Carnegie Mellon University Environmental Health & Safety FIRE | LAB | WORK	**Environmental Health and Safety** **Cryogens – Guideline**
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1. Purpose

Carnegie Mellon University has developed this guideline to cover general procedures for the safe handling and storage of cryogenic fluids and provide recommended safe practices for the handling, storage and transport of these liquids.

2. Scope

This guideline provides instruction for the safe use of cryogenic fluids. It applies to all Carnegie Mellon University personnel engaged in the storage, distribution, or use of such fluids.

3. Definitions

Cryogenic liquids are:

a. Refrigerated, liquefied gases having a boiling point colder than a temperature of minus 130F at a pressure of one atmosphere absolute.
b. Stored at low pressures in multi-walled, vacuum-insulated storage containers.
c. Examples of cryogenic liquids include oxygen, nitrogen, argon, neon, krypton, xenon, hydrogen, helium, liquefied natural gas (LNG)/methane, and solid carbon dioxide (dry ice).

4. Roles and Responsibilities

a. Carnegie Mellon University Environmental Health and Safety is responsible for:
    i. Developing the written Compressed Gas Cylinder Safety Program and revising the Program as necessary;
    ii. Developing a training program on the safe handling, use, storage, and transportation of compressed gas cylinders; and
    iii. Conducting routine inspections to ensure the proper storage and use methods are used.
b. Departments will be responsible for:
    i. Understanding and complying with the requirements of this program;
    ii. Ensuring the proper handling, use, storage, and transportation of cryogens according to this Program;
    iii. Training employees on the safe use, handling, storage, and transportation of cryogens; and
    iv. Contacting CMU EHS if assistance is needed.
c. Employees will be responsible for:
    i. Completing training as necessary;
    ii. Complying with the procedures outlined in this Program; and

iii. Informing their supervisor of any problems, defective equipment, or lack of proper storage space for cryogens used by them.

5. Guidelines

a. Potential Hazards

i. ***Extremely cold temperatures***: Cryogenic fluids can freeze human tissue on contact. Protective clothing, proper gloves and eye protection is required to protect against splashes of cryogenic fluids.

ii. ***Extremely high pressure***: If heat enters the storage vessel of a cryogenic liquid, rapid vaporization and expansion of the liquid could result, thus increasing the pressure in the container. Container capacity must allow for that portion of the cryogenic fluid, which will be in the gaseous state.

iii. ***Asphyxiation***: A cryogenic liquid form of inert gases (helium, neon, argon, krypton, xenon), that escape the storage container will rapidly expand and displace the oxygen necessary to support life in the room.

iv. ***Flammability:*** Many cryogens are also flammable gases such as hydrogen, methane, and carbon monoxide. Liquefied gases such as helium, neon, nitrogen, and hydrogen are capable of condensing oxygen from the air and causing creation of an oxygen enriched environment, which increases the potential of fire.

v. ***Embrittlement of associated materials used with cryogenic systems***: Due to drastic changes in the properties of materials when exposed to the extremely low temperatures the method of connection and connecting equipment used must receive careful consideration. If the properties of a material considered for use with cryogenic liquids are unknown, an experimental evaluation on a pilot or reduced scale should be conducted prior to using the material in a cryogenic system.

b. Safe Handling Procedures for Cryogenic Materials

i. All personnel that handle cryogenic liquids must be trained in the use of specialized equipment designed for the storage, transfer, and handling of these materials.

ii. In addition to laboratory attire, eye protection and insulated protective gloves must be worn to prevent skin contact with the extremely cold surfaces associated with the cryogenic system.

c. Transfer

i. Any transfer operations of cryogenic liquids into open containers must be conducted slowly to minimize boiling and splashing of the cryogenic liquid.

ii. Transfer operations must be conducted only in well-ventilated areas to prevent the possible accumulation of gas, which can replace the oxygen in the surrounding atmosphere and cause asphyxiation, or buildup of flammable vapors.

d. Storage

i. Store cryogenic fluids only in double wall, evacuated containers (Dewar flasks) of either metal or glass.

ii. Avoid all contact of moisture with cryogenic materials. A small amount of moisture freezing across the opening of a Dewar flask, or its safety relief valve, could cause a pressure buildup and potential explosion. The cloudy

vapor that appears when a liquefied cryogenic gas is exposed to the air is condensed moisture, not the gas itself.

iii. Wrap the exposed glass of Dewar flasks with cloth woven tape to prevent flying glass in the event of rupture.

iv. Caution must be observed when lowering objects or experiments into Dewar of cryogenic liquids to prevent an object from freezing tight in the neck of the flask. The obstruction of the Dewar opening will cause excessive and dangerous buildup of internal pressure in the flask and could potentially rupture the vessel.

v. Never handle or carry Dewar flasks by the neck, as the neck is the main support for the inner liner of the container. Always use handles provided on the container.

vi. All cryogenic liquid vessels must be stored in a secure location to prevent access by untrained personnel.

No smoking, open flame, or spark-producing equipment is permitted in an area where flammable cryogenic liquids or oxygen are loaded/unloaded, stored, handled, or used.

For additional questions or concerns please contact EH&S: safety@andrew.cmu.edu