

Specification of the tungsten SEM

VEGA3 LMU

(Large Chamber, Extended Motorized Stage, Variable Pressure Operation)

A fully PC controlled SEM with conventional tungsten (optionally LaB₆) heated cathode intended for both - for high vacuum as well as for low vacuum operations. Outstanding optical properties, flicker-free digital image with super clarity, sophisticated user-friendly software for microscope control and image capturing uses Windows™ platform, standard formats of stored images, easy image management, processing and measurements, automatic set up of the microscope and many other automated operations are characteristic features of the equipment.

The Most Important Features:

- ◆ Unique four-lens **Wide Field Optics™** design offering the variety of working and displaying modes embodying the TESCAN proprietary Intermediate Lens (IML) for the beam aperture optimization
- ◆ The proprietary Intermediate Lens (IML) that works as an „Aperture Changer“ makes the exchange of the effective final aperture in an electromagnetic way
- ◆ Real time **In-Flight Beam Tracing™** for the performance and beam optimization integrating the well-established software Electron Optical Design
- ◆ Fast imaging rate
- ◆ The column construction, without any mechanical centering elements, allows fully automated column set-up and alignment
- ◆ High-throughput large-area automation, e.g. automated particle location and analysis
- ◆ Superior specimen handling using a fully motorized compucentric stage
- ◆ Ideal geometry for EDX, WDX, EBSD; non-distorted EBSD pattern
- ◆ Fast and easy obtaining of the clean chamber vacuum by powerful turbomolecular and rotary fore vacuum pump
- ◆ Fully automated microscope set-up including electron optics set-up and alignment
- ◆ Sophisticated software for SEM control, image acquisition, archiving, processing and analysis; multi-user environment localized in many languages
- ◆ Network operations and built-in remote access/diagnostics, all come as the TESCAN standard
- ◆ Unique live stereoscopic imaging utilizing the **3D Beam Technology**
- ◆ Extended low vacuum mode with chamber pressure up to 2000 Pa for non-conducting specimens imaging

TESCAN technologies are protected by patents, for instance US7193222, EP2082413, DE202008018179, CZ 301692, US8779368, CZ305388, EA021273, CZ 304824, CZ305883 and others.

Electron Optics:

Electron Gun: Tungsten heated cathode / optionally LaB₆

Resolution:

High Vacuum Mode (SE):

3 nm at 30 kV / 2 nm at 30 kV

8 nm at 3 kV / 5 nm at 3 kV

Low Vacuum Mode

(BSE, LVSTD): 3.5 nm at 30 kV / 2.5 nm at 30 kV

Magnification:

2× – 1,000,000×

(for 5'' image width in Continual Wide Field/Resolution)

Field of View:

7.7 mm at WD_{analytical} 10 mm

24 mm at WD 30 mm

Electron Beam Energy:

200 eV to 30 keV

Probe Current:

1 pA to 2 μA

Electron Optics Working Modes:

Resolution: High-resolution mode

Depth: Sets the column up in a mode that enhances depth of focus

Field: Optimizes the column to provide a large non-distorted field of view

Wide Field: Provides an extra-large non-distorted field of view for extra low magnification imaging

Channeling: Working mode for assessment of crystal orientation data of the specimen, acquiring of electron channeling pattern (ECP)

Available modes in low vacuum are Resolution and Depth.

Scanning:

Scanning Speed: From 20 ns to 10 ms per pixel adjustable in steps or continuously

Scanning Features: Point & Line Scan

Focus Window – shape, size and position continuously adjustable

Dynamic Focus – in plane or folded plane tilted up to ±70 deg

Image rotation, Image shift, Tilt compensation

3D Beam –defined tilting scanning axis around XY axis

Live Stereoscopic Imaging

Other scanning shapes available through the optional DrawBeam software

Vacuum System:

Chamber Vacuum: High Vacuum Mode: $< 9 \times 10^{-3}$ Pa* (with Tungsten heated cathode/LaB₆)
 Medium Vacuum Mode: 3 – 150 Pa (with Tungsten heated cathode)
 Low Vacuum Mode: 3 – 500 Pa** (with Tungsten heated cathode/LaB₆)
Optional: 3 – 2000 Pa** (with Tungsten heated cathode/LaB₆)

Column Vacuum: $< 9 \times 10^{-3}$ Pa*

Gun Vacuum for LaB₆: $< 3 \times 10^{-5}$ Pa

Pumping Time after Specimen Exchange: typically < 3 minutes

* pressure $< 5 \times 10^{-4}$ Pa can be displayed with optional WRG vacuum gauge (on request)

** with low vacuum aperture inserted

Chamber:

Chamber: Internal dimensions: \varnothing 230 mm
 Door width: 148 mm
 Number of ports: 11⁺

⁺ configuration and number of ports can be modified to customer's needs

Chamber and Column Suspension:

Standard: Pneumatic

Optional: Mechanic (rubber elements) – not available with LaB₆ option
 Active vibration isolation (integrated)

Specimen Stage:

Type: Compucentric, fully motorized
 Movements: X = 80 mm (–40 mm to +40 mm)
 Y = 60 mm (–30 mm to +30 mm)
 Z = 47 mm
 Rotation: 360° continuous
 Tilt: –80° to +80°
 Maximum Specimen Height:
 54 mm (with rotation stage)
 81 mm (without rotation stage)

Note: Range of the movements can be dependent on WD and configuration.

Optional: It is possible to have the manipulator with following X × Y movement ranges: 40 × 40 mm.

Detectors:

Standard:

SE	Secondary electron detector of Everhart-Thornley type (monocrystal scintillator)
Retractable BSE*	Retractable annular detector (scintillator type) for wide-angle back-scattered electrons with high sensitivity and atomic number resolution (0.1)
pA Meter	Probe Current Measurements
Touch Alarm	Stops movements when sample touches any part of the chamber
IR TV Camera	For live „Chamber View“

Optional¹:

Fixed BSE	Annular scintillator type (YAG Crystal) with high sensitivity and atomic number resolution (0.1); non-retractable
LVSTD (up to 500 Pa)	Original patented SE detector of modified Everhart-Thornley type for low-vacuum operations up to 500 Pa
LVSTD (up to 1000 Pa) – N₂ conditions	
LVSTD (up to 1000 Pa) – water vapor/N₂ conditions	
Retractable Dual Scintillator BSE*	Retractable annular back-scattered electron detector scintillator type (YAG crystal) with high sensitivity and atomic number resolution (0.1) equipped with additional YAG crystal from side for enhanced topographic contrast
Retractable 4-Quadrant semiconductor BSE*	Retractable semiconductor back-scattered electron detector for signal acquisition from all four quadrants separately
STEM	Transmitted electron detector; Bright Field and Dark Field imaging
HADF R-STEM**	Retractable version of STEM detector for simultaneous acquisition of the Bright Field (BF), Dark Field (DF) and High Angle Dark Field (HADF) signals
CL*	Retractable panchromatic cathodoluminescence detector, two wavelength ranges available: 350 nm – 650 nm; 185 nm – 850 nm
Rainbow CL*	Retractable color as well as panchromatic cathodoluminescence detection in separate channels. RGB image processing is fully integrated in microscope control software; no external scanning, wavelength range 350 nm – 850 nm
Compact CL	Modified CL detector specially designed for simultaneous CL and BSE detection
Rainbow CL (Compact)	Modified Rainbow CL detector specially designed for simultaneous CL and BSE detection
Al-coated BSE*	Specially designed BSE detector for simultaneous CL and BSE detection
BSE/CL	Combined retractable, 350 nm – 650 nm
EBIC	Electron beam induced current detection

EasyEDX***	Super-integrated O.E.M. EDX microanalyser
EDX***	Take off angle: 35° at WD 15 mm; 30° at WD 10 mm
WDX*****	Take off angle: 35° at WD 15 mm; 30° at WD 10 mm
EBSD***	Electron back-scattered diffraction

* motorized mechanics as an option

** equipped with motorized mechanics

*** fully integrated third party products

**** integrated active vibration isolation necessary

Notice: It is strongly recommended to use Al-coated BSE detector in case of simultaneous CL and BSE detection.

Optional Accessories¹:

Peltier Cooling stage
Beam Blanker for SEM column
Water Vapor Inlet
Load Lock
Control Panel
Optical Stage Navigation
Nanomanipulators

¹Possible combinations of optional detectors and other accessories must be discussed with TESCAN Brno.

Microscope Control:

All microscope functions are controlled by keyboard, mouse and trackball via the program VegaTC using Windows™ platform.

Computer: **PC Standard**
Intel® Core i3-4160 Dual Core 3.60 GHz, RAM 8GB, HDD 500GB, nVIDIA GT730 2GB DDR3, Windows 10 Pro 64-bit, Certification: CE

Option1: **PC High Performance**
Intel® Core i7-4790 Quad Core 3.60 GHz, RAM 16GB, HDD 2TB, nVIDIA GTX960 2GB GDDR5, Windows 10 Pro 64-bit, Certification: CE

Option2: **PC Dell Precision 3620**
Intel® Core i7-6700 Quad Core 3.40 GHz, RAM 16GB, HDD 2TB, AMD FirePro W5100 4GB, Windows 10 Pro 64-bit, Certification: CE, CCC

The manufacturer reserves the right to change the computer specification according to the topical situation in the computer market.

Image Display: 24" LCD HP FullHD

Image Size: 16,384 × 16,384 pixels, adjustable separately for live image (in 3 steps) and for stored images (11steps), selectable square or 4:3 or 2:1 rectangle

Large Panorama Image Size: Unlimited (up to storage capacity)

Image Formats: BMP, TIFF, JPEG, JPEG2000, GIF, PNG, PGM, PPM

Image Depth: Up to 16 bits per channel

Remote Control: Via TCP/IP, open protocol

Automated Operations:

- ◆ In-Flight Beam Tracing™ beam optimization
- ◆ Spot Size and Beam Current Continual
- ◆ WD (Focus) & Stigmator
- ◆ Contrast & Brightness
- ◆ Scanning Speed (according to Signal - Noise Ratio)
- ◆ Gun Heating
- ◆ Gun Centering
- ◆ Column Centering
- ◆ Vacuum Control
- ◆ Compensation for kV
- ◆ Look Up Table
- ◆ Auto-diagnostics

Software extensions:*Standard:*

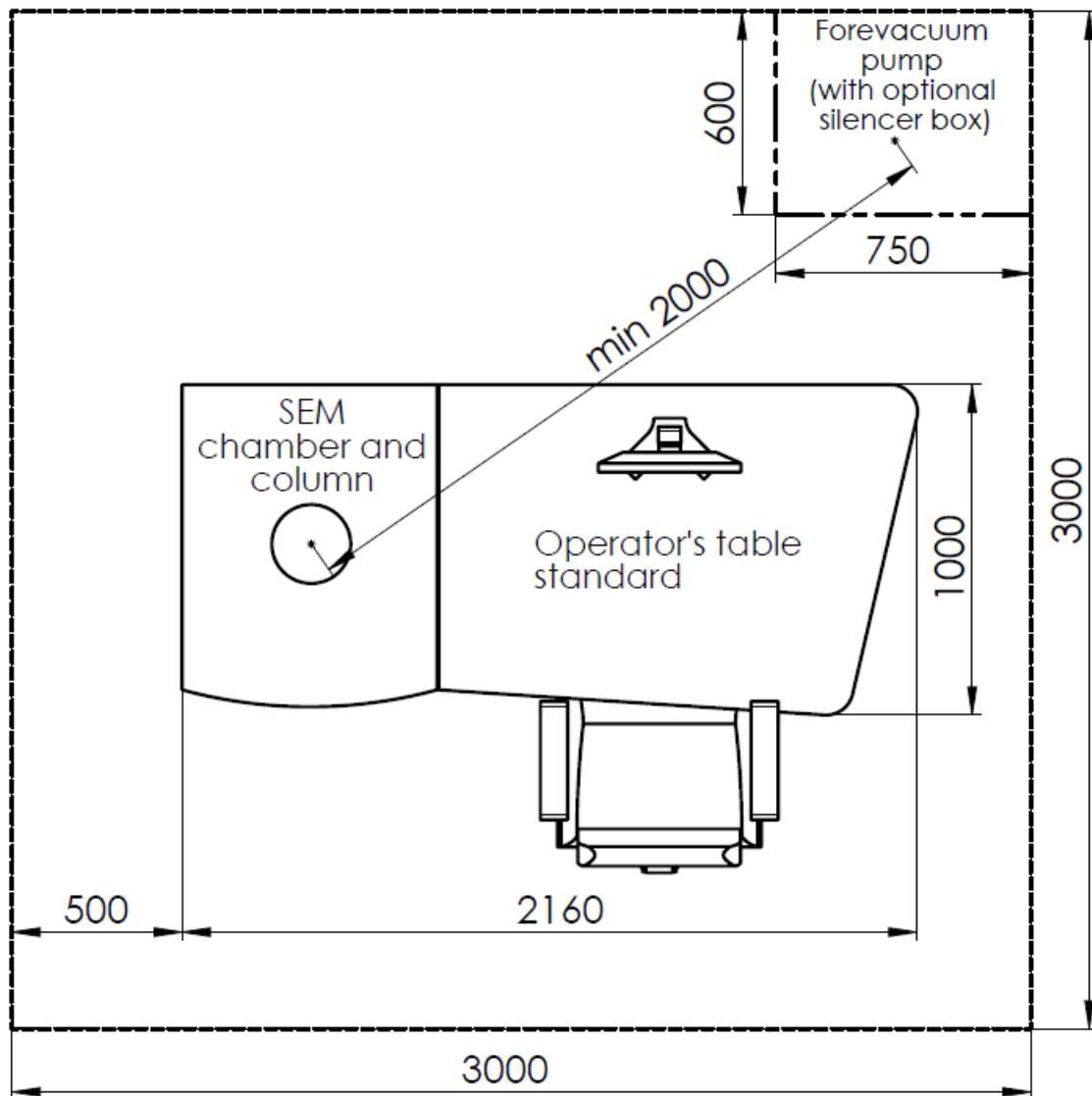
- ◆ Analysis & Measurement
- ◆ Histogram
- ◆ Image Processing
- ◆ 3D Scanning
- ◆ Hardness
- ◆ Multi Image Calibrator
- ◆ Object Area
- ◆ Switch-Off Timer
- ◆ Tolerance
- ◆ X-Positioner
- ◆ Live Video
- ◆ EasySEM™

Optional:

- ◆ Particles Basic
- ◆ Particles Advanced
- ◆ Sample Observer
- ◆ Image Snapper
- ◆ DrawBeam Basic
- ◆ DrawBeam Advanced
- ◆ EasyEDX Integration Software
- ◆ TESCAN TRACE GSR
- ◆ 3D Metrology (MeX)
- ◆ System Examiner
- ◆ Cell Counter
- ◆ Coral (Correlative microscopy module for Life Sciences)
- ◆ SYNOPSIS Client (Correlative microscopy module for semiconductor applications)

For more information about software items see the specification Software Extension Modules.

Footprint of the Microscope (all dimensions in mm):



If a fore-vacuum pump is to be placed in the same room as the VEGA microscope, then it is highly recommended to purchase the TESCAN silencer box together with the microscope.

Installation Requirements:

Power: 230 V \pm 10%/50 Hz (or 120 V/60 Hz - optional), 1300 VA

No water-cooling

Compressed air: 500 – 700 kPa (5 – 7 Bars)

Compressed nitrogen for venting (recommended):
150 – 500 kPa (1.5 – 5 Bars)

Room for installation: min. 3 m \times 3 m; min. door width 0.9 m

Environmental Requirements:

Temperature of environment:

17 – 28 °C (17 – 24 °C for LaB₆ option) with stability better than 2°C with the rate of change 1°C/hour (0.017°C/min)

Relative humidity: < 80 %

Background magnetic field:

synchronous < 300 nT

asynchronous < 100 nT

Vibrations:

For pneumatic suspension:

< 6 μ m/s below 30 Hz

< 12 μ m/s above 30 Hz

For mechanical suspension (option):

< 4 μ m/s below 30 Hz

< 8 μ m/s above 30 Hz

For active isolation (option):

< 12 μ m/s below 30 Hz

< 24 μ m/s above 30 Hz

Altitude: max. 3000 m above sea level

