<table>
<thead>
<tr>
<th>Name</th>
<th>Polishing Zirconium with Hydrofluoric Acid</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Equipment:</td>
</tr>
<tr>
<td></td>
<td>1. LaboPol-5</td>
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<tr>
<td></td>
<td>2. LaboForce-3</td>
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<tr>
<td>Description</td>
<td>• 0.5 Vol.% to 1.5 Vol.% Hydrofluoric acid is mixed with polishing media</td>
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<td></td>
<td>• The head of the polisher accommodates up to 3 pucks for automatic polishing</td>
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<tr>
<td>Location</td>
<td>E3-2119</td>
</tr>
<tr>
<td>SOP Creation Date</td>
<td>2015-03-17</td>
</tr>
<tr>
<td>SOP Created By</td>
<td>Arshad Harooni</td>
</tr>
<tr>
<td>SOP Revision Date</td>
<td>2015-03-17</td>
</tr>
<tr>
<td>SOP Revised By</td>
<td>Arshad Harooni</td>
</tr>
<tr>
<td>SOP Location</td>
<td>E3 2118G</td>
</tr>
<tr>
<td>Manual Location</td>
<td></td>
</tr>
<tr>
<td>Equipment Owner</td>
<td>Mechanical and Mechatronics Engineering Department</td>
</tr>
<tr>
<td>Authorized Trainers</td>
<td>Arshad Harooni</td>
</tr>
<tr>
<td>Support Technicians</td>
<td></td>
</tr>
<tr>
<td>Significant Hazards</td>
<td>• Severe contact with skin or eye(s) can result in death. Less severe contact results in tissue damage and chemical burns</td>
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<td></td>
<td>• Extremely destructive to mucous membrane and upper respiratory tract if inhaled</td>
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<td></td>
<td>• May be fatal if swallowed</td>
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<tr>
<td></td>
<td>• Zirconium particles can create fire/ explosion hazard</td>
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</tbody>
</table>

*Figure 1 LaboPol-5 polishing machine and LaboForce-3 automatic polishing head*
**Administrative Controls**
- The worker must complete the following Online trainings:
  - 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**
- Fume Hood
- Splash googles
- 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
  - Before use, check the gloves for leak by blowing air in them and hearing for leaks.

**Relevant Standards and Codes**
- None

**Relevant MSDS**
- 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](https://sharepoint.uwaterloo.ca/sites/MME/MSDS/MSDS%20Data%20Sheets/Forms/AllItems.aspx)
Accident Procedure

- 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

- 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 googles
- 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

### 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