LEO 1530 VP Ultra-high-resolution VP FE-SEM

CE

Operating Instructions G34-1530VPen01

LEO

This manual is designed for users (operators) who have been trained in the use of this instrument by an authorized professional. Users of this instrument may not deviate from the instructions provided in this documentation.

If the user modifies the instrument without the manufacturer's consent, the manufacturer will not be liable for any damage that may result. Such modifications will also void the warranty.

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LEO Elektronenmikroskopie GmbH reserves the right to make modifications as part of the technical development process.

LEO Electron Microscopy Ltd
Clifton Road
Cambridge CB1 3HQ England
Telephone
Telephone
Fax ++44 1223 412776
E-mail info@leo-em.co.uk

LEO Elektronenmikroskopie GmbH
Carl Zeiss Straße 56
D-73446 Oberkochen, GERMANY
++44 1223 414166
++49 736494 6138
Fax ++49 736494 3226
E-mail info@leo.de

LEO Microscopie Electronique SARL
avenue du 18 juin 1940
Rueil-Malmaison, FRANCE
Telephone:
Telephone:
Fax: ++33 1 41399229
E-mail: LEO-France@compuserve.com

LEO Electron Microscopy Inc.
One Zeiss Drive
Thornwood, New York, USA
++33 1 41399210
++1 914–747–7700
Fax: ++1 914–747–7443
E-mail: 70142.504@compuserve.com

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1.1 Explanation of symbols

1.1.1 Safety information to prevent injuries

DANGER

This symbol calls your attention to the threat of a life endangering situation!
Disregarding this warning will lead to serious injury or death!

WARNING

This symbol calls your attention to the threat of a danger to health or life!
Disregarding this warning can lead to serious injury or death!

CAUTION

This symbol calls your attention to possible danger to life and health.
Disregarding this warning can lead to injuries!

1.1.2 Safety information to prevent damage to equipment

NOTICE

This symbol calls your attention to possible danger.
Disregarding this warning can lead to damage to the machine and surrounding areas!

1.1.3 Other important information

IMPORTANT

This symbol calls your attention to important additional notices.

1.2 Definition of terms

The following terms are used in this instruction manual:

— **FE-SEM**

The LEO 1530 VP **f**ield emission-**s**canning **e**lectro **m**icroscope is referred to as the FE-SEM.

— **LEO 32**

The LEO 32 software that runs under the Windows™ operating system is referred to as LEO 32.

1.3 Proper use

The FE-SEM is designed for the study of surface structures and near–surface structures. The specimens are placed in an evacuated specimen chamber for this purpose.

A fine electron beam is generated in the microscope column, which is also evacuated. This beam scans the surface of the specimen in a specific raster. The resulting signals are collected with a suitable detector.

The signals are usually depicted on a screen. The possible enlargement has an inverse relationship to the size of the raster: The smaller the raster field, the more the image can be enlarged.

DANGER

Using the microscope for any other purpose is prohibited and could be hazardous.

2 Safety

2.1 Accident prevention and safety

IMPORTANT

Do not use the FE-SEM until all users have carefully studied and understood this instruction manual!
Keep this manual handy for easy reference.

This instruction manual has been written for users of the FE-SEM. In conjunction with the complete technical documentation, it should help users to

— avoid hazardous situations

— use the instrument for its intended applications

— avoid downtime and repair costs

— obtain specified instrument data and maximize the service life of the FE-REM

The effectiveness of any measures ultimately depends on how well all parties—the manufacturer, the sales office, and the instrument operators—can work together to uphold safety standards.

2.2 Safety information

The FE-SEM employs cutting–edge technology and conforms to recognized safety requirements. This ensures the highest level of industrial safety. However, the FE-SEM may still present a hazard to human health and safety and/ or damage property if it is used improperly.

It is absolutely critical that users follow the safety information provided in this manual.

DANGER

Death may result if safety features are removed or non–functional!
The instrument may cause injury or death if operated with the safety features removed!
Replace the safety features immediately after any work on the instrument is completed!
Check the safety features regularly!

High–voltage electrical current can be fatal!
Only sufficiently knowledgeable and qualified professional electricians may perform work on any electrical parts of the instrument.

WARNING

Hot parts could injure the operator!
Some trim parts could heat up during long heating cycles and remain hot after the cycle is completed!
Touching the trim with your bare hands may cause burns!
Do not place your hands inside the cover plates!
Wear protective gloves if necessary!

WARNING


Radiation hazard!
This instrument may generate radiation during operation!
It is strictly prohibited to remove any cover panels, particularly those on the electro–optic column and the specimen chamber!
The flange and vacuum parts may not be replaced!
The acceleration voltage is not permitted to exceed 30 kV!

Suffocation hazard when chamber door is opened due to lack of oxygen!
The chamber is filled with nitrogen!
Inhaling nitrogen may cause unconsciousness!
Maintain a safe distance from the chamber door while it is open!
Ventilate the work space well!

CAUTION


Only personnel who are specifically authorized and qualified to do so may work with the FE-SEM!
Each person who works on the FE-SEM must have read and understood this instruction manual in addition to the supplier's documents and instructions!

Provide the entire set of technical documentation to any future owner, operator, or party borrowing the instrument, and stress the importance of reading and understanding all instructions!

Comply with all laws, guidelines, accident prevention measures and generally recognized rules!

NOTICE

Covered or blocked ventilation openings present a fire hazard!
Insufficient ventilation of the electronic cabinet will cause the electronic elements to overheat!
Keep the area in front of the ventilation openings clear! Turn off the FE-SEM immediately if you smell or see smoke!

A low oil level in the rotary pump could damage the instrument!
Failure to use pump oil, or using a non–approved pump oil, could damage the instrument and cause it to malfunction!
Use only approved lubricants on this instrument! (→ Chapter 11.3 - Page 60)

IMPORTANT

Use the FE-SEM only when it is in good working order, and use the instrument only for its intended applications!
Add–ons and modifications to the FE-SEM are prohibited!

If damage or defects that could endanger people or property are discovered on the FE-SEM, shut down the machine immediately and do not use it again until all repairs are completed!

Comply with all safety requirements pertaining to fire and explosion prevention!

A qualified technician sent by the manufacturer must either personally prepare the FE-SEM for its initial use or monitor another person as he/she carries out the necessary steps.

IMPORTANT

Only trained and qualified personnel may perform maintenance, repairs, and any hazardous work on the instrument!

Personnel may not be under the influence of alcohol or other intoxicants!
Smoking near the instrument is prohibited!

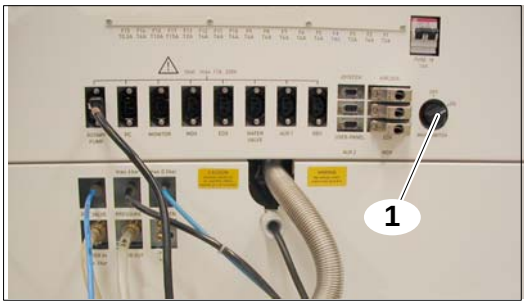
Dispose of used supplies and parts in accordance with all applicable laws, regulations and rules!

2.3 Safety devices

To prevent any risk of property damage or hazard to human health and safety, the FE-REM is equipped with the following safety and protective devices.

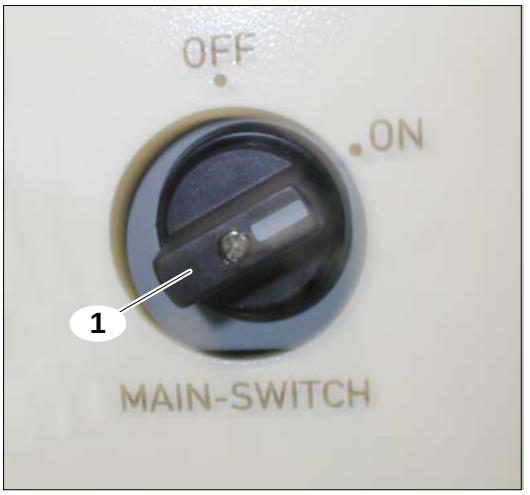
On–off switch

The on–off switch [1] is on the back wall of the electronic cabinet and serves to turn the FE-REM on and off.



IMPORTANT

The on–off switch does not have an emergency shutdown function.
The on–off switch cuts all power to the FE-SEM.



NOTICE

The emergency shutdown feature does not allow open programs on the computer to be closed properly.
Any unsaved changes to files may be lost!

Emergency shutdown button

Pressing the emergency shutdown button cuts off all power to the [2] FE-SEM. The button will remain in its depressed position.

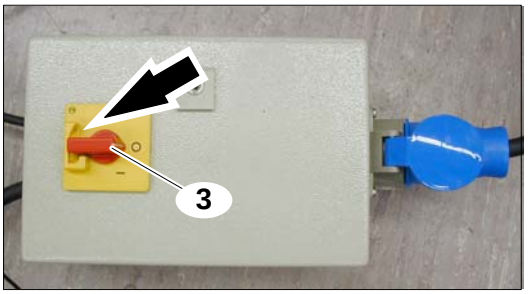
IMPORTANT

Do not use the emergency shutdown button for turning the FE-SEM off during routine operation!
Use the emergency shutdown button to turn the FE-SEM off only in an actual emergency!
The emergency shutdown button must always be accessible and in good working order!

Once the emergency has been resolved, release the emergency shutdown button by turning it turn counter-clockwise. The FE-SEM can then be restarted.

Master switch

The switchbox connects the FE-SEM to the power supply. The master switch [3] can be locked in the “off” position to keep it from being switched on. (→ arrow)



IMPORTANT

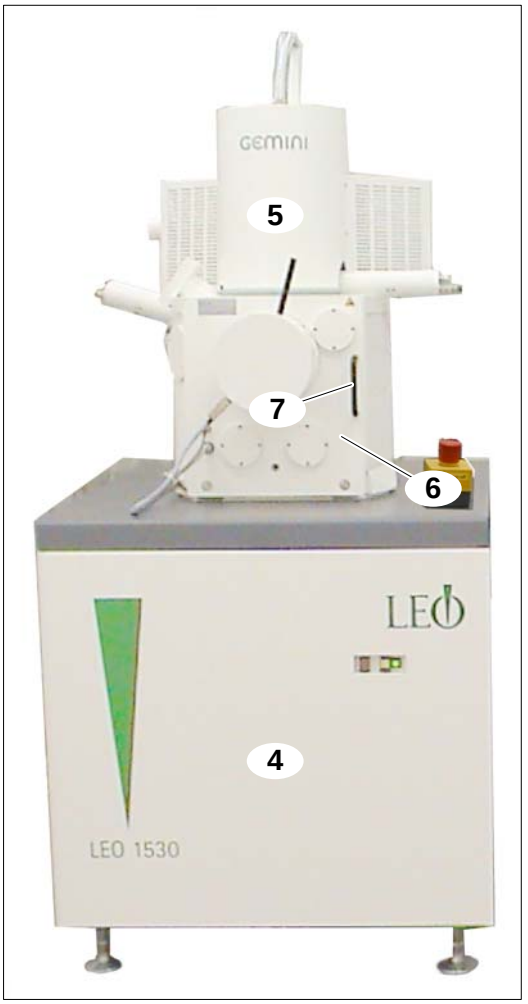
Do not use the master switch to turn the FE-SEM off during routine operation!
The master switch has an emergency shut-down function.

In an emergency, the master switch can be used to turn the FE-SEM off.

Protective cover panels

The electronics cabinet on the FE-SEM [4], the electro–optic column [5] and the specimen chamber [6] are secured with protective panel enclosures.

The chamber door has a handle [7] for inserting and removing specimens and for cleaning, maintenance and repair work. Opening or closing the chamber door activates a door contact switch that is part of the interlock system.



Interlock system

WARNING

Electrocution and radiation hazards!
Disabling interlock system elements is prohibited!

The interlock system is integrated in the FE-SEM to prevent abnormal operation.

The interlock system includes a high–voltage lock and a vacuum lock.

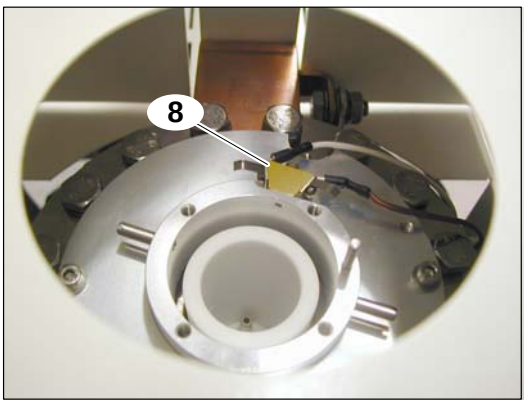
The high–voltage lock turns off the current if there is a malfunction. It consists of:

— Cathode head plug switch [8]

The cathode head plug switch shows whether the high–voltage plug is plugged in.

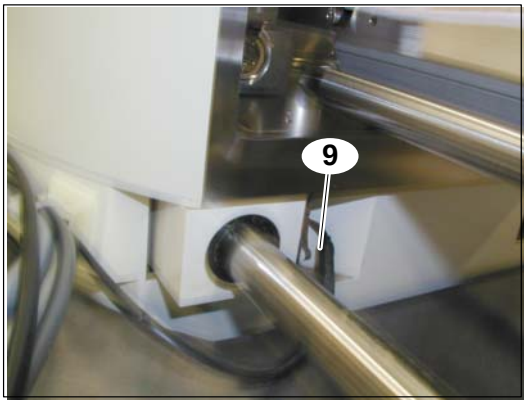
— Cathode head switch (under the protective panels)

The cathode head switch shows whether the cathode head is closed.



— Door contact switch [9]

The door contact switch shows that the chamber door is closed properly.



— Vacuum lock (on VAC board)

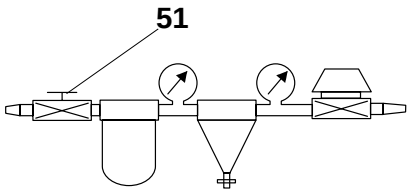
The vacuum lock blocks the high–voltage current if the chamber or column is ventilated.

Shut–off valves

The customer is responsible for installing main shut–off valves [51] for water, nitrogen and compressed air.

The shut–off valves must be easily accessible, and they must close off the connections to the corresponding media when needed.

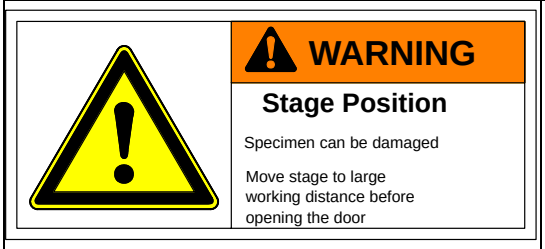
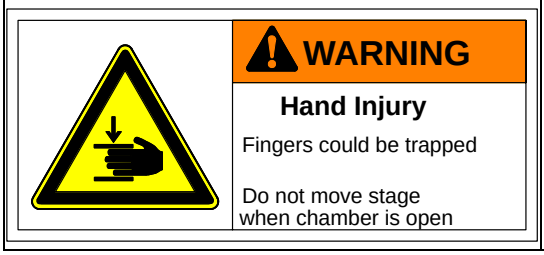
It must be possible to lock the shut–off valves so they cannot be turned back on accidentally.

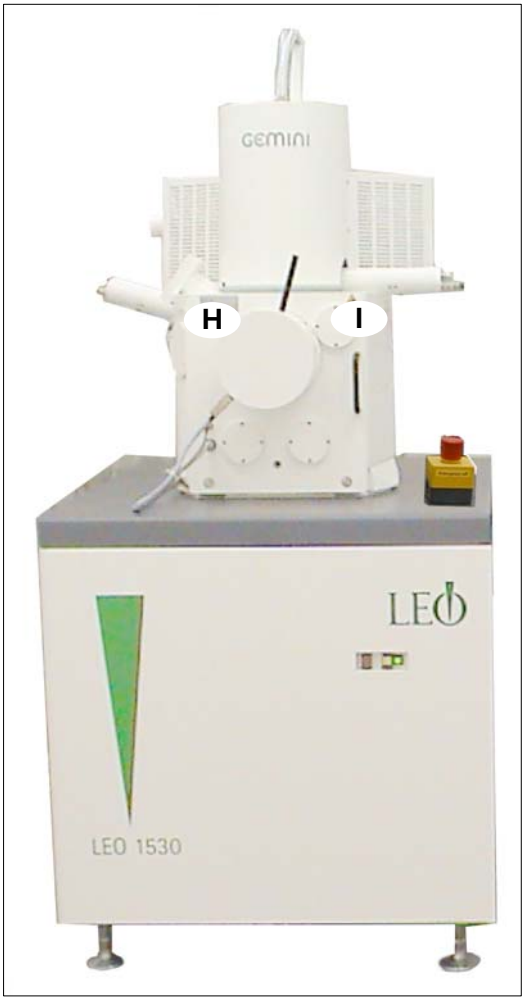


Valve sequence for cooling using a water supply

2.4 Safety labels on the instrument

Appropriate safety labels on the FE-SEM warn users about possible hazards. Each safety label is affixed at the point where a particular hazard exists.

Label	Position
	H
	I



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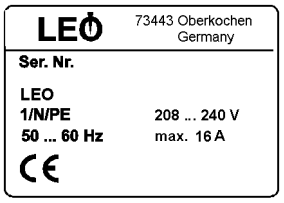
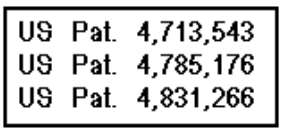
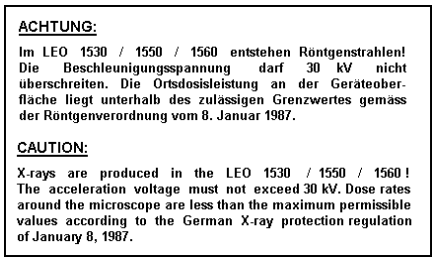
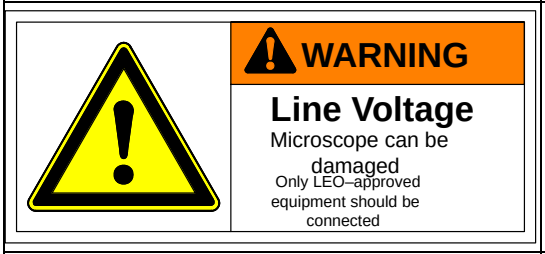
	K
	K
	K
	L
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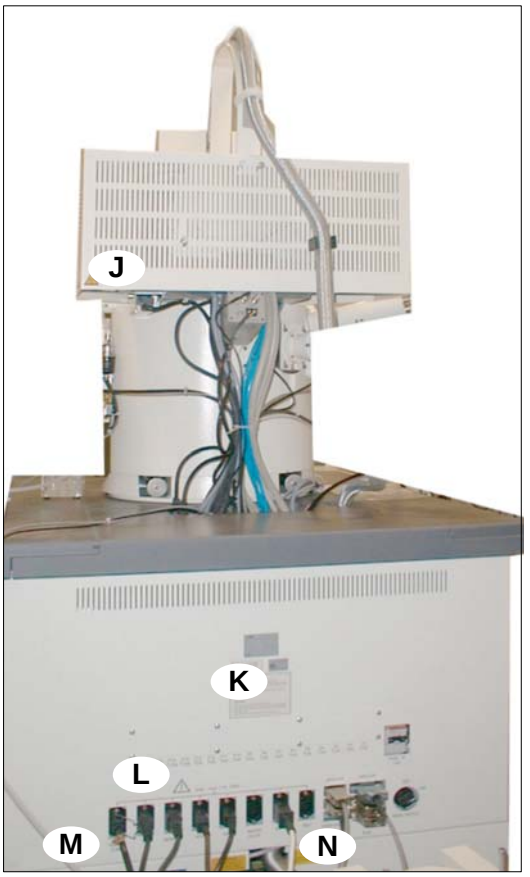

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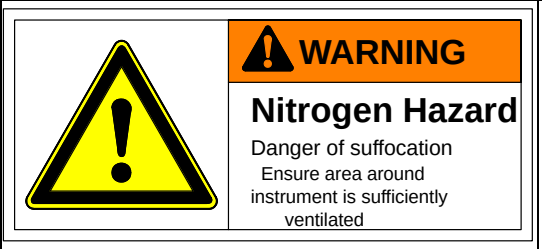	M
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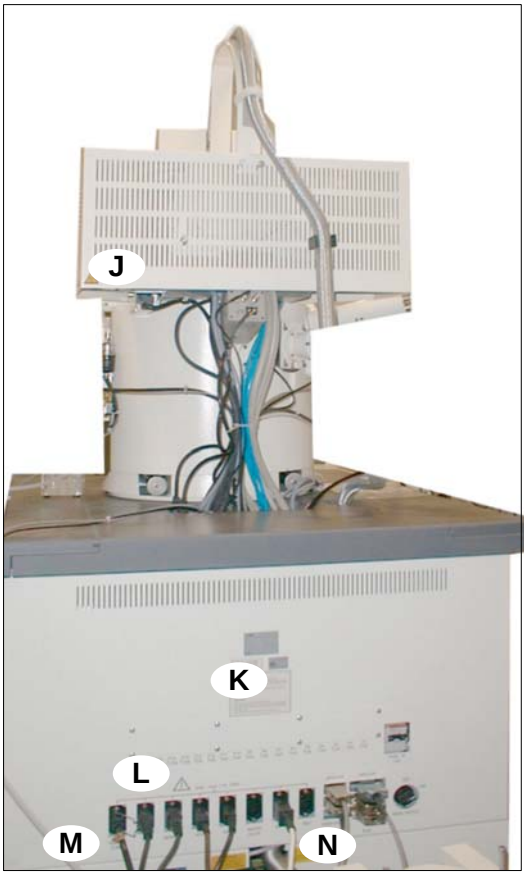


3 Transport und Assembly

NOTICE

FE-REM may be transported only in air–suspended vehicles! Moving parts must be secured during transport to prevent them from sliding or tipping!
Risk of damage if instrument is tipped or dropped! Devices for transporting the instrument must be rated to handle its full weight and dimensions! Note the weight information on the package and on the shipping documents!
(→ Chapter 10 - Page 58)
Do not raise the crates any high than necessary! Avoid rocking the crates back and forth!

Crushing hazard while load is being lowered! The load can cause serious injury as it is lowered!
Maintain a safe distance!
Do not walk under or place your hands/feet under the load while it is being lowered!
Wear safety shoes!
Wear safety gloves!

The complete FE-SEM is delivered in 2 wooden crates and cartons.

Crate 1: Electro–optic column, chamber, frame with vacuum system

Crate 2: Rotary pump, table, computer, screen, pump hoses, vibration damper

1. Unpack the FE-SEM and check the contents against the enclosed shipping document to ensure that all components are present.
2. Check whether any items have been damaged in transit.
   Report any problems to the manufacturer immediately!

IMPORTANT

Returns cannot be accepted at any later point!

3.1 Location requirements

IMPORTANT

The location for the FE-SEM should be determined and prepared before the instrument is delivered. The relevant examinations must be carried out. (→ Chapter 10 - Page 58)

LEO Service is able to assist with examining environmental conditions and identifying appropriate measures. (→ Chapter 8 -Page 53)

See the assembly plan for the dimensions of the FE-SEM and the locations of the electrical, cooling water, nitrogen and compressed air connections.
The customer is provided with the assembly plan before the FE-SEM is delivered. Another copy is included in this instruction manual.
(→ Chapter 3.2 -Page 25)

The minimum area needed (without any accessories attached) is 3.5 m x 5.0 m. The ceiling must be at least 2.3 m high.

The doors and hallways must be at least 0.8 m wide. Corners must be at least 1.2m wide.

3.1.1 Power supply

DANGER

Electrocution hazard
High–voltage electrical current can be fatal!
Only sufficiently knowledgeable and qualified professional electricians may perform work on the instrument's electrical system.

The electrical connection must be provided in accordance with the applicable electrical codes for your country.

For the US and Canada, we recommend a fixed connection; for Europe, we recommend a 16 A plug connection (e. g. CEE Type 16A-6h 208 ... 240 V, 2P + PE).

The main power line must be protected with a miniature circuit breaker (16 A, switch–off behavior K) and a ground fault circuit interrupter (30 mA).

A switch that is easily accessible at all times must be installed at the door. (→ Chapter 3.2 - Page 25)

3.1.2 Grounding

A separate line must be laid for the FE-SEM (cross–section ⩾ 4 mm^2) that is connected to a 2nd PE conductor or a bonding conductor. (→ Chapter 3.2 - Page 25)

3.1.3 Cooling

The electro–optic lenses, the turbo molecular pump and some parts of the electronic system are water–cooled.

Closed–circuit cooling or water from the water supply can be used for cooling. The inside diameter of the connecting tube is 6 mm.
Heat dissipation is approximately 1 kW.

Closed–circuit cooling

LEO offers closed–circuit water cooling or air cooling systems.

Both systems should be located outside the workspace. In the case of an air–cooled system, this allows warm air to be exhausted freely; a water–cooled system needs to be further away because of the noise level.

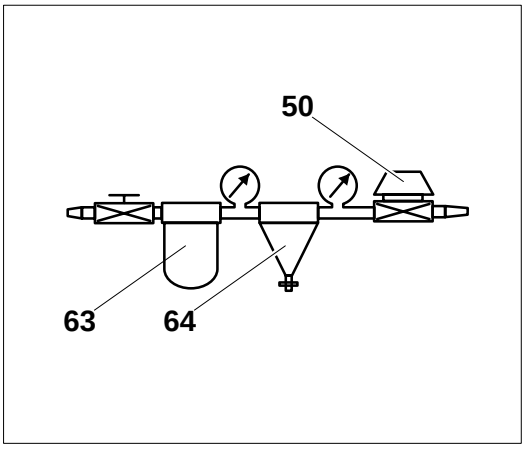
Two outlets (230 V, 16 A) must be installed where the closed–circuit cooling system will be placed. One outlet is for the unit; the other is for servicing purposes.

For water–cooled systems, an unfiltered building water connection and a wastewater connection must be available.

Water consumption is controlled by the system; the system uses approx. 100 l/h at maximum cooling power.

Cooling using a water supply

If you are cooling using a water supply, you must install a water filter [63], a pressure regulator with 2 pressure gauges [64], and a water solenoid valve [50] that interrupts cooling when the FE-SEM is switched off. (→ Chapter 3.2 - Page 25)



IMPORTANT

The items can be ordered as a kit from LEO. The water solenoid valve is controlled by the FE-SEM.

The water must be maintained at a temperature between 16 ˚C and 25 ˚C. The supply pressure is 2 bar and may not exceed 3 bar. The flow rate must be > 2 l/min. The water backflow goes into an open drain.

It must be possible to cut the water supply and lock the valve so that the water cannot be turned back on accidentally.

3.1.4 Exhaust gases

The rotary pump generates exhaust that is vented to the outside using a plastic hose.
(→ Chapter 3.2 - Page 25)

An oil mist filter (option) can also be installed.

3.1.5 Compressed air

CAUTION

Injury is possible due to the high internal pressure in the gas cylinders!
Always operate gas cylinders in an upright position and secure them so they will not tip over!
Place protective caps on gas cylinders before transporting them!

The self–leveling damping system and the valves must be supplied with compressed air (max. 6 bar). The inside diameter of the connecting tube is 8 mm. (→ Chapter 3.2 - Page 25)

The necessary compressed air is generated by a compressor with a pressure reducer and used only in small quantities for leveling.

IMPORTANT

The FE-SEM can also be supplied via a compressed air line. The connection must be equipped with a pressure reducer and a shut–off valve that is secured against accidental re–activation.

3.1.6 Nitrogen connector

The chamber is filled with nitrogen during specimen change.

CAUTION

Wear gloves and work carefully when handling nitrogen cylinders!
Take appropriate measures to keep nitrogen cylinders from tipping over!
Always use nitrogen cylinders in an upright position!
Place protective caps on nitrogen cylinders before transporting them!

Suffocation hazard due to insufficient oxygen!
Inhaling nitrogen may cause unconsciousness!
Use only pressure limiters that are approved for use with nitrogen cylinders!
Keep the valves and fittings completely free of lubricants or oils!
Thoroughly ventilate rooms where nitrogen cylinders are used!

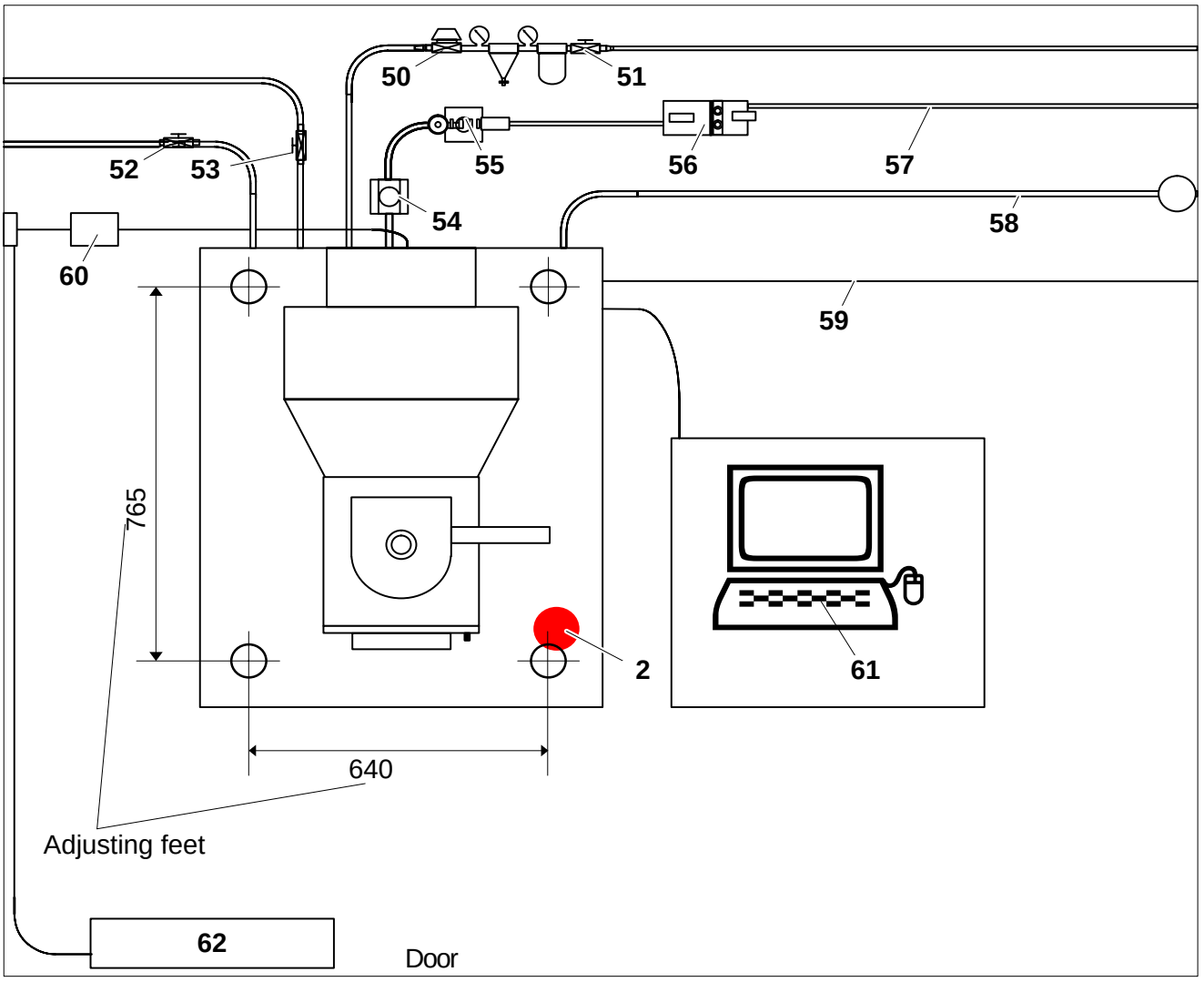
The nitrogen is removed from cylinders with appropriate pressure reducers and hose connectors. (→ Chapter 3.2 - Page 25)

Parameters for nitrogen	Value	Unit
Pressure min. max.	 0.2 0.3	 bar bar
Consumption with open chamber door	approx. 3	l/min
Percentage purity at least	99.996	%
Connection hose Inside diameter	4	mm

IMPORTANT

An internal central supply system can also be used to supply the chamber with nitrogen. The connection must be equipped with a pressure reducer and a shut–off valve that is secured against accidental re–activation.

3.2 Assembly plan



[2] Emergency shutdown button
[50] Water solenoid valve
[51] Water main valve
[52] Compressed air-Main valve
[53] Nitrogen-Main valve
[54] Dynamic vibration-damper
[55] Static damper with adsorption trap
[56] Rotary pump
[57] Exhaust hose
[58] Discharge line
[59] Grounding
[60] Switchbox
[61] Computer with keyboard and mouse
[62] Miniature circuit breaker, Ground fault circuit interrupter-emergency shutdown -switch

3.3 Assembly and adjustment

IMPORTANT

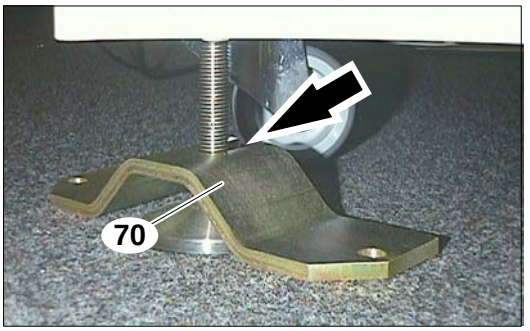
Follow the safety instructions in Chapters 2 and 3!

Only qualified and trained personnel may assemble and adjust the FE-SEM!

1. Assemble the FE-SEM correctly.
   (→ See Chapter 3.2 - (Page 25) for the assembly plan.
2. Remove all items used to secure instrument components during transport.
3. Re–assemble and attach all safety devices that were disabled and removed from the instrument for transport.

3.4 Anti–tip system for earthquake–prone areas (option)

In areas that are prone to earthquakes, the FE-REM must be placed on a heavy–duty anchor installed in the floor and protected from tipping over with a seismic -kit.



1. Place the FE-SEM on the heavy–duty anchor.
2. Place the clamp from the seismic kit set with the slit (arrow) [70] onto the adjustable foot.
3. Use two bolts to connect the clamp to the heavy–duty anchor.
4. Repeat points 2. 3.with the other three clamps and adjustable feet.

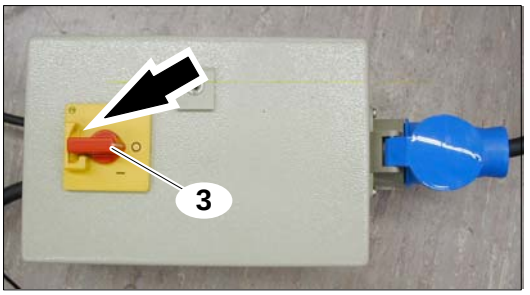
3.5 Storage

IMPORTANT

Follow the safety instructions in Chapters 2 and 3!

FE-SEM may be stored appropriately packed in rooms exposed to an ambient temperature of between 0 ˚C and 70 ˚C.
If the FE-SEM is not used for an extended period of time, perform maintenance on it and check the safety devices before using it again.

1. Turn off the cooling water supply.
   Remove the water from the system if necessary.
2. Cut off the nitrogen supply.
3. Interrupt and shut off the compressed air supply using the pneumatic stop valve.
4. Turn off the FE-SEM. (→ Chapter 5.12 -Page 46)
5. Turn off the master switch [3] and lock in the “off” position (→ arrow).
6. Clearly mark the key to the instrument and store it in a safe place.
7. Unplug the FE-SEM.



4 Installation

4.1 Attaching connectors

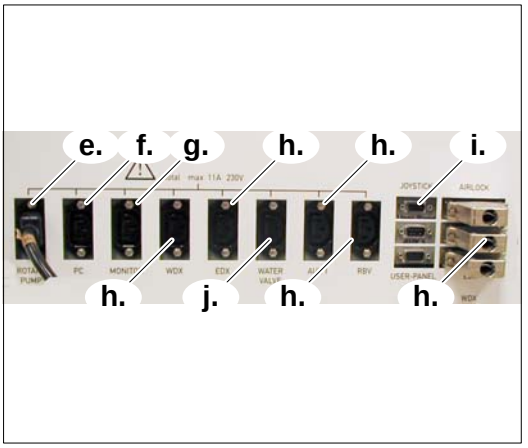
IMPORTANT

Follow the safety instructions in Chapter 2!

Read and note the information in the supplier's documents and instructions!

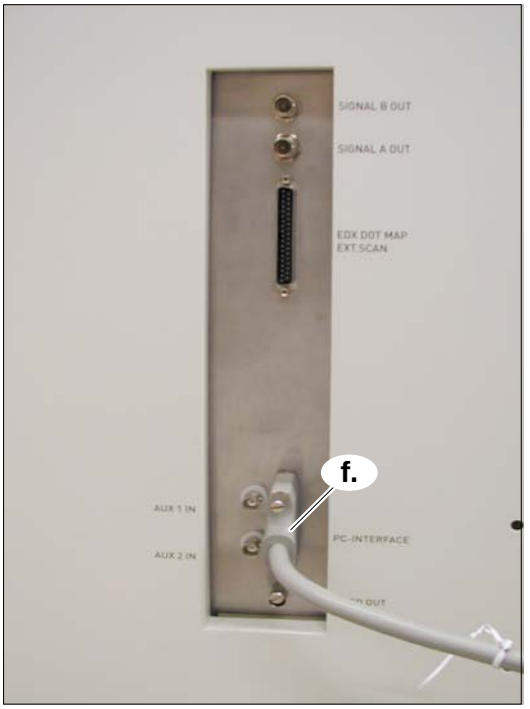
Note and follow the inspection and maintenance schedules!
(→ Chapter 7.1 -Page 50)

Only sufficiently knowledgeable and qualified professional electricians may perform work on any electrical parts of the instrument.



1. Connect lines to the

- **e.** Rotary pump
- **f.** Computer
- **g.** Screen
- **h.** Accessories, if present
- **i.** Joystick box
- **j.** Water solenoid valve

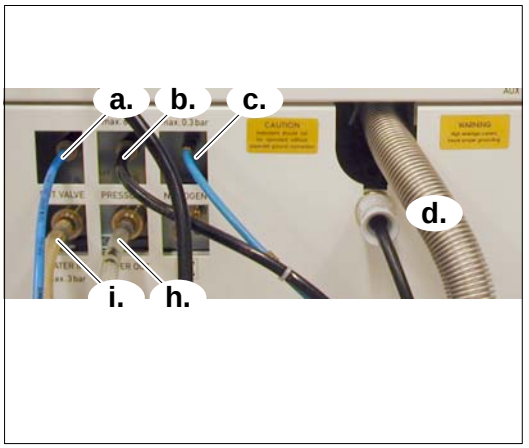


2. Connect lines to the cooling water, nitrogen and compressed air.

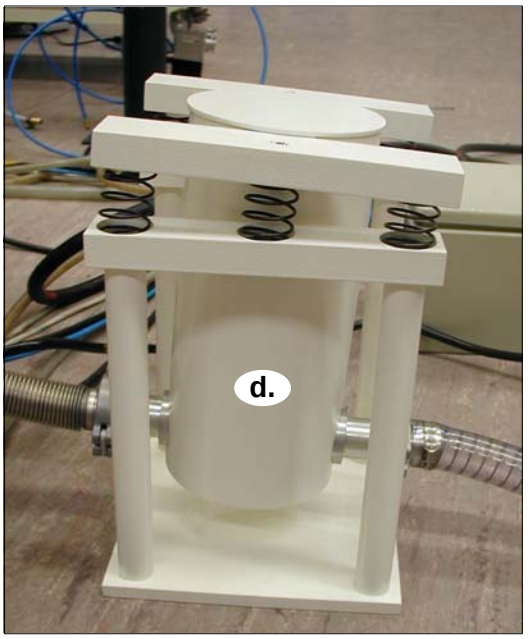
a. Connect the compressed air line to the angle valve on the absorption-trap

b. Connect compressed air

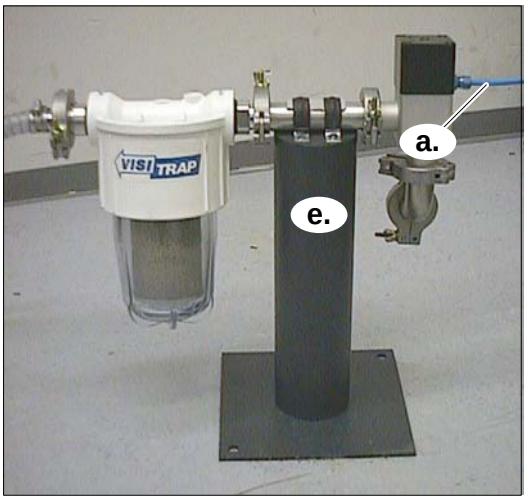
c. Connect nitrogen



d. Connect dynamic vibrationdamper

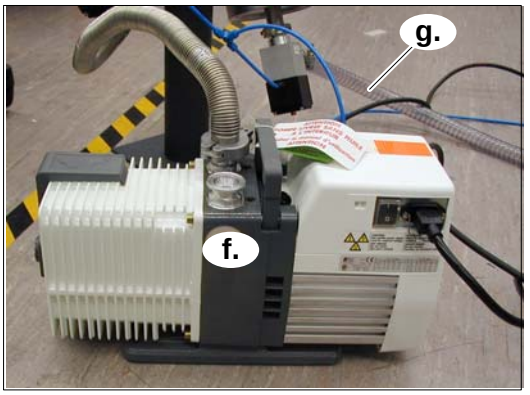


e. Connect static damper with adsorption trap (→ Supplier documentation)



f. Connect rotary pump
(→ Supplier documentation)

g. Connect exhaust hose
(vent plastic hose to outside)
or install an oil mist filter (option)



h. Connect water backflow line

i. Connect water supply line

4.2 Check the main electrical connection

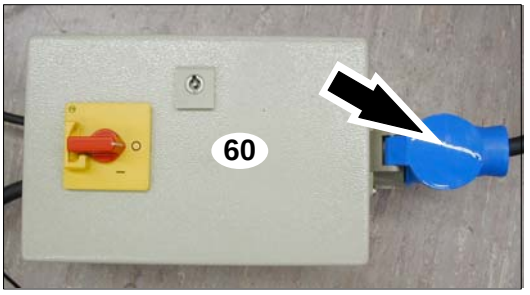
IMPORTANT

Follow the safety instructions in Chapter 2!

The technical data for the main connection must conform to the specifications in Chapter 10 - Page 58.

— Check the voltage of the main power connection.

— Connect the switchbox [60] to the power supply.



5 Operation

WARNING


Radiation hazard!
This instrument may generate radiation during operation!
It is strictly prohibited to remove any cover panels, particularly those on the electro–optic column and the specimen chamber!
The flange and vacuum parts may not be replaced!
The acceleration voltage is not permitted to exceed 30 kV!

Suffocation hazard when chamber door is opened due to lack of oxygen!
The chamber is filled with nitrogen!
Inhaling nitrogen may cause unconsciousness!
Maintain a safe distance from the chamber door while it is open!
Ventilate the work space well!

Covered or blocked ventilation openings present a fire hazard!
Insufficient ventilation of the electronic cabinet will cause the electronic elements to overheat!
Keep the area in front of the ventilation openings clear!

CAUTION


Moving table parts could injure the operator!
Change specimens and perform other tasks only when the table is standing still!

The chamber door presents a crushing hazard while it is closing!
Use the handle or light pressure on the front of the chamber door to close it! Use caution!

5.1 Initial use

IMPORTANT

Follow the safety instructions in Chapters 2 and 5!
A qualified technician sent by the manufacturer must either personally prepare the FE-SEM for its initial use or monitor another person as he/she carries out the necessary steps.

5.2 Switching the instrument on

IMPORTANT

Follow the safety instructions in Chapters 2 and 5!

The emergency shutdown button must be unlocked, and the master switch must be switched on. (→Chapter 2.3 Page 11)

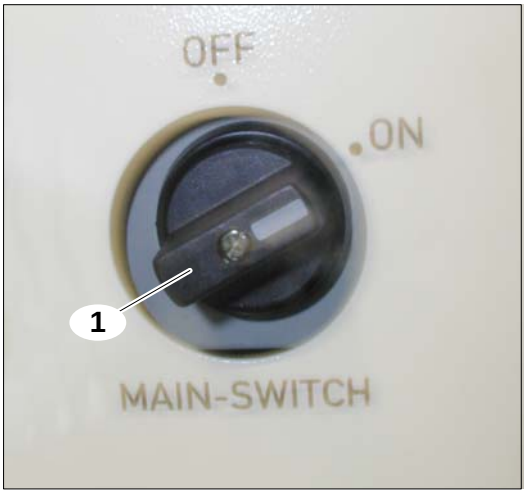
NOTICE

If the emergency shutdown button is depressed or the master switch is in the “off” position, find the cause of the problem!

1. Turn the on–off switch [1] to (“ON”).
2. Open the cooling water valve.

IMPORTANT

If the FE-SEM is equipped with a water solenoid valve, it will be opened automatically.



3. Open the nitrogen valve.

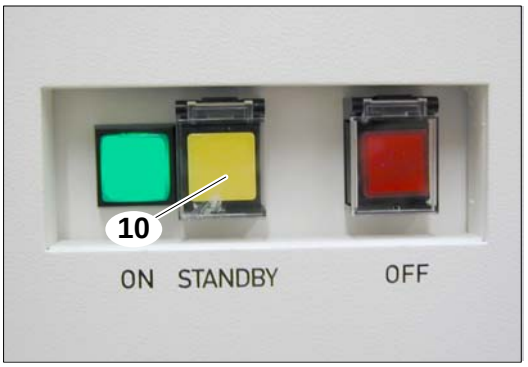
4. Open the cover on the yellow STANDBY-button [10] and press the button.

○ The vacuum control is now on.

○ The rotary pump is now on.

○ The program will start up, and each of the other vacuum pumps will be switched on in sequence.

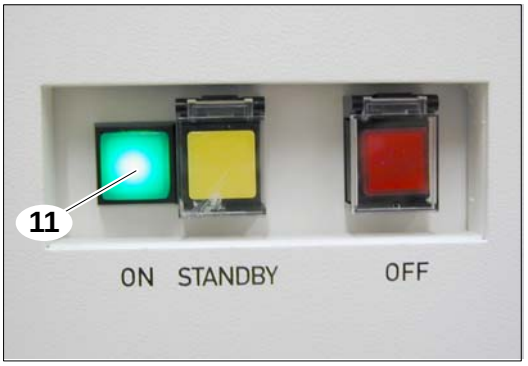
○ The *STANDBY button* will be lit.



5. Press the green ON button [11].

○ The *ON button* will be lit.

○ All of the instrument's electronics are now on.



○ The computer will boot up, and the program icons will appear on the screen.

○ The *ON button* will be lit.

5.3 Starting the LEO 32 program

1. Double–click on the *LEO 32 icon* [12] with the left mouse button.

○ The *LEO 32* program will load.

IMPORTANT

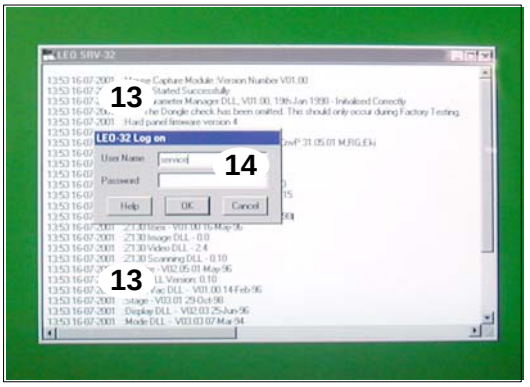
While the program loads, the screen will also show you which systems, if any, are not ready [13]**. This will allow you to trace back errors that may occur.**

○ The *LEO 32 logon dialog* [14] will appear.

2. In the*User Name* field, enter your user name.

3. In the *Password* field, enter your password.

4. Click on “OK” or press “Enter” on the keyboard.



5.4 Loading the specimen chamber

○ The LEO 32 program is running.

○ The main window [15] is displayed.

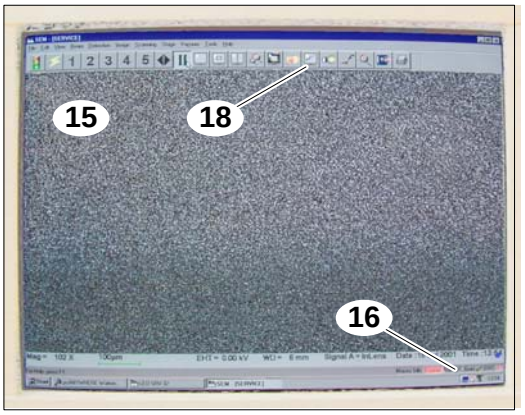
1. Left–click on “Vac” [16].

○ “Vent” will appear in the blue field, along with the question: “Are you sure you want to vent?”

2. Left–click on “yes” .

○ The specimen chamber will fill with nitrogen.

○ The internal and external pressures will equalize after about 1 minute.



NOTICE

The chamber door presents a collision hazard while it is opening or closing!
Check the height of the specimens on the specimen holder and lower the table if necessary!

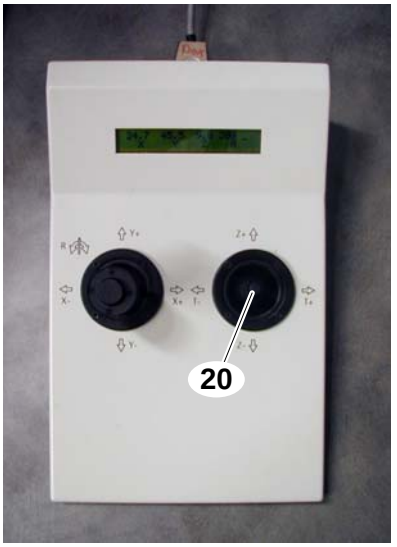
3. Left–click on the “Camera” icon [18] .

○ The inside of the specimen chamber and the table [19] will be displayed.

4. Move the right joystick [20] in the“-Z”-direction (marked on the joystick box).

○ The table will move.

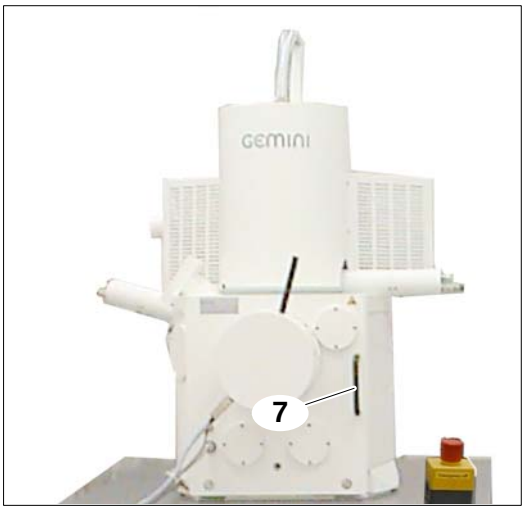
○ The camera shows the new location of the table and the specimen holder.



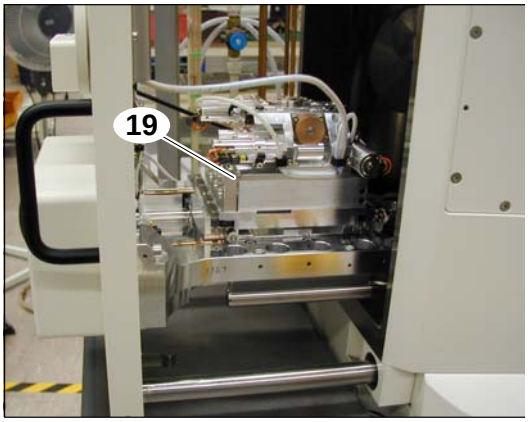
WARNING

Suffocation hazard when chamber door is opened due to lack of oxygen!
The chamber is filled with nitrogen!
Inhaling nitrogen may cause unconsciousness!
Maintain a safe distance from the chamber door while it is open!
Ventilate the work space well!

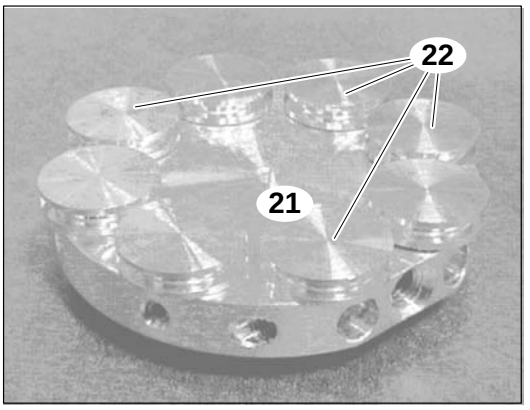
5. Take hold of the door handle and carefully open the chamber door [7].



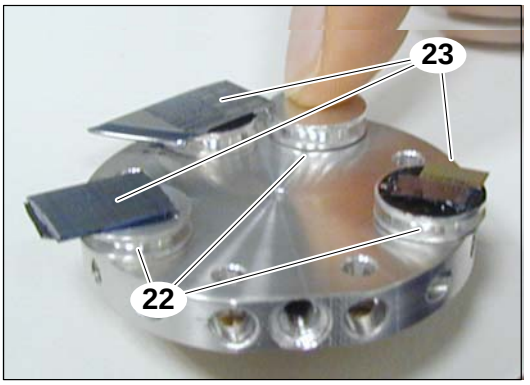
○ The table [19] is now ready for you to load specimens into or remove specimens from the specimen holder.



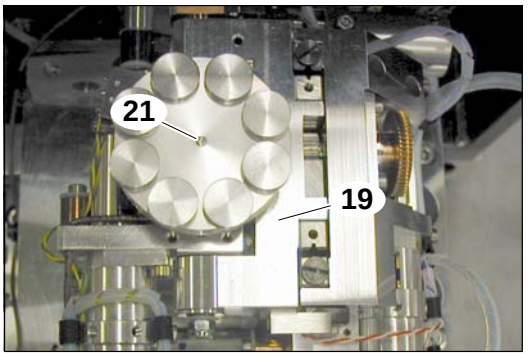
6. Load specimen containers [22] into specimen holder [21] and tighten laterally with an Allen wrench (SW 1.5).



7. Load samples [23] into specimen containers [22].



8. Place the prepared specimen holder [21] on the table [19].

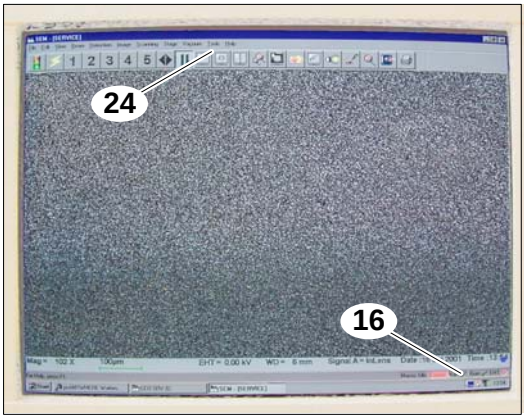


IMPORTANT

The specimen table can be moved in three directions, tipped, and rotated around the beam axis.

9. Close the chamber door [7] by pressing lightly on the front with the palm of your hand, or use the door handle.

5.5 Evacuating the specimen chamber



1. Left–click on “Vac” [16].

○ “Vent” will be displayed in the blue field.

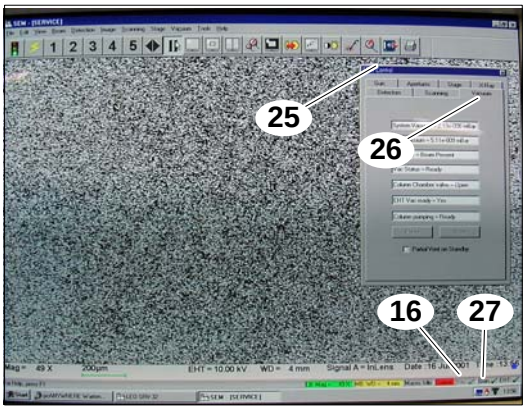
2. Left–click on “Vent” .

○ The specimen chamber will be evacuated.

3. Left–click on “Tools” [24] (on the menu bar).

○ You will see the “Tools” drop–down menu.

4. Left–click on “Go to Control Panel” .



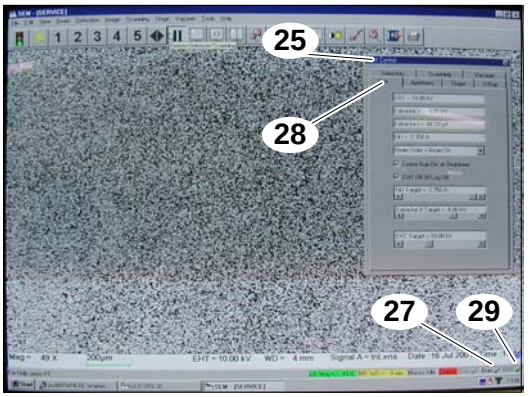
○ You will see the “SEM-Control” [25] dialog box.

5. Left–click on the “Vacuum” [26] module.

○ You will see status messages showing the vacuum level achieved.

When the specified vacuum has been reached, you will see the message “Vac Status ready”, and the red X next to the “Vac” [16] icon in the bottom toolbar will change to a green check mark.

5.6 Activating the electron beam



1. Left–click on “Gun” [27] (on the bottom toolbar).

○ A drop–down menu will be displayed.

2. Left–click on “Gun ON”.

○ The cathode will heat up.
Electrons will be emitted.

3. Left–click on the “Gun” [28] module.

○ You will see the cathode voltage values.

Once the cathode start–up procedure is complete, the red X next to the “Gun” [27] icon on the bottom toolbar will become a green check mark.

4. Left–click on “EHT” [29] (on the bottom toolbar).

○ A drop–down menu will be displayed.

5. Left–click on “EHT ON”.

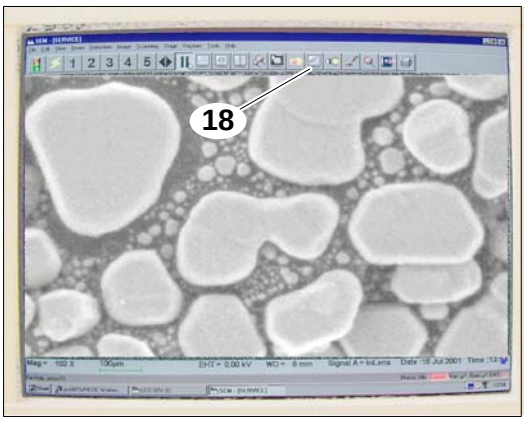
○ The acceleration voltage is now on.

○ The image on the screen will turn lighter.

○ If the focus is (by chance) already correct, the contours of the specimen will appear.

5.7 Focusing the electron beam

The objective focuses the electron beam on the surface of the specimen.



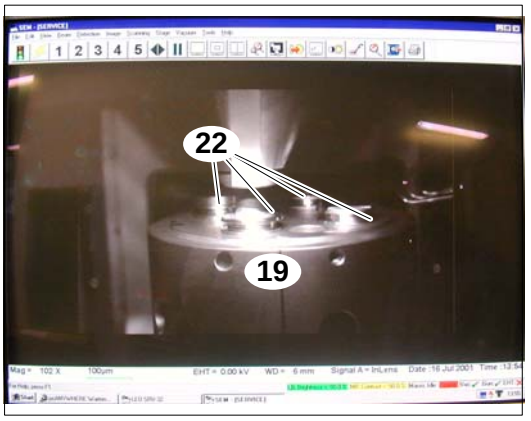
IMPORTANT

The resolution will improve as the electron beam is set more and more precisely.
At very high magnifications with a correspondingly fine electron beam, the secondary electron signals will be weak, which will cause the image to become “grainy”.

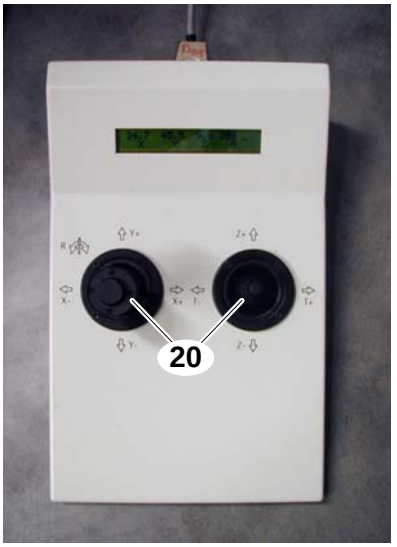
The specimen must be placed in the correct position under the electron beam before you bring it into focus.

1. Left–click on the “Camera” icon [18] .

○ The inside of the specimen chamber and the table [19], specimen containers [22] and specimens will be displayed.



2. Use the joysticks to adjust the table [20] until the area of the specimen surface you wish to examine is directly under the objective.
3. You can rotate, tip, raise and lower the table using the joysticks [20] to move the specimen into the desired position.



4. Left–click on the “Magnification–Focus” icon [30].

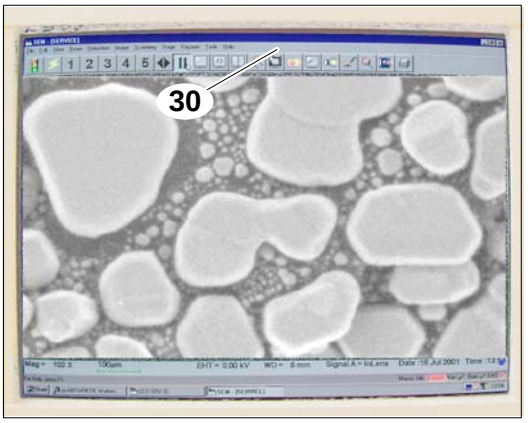
○ On the bottom toolbar, you will see “LB.Mag ...” “MB Focus” highlighted in green.

5. Click on the middle mouse button and move the mouse to the left or right.

○ The contours of the specimen will become visible.

○ The electron beam is now focused.

If the image is not sharp enough, you will need to make further adjustments.



5.8 Modifying the image

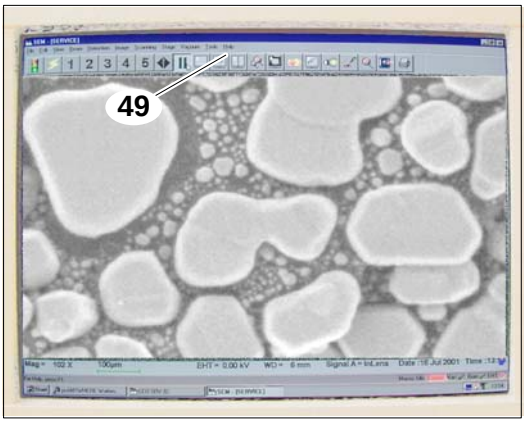
IMPORTANT

At high magnifications, the image is “grainy”. Use a low scanning speed to filter out the “graininess”.

The LEO 32 program has many functions to help you obtain the desired results.

Information of interest can be accessed via Windows help, LEO help, or context–based help.

5.8.1 Windows help



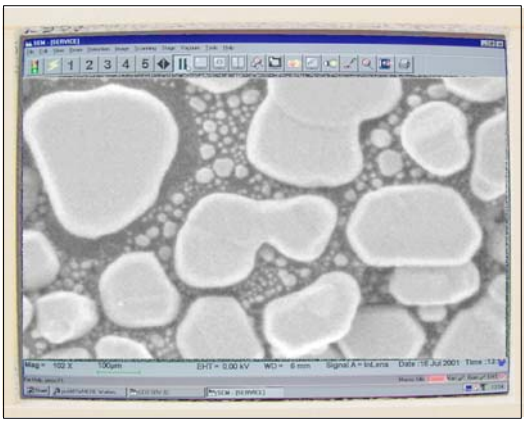
— Left–click on “Help” [49] on the menu bar.

○ You will see a sub–menu with the following choices:

  — Help on help
  — Search
  — LEO help
  — Help keys

— Click on the desired topic in the sub–menu.

5.8.2 LEO help



— Click on “LEO help” in the sub–menu.

○ You will see the following directories for “LEO 1500 series help”:

  — Help software contents
  — Definition of terms
  — Important information
  — Description of instrument components
  — Operating the instrument
  — Operating principle of instrument components
  — Care, maintenance, and troubleshooting
  — Instrument startup
  — Instrument accessories
  — Function of interface links

— Click on the desired topic in the sub–menu.

5.8.3 Context–based help

— Press “F1”.

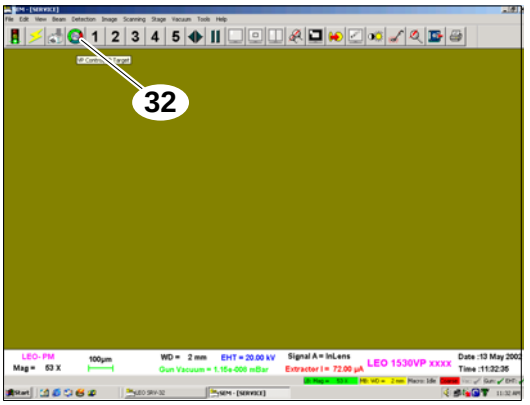
○ This opens the “Using Windows Help” help window.

— Select an action and click on the appropriate area of the screen, or press a key whose function is unknown to you.

5.9 VP-Mode

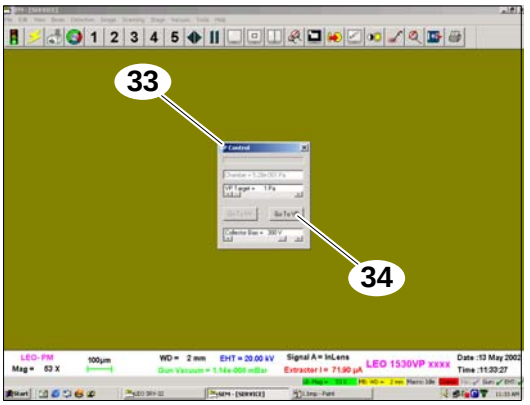
When examining non- or only slightly conductive preparations, charges can be induced on their surfaces, which are difficult or impossible to divert and which result in an altered image. In VP-Mode, these surface charges are avoided or reduced and high–quality images can be produced, even from such preparations.

1. Left–click on “VP-Control/VP Target [32] (on the menu bar).



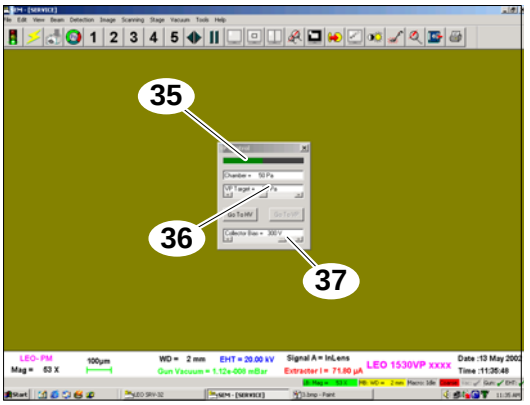
○ You will see the “VP Control [33] window.

2. Left–click on “Go To VP [34] (in the“VP-Control window).

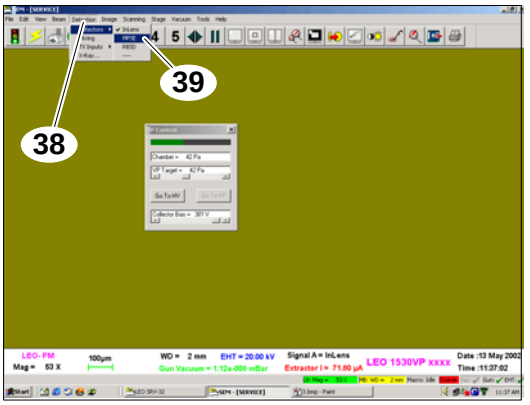


○ Valves are switched over and a green bar [35] displays the pressure changes.

○ The slide can be used to adjust and set the pressure [36] and the collector voltage [37].



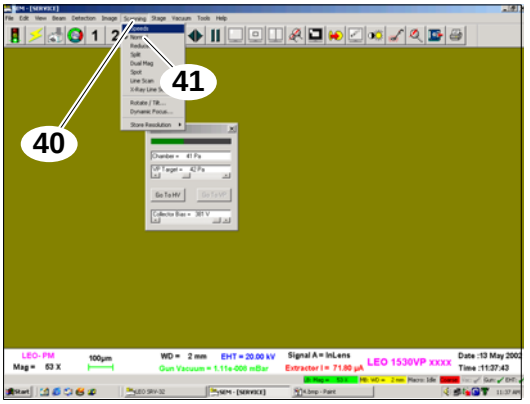
3. Left–click on “Detection [38] (on the menu bar) and in the pull–down windows “Detectors”→ Click on MPSE [39].



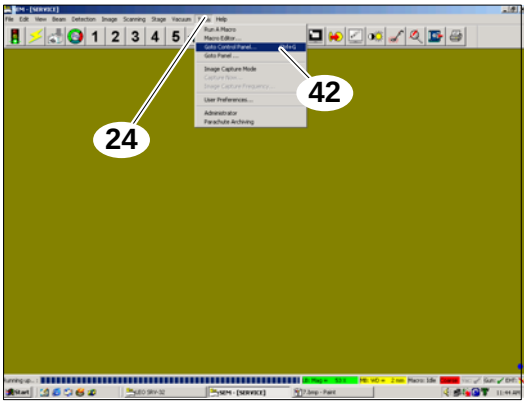
4. Left–click on “Scanning [40] (on the menu bar) and in the pull–down windows “Speeds→ Select speed > 6” [41].

○ The image will appear.

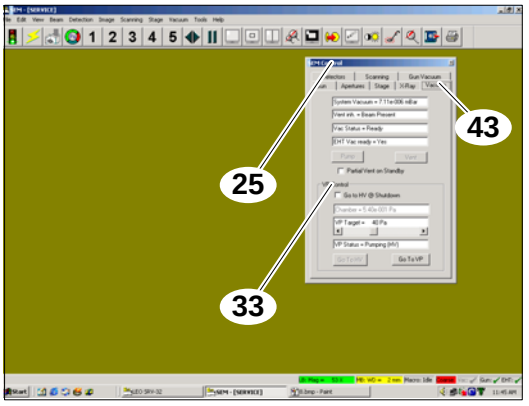
If the image is not sharp enough, you will need to adjust the pressure and collector voltage. (→ P. 2. Page 42)



○ VP-Mode can also be selected from “Tools [24] (in the menu bar) and the pull–down windows “Goto Control Panel” [42]→ ”SEM Control”→ “Vacuum” [43].

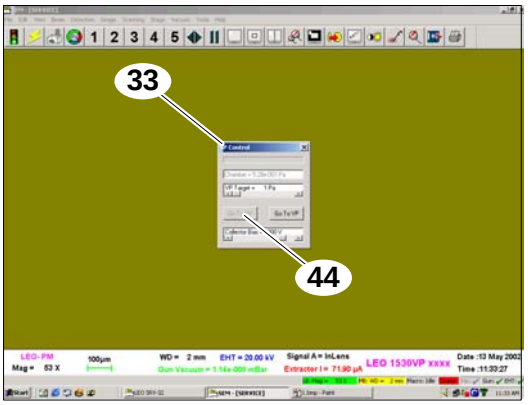


The bottom part of the window shows the same menu “VP Control” [33].



5. To end VP-Mode, click “Go To HV” [44] in the “VP Control” [33] window.

○ The switchover procedure is reset and the valve is switched to normal operation.



5.10 Finishing examination of a specimen

You can save or print out an image if it meets your quality requirements.

5.10.1 Saving an image

1. Left–click on “File” [31] (on the menu bar).

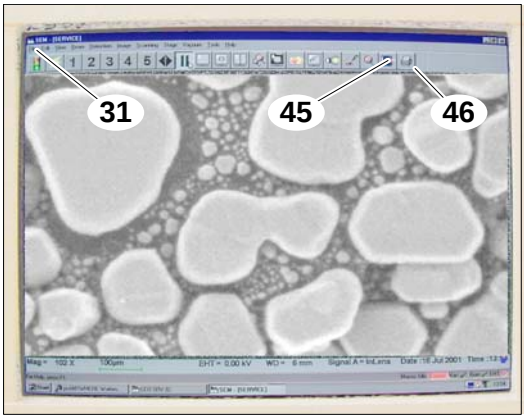
2. Click on “Save file as” in the drop–down menu.

3. Enter the file name and the folder where you want to save the file (path).

4. Confirm your entries by pressing Enter or clicking on “OK”.

○ The image will be saved under the name you entered.

Click on the “Save” icon [45] to save a modified image with the same name.



5.10.2 Printing an image (option)

1. Left–click on “File” [31] (on the menu bar).

2. Click on “Print file” in the drop–down menu.

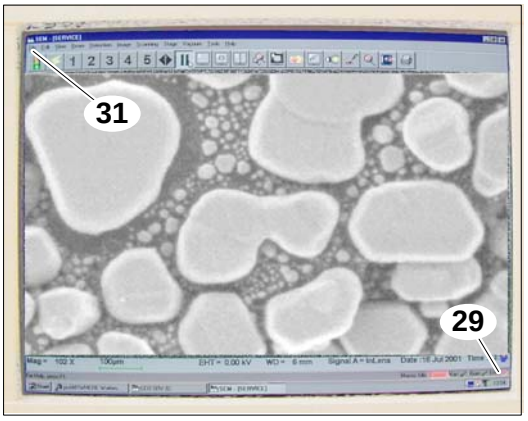
○ The image will be printed with the name you entered.

Click on the “Printer” icon [46] to print a modified image with the same name.

If you did not order a printer with your LEO instrument, you can move the file to another computer with a printer and print it out from there.

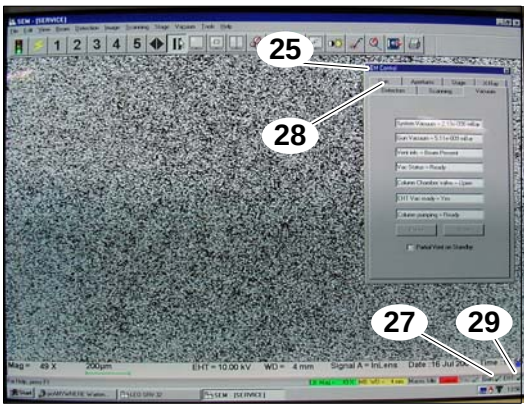
5.11 Placing the FE-SEM in standby mode

Standby mode is the normal status for the FE-SEM once you have finished examining a specimen. The cathode will continue to heat, and the vacuum pump will evacuate the electro–optic column and the specimen chamber.



IMPORTANT

The cathode will not need to be replaced as often if it is operated for extended periods at a constant temperature (not turned off).



1. Left–click on “EHT [29] (on the bottom toolbar).

○ A drop–down menu will be displayed.

2. Left–click on “EHT OFF”.

○ The acceleration voltage will shut down.

○ The electron beam will shut off.

3. Left–click on “File” [31] on the menu bar.

4. Click on “Close file” in the drop–down menu.

5. Click on “Yes” in the next drop–down menu.

6. Click on ”Yes” or “No” to answer the question “Do you want to save these settings?”

○ The LEO 32 program will close.

7. Left–click on “Start” [47].

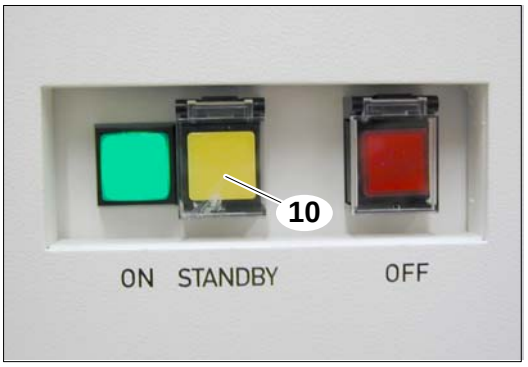
8. Click on “Exit” in the drop–down menu.

○ WINDOWS^{TM} will close.

○ The cursor will appear in the top left–hand corner of the screen.

9. Open the cover on the yellow STANDBY-button [10] and press the button.

○ The standby button will be lit.



5.12 Switching off the FE-SEM

The FE-SEM must be shut down for maintenance, repairs, if the instrument will not be used for an extended period of time or in case of an emergency.

IMPORTANT

The instrument can be shut down from the standby mode, or in an emergency, directly from the operating mode.

NOTICE

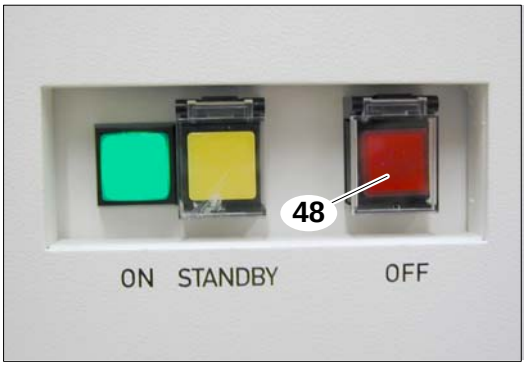
The emergency shutdown feature does not allow open programs on the computer to be closed properly.
Any unsaved changes to files may be lost!

— Open the cover on the red *OFF button* [48] and press the button.
The OFF button will light up.

○ The computer and the instrument's electronic components are now off. A 24 V auxiliary power supply makes it possible to restart the FE-SEM.

○ The vacuum system is now off.
The electro–optic column will be partially ventilated (filled with nitrogen) to keep air or dust from being drawn into the column.

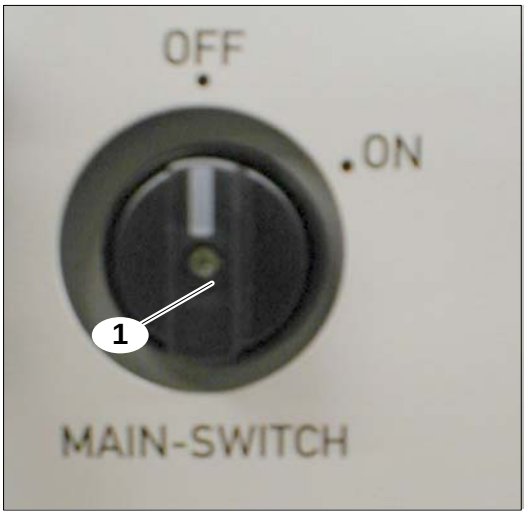
○ The FE-SEM is in Normal OFF mode.
The system is in a status that can be considered to be "Normal-OFF".



5.13 Shutting down the FE-SEM completely.

NOTICE

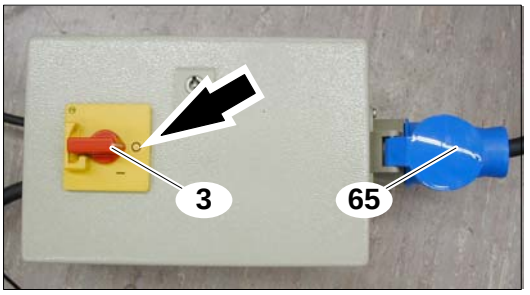
The FE-SEM should not be completely shut down unless there are unusual circumstances!



○ The FE-SEM is in Normal OFF mode.

1. Turn the on–off switch [1] to (“OFF”).

○ The power supply to the instrument is now cut off.



○ Turn the master switch [3] to the “O” position.

○ The FE-SEM is now completely shut down.

2. Use a lock to secure the master switch if necessary.

3. Unplug the power cord [65] if necessary..

6 Troubleshooting

IMPORTANT

Follow the safety instructions in Chapter 2!

Problem:

The FE-SEM won't ventilate.

Possible solutions:

2. Check the compressed air.
3. Check the nitrogen.

Problem:

The FE-SEM won't turn on.

Possible solutions:

DANGER

High–voltage electrical current can be fatal! Only sufficiently knowledgeable and qualified professional electricians may perform work on any electrical parts of the instrument.

1. Check the miniature circuit breaker and determine why it may have tripped or resolve the malfunction.
2. Check the on–off switch.

Problem:

Water Flow OK. = No

Possible solutions:

1. → See the instructions in the "Software" section.

Problem:

The instrument does not achieve Vac Ready after a specimen change.

Possible solutions:

1. Check the chamber door seal and make sure it is clean.

7 Maintenance

DANGER

Death may result if safety features are removed or non–functional!
The instrument may cause injury or death if operated with the safety features removed!
Replace the safety features immediately after any work on the instrument is completed!
Check the safety features regularly!


High–voltage electrical current can be fatal!
Only sufficiently knowledgeable and qualified professional electricians may perform work on any electrical parts of the instrument.

WARNING

Hot parts could injure the operator!
Some trim parts could heat up during long bakeout cycles and remain hot after the cycle is completed!
Touching the trim with your bare hands may cause burns!
Do not place your hands inside the cover plates!
Wear protective gloves if necessary!



IMPORTANT

Only trained and qualified personnel may perform maintenance, repairs, and any hazardous work on the instrument!

Comply with all safety requirements pertaining to fire and explosion prevention!

7.1 Inspection and maintenance schedule

No.	Tasks to be performed	Frequency	Comments
1.	Check for cleanliness	daily	Clean the FE-SEM as needed
2.	Check function of safety devices and covers	weekly	Contact LEO for service if necessary.
3.	Clean/replace HV-Penning electrode	annually	Contact LEO for service
4.	Adjust aperture/magnification	annually	Contact LEO for service
5.	Rotary pump: change oil		→ Supplier documentation

7.2 Baking out the cathode head

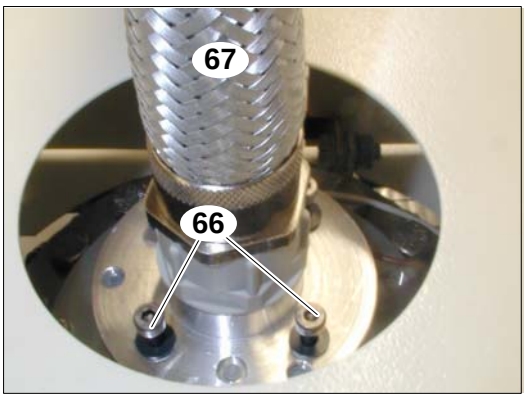
IMPORTANT

Follow the safety instructions in Chapter 2!

The vacuum in the cathode head will deteriorate over time. If the pressure increases to a value of
8 x 10^{-9} ... 9 x 10^{-9} mbar, you need to bake out the cathode head using the following procedure.

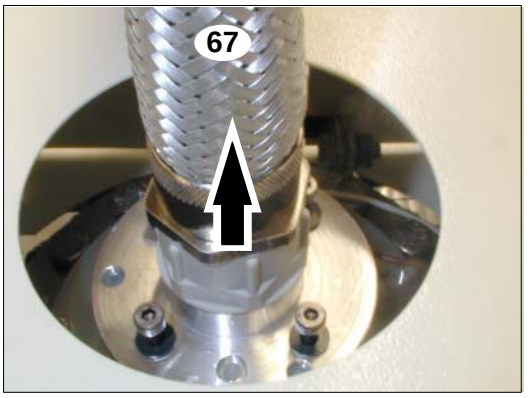
IMPORTANT

Only authorized LEO technicians may perform the bakeout procedure!



1. Shut down the high–voltage connections (EHT and GUN).
2. Loosen and remove the fastening screws [66].
3. Take hold of the high–voltage line [67].

4. Pull the plug out of the cathode head. (→ arrow)



NOTICE

Be careful not to knock the cathode out of alignment! Do not apply any side–to–side force while pulling out the high–voltage line. Pull straight back.

5. Cover the cable bushing with aluminum foil and wrap the high–voltage plug in aluminum foil.

6. “On the Tools” menu, select→ “Go to Panel”→ “Bakeout”.

WARNING

Hot parts could injure the operator!
Some trim parts could heat up during long bakeout cycles and remain hot after the cycle is completed!
Touching the trim with your bare hands may cause burns!

Fire hazard
Do not place any combustible objects on the electro–optic column grid!

You can choose from one of four bakeout cycles:

- **a.** Quick: Heat 2 hours/ cool 1 hour
- **b.** Overnight: Heat 8 hours/ cool 2 hours
- **c.** Weekend: Heat 40 hours/ cool 3 hours
- **d.** User: customized settings.

7. After bakeout is complete, plug the plug back into the cathode and switch the high–voltage line on.

7.3 Replacing the cathode

After approx. 1000 hours of operation, cathode emission will decrease, and the cathode must be replaced.

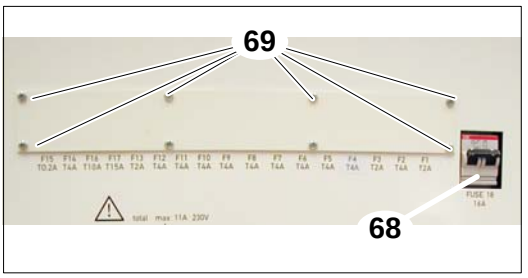
▶ **Only authorized LEO technicians may replace the cathode!**

7.4 Replacing fuses

IMPORTANT

Follow the safety instructions in Chapters 2 and 7!

1. Shut down the FESEM completely.
   (→ Chapter 5.13 - Page 47)
2. Check the miniature circuit breaker [68] (switch in up position).
3. Loosen and remove the screws [69].
4. Remove the panel.
5. Check the fuses. Remove and replace as necessary.
6. Install the strip.
7. Replace and tighten the screws [69].



No.	Value	Circuit	No.	Value	Circuit	No.	Value	Circuit	No.	Value	Circuit
F1	T2A	Water Valve	F6	T4A	EHT	F11	T4A	Spare	F16	T10A	Rotary - Pump
F2	T4A	IP-PSU	F7	T4A	PC	F12	T4A	Spare	F17	T15A	EO-PWSPL
F3	T2A	Heater1	F8	T4A	Spare	F13	T2A	Spare			
F4	T2A	Heater2	F9	T4A	EDX	F14	T4A	Turbo PWSPL			
F5	T4A	Spare	F10	T4A	WDX	F15	T0.2A	24V Contr. Volt.			

8 Customer Service

IMPORTANT

If damage or defects that could endanger people or property are discovered on the FE-SEM, shut down the machine immediately and do not use it again until all repairs are completed!

Only trained and qualified personnel may perform maintenance and repairs on the instrument!

To ensure trouble–free operation of the FE-SEM and obtain reliable results, we recommend that you enter into a service agreement with LEO Elektronenmikroskopie GmbH.

LEO Elektronenmikroskopie GmbH
Oberkochen, GERMANY
Telephone: ++49 736494-6137
Fax: ++49 736494 4851
E-mail: info@leo.de

8.1 Important telephone numbers

Radiation Protection Officer for LEO Elektronenmikroskopie GmbH	
Dr. Sold	++49 7364 202951
LEO Service Hotline	++49 736494 6138
Responsible Service Technician	**Name:** **Telephone:**

. . . . . .

Instrument log A

- Instrument No. _____
- Page No. _____
- Responsible person Name: Tel.:

IMPORTANT

Instructions, tests and changes in location must be documented in instrument log A.

The instrument log must be stored in a different location from the instruction manual! You may copy pages from this instruction manual for the instrument log, but you must number them consecutively!

Instructions

The knowledge of the operating and maintenance technician has been tested by a competent party (e.g., safety officer, supervisor) **before any work was performed**. The technician was familiarized with the safety requirements.

I hereby confirm that the safety instructions were given and my technical knowledge was checked. I read the entire instruction manual. I spoke to my supervisor and resolved everything I was unsure of.

Person instructed in the use of the instrument	Signature	Date	Instructed by

Instrument log B

- Instrument No. _____
- Page No. _____
- Responsible person Name: Tel.:

IMPORTANT

Maintenance, repairs and changes in location must be documented in instrument log B.

The instrument log must be stored in a different location from the instruction manual!
You may copy pages from this instruction manual for the instrument log, but you must number them consecutively!

Work performed and modifications made

Work performed and modifications made	Date	Signature
Work performed and modifications made	Date	Signature

Work performed and modifications made	Date	Signature

9 Disposal

IMPORTANT

The operator must ensure that waste products are disposed of and recycled in a responsible fashion.
(EG guidelines for „waste disposal”)

In particular, users must comply with the following regulations:

EG guidelines for „waste disposal”
Articles 1 through 21
Appendix I
Appendix II A
Appendix II B

No hazardous substances were used to manufacture the FE-SEM. No hazardous substances are created during examination of a specimen.

The instrument is modular. Be careful to separate the materials properly when you dispose of the instrument:

Materials: e.g., metals, non–metals, composite materials, process materials

Electronic scrap material: e.g., transformers, printed circuit boards, cables

Comply with national and regional waste disposal ordinances.

10 Technical Data

General data		
Dimensions	Length Width Height	1910 mm 985 mm 1600 mm
Transit weight	Crate 1: Column unit Crate 2: Table	approx. 820 kg approx. 349 kg
Room size		min. 3.5 x 5.0 x 2.3 m
Installation category		II
Application		exclusively inside buildings

Electrical system	
Nominal AC voltage	208 ... 240 V AC +5%... –10%
Nominal frequency	50 ... 60 Hz
Current input	max. 16 A
Nominal current of line–side fuse	max. 16 A
PE conductor cross–section (protective ground)	> 4 mm^2

Cooling	
Water flow rate	> 2 l/min
Input pressure	2 ... 3 bar
Water temperature	18 ˚C ... 22 ˚C
Water use with closed–circuit cooling system	max. 120 l/h

Nitrogen	
Pressure	0,2 ... 0,3 bar
Nitrogen use when chamber is open	2 l/min
Percentage purity	99,996 %

Compressed air	
Input pressure	max. 6 bar

Ambient conditions	
Ambient temperature	approx. 22 ˚C ±5 ˚C (stability ±1 ˚C)
Relative humidity	< 65%
Floor vibration	< 2 µm/sec rms. < 20 Hz < 6 µm/sec rms. > 20 Hz
Magnetic stray fields	< 3 mG 50/60 Hz
Acoustic noise	< 50 dBA at a frequency of > 200 Hz < 35 dBA at a frequency of < 200 Hz
Degree of pollution	2

11 Appendix

11.1 Wearing parts

Name		LEO no.
Fe cathode		302.102
Oil mist filter	Alcatel	345572-0000-901
Adsorption cartridge		113.856

11.2 Replacement parts

Name		LEO no.
Fuses	T 0.2 A T 2.0 A T 4.0 A T10.0 A T15.0 A	127.013 127.024 122.131 302.848 148.331

11.3 Lubricants

Name		LEO no.
Vacuum oil	Alcatel 120 standard oil	67-770
Adsorptive material	Varian cartridge	113-856

11.4 Accessories

Name		LEO no.
Specimen tweezers		
Specimen holder		
Specimen container		
1.5 mm Allen wrench		

11.5 Supplier documentation

12 Declaration of Conformity
Konformitäts-Erklärung
Déclaration de Conformité

We / Wir / Nous

LEO Elektronenmikroskopie GmbH
Carl Zeiss Str. 56
73446 Oberkochen
Germany

declare under our sole responsibility that the products
erklären in alleiniger Verantwortung, daß die Produkte
déclarons sous notre seule responsibilité que les produits

Scanning Electron Microscopes
LEO 1525, LEO 1530, LEO 1550, LEO 1560
LEO 1530VP, LEO 1550VP, LEO 1560VP with GEMINI column

to which this declaration relates are in conformity with the following standards
auf die sich diese Erklärung bezieht, mit den folgenden Normen übereinstimmt
auxquels se réfère cette déclaration sont conformes aux normes

EN 50081-2	**Conductive and Radiated Emissions (Class A on Radiated Emissions)**
EN 50082-2	**Immunity**
EN 61010-1	**Safety requirements for electrical equipment for measurement control and laboratory use**

following the provisions of directives
gemäß den Bestimmungen der Richtlinien
conformément aux dispositions des directives

89/336/EEC	**Electromagnetic Compatibility, changed by 93/68/EEC**
73/23/EEC	**Low Voltage, changed by 93/68/EEC**

for and on behalf of

Signed:	Johannes Bihr	Dr. Peter Czurratis
Position:	R&D Manager	General Manager
Date:	10.08.2001	10.08.2001

Issue 1 **10.08.2001** 1560uniplatth.doc
The master copy of this Declaration is held by the R&D Manager
and Copies of this Declaration are held in:
LEO Electron Microscopy Ltd. Clifton Road, Cambridge CB1 3QH, United Kingdom and
LEO Microscopie Electronique SARL, 86 avenue du 18 juin 1940, F-92500 Rueil-Malmaison, France
Copies must be re-issued if updated.

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