New Mexico State University
College of Engineering

Cryogenic Materials SOP

Standard Operating Procedures for Chemicals or Processes	
Classification	Hazardous Substance? Yes_xx___ No ____
#1 Process (if applicable)	Experimental work using cryogenic materials such as liquid nitrogen, liquid oxygen, anhydrous ammonia, carbon dioxide etc. This is not process specific.
#2 Chemicals	Carbon Dioxide (CAS 124-38-9), Liquid Nitrogen (CAS 7727-37-9), Liquid Oxygen (CAS 7782-44-7) Anhydrous Ammonia (CAS 7664-41-7), Methane (CAS 74-82-8), Acetylene (74-86-2), Liquid Propane (74-98-6), Liquefied Natural Gas (LNG) (CAS 74-82-8) Liquid Hydrogen (1333-74-0), not inclusive.
#3 Personal Protective Equipment (PPE)	Minimum requirements: Loose fitting thermal barrier gloves (which can be thrown off if exposure occurs), chemical splash goggles, face shield, lab coat, rubber apron and closed toe shoes. • Do not wear polymer gloves (rubber, nitrile, latex etc.) since they will harden instantly on contact with cryogenic temperatures. • Non-metallic tongs may be used to add or remove materials from cryogenic liquids • Do not work with cryogenic materials overhead. Always work from above with no one below. • Watches, rings and jewelry should not be worn, as metals can become frozen to the skin (arm, wrist, or finger).
#4 Handling/ Environmental / Ventilation Controls	Cryogenic materials are condensed gases that are kept under super-cool conditions at very low pressure. Most cryogenic materials are liquids with the exception of carbon dioxide which can be either a solid (dry ice) or as a liquid. At room or ambient temperature they begin to boil (or sublime for dry ice) and return to their gaseous state. During this process heat is absorbed from the surroundings and ice formation is common. The cryogenic material is very cold and will burn on contact with skin and eyes. It can also cause equipment and materials to become brittle and shatter. Care must be taken to ensure that materials are compatible and proper personal protective equipment (PPE) is worn. Anoxic Condition: When a large volume of cryogenic material is allowed to escape into the atmosphere in a small space, the resulting gas will displace oxygen in the area creating an oxygen deficient atmosphere. Below 19.5 percent is considered oxygen deficient (anoxic) environment. Above 23.5 percent is considered oxygen enriched. Either condition can result in loss of consciousness or even death. • Room ventilation needs to be maintained at all times to ensure healthy conditions exist. • Area evacuation is needed if cryogenic material is in use in a small space and HVAC system malfunctions. Flammability: Cryogenic materials are associated with fire and explosion hazards, and care must be taken to avoid such hazards. Some cryogenic gases are flammable, including hydrogen, methane, and acetylene, while oxygen can support and accelerate the combustion of flammables and other materials. • Ignition sources must be prohibited in areas where combustible cryogens are stored or used. Ignition sources include obvious ones such as open flames and welding, but electrical equipment must also be considered. • Flammables must be kept and stored away from oxygen. One must also be aware that liquefied inert gases, including liquid nitrogen and helium, may condense oxygen from the atmosphere causing oxygen entrapment in unsuspected areas. In addition, extremely cold surfaces are also capable of condensing oxygen from the atmosphere. Cryogenic burns and frostbite hazards: Cryogenic fluids (liquid or cold gas) that are allowed to come in contact with human skin can cause severe damage to living

	tissue, including cold burns and frostbite. Damage can occur very quickly with only brief contact, longer than only a few seconds.
#5 Special Handling Procedures & Storage Requirements	Pressure Safety Valves (PSV): A cryogenic material will expand in volume approximately 1000 times during the change in state from liquid to gas, or from solid to gas. Therefore a PSV needs to be installed between any two valves in series that can be closed to prevent rupture of piping systems. Verify that materials for equipment, piping and handling are compatible with cryogenic temperatures. In general a stainless steel alloy is best for cryogenic service. Any polymeric materials should be chosen carefully with special materials for applications such as valve seats, gaskets and O-rings available depending on the application. If using LOX, ensure that everything that will come into contact with LOX is rated and cleaned for oxygen service as well as the temperature. Storage: 1. Store cryogenic materials in well ventilated areas to prevent anoxic conditions. 2. Use only approved storage vessels that have pressure relief valves. 3. Never adjust, block or plug a pressure relief valve. 4. Avoid contact of moisture with storage containers to prevent ice plugs in relief devices. 5. Periodically check container necks for plugs; core out ice plugs if present since they act like a closed valve where gas produced from the cryogenic liquid will build up enough pressure to rupture or explode the container. 6. Keep all heat sources away from cryogenic liquids. 7. Do not use cryogenic materials in walk-in cold rooms because they may not have sufficient air exchange and could become oxygen deficient (anoxic condition).
#6 Spill and Accident Procedures	Spill and Accident Procedures: 1. Turn off the source of cryogenic liquid , to stop further spillage, if possible 2. Evacuate the area until ventilation system (HVAC) corrects the anoxic environment to healthy conditions. 3. If exposure occurs, follow procedures shown below in Decontamination #10 or refer to the SDS. Call 911 in the event of a spill beyond lab staff capabilities. 4. For emergency response call 911 or EH&S at 646-3327
#7 Waste Disposal	Waste Disposal Return unused portion of cryogenic material to source or supplier. Or for small quantities contact the CHP or ESH for instructions.
#8 Special Precautions	See Section #4 above
#9 Approval Required	1. Completion, review and approval of Experimental Safety Plan (ESP) required before research start 2. Changes documented using a revision to the ESP
#10 Decontamination (SDS Information)	• First-aid measures after inhalation: Remove victim to uncontaminated area wearing self-contained breathing apparatus. Keep victim warm and rested. Call a doctor. Apply artificial respiration if breathing stopped. • First-aid measures after skin contact: For exposure to liquid, immediately warm frostbite area with warm water not to exceed 105°F (41°C). Water temperature should be tolerable to normal skin. Maintain skin warming for at least 15 minutes or until normal coloring and sensation have returned to the affected area. In case of massive exposure, remove clothing while showering with warm water. Seek medical evaluation and treatment as soon as possible. • First-aid measures after eye contact: Immediately flush eyes thoroughly with water for at least 15 minutes. Hold the eyelids open and away from the

	eyeballs to ensure that all surfaces are flushed thoroughly. Get immediate medical attention. • First-aid measures after ingestion : Ingestion is not considered a potential route of exposure
#11 Process Procedure – Define Steps	Not Applicable
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