

# Philips CM 10 TEM

## Overview

The CM 10 is a transmission electron microscope with a maximum acceleration voltage of 100 kV.

The main microscope controls are localized on the LEFT and RIGHT panels:

### CM 10 Left Panel



Fine or Course Intensity

Beam Intensity (spread / condense beam)

WOBBLER

The left panel contains only two controls important for users to know:

- Intensity (beam)
- WOBBLER (for focussing)

### CM 10 Right Panel



MAGNIFICATION

BEAM SHIFT

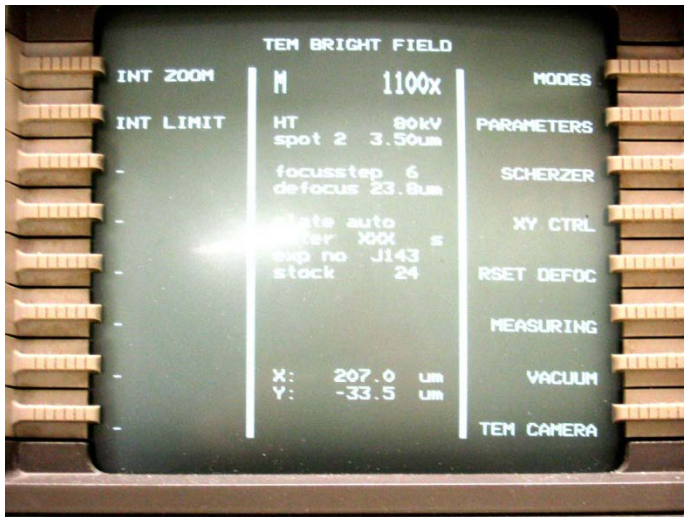
FOCUS

Step Size

The right panel contains most of the CM 10 controls:

- Microscope ON/OFF switch
- Vacuum system ON/FFF (in normal operation the OFF switch is lit)
- Ultra High Vacuum (UHV) indicator (normally lit)
- High Vacuum (HIVAC) indicator (normally is lit)
- High Tension (HT) button (lit when on)
- Filament knob
- Emission (beam current) indicator
- Spot size knob –normal # 2
- Magnification knob
- Focus knob
- Beam shift, X and Y

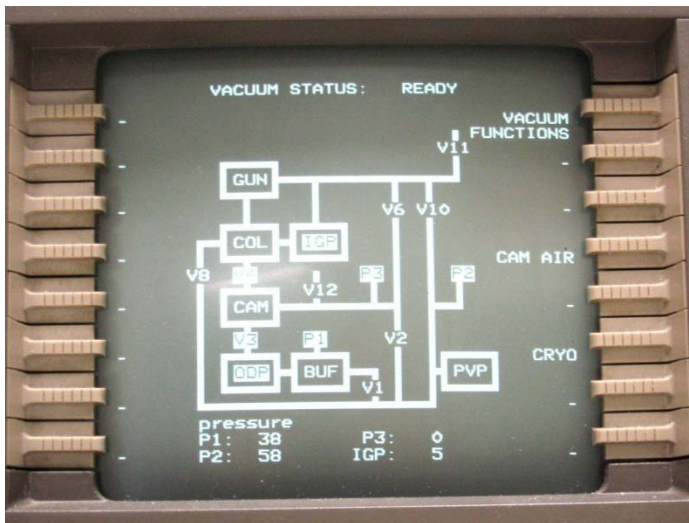
## Computer Monitor



An internal computer controls all microscope functions. The computer monitor on the right panel provides all information about the microscope's condition. Information on the computer is organized into "pages." Computer has no keyboard, but is operated by the gray buttons on the left and right sides of the screen. These buttons function in two ways: (1) select/change the page and (2) set/change the parameters. The buttons function differently on different pages

depending on the content. There is a *special* button called "**Ready**" on the bottom-right side of the monitor. It takes you one step back in the Menu hierarchy. Sometime it also functions as an "**Enter**" button. Combine the green and "**Ready**" buttons to change the screen pages.

The "**TEM Bright Field**" screen (seen above) is normally used for everyday operation. It contains three fields: **left** and **right** fields label the green buttons (**XY** and **VACUUM** are commonly used); the **central** field contains information about the microscope status. Most information is self-explanatory: magnification, accelerating voltage, spot size etc. Many options for the green buttons are also self-explanatory. For instance, pressing the green button next to the "**VACUUM**" will bring up the CM120 vacuum diagram:



On the diagram, a white background indicates that a valve is open (V7), black – closed (V10). For proper microscope operation the following conditions must be met:

**V3 and V4** valves – open;  
**P3 and IGP** reading (bottom of the page) – **less than 30**.

Abbreviation used on this page: **IGP** – Ion Getter Pump; **ODP** – Oil Diffusion Pump; **PVP** – Mechanical Pump; **BUF** – buffer tank; **CAM** – photo camera; **COL** – column; **GUN** – electron gun.

Similarly, other functions may be accessed by pressing the corresponding gray

button. Pressing "**Ready**" returns you to the previous screen.

## Grid Holder

The CM 10 holder will feel very fragile and delicate. It's very true. *Please, pay special attention when handling FEI/Phillips holders – they ARE really fragile and delicate!* Before using, inspect the holder: check the O-ring for cracks or dust, it must be clean; Check conical area next to the O-ring – it must be clean without visual scratches etc; Inspect clamp mechanism, make sure it's not damaged. Report any problem immediately! *Please, be aware: most of the FEI/Phillips holders could hold only one grid!*



### How to load the grid?

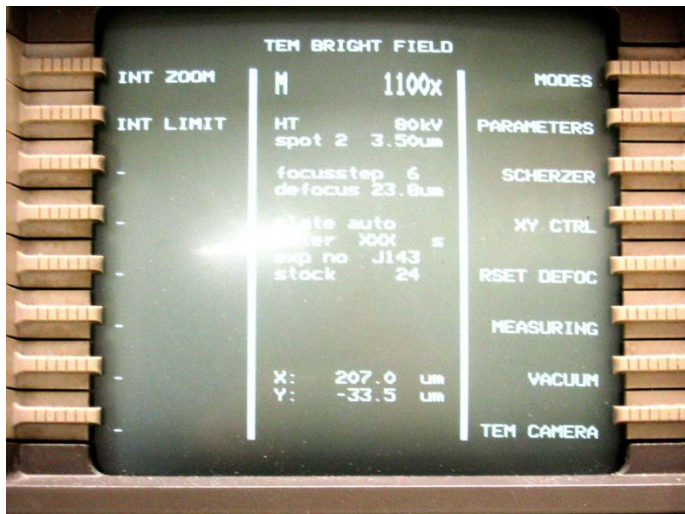
There is a special "**tool**" to open the "**clamp**," which holds the grid in the "**carrier**." In order to open the clamp, (1) locate the small hole at the base of the clamp. (2) Insert the tool into the hole and slowly move the clamp up into a vertical position (make sure the clamp is secured in this position); do not apply excessive force! (3) When clamp is in the vertical position, load the grid into the carrier; make sure it's centered well and slowly move clamp down into the closed position. Control this movement with the tool. Do not remove the tool from the hole unless clamp is completely closed. The normal orientation for the grid is sample down. Improper operation will damage the clamp mechanism.

# Using the CM 10 Electron Microscope, basic operation

Remarks: in this Instruction, references to the computer screen page/function associated with gray buttons are presented in **BOLD GREEN**. The name of the physical switch/knob/button – **BOLD RED**. Parameters, which operators need to set/change (like magnification) – **BOLD BLUE**.

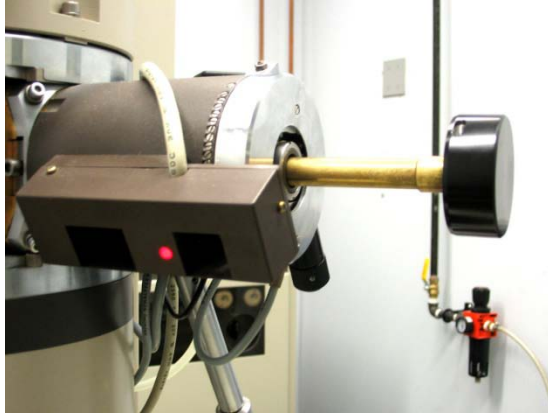
## Step-by-step Instructions

1. Make sure that **HT**, **UHV** and **HIVAC** indicators on the right panel are lit.
2. Go to **Vacuum Page**



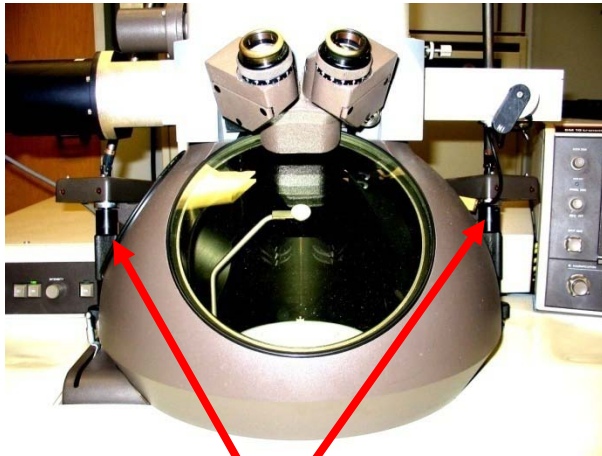
This is your **Main Page**

3. Check the vacuum in the scope: → **VACUUM**. Make sure that **V3**, **V4**, are opened; **IGP** < 30 and **P3** < 30. Using **Ready**, return to **XY Control** page.
4. Set magnification **M x1250** using **MAGNIFICATION** (right panel).
5. Turn **FILAMENT ON**: make a few clockwise turns of the **FILAMENT** knob to initiate 2-3 min. long program of LaB<sub>6</sub> filament heating. Observe, also, **EMISSION** (beam current) increase. It will beep once when filament is ready.
6. Observe the beam on the big fluorescent microscope screen.
7. Using **SHIFT X and Y** (beam shift) on the right panel of the microscope, center the beam. Spread and condense beam (**INTENSITY**, left panel) a few times to make sure it's centered well and symmetrical.
8. Insert the specimen holder.



1. Make sure the specimen is properly fastened in the specimen holder.
2. Check that the O-ring and conical surface of the holder is clean.
3. Locate a small pin on the end of the holder closer to the grid.
4. Carefully insert the holder into the goniometer compustage with the small pin on the holder in the 6 to 7 o'clock position. The prepumping cycle will initiate and the red indicator light will come on.
5. When the red light goes off (about 1 minute), rotate the specimen holder fully **counterclockwise** until it does not rotate further and insert into the microscope carefully as it will be sucked into the vacuum of the microscope. The holder may first go in to the slot that accepts the pin, this is not fully inserted and you continue to turn the holder until it is pulled all the way in.
6. Reverse these directions to remove the specimen holder from the microscope.

7. Check that the IGP < 30, the machine will turn off the HT if the vacuum goes too high.



**Translators**

8. Use the translators to move the grid in the X and Y direction. The machine will beep if you go over the set limit of 980 in either direction.

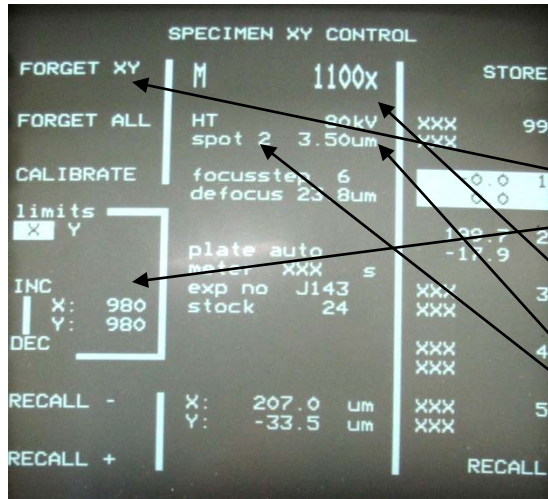
9. Centre, adjust magnification and focus your specimen with controls on the Right Panel

The **wobbler** deflects the beam alternately to either side of the optical axis. When the objective is focused exactly of the specimen plane, no change in the image is apparent. Make sure to turn off before you record an image. The **wobbler** is not very effective at high magnifications. depending on the specimen.

10. Ending your session:
  - Set mag to 1250X
  - Spread the beam over the viewing area.
  - Turn off the filament.
  - Take the holder out and remove your grid

11. Either re-insert the specimen holder into the column or block the open port with the rubber stopper to avoid dust entering.

### The XY Control Screen



- Allows you to store positions that the translators will return to
- Remove one or all stored positions
- Grid X and Y limit do not exceed – machine will beep
- Magnification
- HT in use (usually 89 Kv)
- Spot size being used

### 12. Using the Digital Imaging System

1. Log on to the Gate Keeper with your password if you have not already done so.
2. Click on the AMT icon to launch the camera software.



3. Click the toggle switch near the right translator to insert the camera into the column



4. Under the camera control the Survey round button should be selected

5. Click on the "Click for Live Image"

6. Adjust Intensity to position the peak in the centre of the window.

7. The Speed/Quality button switches between frame averaging Quality and Speed mode. Has no effect on final image.

8. Focus button enlarges the centre region of image to help you focus.
9. Click the "Click for Final Image" button
  - takes 10 seconds or so
  - image is ready for digital storage**
10. **When viewing images with the camera reduce the Intensity before reducing the microscope magnification to avoid "blasting" the camera with too high a beam intensity.**

# Common Problems and Solutions

If you do not know or are unsure of anything ask one of the Imaging Facility staff, do not risk serious damage to the instrument.

## 1. There is no light.

- 1) Check that the green HT light is lit. If you accidentally let air into the column while changing the specimen the HT will go off.
- 2) Use the translators to make sure you are not on a grid bar – these will seem very large at high magnifications
- 3) Reduce the magnification until you get light again.
- 4) Use the SHIFT X and Y knobs to realign the light – you may have to lower the magnification to do this then increase it again.

## 2. Vacuum indicating LEDs for UHV/ HIVAC/PREVAC

Indicate the vacuum condition. The TEM would work only at the condition of both UHV and HIVAC are illuminated. Some features in the vacuum system include (can be seen on Vacuum pages):

P1 = buffer tank (30-38).

P2 = rotary pump (pre-pump) (could be 100, but must be down when the VAC is ON).

P3 = oil diffusion pump (~30, should be below 60, may reach 100 when the film is changed).

IGP= Ion Getter Pump (~10-20, should be below 52, may reach higher when column is aired).



**Vacuum accidents can be caused by forcing the sample into the column before the red light goes off, or by lower compressor air, etc.**

**3. You can not get the specimen in focus.**

- 1) Check which focus stop you are on. At high magnifications you will want to use a lower setting.**
- 2) Reduce the magnification and focus then increase the magnification and fine focus.**
- 3) Check that the WOBBLER is not on. A green light will be lit.**
- 4) If using the small screen check that the binocular eye pieces are adjusted for “your eyes”.**

**4. The machine is making “beep” noises.**

**The TEM uses beeps to inform you of various operations, i.e.**

- 1) The HT is saturated and ready to go.**
- 2) The lenses have reversed the image.**
- 3) You have overshot the X and Y limits (set at 980 usually) and are near the edge of the grid.**
- 4) General warnings – a continued beeping requires the Imaging Staff.**

**The machine is making “swoishing sounds”. Do not be alarmed this is the sound of the pneumatic valves opening and closing in regard to the vacuum system. Continued valving means a problem and should be reported.**

**5. Everything seems wrong.**



# Parameters

## Resolution:

0.34 nm point to point at 100 kV spot size 1 micron

## Column Pressures:

$1.33 \times 10^{-5}$  Pa at IGP reading of 12

$6.67 \times 10^{-5}$  Pa at IGP reading of 26 Ultra High Vacuum

$6.67 \times 10^{-4}$  Pa at IGG reading of 52 Working Vacuum (not LaB6!)

## Pumping Times:

Gun Airlock < 3 minutes

Camera Airlock with film 5 to 7 minutes

(Depends on how well plates and film have been dried)