and other fittings should be examined to ensure they correspond and are undamaged.

5.4.6 Cylinders should be placed with the valve accessible at all times. The main cylinder valve should be closed as soon as it is no longer necessary that it be open (i.e., it should never be left open when the equipment is unattended or not operating). This is necessary not only for safety when the cylinder is under pressure, but also to prevent the corrosion and contamination resulting from diffusion of air and moisture into the cylinder after it has been emptied.

5.4.7 Cylinders are equipped with either a hand wheel or stem valve. For cylinders equipped with a stem valve, the valve spindle key should remain on the stem while the cylinder is in service. Only wrenches or tools provided by the cylinder supplier should be used to open or close a valve. At no time should pliers be used to open a cylinder valve. Some valves may require washers; this should be checked before the regulator is fitted.

5.4.8 Cylinder valves should be opened slowly. Main cylinder valves should never be opened all the way.

5.4.9 When opening the valve on a cylinder containing an irritating or toxic gas, the user should position the cylinder with the valve pointing away from them and warn those working nearby. Regulators are gas specific and not necessarily interchangeable. Always make sure that the regulator and valve fittings are compatible. If there is any question as to the suitability of a regulator for a particular gas, check with Environmental Health Services or call your vendor for advice. After the regulator is attached, the cylinder valve should be opened just enough to indicate pressure on the

regulator gauge (no more than one full turn) and all the connections checked with a soap solution for leaks. Never use oil or grease on the regulator of a cylinder valve.

5.4.10 Piping material shall be compatible with the gas being supplied. Copper piping shall not be used for acetylene, or plastic piping for any portion of a high pressure system. Do not use cast iron pipe for chlorine; do not conceal distribution lines where a high concentration of a leaking hazardous gas can build up and cause an accident. Distribution lines and their outlets should be clearly labeled as to the type of gas contained. Piping systems should be inspected for leaks on a regular basis. Special attention should be given to fittings as well as possible cracks that may have developed.

5.4.11 A cylinder should never be emptied to a pressure lower than 172 kPa (25 psi/in^2) (the residual contents may become contaminated if the valve is left open). When work involving a compressed gas is completed, the cylinder must be turned off, and if possible, the lines bled. When the cylinder needs to be removed or is empty (see above), all valves shall be closed, the system bled, and the regulator removed. The valve cap shall be replaced, the cylinder clearly marked as "empty," and returned to a storage area for pickup by the supplier. Empty and full cylinders should be stored in separate areas.

5.4.12 Where the possibility of flow reversal exists, the cylinder discharge lines should be equipped with approved check valves to prevent inadvertent contamination of cylinders connected to a closed system. "Sucking back" is particularly troublesome where gases are used as reactants in a closed system. A cylinder in such a system should be shut off and removed from the system when the pressure remaining in the cylinder is at least 172 kPa (25 psi/in^2). If there is a possibility that the container has been contaminated, it should be so labeled and returned to the supplier.

5.4.13 Liquid bulk cylinders may be used in laboratories where a high volume of gas is needed. These cylinders usually have a number of valves on the top of the cylinder. All valves should be clearly marked as to their function. These cylinders will also vent their contents when a preset internal pressure is reached, therefore, they should be stored or placed in service where there is adequate ventilation. If a liquid fraction is removed

from a cylinder, proper hand and eye protection must be worn and the liquid collected in a Dewar flask.

5.4.13.1 Always use safety glasses (preferably a face shield) when handling and using compressed gasses, especially when connecting and disconnecting compressed gas regulators and lines.

5.4.13.2 All compressed gas cylinders, including lecture-size cylinders, shall be returned to the supplier when empty or no longer in use.

5.5 Transport action of Cylinders

5.5.1 The cylinders that contain compressed gases are primarily shipping containers and should not be subjected to rough handling or abuse. Such misuse can seriously weaken the cylinder and render it unfit for further use or transform it into a rocket having sufficient thrust to drive it through masonry walls.

5.5.2 To protect the valve during transportation, the cover cap should be screwed on hand tight and remain on until the cylinder is in place and ready for use.

5.5.3 Cylinders should never be rolled or dragged.

5.5.4 When moving large cylinders, they should be strapped to a properly designed wheeled cart to ensure stability.

5.5.5 Only one cylinder should be handled (moved) at a time.

5.6 Cryogenic Liquids

5.6.1 A number of hazards may be present from the use of cryogenic liquids in the laboratory. Employees should be properly trained in these hazards prior to use. The transfer of liquefied gasses from one container to another should not be attempted or

the first time without the direct supervision and instruction of someone experienced in the operation.

5.7 **Fire/Explosions**

5.7.1 Neither liquid nitrogen nor liquid air should be used to cool a flammable mixture in the presence of air because oxygen can condense from the air and lead to a potentially explosive condition.

5.7.2 Adequate ventilation must always be used to prevent the build-up of vapors of flammable gases such as hydrogen, methane, and acetylene.

5.7.3 Adequate ventilation is also required when using gases such as nitrogen, helium, or hydrogen. In these cases, oxygen can be condensed out of the atmosphere creating a potential for explosive conditions.

5.8 **Pressure**

5.8.1 Cylinders and other pressure vessels used for the storage and handling of liquefied gases should not be filled to more than 80% of capacity, to prevent the possibility of thermal expansion and the resulting bursting of the vessel by hydrostatic pressure.

5.9 **Embrittlement of Structural Materials**

5.9.1 Appropriate impact-resistant containers must be used that have been designed to withstand the extremely low temperatures.

5.10 **Contact with and Destruction** of Living Tissue

5.10.1 Even very brief contact with a cryogenic liquid is capable of causing tissue damage similar to that of thermal burns. Prolonged contact may result in blood clots that have potentially serious consequences.

5.10.2 In addition, surfaces cooled by cryogenic liquids can cause severe damage to the skin. Gloves and eye protection (preferably a face shield) should be worn at all times when handling cryogenic liquids.

5.10.3 Gloves should be chosen that are impervious to the fluid being handled and loose enough to be tossed off easily. Appropriate dry gloves should be used when

handling dry ice. "Chunks" or cubes should be added slowly to any liquid portion of the cooling bath to avoid foaming over.

5.11 **Asphyxiation**

As the liquid form of gases warm and become airborne, oxygen may be displaced to the point that employees may experience oxygen deficiency or asphyxiation. Any area where such materials are used should be well ventilated. For this same reason, employees should avoid lowering their heads into a dry ice chest. (Carbon dioxide is heavier than air, and suffocation can result.)

5.12 **Leaking Compressed gas management:**

Occasionally, a cylinder or one of its component parts develops a leak. Most such leaks occur at the top of the cylinder in areas such as the valve threads, safety device, valve stem, and valve outlet.

If a leak is suspected, do not use a flame for detection; rather, a flammable-gas leak detector or soapy water or other suitable "snoop" solution should be used. If the leak cannot be remedied by tightening a valve gland or a packing nut, emergency action procedures should be affected. Laboratory workers should never attempt to repair a leak at the valve threads or safety device; rather, they should consult with the supplier for instructions.

If the substance in the compressed gas cylinder is inert, or non-hazardous, contact the supplier for instructions.

6. Responsibilities

6.1 All Laboratory staff

7. Reference

7.1 Flammable gases Policy for Laboratory Safety

8. Attachments

8.1 None

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