



**Arizona State University NanoFab**

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# LESKER #3

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Rev H

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## 1. Purpose / Scope

- 1.1. This document covers the procedure that should be followed for normal operation of the Lesker #3 Electron Beam Evaporator for the purpose of depositing various materials on substrate materials that will be used for research purposes. **It is suggested that you review this document thoroughly before proceeding with the operation of this tool.**

**If an error condition occurs at anytime during your process immediately shut off the power supplies if they are on & place the tool in a safe mode. Place the sign on the tool to down, contact CSSER staff & submit a service request.**

## 2. Reference Documents

None

## 3. Equipment / Supplies / Material

- 3.1. Nilfisk clean room vacuum
- 3.2. Crucible liner(s) with source material. The part number for the liner is EVCEB-4 (if purchased from Lesker). Ensure that the crucible liner material is compatible with evaporation source. It is possible to damage the tool if the improper crucible liner is used.
- 3.3. Charge for the tool use is \$25 per hour.
- 3.4. The link to the reservation calendar can be found at [http://my.calendars.net/csser\\_lskr3\\_ebd](http://my.calendars.net/csser_lskr3_ebd). The reservations that are scheduled and not used are subject to charge.

## 4. Safety

- 4.1. Do not attempt to repair the tool under any circumstances. Submit a service request and contact ASU NanoFab staff.
- 4.2. Red EMO Button can be pressed at any time an emergency situation arises. Contact NanoFab staff to follow up with any emergency condition.

## 5. Set Up Procedures

### 5.1. Tool Start-Up

- 5.1.1. While the tool is idle, the chamber is left “under vacuum” with the software running.
- 5.1.2. In case the software needs to be restarted; from the desktop, click on “Shortcut to Cware”, then “Login Here” and use “admin” for the user name and password.

### 5.2. Tool preparation

- 5.2.1. Fill out machine log sheet with name, date, and starting time.
- 5.2.2. Check the crystal life on the rate monitor; if it is below 60%, then contact staff to replace crystal.
- 5.2.3. Check the white Neslab chiller located next to the tool. Verify that the temperature display is  $15 \pm 1^\circ \text{C}$ . Verify that water level is between two horizontal markings inside the

reservoir. Use DI water from any solvent sink to fill the chiller reservoir when the level is low.

- 5.2.4. Check the cooling water supply by selecting the “Cooling” page. Check to see that a green background is displayed on the “Src1 Flow Switch” and “Water Not over Temp”. Notify ASU NanoFab staff if there is an issue.

## 6. Operation Procedures

**THE TOUCH SCREEN IS FRAGILE AND EXPENSIVE! Use only light touches with your fingers to operate it, extra pressure will not make it work better. DO NOT USE PENS, TWEEZERS OR ANYTHING ELSE.**

### 6.1. Vent Chamber

- 6.1.1. Select the “Start PC Vent” button and wait for approximately 2 minutes for a recipe complete message and then press the “OK” button.
- 6.1.2. Open the chamber door. Use the Nilfisk vacuum to remove any loose particles from inside the chamber.
- 6.1.3. Replace the plastic liner in the view window if necessary.

### 6.2. Load Deposition Materials

- 6.2.1. Select “Deposition” button to switch to the deposition screen.
- 6.2.2. Select the “Ebeam Shutter” button to open the shutter for easier access.
- 6.2.3. ASU NanoFab provides the aluminum source. It is located in “Cru Pos #4. Inspect the aluminum source for damage. If it is damaged, notify staff for a replacement source. There are four crucible positions, so up to four different sources can be evaporated sequentially. The aluminum source can be removed if the space is needed for another source. Otherwise leave the aluminum source in the crucible.
- 6.2.4. Ensure that the amount of the material in the aluminum crucible liner is at the proper level. Use the Add/no Add gauge to determine if an aluminum pellet is needed.

Note: If the amount is not enough, then damage to the gun will occur. If the amount is too much, than crucible might be cracked or damaged. Also if the source material is higher than the lip of the crucible, the gun will be damaged when the crucible position is rotated.

- 6.2.5. Load each source into a crucible position. Select the “Cru Pos #” buttons to rotate the hearth to a different position. The “Active” will notate which Cru Pos #” is currently selected. Also, there is a box provided to label the source in each “Cru Pos #” position.

### 6.3. Load Substrate

- 6.3.1. Select “Platen Motion” button to display motion control page.
- 6.3.2. Ensure that the platen is in the “Home” position and remove the platen. If needed, select the “Home” button to rotate the platen to the home.
- 6.3.3. Load substrates into the center of the platen and then replace the platen into the chamber and close chamber door.

#### 6.4. Pump Chamber Down

- 6.4.1. Select the “Start PC pump” button and note the time at which the recipe was started.
- 6.4.2. Wait until the “Recipe Completed” is displayed, note the time again and calculate the amount of time that it took to complete the PC pump recipe. Enter that time into the log sheet under “Recipe Time”.
- 6.4.3. Wait for the chamber to reach a pressure of  $3.0 \times 10^{-6}$  Torr. When that pressure is reached, note the current time and compare it to the time when the PC pump recipe was completed. Calculate the time it took to reach base pressure and enter that value into the log sheet under “pump to base time”. It should take approximately 45 to 60 minutes. A base pressure of  $5.0 \times 10^{-5}$  can be used for training depositions.

#### 6.5. Substrate Heater-This option is available for those users that want to use the feature. The tool can be used without the substrate heater. Jump to paragraph 6.6 if this option is not needed.

- 6.5.1. The substrate heater should not be turned on until the chamber has reached the desired base pressure. If the substrate heater will cause out-gassing in the chamber and affect the pumping action.
- 6.5.2. Start the rotation of the platen by pressing the “Fwd” button on the “Platen Motion screen”.
- 6.5.3. Ensure the touch screen is displaying the heater control screen by touching the “Heating” button.
- 6.5.4. Enter the Substrate Heater set point by touching the “Temp SP” window. Enter the value desired.
- 6.5.5. Ensure that the ramp rate is at 10. Refer to the R/R input window.
- 6.5.6. Touch the Substrate Heater On/Off button to display “ON”.
- 6.5.7. Touch the Auto button to display “ON”.

#### 6.6. Rate Monitor

- 6.6.1. From the Windows Start Menu, open the SQM 242 Rate Monitor Program.
- 6.6.2. Select “File” then “Open”. A list of source materials will display. Select the desired source and click “open”.
- 6.6.3. Verify that the density and Z-ratio are correct. Also verify that the tooling factor is equal to 154.
- 6.6.4. Select “Start” on the SQM program to zero the crystal monitor.

#### 6.7. Deposition

- 6.7.1. Open the door containing the touch screen and press “RESET” button on the High Voltage Controller.
- 6.7.2. Verify that all the interlock LED’s on the controller come on.
- 6.7.3. Check that the Sweep Select is on position “1” by verifying that led is on.
- 6.7.4. Close the door.
- 6.7.5. Ensure the touch screen is displaying the deposition control screen by selecting the “Deposition” button.

6.7.6. Check that the “Ebeam shutter” is closed. If it is open a green background will be displayed.

6.7.7. Ensure that the crucible position indicator is “Active” for the desired metal.

6.7.8. Start the rotation of the platen by pressing the “Fwd” button on the “Platen Motion screen.

6.7.9. Press the EB ON button and the EB HV On button. Wait 2 minutes for the high voltage power supply to warm up.

**WARNING: Do not leave the tool unattended while the high voltage is on.**

6.7.10. Open the door containing the touch screen and ensure that the high voltage value is within  $\pm 0.05$  of the value listed on table 7.3. If the value is outside of those limits, then turn the high voltage off. Contact ASU NanoFab staff for assistance.

6.7.11. Record the base pressure on the log sheet.

6.7.12. The maximum deposit rate is to  $3\text{\AA}$  per second and maximum thickness is  $3\text{K}\text{\AA}$ . If there are process needs that are outside of this limit please contact ASU NanoFab staff for assistance.

6.7.13. Set the emission current ramp rate. The ramp rate is 0.05. **DO NOT LEAVE THE RAMP RATE AT ZERO. IT WILL DAMAGE THE CRUCIBLE.**

6.7.14. The crucible will need to be preheated with the beam. Enter a set point (for beam current) of 2% and wait a few minutes for the material to warm.

6.7.15. Observe the beam during the ramp, and periodically during the deposition. Ensure that it is not overheating the crucible or hitting anywhere on the hearth. If the beam is not aligned to the crucible, then reduce the emission current to zero and shut off the high voltage supply. Contact staff for assistance.

6.7.16. Using increments of 1-2% at a time increase the emission current value, while using a ramp rate of 0.05.

6.7.17. Select “Zero Sensor” on the SQM Rate monitor window to zero the crystal.

6.7.18. Select the “Ebeam Shutter” button to open the shutter and begin deposition.

6.7.19. Adjust the set point to make adjustments to the deposition rate, as needed.

6.7.20. Halfway through the deposition, record the deposition pressure, deposition rate, set point on the log sheet.

6.7.21. When deposition is complete, press the “Ebeam Shutter” button to close the shutter, record the total thickness on the log sheet.

6.7.22. Select “Stop” on the SQM Rate monitor window.

6.7.23. Set the ramp rate to 0.05.

6.7.24. Enter “0” into the Set Point. Wait until the current drops to zero before doing anything else. If the power supply is turned off too quickly, damage to the crucible is a high possibility.

6.7.25. Press the “EB HV OFF” button, then the “EB OFF” button.

6.7.26. If the substrate heater was used; Turn the heater off and let the substrate temperature drop below 80° before venting the chamber.

6.7.27. If deposition is complete, then go to 6.8

6.7.28. If another layer is desired, then repeat steps 6.6.1 to 6.6.3 then skip to 6.7.7 to 6.7.28.

6.8. Shut Down

6.8.1. Wait 10 minutes for the sample(s), platen and chamber to cool.

6.8.2. Select the “Start PC Vent” button and wait for approximately 2 minutes for a recipe complete message and then select the “OK” button.

6.8.3. Open chamber door and remove platen.

6.8.4. Remove your samples from the platen and place the platen in the chamber.

6.8.5. Clean the inside of the chamber with the Nilfisk vacuum. Do not use the vacuum on the filament or source metals as it may contaminate them.

6.8.6. Replace the view port liner if needed.

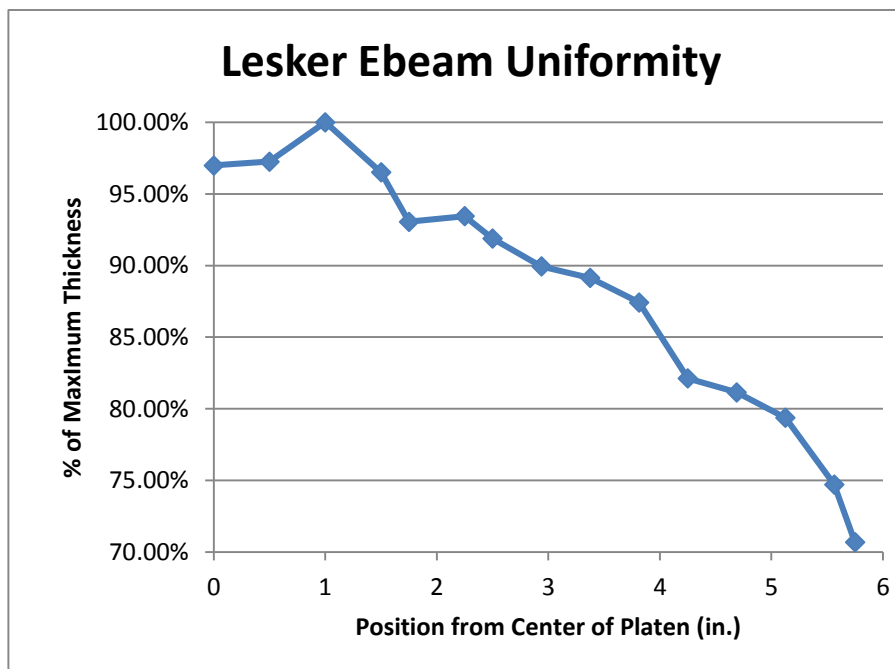
6.8.7. Close the chamber door.

6.8.8. Select the “Start PC pump” button and ensure that the vacuum gauge value reaches 9.0e x 10<sup>-5</sup> Torr before leaving the tool.

6.8.9. Record the end time on the log sheet. ASU NanoFab staff reserves the right to estimate the end time if the user leaves it blank.

## 7. Process Data

### 7.1. Platen Uniformity



7.2.

Materials List

**Allowed**

- Aluminum
- Aluminum Oxide
- Chromium
- Copper
- Germanium
- Molybdenum
- Molybdenum Oxide
- Nickel
- Nichrome
- Palladium
- Platinum
- Silicon Dioxide
- Silver
- Titanium
- Titanium Oxide

**Not Allowed**

- Magnesium Fluoride
- Tungsten
- Zinc

If the material is not listed, check with ASU NanoFab staff for approval.

7.3. High Voltage Output log sheet

**High Voltage Table**

Date	Voltage	Engineer



**8. Revision History**

Effective Date	Originator	DESCRIPTION OF REVISION	Issue
5/5/09	Paul Boland	Initial Release	A
6/8/09	Paul Boland	Updates and Clarifications, Added uniformity	B
9/22/09	Todd Eller		C
1/20/10	Todd Eller		D
3/18/10	Todd Eller		E
1/30/12	Todd Eller		F
2/20/13	Todd Eller		G
4/10/15	Todd Eller		H