INSTRUCTIONS

JSM-840

SCANNING MICROSCOPE

JEOL LTD. / 日本電子
Tokyo Japan
2. SPECIFICATIONS

This chapter contains specifications and installation requirements related to the handling of the instrument.

2.1 Performance

- Resolution
  - Secondary electron mode: 4.0 nm guaranteed at 8 mm working distance and 35 kV.
  - Backscattered electron mode: 10.0 nm guaranteed at 39 mm working distance and 35 kV.
- Magnification:
  - 10X (at working distance 39 mm) to 300,000X (zoom mode).
  - Automatic magnification compensation for changes in accelerating voltage and working distance.
  - 100X (instantaneously resettable from any magnification).
- Imaging modes:
  - Secondary electrons, high speed reflected electrons, backscattered electrons (composition and topography), electron channeling pattern (SACP40 required for selected area channeling pattern).
- Accelerating voltage: 0.2 to 40 kV.
- Probe current: $10^{-12}$ to $10^{-5}$ A.

2.2 Electron Optic System

- Electron gun
  - Accelerating voltage: 0.2 to 1 kV: variable in 0.2 kV steps.
  - 1 to 40 kV: variable in 1 kV steps.
  - Filament: Precentered tungsten hairpin type filament (cartridge type).
  - Anode: Precentered single crystal LaB$_6$ cathode (option: LBG40).
  - Bias: Two positions selectable (manual).
  - Emission current: Self-bias; fully compensated and optimized.
  - Filament heating current: Manual override provided.
  - Alignment: Monitored on the meter.
- Lens system (3 lens system)
  - Lens operating modes: SEM mode (probe current: $10^{-12}$ to $10^{-5}$ A).
  - SEM1 mode (probe current: $10^{-12}$ to $10^{-5}$ A, no image fine-shift).
  - ECP mode (for electron channeling pattern).
  - EMP mode (for electron source imaging).
  - P SCAN mode (no probe scan).
- Condenser lens: 2-stage, electromagnetic, zooming system.
2.3 Specimen Stage

- Type:
- Specimen movement range
- X-direction:
- Y-direction:
- Z-direction:
- Tilt:
- Rotation:
- Specimen size
  - 12.5 mm dia. specimen holder:
  - 32 mm dia. specimen holder:
  - 50 mm dia. specimen holder:
- Specimen exchange:
- Absorbed current measuring terminal:
- Specimen protection buzzer:

Full eucentric goniometer stage.

0 to 15 mm.
0 to 25 mm.
8 to 39 mm (fine shift ±1.5 mm), continuously variable.
$0^\circ \sim 90^\circ$.
$360^\circ$ endless.

Up to 12.5 mm dia. X 10 mm H (specimen height adjustable).
Up to 32 mm dia. X 20 mm H (specimen height adjustable).
Up to 50 mm dia. X 10 mm H (specimen height adjustable).
Airlock type (up to 32 mm dia. specimens) and drawout type.
Built-in.
Built-in.

2.4 Electron Detector System

- Secondary electron detector:
- Detector:

Secondary electrons and high speed reflected electrons.
Scintillator-light pipe-photomultiplier system complete with collector.
• Collector voltage: Variable in 5 steps.
• Secondary electron acceleration: 10 kV (with ON/OFF switch).
• Contrast control: Adjustment of photomultiplier dynode voltage, linked with probe current.
• Brightness control: Adjustment of dc level of video output signal.
• Backscattered electron detector
• Detector: Si P-N junction (divided annular type).
• Operating conditions: Working distance: 8 to 15 mm; accelerating voltage: 5 to 40 kV; probe current: higher than 10⁻¹¹ A.
• Video output signal: Composition and topography.
• Contrast control: Adjustment of video amplifier gain (100X to 100,000X).
• Brightness control: Adjustment of dc level of video output signal (separate control of compositional and topographic signals).
• Responsive scan speeds: SLOW 1, SLOW 2, PHOTO.

2.5 Scan System

• Scan modes:
  • Full frame scan (PIC), selected area scan (RDC), line scan (LINE), line scan for profile display (LSP), SPOT
  • Selected area scan:
    • Full frame to 10% frame; position shiftable, aspect ratio adjustable.
  • Line scan:
    • Position shiftable in LINE and LSP modes.
  • Spot:
    • Position shiftable.
  • Cursor display:
    • Possible (position shiftable).

<table>
<thead>
<tr>
<th>Scan speeds</th>
<th>Horizontal (ms/line)</th>
<th>Vertical (s/frame)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TV*</td>
<td>0.0635</td>
<td>0.02 (0.0166)</td>
</tr>
<tr>
<td>SR</td>
<td>0.127</td>
<td>0.04 (0.033)</td>
</tr>
<tr>
<td>SLOW 1</td>
<td>20 (16.7)</td>
<td>16</td>
</tr>
<tr>
<td>SLOW 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHOT</td>
<td>4 ~ 240 (4 ~ 233)</td>
<td>1 ~ 600 in 6 steps</td>
</tr>
<tr>
<td>MF</td>
<td>in 6 steps</td>
<td></td>
</tr>
</tbody>
</table>

( ) apply to 60 Hz.
*For video recording, optional attachment SM-TVD40 required.

• Magnification range

<table>
<thead>
<tr>
<th>WD indicator reading (mm)</th>
<th>Available magnification range</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 ~</td>
<td>30X or more (100X or more)</td>
</tr>
<tr>
<td>5 ~</td>
<td>25X or more (90X or more)</td>
</tr>
<tr>
<td>11 ~</td>
<td>20X or more (80X or more)</td>
</tr>
<tr>
<td>20 ~</td>
<td>15X or more (70X or more)</td>
</tr>
<tr>
<td>29 ~</td>
<td>12X or more (60X or more)</td>
</tr>
<tr>
<td>38 ~ 53</td>
<td>10X or more* (50X or more)</td>
</tr>
</tbody>
</table>

Values in parentheses apply to the TV mode.
*At 10X and 11X, image missing may occur at the marginal part of the film.
2.6 Display System

- Image display modes:
  - Normal (NORM; normal scanning image).
  - Direct magnification image (D-MAG; the magnification of the image on the viewing CRT is same as that indicated on the MAGNIFICATION indicator).
  - Two different images (MDD; simultaneous image display of two video signals by split screen imaging).
  - Y-modulation image with brightness modulation (YZ-MDD).
  - Waveform monitoring (WFM).

- Image display tubes
  - Viewing: 12" high-resolution, long-persistence CRT.
  - Recording: 5" ultrahigh-resolution, short-persistence CRT.

- Image selector:
  - Gamma control and differentiation.
  - Two channels provided. Secondary electron image and high speed reflected electron image (SEI), backscattered electron image (compositional image (COMP), topographic image (TOPO), image by optional detector (AUX)).
  - Reversible, in the two channels.

- Signal polarity:
- Video signal mixing:
  - Possible, in the same channel.

- Data display (operation panel):
  - Accelerating voltage . . . 3 digits, LED display.
  - Magnification . . . 6 digits, LED display.
  - Working distance . . . 2 digits, LED display.
  - Probe current . . . Approx. value (\( \times 10^{-9} \) AMP, LED display).
  - Optimum objective aperture . . . Aperture number (for accelerating voltage and probe current in use), LED display.
  - Contrast . . . LED bar display (for exposure determination).
  - Brightness . . . LED bar display (for exposure determination).
  - Film number . . . 4 digits, LED display. Automatic advance, manual override provided.

- Micrograph data
  - Data display:
    - Viewing CRT (TV, SR and PHOT scan speeds).
    - Recording CRT (PHOT scan speeds).

- Data
  - SEM/SEM1 mode:
  - ECP mode:
  - Accelerating voltage, magnification, micron bar, micron value, working distance, film number.
  - Accelerating voltage, (magnification), rocking angle bar, calibrated rocking angle, working distance, film number.

- Display position:
  - Bottom of the CRT screen.

- Display modes:
  - White characters, white characters on a black background.
  - Magnification erasable.

2.7 Photographic Recording System

- Camera
- Lens:
- Aperture:
  - f: 75 mm, F: 1.8.
  - f/1.8, 2.8, 4, 5.6, 8, 11, 16, 22.
2.8 Vacuum System

- Type: Fully automatic, DP-DP series pumping system.
- Independent venting/pumping: Electron gun (nitrogen gas venting), specimen chamber (nitrogen gas venting) and specimen exchange chamber.
- Nitrogen gas line connection: Possible, with automatic gas shutdown.
- Operating pressure
  - Electron gun: \(10^{-4}\) Pa order
  - Specimen chamber: \(10^{-4}\) Pa order
- Pumpdown time
  - Electron gun: 2 minutes.
  - Specimen chamber: 5 minutes.
  - Specimen exchange chamber: 1 minute.
- Electron gun isolation valve: Built-in, pneumatic drive.
- Specimen exchange chamber isolation valve: Built-in, manual.
- Vacuum gauges: 3 Pirani gauges.
- Vacuum pumps
  - Oil rotary pump: 1, 100 l/min.
  - Oil diffusion pumps: 1, 4", 420 l/s with water-cooled baffle. 1, 2.5", 120 l/s with water-cooled baffle.
- Vacuum reservoir: 1, 10 l.

2.9 Safety Devices

Protection and warning devices are provided against power failure, water failure, vacuum deterioration, nitrogen gas pressure drop and current leakage.

2.10 Installation Requirements

2.10.1 Services
- Power: Single phase, 240/220/200/180V, 50/60 Hz, 6 kVA. Fluctuation: less than \(\pm 10\%\).
- Grounding terminal: 1, 100 \(\Omega\) or less.
- Cooling water
  - Flow rate: 5 l/min or more.
- Pressure: 0.08 to 0.25 MPa (gauge pressure).
- Temperature: 20 ± 5°C.
- Faucet: 1, 14 mm O.D.
- Drain: 3, larger than 25 mm I.D. or 1, larger than 75 mm I.D.
- Dry nitrogen gas: 0.4 to 0.5 MPa (gauge pressure).

2.10.2 Environment
- Installation room: 3000 mm X 3200 mm or more.
- Doorway: 850 mm or more.
- Room temperature: 20 ±5°C.
- Humidity: Less than 60%.
- Stray field: Less than 0.3 μT.
- Floor vibration: Less than 3 μm (P–P).
- Light shield: Necessary.

2.10.3 Dimensions and Weight

<table>
<thead>
<tr>
<th></th>
<th>Width (mm)</th>
<th>Depth (mm)</th>
<th>Height (mm)</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main console incl. column</td>
<td>790</td>
<td>1150</td>
<td>1620</td>
<td>350</td>
</tr>
<tr>
<td>Operation and display system</td>
<td>900</td>
<td>950</td>
<td>1280</td>
<td>130</td>
</tr>
<tr>
<td>Power supply</td>
<td>840</td>
<td>540</td>
<td>630</td>
<td>100</td>
</tr>
<tr>
<td>Pump box</td>
<td>360</td>
<td>240</td>
<td>500</td>
<td>30</td>
</tr>
</tbody>
</table>
Installation layout

Recommended floor area: 3000 mm x 4000 mm (SEM only)
4000 mm x 4000 mm (SEM with wavelength dispersive spectrometer(s))

2.11 Guarantee

This instrument is guaranteed for one full year from the date of completion of installation, except for defects resulting from natural disaster or careless handling. Defects in materials and workmanship will be corrected without charge at the installation site.

Note: These specifications are subject to change without notice due to improvements made to the instrument.
3. COMPOSITION AND CONSTRUCTION

3.1 Composition

The JSM-840 basic unit consists of a column section (incl. console), an operation and display section, a power supply box and a pump box.

The column section incorporates the electron optical column and the vacuum system and the operation and display system incorporates the control panels, display panel, photographic recording system (recording camera and film holder: optional), etc. (Fig. 3.1).

![Diagram of JSM-840](image)

**Fig. 3.1 General view of JSM-840**