OPERATING INSTRUCTIONS FOR HITACHI H-7000 TEM

(revised: 7/10/2018)

Routine Operation

Start up

1. Cooling water

Run cooling water to vacuum and electrical systems by turning timer on Haskris cooler to "hold".

Check water flow level (Tank water level indicator=full with light on; 30 psi; gpm 1.3).

2. Starting the microscope

(1). Turn the POWER SWITCH KEY on right lower panel to **EVAC ON**.

(2). Check that the GUN EVAC and COLUMN EVAC selector switches have EVAC selected.

(3). Fill the anticontamination traps with liquid nitrogen (LN2). The trap at the back of the column takes 2 liters and the one on the left side 500 mL.

Add the LN2 200 mL at a time, waiting for boiling to subside between amounts to minimize splashing.

(4). Wait 20-30 mins for high vacuum to be attained. While you are waiting, please record your logon book.

When the microscope is ready all VACUUM INDICATOR LIGHTS on the right-hand desk panel are green, except for SPEC which should be orange. (See below)

	COL	GUN	SPEC	CAMERA
AIR				
CLOSE			orange	
EVAC	green	green		green

3. Generating a beam

(1). When the microscope is ready (above), turn the key (right lower panel) to **COL ON**.

(2). Press READY/OFF button (left main panel) once to light.

(3). Select and press the desired **ACCEL VOLTAGE** button (we normally use 75 KV).

(4). Press READY/OFF button again to light.

(5). Check voltage on HV/BEAM meter. If HV is cut off (especially when scope has not run for a while), repeat above process. If necessary, press "flash" button on left lower panel to momentarily flash the filament.

(6). Turn BIAS control on left main panel fully clockwise and return it 2 revolutions.

(7). Turn FILAMENT control knob on left main panel gradually and saturate filament. Check current on HV/BEAM meter. Adjust the current to about 25 μA with BIAS knob, if necessary.

(8). Turn BRIGHTNESS control knob on left main panel counterclockwise to focus a spot on screen. Center spot by manipulating BRIGHTNESS CENTERING knobs on right main panel. Disperse beam again.

Avoid prolonged exposure of screen to cross-over beam.

4. Specimen unloading

(1). Turn the filament current off.

(2). Pull the specimen holder until it stops; turn the specimen holder counterclockwise until it stops; further pull and turn the holder in the same way as above.

(3). Turn the specimen chamber evacuation switch to AIR. After a few seconds, the SPEC AIR red lamp of the VACUUM STATE is lit to indicate completion of airleak.

(4). Pull out the specimen holder straight out. Pay attention not turn the holder.

(5). Remove the specimen/grid from the specimen holder and put a new specimen/grid in.

5. Specimen Loading

(1). Load the grid onto the grid holder

(2). Match the specimen holder with cylinder groove in the specimen stage of the microscope column and insert it until stops. Do **NOT** turn the specimen holder. Otherwise air will be admitted into the column.

(3). Turn the specimen chamber evacuation switch to EVAC. The specimen chamber evacuation lamp lights up (in yellow).

(4). Wait until the light goes off, then the SPEC EVAC green lamp of VACUUM STATE lights up to indicate completion of pre-evacuation of the specimen holder.

(5). Holding the grip of the specimen holder, turn it ***clockwise*** until stops and push it in the axial direction until it stops. Further turn it ***clockwise*** and insert it until stops.

6. Photographing with the Gatan digital camera

(1). Spread the beam to cover the smaller fluorescent screen.

(2). Place the plastic cover on the viewing

(2). Depress the TV button (left main panel) to deactivate the film camera.

(3). Pull the screen lever (on the right side of the column) up.

(3). Insert the digital camera using Gatan's software.

Make sure to remove the camera after imaging.

7. Shutting the system down

(1). Gradually turn the filament off

(2). Press READY/OFF button on left main panel once or twice to turn off the HV

(3). Switch the key to EVAC ON, then switch to OFF.

(4). Turn the timer on the Haskris water cooler water to 30 min.

(5). Write down the time on the logbook.

Routine Alignment of the TEM

A simple alignment is required for using the instrument properly in routine operations as instructed below.

1. Alignment of Illumination System

(1). Make sure filament current is no more than 25 μA by turning the BIAS and reading the current on the HV meter.

(2). Remove the specimen to position B (center position) by pulling on the specimen rod and turning it counterclockwise.

(3). Remove the condenser and objective lens apertures from the optical axis by moving the aperture levers to the right

(4). Set MAG to about 5,000 X

(5). Turn BRIGHTNESS (on left main panel) counterclockwise to focus beam into a spot. Center the spot using BRIGHTNESS CENTERING controls (on right main panel). Promptly disperse the beam by turning BRIGHTNESS clockwise.

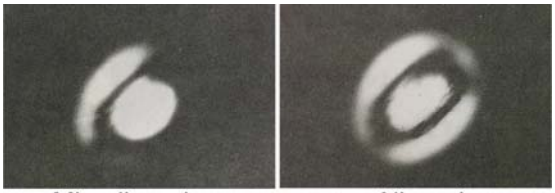
(6). Insert the condenser aperture by moving the lever to the left.

Re-center the spot on screen as described above and again disperse the beam.

- If the beam does not disperse ***concentrically***, adjust the end and side knobs (x/y) on the condenser aperture apparatus until the bore is centered on the optical axis.
- If the beam disperses ***elliptically***, adjust the COND STIGM knobs (on the right sub panel - x/y knobs), until compensated.

(7). Form a spot using BRIGHTNESS, then turn the FILAMENT knob counterclockwise to under-saturate the filament current.

The spot should look like a doughnut with shadow of the filament tip in the center (Figure below). If it is oddly shaped, correct it by adjusting the GUN TILT x/y knobs on the left sub panel.



In case the beam spot escapes from the center of the fluorescent screen after correction, bring it to the center by manipulating the GUN HORIZ knobs.

For more accurate alignment, do the following:

(a). Match the SPOT SIZE selector knob (left lower panel) with graduation 1 and locate the beam spot at the center of the fluorescent screen by using the BRIGHTNESS CENTERING knob.

(b). Match the SPOT SIZE selector knob with graduation 7 and bring the beam spot to the center of the fluorescent screen by using the GUN HORIZ KNOBS.

(c). Repeat steps (a) and (b) a few times until the beam spot is located right at the center of the fluorescent screen in different spot sizes.

(d). Match SPOT SIZE with 3 or 4, using method above.

ILLUMINATION OF SPOT SIZE

Smaller spot sizes (1, 2) are dimmer but more coherent than larger ones (7, 8). Spot sizes 3 and 4 are default settings. Use spot size 1 or 2 for highest coherence in diffraction or high resolution or low dose modes. Use spot sizes of 6-8 for imaging large areas or to reduce background "speckle" by reducing coherence.

2. Alignment of Imaging System

Introduce a test specimen and set MAG at 10,000 X. The condenser aperture should be in (lever left); the objective aperture should be out.

(1). Alignment of voltage center

(a). Press HV MODUL switch (on right main panel) to superimpose AC on accelerating voltage.

(b). Adjust BEAM TILT knobs (on right sub-panel) to match the voltage center with center of the fluorescent screen.

(c). Center beam spot with BRIGHTNESS CENTERING.

(d). Repeat above steps (b) and (c) several times until the voltage center matches the brightness center.

(e). Press the HV MODUL switch to turn it off.

In case the beam spot is distorted in an elliptical shape when formed by turning the BRIGHTNESS control knob, an excessive astigmatism is present in the illumination system. Correct astigmatism by using the COND STIGM knobs on the right sub-panel.

(2). Alignment of objective lens aperture

(a). Introduce field limiting aperture.

(b). Press DIFF selector on left main panel.

(c). Adjust MAG to set camera at 0.4 m (read on CRT)

(d). Minimize spot size with DIFF SPOT knob.

(e). Insert objective lens aperture (lever to left)

(f). Adjust end and side knobs on objective aperture apparatus (x/y) until aperture shadow is concentric with spot.

(g). Extract the field limiting aperture.

(h). Select ZOOM mode.

(3). Astigmatism Correction of Objective Lens

Astigmatism of the objective lens appears as an image blurring phenomenon that one image is accompanied with another different-focus image at right angles to each other. Under this condition, exact focusing is impossible. Correction can be made as follows:

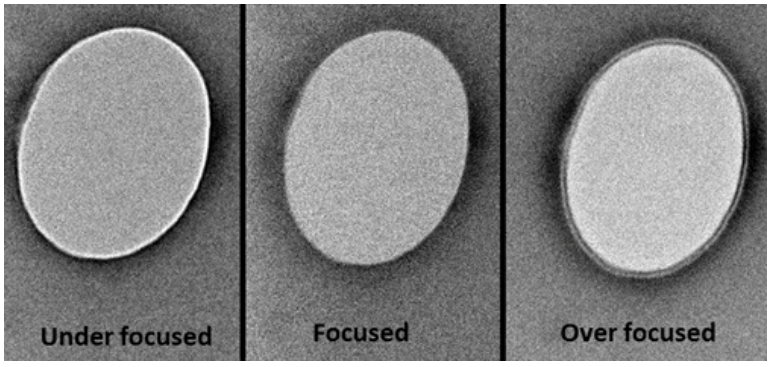
(a). Introduce a test specimen.

(b). Reset the OBJ STIGM X and Y control knobs (stigmator) on the left panel.

(c). Increase MAG 2-3 X higher than for photography and find as circular a hole as possible within a diameter range of about 1 cm on the fluorescent screen.

(d). Slightly over-focus the image by turning the FOCUS knob clockwise (see figure below).

(e). Adjust OBJ STIGM x/y knobs to make the over-focused fringe symmetrical (see figure below).



3. Alignment of Z-Axis

(1). Depress the RESET button on the TV monitor.

(2). Increase the magnification to 20,000. NOTE: *you can only increase, but not decrease the magnification at this point.*

(3). Turn on Wobbler.

(4). Adjust Z-axis on the stage until movement stops.