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| **Brueckner Lab-Specific Standard Operating Procedure (LSOP)****Liquid Nitrogen** |
| **Principal Investigator(PI):** Christian Brueckner |
| **Building:** Chemistry | **Lab(s) Covered by LSOP:** R413/R415 |
| **Department:** Chemistry | **Lab Phone Number(s):** 6-6596/6-6598 |
| **SECTION 1 – HAZARDOUS CHEMICAL(S) or PROCESS(ES) and HAZARDS INVOLVED** |
| Liquid nitrogen is not chemically reactive, but under typical laboratory conditions it is at its normal boiling point. Consequently, if it comes in contact with any object or substance that is at a temperature greater than ‑195.8 °C, it will boil vigorously. The greater the mass or the higher the temperature of the object or substance, more vigorously it boils. For example, liquid nitrogen boils explosively if mixed with water. Dewar flasks made of glass can break (implode) if liquid nitrogen is poured over the rim. Use a siphon to empty a glass Dewar; often, the rim cannot withstand sudden temperature change. The boiling point of oxygen is -183 °C. Therefore, liquid nitrogen that is open to the air will condense oxygen as a liquid and the mixture of liquid oxygen and liquid nitrogen is a powerful oxidizing agent that reacts violently with most flammables, combustibles, and other reducing agents.Over-pressurization will develop in inadequately vented pressurized systems due to the expansion of cryogenic liquid vaporizing into large volumes of gas. Sudden release of this pressure can cause personal injury by issuing cold gas or liquid. In some instance pressure relief valves are needed. NOTE: If a large quantity of ice has formed on top of the cylinder do not attempt to decant. |
| **SECTION 2 – ADMINISTRATIVE CONTROLS** |
| * Anyone using the chemicals and procedures described herein needs to have undergone the annual EH&S: [Chemical Hygiene Training](http://www.ehs.uconn.edu/Chemical/?p=training)
* Be aware of the applicable safety data sheets (SDS): <http://www.msds.com>
* [Working Alone](http://policy.uconn.edu/2012/07/30/working-alone-policy/) is not permitted when using chemicals or processes described in this LSOP.
* Any reaction flask containing liquid nitrogen needs to be clearly labelled as such.
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| **SECTION 3- ENGINEERING CONTROLS** |
| * All research with liquid nitrogen must be conducted in a chemical fume hood, under dry conditions, with the sash at the lowest working height and with sliding sash panels (if applicable) aligned to form a barrier between the researcher and the experiment.
* Chemical fume hoods must have been tested by EHS within the last year. If the hood is not working properly, contact Facilities (486-3113) to repair the hood or EH&S to retest (486-3613).
* Use care and caution when transporting a Dewar to lab area. Lid is not tight.
* Taking elevator is not allowed if carrying liquid nitrogen.
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| **SECTION 4 – WORK PRACTICES** |
| Liguid nitrogen must be handled and stored in a well-ventilated place. All containers must be clearly labeled with the chemical name and hazard classes and kept tightly-sealed. |
| **SECTION 5 – PERSONAL PROTECTIVE EQUIPMENT (PPE)** |
| **Hand Protection** * Wear loose fitting gloves made for cryogenic work or smooth leather welding type gloves without gauntlets. Loose fitting gloves can be thrown off if some liquid nitrogen leaks or is spilled into them.
* Rubber gloves should not be used because they will harden instantly - if your hand is bent, you may not be able to remove your hand.
* A thin gas barrier forms between the skin and the cryogenic liquid when it is spilled on the skin. This will protect you unless the liquid hits you under force. This gas barrier is very cold and can also burn you.
* Use non-metallic tongs to add or remove materials from nitrogen liquid.

**Eye Protection** * Face shields and goggles provide the best protection for the eyes and face. Safety glasses will not protect your face, and cold liquids can hit your face and run under the glasses into your eyes. Safety goggles will keep liquid out of eyes but leave face exposed.
* When filling Dewar flask or transferring liquid nitrogen from one container to another, face shields must be worn.

**Clothing** * Closed toe shoes are required when handling cryogenic liquids. Leather will shed the spilled liquid. Cuff-less pants should cover the shoe top. Sneakers are typically made with absorbent materials which could draw liquid toward your skin.
* Long sleeve shirts made of non-absorbent material are best.
* An apron made of leather or other non-absorbent material should be used when working with liquid nitrogen. Most clothing material will absorb spilled liquid nitrogen, bringing the liquid close to the skin.
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| **SECTION 6 – STORAGE** |
| * Store liquid nitrogen as indicated in safety data sheets (SDSs): <http://www.msds.com/>
* Ensure labels on original bottles remain legible and prominently displayed to identify contents.
* Ensure both original and secondary containers remain intact and are stored with tight-fitting caps or lids.
* For short-term (overnight) storage, use insulated containers designed for the purpose. For long-term storage, follow the recommendations of the supplier.
* The fill station is outdoors so requiring no special attention to ventilation.
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| **SECTION 7 – SPILL AND ACCIDENT PROCEDURES** |
| * If a spill of liquid nitrogen occurs, make sure you do no come in contact with the liquid. It will evaporate on its own and requires no clean up.
* If you are in an interior space with little or no ventilation, evacuate the area since large amounts of evaporating liquid nitrogen will quickly deplete the area of oxygen.
* Always push Dewar flask if they need to be moved. Never pull on Dewar flask - they are very heavy and can tip and crush you. Large Dewars can lead to injuries (back injuries, crushed foot, crushed hand).
* Do not re-enter area unless it is proved safe to do so. The presence of oxygen deficiency monitors will indicate the oxygen levels in the vicinity.
* Prevent liquid nitrogen from entering drains, basements, pits or any confined space where accumulation  may be dangerous.

**Report any incident to the PI and fill out the** [**accident form**](https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwiF3bPe1dPXAhVRRN8KHX4wDf4QFggmMAA&url=https%3A%2F%2Fchemistry.uconn.edu%2Fwp-content%2Fuploads%2Fsites%2F1259%2F2015%2F09%2FIncident-Report-Form.doc&usg=AOvVaw3Uov8IQ2Z-Kan) |
| **SECTION 8 – FIRST AID PROCEDURES** |
| *Eyes** Eye contact: Immediately flush eyes with warm water for 15 minutes. And get medical attention

*Skin** If skin comes into contact with liquid nitrogen, run the area under cool or warm water for fifteen minutes. Never use hot or cold water. The re-warming, or thawing, of affected area(s) should be done gradually. It may take up to 60 minutes to thaw the affected area(s) and bring back the natural color of the skin.
* If your finger is burned, do not put it in your mouth. This could burn your mouth or tongue.
* Do not rub a burned area: rubbing can cause further tissue damage.
* Always seek medical attention for frostbite injuries. You should obtain medical assistance as soon as possible when cryogens contact your skin. Immediately upon exposure, the frozen skin appears waxy and yellow and the burn usually is not painful. Then it painfully swells and blisters while the skin defrosts.

*Inhalation** Move to fresh air

**Report any incident to the PI and fill out the** [**accident form**](https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwiF3bPe1dPXAhVRRN8KHX4wDf4QFggmMAA&url=https%3A%2F%2Fchemistry.uconn.edu%2Fwp-content%2Fuploads%2Fsites%2F1259%2F2015%2F09%2FIncident-Report-Form.doc&usg=AOvVaw3Uov8IQ2Z-Kan) |
| **SECTION 9 – WASTE MANAGEMENT** |
| * Allow the unused liquid nitrogen to evaporate on the floor.
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| **SECTION 10 – DECONTAMINATION PROCEDURES** |
| Work Area | * Work in well ventilated area.
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| Personal Hygiene | * Use standard chemical hygiene practices regarding PPE (see above)
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| **SECTION 11 – SPECIFIC PROCEDURE** |
| **For filling smaller, open-top, Dewars:**  * Connect transfer hose to small Dewar fill adapter.
* Place adapter into mouth of Dewar.
* Open valve slowly, nitrogen will begin to flow.
* Transfer hose and Dewar plumbing will begin to ice up. Once sufficiently cold, liquid will feed  into Dewar.
* Be cautious of liquid nitrogen spray/boiling/over-spill.
* When Dewar is full, close valve
* Remove fill adapter from Dewar, being cautious of drips and spillage.
* Remove fill adapter from transfer hose.

Note: Make sure to wear proper PPE as discussed before. |

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| **SECTION 12A. APPROVAL** |
| I have reviewed, understand and agree to follow this lab-specific standard operating procedure (LSOP) for the use of Liquid nitrogen*.* Failure to follow this LSOP or lab-specific training guidelines is a violation of the [*University Health & Safety Policy*](http://policy.uconn.edu/2011/05/19/health-and-safety-policy/) and [*University Code of Conduct*](http://policy.uconn.edu/2011/05/17/employee-code-of-conduct/).Further approval and/or review of this LSOP by the PI is required if any of the following events occur:* A significant change in amount (i.e., doubling of the scale of reaction) or substitution of the chemicals in the procedure is planned
* A major change in the agreed-upon experimental set-up is planned (heating instead of room T, etc.)
* Any signs of a failure in safety design or equipment are observed
* Any signs or symptoms of a chemical exposure to any personnel are observed
* Unexpected and/or potentially dangerous experimental results occur (e.g., fire, uncontrolled buildup of heat and/or pressure, etc.)
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| **Researcher Name/Signature** | **Trainer Name/Signature** | **Training Date** |
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| **SECTION 12B. PRINCIPAL INVESTIGATOR CERTIFICATION** |
| I approve the contents of the lab-specific standard operating procedure listed above. |
| **PI Signature:** | **Date:** |
| **A HARD OR ELECTRONIC COPY (https://bruckner.research.uconn.edu/safety-resources/) OF EACH LAB-SPECIFIC STANDARD OPERATING PROCEDURE MUST BE READILY AVAILBALE IN THE LAB.** |