

MME Standard Operating Procedure (SOP)

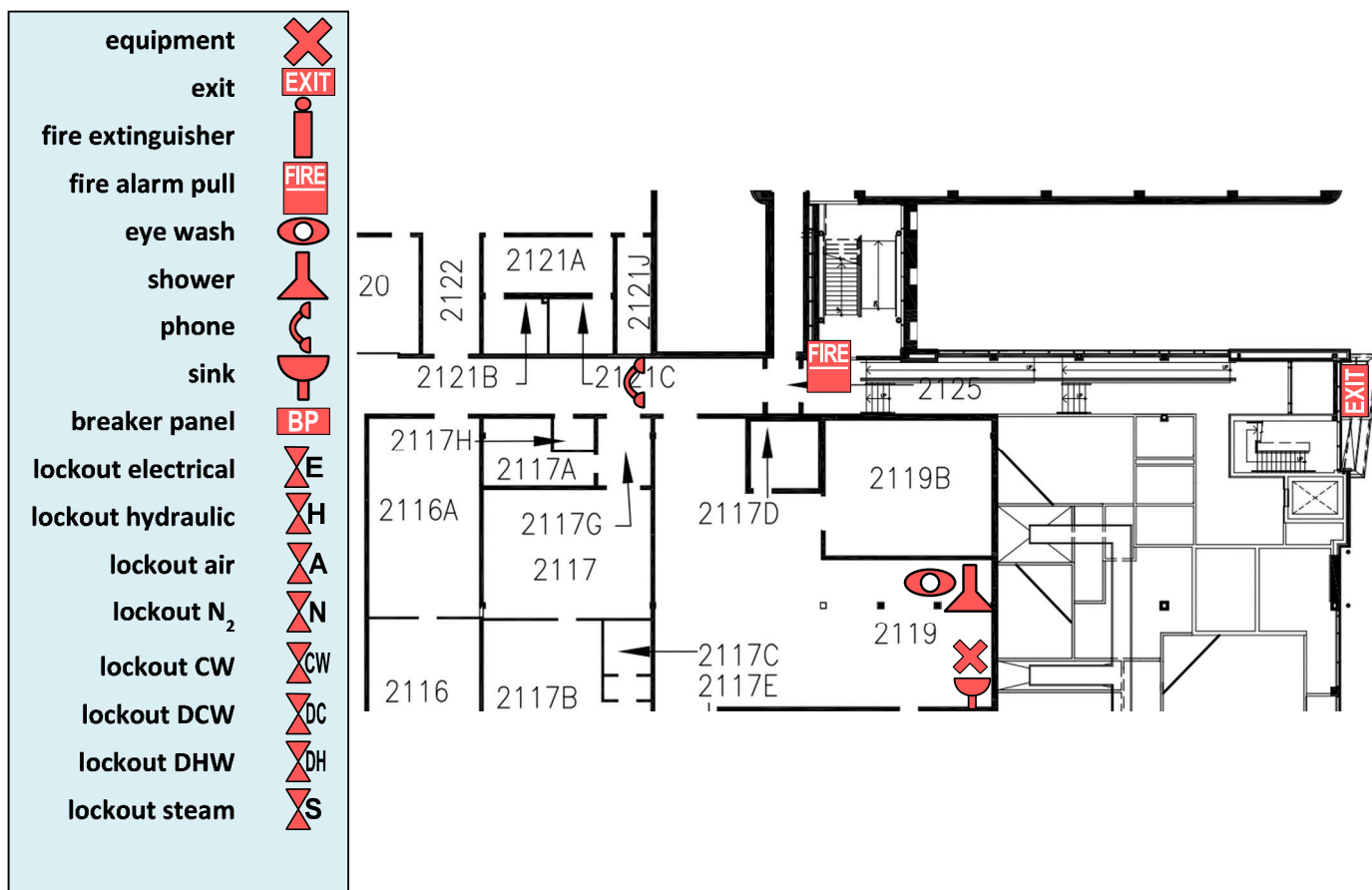
Name	Polishing Zirconium with Hydrofluoric Acid Equipment: 1. LaboPol-5 2. LaboForce-3
Description	<ul style="list-style-type: none"> 0.5 Vol.% to 1.5 Vol.% Hydrofluoric acid is mixed with polishing media The head of the polisher accommodates up to 3 pucks for automatic polishing
Location	<ul style="list-style-type: none"> E3-2119
SOP Creation Date	<ul style="list-style-type: none"> 2015-03-17
SOP Created By	<ul style="list-style-type: none"> Arshad Harooni
SOP Revision Date	<ul style="list-style-type: none"> 2015-03-17
SOP Revised By	<ul style="list-style-type: none"> Arshad Harooni
SOP Location	<ul style="list-style-type: none"> E3 2118G
Manual Location	
Equipment Owner	<ul style="list-style-type: none"> Mechanical and Mechatronics Engineering Department
Authorized Trainers	<ul style="list-style-type: none"> Arshad Harooni
Support Technicians	
Significant Hazards	<ul style="list-style-type: none"> Severe contact with skin or eye(s) can result in death. Less severe contact results in tissue damage and chemical burns Extremely destructive to mucous membrane and upper respiratory tract if inhaled May be fatal if swallowed Zirconium particles can create fire/ explosion hazard



Figure 1 LaboPol-5 polishing machine and LaboForce-3 automatic polishing head

Administrative Controls	<ul style="list-style-type: none"> • The worker must complete the following Online trainings: <ul style="list-style-type: none"> ○ Employee Safety Orientation ○ General Lab Safety • The worker must read and understand the hydrofluoric acid's MSDS. • The worker must read additional material on acceptable practices for working with hydrofluoric acid • The worker must be aware of the first aid measures in case of an accident • The worker must be aware of the location of the closest eye wash station and safety sower • The worker must know how to summon help • The stock solution will have a concentration no higher than 2 Vol.% hydrofluoric acid • The solution concentration must be limited to 1.5 Vol.%. Hydrofluoric acid or lower. A quantity larger than 500 mL should never be prepared. • The waste generated from polishing must be collected in a waste collection bucket • During use, the equipment and waste collection bucket must be clearly labeled to warn others that hydrofluoric acid use. • After use, flush the polishing equipment with plenty of water and decontaminate the equipment with calcium carbonate • The worker must carry 2.5% calcium gluconate cream with him/her for several days after working with hydrofluoric acid. Hydrofluoric acid solution with concentration less than 7% can contact skin without causing pain. Symptoms of hydrofluoric acid can appear several hours after initial contact.
Engineering Controls	
PPE Required	<ul style="list-style-type: none"> • Fume Hood • Splash goggles • Lab apron • 2.5% Calcium Gluconate Cream should be in one of lab apron's pockets • Butyl Gloves • Two layers of nitrile glove on each hand <ul style="list-style-type: none"> ○ Before use, check the gloves for leak by blowing air in them and hearing for leaks.
Relevant Standards and Codes	<ul style="list-style-type: none"> • None
Relevant MSDS	<ul style="list-style-type: none"> • Zr powder (Produced by ATI Wah Chang) • Hydrofluoric Acid MSDS can be found at: https://sharepoint.uwaterloo.ca/sites/MME/MSDS/MSDS%20Data%20Sheets/Forms/AllItems.aspx

Accident Procedure	<ul style="list-style-type: none"> Any hydrofluoric acid contact with skin or eye(s) should be reported to medical authority as soon as possible. Cases of inhalation or ingestion should also be reported. In case of eye contact, flush eye(s) for 15-20 minutes. In case of skin contact, remove contaminated articles. Flush the affected area with water for 5 minutes and then apply calcium gluconate. Wear gloves and massage the gel into the burn site. Apply the gel frequently and massage continuously until medical attention is received. In case of ingestion, do not induce vomiting. Rinse mouth thoroughly with water. In case of inhalation, move to fresh air. In case of spill, if safe to do so, neutralize the affected area with calcium carbonate. Flush the area with plenty of water Explosion can occur if wet zirconium powder catches fire. If zirconium fines catch on fire, the room should be evacuated immediately. Inform UW Police and Fire Department.
Emergency Shutdown Procedure	



Pre-start Checklist

- Turn on fume hood and wait for the fan to turn on.
- Confirm that the fume hood is working by using a tissue paper
- Wear two pair of nitrile gloves, lab coat, splash goggles
- Wear Butyl gloves
- Ensure that LaboPol-5's discharge tube and waste collection bucket are made of HDPE, PVC or CPVC
- Pour a fistful of calcium carbonate in the waste collection bucket
- Put LaboPol-5's waste water discharge tube into the waste collection bucket.

- Label LaboPol-5 and the waste bucket to ensure that everyone is aware that hydrofluoric acid is in use.

Start-up Procedure

- Prepare the polishing solutions in the fume hood. Use DI water to dilute the hydrofluoric acid
- Take off the Butyl gloves but leave the two pairs of nitrile gloves on.

Operating Procedure

- Make note of how full the waste collection bucket is and check it periodically to ensure that it does not overflow.
- Mount the desired MD-Chem polishing pad
- Set LaboPol-5's speed to a low setting and turn it on
- Rinse the pad thoroughly with DI Water
- If possible, use LaboForce-3 automated polishing head to polish the samples. This will create more distance between the operator and hydrofluoric acid solution
- Mount the samples to be polished. Ensure that they are not spinning about their axis during polishing
- Pour polishing media onto the pad. Add water to the pad whenever it gets dry. Increase the speed to about 120 RPM
- After ~1 minutes, decrease the speed. Add hydrofluoric acid to the pad. Increase the speed. Add water and polishing media to the pad as necessary
- Remove the sample. Wash it thoroughly with water and ethanol. Dry the sample and check it for scratches and microstructure
- Repeat last 5 steps unit scratch free surface is revealed. Some microstructure should also be visible.
- Repeat last 6 steps with different polishing media

Shutdown Procedure

- Rinse the MD-Chem pad with plenty of water and place it in its designated bag. Never let polishing pads used with different polishing media come in direct contact with each other
- Turn off LaboPol-5

Clean-up

- Rinse the equipment with plenty of water
- Pour calcium carbonate over the wheel and flush it with some more water
- Wipe the equipment with a solution of calcium carbonate and water
- Place LaboPol-5's waste water discharge tube back in the sink
- Put the chemicals and waste discharge bucket in their designated areas
- Remove PPE

Lockout

Maintenance and Repair

Before use:

- Visually check for leaks in the LaboPol-5's discharge tube or waste collection bucket
- Check the non-disposable PPE for cracks, discoloration or degradation. Discard them if necessary.

As needed:

- When the waste collection bucket get 80% full, organize a waste pick up with Environmental Safety Facility