

## 600 MULTIPROBE SYSTEM SPECIFICATIONS

### ELECTRON GUN

Source	LaB <sub>6</sub> cathode - field replaceable
Alignment	Via electrostatic deflection & mechanical (micrometer) movement.
Vacuum	The entire optical column is operated in a UHV environment.
Orientation	Coaxial with Auger energy analyzer.
Lens System	Double gap magnetic condenser lens. Magnetic objective lens with externally adjustable aperture.
Beam Deflection/ Stigmation	Via electrostatic octapole plates.
SEM Resolution	< 350Å at 10kV (Dark Space Resolution)
Accelerating Voltage	1.5-25keV continuously variable.
Beam Currents (@10kV)	1×10 <sup>-10</sup> Amps (350Å Beam-Dark Space Resolution) 1×10 <sup>-9</sup> Amps (700Å Beam-Dark Space Resolution)  1×10 <sup>-6</sup> Amps (1µm Beam - 20% + 80% signal levels across a 1500 LPI grid)
Maximum Beam Current	>10µAmp @ 10kV
Working Magnification	100× +100,000× continuously variable.
Working Distance	2.3 cm Sample to CMA 1.1 cm Sample to objective pole piece
Control	Microprocessor control of all gun parameters available through an operator keyboard. Automatic tracking of deflection voltages, stigmator voltages and lens currents.

### AUGER ELECTRON SPECTROMETER

Spectrometer Type	Full cylindrical mirror analyzer (concentric with electron gun).
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Analyzer capture angle	12° - The analyzer is a full CMA and accepts electrons from the full 360° around the analyzer axis. Capture Angle is 42° ± 6° from analyzer axis.
Energy Resolution	0.3% to 2.0% continuously variable and externally adjustable.
Energy Range	0 to 3200eV (Computer controlled)
Analysis Area	1.0 mm diameter @ 2.0% resolution-signal remains within 10% of maximum value.
Detection Mode	Pulse counting for signal levels up to 10 <sup>6</sup> cps, with automatic switching to V/f for higher level signals. N(E) vs E data obtained.
Sensitivity	125,000 cps above background on Cu 920eV peak. Energy resolution @ 0.6% Beam energy @ 10.0kV *Beam Current @ 1×10 <sup>-8</sup> Amps.
Signal to Noise	>80 on Cu 902eV peak. (Acquisition time = 1 sec/pt) Energy resolution @ 0.6% Beam energy @ 10kV *Beam current @ 1×10 <sup>-9</sup> Amps.
(Signal to noise in the pulse count mode defined as s/ B.)	>250 on Cu 920eV peak (Acquisition time = 1 sec/pt) Energy resolution @ 0.6% Beam energy @ 10kV *Beam current @ 1×10 <sup>-8</sup> Amps.

\*Beam current is measured with a +130v bias applied to the target.

### SPECIMEN HANDLING SYSTEMS

The specimen handling consists of the precision specimen stage, specimen introduction attachment, specimen parking attachment, specimen fracture attachment and various stage modules and specimen holders.

### 15630 PRECISION SPECIMEN STAGE WITH 185 AMBIENT MODULE

Module Compatibility	Accepts one 185 Ambient Module, 186 Rotation Module, 187 Heating Module or 188 Cooling Module.
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Number of Specimen Holders/Module

One; accepts 190 Flat Specimen holder, 191 Recessed Specimen holder, 192 Fracture Specimen holder, and 193 Faraday Cup.

Sample Translation

Y-Axis

Orientation: Perpendicular to the mounting flange.  
Travel:  $\pm 1$ cm  
Resolution:  $10 \mu\text{m}$   
Sensitivity:  $.7 \mu\text{m}/\text{degree}$  input  
( $250 \mu\text{m}/\text{Rev}$ )

Tilt Axis

Orientation: parallel to X-axis  
Travel:  $60^\circ$  from vertical  
Resolution:  $.1^\circ$   
Sensitivity:  $.0055^\circ/\text{degree}$  input ( $2^\circ$  Rev)

Z-Axis

Orientation: Perpendicular to tilt axis in vertical direction.  
Travel:  $+ .5\text{cm} - 1\text{cm}$   
Resolution:  $20 \mu\text{m}$   
Sensitivity:  $1.4 \mu\text{m}/\text{degree}$  input  
( $500 \mu\text{m}/\text{Rev}$ )

X-Axis

Orientation: Normal to Y-axis, variable with tilt.  
Travel:  $\pm 1$ cm  
Resolution:  $10 \mu\text{m}$   
Sensitivity:  $.7 \mu\text{m}/\text{degree}$  input  
( $250 \mu\text{m}/\text{Rev}$ )

Position Reproducibility -  $5 \mu\text{m}$

MODEL 190 FLAT SPECIMEN HOLDER

Size 1" diameter with two holddown clips.  
Sample Size Clips hold sample 0.5" wide by 1" long. (Up to 3" diameter specimens may be used on the stage using direct specimen mounting).

MODEL 191 RECESSED SPECIMEN HOLDER

Size 1" diameter with recess and two holddown clips.

Sample Size                      Recess holds sample 1cm wide × 2cm long × 0.5cm thick.

**MODEL 192 FRACTURE SPECIMEN HOLDER (OPTIONAL)**

Sample Size                      Accepts prepared (notched) samples .140" in diameter × 0.85" long.

**MODEL 193 FARADAY CUP**

Aperture Size                    .010" diameter aperture.

Measurement                    Faraday cup connected to ion connector on 15630 stage.

**MODEL 194 BEAM DIAMETER STANDARD**

Grid                                1500 LPI with .004" aperture.

**MODEL 185 AMBIENT MODULE**

Description                      Ambient temperature module.

Compatibility                    Attaches to 15630 stage; accepts one 190, 191, 192, 193 or 194 specimen holders, Faraday cup or beam diameter standard.

Electrical Connections        Target, ion.

**MODEL 186 ROTATION MODULE (OPTIONAL)**

Description                      Ambient temperature rotation module with axis through center of holder.

Compatibility                    Attaches to 15630 manipulator. Accepts one 190, 191, 192, 193, or 194 specimen holders, Faraday cup or beam diameter standard.

Rotation                         Continuous ±180° from sample loading position.

Resolution                       0.1°

Sensitivity                       .0277°/degree input (10°/Rev)

Electrical Connections        Target ion

**MODEL 187 HEATING MODULE WITH 20027 CONTROLLER (OPT)**

Description                      Heating module with internal heater and thermocouple.

Compatibility	Attaches to 15630 manipulator. Accepts one 190, 191, 192, 193 or 194 specimen holders, Faraday cup, or beam diameter standard.
Sample Heating	Provided by Model 20027 controller 100W (4A 25V) max. Thermocouple controlled (Chromel/Alumel) sample holder directly connected to thermocouple.
Electrical Connections	Target (common with TC), Ion, Heater (2), Thermocouple (2).
Temperature Range	Ambient - 600°C operating range.
Temperature Accuracy	±10°C
Temperature Stability	±10°C

**MODEL 188 COOLING MODULE (OPTIONAL)**

Cooling	Internal thermal conductor connected to Model 6, external cryogenic dewar.
Readout	Thermocouple (Chromel/Alumel) (requires separate external meter to read °C).
Compatibility	Attaches to 15630 manipulator. Accept one 190-194 specimen holders, Faraday cup or beam diameter standard.
Temperatures	Ambient or -100°C.
Electrical Connections	Target (common with TC), Ion, thermocouple (2).

**SPECIMEN INTRODUCTION ATTACHMENT**

Number/Type of Specimen Holder	one - holds 190-194 specimen holders, Faraday cup, or beam diameter standard.
Entry Mechanism	Load hatch to put specimen holder on transfer fork. Hand operated probe to push holder into vacuum system.
Specimen Transfer	Holders may be transferred to 15630 stage or 15635 Specimen Parking.
Introduction Time	Less than 10 minutes from air to analysis position for non-outgassing samples.
Pump Controls	Automated pump down and up to air sequencing provided by Auto Valve Control and pneumatic valves.

Pumping	Dual sorption pumps or Turbo molecular pump - 40 $\mu$ /sec air cooled with 1.5m <sup>3</sup> /hr backing pump.
Base pressure	<10 <sup>-3</sup> Torr with sorption pumps. <10 <sup>-4</sup> Torr with Turbo molecular pump.

**MODEL 15635 SPECIMEN PARKING ATTACHMENT**

Number/Type of Specimen Holder	Six - holds 190-194 specimen holders or Faraday cup.
Specimen Transfer	HOLDERS may be transferred to 15630 stage or Introduction Attachment.
Parking Wheel-Travel	2" range
Control	Rotary motion, 0.66" travel/turn
Parking Wheel-Rotation	360° range, detents at 60° for center of each holder.
Control	Rotary motion, 60° wheel rotation/turn

**MODEL 15535 SPECIMEN FRACTURE ATTACHMENT**

Installation	Mounts to 15635 Specimen Parking Attachment.
Specimen Mounting	Accepts specimen mounted in Model 192 Fracture Specimen Holder, on parking wheel.
Specimen Fracture Area	.085" diameter.
Fracture Actuator	Plunger actuated lever for shear fracture.
Cooling Option	Internal thermal conductor connect to Model 6, external cryogenic dewar.
Temperatures	Ambient or -100°C

**SPUTTER ETCHING SYSTEM**

Sputter etching consists of the 04303 Differentially Pumped Ion Gun, 11065 Ion Gun Control, and 04220 Argon Gas Admission System.

Beam Voltage	Up to 5kV variable.
Maximum Ion Beam Current	5 $\mu$ A
Beam Current Density	>600 $\mu$ Amp/cm <sup>2</sup> at 5.0cm from gun (10 $\text{\AA}$ /sec sputter rate on SiO <sub>2</sub> )

Beam Size	800 $\mu$ m to 200 $\mu$ m FWHM, variable at 5.0cm from gun.
Beam Deflection Mechanical	$\pm$ 4mm in X and Y directions via built-in port aligner.
Electrical Static	$\pm$ 0.5 $\mu$ m in X and Y directions via two ten-turn potentiometers.
Raster	Independent X, Y rastering, max. 10mm by 10mm, centered on static beam position.
Gas Inlet	Precise control with precision leak valve (Ar gas used).
Pressure Differential	1000:1 with 40 $\ell$ /sec pumping speed for argon in test chamber ( $<5 \times 10^{-7}$ Torr in test chamber due to argon while sputtering).
Differential Pumping (Optional)	10,000:1 with differential pumping option connected to turbo molecular pump.

#### ELECTRON BEAM SCANNING CAPABILITIES

Control	Microprocessor control of all beam scanning parameters via push button keyboard entry.
Display	TV, storage CRT, high resolution CRT and camera, graphics terminal (Auger spectra, line scans and depth profiles) and dry silver copier (Auger spectra, line scans and depth profiles).
Display Signals	Absorbed current, secondary electron signal and Auger signal, backscattered electron signal.
Scanning Modes	TV, photograph, frame, line, point, positive/negative image, y-modulate, and external computer control.

#### DATA HANDLING SYSTEM

The DP system consists of computers, memory, terminal, copiers, computer interface and software.

##### Hardware

Computer Interface	11/04 with floppy disk storage or 11/34 with hard disk storage interfacing to system through 20137A computer interface.
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Terminal	Interactive graphics terminal HP2629.
Displays	Graphics terminal printer, standard, Optional - Dry Silver Copier or 8 Color Plotter, HP7220T, or 2 Color Plotter HP 7470A.
Software	Model 8072-YV6 for 11/04 system or Model 8072-LV6 for 11/34 system.
Data Acquisition	Foreground/Background acquisition.
Data Processing Routines	Quantitative analysis, smooth, integrate, differentiate, normalization by E, (8951 Curve fit software, optional).
Data Display Routines	Graphics terminal system, display expansion, dry silver copier, scope display (8925 8 color plotter software, optional).

## VACUUM SYSTEM

### Vacuum Pumps

Intro Attachment Rough Pumping	Dual sorption pumps or 40 $\mu$ /sec air cooled turbo molecular pump with 1.5m <sup>3</sup> /hr. backing pump.
Ion Pumps	120 $\mu$ /sec or 220 $\mu$ /sec. differential ion pump with control.
Pump Isolation (Opt.)	Manual gate valve to isolate ion pumps from test chamber.
Sublimation	4 element Ti sublimation pump.
Base Pressure	Test chamber 5 $\times$ 10 <sup>-10</sup> Torr.

### Vacuum Gauges

UHV	Thermionic Ionization (nude ion) Gauge in test chamber with controller.
Roughing	Thermocouple Gauge (intro chamber) read by Auto Valve Control.

### Bakeout System

Ovens	Heating elements integral part of console. External fabric oven shrouds for analysis chamber and pump well.
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Temperature	>100°C
Control	Bakeout timer 0 - 24 hours 50Hz 0 - 20 hours 60Hz

**ENVIRONMENTAL REQUIREMENTS**

Magnetic Fields	Static magnetic field less than 1 gauss; time varying component less than 3 milligauss.
Relative Humidity	Less than 50%.
Temperature*	20°C ± 3°C
Vibration	Not to exceed 10µm at 1-60Hz.
Heat Dissipation	3.7 kW (13,000 BTU/hr.) under typical operating conditions.

**UTILITY REQUIREMENTS**

Electrical System Operation	208/230 V, 50-60 Hz, 30 A, single phase (Hubble #2620 connector supplied).
System Bakeout	208/230 V, 50-60 Hz, 30 A, single phase (to be hard wired by customer).
Liquid Nitrogen	10 l per pumpdown.
Dry Nitrogen	0.3 bar (27 kPa, 4 PSI) maximum.
Compressed Air	8 bar (826 kPa, 120 PSI) minimum.

↑  
*internally regulated @ 80 PSI*

\*Temperature required to achieve reliable system operation. Long-term measurements at very high magnification may require more stringent temperature regulation to avoid drift due to thermal expansion. Electronic control units are typically turned off during system bakeout and during such times should be kept below 30°C.

**SHIPPING AND INSTALLATION**

Shipping Weight	Approximately 2000 kgm (4500 lb.).
Shipping Volume	Approximately 14.2m <sup>3</sup> (500 ft. <sup>3</sup> ).
Laboratory Entrance	0.91 m (36 in.) minimum (access required for system to clear).

Note: The above information is based on a standard system configuration. Utility requirements, as well as shipping weight and volume, may vary with the addition of optional accessories.