JEOL 2100 MANUAL

Quick check list

1. If needed, fill the reservoir with LN2

2. Raise HT to 200kVby following the procedure explained in 1.6.

3. Insert specimen holder into TEM (*Insert holder in airlock, set air/pump switch to pump (yellow light turns ON), when green light turns ON, rotate fully clockwise in two stages and push in completely*)

4. Generate electron beam by clicking Filament ON

5. Insert the largest condenser aperture into the column, center it and correct forcondenser astigmatism

6. Adjust eucentric height (*click STD focus button and use Z buttons to focus*)

7. Correct gun shift at spot size 1 and condenser shift at spot size 5. Iterate.

8. Adjust condenser lens deflection coils by adjusting Tilt X and Y and Shift X and Y. (Pivot points)

9. Center voltage axis (*click wobbler HT. Image should expand and contract around the center. If not, click BRIGHT TILT switch, adjust DEF/STIG so that image expands and contracts around the center of the fluorescent screen*)

10. Correct for objective lens astigmatism.

1. Initial check and Turning on the accelerating voltage

1. Check the ion pump gauge reading (the blue number in the middle). It should be around or better then2×10^{-5} Pa.
2. Check the cooling water flow meters on the back wall in the maintenance room.

3. *If needed, fill the anti-contamination device (ACD) (cold trap) with LN2. Be sure that the viewing screen cover is on before filling the trap.*
4. ***Caution:*** *The Dewar should be re-filled every 4-6 hours.*

5. <u>High voltage generation-</u> **PERFORMED BY FIRST OPERATOR IN A DAY**

- *set HT to 140 kV*
- *turn ON HT*
- *then AUTO HT:*
- *140 kV to 160 kV, step 1 kV, time/step=20 (6.7 min)*
- *160 kV to 180 kV, step 0.5 kV, time/step =10 (6.7 min)*
- *180 kV to 200 kV, step 0.1 kV, time/step =3 (10.0 min)*
- Wait for voltage to stabilize.

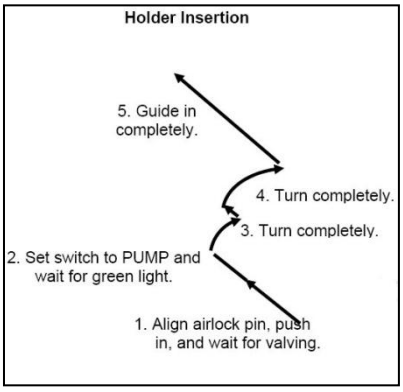
2. Inserting thespecimen holder in the TEMcolumn

Load the sample

- *Use Gloves! Load your sample on the specimen holder.*
- Carefully check the o-ring and sample area for dust and lint.

Insert the holder

- Make sure that the **stage position is neutral** and that the airlock switch is set to AIR position.
- Align the specimen guide pin with the guide groove on the TEM goniometer. Push the holder into the airlock system until it stops and set the PUMP/AIR switch to pump. *(The yellow lamp lights up)*
- When the green lamp lights up, turn the holder a bit clockwise, push the holder until it stops, and turn it fully clockwise, you will feel that the vacuum is trying to pull the holder in. Gently let the holder slide into the TEM until it stops. **Do not let go of the holder while it is going into the TEM column.** If it goes too fast the holder and/or the stage can be damaged.
- Select the holder you are using on the main screen of the TEM Controller window.



3. Electron Beam Generation

1. Click Filament **ON** in the **High Voltage Control** window.
2. Turn BRIGHTNESS knob to see if the electron beam appears on the fluorescent screen. Adjust the BRIGHTNESS knob and the SHIFT X and Y knobs to make the beam bright.

   If you cannot find the beam, the specimen or grid may be in the way. Try moving it around. Use LOW MAG.

Aligning the TEM

4. Condenser lens (CL) Aperture

1. Select MAG1 and a suitable magnification, e.g. 40k.
2. Insert the largest CL aperture into the column and center it as follows:
    - Obtain the smallest electron beam using the BRIGHTNESS knob and center it using the SHIFT X and Y knobs.
    - Slowly widen the electron beam using the BRIGHTNESS knob. If the beam moves off the screen center as you widen it, center it using the aperture knobs.
    - Adjust the aperture knobs so that the beam expands and contracts coaxially when you turn the BRIGHTNESS knob back and forth around the focus position.

5. Correcting CL Astigmatism

If astigmatism is present in the CL, the beam, when brought to a focus on the screen, is elongated. Correct astigmatism of the CL lens to make the shape of the electron beam spot round.

1. Focus the beam using the BRIGHTNESS knob.
2. Press COND STIG switch.
3. Slowly turn the BRGHTNESS knob back and forth around the focus position and adjust the DEF/STIG X and Y knobs so that the shape of the electron beam spot becomes round just before and after the focus position.
4. Press the COND STIG switch to deselect it.

6. Adjust Eucentric Height (Wobbler)

1. Locate the specimen *(or carbon network on grid)* screen at a magnification of 50-100k.
2. Press the STD FOCUS switch on the right Control panel.
3. Press IMAGE WOBB X or Y knob
4. Use the Z height controls to focus the image (minimum contrast).
5. Deselect the IMAGE WOBB knob
6. After this alignment all coarse focusing should be done with the Z height adjustment.

7. Gun Shift and Condenser Shift Correction

1. Select the MAG mode and set the magnification to 100k.
2. Set the SPOT SIZE knob to 1 and focus the beam using the BRIGHTNESS knob.
3. Click DEF Select **Gun** in the **Alignment Panel for Maintenance** window.
4. Center the beam on the fluorescent screen using the SHIFT X and Y knobs.
5. Click DEF Select **Gun** to deselect it.
6. Set the SPOT SIZE knob to 5 and focus the beam using the BRIGHTNESS knob.
7. Press the BRIGHTNESS TILT switch or click the DEF Select CLA in the **Alignment Panel for Maintenance** window.
8. Center the electron beam on the screen using the SHIFT knobs.
9. Click DEF Select CLA to deselect.
10. Repeat steps above until the electron beam stays at the center of the fluorescent screen when you change the SPOT SIZE.

8. Adjusting CL Deflection Coil (Pivot points)

A. Adjusting the Tilt X and Y

This adjustment consists of adjusting the ratio of the currents in the 1st and 2nd CL deflection coils so that the electron beam spot remains stationary when you tilt the electron beam.

1. Focus electron beam using the BRIGHTNESS knob
2. Click Compensator **Tilt** in the **Alignment Panel for Maintenance** window.
3. Click the Wobbler **Tilt X** in the **Alignment Panel for Maintenance** window. Unless the ratio of the currents is adjusted properly, the electron beam spot splits into two parts in the X direction.
4. Unify the split spot using the DEF/STIG X knob *(when the beam spot moves off the screen, lower magnification and continue adjustment).*

1. If the beam spot splits into two parts in the Y direction, click Compensator **Angle** in the **Alignment Panel for Maintenance** window, then unify the split spot using the DEF/STIG X knob. After unifying the spot, click the compensator angle to turn it off.
5. Click the Wobbler **Tilt X** button in the **Alignment Panel for Maintenance** window to turn it off.
6. Click the Wobbler **Tilt Y** button in the **Alignment Panel for Maintenance** window. Unless the ratio of the currents is adjusted properly, the electron beam spot splits into two parts in the Y direction.

7. Unify the split spot using the DEF/STIG Y knob. (If the beam moves off screen, lower magnification and continue adjustment)

2. If the beam spot splits into two parts in the X direction, click Compensator **Angle** in the **Alignment Panel for Maintenance** window, then unify the split spot using the DEF/STIG Y knob. After unifying the spot, click the compensator angle to turn it off.

8. Click the Compensator **Tilt** button to turn it off

B. Adjusting Shift X and Y

This adjustment consists of adjusting the ratio of currents in the 1st and 2nd CL deflection coils so that the caustic spot tilt remains unchanged when you shift the caustic spot.

1. Press the SA DIFF switch.
2. Turn BRIGHTNESS knob fully clockwise.
3. Adjust the DIFF FOCUS knob to obtain a caustic spot on the fluorescent screen.
4. Click Compensator **Shift** in the **Alignment Panel for Maintenance** window to turn it on.
5. Click wobbler **Shift X** in the **Alignment Panel for Maintenance** window to turn it on.
9. Unless the ratio of the currents in the 1st and 2nd deflection coils is adjusted properly, the caustic spot splits into two parts in the X direction.
6. Unify the split spots using the DEF/STIG X knob. (When the caustic spot moves off screen, shorten the camera length and continue adjustment).
10. If the electron beam spot splits into two parts in the Y direction, click Compensator **Angle** in the **Alignment Panel for Maintenance** window, then unify the split spot using the DEF/STIG X knob. After unifying the spot, click Compensator **Angle** to turn it off.
7. Click Wobbler **Shift X** in the **Alignment Panel for Maintenance** window to turn it off.
8. If the caustic spot is shifted from the screen center, press BRIGHT TILT and center it using the DEF/STIG X and Y knobs.
9. Click Wobbler **Shift Y** in the **Alignment Panel for Maintenance** window.
11. Unless the ratio of the currents in the 1st and 2nd deflection coils is adjusted properly, the caustic spot splits into two parts in the Y direction. 7
10. Unify the split spot using the DEF/STIG Y knob.
12. If the electron beam spot splits into two parts in the X direction, click Compensator **Angle** in the **Alignment Panel for Maintenance** window, then unify the split spot using the DEF/STIG X knob. After unifying the spot, click Compensator **Angle** to turn it off.

11. Click Wobbler **Shift Y** in the **Alignment Panel for Maintenance** window to turn it off.
12. Click Compensator Shift Y in the **Alignment Panel for Maintenance** window to turn it off.
13. Press MAG1 to return to TEM mode.

9. Centering the Voltage Axis (HT Wobb)

1. Find a sharp specimen edge and decrease BRIGHTNESS until the specimen is still visible. The image should be in focus.
2. Press the HT WOBB switch. The image then expands and contracts periodically.
3. Manipulate DEF/STIG (X,Y)knobs so that the image expands and contracts around the center of the screen.
4. Press the HT WOBB switch to turn it off.

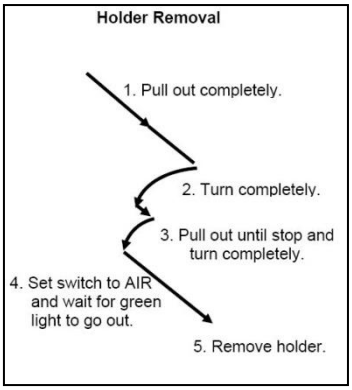
10. Objective Lens (OL) Astigmatism Correction

1. Find an amorphous area.
2. In MAG1, set magnification to 200k or higher.
3. Lift the screen.
4. Insert the CCD camera, click start view in Digital Micrograph window to view the image of the amorphous material. Select the ROI by press alt + ⬚
5. In the Digital Micrograph Window, Click Process → Live → FFT.
6. A correct objective stigmatism corresponds to a thon rings circularly symmetric.
7. Click OBJ STIG switch.
8. Adjust DEF/STIG (X,Y) knobs to get a better sphere.
9. Click OBJ STIG switch to deselect it.

11. ENDING TEM SESSION

A. Removing Holder from TEM

1. Click Filament **OFF** in the **High Voltage Control** window.
2. Click the **OK** button in the message window to turn off the Filament.
3. Double-click the **Stage Neutral** button in the TEM Controller window.
4. Pull the Holder until it stops, turn it fully counterclockwise, pull it a bit until it stops, and then turn it fully counterclockwise until it stops.
5. Set the PUMP/AIR switch to AIR, wait 30 seconds, and then pull out the specimen holder from the TEM.



B. Returning ACD to Room Temperature

If you are the last user of the day and cold-trap was used, heat the trap up to ambient temperature.

1. Remove all the apertures!
2. Insert the heater assembly into the coolant reservoir and insert the heater plug into the HTR socket on the connector box.
3. Select **TEM Controller-Maintenance-ACD & Bake** to open the **Bake Out/ACD Heat** window; then click the **On**button in the **ACD Heat** tab. The evacuation system enters ACD mode (SIP if OFF).

How to use EDXS

1. Select the thin area you are interested in and move it to the screen center using the track ball.
2. Select the 2nd or smaller condenser aperture and spot size 3 or less.
3. Open the EDX software by double clicking on  (SSM dead time). Select “fast map”!

4. Press knob for detector in.
5. Select the appropriate spot.
6. Select the appropriate CA.
7. Set the process time on Acquisition → Acquisition condition → PHA mode → resolution.
8. Never move the sample with detector in, always take it out before and then find new area for EDS! Then repeat steps 1-8!