STANDARD OPERATING PROCEDURE- CRYOGENIC LIQUIDS

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| **CONTACT INFORMATION** | | | |
| **Location** | Building: | | Room: |
| **Street Address:** |  | | |
| **Lab Safety Contact:** | Name: | | |
| Lab Phone: | Office Phone: | |
| **Emergency Contact** | Name: | Phone: | |
| **TYPE OF STANDARD OPERATING PROCEDURE** | | | |
| Indicate which type of Standard Operating Procedure applies  Specific Process or Equipment  Specific Hazardous Chemical  Hazard Class for a Group of Chemicals | | | |
| **DESCRIBE PROCESS/EQUIPMENT, HAZARDOUS CHEMICAL or HAZARD CLASS** | | | |
| **Cryogenic Liquids**  Cryogenic liquids are liquids with a boiling point of less than -73 °C. Under normal temperatures and pressures these liquids are converted to gas. Although technically not a cryogen, frozen carbon dioxide (dry ice) is sometimes included with this category. Solid carbon dioxide converts to carbon dioxide gas at -78°C.  Cryogenic liquids can be placed in three groups:   * Inert gases (Argon, helium, and nitrogen): They do not react or support combustion. * Flammable gases (hydrogen, methane, carbon monoxide): Produce a gas that can burn in the air when ignited. * Oxygen: Reacts explosively with organic materials and supports combustion.   Cryogenic liquids are used in the lab in many different ways. Some common uses include sample preservation, equipment cooling, and handling and storage of biological samples. | | | |
| **HAZARD SUMMARY** | | | |
| **Extreme Cold Hazard**  Cryogenic liquids and their associated vapors and gasses are extremely cold. Comes in contact with laboratory materials (plastics, steel, etc.) may cause them to become brittle and break. Contact with human tissue can cause cryogenic burns. The burns may not be immediately apparent but can develop at a later time. The burn causes the skin to appear white and waxy. Once the injury has thawed the site will become painful and turn pink/red.  **Asphyxiation Hazard**  Cryogenic gases are heavier than air and therefore accumulate near the floor. Even if the gas is not toxic, cryogenic materials can create an anoxic environment when ventilation is limited because it displaces the surrounding air. Small amounts of cryogenic liquid can readily vaporize producing large volumes of gas. For example, at room temperature one liter of liquid nitrogen vaporizes to 695 liters of nitrogen gas.  **Toxic and Flammable Hazards**  Cryogenic material can also be toxic and flammable under certain conditions. For example liquid carbon monoxide can release large amounts of deadly carbon monoxide gas.  **Pressure Hazards**  Cryogens have high liquid to gas expansion ratios with an average around 700 to 1. Vaporization in a container that is not equipped with a pressure relief device can produce a large amount of pressure, potentially rupturing the container.  Refer to the Safety Data Sheet (SDS) for specific information about the toxic hazards of the associated cryogen.  For more helpful information please consult the following website: [https://www.ccohs.ca/oshanswers/chemicals/cryogenic/cryogen1.html](https://nam04.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.ccohs.ca%2Foshanswers%2Fchemicals%2Fcryogenic%2Fcryogen1.html&data=02%7C01%7Clhanson3%40usf.edu%7C48e8fcd374984c2f0e0508d7cce4cc27%7C741bf7dee2e546df8d6782607df9deaa%7C0%7C0%7C637203155617942683&sdata=3EK7JIrPK3%2FsVJ3c69XnJTDHpQD7zb7Mz52NUbuc%2BZM%3D&reserved=0)  [https://www.ccohs.ca/oshanswers/prevention/cryogens.html](https://nam04.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.ccohs.ca%2Foshanswers%2Fprevention%2Fcryogens.html&data=02%7C01%7Clhanson3%40usf.edu%7C48e8fcd374984c2f0e0508d7cce4cc27%7C741bf7dee2e546df8d6782607df9deaa%7C0%7C0%7C637203155617942683&sdata=iqy0m%2F2cqGMcWqyPE5wjf47M%2BqWBMU%2B1WdN8PC1ohMQ%3D&reserved=0) | | | |
| **SPECIAL HANDLING AND STORAGE REQUIREMENTS** | | | |
| Include general precautions on how to minimize hazards associated with this activity.  **Handling:**  Only work with cryogens in well ventilated areas to avoid oxygen depletion or buildup of flammable or toxic gases. Never use liquid hydrogen, helium, and oxygen near flammable materials and ignition sources.  Inspect dewars daily to insure that no air or ice plugs exist in the neck openings. Never fill the container more than 80% to protect against thermal expansion.  If you are carrying a dewar with a cryogenic liquid, make sure that it is the only thing that you are carrying. Carry the transfer dewar away from your body and avoid groups of people.  Only use proper transfer equipment when transferring cryogenic liquids.  Cryogenic liquid/ dry ice baths should be open to the atmosphere to avid pressure buildup.  When thawing cryotubes place the cryotube in a heavy walled container or behind safety shield in case the tube shatters.  **Storage:**  Only store and transport cryogenic materials in dewars or cryogenic liquid cylinders designed for that particular  cryogen. Even in well-insulated containers, a cryogenic liquid cannot be indefinitely maintained as a liquid. Therefore, the container should be equipped with manufacture approved pressure release devices. Do not use dewars with homemade lids. These devices should be inspected regularly to ensure that they are in good working condition.They should be stored in a well-ventilated area with their pressure relief valve in the open position. Never store cryogenic materials in cold rooms or other enclosed spaces. They should be stored according to their hazard class, never store flammable gases or oxygen near flammable materials or ignition sources.  Additionally follow all specific storage guidance outlined in the chemical’s SDS. | | | |
| **ENGINEERING AND VENTILATION CONTROLS** | | | |
| Ensure that the room where the cryogenic materials are stored is equipped with proper exhaust ventilation. This will prevent the displacement of breathable air.  Do not place cylinders in an enclosed space as they do not have adequate ventilation (i.e. small closet, cold room).  If the process does not permit the use of cryogenic materials in well-ventilated areas contact USF EHS. | | | |
| **PERSONAL PROTECTIVE EQUIPMENT** | | | |
| **PPE Requirements:**  Long pants or clothing that covers all skin below the waist  Shoes that cover the entire foot; Leather shoes are advised, avoid wearing tennis shoes/ sneakers.  Gloves; indicate type: Insulated cryogenic-resistant gloves must be worn. The gloves should be loose-fitting so that they can be easily removed if they become contaminated. Inspect the gloves regularly and replace when needed.  Inspect gloves before use. Use proper glove removal technique to avoid skin contact with outer surface of glove. Wash hands after removing gloves.  Safety goggles  Safety glasses  Face shield; use when removing samples from liquid-phase cryogenic storage.  Lab coat  Flame-resistant lab coat  Other: A non-absorbent cryogenic apron must be worn where splashing or spraying may occur. Avoid open pockets and turn-ups where liquid could collect. Trouser bottoms should overlap boots or shoes for the same reason. Insulated tongs and forceps should be used to add or remove cryogenic materials.  If the use of an N95, half mask, or full face respirator is requested, the individual and/or their supervisor must first contact Environmental Health & Safety for a consultation to determine if respirator use is necessary. If EH&S determines the use of a respirator is necessary, the individual must participate in the University’s respirator program. This includes a medical evaluation; respirator fit test, and training. | | | |
| **EMERGENCY PROCEDURES** | | | |
| In case of fire or large and/or extremely hazardous chemical releases pull the fire alarm and evacuate the area  If someone is seriously injured or unconscious  **CALL 911 or CAMPUS POLICE AT <enter your campus PD #>**  From a safe place, provide as much information as possible to the emergency responders including chemical name, volume, hazards, injuries, and location.  **Small Spills (<1 Liter):** If a small amount is spilled, allow the liquid to evaporate if there is adequate ventilation. Do not attempt to clean up the spill. Report the spill to USF Environmental Health and Safety.  **Large Spills (>1 Liter):** If a large spill occurs shut off all sources of ignition and evacuate the area immediately. If safe to do so, attempt to stop the spill and ventilate the area. Call USF EHS immediately. Before returning to the area, ensure that there is no oxygen deficiency within the space.  **Chemical Exposure**: Slowly thaw the affected area by placing it into lukewarm (not warm or hot) water. Do not rub the affected area or break blisters that have formed. Cover the wound with a sterile dressing. Do not remove clothing if it has frozen onto the skin until the area has been completely thawed. If the burn is severe or there is a loss of sensation to the area seek medical attention immediately.  **Inhalation Exposure:** If anyone in the lab begins to experience dizziness, becomes lightheaded, or becomes unconscious, close the tank and leave the area to get fresh air. Seek medical attention if necessary. If breathing has stopped, call emergency services and begin CPR. Before returning to the area ensure that there is no oxygen deficiency, flammable atmosphere, or other hazards.  **Evacuation Procedure**   * Immediately evacuate the building via the nearest exit when the fire alarm is activated. * If unable to evacuate due to a disability, shelter in the area of rescue / refuge, typically a stairwell landing, and wait for assistance from drill volunteers or emergency responders. * Instruct visitors and students to evacuate and assist them in locating the nearest exit. * Do not use elevators to exit the building during an evacuation as they may become inoperable. * Carry only those personal belongings that are within the immediate vicinity. * Close doors to limit the potential spread of smoke and fire. * Terminate all hazardous operations and power off equipment. * Close all hazardous materials containers. * Remain outside of the building until the building is released for reentry. * Do not restrict or impede the evacuation. * Convene in the designated grassy gathering area and await instruction from emergency responders or drill volunteers. Avoid parking lots. * Report fire alarm deficiencies, (e.g., trouble hearing the alarm) to facilities personnel for repair. * Notify evacuation drill volunteers or emergency responders of persons sheltering in the areas of rescue/ refuge. * **Never assume that an alarm is a “false alarm”. Treat all fire alarm activations as emergencies. Get out of the building!**   **Incident and Near Miss Reporting**: Report any incident that occurs in any University of South Florida affiliated teaching or research laboratory/studio or field research project. An incident means any unplanned event within the scope of a procedure that causes, or has the potential to cause, an injury or illness and/or damage to equipment, buildings, or the natural environment. Due to medical privacy concerns, no personal identifying information of the person involved in the incident shall be entered or submitted with the form.  <http://www.usf.edu/administrative-services/environmental-health-safety/reporting/index.aspx>  **Workers’ Compensation Procedure:** Call AmeriSys at 800-455-2079 to report a work-related injury or illness. Complete the Supervisor’s Accident Investigation Report available at the link above and send it to EH&S within 24 hours. | | | |
| **WASTE DISPOSAL** | | | |
| Return the dewar and unused product to the vendor. Never pour cryogenics down the drain, this can cause major damage to the plumbing system. Allow dry ice to vaporize in a well-ventilated, protected area.  All chemical waste generated within USF System laboratories is considered hazardous waste and must be disposed of as hazardous waste in accordance with USF Hazardous Waste Management Procedure, the EPA, and the DEP. The USF Hazardous Waste Management Procedure can be found using the following link, <https://www.usf.edu/administrative-services/environmental-health-safety/documents/hazwaste-managementprocedure.pdf> | | | |
| **TRAINING REQUIREMENTS** | | | |
| All individuals working with chemicals in USF laboratories must take EH&S’s Laboratory Safety Training. To register for Laboratory Safety Training, please use the following link, <https://www.usf.edu/administrative-services/environmental-health-safety/training/course-descriptions.aspx#labsafety>  This procedure may warrant additional safety training per the PI, EH&S, or an authorizing unit such as the Biosafety or Radiation Safety programs. Check training requirements for this activity below:  Research Specific Training from the PI/Lab Supervisor or their designee  EH&S Laboratory Safety Training  EH&S Hazard Communication  EH&S Hazardous Waste Awareness and Handling  EH&S Respirator Fit Test  EH&S Biomedical Waste  EH&S Universal Pharmaceutical Waste Training  EH&S Fire Prevention Safety  EH&S Slips, Trips, and Falls  RIC Biosafety Core Course  RIC Shipping Biohazardous Materials  RIC BSL 3  RIC Radiation Safety  RIC Laser Safety  RIC Boating Safety  RIC Scientific Diving  Other:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | | | |
| **PRIOR APPROVALS** | | | |
| This activity requires prior approval from the PI/designee.  If this box is checked, working alone is not allowed for certain activities: filling dewars, retrieving samples from the dewar | | | |

By signing and dating here the Principal Investigator or a designee certifies that the Standard Operating Procedure (SOP) for **Cryogenics** is accurate and effectively provides safe standard operating procedures for employees and students in this lab who will handle this hazardous chemical.

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Signature Printed Name Date

I affirm that I have read and understand the Standard Operating Procedure for **Cryogenics** and have undergone the EH&S Laboratory & Research training and any lab specific training regarding this SOP.

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| Printed Name | Signature | Date |
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