

**IWD Part 1, Activity Specific Information**

IWD #: MST-8-3-1698-C135-3    Revision #: 4			Activity/Task Title EML Cryogenic Work
Work Document #			Planner/Preparer (Name/Z #/Date) Rodney McCabe / 178257 / 04-17-2019
TA 3	Building 1698	Room C-135	Other Location(s)(TA) as required

**Activity Description/Overview:**

This IWD covers work involving cryogens performed by EML users on equipment in the Electron Microscopy Laboratory area.

EML tasks involving cryogens include:

- A. Transporting liquid nitrogen from the MPA-10 filling station.
- B. Use of liquid nitrogen for TEM cold traps, sample holders, and EDS dewars.
- C. PIPS cryostage charging and operation.
- D. Cooling electrolytic baths for electropolishing

Hazard Analysis (HA) Method Used: ☒ Brainstorming    ☐ Other: \_\_\_\_\_

List Names of HA Team (Attach sheet if necessary): Rodney McCabe, Ben Morrow, Matt Schneider, Roberta Beal    Date HA Performed: 04-17-2019

The RLM approval indicates Integrated Work Management (IWM) has been applied appropriately, work is authorized, workers are qualified, work will be performed in accordance with Environment, Safety, Health, and Quality (ESH&Q)/Security and Safeguards (S&S) requirements and the IWD, and facility safety basis, aggregate hazards, and collocated hazards were appropriately included in the hazard analysis. RLM acknowledges completion of a peer review.

RLM (Signature/Z#/Date) Required: [Signature] 187042 6/28/2019

The Facility Operator Director (FOD) approval on Form 2100 indicates work is appropriate to be conducted in this facility (the activity is within the Authorization Basis [AB] and the work is appropriate for the facility), and facility safety basis, aggregate hazards, and collocated hazards will be managed.

Work activities in multiple FOD jurisdictions, e.g., additional facility safety envelopes, require FOD or Representative approval, where applicable.

FODs or FOD Representatives (Signature/Z#/Date/TA) Required: [Signature] 180035 7/11/18 M-3

Subject Matter Exper(s) (SME[s]) Review (Signature/Z#/Date) If Required: [Signature] 121975 5/14/19

[Signature] 317874 6/8/19 1#

**Hazard Determination by Hazard Grading Table**

- ☐ Low-Hazard
- ☒ Moderate-Hazard
- ☐ High-hazard/Complex

**IWD Type:**

- ☐ Standing IWD    ☐ Standard IWD

Expiration Date: 6/28/2022

RLM and FOD or FOD Representative reapproval is required.

Annual Review Completed (RLM Initial/Date): \_\_\_\_\_

Name of Primary Person in Charge (PIC) (Print): Rodney J McCabe

Name of Alternate PIC: Ben Morrow

Name of Alternate PIC: Matt Schneider

Classification review completed, if required.

Reviewer Signature/Z#/Date

## General Training Outline

<b>Work Tasks/Steps</b> Identify work steps/tasks in sequence when such sequencing contributes to safety, security, and/or environmental protection.	<b>Hazards, Concerns, and Potential Accidents/Incidents</b> Identify both activity and work-area hazards for each task/step.	<b>Controls, Preventive Measures, and Bounding Conditions</b> Specify preventive measures, controls for each hazard (e.g., lockout/tagout points, specific Personal Protective Equipment [PPE], Tamper Indicating Devices [TIDs], alarms, safes, recycle, waste minimization).	<b>Reference Documents</b> List permits, operating manuals, security plans, and other reference procedures.	<b>Training</b> List training and qualification requirements. (P300, <u>Integrated Work Management, Section 6.1</u> )
				<ul style="list-style-type: none"> <li>- LANL Lab-Wide training as required in this document.</li> <li>- EML Site Specific Walk-through training.</li> <li>- On-the-job training by one of the PICs.</li> </ul>

### Task A: Transporting Liquid Nitrogen from the MPA-10 Filling Station.

<b>Work Tasks/Steps</b> Identify work steps/tasks in sequence when such sequencing contributes to safety, security, and/or environmental protection.	<b>Hazards, Concerns, and Potential Accidents/Incidents</b> Identify both activity and work-area hazards for each task/step.	<b>Controls, Preventive Measures, and Bounding Conditions</b> Specify preventive measures, controls for each hazard (e.g., lockout/tagout points, specific Personal Protective Equipment [PPE], Tamper Indicating Devices [TIDs], alarms, safes, recycle, waste minimization).	<b>Reference Documents</b> List permits, operating manuals, security plans, and other reference procedures.	<b>Training</b> List training and qualification requirements. (P300, <u>Integrated Work Management, Section 6.1</u> )
<p>This task involves transporting Liquid Nitrogen from the MPA-10 filling station to the EML.</p> <ol style="list-style-type: none"> <li>1. Don PPE (eye protection, gloves).</li> <li>2. For filling dewars, follow procedure outlined in IWD# MPA-CMMS-3-3234-DOCK-3</li> <li>3. Transportation of LN2 requires use of safety glasses and cryogenic PPE for all regions where skin makes contact with a dewar.</li> <li>4. Dewars may be stored in room C-135H outside of room C-135B.</li> </ol>	<p><u>Chemical Hazards:</u> Cryogenics (less than 5L) - Liquid Nitrogen</p> <p><u>Physical Hazards:</u> - Thermal &amp; Pressure Issues (exothermic reactions) - Cryogen use</p> <p><u>Chemical exposure:</u> - Skin contact - Eye contact - Ingestion - Inhalation</p> <p><u>Physical Hazards:</u> - Cryogenic burns - Asphyxiation hazard</p>	<p><u>Required Personal Protective Equipment:</u></p> <ul style="list-style-type: none"> <li>- Cryogenic gloves</li> <li>- Safety glasses / face shield</li> <li>- Close-toed footwear required</li> </ul> <p><b>Note: All skin making contact with the liquid nitrogen dewar must be protected with cryogenic PPE.</b></p> <p><u>Engineering Controls:</u></p> <ul style="list-style-type: none"> <li>- Use of caps to prevent condensation of air into dewars.</li> <li>- Availability of appropriate PPE.</li> </ul> <p><u>Administrative Controls:</u></p> <ul style="list-style-type: none"> <li>- Follow all precautions as outlined on the MSDS for each chemical</li> <li>- Filling occurs out doors so that there is no possibility of confined-space asphyxiation</li> </ul>	<ul style="list-style-type: none"> <li>- Procedure P101-5: Cryogenic</li> <li>- IWD# MPA-CMMS-3-3234-DOCK-3</li> </ul>	<ul style="list-style-type: none"> <li>- Chemical Workers, Authorized (Haz Com) (4261)</li> <li>- Cryogenic Fluids Worker (2720)</li> <li>- Authorized worker on IWD# 10-3-3234-DOCK-1 Inert Cryogen/Gas Cylinder Handling</li> </ul>

		- Cryogenics can displace oxygen and will expand ~1000x between the liquid and gaseous phases. The safe volume of cryogenics in a room is calculated by $V_s \text{ (liters)} = V_{\text{room}} \text{ (m}^3\text{)}/14$ . If the cryogen volume is greater than $V_s$ , contact the ESH POC to evaluate the ventilation.		
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**Task B: Use of Liquid Nitrogen for TEM Cold Traps, Sample Holders, and EDS dewars**

<b>Work Tasks/Steps</b> Identify work steps/tasks in sequence when such sequencing contributes to safety, security, and/or environmental protection.	<b>Hazards, Concerns, and Potential Accidents/Incidents</b> Identify both activity and work-area hazards for each task/step.	<b>Controls, Preventative Measures, and Bounding Conditions</b> Specify preventive measures, controls for each hazard (e.g., lockout/tagout points, specific Personal Protective Equipment [PPE], Tamper Indicating Devices [TIDs], alarms, safes, recycle, waste minimization).	<b>Reference Documents</b> List permits, operating manuals, security plans, and other reference procedures.	<b>Training</b> List training and qualification requirements. (P300, <u>Integrated Work Management, Section 6.1</u> )
<p>This task involves filling TEM cold traps, specimen holders and EDS dewars with Liquid Nitrogen for the purpose of assisting the vacuum system and removing the dewars when finished.</p> <p>Cold Trap Procedure:</p> <ol style="list-style-type: none"> <li>1. Don PPE (safety glasses, cryogenic gloves).</li> <li>2. Remove the Styrofoam cap and plastic cover from cold trap</li> <li>3. Carefully fill the cold trap with liquid nitrogen to within approximately one inch from the top.</li> <li>4. Replace plastic cover on cold trap.</li> <li>5. Replace cap on dewar and return liquid nitrogen and gloves to appropriate location.</li> <li>6. If a different user will be on the TEM following your time, top off the cold trap dewar before the end of your session using the outlined procedure and notify the user that cold trap was used.</li> <li>7. Otherwise, don PPE (safety glasses, cryogenic gloves), remove the Styrofoam cap and plastic cover from the cold trap, remove the cold trap dewar and set on the side counter, and run the cryocycle.</li> </ol>	See above in Task A	<p>See above in Task A</p> <p>Take care to fill dewar slowly, minimizing splashing of the cryogen.</p> <p>The safe volume for rooms C135A&amp;G have been calculated and is 4.8L liquid nitrogen without ventilation. The safe volume for rooms C135A&amp;G have been calculated and is 8L liquid nitrogen with ventilation.</p> <p>The room has between 5-7 air changes per hour.</p>	<p>- Procedure P101-5: Cryogenic Liquids and Cryogenics.</p> <p>- Tecnai documentation.</p>	<p>- Chemical Workers, Authorized (Haz Com) (4261)</p> <p>- Cryogenic Fluids Worker (2720)</p>

<p>EDS Dewar Procedure:</p> <ol style="list-style-type: none"> <li>1. Don PPE (eye protection, cryogenic gloves).</li> <li>2. Roll the step stool in front of the microscope table.</li> <li>3. Climb the step stool and stand on the microscope table while filling the Dewar.</li> <li>4. Remove the EDS Dewar lid</li> <li>5. Carefully fill the cold trap with liquid nitrogen</li> <li>6. Replace EDS Dewar lid</li> <li>7. Replace cap on dewar, climb down the step stool, and return liquid nitrogen and gloves to appropriate location.</li> <li>6. Return the step stool to storage position</li> </ol>				
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#### Task C: PIPS Cryostage Charging and Operation

<p>This task involves PIPS operation using the cryostage and properly removing samples.</p> <ol style="list-style-type: none"> <li>1. Don PPE (safety glasses, gloves).</li> <li>2. Follow procedure outlined in pages 22-28 of the Gatan Cryostage User's Manual. Dewar is a non-pressurizing container.</li> <li>3. When finished, inform the following user if liquid nitrogen is in use with appropriate signage.</li> </ol> <p><b>Note: it is important to allow the sample to sit in the airlock position for at least 10 minutes prior to venting the airlock. Failure to do so may result in damage to the sample and icing on the whisperlock.</b></p>	See above in Task A	<p>See above in Task A</p> <p>Take care to fill dewar slowly, minimizing splashing of the cryogen.</p>	<p>- Procedure P101-5: Cryogenic Liquids and Cryogens.</p> <p>- Gatan Precision Ion Polishing System (PIPS™) Cold Stage: Upgrade Owner's Manual and User's Guide</p>	<p>- Chemical Workers, Authorized (Haz Com) (4261)</p> <p>- Cryogenic Fluids Worker (2720)</p>
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#### Task D: Cooling Bath for Tenupol electropolisher.

<p>This task involves adding LN to a cooling bath for an electrolyte</p> <ol style="list-style-type: none"> <li>1. Don PPE (safety glasses, gloves).</li> <li>2. Slowly pour LN into cooling bath.</li> </ol>	See above in Task A	<p>See above in Task A</p> <p>Take care to fill dewar slowly, minimizing splashing of the cryogen.</p>	<p>- Procedure P101-5: Cryogenic Liquids and Cryogens.</p> <p>- Tenupol 5 Owner's Manual and User's Guide</p>	<p>- Chemical Workers, Authorized (Haz Com) (4261)</p> <p>- Cryogenic Fluids Worker (2720)</p>
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