

# Thermal Evaporator Operating Instructions

This machine is to be used by authorized personnel only. For training contact:  
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Enter all necessary information in the Log Book for each use.

The chamber must always be kept under high vacuum between uses. Currently the only metal qualified to run in this tool is Aluminum.

## Venting the Chamber

- 1) If the Ion gauge is on then turn it off by hitting the “EMIS” button on the Variac controller (see [Figure 1](#))
- 2) The filament power, controlled by the Variac seen in [Figure 2](#), should have been at “0” for at least 3 minutes before venting the chamber. If you just finished depositing then you must wait.
- 3) Close the main gate valve by turning both switches on the gate valve control unit DOWN one at a time (see [Figure 3](#)).
- 4) Switch the Chamber valve in [Figure 4](#) to the DOWN/open position. (DOWN=OPEN, UP=CLOSED)
- 5) Check that the Rough valve is UP/closed (DOWN=OPEN, UP=CLOSED) and SLOWLY open the nitrogen vent valve (Green valve) and leave it open about halfway.
- 6) Allow 2-3min for the chamber to fully vent.
- 7) Close Chamber valve by turning it UP after venting is completed.
- 8) Open chamber by raising the bell jar via the bell jar control unit seen in [Figure 4](#). Turn the HOIST switch to the RAISE position.

**CAUTION:** Do not force chamber open with the drive motor! If it doesn't open smoothly/easily, the chamber has not completely vented. Always wait for complete venting before a 2nd attempt. Also, be careful NOT to raise the chamber too high, there is no kill switch to stop it from reaching a maximum vertical height or to protect it from burning out the drive belt.

- 9) Close the green Nitrogen Vent valve.
- 10) When you are done using this tool, follow the [Pump Down](#) procedures and leave the chamber in high vacuum.

## Deposition

- 1) Follow the Venting the Chamber procedure and vent chamber.
- 2) Check tungsten filament integrity and change if necessary. Filament should be continuous with no breaks or gaps on the strand.
- 3) If using a tungsten filament, then cut 1.5" to 2" long pieces of source metal wire, e.g. Aluminum, and load them inside the filament carefully without applying force to the filament. Tungsten filaments are very brittle and break easily.
- 4) Make sure the loaded wires are centered within the filament coil.
- 5) Load your substrate by placing them on the available substrate holders. Use clips if necessary to hold your substrates to the substrate holder.
- 6) Attach the substrate holder to the central rod on the chamber's base plate using the designated screw and a screw driver. Your substrate should be sitting over the filament/boat.
- 7) A 6" Si wafer is used as a "mirror" to observe the filament during the deposition. Check its position and angle to ensure good observation.
- 8) Make sure plate covering the viewport is secure and has the correct angle to protect the viewport during deposition.
- 9) Close chamber by lowering the bell jar using the bell jar control unit as seen in Figure 4. Turn the HOIST switch to LOWER.
- 10) While lowering the bell jar, ensure that there is approximately an equal distance between the sides of the bell jar seals and the edge of the chamber plate so that the bell jar sits centered with respect to the plate.
- 11) Turn the motor switch back to the neutral/center position once the bell jar seal is seated against the bulkhead/base plate.
- 12) Follow the Pump Down procedure to pump the chamber down to the process pressure.
- 13) Check that the pressure is approximately  $5 \times 10^{-6}$  Torr or lower by turning on the Varian gauge controller and letting it to remain on for at least 5 minutes.
- 14) Turn on the power to the right most Variac (labeled Filament, see Figure 2)
- 15) Warm up the filament by SLOWLY (in no less than 30 seconds) increasing the power from 0 to 20 graduations on the Variac wheel. You should begin to see the filament turning orange by looking at the wafer mirror through the glass window.
- 16) Increase the voltage SLOWLY (in no less than 30 seconds) until the pointer rests at 40.
- 17) Watch through the window at the mirror to observe the filament and to wait for the filament to become fully saturated/wet with the metal of interest. The filament color should be a medium orange color but no brighter than that.
- 18) Leave the filament setting at 40 until all of the metal appears to have evaporated, then increase it slowly (in no less than 30 seconds) to 50 for an additional minute.

**NOTE:** If the pressure increases above  $8 \times 10^{-6}$  Torr there may be a problem with the deposition, but most likely it is just the filament outgassing.

- 19) Decrease the power SLOWLY (in no less than 30 seconds) to zero.
- 20) Turn the Variac power off and wait at least 3 minutes. The filament should not be glowing.

### **Pump Down**

- 1) Ensure that Vent Nitrogen (green) valve is off.
- 2) If a gauge is available, check that the cryo-pump operating temperature is below 20K.
- 3) Close chamber by lowering the bell jar using the bell jar control unit as seen in [Figure 4](#). Turn the HOIST switch to LOWER.
- 4) While lowering the bell jar, ensure that there is approximately an equal distance between the sides of the bell jar seals and the edge of the chamber plate so that the bell jar sits centered with respect to the plate.
- 5) Turn the motor switch back to the neutral/center position once the bell jar seal is seated against the bulkhead/base plate.
- 6) Open Roughing Valve in [Figure 4](#) by turning it DOWN. (DOWN=OPEN, UP=CLOSED)
- 7) Open Chamber Valve in [Figure 4](#) by turning it DOWN. (DOWN=OPEN, UP=CLOSED)
- 8) Wait until the Thermocouple (TC) gauge meter (see [Figure 5](#)) reads below 80 mTorr (around 3 to 6 minutes) If more than 10 minutes elapses and the TC display remains above 100 mT then there might be a pumping problem, e.g. a leak, etc., and the system needs to be placed down.
- 9) Close the Chamber valve by turning it UP. (DOWN=OPEN, UP=CLOSED)
- 10) Close the Roughing valve by turning it UP. (DOWN=OPEN, UP=CLOSED)
- 11) Open the gate valve by turning both switches on the gate valve control unit DOWN one at a time (see [Figure 3](#)).
- 12) Wait approximately 60 seconds.
- 13) Press "EMIS" on the Varian gauge controller & check that the ion gauge is ON (see [Figure 7](#)). The controller will initially display "E06" and then the gauge filament will illuminate after a few seconds displaying a pressure reading, initially in the  $10^{-4}$  Torr range or lower.  
**Note:** If leaving the chamber to pump down overnight or for an extended period of time, turn off the gauge by hitting the "EMIS" button again.
- 14) Wait until chamber is pumped down to  $5 \times 10^{-6}$  Torr or lower (around 2 hours). If there is more than 120 minutes needed to hit  $5 \times 10^{-6}$  Torr, then there might be a pumping problem and the system needs to be placed down.

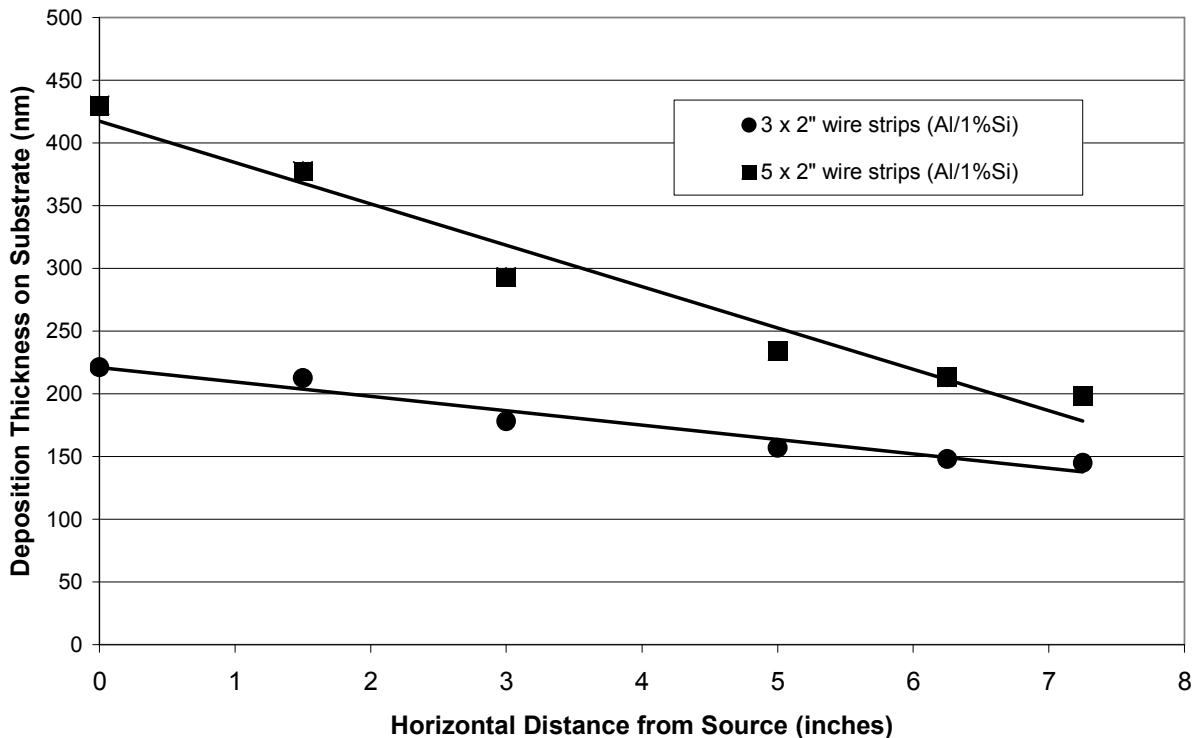
## Cryo-Pump Regeneration

This procedure is to be performed ONLY by MNFC staff and no one else!

- 1) Close the gate valve.
- 2) Vent the chamber.
- 3) Turn off both switches on the cryo compressor.
- 4) Flow a small stream of N<sub>2</sub> into the cryo pump. You should be hearing a slight hissing behind the pump. Leave the N<sub>2</sub> running for several hours.
- 5) Turn N<sub>2</sub> off.
- 6) Open gate valve, chamber valve, roughing valve in that order.
- 7) Rough the body of the cryopump to below 100mTorr
- 8) Close gate valve, chamber valve, roughing valve in that order
- 9) Turn on both of the cryo-pump switches. If a gauge is available, watch for the cryo pump temperature to come down to about 17K. This should take 1-2 hours or possibly more.
- 10) When the pump is cold the system is ready for use.

### Graph 1 – Aluminum Deposition Thickness Guide

(Data collected by Steve Orozco & Omid Mahdavi between 8/7/07-8/9/07)





**Figure 1** – Varian Ion Gauge Controller



**Figure 4** – Panel holding the roughing switches



**Figure 2** – Variac controlling filament/boat current



**Figure 5**- Bell jar control unit. Use switch on top to control bell jar position.



**Figure 3** – Gate valve open/close switches



**Figure 6** – TC gauge meter



**Figure 7-** Ion Gauge in operation

Process Consumables

- Tungsten Filament, 10 coils, Kurt J. Lesker EVF54030W

Revision	Description of Change	Initiator	Date
0	New Spec	Omid Mahdavi	6/15/07
1	Add Dep Data	Omid Mahdavi	8/08/07