STANDARD OPERATING PROCEDURE-DRY ICE

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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** | | | |
| **Dry Ice Handling** | | | |
| **HAZARD SUMMARY** | | | |
| Dry ice is the solid form of carbon dioxide that is available in flakes, pellets or block form and is non‐combustible. It is used primarily as a cooling agent to cool reactions or to ship biological specimens. Its advantages include lower temperature than that of water ice and not leaving any residue (other than incidental frost from moisture in the atmosphere). Dry Ice will sublime (vaporize directly to the gas state) at a temperature of ‐78.5C (‐109.3F) or higher. Dry ice will sublimate about 5 to 10 pounds every 24 hours (blocks last longer) in a typical storage cooler.  Asphyxiation  One of the main dangers associated with dry ice is the risk of asphyxiation when used or stored in poorly ventilated or tightly enclosed areas. Dry Ice sublimes into gaseous carbon dioxide which can cause asphyxiation in situations where high concentrations may accumulate and subsequently displace air from the room. Short exposures to cold gas vapor lead to discomfort in breathing with prolonged inhalation can produce serious effects on the lungs and could possibly provoke an asthma attack.  Burns/ Frosbites  Dry ice can cause burns if the substance itself, or surfaces which are or have been in contact with the substance (e.g. metal transfer hoses), come into contact with the skin. Local pain may be felt as the skin cools, though intense pain can occur when cold burns thaw and, if the area affected is large enough, the person may go into shock.  Explosion  Dry ice is not flammable or explosive, but it releases a large volume of carbon dioxide gas as it sublimates. If packaged in a container that does not allow for release of the gas, it may explode, causing personal injury or property damage. A dry ice bomb produces extremely loud noise and shoots out pieces of the container and dry ice. Injuries can result from scattered pieces of the container or pieces of dry ice which could become embedded in the skin resulting in internal frostbite. | | | |
| SPECIAL HANDLING AND STORAGE REQUIREMENTS | | | |
| Storage:  -Dry ice is to be stored insulated containers such as an insulated chest, insulated coolers, or a special coolers designed for the storage of dry ice. The thicker the insulation, the slower it will sublimate. Dry ice will sublimate about five to ten pounds every 24 hours (blocks last longer) in a typical storage cooler.  -Dry ice must be stored in a well-ventilated location. Do not store dry ice in unventilated rooms, cellars, autos, or boat holds. The sublimated carbon dioxide gas will sink to low areas and replace oxygenated air. This could cause suffocation if breathed exclusively.  -Do not store Dry Ice in a completely airtight container. The sublimation of Dry Ice to Carbon Dioxide gas will cause any airtight container to expand or possibly explode (one pound of dry ice produces about 250 liters of gaseous carbon dioxide). Dry ice is NEVER to be stored in any type of tightly sealed devices or confined area such as in walk-in coolers, refrigerators, freezers, closets, or cars/vans.  -If you store dry ice in a refrigerator or freezer the extremely cold temperature may cause your thermostat to turn off the freezer. It will keep everything frozen in the freezer but it will be used up at a faster rate producing a lot of CO2 gas which can be dangerous as refrigerator or freezer are usually air tight. So it is not recommended but it is the perfect thing if your refrigerator breaks down in an emergency.  Handling:  Dry Ice temperature is extremely cold at -109.3°F or -78.5°C. Always handle Dry Ice with care and wear protective cloth or leather gloves whenever touching it. An oven mitt or towel will work. If touched briefly it is harmless, but prolonged contact with the skin will freeze cells and cause injury similar to a burn.  Shipping/Transportation:  Although dry ice is not classified as a dangerous substance by the European Union, or as a hazardous material by the United States Department of Transportation for ground transportation, when shipped by air or water, it is regulated as a dangerous good and IATA packing instruction 954 (IATA PI 954) requires that it be labeled specially, including a diamond-shaped black-and white label, UN 1845. Also, arrangements must be in place to ensure adequate ventilation so that pressure build-up does not rupture the packaging. For transportation / shipping purposes dry ice must be packaged in containers that allow the release of CO2 gas. | | | |
| **ENGINEERING AND VENTILATION CONTROLS** | | | |
| Normal air is 78% Nitrogen, 21% Oxygen and only 0.035% Carbon Dioxide. If the concentration of carbon dioxide in the air rises above 0.5%, carbon dioxide can become dangerous. When ventilation is inadequate and the CO2 gas will build up and displace oxygen from the local atmosphere. An atmosphere containing less than 18% oxygen is potentially hazardous and entry into atmospheres containing less than 20% should be avoided.  If Dry Ice has been in a closed room/area for more than 10 minutes, open doors and allow adequate ventilation before entering. Dry Ice CO2 is heavier than air and will accumulate in low spaces. Do not enter closed storage areas that have or have had stored Dry Ice before airing out completely. Leave area containing Dry Ice if you start to pant and breath quickly develop a headache or your fingernails or lips start to turn blue. This is the sign hypoxia/asphyxia i.e. you have breathed in too much CO2 and not enough oxygen.  Symptoms of hypoxia: Changes in the color of your skin, ranging from blue to cherry red, Confusion, Cough, Fast heart rate, Rapid breathing, Shortness of breath, Sweating, Wheezing  The general effects of reduced oxygen content in the atmosphere are given below:  19.5 % Minimum acceptable oxygen level.  15 - 19% Decreased ability to work strenuously. Impair coordination. Early symptoms.  12-14% Respiration increases. Possibility of fainting without prior warning.  Physical and intellectual performance diminishes without the person being aware.  10-12% Respiration increases. Lips blue.  8-10% Mental failure. Fainting. Nausea, Unconsciousness. Vomiting.  6-8% Fainting within a few minutes – resuscitation possible if carried out immediately.  8 minutes: fatal, 6 minutes: 50% fatal, 4-5 minutes:  4-6% Fainting almost immediate, Coma in 40 seconds.  Death ensues, brain damage even if resuscitated.  Normal CO2 Level  The levels below are quite normal and maximum levels may occasionally happen from time to time. The effects of increased CO2 levels on adults at good health can be summarized to:  350 - 450 ppm Normal outdoor level  < 600 ppm Acceptable levels  600 - 1000 ppm Complaints of stiffness and odors  1000 ppm ASHRAE and OSHA standards  1000 - 2500 ppm General drowsiness: 1000 - 2500 ppm  2500 - 5000 ppm Adverse health effects expected  5000 ppm Maximum allowed concentration within a 8 hour working period  Extreme and Dangerous CO2 Levels  30000 ppm Slightly intoxicating, breathing and pulse rate increase, nausea  50000 ppm Above plus headaches and sight impairment  100000 ppm unconscious, further exposure death | | | |
| **PERSONAL PROTECTIVE EQUIPMENT** | | | |
| **PPE Requirements:**  Long pants or clothing that covers all skin below the waist  Shoes that cover the entire foot  Gloves; indicate type: non-absorbent insulated gloves extending beyond the wrist must be worn when handling anything that is or has been in recent contact with dry ice.  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  Lab coat  Flame-resistant lab coat  Other:  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.  **Chemical Exposure**: Remove any contaminated clothing, and IMMEDIATELY flush contaminated skin with water for at least 15 minutes following any skin contact. For eye exposures, IMMEDIATELY flush eyes with water for at least 15 minutes. Consult SDS for guidance on appropriate first aid. Where medical attention is required, bring the SDS(s) of chemical(s) to aid medical staff in proper diagnosis and treatment.  **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** | | | |
| Disposal of unneeded dry ice is accomplished by letting the unused portion sublimate (recommended for well-ventilated locations because it will occur over a period of several days and the ventilation will take care of the gas liberated).  NEVER dispose of dry ice in a sink, toilet or other device. Such action can destroy the structure because of the temperature difference. NEVER dispose of dry ice in the trash or garbage.  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 Hazardous Waste Pharmaceutical 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. | | | |

By signing and dating here the Principal Investigator/ or a designee certifies that the Standard Operating Procedure (SOP) for ***Dry Ice Handlings*** 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 ***Dry Ice Handling*** 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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