



Scanning Electron Microscope

VEGA II LSH

Instruction for use

TESCAN, s.r.o.
Libušina tř. 21
623 00 Brno
Czech Republic

Tel.: +420 547 130 411
Fax: +420 547 130 415
E-mail: support@tescan.cz

Operating instruction

Contents

1. Introduction and technical specification
- 2.
3. System description
 - 3.1 Physical part
 - 3.1.1 Function principle of the column VEGA
 - 3.1.2 Description of the imaging modes
 - 3.1.3 Chamber with the specimen stage and detectors
 - 3.1.4 Vacuum system
 - 3.2 Electronics
 - 3.3 Computer
 - 3.4 Software
 - 3.5 Description of the control elements and connection points
 - 3.6 Used symbols
4. Operation

Warning !!!

 - 4.1 Switching-on of the microscope
 - 4.2 Switching-off of the microscope
 - 4.3 Specimen exchange
 - 4.4 Setting-up of the microscope
5. Maintenance
 - 5.1 Cathode exchange
 - 5.1.1 Microscope start after cathode exchange
 - 5.2 Apertures exchange
 - 5.3 Cleaning of the column
 - 5.4 Fuses exchange
6. Transport and storage
7. Instructions for installation
8. Repairs of the machine and using of the spare parts
9. Assembly of the complete delivery

APPENDIX: Possible trouble shooting

1. Introduction and technical specification

Specification of the SEM VEGA II LSH

(High Vacuum Operation, Large Chamber, Motorized Stage)

A fully PC controlled SEM with conventional tungsten heated cathode. Outstanding optical properties, flicker-free digital image with super clarity, sophisticated software for microscope control and image capturing using Windows™ platform, standard BMP, TIFF, JPEG and JPEG2000 format of stored images, enhanced image archiving, 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 for the beam aperture optimization.
- Fast imaging rate.
- Construction of the column is without any mechanical centering elements and using fixed aperture provides comfortable operation and easy maintenance.
- The exchange of the effective final aperture is made in an electromagnetic way - the intermediate lens works as an „Aperture Changer“.
- High-throughput large/area automation, e.g. automated particle location and analyses.
- Superior specimen handling using a motorized semi-compucentric stage, ideal geometry for EDX, WDX, EBSD.
- 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.
- Network operations and built-in remote access/diagnostics, all come as the Tescan standard

Electron optics working modes:

Resolution: automatically configures the column to produce the highest resolution for the chosen working conditions.

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

Field: optimizes the column to provide an extra large non-distorted field of view.

Fish-Eye: provides a “macro” view of the sample.

Rocking Beam: working mode for assessment of crystal orientation data of the specimen, acquiring of electron channeling pattern (ECP).

Resolution: 3 nm at 30 kV

Magnification: 13-1 000 000x in Resolution Mode at 30kV
Min. Magnification in Fish Eye Mode: about 4x

Accelerating voltage: 200 V to 30 kV

Electron Gun: Tungsten heated cathode

Probe Current: 1 pA to 2 μ A

Chamber: Internal Diameter: 230mm
Number of Ports: 11
Door Width: 148 mm

Specimen Stage:

Type: semi-compucentric

Movements: X = 40 mm – motorized (-20 mm to +20 mm)

Y = 40 mm – motorized (-10 mm to +30 mm)

Z = 47 mm – motorized

Rotation: 360° continuous - motorized

Tilt: manual: -75° to +50° from WD 15mm and for eucentric height of the specimen

Maximum specimen height: 60 mm

Detectors:

Standard: **SE** - ET type (YAG Crystal)

Probe Current Measurements, Touch Control

TV Camera for the „Chamber View“

Options: **Retractable BSE** - Retractable annular scintillator type (YAG Crystal) with high sensitivity and atomic number resolution (0.1)

Fixed BSE - Annular scintillator type (YAG Crystal) with high sensitivity and atomic number resolution (0.1), non-retractable

Retractable dual scintillator BSE Detector

Retractable 4-Quadrant semiconductor BSE Detector

TE - Detector

EBIC

EDX* - Take off angle: 45° at WD 23 mm (single EDX) or

35° at WD 15 mm (EDX and WDX simultaneous)

or

45° at WD 23 mm (simultaneous EDX and EBSD

–

Φ_{\max} 100 mm)

WDX* (Oxford - Microspec) - Take off angle 35°, WD 15 mm

EBSD* - Φ_{\max} 100 mm

* - fully integrated third party products

Optional accessories: Peltier Cooling stage
Beam Blanker

Chamber vacuum: < 1×10^{-2} Pa

Column vacuum: < 1×10^{-2} Pa

Pumping time after specimen exchange: typically < 3 minutes

Chamber and column suspension: mechanic – by means of rubber dumping elements

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

Computer: Intel® Pentium® IV Processor 3.0 GHz, 512MB DDR 400MHz, HDD 80 GB, 3.5" Floppy Disk, DVD-ROM (CD-RW), Network Card 10/100, Graphic Card ATI Radeon X550 256MB DDR VIVO, Desktop ATX, Mouse Logitech BJ-58 optical, + Windows XP Pro.

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

Remote Control: Via TCP/IP

Image Display: 19" LCD monitor

Image size: Up to 4 096 x 4 096 pixels, adjustable separately for live image (in 4 steps) and for stored images (9 steps), selectable square or 4:3 or 2:1 rectangle

Scanning:

Scanning Speed - from 200 ns to 10 ms per pixel adjustable in steps or continuously

Focus Window - shape, size and position continuously adjustable

Dynamic Focus, Point & Line Scan

Automated operations:

Vacuum Control

Filament Heating

Gun Alignment

Centering of Resolution mode

Compensation for kV

Probe current optimized for Spot Size

Spot size optimized for Magnification

Scanning Speed (according to Signal - Noise - Ratio)

Contrast & Brightness

Focus & Stigmator

Look Up Table

Software

Measurement

Image Operation

Image processing

3D Scanning

Hardness

Multi Image Calibrator

Object Area

Print Magnification

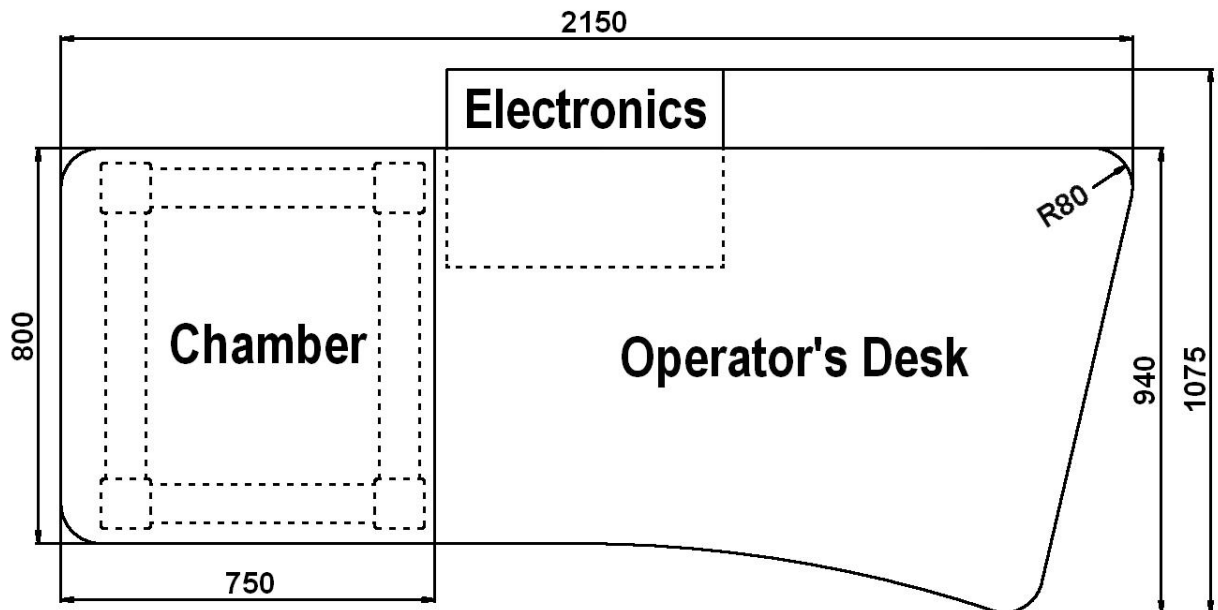
Switch-Off Timer

Tolerance

Morphology
Particle Analysis
Image Snapper
Sample Observer
MouseLink

For more information about software see the specification in the appendix Image Processing and Analysis

Footprint of the microscope (all dimensions in mm):



Installation requirements:

Power: 230 V \pm 10%/50 Hz (or 120 V/60 Hz - optional), 1300 VA
No water-cooling
Compressed nitrogen for venting (recommended): 1.5 – 5 Bars
System dimension: 2.15m x 1.075m
Room for installation: min. 3m x 2.5m

Environmental requirements:

Temperature of environment: 18 – 28 °C
Relative humidity: max 80 %
Vibration: max. 1 μ m
Background magnetic field: max. 3×10^{-7} T

December 2005

We are constantly improving the performance of our products; so all specifications are subject to change without notice.

3. System description

The scanning electron microscope VEGA II consists of four basic parts:

Physical part

Electronics

Computer

Software

3.1 Physical part

It is the physical part of the microscope where the image of the specimen surface and other wanted signals arise. It is that part in which the focused electron beam impinging on the surface of the tested specimen, arises, is formed and deflected. The specimen is placed in the microscope chamber where it can be positioned by means of the manipulator. All the space, in which these processes go off, is evacuated by means of the vacuum pumps. The physical part of the microscope contains then the blocs as follow:

1. Column
2. Chamber with specimen stage and detectors
3. Vacuum system

3.1.1 VEGA II Column

The scanning electron microscope displays a tested object by means of the thin focused electron beam (probe) that is formed and scanned by the microscope column. Most displaying qualities of the microscope depend on the parameters of this electron beam: spot size, angular aperture angle of the incident beam and current in the spot. Spot size determinates resolution of the microscope as well as a usable magnification at the stable picture sharpness. Mostly, it is supposed that the spot is circular and has got Gaussian intensity profile. So we can specify its size e.g. with half-width of intensity distribution. If there are no aberrations of the optical system taken in the account the spot size is determined with the size of the electron source and its demagnification. Practically, the spot size is influenced by the optical aberrations of the final lens - objective. The lens aberrations grow less due to the shortened working distance.

Incident electron beam has a form of a cone, vertex angle of which is determined by the aperture angle. The bigger the aperture angle is, the larger is the cone and the lower is the depth of focus and the defects of the lens are more evident. The aperture angle is smaller at the longer working distance and at the smaller demagnification of the objective lens.

The current of the incident beam is determined by the number of electrons that pass through the probe in the defined time. The current intensity in the probe increases according to the aperture angle as well as spot size. The image noise of the electron microscope depends on number of electrons used for the information acquiring from each picture element. It is necessary to use a longer time for image scanning at the smaller probe current and alternatively.

It is evident that the probe parameters influence each other. Optical system of the microscope allows the operation in the different modes when some parameters of the

beam can be preferred and the other can be kept down. There are some typical examples:

- Operation at the high magnification. It is necessary to reach a high resolution, small spot size as well as aberrations of the lens (short working distance), optimal aperture angle, small probe current and slow scanning speed must be used.
- Operation with high current. Spot size and aperture angle are big, resolution is small, useful magnification is small but faster scanning can be used and the image is without noise.
- Operation with high depth of focus. Aperture angle is to be small, working distance long, demagnification of the lens small, but spot size is big and resolution is small.

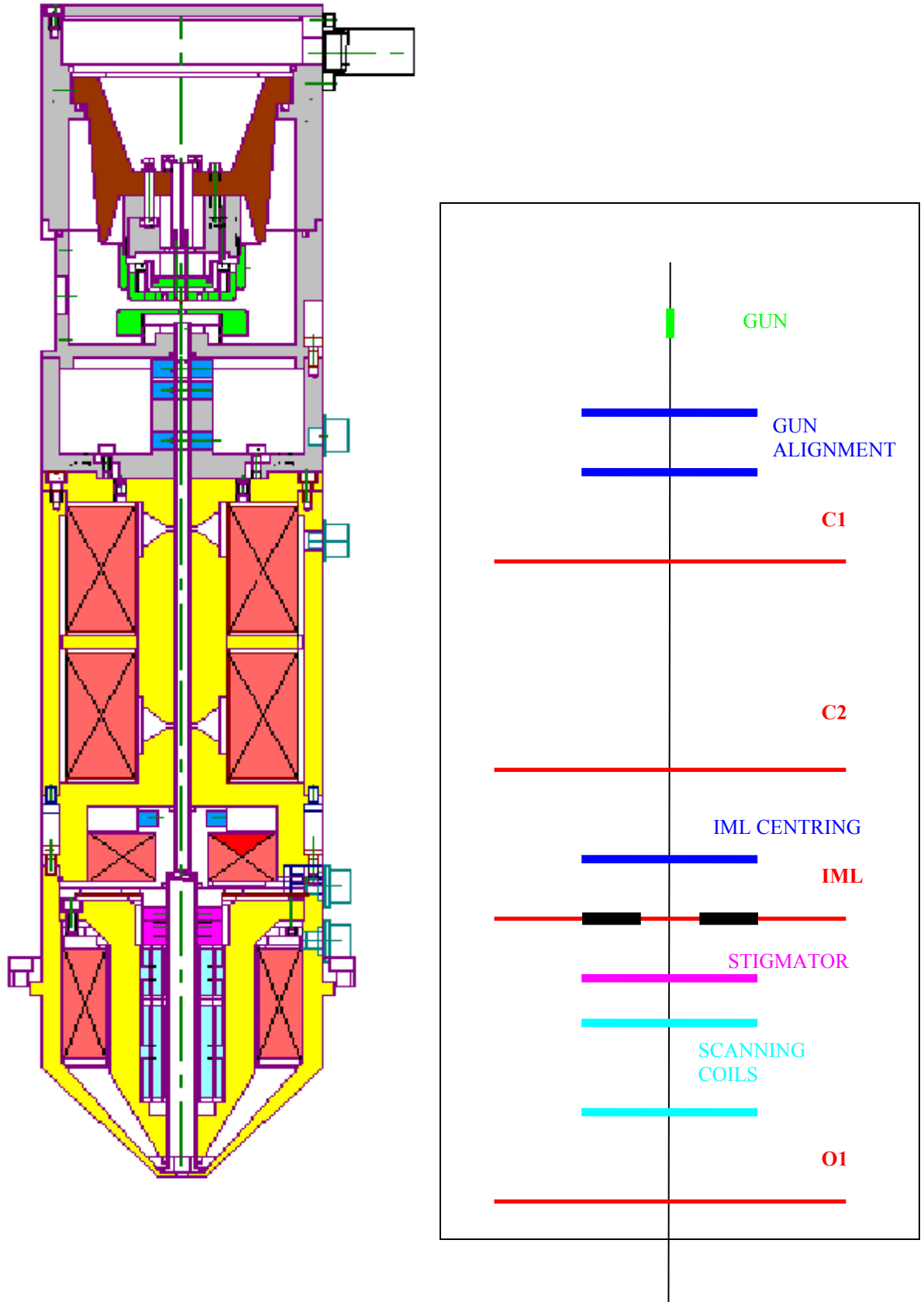
The column of the microscope is an electron optic system for forming and positioning of the electron beam. The column of the microscope VEGA II consists of following main parts:

- **Electron gun** is a source of accelerated electrons. It consists of cathode, Wehnelt cylinder and anode. Cathode and Wehnelt cylinder are connected to the negative electric potential; anode and remaining part of the column are on the earth potential. The cathode is tungsten filament heated on such a high temperature that causes emission of free electrons. The voltage between Wehnelt cylinder and anode determinates accelerating voltage of electrons and so their energy. Electrons flow from the gun is specified with the emission current. The emission current can be changed by putting of the negative potential between Wehnelt cylinder and cathode. The whole gun system works like a „virtual source“ of electrons with following specifications: dimension (25 - 50 μm), electrons energy (200 eV till 30 keV), emission current (till 300 μA) and brightness.
- **The gun centring** is formed by a system of the electromagnetic deflection coils under the gun. It is intended for the tilting of the electron beam emitted from the gun so that it enters in the axis of the optical system of the column. It is controlled by the procedure gun alignment. The gun is correctly centred if the middle, the most intensive part of the electron beam is selected and the brightness of the image is the highest.
- **The spray aperture** is placed under the centring coils of the gun. It is intended for the retaining of the marginal parts of the electron beam emitted by the gun.
- **Couple of condensers C1 and C2.** Condensers are strong magnetic lens for the demagnification of the virtual source. The higher the excitation of the condenser is, the shorter its focal length is and the higher its demagnification is. The wanted demagnification can be reached, mostly, by the various combinations of the demagnification of both condensers according to the chosen mode of the condenser control ZOOM CONDENSER and OPTISPOT (in the displaying mode RESOLUTION). The condensers are controlled by means of the procedure probe current. The smaller the wanted spot size or the smaller the probe current is, the higher the condensers excitation is. The condenser C1 affects the demagnification of the electron source and the condenser C2 also the dimension of the aperture angle.
- **The fixed aperture** cuts to size the resulting incident beam. It is placed in the holder at the end of the central vacuum pipe of the column, about 60 mm under the condenser C2. The optimum size of the aperture hole is 50 μm .

- **The auxiliary lens IML** and the centring coils of this lens **IML Centring**. IML is a weak magnetic lens used for the aperture change of the beam entering to the final lens O1 or for projecting the focused beam on the specimen surface when the O1 is off. The change of the excitation IML causes the shifting of the electron beam also across the optical axis and so it is necessary to compensate this shifting by means of centring coils IML Centring.
- **Stigmator** is electromagnetic, octupole. It is intended for the compensation of the astigmatisms in all the modes.
- **Two stages of the scanning coils** toroidal windings on the ferrite rings. A controlled saw-teeth current power supply is connected to the coils. The saw-teeth frequency determines scanning speed of the electron beam, amplitude determines field of view of the microscope and so the magnification. The saw-teeth amplitude of both scanning coils stages can be controlled separately and so it is possible to change not only the magnification but also position of the „pivot point“, i.e. the point in which the scanning electron beam cuts the axis of the column. It is possible to shift the middle electron beam by the addition of the DC offset to the saw-teeth, independent in the both stages. Scanning coils together with stigmator and connectors form one structural block.
- Objective O1 is the last magnetic lens of the column that forms the resulting electron beam. In the usual modes the excitation of O1 is determined by the working distance, what is the distance between the lower objective pole piece and specimen surface.

The column VEGA II has a fixed aperture placed over the intermediate and objective lenses and scanning coils. It allows a great variability in the choice of different scanning modes.

Fig.1 Section through the column VEGA II and diagrammatic representation of the optical elements



3.1.2 Description of the displaying modes

The basic displaying mode is the mode **RESOLUTION** (Fig.2) when IML is off. In this mode VEGA II works like others common three lens microscopes. The aperture is nearly optimal for short working distances (4 - 5 mm) and accelerating voltage 30 kV at the full excitation C2 and with the aperture hole 50 μm . The pivot points of scanning and electric image shift are close of the principal plane of the objective O1 so that curvature of field, distortion and field of view are as good as possible. The centring O1 is executed by the shifting of the central electron beam parallel to the axis O1. The mode is intended for the displaying with the resolution.

The mode **DEPTH** differs from the foregoing mode by the auxiliary lens IML (Fig.3) being on. This fact causes a reduction of the aperture of the electron probe to the detriment of the spot size. The centring coils are excited so that no shifting of the displayed place occurs at the changing from the mode **RESOLUTION** into the mode **DEPTH**. This mode is used if the depth of focus needs to be higher. The similar effect can be obtained at the three lenses microscopes by the exchange of the aperture.

The mode **FIELD** utilises the intermediate lens IML for the electron beam focusing while the objective O1 is off (Fig.4). The beam aperture is very small and the depth of focus is so big that the image is focused practically in all accessible positions of the specimen stage. As O1 is off in this case, it does not affect the middle beam that need not pass near the centre of the O1. The position of the pivot point scanning is optimised according to the field of view. The centring coils IML Centring are to be excited so that the image is not shifted at the focusing. The DC component of the scanning coils current is set up so that no shift of the displayed place occurs at the switching from the mode **RESOLUTION** to the mode **FIELD**. The disadvantage of this mode is a big spot size; the maximum magnification to be used is some hundreds. The mode is used for the searching for the part of the specimen to be investigated.

The mode **FISH EYE** uses the intermediate lens IML for the focusing of the electron beam while the objective O1 is excited to the maximum value (Fig.5). It causes an increase of the deflection effect of the scanning coils. The aperture of the beam is very small and the depth of focus is so big that the image is focused practically in all accessible positions of the specimen stage. The coils IML Centring serve for minimising the image shift when focusing. The DC component of the scanning coils current is set up so that the field of view is centred in the image at the switching-over. The disadvantage of this mode is big distortion and big spot size. The mode is used for the searching for the part of the specimen to be investigated. It is not possible to define the magnification in this mode.

In the mode **ROCKING BEAM** scanning and lens focusing is controlled so that the electron beam impinges all the time into one point of the specimen surface. Only the angle of incidence of the electron beam - rocking beam - is changed by means of scanning. The obtained image ECP results from the number of back scattered electrons for each particular angle of incident beam. The excitation ratio of the scanning coils is set up so that the beam utilizes the whole area of the objective lens bore and enters the lens parallel to the optic axis. All electron beams parallel to the optic axis are focused by the lens into one point on the specimen surface. As a

consequence the scanning is transformed into beam rocking, i.e. the resulting pivot point of the scanning lies on the specimen surface plane. The intermediate lens focuses the beam into upper focal point of the objective lens. The result is that the beam after its passing through objective lens is parallel and angular resolution of ECP images is maximum. With respect to the fact that ECP images are created by the back scattered electrons signal. The ROCKING BEAM MODE is available at the microscopes working with BSE detector only.

Fig.2 Optical scheme in the mode
“RESOLUTION“

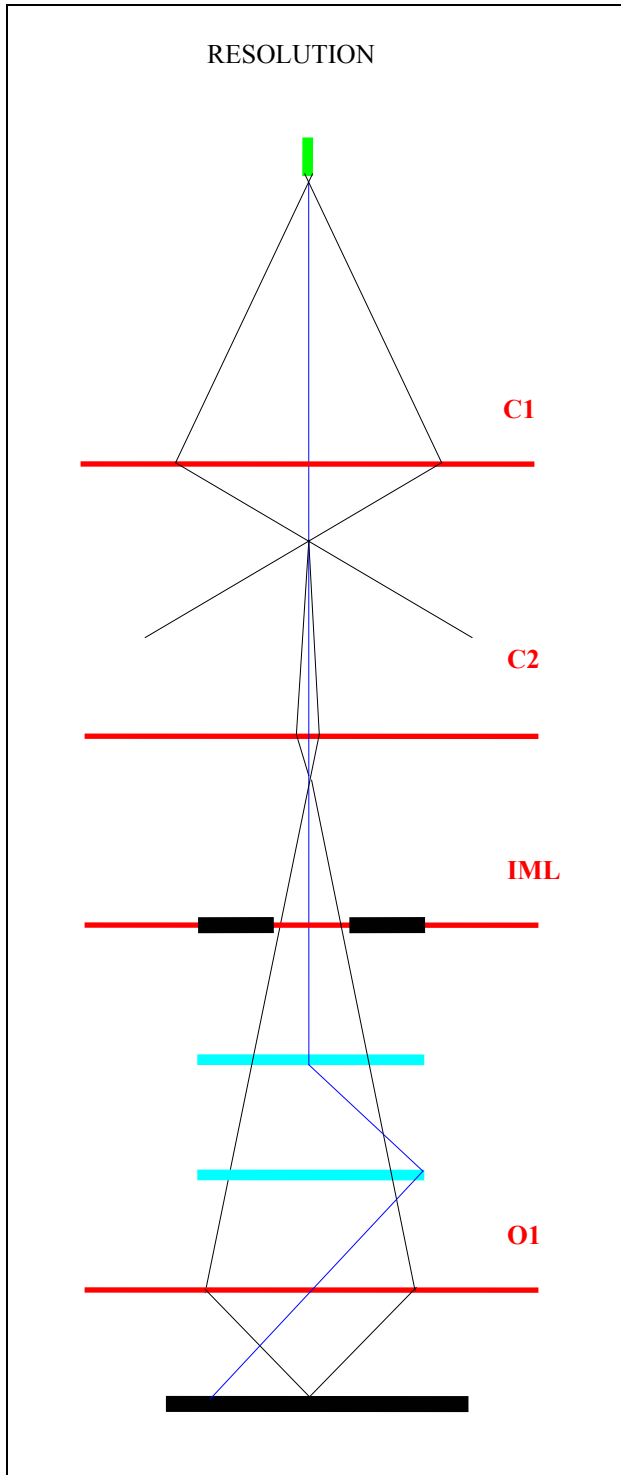


Fig.3 Optical scheme in the mode
“DEPTH“

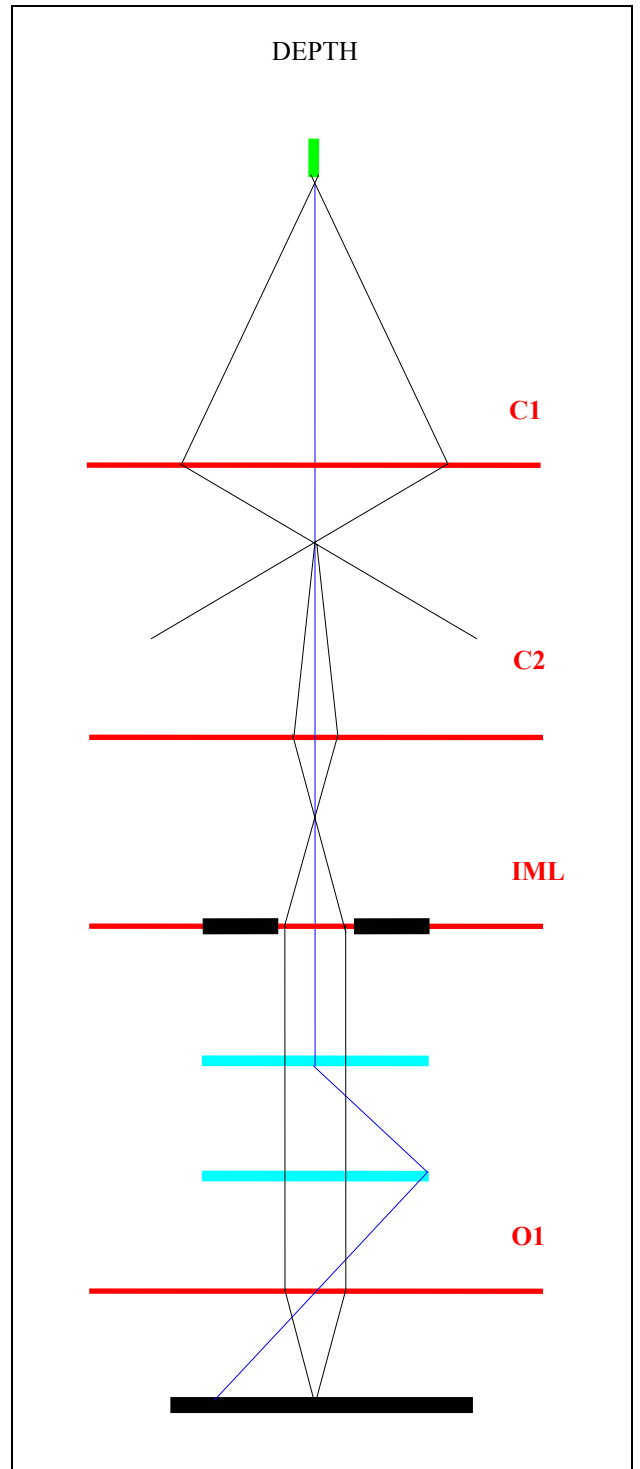


Fig.4 Optical scheme in the mode
“FIELD“

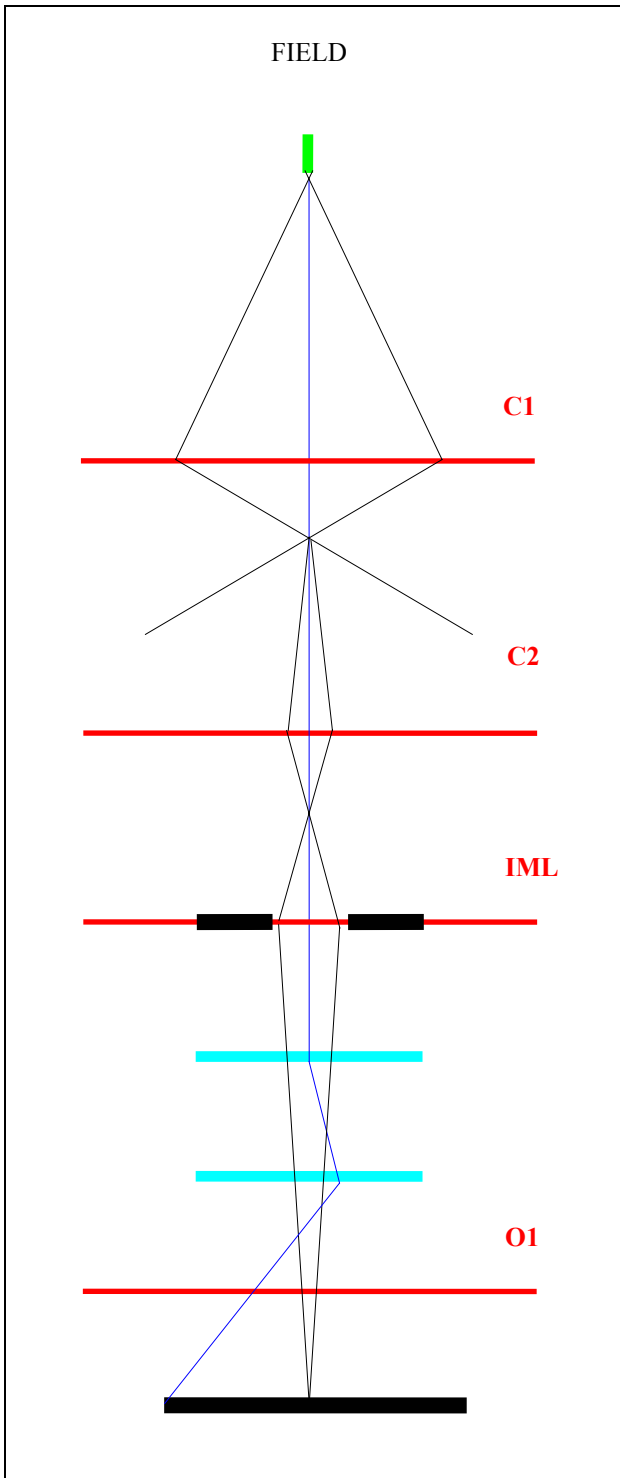
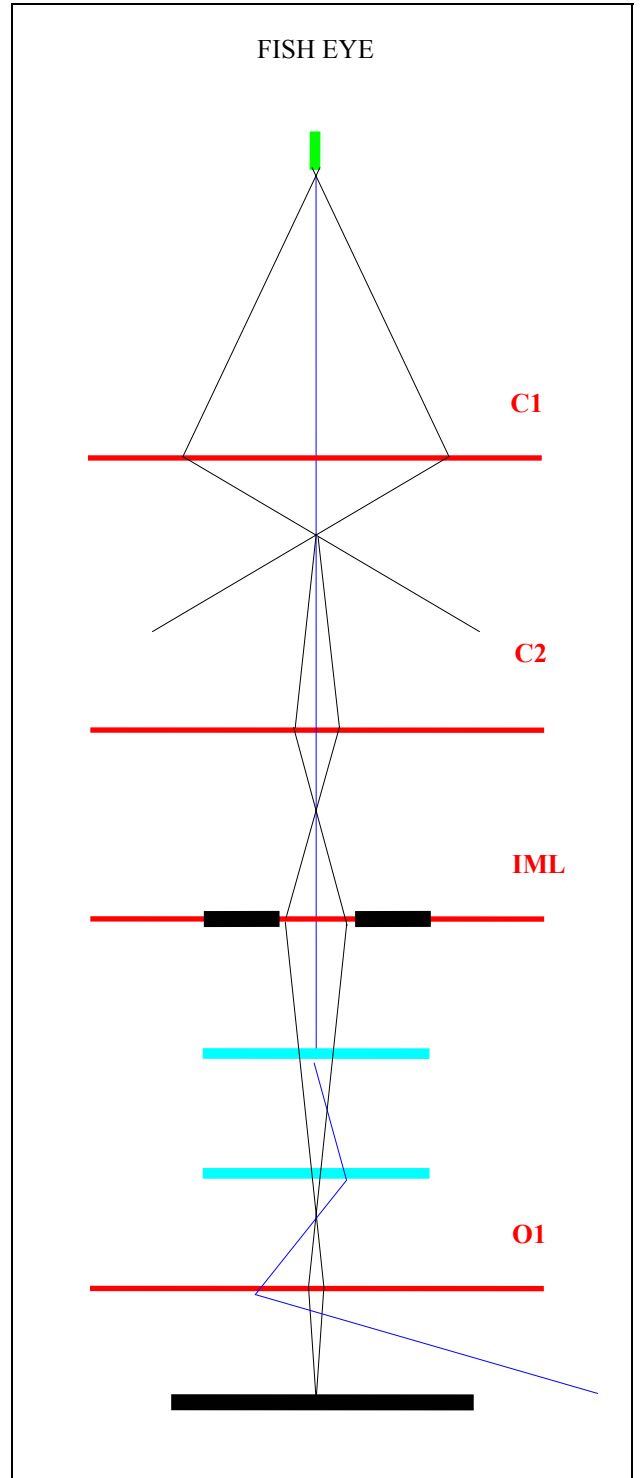


Fig.5 Optical scheme in the mode
“FISH EYE“



3.1.3 Chamber with specimen stage and detectors

The chamber is a hollow evacuated body under the column which the investigated specimen is placed in.

The specimen stage attached to the door on the front side of the chamber is intended for the positioning of the specimen.

- For types of microscopes **VEGA II SBx** the stage allows the shifting of the specimen in both horizontal directions, its rotation and tilting. The vertical shifting of the specimen is done manually. The vertical shifting of the specimen that is intended for the setting up of the working distance and marked Z , is executed by the vertical shifting of the whole manipulator along the chamber door by means of a big vertical knurled knob on the chamber door. The Z' -shifting ensures a precise setting up of the specimen height into the so-called eucentric position, i.e. so that the tilting axis goes exactly through the surface of the observed part of the specimen.

- For types of microscopes **VEGA II LSx/LMx** the stage allows the motorised shifting of the specimen in horizontal and vertical direction, its rotation (for types of microscopes **VEGA II XMx** also motorised tilting). The vertical shifting of the specimen intended for the setting up of the working distance is marked Z and the value Z is displayed on the computer monitor.

The specimen is fixed in an insulated way to the stage so that it is possible to measure the beam current absorbed by the specimen. The delivered pA-meter is fixed on a port of the chamber and interconnected with specimen by means of a coaxial connector. The measured value is displayed on the computer monitor. Besides, the pA-meter works as an audible indicator of the specimen contact with others parts of the microscope - pole piece of the objective, detectors, etc.

Detection system is made by detectors of the products of the electron beam interaction with the specimen surface. The VEGA II is equipped with the detector of **secondary electrons** of the Everhart-Thornley type obligatory. This detector speeds the low-energy secondary electrons that have arisen on the specimen surface, and focuses them onto the scintillator. The light flashes having arisen after the impingement of the electrons on the scintillator are transferred through the light guide to the photo-multiplier outside the chamber of the microscope. The output signal from the photo-multiplier is intensified by the preamplifier, that is mechanically connected with the chamber, before its transferring into the electronics.

Detector of **back scattered electrons**, which is provided for types of microscopes **VEGA II xxU** (optionally for other types), is of the scintillation type. An annular mono-crystal scintillator (YAG) with a conductive surface is placed in the optic axis right under the lower pole extension of the objective. The back scattered electrons with high energy impinging the scintillator without any additional acceleration, excite scintillator atoms that emit visible radiation photons successively. The photons are carried by means of the light guide through the side outlet of the scintillator to the cathode of the photo-multiplier and then are processed like the signal coming from the secondary electrons.

Low Vacuum Secondary Tescan Detector (LVSTD) is intended for types of microscopes **VEGA II xxU**, is described in a separate user's guide.

3.1.4 Vacuum system

Vacuum system ensures the high vacuum in the column and in the chamber that is necessary for the microscope working. The pumping system is double-stage system with rotary and turbo-molecular pump. The system also contains electromagnetic valves that ensure vacuum tight closing of column, chamber space and turbo-molecular pump from the rotary pump in case of stop working of the vacuum pumps or, on the contrary, ensure aeration of this space for the specimen or cathode change or for the apertures cleaning.

The vacuum system is controlled by means of an independent microprocessor electronic unit that communicates with the control computer. A part of the vacuum system is one Pirani gauge for the informative measuring of the vacuum level in the column and in the microscope chamber for the continuous protection of all high voltage power supplies.

- Types of microscopes **VEGA II SBU/LSU/LMU/XMU** are model operating in variable pressure modes (high, medium and low vacuum mode). High and medium vacuum operation mode with differential pumping diaphragm in upper position makes possible to use all working modes of the optical system at the pressure from 5×10^{-3} to 150 Pa. Low vacuum operation mode with differential pumping diaphragm in lower position allows for investigation of specimens in very low vacuum – up to 500 Pa.

- Type of microscope **VEGA II LSU** has hand-operated closing valve which connects or separates the chamber and the pumping piping so that it is possible to reach all high, medium or low vacuum (5 - 500 Pa) in the chamber. Turning the valve controller clockwise and pushing in the direction of chamber axis the valve is closed and the chamber is separated from the pumping piping. Such a state is assigned to the medium and low vacuum mode. In the low and medium vacuum modes the chamber is pumped by means of the rotary pump and the demanded pressure in the chamber is kept by means of the needle dosing valve with stepper motor. Turning the valve controller anti clockwise and pulling away from the chamber axis the valve will be opened and the chamber will be connected with the pumping piping. In this case the vacuum created in the microscope chamber will be the same as the vacuum in the microscope column.

- Types of microscopes **VEGA II LMU/XMU** have closing valve which connects or separates the chamber and the pumping piping so that it is possible to reach high, medium or low vacuum (5 - 500 Pa) in the chamber. The valve is opened and closed automatically by clicking the button named “UNIVAC” in the vacuum system and accelerating voltage control panel. The value of the pressure can be changed in the editing field. When the button “UNIVAC” is on, the valve is closed and the chamber is separated from the pumping pipe to the electron gun. Such a state is assigned to the low and medium vacuum modes. In the low and medium vacuum modes the chamber is pumped by means of the rotary pump and the wanted pressure in the chamber is kept by means of the needle dosing valve with stepper motor. When the button “UNIVAC” is off, the valve is opened and the chamber is connected with the pumping piping. In this case the vacuum created in the microscope chamber will be the same as the vacuum in the microscope column.

- The vacuum system is controlled by means of an independent microprocessor electronic unit that communicates with the control computer. Part of the vacuum system is one Pirani gauge (two Pirani gauges for types of microscopes VEGA II xxU) for the informative measuring of the vacuum level in the column and provides continuous protection of all high voltage power supplies. Second Pirani gauge in the microscope chamber for types of microscopes VEGA II xxU is also used as feedback for the regulation of the pressure in the chamber according to the set up value in the low vacuum mode.

3.2 Electronics

The microscope electronics ensures feeding and control of the physical part of the microscope and amplification and transmission of the useful signals to the computer.

The electronics is composed of several independent units:

Vacuum electronics is a microprocessor controlled unit for the control of the vacuum system. It works independent on the control computer, which it can communicate by means of the serial communication (RS 232) through the communication module with. It generates the signal for the enable high voltage sources working.

Communication module is a part of the electronics that ensures the communication with the PC by means of Ethernet connection. It contains besides data transmitter/receiver (to the computer) circuits for the generating of the control deflection signal and for the digitalisation of the video signal. It controls all following units by means of internal serial communication. It employs two digital signal processors.

Scanning generator produces current signals for the control of the electron beam position. It works with control deflecting signals generated by the communication module or with the external signals for the control of the electron beam position. It contains circuits for electronic ZOOM and for the rotation of the image, electronic shifting of the image and scanning current amplifiers for the driving of the electromagnetic deflection system of the column.

Current sources excite all deflection, correction and focusing electromagnetic elements. They produce the reference voltage for the change of the excitation of all optical elements simultaneously with the change of the accelerating voltage.

Accelerating voltage source is a high voltage source for the electron gun of the microscope. It also contains a current source for the heating of the cathode filament on the accelerating voltage potential and a switch of the bias resistance for the automatic bias of the Wehnelt cylinder.

Small high voltage sources - it is a system of the sources for photo-multipliers and for the scintillators.

Controlling unit for steppers motors is intended for feeding and control of the steppers for the stage shifts X, Y, Z, rotation and tilt. The complete control is executed by means of mouse.

3.3 Computer

The microscope control and the processing of the acquired signals are executed by means of the standard personal computer. The producer reserves the right to change the computer configuration according to the proceeding development of the microscope as well as according to the development of the computer market situation. The client may well also order an extended computer configuration as an option.

3.4 Software

Software is necessary for the control of all microscope functions, for the control of the image acquisition, for its processing and evaluation. The controlling and images evaluating program is a 32-bit application in the operation system Windows 2000™ or Windows XP™. The program is started after the computer starting by clicking on the respective icon marked by the legend VEGA TC. The program service is described in the Help-file of the software VEGA TC.

3.5 Description of the control elements and of the connection points

Main switch key - The main switch key is located in the left upper corner of the column cabinet under the table top. The main switch is **started** by its turning to the right, and **switched off** by its turning to the left. **Attention!** The microscope is connected to the supply mains by means of the plugging in into the feeding socket. After plugging in some parts of the microscope are alive. The proceeding of the starting and turning-off of the microscope is described very detailed in the chapter 4.

Keyboard, mouse, track-ball - are the elements for the control of the microscope by means of the program VEGA TC. They are used according to the practice for Windows™, and according to the description in the chapter 4. „Microscope operation“ as well as in the Help- file of software VEGA TC.

Control elements X, Y - they are located on the chamber door of the microscope and they are intended for the shifting of the investigated specimen in two directions normal each to other in a horizontal plane - range 40 x 24 mm. (Types **VEGA II SBx**).

Rotation control - it is also located on the chamber door of the microscope and it is intended for the rotation of the investigated specimen in the horizontal plane without stop. (Types **VEGA II SBx**).

Control element Z - is located on the upper area of the chamber door and is intended for the vertical shifting of the specimen in the range of 27 mm. (Types **VEGA II SBx**).

Control element Z' - is located on the chamber door and is intended for the setting up of the eucentric position, i.e. of such a position considering elevation of the specimen, when the tilting axis is placed in the specimen surface plane. In that case, the investigated point on the screen does not shift (or shifts precious little) at the tilting of the specimen. **Z'** is so intended for the compensation of the different thickness of the specimens. (Types **VEGA II SBx**).

Specimen tilting - lever control on the chamber door which is intended for the tilting of the stage with an investigated specimen. (Types **VEGA II SBx**, **VEGA II LSx**, **VEGA II LMx**).

Connection points - are sockets on the distribution board in the box of electronics. They are intended for the connection of computer, monitor, printer, and microscope supplementary accessories which can be added to the microscope by the user, and for the feeding of the service instruments like electric soldering gun, measuring instruments, etc. The electric appliances with the consumption higher than that one mentioned on the label at the sockets, i.e. 2A mustn't be connected to the sockets.

3.6 Used symbols

The used symbols correspond to the standard ČSN EN 61010-1 with the exception of the symbol:



It indicates the connectors with high voltage that is not dangerous to the effect of the mentioned standard (the touch can cause only shock).

4. Operation

Warning !!!

The user is liable to make himself familiar with tending of the device and with the safety rules valid in the country of the user. The microscope works with the electric voltages that can be dangerous to life. Any interference with the device above the framework of the operations mentioned in these instructions, especially taking off of the housing and manipulation in the electric parts may be carried out only by the authorised person. It is also forbidden to substitute the parts of the microscope by other parts that are not original and are not delivered by the microscope producer (e.g. the substitution of the original steel blinds on the flanges of the microscope chamber by the light alloy blinds can cause an emission of detrimental ionising radiation!). The microscope is provided with a number of the automatic protections making impossible a wrong handling (e.g. it is not possible to switch on high voltages sources if the specimen chamber or electron gun space are open or are not evacuated to the working vacuum). Putting out of operation of these protections can cause a destruction of the machine, endanger health of the operating staff and for that reason is strictly forbidden.

4.1 Starting of the microscope

1. Push the feeding plug of the microscope into the mains voltage socket. Herewith the microscope is put into the state „Stand by“ when the feeding of the mains transformer in the vacuum electronics panel is connected and so the function of the main switch is allowed.
2. Turn the main switch key to the right. By that the feeding of the whole vacuum electronics, computer, peripheries and electronics communication module is connected through a relay. Wait for the computer loading.
3. Start the program for the microscope control clicking on the icon marked „VEGA TC“. The dialog that asks to order the operator's password. The program VEGA TC having been loaded the microscope electronics will be started and set up into the state of the last program closing by the registered operator.
4. Start the microscope pumping using the procedure mentioned in the VEGA TC software Help-file i.e. clicking the button „PUMP“ in the vacuum system and accelerating voltage control panel that is opened after starting program VEGA TC. In this panel named „Filament - HV - Vacuum“ the increase of the vacuum is indicated by the increase of the indication column as well as the working value attaining is indicated by the change of the column colour from red to green.
5. Having reached the working vacuum start the accelerating voltage using the procedure mentioned in the VEGA TC Help-file (clicking the button „HV“ in the vacuum system and accelerating voltage control panel). The following fine tuning of the cathode heating intensity as well as the set-up of the whole device

are mentioned in the said Help-file. It is recommended to use the automatic procedures. If the registered operator is filed in the group „Basic“ the procedures of the interactive set-up are not accessible for him. Transfer to another user category can be executed only by the user of the category „Supervisor“).

Notices:

- If you leave the driving program VEGA TC, microscope electronics will stay on to keep working condition of the microscope steady. The microscope can be switched off by means of the OFF button located on Filament-HV-Vacuum panel.
- The program for the microscope control can run together with the other programs so that it is usual in MS Windows™. The control computer can be used as for the control of the microscope as for the other activity (for ex. characteristic X-ray analysis, processing of saved images, documents edition, etc.) The multiple starting of the program VEGA TC is forbidden.

4.2 Stop of the microscope

1. Switch off the accelerating voltage by clicking on the button HV in the panel for the vacuum and accelerating voltage control. The state „off“ is indicated immediately but the procedure off switching is controlled by program and lasts several second.
2. Switch off the vacuum system by clicking on the button OFF in the part of the vacuum control of the same panel. By that the valve between the rotary pump and the turbo-molecular one will close and both pumps switch off without venting of the column and of the microscope chamber. The OFF button also automatically closes the program „VEGA TC“. It causes the saving of the last set-up and configuration of the microscope on the hard disk.
3. Shut down the PC as it is usual for operating system Windows XP™.
4. Turn the main switch to the left.
5. Pull the plug from the socket.

Note:

The switch off of the microscope by means of the simple breaking of the power supply i.e. by the switching off by means of the main switch key or by pulling the plug from the socket may be used only in the reasonable (emergency) cases.

4.3 Specimen exchange

The specimen should get stuck or be fasten otherwise to the delivered stub in the form of a disc with a stem for being fastened in the manipulator stage before being put into the microscope. The standard diameter of the delivered stubs (specimen holders) is 12.5 mm. The surface of the explored specimen must be conductive or must be made conductive using one of the methods described in the technical literature. The conductive surface of the specimen should be contacted to the stub.

1. Vent the microscope using the procedure mentioned in the VEGA TC software manual (Help-file), i.e. by clicking on the button named „VENT“ in the panel of the vacuum system and accelerating voltage control. In this panel there is indicated the increase of the pressure in the column space by means of the lowering of the indication column.
2. Set up the specimen tilting on the value „0“, shifting X, Y approx. in the middle of the shifting ranges and shifting Z must be 10 mm at least.
3. Pulling back draw the door of the chamber with the specimen manipulator up to stop.
4. Using the delivered hexagonal key size 1.5 mm from the accessories loose the stub stem of the specimen that you want to change (it is possible to fasten till six specimen holders in the holes on the circle and/or one central holder). Afterwards pull up the holder using tweezers.
5. Put the stub with a prepared new specimen and using the key 1.5 mm tighten the stub stem by means of the screw in the hole on the stage side.
6. Push the door with the manipulator till the chamber. Do it carefully so that the specimen or another part of the manipulator does not touch the detector or the pole piece of the lens. Check it visually. The specimen holder is not conductively connected with other microscope parts, in case of conductive connection (i.e. specimen contact with other microscope part) it is indicated by a special electric circuit.
7. Evacuate the chamber and the microscope column using the procedure mentioned in the VEGA TC software manual, i.e. clicking on the button named „PUMP“ in the panel of the vacuum system and accelerating voltage control. In this panel there is indicated the increase of the vacuum in the column space by means of the increase of the indication column as well as the reach of the working value by changing the indication colour from red to the green.

4.4 Setting up of the microscope

The image from the microscope is always loaded with the optical aberrations. Some of these aberrations can be corrected by means of the adjusting and correcting optical elements. Their correct setting influences the quality of the image.

The microscope VEGA II is delivered after setting with the possibility to set up the whole system according to the configuration that is saved by the producer on the disc of the computer any time. Besides, each registered user has an opportunity to save his configuration of the microscope setting that can be called automatically or after ordering, if it is one of the saved special working modes of the device.

The qualities of the optical system can be changed because of the change of the mutual position of some important elements during the operations made by the user like e.g. the cathode filament exchange or aperture exchange and the setting up of the microscope is to be corrected. Besides, some special working modes of the device need different setting up of the optical system than the basic one. The setting up is done exclusively by means of electromagnetic setting elements controlled by the computer program. The sole mechanical setting element - lateral shift of the electron gun is set in the producer factory and its adjustment may be executed only by the

authorised service specialist. The setting procedures are largely automated. Besides an automatic setting each setting element can be set in an interactive way by means of setting elements on the desk top of the monitor. The access to the interactive setting of some elements is allowed only to the selected users. The users are divided according to the allowed access to the setting elements into the groups - Basic, Expert, Supervisor, Service, and Guest. The users can be classified in the groups only by the users from the category Supervisor. A detailed description of the control elements and of the setting procedures is mentioned in the VEGA TC software manual (the Help-file).

5. Maintenance

5.1 Cathode exchange

The microscope VEGA II uses an electron gun with direct heated tungsten cathode filament. The cathode filament will be consumed during the microscope running and after certain time will be burnt. The filament life depends above all on the used emission current and on the vacuum conditions and is about 100 till 150 hours of running. The cathode exchange is the operation made by the user. It is necessary to exchange or clean the Wehnelt cylinder aperture every time by the filament exchange, and if a need there is, to clean the anode.

It is necessary to keep the principles of the vacuum hygiene during the filament exchange. Dismantling and mounting of the gun is to be done in a clean, dust-free environment, if possible, and using gloves.

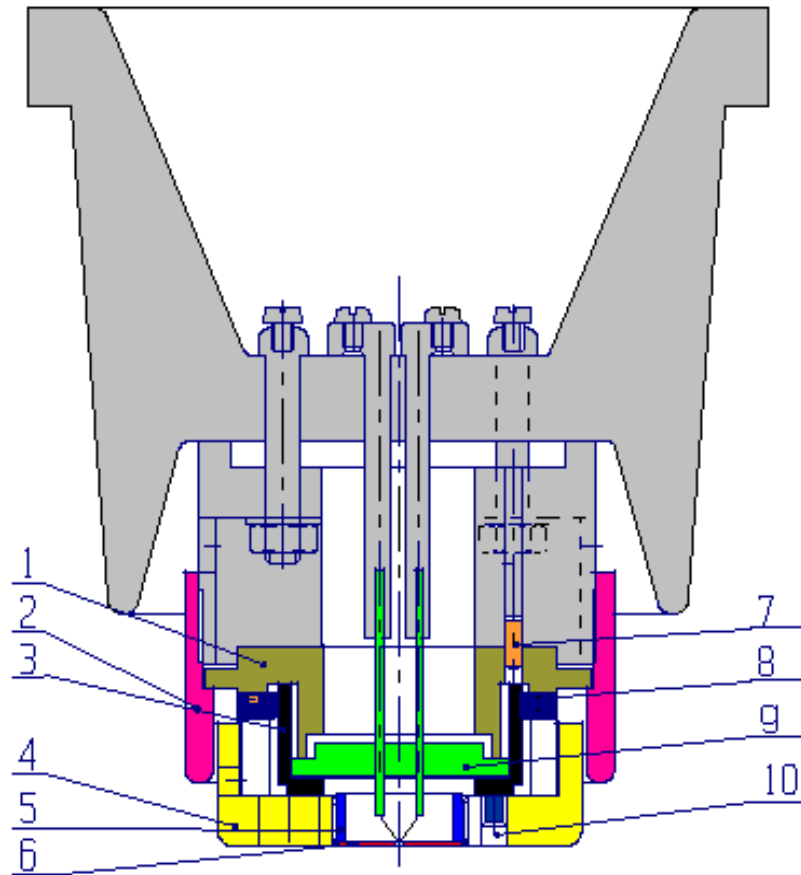
Cathode exchange proceeding:

1. Check, if the cathode filament is really burnt, i.e. the emission current does not flow at the switched on high voltage and usual stage of the cathode heating and at the not zero emission current (see „Filament-HV-Vacuum“ panel).
2. Switch off the accelerating voltage (by clicking on the button HV).
3. Vent the microscope (the button VENT).
4. Pulling upwards take off the electron gun and put it cathode being upwards.
5. Protect the open part of the column against dust using for ex. PE or AL foil.
6. If the electron gun body is hot after the previous running, let it become cool for some minutes.
7. The gun system dismantling is to be made according to the picture no. 6.
8. Screw off the polished stainless cap nut (2).
9. Take the polished stainless Wehnelt cylinder (4) and pulling away from the ceramic insulator take out the movable part of the gun and put it into the jig for filament centring. The jig is a part of the microscope accessories. The guide pin (7) must fall into the jig hole.

Note: You can make you sure that the filament is burnt by measuring of the resistance between the pins of the filament holder (9) before the dismantling of the Wehnelt cylinder.

10. Using the hexagonal key 1.5 loosen four securing bolts (10) on the face of the Wehnelt cylinder (4) by about one revolution.
11. Screwing anti clockwise direction screw off the Wehnelt cylinder (4).
12. Using a special key from the accessories screw off the securing nut (5) of the aperture (6) from the inside of the Wehnelt cylinder. Take out the aperture. In case, the Wehnelt cylinder is contaminated, clean it.
13. Insert the cleaned aperture or the new one (6) into the Wehnelt cylinder (4) and screw the securing nut (5) so that the aperture remains free. Put the aperture centring jig from the accessories into the securing nut. The cone in the jig axis must pass through the aperture hole. Using a special key lock the aperture by turning the nut (5) as well as the centring jig in clockwise direction up to stop. Take off the centring jig.
14. Loosen four centring screws (8) by about half revolution and using tweezers take out the centring piece (3) and filament holder (9).
15. Put in the holder with a new filament (9) and centring piece (3) so that flats on the external periphery of the piece point against the centring screws (8). Retighten slightly little by little the centring screws (8) by about half revolution.
16. Screw on the Wehnelt cylinder (4) carefully again. The filament top should be seen in the aperture hole (6) during the tightening. The following operations have to be executed using a magnifier or stereo-microscope.
17. Centre the filament top in the hole tightening and loosening two opposite centring screws (8) by means of two screwdrivers in both directions.
18. Set up the filament height as follows: Screwing the Wehnelt cylinder set up the filament top on the level of the aperture (6). Loosen the Wehnelt cylinder by half revolution. Tighten slightly the securing bolts.
19. Repeat the filament centring according to the point 17.
20. Lock the filament holder tightening the centring screws (8) as well as the securing bolts (10).
21. Take out the movable part of the gun from the jig and insert it into the fixed gun part. Doing that, start with inserting the filament holder pins into the tubes in the fixed gun part. The guide pin (7) must fall in the opposite hole.
22. Fix the movable part of the gun by screwing in the cap nut (2).
23. Clean the gun body and gun chamber using the pressure dry air or nitrogen. Put the gun on the column.
24. Evacuate the microscope (the button „PUMP“ in the „HV & Filament & Vacuum“ Panel).
25. Enter „Filament Change“ in the menu VEGA II in order to reset filament running hours.

Fig.6 Electron gun



- 1 ... Body of the movable part of the gun
- 2 ... Cap nut
- 3 ... Centring piece
- 4 ... Wehnelt cylinder
- 5 ... Aperture securing nut
- 6 ... Wehnelt cylinder aperture
- 7 ... Guide pin
- 8 ... Cathode centring screws
- 9 ... Holder with a filament
- 10... Locking bolts

5.1.1 Microscope start after cathode exchange

1. Select the maximal accelerating voltage 30 kV and switch it on. Watch the stability of high voltage value, in case of any discharges wait approximately 10 minutes, discharges should cease. When the high voltage gets stabilized click on the button AUTO on Filament – HV – Vacuum panel to start procedure for automatic heat up of the cathode (cathode heating intensity will be increased till the saturation, i.e. to the zone where the further heating current increasing does not increase the emission current) and auto gun centring, the brightness and contrast of the image will be automatically optimised at the end. When procedure is finished watch the stability of the emission current. In case of any instability, the current should stabilise in a few minutes. In cases of high voltages or emission current constant instabilities, the surface of the Wehnelt cylinder or that one of the anode is dirty or in space of the gun chamber there are dust particles and it is necessary to clean it.
2. Check the parameter of the emission current under the conditions: 30kV, bias Middle, PC 10 and move the empty stub under the objective. The value of the emission current should be within the limit 65 – 85mA.
3. If the parameter is in the limit, the microscope is in general ready to use.
4. In case the parameter of the emission current is bigger than 85mA, the distance between top of the filament and the level of the aperture is too small and it is necessary to adjust it. It is needed to slightly loosen the Wehnelt cylinder. In case the parameter is smaller than 65mA, it is needed to slightly retighten the Wehnelt cylinder.
5. In case of work within another range of high voltages, cathode needs to be heated up and centred as well. Follow the same steps as described in the previous paragraph.

Notes:

1. The cathode exchange and the gun set up after the exchange is allowed to the users of the category Expert and higher.
2. The life-time of the cathode filament depends mainly on the following circumstances:
 - a) Vacuum conditions. A too short life-time of the filament is caused mostly by a bad vacuum in the gun space. That is why we recommend not to start the accelerating voltage immediately after vacuum has been reached („VACUUM Status: READY“), but to wait for some minutes after reaching critical vacuum.
 - b) Intensity of the heating current. It is convenient to use the low emission currents for the routine work, because the saturation is reached at the lower heating current. Check the correct filament heating often. A slight cathode sub-heating can prolong the cathode life considerably and it is recommended to use it with exception of scanning images at the extremely high magnification.

5.2 Apertures exchange

The VEGA II microscope column is fitted with two apertures. The upper one - spray aperture (500 µm) is located directly over the condenser C1, the lower one - final aperture (50 µm) is located at the end of the central vacuum tube (liner), about in the middle of the lens IML. Both apertures are in the aperture holders that are inserted in the central vacuum tube.

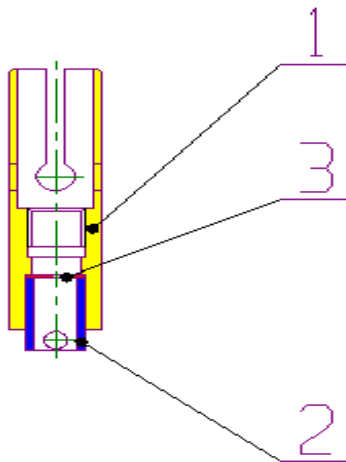
The apertures become contaminated during the microscope running, which can cause the decreasing of the optical qualities of the column. That is why the apertures need to be cleaned or exchanged from time to time.

Apertures exchange proceeding:

It is necessary to keep the principles of the vacuum hygiene during the filament exchange. Dismantling and mounting of the gun is to be done in a clean, dust-free environment, if possible, and using gloves.

1. Vent the microscope (the button VENT).
2. Pulling upwards take off the electron gun and put it cathode being upwards.
3. Screw off the anode turning anti clockwise direction.
4. Insert the setting rod from the delivered accessories into the central vacuum tube and lower it carefully till you come to the spray-aperture holder. Turning the setting rod in the clockwise direction screw on the thread at the end of the setting rod into the spray-aperture holder and pulling upwards take out the spray-aperture holder. Screw off the holder from the rod.
5. Using the same proceeding take out the aperture holder.
6. Dismantle the apertures holders as follows: Put the curved tweezers points into the holes in the holder inside spring collet (2) that protects the aperture (3) against falling-out and pulling away take it out from the aperture holder body (1).
7. Shake out the aperture.

Fig.7 Aperture holder



8. Put the aperture holder body on the pad, the cut side being down. Let go the cleaned aperture or the new one in the hole. Check, if the aperture is placed the side with the bigger hole being upwards. Having put the holder in the tube of the column, the aperture is placed the smaller hole being upwards, as shown in the picture 8. Contrariwise turn the aperture knocking the holder at the pad. Take the spring collet (2) with the tweezers and pushing it into the aperture holder body (1) ensure the aperture (3) against falling-out. Check the cleanness of the both

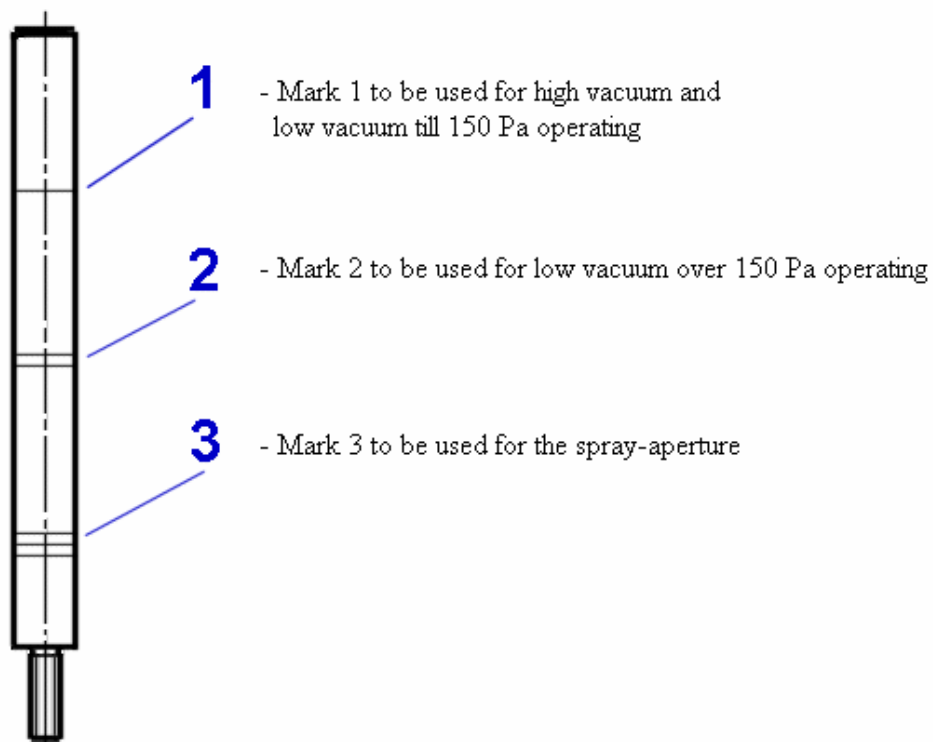
aperture sides surface using the optical microscope; if necessary clean the aperture using pressure dry air or nitrogen.

Fig.8 Aperture



9. Screw the aperture holder on the setting rod and insert it in the central vacuum tube till the mark 1 or 2 (according to vacuum mode).

Fig.9 Setting rod



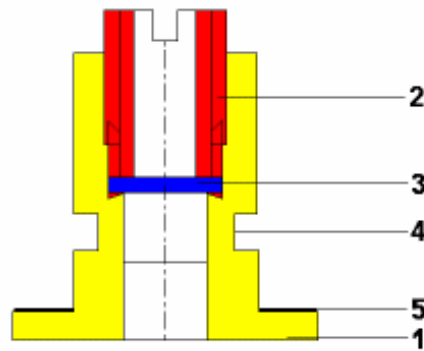
10. Likewise insert the spray aperture holder in the central vacuum tube till the mark 3.
11. Screw on the anode and tighten very slightly.
12. Clean the gun body and the gun chamber using pressure dry air or nitrogen. Put the gun on the column.
13. Evacuate the microscope.

Final aperture exchange proceeding in Low vacuum mode for types of microscopes **VEGA II xxU**:

1. Put the aperture holder body on the pad, the wider part being down (1). Let go the cleaned aperture or the new one (100 μm) in the hole. Check, if the aperture is placed the side with the bigger hole being upwards. Having put the holder in the tube of the column, the aperture is placed the smaller hole being upwards, as

shown in the picture 10. Contrariwise turn the aperture knocking the holder at the pad. Take the collet (2) with the tweezers, the collet thread being up and screw it in the aperture holder body (1) to ensure the aperture (3) against falling-out. Check the cleanness of the both aperture sides surface (preferably using the optical microscope) if necessary clean the aperture using pressure dry air or nitrogen.

Fig.10 Aperture holder VP



2. Fit the sealing ring in the groove of the holder body (4). Similarly fit the pad in the holder body (5).
3. Before inserting of the aperture in the objective, move out the BSE detector.
4. Open the door of the chamber and insert the aperture holder into the objective, the wider part being down.
5. Take out the aperture holder by using screw what is piece of equipment. Drive the screw in the aperture holder and pulling down take out the aperture holder.

Enter [Change Uni Mode](#) in the menu VEGA II in order to store vacuum mode exchange.

Enter [Change Aperture](#) in the menu VEGA II in order to store the time of the exchange.

The apertures become contaminated during the microscope running, which can cause the decreasing of the optical qualities of the column. That is why the apertures need to be cleaned or exchanged from time to time.

Note:

It is possible to take out also the central vacuum tube of the microscope after the taking out of the apertures in order to do the cleaning. Insert the curved points of the tweezers from the delivered accessories into the holes at the upper end of the vacuum tube and pulling upwards take out the tube. Mounting again push the tube nice vertically so that the tube does not become bent.

5.3 Cleaning of the column

The contamination on the inner vacuum surfaces of the column appears during the microscope operation and decreases the qualities of the microscope. That is why it is necessary to clean the vacuum surfaces from time to time. It is possible to divide the impurities according to their origin into the following groups:

- Organic, badly conductive covers, arising by means of the interaction of the organic residual gases in the vacuum with the electrons. These coatings appear along the whole way of the primary electrons. They cause a bad electric conductivity and so the charging of the apertures and of the specimen surface.
- The tungsten coats arise by steaming and de-dusting of the tungsten from the tungsten cathode filament. They impair the electrostatic strength of the system cathode - Wehnelt cylinder - anode; they cause leakage of the heating current and micro-discharges in the electron gun.
- Dust particles retained on the internal surfaces. They enter into the microscope with every venting during the exchange of specimens, apertures or cathode. Dust particles retained on the apertures make the optical qualities worse.
- Impurities taken into the microscope by incorrect proceeding during the exchange of apertures, cathode filament or specimen.

The frequency and the way of the cleaning depend on the definite part of the optical system, on the kind of the impurities and on the operation conditions. The following frequencies of the cleaning are recommended for the usual operation:

- Wehnelt cylinder aperture - at every cathode filament exchange
- Wehnelt cylinder, anode - according to the need, if the emission current is unstable, if there is an emission current without filament heating, if there are discharges of the high voltage in the gun
- Aperture - at worsened optical qualities i.e. if the astigmatism appears, if there are changes of the values for lens centring, if there are very different values of the microscope setting for the different accelerating voltage, etc.
- Spray-aperture, aperture holders, vacuum tubes - once in 3 till 6 months
- Other parts - at the service examination

The cleaning of the de-mountable parts of the microscope:

All parts of Wehnelt cylinder including Wehnelt aperture, spray aperture (500 μm , molybdenum aperture), aperture holders, anode:

1. Dilute the fine abrasive powder (for example dishwasher powder) in distilled water and put the parts for 20 minutes to ultrasonic washing machine.
2. After this, wash the parts in the pure distilled water.
3. In the end wash the parts in the ultrasonic washing machine filled with isopropyl alcohol for 10 minutes.

Final aperture (50 μm , platinum aperture) and final aperture for LV (100 μm , platinum aperture):

1. Final apertures clean in the ultrasonic washing machine filled with isopropyl alcohol.

2. Anneal apertures in alcohol burner, use only alcohol, to prevent product of combustion to pollute aperture.

Vacuum tube:

1. Bring a small quantity of the fine abrasive powder on the roll of wool or cloth (the best is the cloth without fiber) looped over skewer and mechanically clean the internal faces of the vacuum tube.
2. Carefully clean the small hole, for example by brush.
3. In the end wash the tube in the pure distilled water and isopropyl alcohol.

Note: Dry the parts before their mounting by using compressed air or nitrogen; the assembly has to be done using gloves.

5.4 Fuses exchange

The device has no fuses that might be exchanged by the user. All fuses of the device are protected with the covers that may be taken off by the service engineer of the producer or of the authorised service company only. It is not allowed to replace the fuses with that ones of types and values that differ from the data in the documentation and on the fuse holder.

6. Transport and storage

The transport mode is stipulated in the delivery contract and depends on the territory where the microscope will be delivered. It must be always agreed with the microscope producer. The device is delivered partly disassembled and packed. Taking over the transport cases from the transport company the buyer is obliged to check their state and if they are damaged to write the protocol of damage and inform the seller and the producer. The packed device has to be stored in dry and clean rooms with the temperature of -20°C till $+40^{\circ}\text{C}$ and must not be exposed to the effects of the aggressive agents causing corrosion (acids vapours, etc.).

7. Instructions for installation

The microscope is delivered only including installation. It is necessary to order the installation at the seller of the microscope and to confirm the readiness of the laboratory for the installation. After that, the technicians of the producer or the charged service company do the installation of the machine, its connecting to the supply mains and user's training. It is not allowed to connect the microscope to the supplying mains or to manipulate with it in any way before the technicians of the producer come, with the exception of the manipulation in order to bring it into the store. A protocol about the executed installation of the microscope and its handling into use is to be written. From this moment, the guarantee period starts running and the user is allowed to utilise the machine according to this operating instruction.

8. Repairs of the machine and using of the spare parts

Only the original spare parts delivered by the producer of the microscope are allowed to be used in order to replace the worn, damaged or others defective parts. Repairs and maintenance exceeding the scope of the operations specified in the article 5.1 till 5.5 may be executed by the technician of the producer or by the charged service companies only.

9. Assembly of the complete delivery

The basic assembly of the microscope includes following parts:

1. Cabinet of the column with the vacuum control unit, turbo-molecular pump and electromagnetic valves
2. Chamber with the specimen stage on the spring-mounted and the column
3. Rotary pump
4. Cabinet of the electronics
5. Operator's desk
6. Personal computer, monitor, keyboard, mouse and track-ball
7. BSE detector for types of microscopes **VEGA II xxU**
8. Chamber TV camera for types of microscopes **VEGA II LSx/LMx/XMx**

Note: The microscope can be equipped with an extended computer configuration or with other peripherals for the recording and the generation of the durable copy of the image.

According to the client's order the microscope can be equipped with the special accessories as:

- LVSTD – Low Vacuum Secondary Tescan Detector for types of microscopes **VEGA II xxU**
- BSE detector for types of microscopes **VEGA II xxH**
- TE detector
- Cooling specimen stage

Other accessories will be developed step by step by the company TESCAN and offered to the users. If the user wishes to equip the microscope with the accessories of another producer (e.g. characteristic X-rays spectrometer), the connection of the accessories is to be discussed and approved by the company TESCAN.

ANNEX:

The problems that could occur:

In case of any questions contact the producer:

TESCAN, s.r.o.
Libušina tř. 21
623 00 Brno
Czech Republic

Tel.: +420 547 130 411
Fax: +420 547 130 415
E-mail: support@tescan.cz