

Standard Operating Procedure

SUSS MJB4 Mask Aligner



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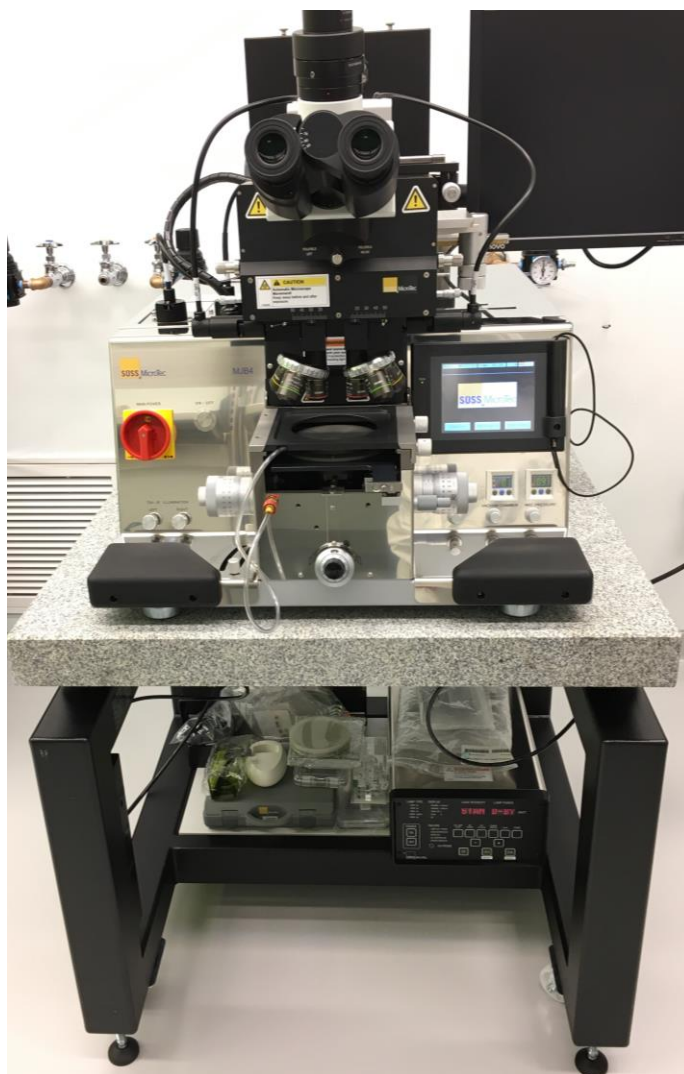
SUSS MJB4 Mask Aligner SOP

1. Logbook Sign-In

All users are requested sign in the logbook first.

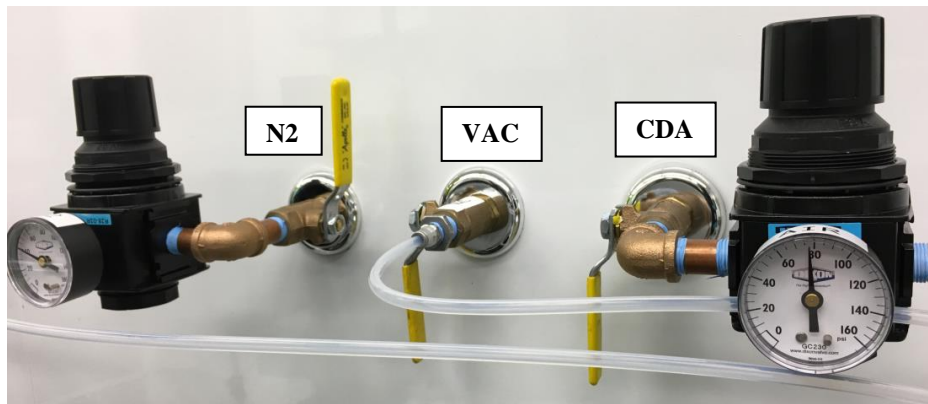
2. System check

- 1) Check to make sure that the mask aligner in **Power Off** status
 - > The machine is quiet
 - > No light coming from UV lamp house
 - > No LED lights on control units



- 2) Check on the wall behind machine to make sure that the N₂, Compressed Air (CDA) and Vacuum (VAC) valves are closed.

Note: report to manager immediately if any issues were found.

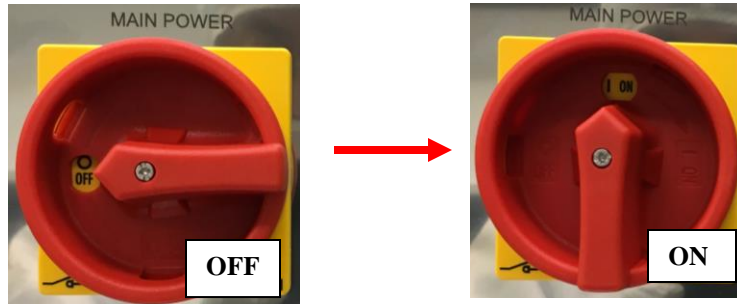


3. Turn on the mask aligner

- 1) Open **N2**, **CDA** and **Vacuum** on the wall. The bars should become parallel with ground:
 - > Check to make sure the **N2** pressure at **40 psi**
 - > Check to make sure the **Air** pressure at **80 psi**
 - Warning:** the mask aligner **vibration damping air table** is connected to the **Air** outlet shared with the **Zygo optical profiler** on the left. **Never** disconnect the gas line.



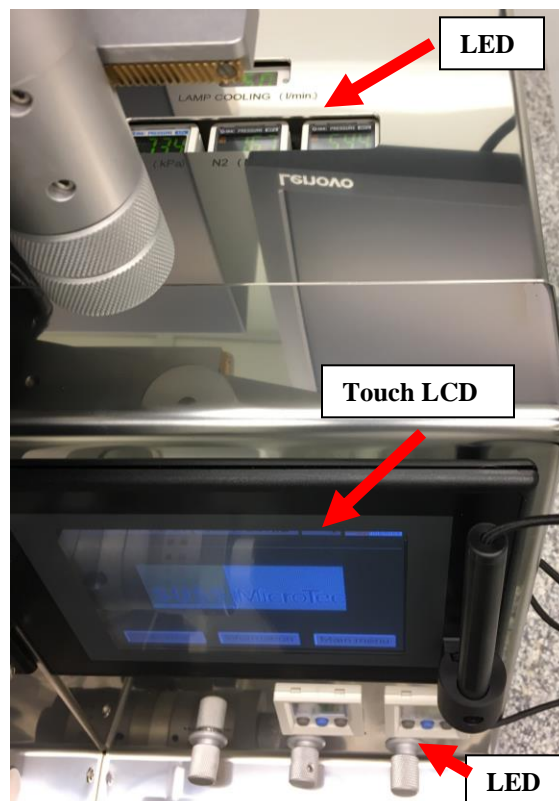
- 2) Turn **ON MAIN POWER**: rotate the **red dial switch** **clockwise** from **flat OFF** position to **vertical ON** position on the left side of machine (see picture below).



- 3) Wait until the small LCD display on the right side shows “**start machine with ON/OFF button**”.
- 4) Press the machine **ON/OFF** button on the right side of **MAIN POWER** dial switch.



- 5) Check the LED gauges below and above the touch LCD display.




- > **Make sure** the **LAMP COOLING**, **VAC**, **N2** and **CDA** LEDs are **all in green**, **report to manager immediately if not**.
 - > **Make sure** the **VACUUM CHAMBER** and **WEC PRESSURE** LEDs are **all in green**, **report to manager immediately if not**
- 6) **Turn on the Lamp Power Supply unit** on the bottom of the table: press **ON** button on the control panel and wait to see **READY** on the digital display.
- > Make sure the **LAMP TYPE** highlights **350W Hg**. If not, report to manager immediately.

Warning: **Never proceed if other power settings were chosen. The Hg lamp will be burned with any wrong power settings. The cost of ~\$10k will be charged to user PI's account.**



7) Ignite Hg UV lamp:

- > Choose **Constant Power (CP)** mode by pressing  button on the Lamp Power Supply unit.
- > Wait until **START** appears in digital display.
- > Press **START** button as highlighted in above picture.
- > The **LAMP LIFE/POWER LED** will flash in **FAILURE** region, and the digital display shows **LAMP COLD**
- > Wait for several minutes till digital display shows **0.0** (**LIGHT INTENSITY**) and **275 Watt** (**LAMP POWER**). The Hg UV light will be ignited.
- > **Wait for additional 15 minutes** until the UV light becomes stabilized before proceeding to next step.

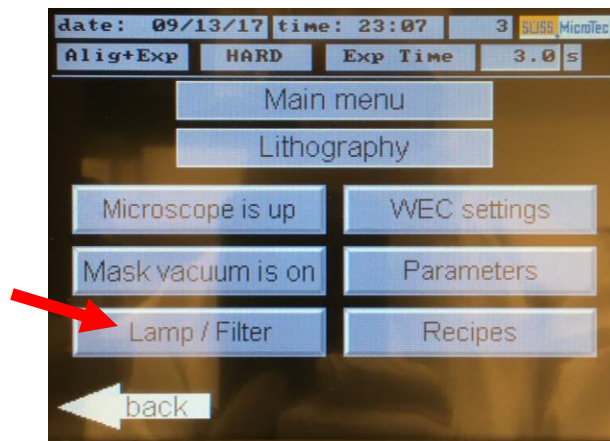
Warning: **failure to follow the procedure will affect alignment resolution and shorten Hg lamp lifetime.**

4. Perform Lamp Test

1) Press **Main Menu** on LCD touch screen below:



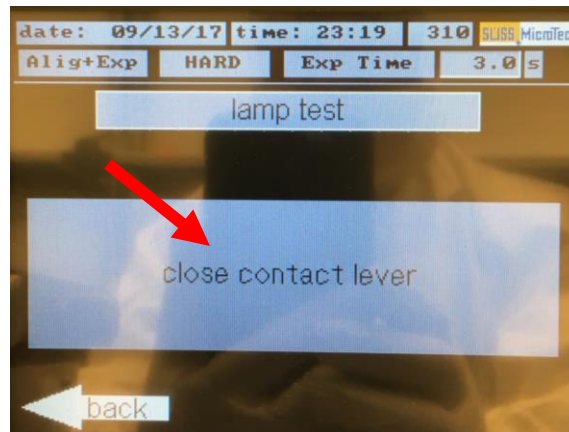
2) Touch **Lamp/Filter** button below:



3) Touch **lamp test** button below:



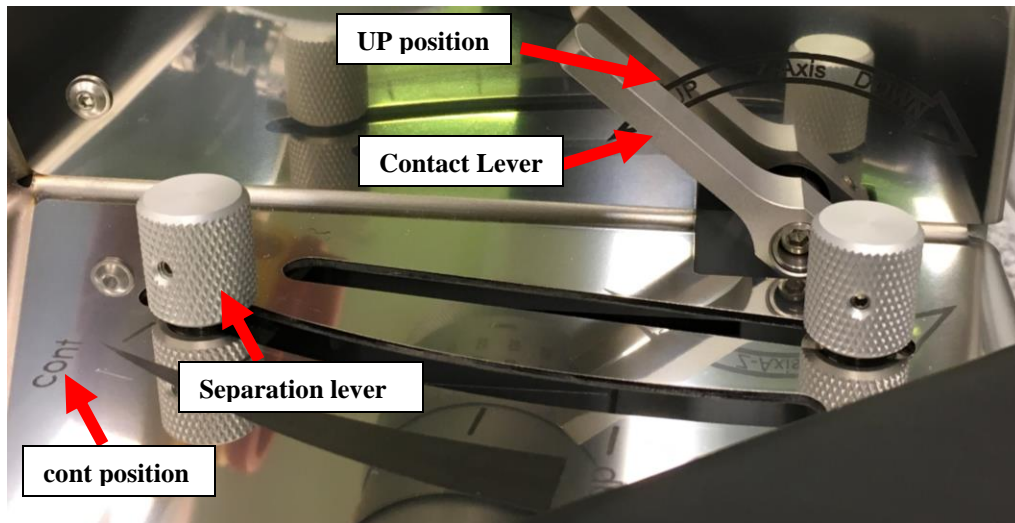
- 4) Follow the instruction on screen below to **close contact lever**.



- > Check to make sure the **Separation Lever** is at **Contact (Cont)** position;
- > **Slowly** push the lever forward until stopped at **UP** position. Once a **click sound** is heard **quickly stand away from the microscope to avoid being hit!**

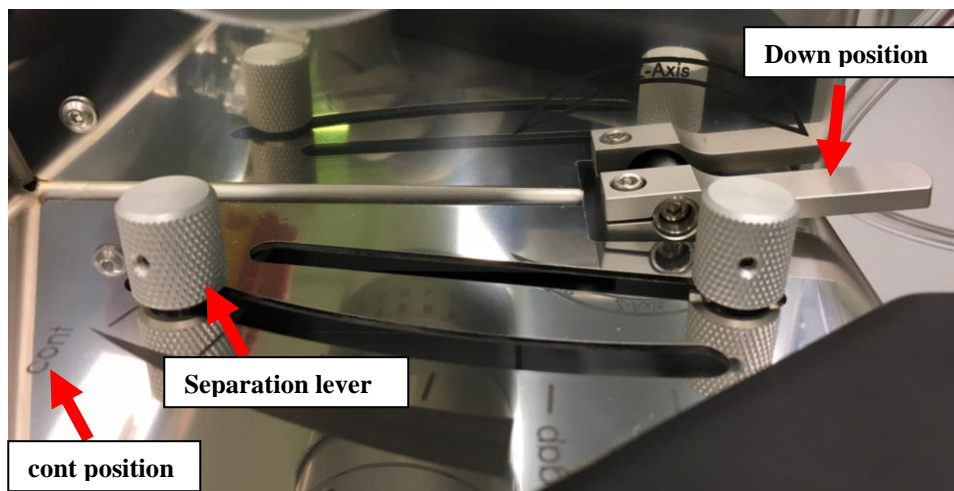
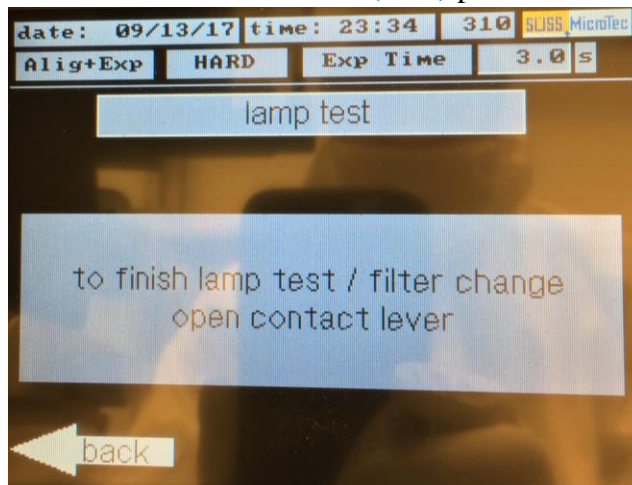
Warning:

- > **Parts will be damaged if push the Contact Lever quickly.**



- 5) **Put on the protective glass.** Check to make sure that **UV light comes out and covers the mask and substrate holders.** **Do Not stare** at the UV light without UV glass. Write down the light intensity displayed in the power supply under the table; this will be used to calculate the exposure time.
- 6) Once Lamp test is done, follow the instruction on touch screen below to **open contact lever**:
- > Check to make sure the **Separation Lever** is at **Contact (Cont)** position;
 - > **Slowly** pull the lever back to **Down** position. The microscope will slide to back position.

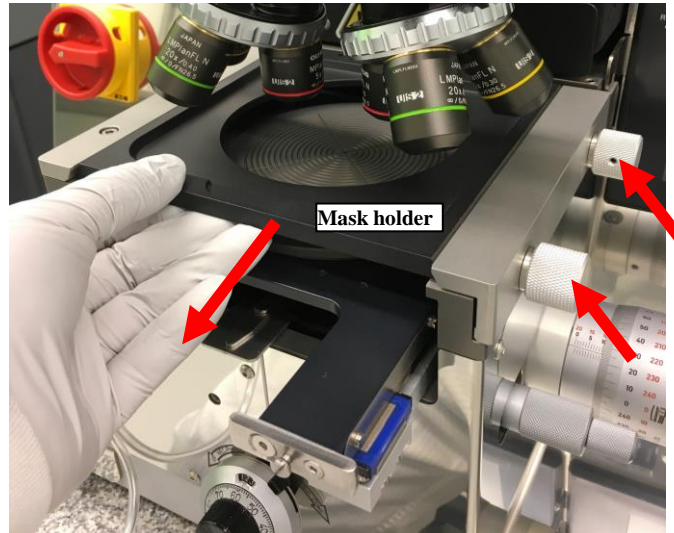
Warning: NEVER force to move if the Contact Lever is stuck. Maybe the Separation Lever needs to be switched to **Contact (cont)** position.



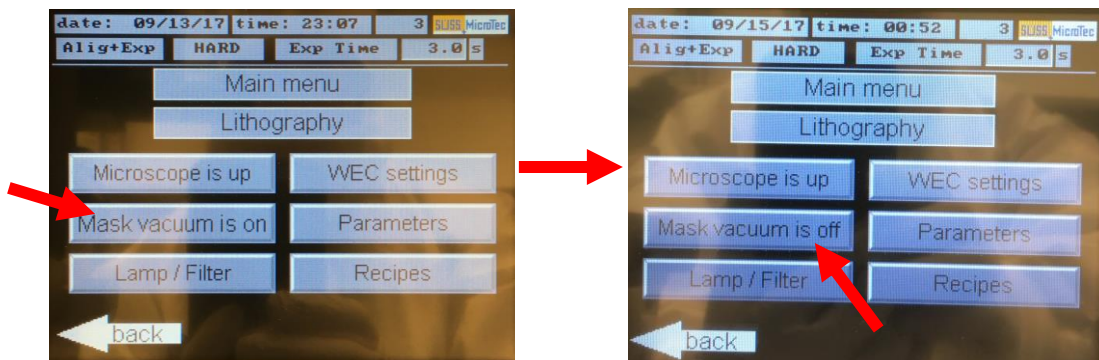
7) Click **back** arrow on the screen to return to Main menu. The microscope will slide back.

5. Load Mask

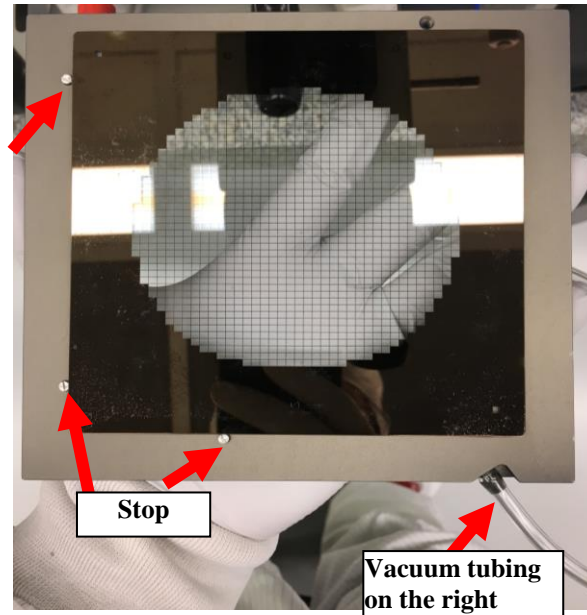
- 1) Clean mask with **IPA** if necessary and dry with **N₂** in solvent hood.
- 2) **Loosen** two knurled screws on the right side of mask holder frame and **carefully** pull the mask holder out from the alignment station.



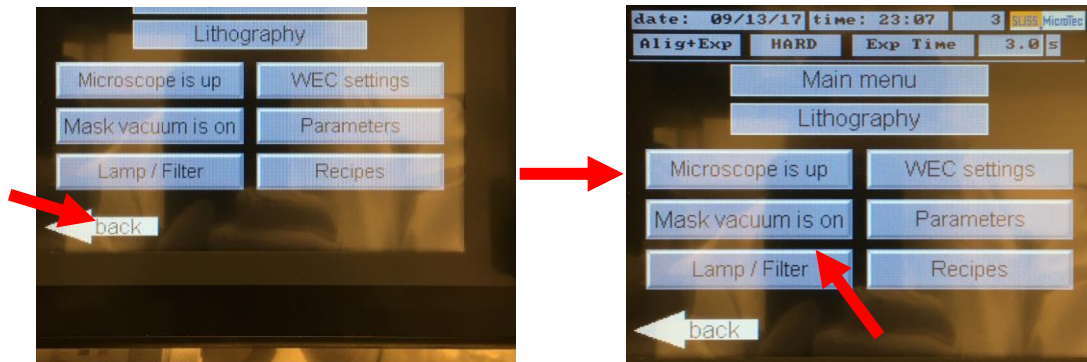
- 3) **Flip the mask holder** with vacuum tubing on the right.
- 4) Turn mask vacuum off: **press and hold Mask Vacuum is on** button on touch screen until **Mask Vacuum is off** appears.



- 5) **Carefully** place the mask **chrome side up (bronze color)** with any **ID markings on your left** and the mask corner pressed against **three stop screws** on the holder corner.



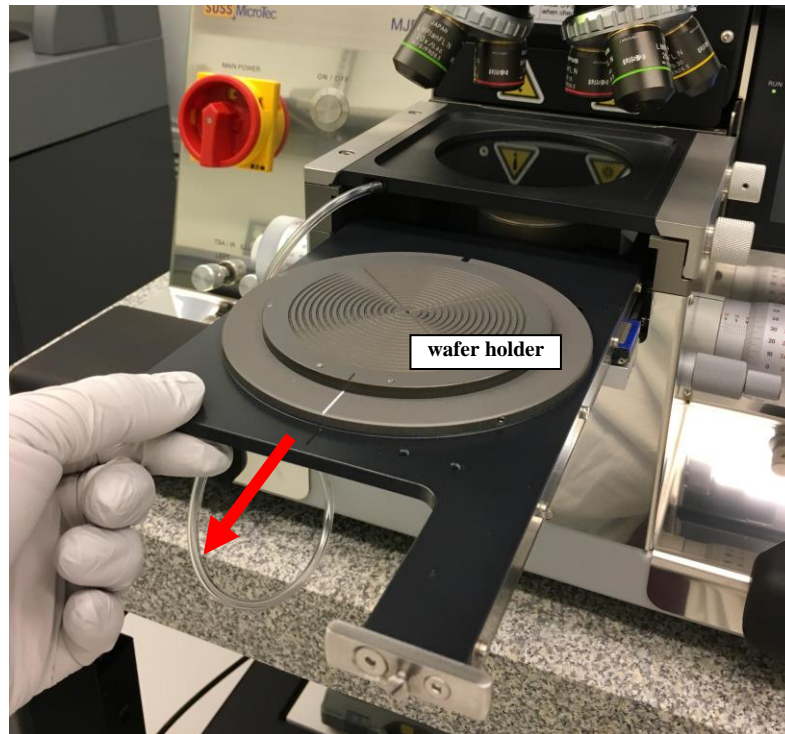
- 6) Press **Mask Vacuum is off** button to go back to **Mask Vacuum is on**. The mask will be sucked onto the holder. **Flip the mask holder a little bit to make sure the vacuum is indeed on and the mask cannot move.**
- 7) Blow to clean the mask holder with N2 gun
- 8) Flip the mask holder back over and slowly slide it all the way back, and fix the mask holder by hand tightening two knurled screws.



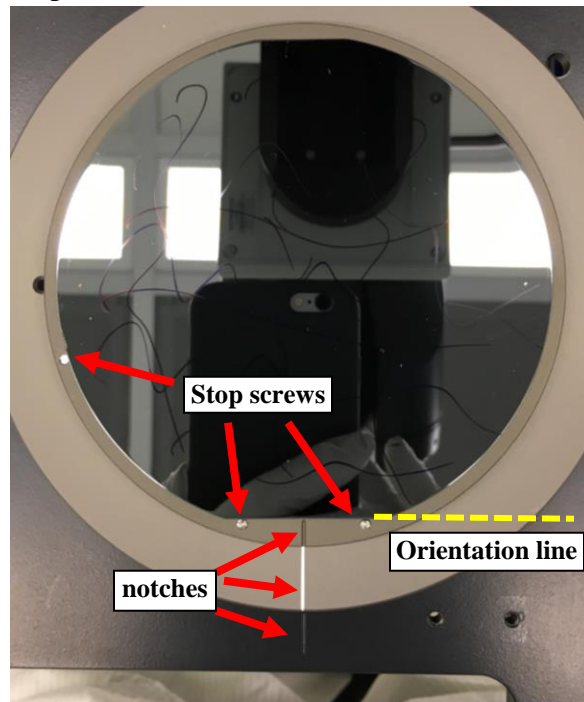
6. Load Wafer

Warning: this mask aligner can only hold the wafer size up to **4 inch**. **Never attempting to load larger-size wafer which will damage the parts.**

- 1) Slowly pull out the wafer holder until stopped.
- 2) Place the wafer with photo resist side facing up.

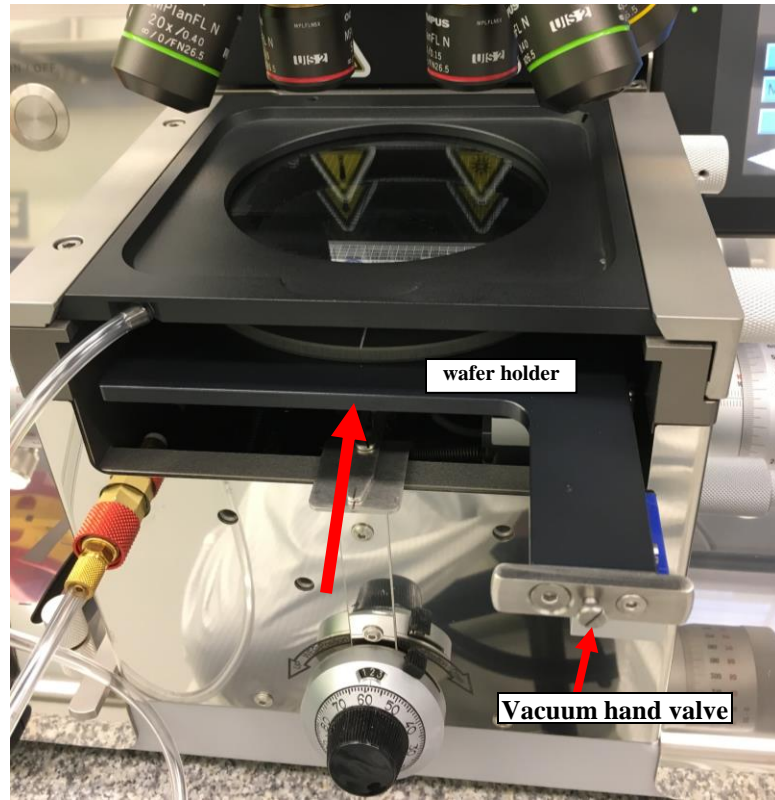


- 3) Place the wafer orientation flat line (the longer one) against bottom stop screws with the left edge resting against the third stop screw on the holder (see picture below)
- 4) Turn the holder slightly to align the bottom notch with the other two notches on the bottom frame (see picture below)



- 5) **Press and hold** the **vacuum hand valve** on the frame as highlighted below and slowly push the holder all the way back and **then release** the **vacuum hand valve**.

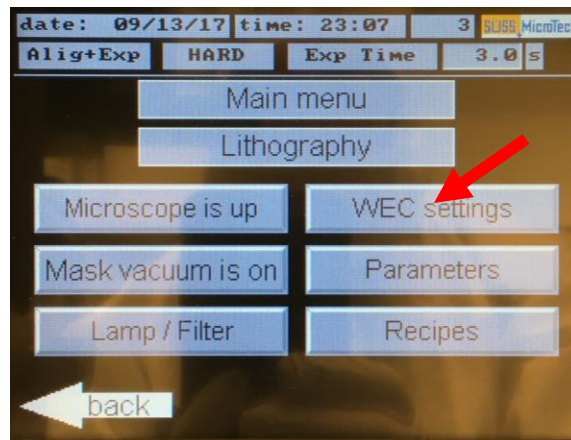
Warning: fail to follow above step will lead to wafer sliding off the position on the holder.



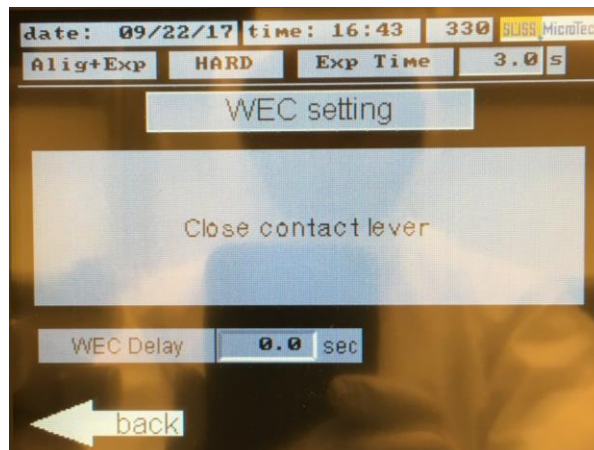
7. Wedge Error Compensation (WEC) Setting Adjustment

Warning: WEC adjustment must be performed each time with a new mask or substrate before substrate alignment and final UV exposure. Missing this critical step will lead to part damage and charges (~\$10,000) applied to user PI's account.

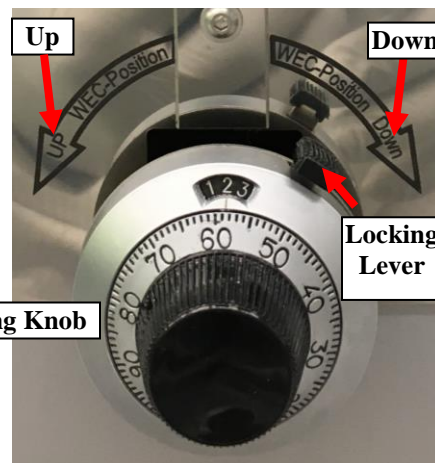
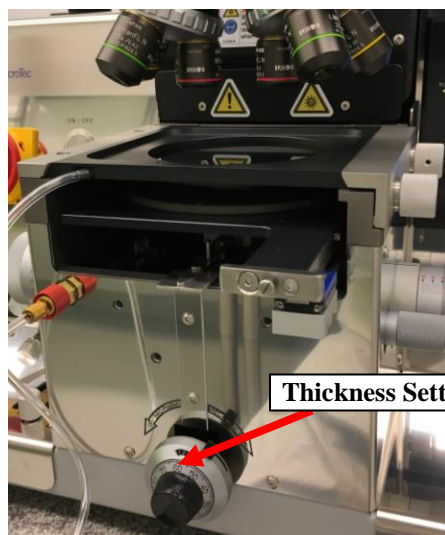
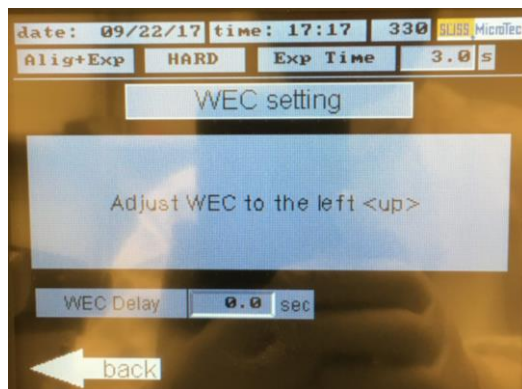
- 1) Touch the **WEC** settings button below.



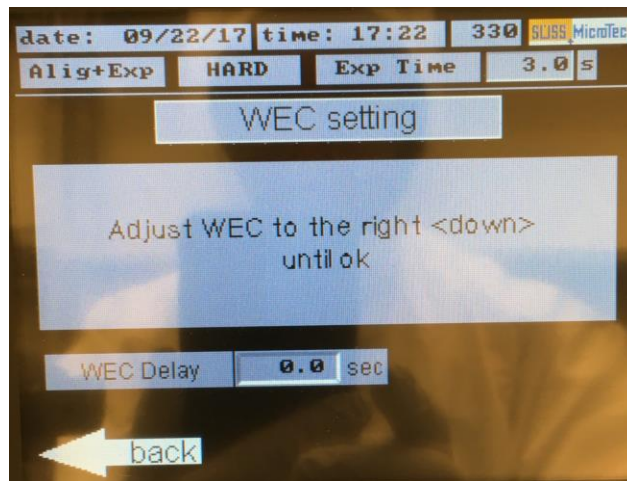
- 2) Follow screen instruction below to close the **Contact Lever**: make sure the **Separation Lever** is at **CONT** position and push the **Contact Lever** forward **slowly** all the way to **UP** position.



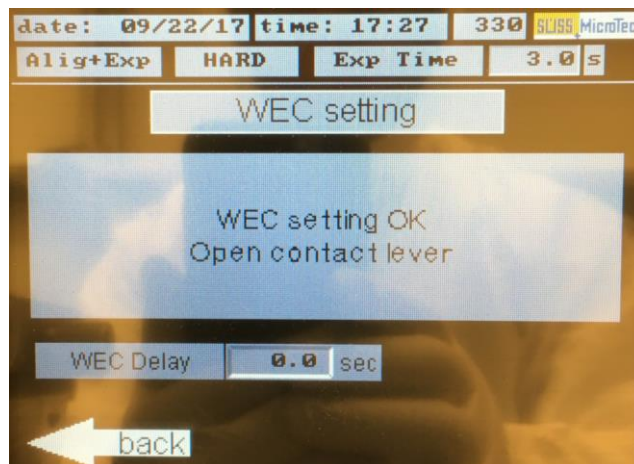
- 3) Unlock the **Thickness Setting Knob** with the **locking lever** (on the top-right side of the thickness setting knob).
- 4) Follow screen instruction below to “**Adjust WEC to the left <up>**”: **slowly** turn the **Thickness Setting Knob** to the **Up** position (**counterclockwise**) as shown below.
Warning: Slowly turn the knob to avoid wafer crashing into mask.



- 5) Continue turning the **Thickness Setting Knob** **counterclockwise** several turns until screen shows “**Adjust WEC to the right <down> until ok**”.



- 6) Follow screen instruction above to “**Adjust WEC to the right <down> until ok**”: slowly turn the **Thickness Setting Knob** to the **Down** position (**clockwise**).
- 7) Make several turns until screen shows “**WEC setting OK, Open contact lever**”.

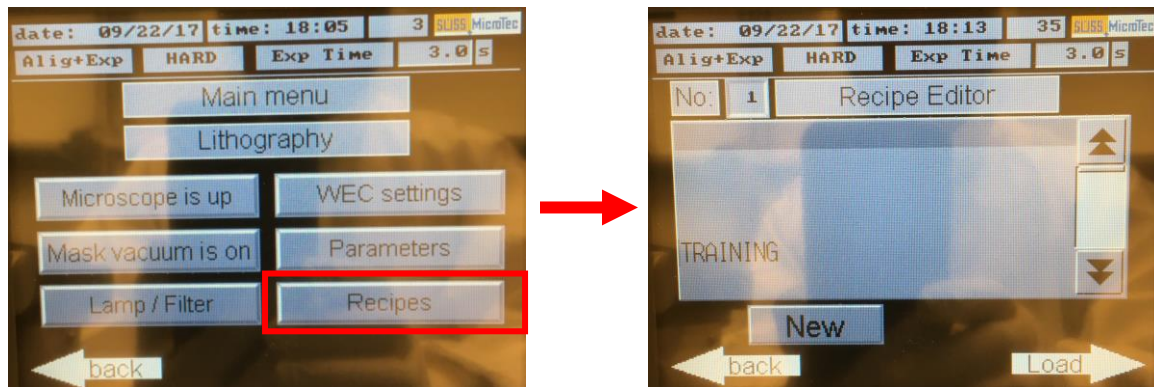


- 8) Lock the **Thickness Setting Knob** with the **locking lever**. Then follow screen instruction to **slowly** pull the **Contact Lever** back to **Down** position and to go back the **Main menu** screen.

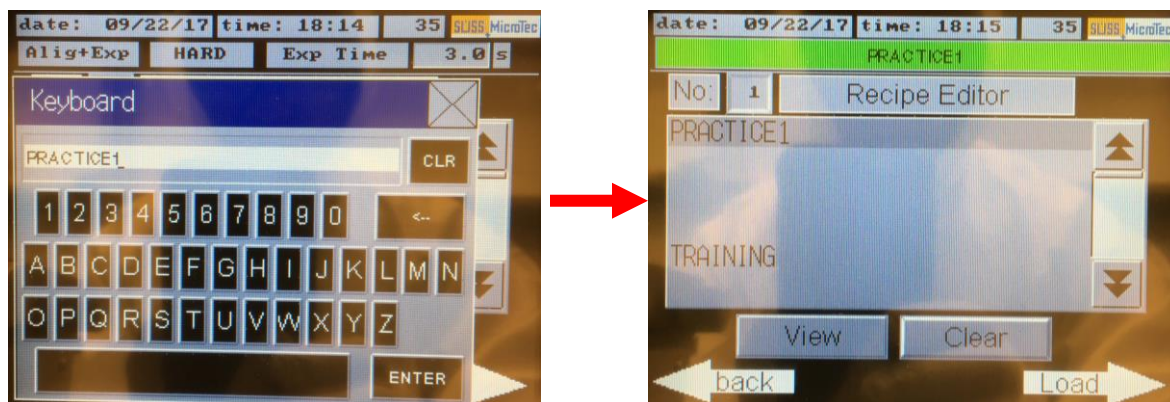
8. Mask Alignment and Exposure (Hard Contact mode)

Note: Only **Soft Contact** and **Hard Contact** modes are available on our mask aligner. It is highly recommended to choose **Hard Contact** mode for the best resolution (1~ 10 μm)

- 1) Create new recipe.
 - > Touch **Recipes** on the **Main menu** screen to go to **Recipe Editor** screen below, and touch blank screen to enable **New** button on the bottom.



- > Touch **New** button to pop up the keyboard, hit **CLR** button and put new recipe name e.g. PRACTICE1 and touch **ENTER** to go back to **Recipe Editor** screen

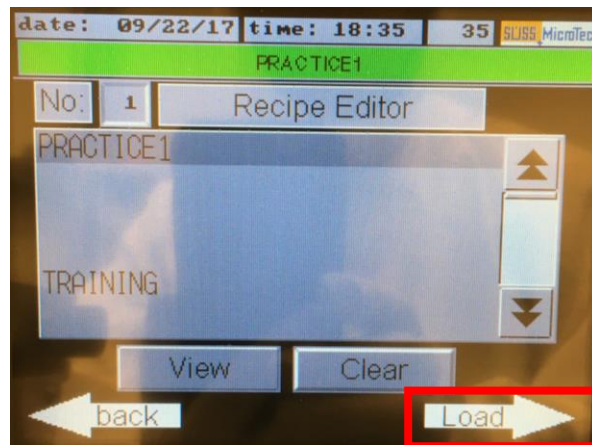


- > Highlight the new recipe, e.g. PRACTICE1 and touch **View** button on the bottom to check parameter settings in the **Parameter Info** window below:

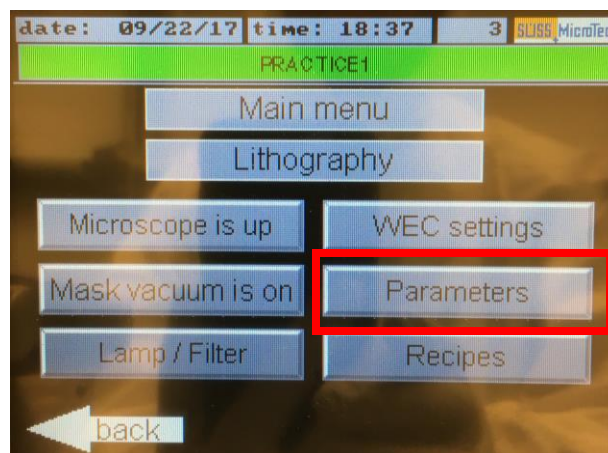


- > Close the **Parameter Info** window to go back to **Recipe Editor** window
- 2) Change parameters in saved recipe.

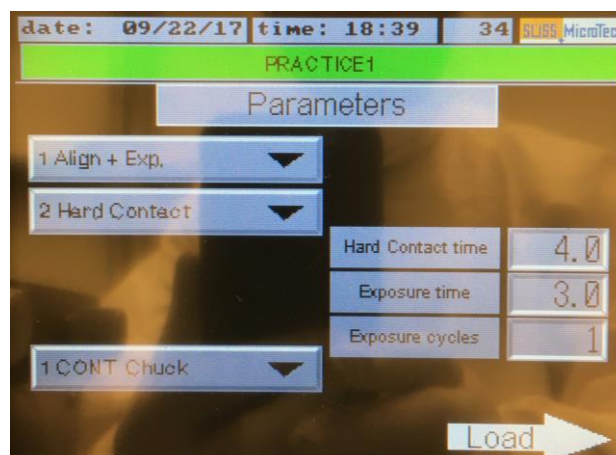
- > Highlight the recipe in the **Recipe Editor** window below and hit Load on the bottom right corner



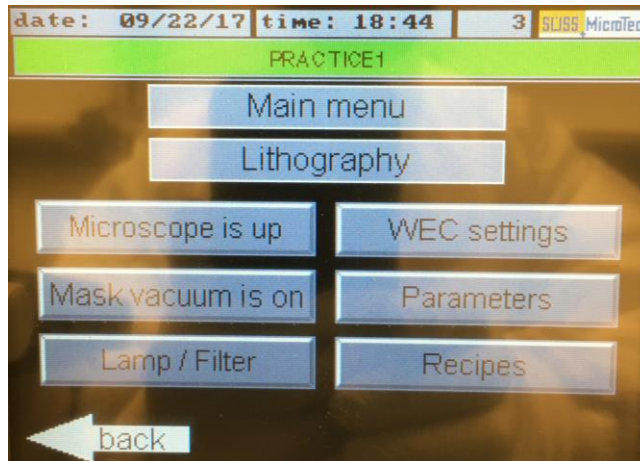
- > The **Main menu** will be shown with the recipe name on the top highlighted in green, e.g. PRACTICE1



- > Touch **Parameters** button to go to the **Parameters** menu screen with the recipe name on the top highlighted in green, e.g. PRACTICE1

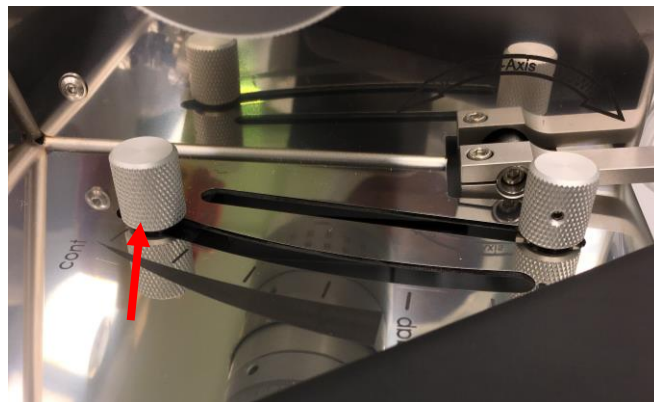


- > Edit parameters in the recipe:
 - > Touch the dropdown list and choose the following settings from pop down list
 - > **1 Align + Exp**
 - > **2 Hard Contact**
 - > **Keep Hard Contact time at 4.0 sec**
 - > Exposure time and Exposure cycles can be adjusted by touching the number and edit in the popup box.
The exposure time can be decided by following equation:
Exposure Time = Required Dose/Channel Intensity
 - > **3 CONT Chuck**
 - > Hit **Load** to go back to **Main menu**

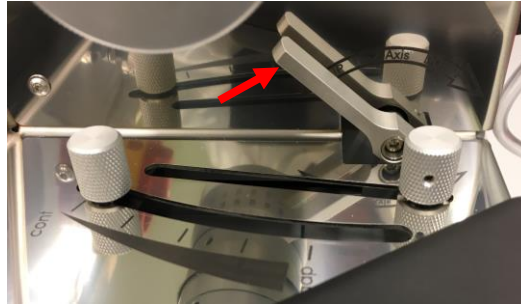


3) Perform initial alignment.

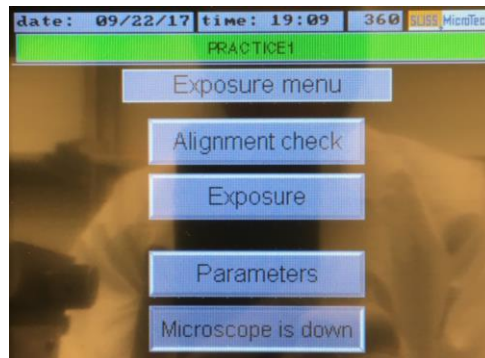
- > Make sure the **Separation lever** is at **CONT (Contact)** position after **WEC**. If not, slowly push it all the way forward.



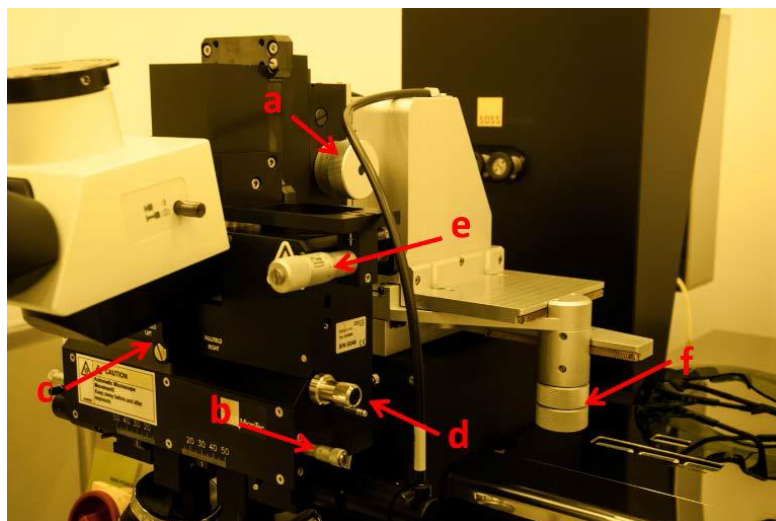
- > Slowly push the Contact lever all the way forward to “**UP**” position. The microscope will move down automatically.



- 4) The **Exposure** menu will appear on the touch screen.



- 5) **Move Separation Lever down, away from CONT (contact) position**. Otherwise, your mask will be damaged by the movement of wafer. The photo resist will also be destroyed.
- 6) The **Alignment** menu will appear on the touch screen.
- 7) Microscope setup
- > Turn **clockwise** the **TSA Illumination Left/Right** knobs to find mask patterns on the microscope monitor.
 - > Adjust the coarse focus knob on the scope to focus on the mask.



- a. Coarse focus b. Fine focus c. Split field mode
d. Intra-objective distance e. Rotation f. x/y stage movement

- > Select your desired magnification by rotating the objective turrets.
 - > Use two **fine focus adjustment** on each side of the microscope to individually correct the focus.
 - > Two objective lateral translator knobs on each side of the microscope can be used to move objectives relative to each other in x direction.
- Note:** Minimum separation between two objectives is **32 mm**.
- > The micrometer on the upper right adjusts the yaw.
 - > The microscope assembly can be positioned relative to the mask with the big white knobs on the far upper right.

Note: the image in the eyepieces is rotated by 180 degrees.

Warning:

- > **Microscope position cannot be changed when the microscope is up.**
Forcing to do so will damage the parts

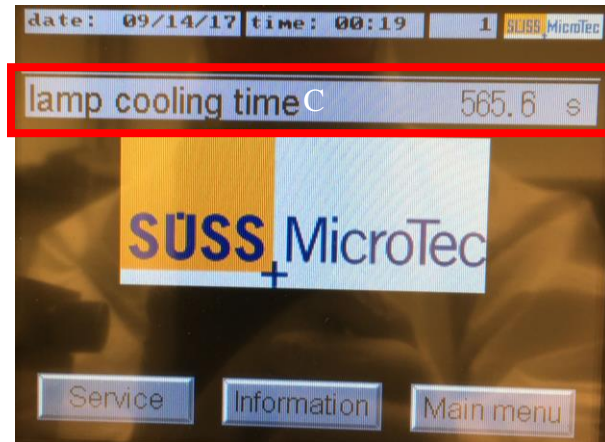
- 8) Align substrate with the mask by adjusting the **stage X/Y and Theta** knob.
- 9) After alignment, push the **Separation Lever** back to **CONT** (contact) position and the Exposure menu will appear:
- 10) Press **Alignment check** button on the screen to allow program performing alignment check on Hard Contact mode.
- 11) Hit **Exposure** on the screen to UV exposure on the substrate.
- 12) Select **Yes** on the screen.
Warning: stay away from the microscope which will move forward to start exposure. Put on the protective glass and **do not stare at the UV light**.
- 13) After finish, follow screen instruction to pull the **Contact Lever** back to **Down** position. The Main menu will appear on the screen.

9. Unloading the Substrate and Mask

- 1) Unload the wafer.
 - > Press and hold the vacuum knob on the wafer holder, slowly slide the wafer holder all the way out.
 - > Remove the substrate using the tweezers; then push the holder all the way back slowly.
- 2) Remove the mask.
 - > Check to make sure **Mask Vacuum is on**. **Note: Be careful and double check vacuum is on, otherwise your mask may fall off when you flip the mask holder.**
 - > Loosen two knurled screws on the right side of frame.
 - > Slowly pull the mask holder out; flip it over and hold the mask.
 - > Touch and hold **Mask Vacuum is on** button on the screen until **Mask Vacuum is off** button appears.
 - > Remove the mask and slide the mask holder back to alignment station.

10. Closing Mask Aligner

- 1) Turn the TSA Illumination Left/Right knob counterclockwise until stopped.
- 2) Hit **OFF** button on the **Lamp Power Supply** to switch to **STANDBY** status
- 3) **Press and Hold** machine **ON/OFF** button until the touch screen show lamp cooling time countdown from **600 seconds**:



- 4) **Wait 10 minutes** until the lamp cooling by **N2** is over and “**start machine with ON/OFF button**” appears on the touch screen.



- 5) Turn **OFF MAIN POWER**: rotate the **red dial switch** from **vertical ON** position to **flat OFF** position.
- 6) Close N2, CDA and Vacuum on the wall. The bars should **remain vertical** versus ground.

11. Logbook Sign-Off

Users are requested to sign off the logbook and make comments for any concerns. Please **CONTACT** cleanroom manager (Lei Wang at 203-745-8460) for emergencies.

