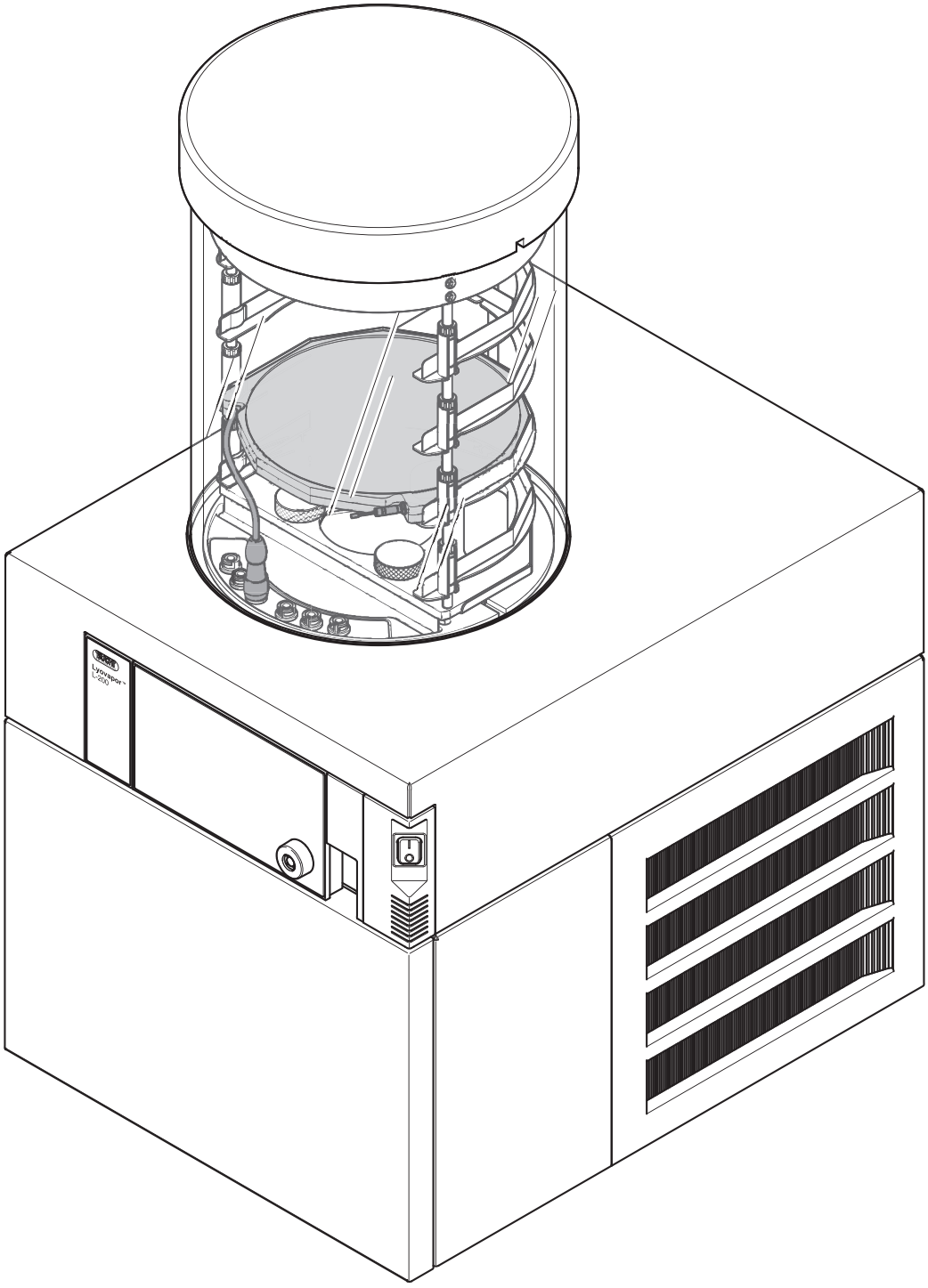
# Lyovapor™ L-200/L-200 Pro
# Operation Manual



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# Contents

# 1 About this document

This operation manual is applicable for all variants of the instrument.

Read this operation manual before operating the instrument and follow the instructions to ensure safe and trouble-free operation.

Keep this operation manual for later use and pass it on to any subsequent user or owner.

BÜCHI Labortechnik AG accepts no liability for damage, faults and malfunctions resulting from not following this operation manual.

If you have any questions after reading this operation manual:

▶ Contact BÜCHI Labortechnik AG Customer Service.

https://www.buchi.com/contact

## 1.1 Connected devices

In addition to these operating instructions, you should also follow the instructions and specifications in the documentation for the connected devices.

## 1.2 Warning notices in this document

Warning notices warn you of dangers that can occur when handling the device. There are four danger levels, each identifiable by the signal word used.

| Signal word | Meaning |
|---|---|
| DANGER | Indicates a danger with a high level of risk which could result in death or serious injury if not prevented. |
| WARNING | Indicates a danger with a medium level of risk which could result in death or serious injury if not prevented. |
| CAUTION | Indicates a danger with a low level of risk which could result in minor or medium-severity injury if not prevented. |
| NOTICE | Indicates a danger that could result in damage to property. |

## 1.3 Symbols

The following symbols may be displayed in this instruction manual or on the device:

### 1.3.1 Warning symbols

| Symbol | Meaning |
|---|---|
|  | General warning |
|  | Breakable items |
|  | Device damage |

### 1.3.2 Mandatory directive symbols

| Symbol | Meaning | Symbol | Meaning |
|---|---|---|---|
|  | Wear safety goggles |  | Wear protective clothing |
|  | Wear protective gloves |  | Heavy load, do not lift without assistance |

### 1.3.3 Mark-ups and symbols

**NOTE**

This symbol draws attention to useful and important information.

☑ This character draws attention to a requirement that must be met before the instructions below are carried out.

▶ This character indicates an instruction that must be carried out by the user.

⇨ This character indicates the result of a correctly carried out instruction.

| Mark-up | Explanation |
|---|---|
| *Window* | Software Windows are marked-up like this. |
| *Tab* | Tabs are marked-up like this. |
| *Dialog* | Dialogs are marked-up like this. |
| *[Button]* | Buttons are marked-up like this. |
| *[Field names]* | Field names are marked-up like this. |
| *[Menu / Menu item]* | Menus or menu items are marked-up like this. |
| **Status** | Status is marked-up like this. |
| **Signal** | Signals are marked-up like this. |

## 1.4 Trademarks

Product names and registered or unregistered trademarks that are used in this document are used only for identification and remain the property of the owner in each case.

# 2 Safety

## 2.1 Proper use

The Lyovapor™ L-200 is used for freeze-drying solid materials in ampoules, vials, dishes, round-neck or wide-neck flasks and trays is exclusively intended for that purpose. The Lyovapor™ L-200 can be used in laboratories for the following tasks:

- Sublimating and re-sublimating water

## 2.2 Use other than that intended

Use of any other kind than that described in the section Chapter 2.1 "Proper use", page 9 and any application that does not comply with the technical specifications (see Chapter 3.6 "Technical data", page 17) constitutes use other than that intended.

In particular, the following applications are not permissible:

- Use of the instrument in an environment with a potential risk of explosion or areas which require explosion-safe apparatus.
- Use of the instrument for processing substances outside of research and development.
- Production and processing of substances that can lead to spontaneous reactions, such as explosives, metal hydrides or solvents that can form peroxides.
- Processing with explosive gas mixtures.
- Use of acids and alkalis without first checking material compatibility.

Damage or hazards attributable to use of the product other than as intended are entirely at the risk of the operator alone.

## 2.3 Staff qualification

Unqualified persons are unable to identify risks and are therefore exposed to greater dangers.

The device may only be operated by suitably qualified laboratory staff.

These operating instructions are aimed at the following target groups:

**Users**

Users are persons that meet the following criteria:

- They have been instructed in the use of the device.
- They are familiar with the contents of these operating instructions and the applicable safety regulations and apply them.
- They are able on the basis of their training or professional experience to assess the risks associated with the use of the device.

**Operator**

The operator (generally the laboratory manager) is responsible for the following aspects:

- The device must be correctly installed, commissioned, operated and serviced.
- Only suitably qualified staff may be assigned the task of performing the operations described in these operating instructions.
- The staff must comply with the local applicable requirements and regulations for safe and hazard-conscious working practices.
- Safety-related incidents that occur while using the device should be reported to the manufacturer (quality@buchi.com).

**BUCHI service technicians**

Service technicians authorized by BUCHI have attended special training courses and are authorized by BÜCHI Labortechnik AG to carry out special servicing and repair measures.

## 2.4 Location of warning signs on the product

The following warning symbols are present on the instrument.

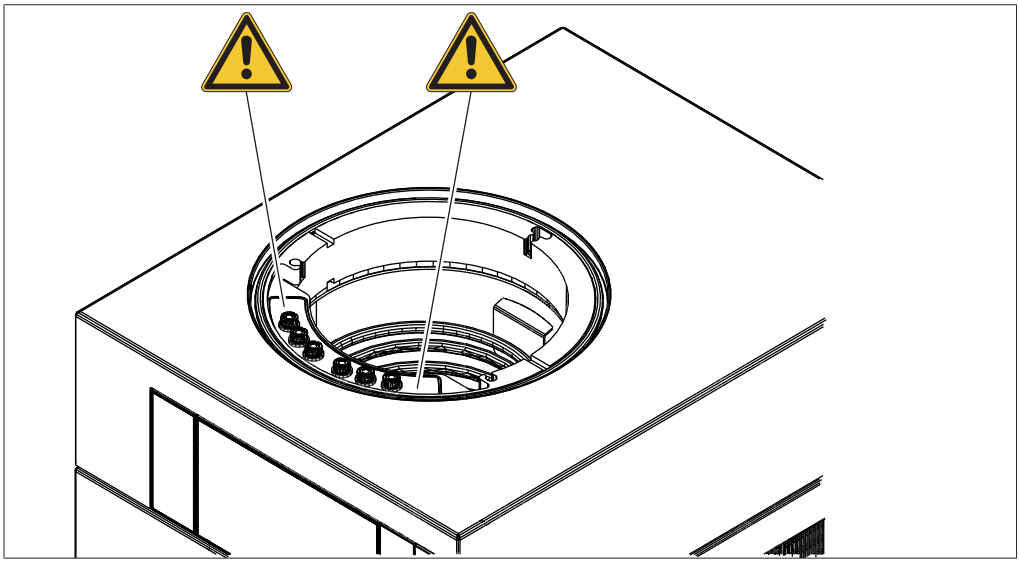


Fig. 1: Location of warning signs on the product

⚠ General warning

## 2.5 Residual risks

The device has been developed and manufactured using the latest technological advances. Nevertheless, risks to persons, property or the environment can arise if the device is used incorrectly.

Appropriate warnings in this manual serve to alert the user to these residual dangers.

### 2.5.1 Faults during operation

If a device is damaged, sharp edges or exposed electrical wires can cause injuries.

- ▶ Regularly check device for visible damage.
- ▶ If faults occur, switch off the device immediately, unplug the power cord and inform the operator.
- ▶ Do not continue to use devices that are damaged.

### 2.5.2 Damage to the ice condenser

Damage to the ice condenser leads to coolant leakage and failure of the instrument.

- ▶ Wait until the ice is completely thawed.
- ▶ Do not use mechanical means to remove ice from the ice condenser.

### 2.5.3 Glass and acrylic breakage

Broken glass and acrylic can cause severe cuts.

Damaged glass and acrylic components may implode if subjected to a vacuum.

Minor damage to the ground joints impairs the sealing effect and may therefore diminish sublimination capacity.

- ▶ Handle the flask and other glass and acrylic components carefully and do not drop them.
- ▶ Always place the flasks in a suitable holder when they are not mounted on the Lyovapor™.
- ▶ Always visually inspect glass and acrylic components for damage every time they are to be used.
- ▶ Do not continue to use glass and acrylic components that are damaged.
- ▶ Always wear protective gloves when disposing of broken glass and acrylic.

### 2.5.4 Low internal pressure

Evacuating the system reduces the pressure in the drying chamber. This reduced pressure can cause glass and acrylic components to implode.

- ▶ Make sure that all glass and acrylic components are free of damage.

### 2.5.5 Cold and hot surfaces

The condenser coil and probes can be extremely cold. Heatable shelf areas can be extremely hot. If touched, hot and cold surfaces can cause skin burns.

- ▶ Do not touch cold or hot surfaces or liquids and/or wear suitable protective gloves.

## 2.6 Personal protective equipment

Depending on the application, hazards due to heat and/or corrosive chemicals may arise.

- ▶ Always wear appropriate personal protective equipment such as safety goggles, protective clothing and gloves.
- ▶ Make sure that the personal protective equipment meets the requirements of the safety data sheets for all chemicals used.

## 2.7 Modifications

Unauthorized modifications may impair safety and lead to accidents.

- ▶ Use only genuine BUCHI accessories, spare parts and consumables.
- ▶ Technical modifications to the device or accessories should only be carried out with the prior written approval of BÜCHI Labortechnik AG and only by authorized BUCHI technicians.

BUCHI accepts no liability whatsoever for damage arising as a result of unauthorized modifications.

# 3 Product description

## 3.1 Description of function

The Lyovapor™ is a freeze-dryer in which frozen preparations can be gently dried.

The basis of freeze-drying is sublimation. Sublimation refers to the process whereby a substance transforms directly from the solid to the gaseous state.

The physical process of sublimation can be explained using the solvent water as an example.

- The water is frozen.
- The frozen water is transformed into the gaseous state under vacuum at a pressure below the triple point.
- The vacuum prevents the ice melting when heat is applied to the preparation.

Thus, freeze-drying takes place in three phases:

1. **Freezing phase:** the preparation is frozen at atmospheric pressure.
2. **Main drying phase:** heat is applied to the frozen preparation under a vacuum. The frozen water is removed by sublimation.
3. **Secondary drying phase (only possible with heatable shelves):** the trace levels of water remaining are removed by heating.

The Lyovapor™ consists of an ice condenser and various top-mount drying racks. The top-mount drying racks can be chosen to suit the availability of the preparation being dried and the requirements of the end product.

The following top-mount drying racks can be used:

- Non-heatable and heatable shelves in rack
- Trays in rack
- Top-mount rack with manifold valves

### 3.1.1 Freezing phase

In the freezing phase, the aqueous preparation is transformed to a solid state. Freezing takes place under atmospheric pressure using a separate freezer, a liquid nitrogen bath, or a mixture of dry ice and alcohol.

The end of the freezing phase is reached as soon as the water contained in the preparation has fully crystallized.

### 3.1.2 Main drying phase

In the main drying phase, the ice crystals are removed from the preparation by sublimation. Sublimation in the Lyovapor™ takes place under a vacuum with the addition of thermal energy.

To create the vaccum, the pressure is lowered to the level required for sublimation.

For water that is: less than 6.11mbar.

As the ice condenser is colder than the preparation being dried, the vapour pressure in the area of the ice condenser is lower than in the area of the preparation. The water vapour escaping from the preparation therefore flows towards the ice condenser. The water vapour condenses on the coil of the ice condenser.

If a manifold-valve rack is used, heat transfer takes place by convection and radiation from the surroundings. Control of the thermal energy transferred is then difficult.

If using a drying chamber with heatable shelves, heat transfer takes place by direct contact. The temperature of the heatable shelves is controllable. Control of the thermal energy transferred is then possible.

Controlling the heat transfer prevents the following critical temperatures for amorphous and crystalline materials to be reached:

- the glass transition temperature $T_g'$ of the frozen preparation
- the collapse temperature $T_c$.
- the eutectic temperature $T_{eu}$.

Above the glass transition temperature and the collapse temperature, the viscosity of the frozen preparation increases. The increased viscosity leads to the collapse of the preparation's matrix structure.

Above the eutectic temperature, the preparation melts.

During the main drying phase, the product temperature must remain below the collapse temperature for amorphous materials in the preparation.

Sublimation of the ice crystals progresses downwards from the surface of the product. Above the sublimation boundary, the product is dry ("freeze-dried cake"), while further inside the product is still frozen.

The end of the main drying phase is reached when all ice crystals have been removed from the preparation.

After the main drying phase, the remaining fluid content in the preparation can still be between 5 to 10%.

### 3.1.3 Secondary-drying phase

In the secondary-drying phase, the unfrozen water is removed from the preparation by desorption. The secondary-drying function is performed by the heatable shelves in the drying chamber of the Lyovapor™.

In the secondary-drying phase, the temperature of the heatable shelves is raised and held for several hours.

The end of the secondary-drying phase is reached when the residual moisture in the preparation is between 1% and 5%.

## 3.2 Configuration

### 3.2.1 Front view

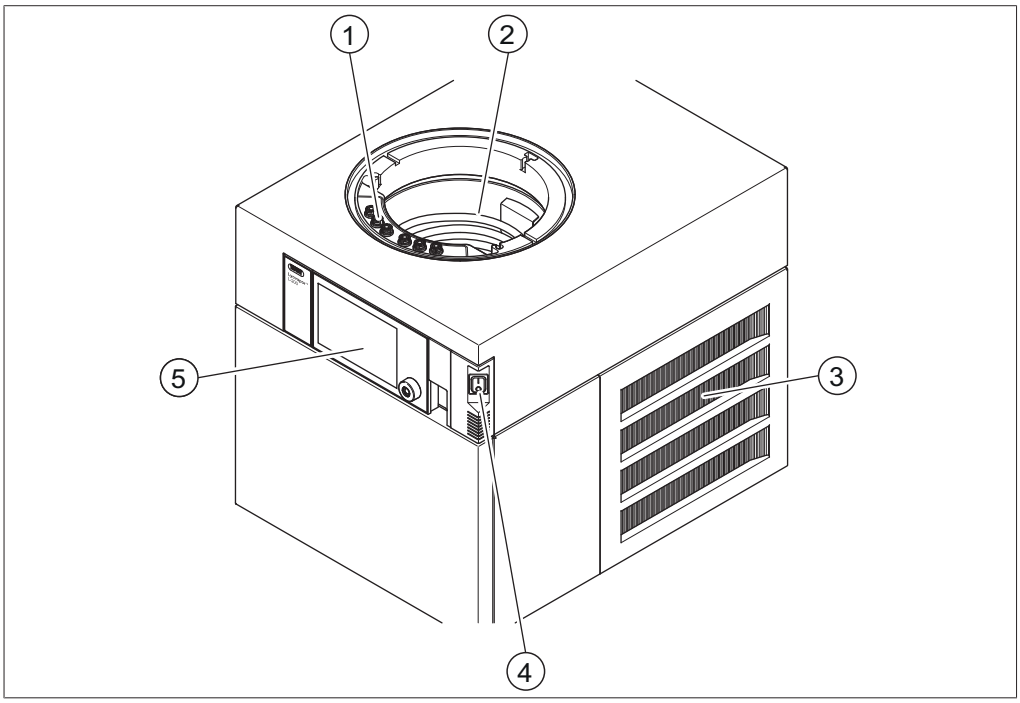



Fig. 2: Front view Lyovapor™ L-200

1 Connections for heated shelves (Lyovapor™ L-200 Pro only) (48 V, max. 2 A)
2 Ice condenser
3 Ventilation slots
4 On/Off master switch
5 User interface

### 3.2.2 Rear view

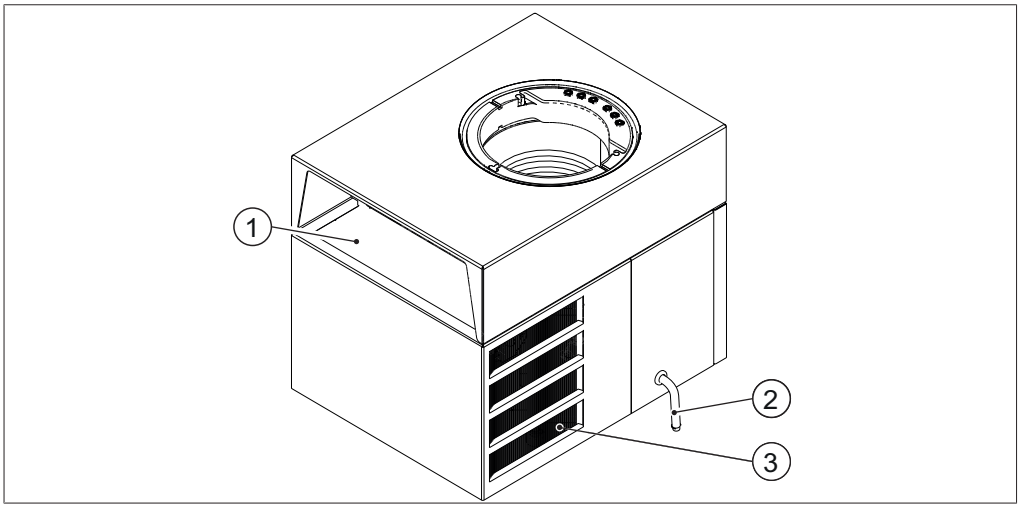



Fig. 3: Rear viewLyovapor™ L-200

1 Connections on the rear side (See Chapter 3.2.3 "Connections on the rear side", page 15)
2 Drain hose for condensate
3 Ventilation slots

### 3.2.3 Connections on the rear side

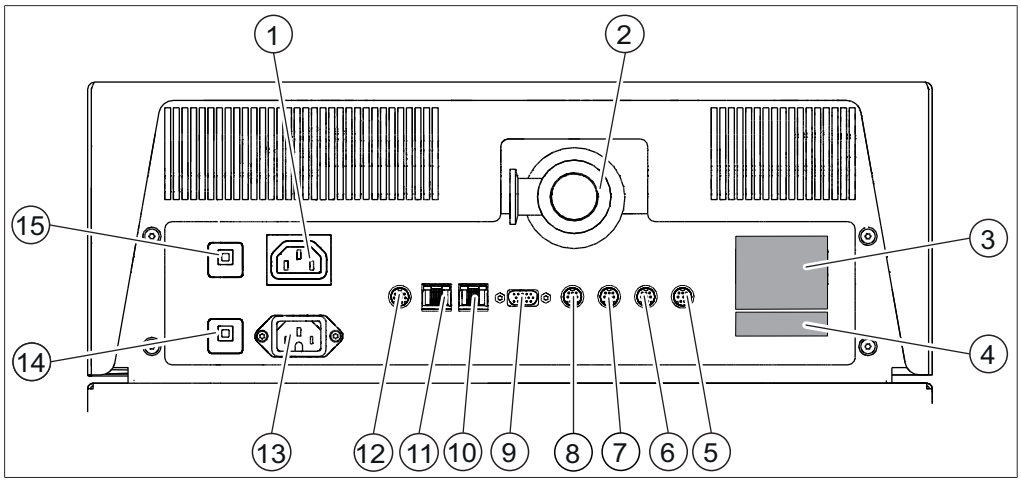



Fig. 4: Connections on rear panel

| | | | |
|---|---|---|---|
| 1 | Vacuum pump connection | 2 | Vacuum connection |
| 3 | Type plate | 4 | Refrigerant details |
| 5 | Main valve connection (24 V, ≤ 0.4 A) | 6 | Pressure regulating valve connection (24 V, ≤ 0.4 A) |
| 7 | Aeration valve connection (24 V, ≤ 0.4 A) | 8 | Spare (24 V, ≤ 0.4 A) |
| 9 | External pressure sensor connection (24 V, max. 0.125 A) | 10 | Internal pressure sensor connection (5 V, max. 0.125 A) |
| 11 | LAN port | 12 | COM port (24 V, ≤ 0.4 A) |
| 13 | Power supply connection | 14 | Fuse |
| 15 | Fuse | | |

### 3.2.4 Control panel

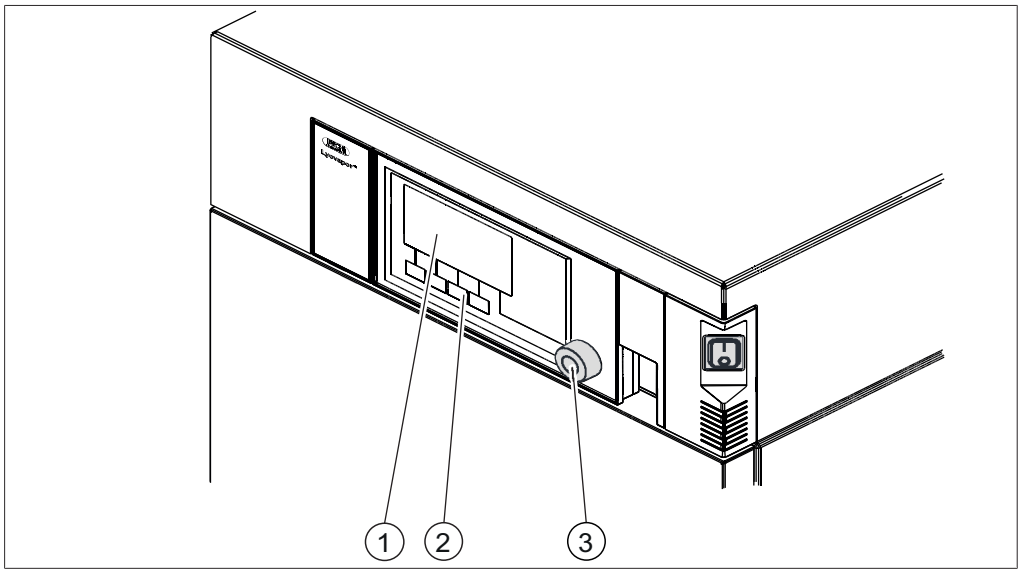



Fig. 5: Control panel

| | | | |
|---|---|---|---|
| 1 | View | 2 | Function buttons |
| 3 | Navigation control | | |

### 3.2.5 Pro control panel

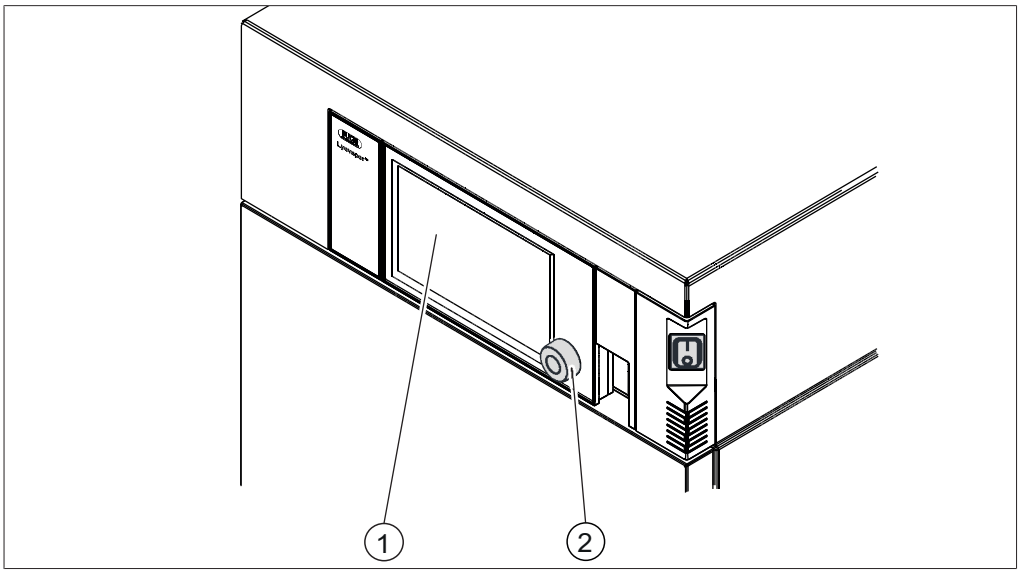



Fig. 6: Pro control panel

| | | | |
|---|---|---|---|
| 1 | Touch-screen display | 2 | Navigation control |

## 3.3 Type plate

The type plate identifies the instrument. The type plate is located on the rear of the instrument.

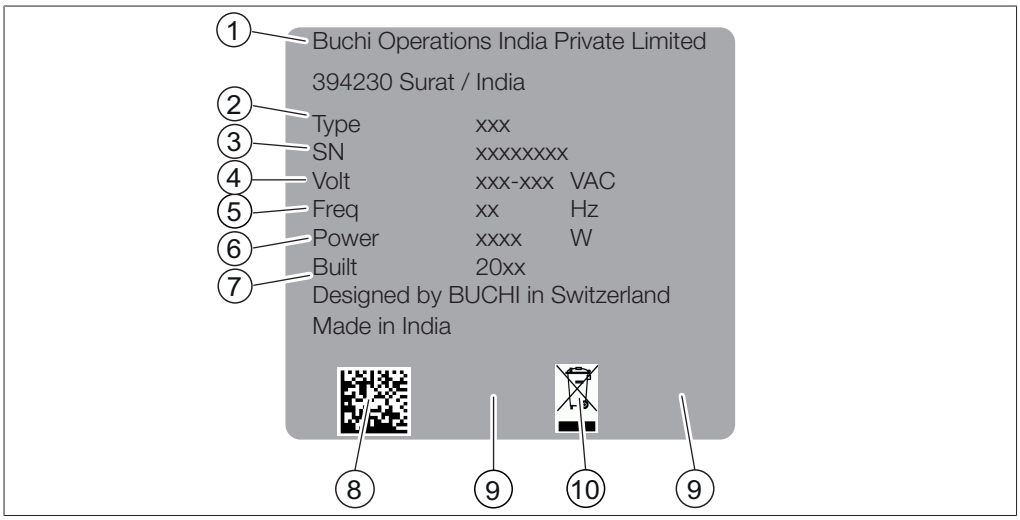



Fig. 7: Type plate

| | | | |
|---|---|---|---|
| 1 | Company name and address | 2 | Instrument name |
| 3 | Serial number | 4 | Input voltage range |
| 5 | Frequency | 6 | Power consumption maximum |
| 7 | Year of manufacture | 8 | Product code |
| 9 | Approvals | 10 | Symbol for "Do not dispose of as household waste" |

The following instrument names are possible:

- L-200
- L-200 Pro

## 3.4 Scope of delivery

**NOTE**

The scope of delivery depends of the configuration of the purchase order.

Accessories are delivered as per the purchase order, order confirmation, and delivery note.

## 3.5 Refrigerant Specification

The refrigerant details are shown on the back of the instrument.

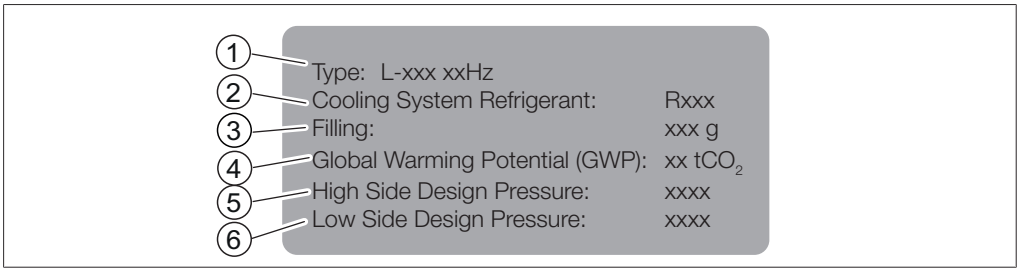



Fig. 8: Refrigerant details

| | | | |
|---|---|---|---|
| 1 | Instrument name | 2 | Refrigerant details |
| 3 | Filling capacity | 4 | Global warming potential |
| 5 | High-pressure system design pressure | 6 | Low-pressure system design pressure |

## 3.6 Technical data

### 3.6.1 Lyovapor™ L-200

| Specification | L-200 for 50Hz | L-200 for 60Hz |
|---|---|---|
| Dimensions without drying attachments (W x D x H) | 460 × 585 × 510 mm | 460 × 585 × 510 mm |
| Weight | 75 kg | 75 kg |
| Minimum clearance on all sides | 300 mm | 300 mm |
| Connection voltage | 220-240 VAC | 208-230 VAC |
| Power consumption (rated) | 1200 W | 1200 W |
| Power consumption (maximum) | 1800 W | 1800 W |
| Lug | 10 A/250 V | 10 A/250 V |
| Frequency | 50 Hz | 60 Hz |
| Overvoltage category | II | II |
| Protection rating | IP20 | IP20 |
| Pollution degree | 2 | 2 |
| Condensing capacity at 20 °C ambient temperature | ≥ 6 kg / 24 h | ≥ 6 kg / 24 h |
| Lowest condenser temperature | -55 °C | -55 °C |
| Temperature divergence | ± 1.0 °C | ± 1.0 °C |

| Specification | L-200 for 50Hz | L-200 for 60Hz |
|---|---|---|
| Condenser capacity | ≤ 6 kg | ≤ 6 kg |
| Condenser surface area | 1410 $cm^2$ | 1410 $cm^2$ |
| Number of compressors | 1 | 1 |
| Refrigerant | R507 CFC-free | R507 CFC-free |
| Refrigerant quantity | 485 g | 467 g |
| Drying shelf temperature | up to 60 °C | up to 60 °C |
| Inert gas pressure | 1.1 - 1.2 bar (max. 2 bar) | 1.1 - 1.2 bar (max. 2 bar) |
| Drying shelf temperature tolerance | ± 1.0 °C | ± 1.0 °C |
| Cooling capacity compressor | 1.97 kW | 2.33 kW |
| Vacuum generation time to 0.1 mbar* | Typically ≤ 10 min | Typically ≤ 10 min |
| Volume-based leakage rate* | Typically ≤ 0.001 mbar x L/sec | Typically ≤ 0.001 mbar x L/sec |
| Minimum system vacuum* | Typically ≤ 30 mTorr | Typically ≤ 30 mTorr |
| Optimum control range vacuum* | 50 to 500 mTorr | 50 to 500 mTorr |

* With Pfeiffer Duo 6 vacuum pump / without samples

### 3.6.2 Ambient conditions

For indoor use only.

| | |
|---|---|
| Max. altitude above sea level | 2000 m |
| Ambient temperature | 15 - 30°C |
| Maximum relative humidity | 80 % for temperatures up to 30°C |
| Storage temperature | max. 45°C |

### 3.6.3 Materials

| Component | Materials |
|---|---|
| Lyovapor™ housing | Steel 1.4301/304 with powder coating |
| Vacuum chamber and components | Steel 1.4301/304 |
| Main connector | PE-UHMW 1000 |
| Drying chamber tube and cover | PMMA GS |
| Seals | FKM |
| Manifold drying rack | Steel 1.4301/304 |
| Manifold valves | Natural rubber, PP |
| Cooling medium circuit | Copper for freezing applications to EN 12735-1 |
| Vacuum clips | Aluminium |
| Condensate drain tube | Silicone |
| Condensate drain, ventilation and control valve | Brass with EPDM seal |
| Main valve | Aluminum with FKM seal |

# 4 Transport and storage

## 4.1 Transport

**NOTICE**

**Risk of breakage due to incorrect transportation**

Make sure that the instrument is fully dismantled.

Pack every instrument components properly to prevent breakage. Use the original packaging whenever possible.

Avoid sharp movements during transit.

- ▶ After transporting, check the instrument and all glass components for damage.
- ▶ Damage that has occurred in transit should be reported to the carrier.
- ▶ Keep packaging for future transportation.

## 4.2 Storage

- ▶ Make sure that the ambient conditions are complied with (see Chapter 3.6 "Technical data", page 17).
- ▶ Wherever possible, store the device in its original packaging.
- ▶ After storage, check the device, all glass components, seals and tubing for damage and replace if necessary.

## 4.3 Lifting the instrument

**⚠ WARNING**

**Danger due to incorrect transportation**

The possible consequences are crushing injuries, cuts and breakages.

- ▶ The instrument should be transported by four persons at the same time.
- ▶ Lift the instrument at the points indicated.

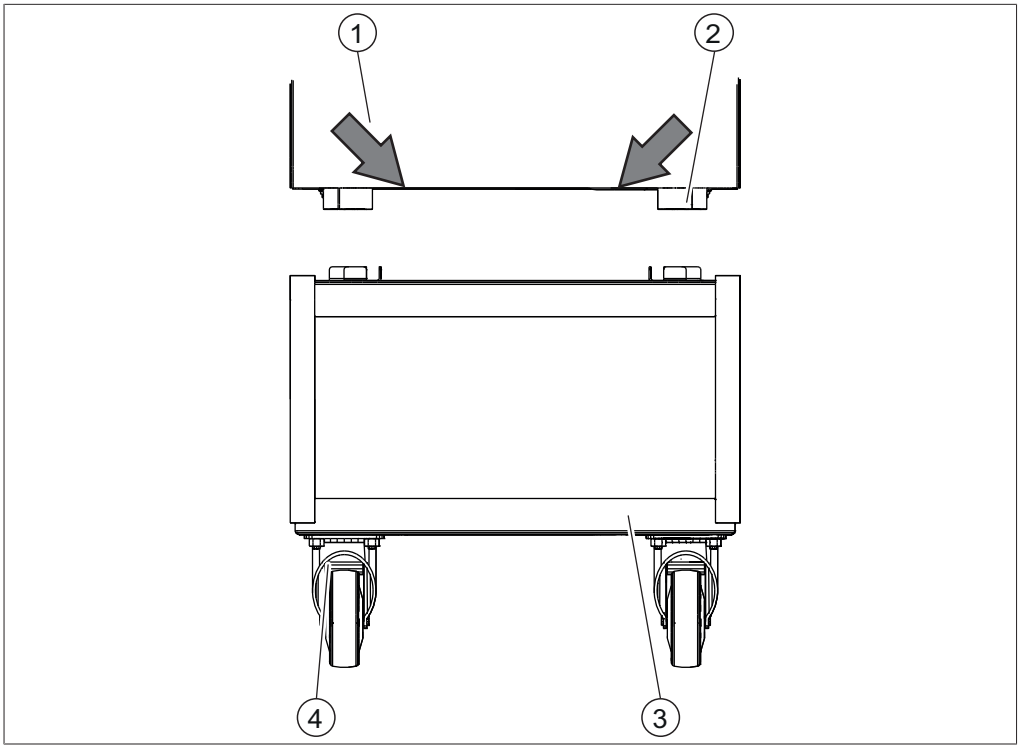



Fig. 9: Lifting the instrument

| | | | |
|---|---|---|---|
| 1 | Instrument | 2 | Feet |
| 3 | Equipment trolley | 4 | Castor brakes on trolley |

Precondition:

☑ Make sure that the castor brakes on the equipment trolley are locked on.

▶ Lift the instrument – this requires four persons each lifting at one of the points indicated on the front and rear of the instrument.

▶ Set the instrument down on the equipment trolley.

# 5 Installation

## 5.1 Installation site

**NOTICE**

**Instrument damaged if switched on too early.**

After transporting, wait twelve hours before switching on the instrument. The fluid in the cooling system requires twelve hours to collect in the refrigerant compressor.

The installation site must meet the following requirements:

- Firm, level surface
- Minimum space requirement: 520 mm x 645 mm x 510 mm (W x D x H).
- Take into account the maximum product dimensions and weight.
- Take into account the 1100 mm operating height of the drying attachments.
- Clearance on each side of the instrument must be at least 30 cm. This clearance ensures air circulation and prevents the instrument from overheating.
- Do not place loose papers or cloths below or to the sides of the instrument, as these could impede the air circulation if drawn in.
- Operate the instrument at an ambient temperature of +15°C to +30°C.
- Do not expose the instrument to any external thermal loads, such as direct solar radiation.
- When installing the instrument, make sure that the feet do not bend.
- When mounting on an instrument cart, place the feet of the instrument into the supports on the instrument cart.

**NOTE**

Make sure that the power supply can be interrupted at any time during an emergency.

## 5.2 Securing against earthquakes

The Lyovapor™ L-200 has an earthquake fixing point to protect the device against falling.

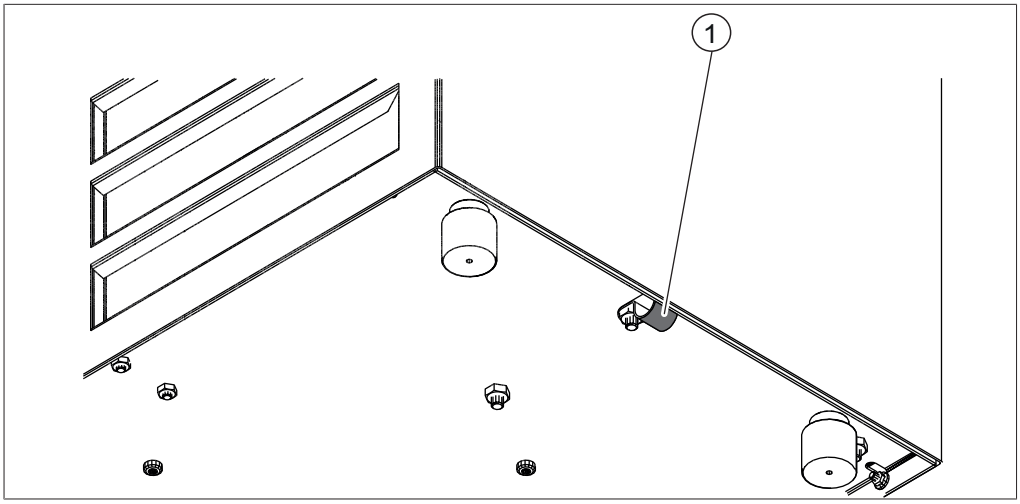



Fig. 10: Lyovapor™ L-200

1 Lashing mount

▶ Tie the lashing mount to a fixed point using strong cord or a wire.

## 5.3 Putting the instrument in operation

**NOTICE**

**Instrument damaged if restarted too early**

Wait ten minutes before restarting the instrument. The oil in the refrigerant compressor requires ten minutes to return to the collection tank.

### 5.3.1 Preparing the instrument

▶ Clean the instrument with a damp cloth before commissioning.
▶ Check all sealing surfaces for scratches, dust, and cleanliness.

### 5.3.2 Establishing electrical connections

**NOTE**

Observe the legal requirements when connecting the instrument to the power supply.

‣ Use additional electrical safety features (e.g., residual-current circuit breakers) to comply with local laws and regulations.

The power supply must fulfil the following conditions:

1. Provide the mains voltage and frequency specified on the type plate of the instrument.
2. Be designed for the load imposed by the instruments connected.
3. Be equipped with suitable fuses and electrical safety features.
4. Be equipped with proper earthing.

## NOTICE

**Risk of property damage and diminished performance due to use of unsuitable power cables.**

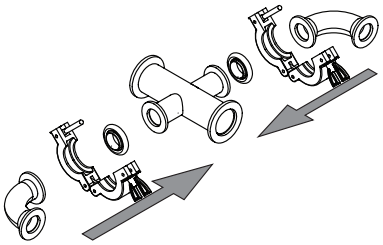
The power supply cables supplied with the product by BUCHI precisely match the requirements of the device. If other power cables that do not meet those requirements are used, the device may be damaged and/or its performance diminished.

- ▶ Use only the power supply cables supplied with the product or ordered separately from BUCHI.
- ▶ If using any other power supply cables, make sure that they match the specifications on the type plate.

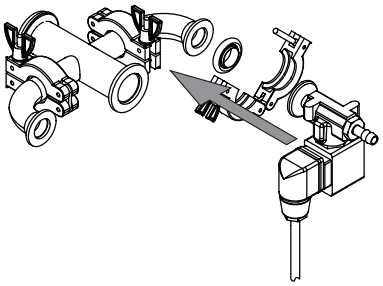
- ▶ Make sure that all connected devices are earthed.
- ▶ If an extension lead is required, make sure that it is earthed and has a suitable power rating.
- ▶ Make sure that the power plug is freely accessible at all times.
- ▶ Plug the power cable into the connection labelled **Power IN** on the back of the instrument.
- ▶ Plug the mains plug into the power socket.

### 5.3.3 Fitting the advanced vacuum control unit

▶ Fit the 90° elbows onto the cross-pipe.

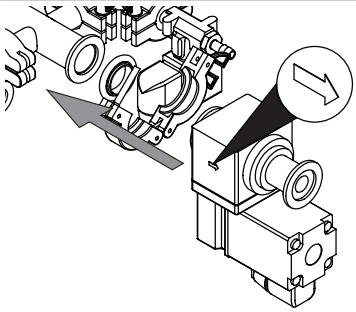


▶ Fit the aeration valve onto the 90° elbow.

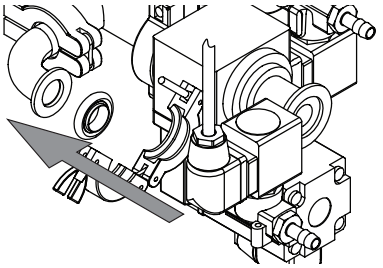


Precondition:
☑ The arrow is pointing in the direction of the vacuum pump.

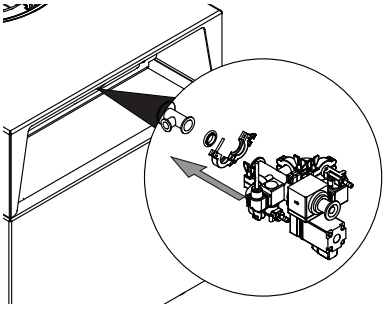
▶ Fit the main valve onto the cross-pipe.



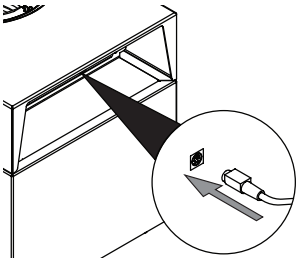
▶ Fit the pressure-regulating valve onto the 90° elbow.



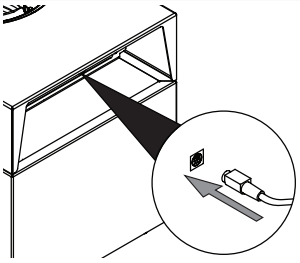
▶ Fit the assembled advance vacuum control unit onto the instrument.



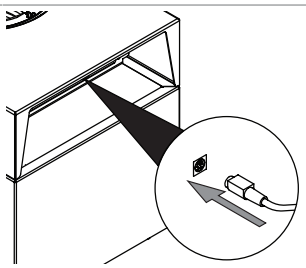
▶ Plug the aeration valve connector into the socket marked **Aeration Valve**.



▶ Plug the pressure-regulating valve connector into the socket marked **Regulation valve**.



▶ Plug the main valve connector into the socket marked **Main Valve**.



### 5.3.4 Manual switch on the main valve

Use the main valve manual switch to set the vacuum control mode.

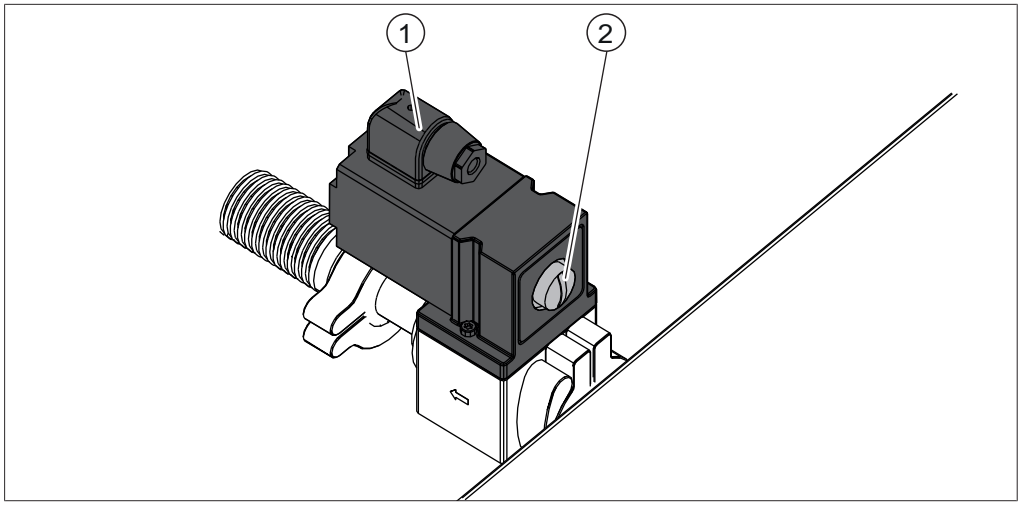
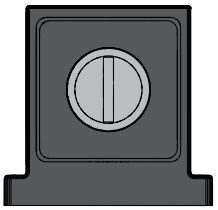
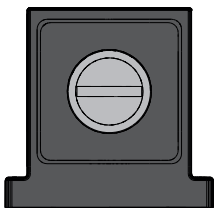



Fig. 11: Manual switch on main valve

1 Main valve
2 Manual switch on main valve

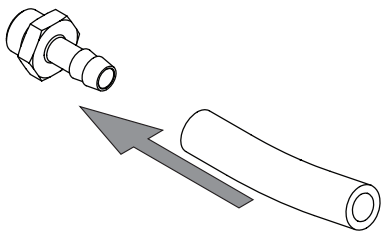
**Manual switch positions**

| Manual switch position | Meaning |
|---|---|
|  | Precondition:<br>☑ Pressure-regulating valve and venting valve are connected.<br>▶ The vacuum is regulated by the pressure-regulating valve and venting valve. |
| | Precondition:<br>☑ Pressure-regulating valve and venting valve are not connected.<br>▶ The vacuum is regulated by the main valve. |
| | Precondition:<br>☑ The main valve manual switch is depressed.<br>▶ As long as the main valve manual switch is depressed, vacuum regulation is deactivated. |
|  | The vacuum is not regulated. |

### 5.3.5 Connecting the inert gas (optional feature)

Precondition:
☑ Make sure that the pressure of the inert gas matches the technical specifications. See Chapter 3.6 "Technical data", page 17

▶ Fit the inert gas tube onto the gas connection on the pressure regulating valve.
▶ Fix the inert gas tube with the tube clip.



### 5.3.6 Assembling pressure sensor PPG010 (optional accessory)

The pressure sensor measures the pressure in the ice condenser.

To protect against damage in transit, the pressure sensor is supplied pre-calibrated in the original packaging.

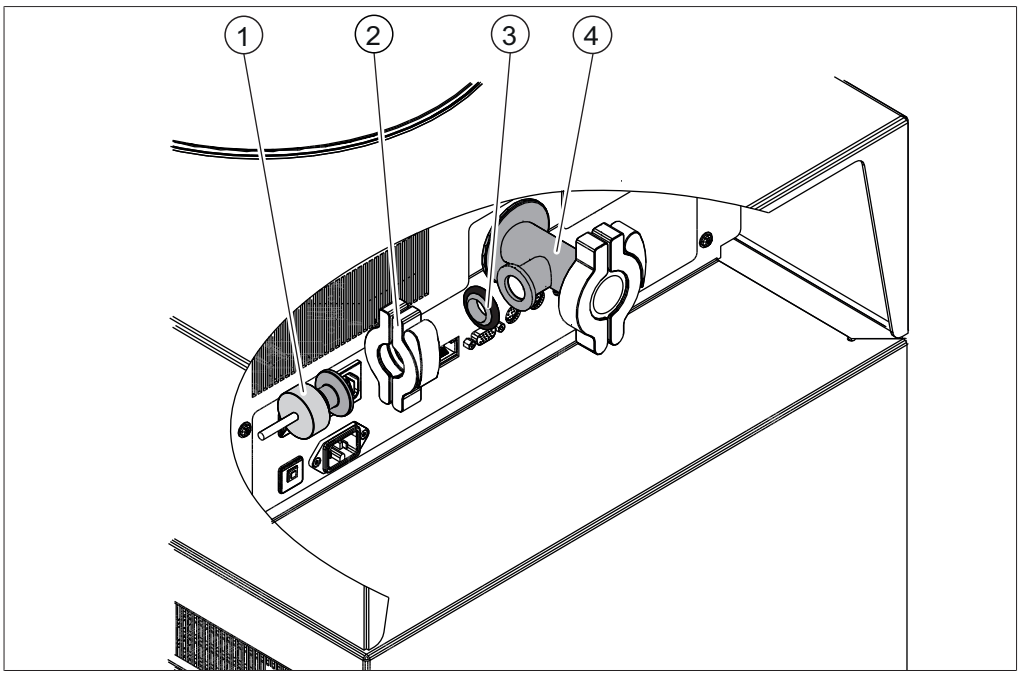



Fig. 12: Fitting the pressure sensor

| | | | |
|---|---|---|---|
| 1 | Pressure sensor PPG010 | 2 | Clamp, ISO-KF 16 |
| 3 | Seal, ISO-KF 16 | 4 | Connection, ISO-KF 16 |

- ▶ Switch the On/Off master switch to Off.
- ▶ Remove the shipping cap from the connection (4).
- ▶ Fit the pressure sensor (1) and seal (3) to the connection (4) and fix with the clamp (2).
- ▶ Plug the pressure sensor electrical connection into the socket marked **Internal Vacuum Sensor**.
- ▶ Select the sensor from the submenu *[Settings]* on the control panel.

### 5.3.7 Assembling the alternative pressure sensor (optional accessory)

Instead of the standard pressure sensor, an alternative pressure sensor can be used.

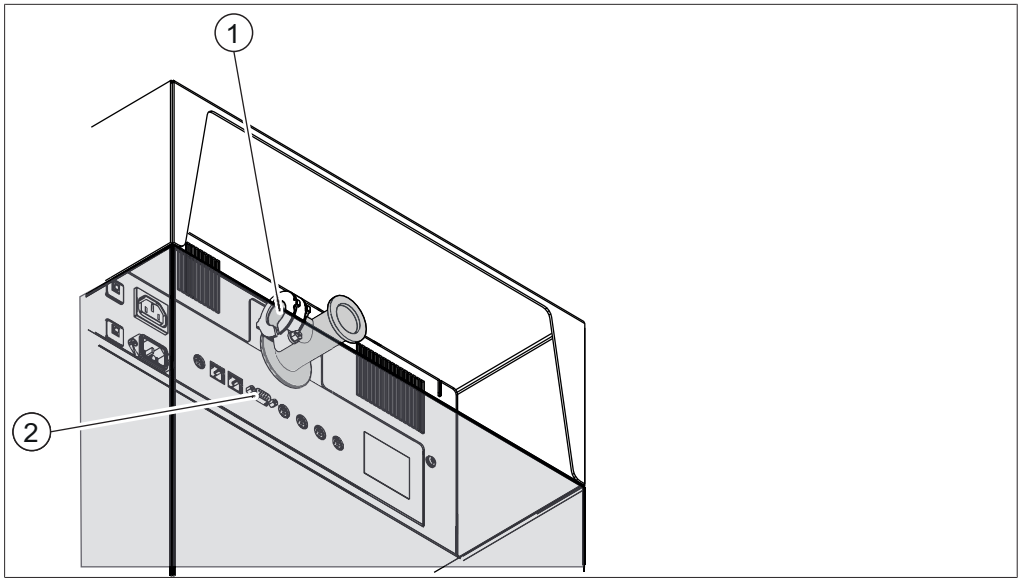


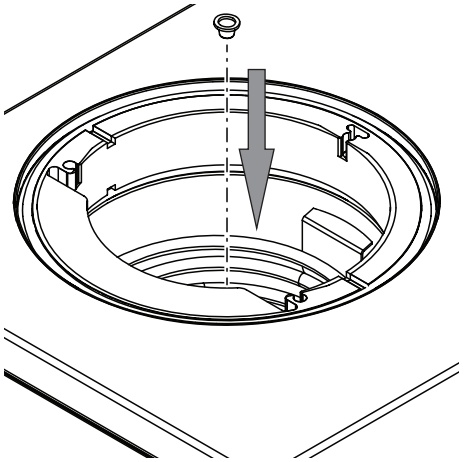

Fig. 13: Fitting alternative pressure sensor

1 Connection, ISO-KF 16 2 External pressure sensor connection

- ▶ Switch the On/Off master switch to Off.
- ▶ Remove the blanking cap from the connection (1).
- ▶ Connect the pressure sensor to the connection (1).
- ▶ Plug the pressure sensor connecting lead into the socket marked **External Vacuum Sensor** (2).
- ▶ Select the sensor from the submenu *[Settings]* on the control panel.

### 5.3.8 Fitting the drain valve strainer

- ▶ Place the drain valve strainer in the waste outlet in the base of the ice condenser.



### 5.3.9 Preparing the condensate drain hose

**⚠ CAUTION**

**Risk of scalding by hot water**

- ▶ Make sure the condensate drain hose is not loose.

## NOTICE

**Contamination of the device**

Escaping condensate can contaminate the instrument.

- ▶ Fit the condensate drain hose with a downward slope. Make sure that the drain hose is not immersed in the condensate.
- ▶ Seal the condensate drain hose with the end plug as soon as cleaning of the instrument is completed.

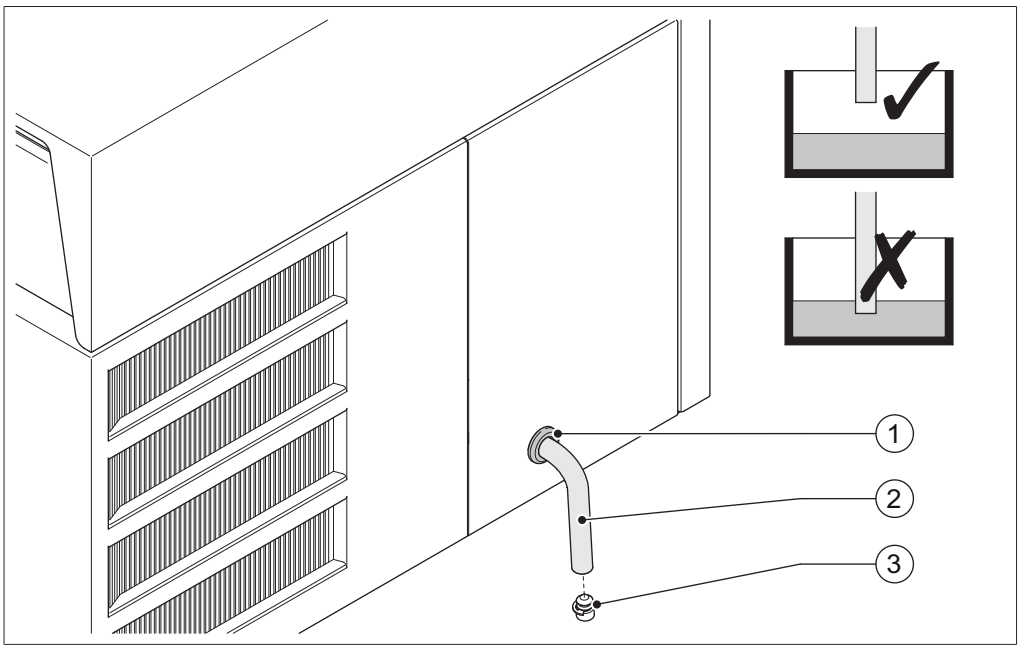



Fig. 14: Condensate drain hose

1 Rubber ring
2 Drain hose for condensate
3 End plug

The condensate drain hose is on the side of the instrument. The drain hose is sealed with an end plug. The condensation is drained off through this drain hose after completion of the freeze-drying process.

- ▶ Pull the drain hose (2) together with end plug (3) out of the side panel of the instrument.
- ▶ Remove the end plug.
- ▶ Direct the drain hose into a waste outlet or place a container underneath it.

## 5.4 Commissioning the vacuum pump

The vacuum pump evacuates the top-mount drying rack during the freeze-drying process.

**NOTICE**

**Closed gas ballast valve when using solvent.**

A closed gas ballast valve when using solvents can cause damage to the instrument.

▶ When using solvents, keep the gas ballast valve open.

**NOTE**

To increase the service life of the vacuum pump, operate the vacuum pump with an open gas ballast valve.

**NOTE**

Prepare the vacuum pump according to the manufacturer's instructions. See relevant documentation.

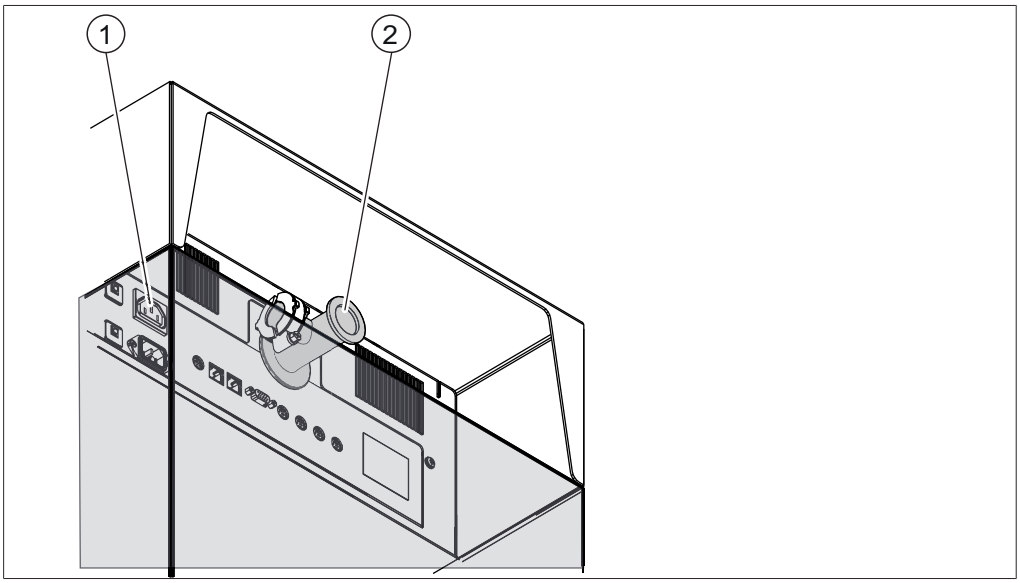



Fig. 15: Connections for vacuum pump

| | | | |
|---|---|---|---|
| 1 | Vacuum pump connection | 2 | Vacuum tube connection, ISO-KF 25 |

▶ Switch the On/Off master switch to Off.
▶ Connect the vacuum pump vacuum tube to the vacuum tube connection (2).
▶ Plug the vacuum pump electrical connection into the socket marked **Vacuum Pump**.

## 5.5 Establishing LAN connection

### 5.5.1 Requirements for local network settings

▶ The following port has to be enabled in the firewall settings on the internet gateway:

- TCP (HTTPS) traffics through remote port 443

▶ In order to use the BUCHI Cloud a DNS server must be configured on the instrument.

**NOTE**

If there is no DNS server available enter the IP address for the BUCHI Cloud connection manually.

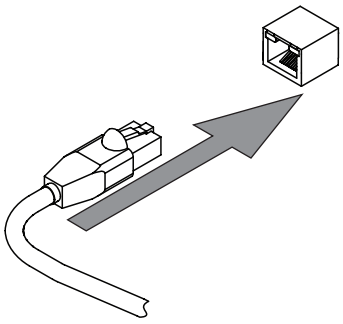
**NOTE**

If there is no DHCP server available enter the IP address, gateway subnet mask and DNS server manually.

### 5.5.2 Preparing the instrument for app using

**NOTICE! Do not unplug the LAN cable while the device is connected to the BUCHI Cloud Services**

▶ Connect the instrument with the LAN network.



**Navigation path**

➔  ➔ *[Settings]* ➔ *[Network]*

▶ Navigate to the action *[Network]*.
▶ Enable the function *[DHCP]*.
⇨ The instrument is prepared.

### 5.5.3 Enabling BUCHI Cloud access

Enable access to BUCHI Cloud in order to use the BUCHI Monitor App.

**Navigation path**

➔  ➔ Settings ➔ Network ➔ BUCHI Cloud

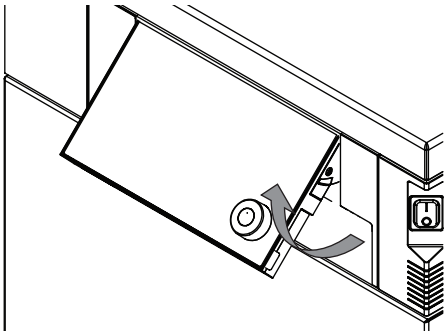
▶ Navigate to the action *[[BUCHI Cloud]]* via the navigation path.
▶ Select the option *[Yes]*.
⇨ The instrument is connected to the BUCHI Cloud.

## 5.6 Insert SD card (Pro control panel only)

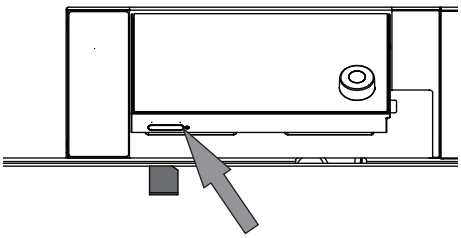
**NOTE**

Only insert or remove the SD card in Standby mode.

▶ Fold the control panel forward.



▶ Insert the SD card on the underside.



▶ Switch on the instrument.

⇨ The status bar shows the SD card symbol.

The following data is stored on the SD card:

- Numbering
- Date
- Time
- Set pressure
- Current pressure in the ice condenser
- Inlet temperature of the ice condensers
- Set drying shelf temperature
- Current temperature of the drying shelves
- Current sample temperatures

# 6 Operating the control panel

This section describes the operation of the instrument using the control panel.

**⚠ CAUTION**

**Risk of injury from glass splinters**

Sharp objects can damage the display.

▶ Keep sharp objects away from the display.

## 6.1 Layout of the control panel

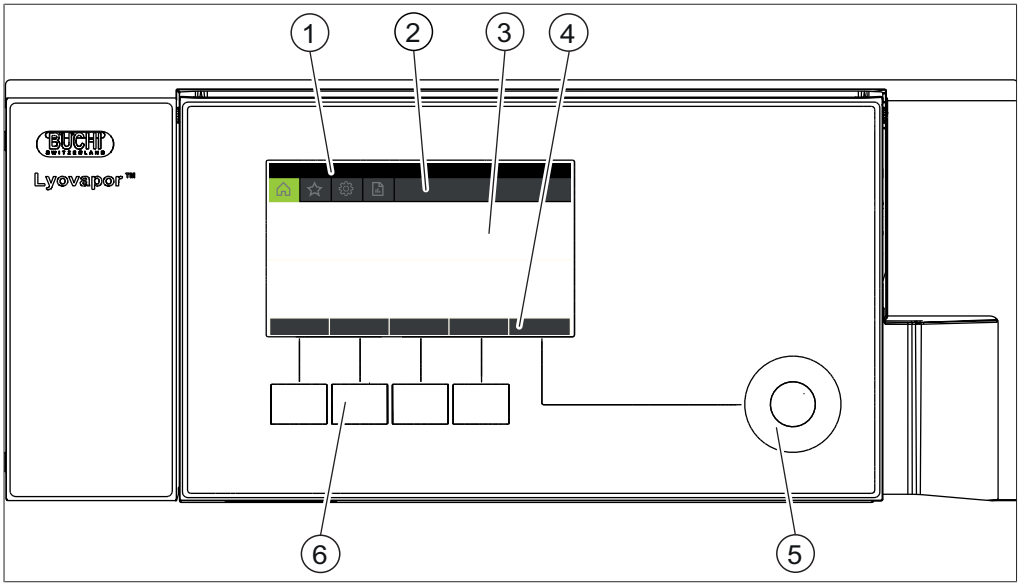



Fig. 16: Layout of the control panel

| No. | Description | Function |
|---|---|---|
| 1 | Status bar | Shows the current status of the instrument. |
| 2 | Menu bar | Shows symbols representing the menus. |
| 3 | Content area | Shows current settings, submenus or actions depending on current operation. |
| 4 | Function bar | Shows functions that can be performed according to the current operation. |
| 5 | Navigation control | Used for navigating the user interface.<br>Pressing the control performs the assigned function on the function bar. |
| 6 | Function buttons | Pressing a function button performs the assigned function on the function bar. |

## 6.2 Function bar

The function bar shows available functions according to the current operation.

The functions on the function bar are executed by tapping the relevant function buttons or pressing the navigation control.

**General function buttons**

| Symbol | Description | Meaning |
|---|---|---|
|  | *[Back]* | The display reverts to the previous view. |
|  | *[Cancel]* | Cancels an operation. |
|  | *[Add to favourites]* | Adds the selected item to the *[[Favourites]]* menu. |
|  | *[Remove from favourites]* | Removes the selected item from the *[Favourites]* menu. |
|  | *[Confirm]* | Confirms an entry. |
|  | *[Edit]* | Allows the selected item to be edited. |
|  | *[Menu]* | Allows selection of a menu from the menu bar using the navigation control. |
|  | *[Save]* | Saves the setting. |

**Process control function buttons**

| Symbol | Description | Meaning |
|---|---|---|
|  | *[Defrost]* | Defrosts the ice condenser. |
|  | *[Aerate]* | Vents the system. |
|  | *[Shut down]* | The instrument shuts down. |
|  | *[[Start]]* | Starts the freeze-drying process. |
|  | *[Start conditioning]* | Starts the conditioning phase. |
|  | *[[Skip]]* | Skips the current process. |

## 6.3 Menu bar

The menus are represented by symbols on the menu bar. Navigation through the menus is by input controls.

The following menus are available:

| Menu symbol | Meaning | Submenu/Action |
|---|---|---|
|  | *[Start]* menu | • Process control parameters |
|  | *[Favourites]* menu | • Bookmarks for individual entry points |

| Menu symbol | Meaning | Submenu/Action |
|---|---|---|
|  | *[Configuration]* menu | • Process settings<br>• Settings<br>• Servicing<br>• Service<br>• System information |
|  | *[Messages]* menu | • Notifications<br>• Logbook |

### 6.3.1 Start menu

On the *[Start]* menu, parameters can be set manually.

**Changing parameters**

▶ Select a parameter by turning the navigation control.
  ⇨ The control panel highlights the selected parameter in green.
▶ Tap the function *[Edit]* on the function bar.
  ⇨ The control panel highlights the selected parameter in black.
▶ To increase or decrease the figure, turn the navigation control clockwise or anti-clockwise.
▶ Tap the function *[Save]* on the function bar.
  ⇨ The setting is saved.

### 6.3.2 Favourites menu

The *[Favourites]* menu allows you to define submenus and actions as bookmarks.

**Adding a favourite**

▶ Navigate to a submenu or action.
▶ Tap the function *[Add to favourites]* on the function bar.
  ⇨ The user interface switches to the *[Favourites]* menu and displays the favourite created.

**Removing a favourite**

▶ On the *[Favourites]* menu, navigate to the favourite you wish to remove.
▶ Tap the function *[Remove from favourites]* on the function bar.
  ⇨ The favourite is removed.

### 6.3.3 Configuration menu

On the *[Configuration]* menu, you can enter a variety of settings and retrieve information.

**Process settings submenu**

The submenu *[Process Settings]* contains functions for automatic process control.

| Action | Option | Explanation |
|---|---|---|
| *[Vacuum test after conditioning]* | Off/On | Automatic vacuum test after the conditioning phase |

**Settings submenu**

The submenu *[Settings]* contains system settings for the instrument.

| Action | Option | Explanation |
|---|---|---|
| *[Mobile connection password]* | View | The control panel shows a password for entry in the BUCHI Monitor app. |
| *[Mobile connection QR code]* | View | The control unit shows a QR code for reading by the BUCHI Monitor app. |
| *[Language]* | Choice of display language on the control panel | The following languages are available:<br>English/German/French/Italian/Spanish/Russian/Portuguese/Japanese/Chinese/Indonesian/Korean |
| *[Temperature unit]* | Choice of unit for indication of temperatures | The following units are available:<br>°C (Celsius)/°F (Fahrenheit)/K (Kelvin) |
| *[Pressure unit]* | Choice of unit for indication of the vacuum | The following units are available:<br>HPa (hectopascals), mbar (millibars), torr (= torr), mTorr (= millitorr), mmHg (millimetres of mercury) |
| *[Date]* | Date input | Enter in sequence: Day, month, year. Apply the settings by pressing *[Save]*. |
| *[Time]* | Time input | Enter in sequence: Minutes, hours. Apply the settings by pressing *[Save]*. |
| *[Pressure sensor]* | Pressure sensor selection | The following pressure sensors are available:<br>None, Inficon PPG010, Inficon Porter CDG020D, Inficon PSG 550 |
| *[Vacuum pump oil change]* | Enter value | Enter the oil change interval recommended by the manufacturer. |
| *[Button tone]* | Off/On | Setting for audible signal in response to input controls. |
| *[Display brightness]* | Enter setting | Display illumination level in %: 0 - 100 |
| *[Network]* | Enter value | The following parameters can be edited:<br>Device name/MAC address/DHCP/System IP address/Subnet mask/Gateway/DNS server/BUCHI Cloud/Server IP address |
| *[Delete app connection]* | Confirmation question | Resets external connections to the instrument. |

**Submenu Maintenance**

The submenu *[Maintenance]* contains tests for maintaining the instrument.

| Action | Option | Explanation |
|---|---|---|
| *[Vacuum test]* | Perform vacuum test | See Chapter 9.2 "Performing a vacuum test", page 79 |

| Action | Option | Explanation |
|---|---|---|
| *[Leak test]* | Perform leak test | See Chapter 9.3.1 "Performing a leak test with a drying chamber", page 80 |

### Submenu Service

**NOTE**

While freeze-drying is in progress, no settings can be changed on the Service submenu.

| Action | Option | Explanation |
|---|---|---|
| *[Refrigerant circuit]* | View | The following information on the refrigerant circuit is available:<br>• Hours of duty<br>• Compressor<br>• Ice condenser inlet temperature<br>• Ice condenser outlet temperature<br>• High-pressure safety cut-out<br>• Low-pressure safety cut-out |
| *[Vacuum system]* | View | The following information on the vacuum pump is available:<br>• Pump hours of duty<br>• Pump oil hours of duty<br>• Pressure in the ice condenser<br>• Main valve<br>• Vacuum pump<br>• Venting valve<br>• Regulating valve |
| *[Defrosting system]* | Display/entry of figures | The following information on the defrosting system is available:<br>• Hours of duty<br>• Drain valve open/closed |

### Submenu System Information

The submenu *[System information]* contains details of the connected components and information on network connection diagnosis.

| Action | Option | Explanation |
|---|---|---|
| *[Control panel]* | View | The following information on the control panel is available:<br>• Serial number<br>• Firmware version<br>• Hours of duty<br>• Status<br>• PCB Temperature<br>• 24V power supply<br>• 5V power supply |

| Action | Option | Explanation |
|---|---|---|
| *[L-200]* | View | The following information on the L-200 is available:<br>• Serial number<br>• Firmware version<br>• Hours of duty<br>• Status<br>• PCB Temperature<br>• 48V power supply<br>• 24V power supply<br>• 5V power supply<br>• 3.3V power supply |
| *[Network diagnostics]* | View/Enter settings | The following network diagnosis information is available:<br>• Network interruptions<br>• Event list |

### 6.3.4 Messages menu

The *[Messages]* menu shows the current instrument messages and the instrument's message history.

The following message types are possible:

- I = Information
- W = Warning
- E = Error

#### Submenu Notifications

The submenu *[Notifications]* shows a list of unacknowledged and unresolved notifications together with date and time in each case.

#### Submenu Logbook

The submenu *[Logbook]* shows the instrument's message history.

Logbook:

- List of the last 100 messages.
- Every occurrence is shown with date and time.

The following status types are possible:

| Symbol | Description | Meaning |
|---|---|---|
| **x** | Acknowledged | The message has been be processed and acknowledged. |
| **<** | Sent | The message initiator is no longer present. |
| **>** | Received | The display shows a message. |

## 6.4 Status bar

The status bar shows the status of the instrument.

The following statuses are possible:

**Indication on status bar**

| View | Status |
|---|---|
| **Unload / Load** | Before the freeze-drying process:<br>Load the top-mount drying rack with a frozen sample. |
| | After the freeze-drying process:<br>Remove the dried sample from the top-mount drying rack. |
| **Aerating** | The system is venting. |
| **Shutting down** | The instrument is shutting down.<br>• The aeration valve and the drain valve are closed.<br>• The status bar shows the remaining time. |
| **Defrosting** | The instrument is defrosting.<br>• The aeration valve and the drain valve are open.<br>• The status bar shows the remaining time.<br>• Manual defrosting with water possible. |
| **Standby** | The instrument is in energy-saving mode. |
| **Conditioning** | The instrument is starting up. |
| **Warming up pump** | The vacuum pump is being brought up to operating temperature. |
| **Vacuum Test** | The instrument is performing a vacuum test. |
| **Leak Test** | The instrument is performing a leak test. |
| **Manual Drying** | The instrument is in the course of a manual freeze-drying process. |
| **Recovering** | The system is in the process of recovering from a power failure.<br>The current parameters of the freeze-drying process are being re-established. |
| **Reconditioning** | The instrument is restarting after a temporary power failure. |

**Symbols on the status bar**

| Symbol | Status |
|---|---|
|  | The instrument is connected to the BUCHI Cloud. |
|  | The instrument is defrosting. |
|  | The instrument is starting up. |
|  | The instrument is in energy-saving mode. |

| Symbol | Status |
|---|---|
|  | Before the freeze-drying process:<br>Load the top-mount drying rack with a frozen sample. |
| | After the freeze-drying process:<br>Remove the dried sample from the top-mount drying rack. |
|  | The system evacuates to the set pressure. |
|  | The instrument is performing a vacuum test or a leak test. |

## 6.5 Carrying out freeze-drying

### 6.5.1 Preparing the instrument

| | |
|---|---|
| Time required: | approx. 30min |

**NOTE**

To minimize the condensation of moisture from the air in the condenser, place a drying rack.

**Navigation path**

➔ Start

- ▶ Navigate to the *[Start]* menu via the navigation path.
- ▶ Tap the function *[Start conditioning]* on the function bar.
  - ⇨ The temperature in the ice condenser decreases to operating temperature.
  - ⇨ The vacuum pump is brought up to operating temperature.
  - ⇨ After completion of the conditioning phase, the status bar shows the status **Unload / Load**.

### 6.5.2 Starting freeze-drying

**⚠ CAUTION**

**Risk of skin burns from touching parts of the ice condenser after completion of conditioning.**

- ▶ Wear protective gloves when working on the instrument after the conditioning phase.

**Navigation path**

➔ Start

Precondition:
☑ The instrument has been prepared.

- ▶ Fit a top-mount drying rack. See Chapter 8 "Operating top-mount drying racks", page 65.

- ▶ Load the top-mount drying rack with frozen samples.
- ▶ Navigate to the *[Start]* menu via the navigation path.
- ▶ Enter the required settings for the process parameters.
- ▶ Tap the function *[Start]* on the function bar.
  - ⇨ The freeze-drying process starts.
  - ⇨ The control panel shows the *Start* menu with a black background.
  - ⇨ The status bar shows a clock counting up and the status **Manual Drying**.
  - ⇨ The system evacuates to the set pressure.

### 6.5.3 Editing parameters while the process is running

**Navigation path**

➔ Start

Precondition:
☑ The freeze-drying process has been started.

- ▶ Navigate to the *[Start]* menu via the navigation path.
- ▶ Navigate to the desired parameter using the navigation control.
- ▶ Tap the function *[Edit]* on the function bar.
  - ⇨ The control panel highlights the selected parameter in white.
- ▶ Turn the navigation control to increase or decrease the parameter setting.
- ▶ Tap the function *[Save]* on the function bar.
  - ⇨ The setting is saved.

### 6.5.4 Ending freeze-drying

**Navigation path**

➔ Start

Precondition:
☑ The sample is dry.

- ▶ Navigate to the *[Start]* menu via the navigation path.
- ▶ Tap the function *[Aerate]* on the function bar.
- ▶ Answer **YES** to the confirmation question.
  - ⇨ The system is vented.
  - ⇨ The status bar shows the status **Aerating**.
- ▶ As soon as the status bar shows the status **Unload / Load**, remove the dried sample from the drying rack.

### 6.5.5 Shutting down the instrument

| | |
|---|---|
| Time required: | 40min |

**NOTICE**

**Do not use force to remove the ice from the ice condenser.**

**Navigation path**

➔ Start

Precondition:
☑ The freeze-drying process has ended.

▶ Position the condensate drain hose so that the condensate can be drained off. See Chapter 5.3.9 "Preparing the condensate drain hose", page 27
▶ Navigate to the *[Start]* menu via the navigation path.
▶ Tap the function *[Shut down]* on the function bar.
  ⇨ The instrument is shutting down.
  ⇨ The status bar shows the remaining time and the status **Defrosting**.
  ⇨ After the instrument has shut down, the status bar shows the remaining time and the status **Shutting down**.

### 6.5.6 Switching off the instrument

Precondition:
☑ The instrument has been shut down. See Chapter 6.5.5 "Shutting down the instrument", page 40

▶ Switch the On/Off master switch to Off.

# 7 Operating Pro control panel

This section describes the operation of the instrument using the Pro control panel.

**⚠ CAUTION**

**Risk of injury from glass splinters**

Sharp objects can damage the display.

▶ Keep sharp objects away from the display.

## 7.1 Layout of Pro control panel

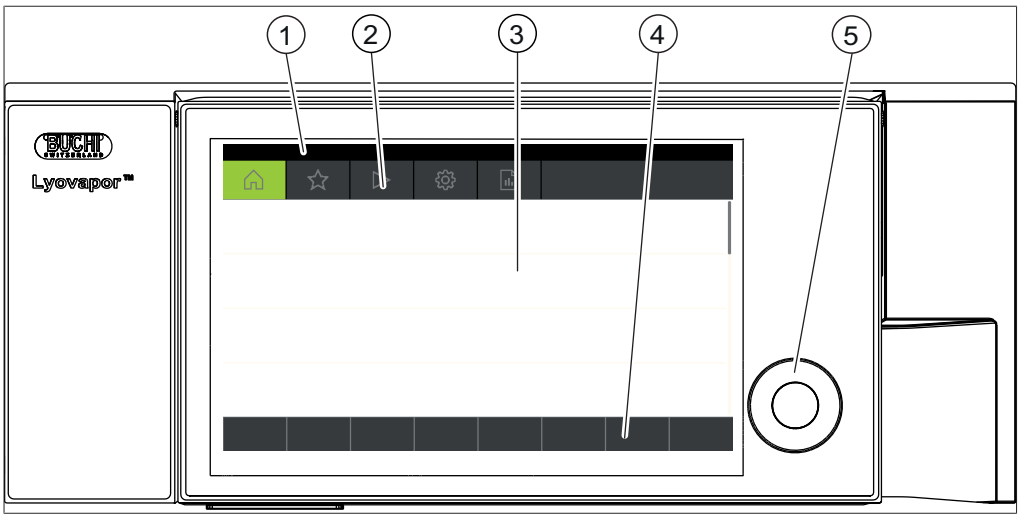



Fig. 17: Layout of Pro control panel

| No. | Description | Function |
|---|---|---|
| 1 | Status bar | Shows the current status of the instrument. |
| 2 | Menu bar | Shows symbols representing the menus. |
| 3 | Content area | Shows current settings, submenus or actions depending on the current operation. |
| 4 | Function bar | Shows functions that can be performed according to the current operation |
| 5 | Navigation control | Used for navigating the user interface. Pressing the control performs the assigned function on the function bar. |

## 7.2 Function bar

The function bar shows functions that can be performed according to the current operation.

The functions on the function bar are executed by tapping the relevant function buttons or pressing the navigation control.

**General function buttons**

| Symbol | Description | Meaning |
|---|---|---|
|  | *[Back]* | The display reverts to the previous view. |

| Symbol | Description | Meaning |
|---|---|---|
| ESC | *[Cancel]* | Cancels an operation. |
| ☆ | *[Add to favourites]* | Adds the selected item to the *[[Favourites]]* menu. |
| REMOVE | *[Remove from favourites]* | Removes the selected item from the *[Favourites]* menu. |
| OK | *[Confirm]* | Confirms an entry. |
| EDIT | *[Edit]* | Allows the selected item to be edited. |
| MENU | *[Menu]* | Allows selection of a menu from the menu bar using the navigation control. |
| SAVE | *[Save]* | Saves the setting. |

**Process control function buttons**

| Symbol | Description | Meaning |
|---|---|---|
| | *[Defrost]* | Defrosts the ice condenser. |
| AERATE | *[Aerate]* | Vents the system. |
| OFF | *[Shut down]* | The instrument shuts down. |
| START | *[[Start]]* | Starts the freeze-drying process. |
| ON | *[Start conditioning]* | Starts the conditioning phase. |
| MANUAL | *[Manual]* | Switches to manual freeze-drying. |
| METHOD | *[Method]* | Switches to freeze-drying with programmable parameters. |
| NEW | *[New]* | Creates a new method |
| > | *[Right]* | Moves the selection to the right. |
| < | *[Left]* | Moves the selection to the left. |
| | *[Progression]* | Graphical display of method progression showing pressure and temperature details. |
| ACTIVATE | *[Activate]* | Confirms selection of a method. |
| SKIP | *[[Skip]]* | Skips the current process. |
| DELETE | *[Delete]* | Deletes the selected method or step. |

| Symbol | Description | Meaning |
|---|---|---|
| COPY | *[Copy]* | Copies the selected method. |

## 7.3 Other symbols on the control panel

| Symbol | Description | Meaning |
|---|---|---|
|  | *[Closed]* | The assigned method is active and cannot be changed. |

## 7.4 Menu bar

The menus are represented by symbols on the menu bar. Navigation through the menus is by the input controls.

The following menus are available:

| Menu symbol | Meaning | Submenu/Action |
|---|---|---|
|  | Start menu | • Process control parameters |
|  | Favourites menu | • Bookmarks for individual entry points |
|  | Method menu | • For saving freeze-drying methods<br>• Editing and activating freeze-drying method |
|  | Configuration menu | • Process settings<br>• Settings<br>• End point determination<br>• Maintenance<br>• Service<br>• System information |
|  | Messages menu | • Notifications<br>• Logbook |

### 7.4.1 Start menu

On the *[Start]* menu, parameters can be set manually.

**Setting parameters using the navigation control**

▶ Select a parameter by turning the navigation control.

⇨ The control panel highlights the selected parameter in green.

▶ Tap the function *[Edit]* on the function bar.

⇨ The control panel highlights the selected parameter in black.

▶ To increase or decrease the figure, turn the navigation control clockwise or anti-clockwise.

▶ Press the navigation control.
⇨ The setting is saved.
⇨ The control panel highlights the new setting in green.

**Setting parameters using the touch-screen**

▶ Select the parameter by tapping the control panel screen.
⇨ The control panel shows a dialog box with a numeric input box.
⇨ The control panel highlights the selected parameter in black.
▶ Enter the value in the numeric input box.
▶ Tap the function *[Save]* on the function bar.
⇨ The setting is saved.
⇨ The dialog box closes.
⇨ The control panel highlights the new setting in green.

### 7.4.2 Favourites menu

The *[Favourites]* menu allows you to define submenus and actions as favourites.

**Adding a favourite**

▶ Navigate to a submenu or action.
▶ Tap the function *[Add to favourites]* on the function bar.
⇨ The user interface switches to the *[Favourites]* menu and displays the favourite created.

**Removing a favourite**

▶ On the *[Favourites]* menu, navigate to the favourite you wish to remove.
▶ Tap the function *[Remove from favourites]* on the function bar.
⇨ The favourite is removed.

### 7.4.3 Method menu

The *[Method]* menu allows freeze-drying processes with multiple phases and steps to be saved. See Chapter 7.6 "Editing a method", page 50

### 7.4.4 Configuration menu

On the *[Configuration]* menu, you can enter a variety of settings and retrieve information.

**Process settings submenu**

The submenu *[Process Settings]* contains actions for automatic process control.

| Action | Option | Explanation |
|---|---|---|
| *[Vacuum test after conditioning]* | Off/On | Automatic vacuum test after the conditioning phase |
| *[Leak test after conditioning]* | Off/On | Automatic leak test after the conditioning phase |

**Settings submenu**

The submenu *[Settings]* contains system settings for the instrument.

| Action | Option | Explanation |
|---|---|---|
| *[Mobile connection password]* | View | The control panel shows a password for entry in the BUCHI Monitor app. |

| Action | Option | Explanation |
|---|---|---|
| *[Mobile connection QR code]* | View | The control unit shows a QR code for reading by the BUCHI Monitor app. |
| *[Language]* | Choice of display language on the control panel | The following languages are available:<br>English/German/French/Italian/ Spanish/Russian/Portuguese/Japanese/Chinese/Indonesian/Korean |
| *[Temperature unit]* | Choice of unit for indication of temperatures | The following units are available:<br>°C (Celsius)/°F (Fahrenheit)/K (Kelvin) |
| *[Pressure unit]* | Choice of unit for indication of the vacuum | The following units are available:<br>HPa (hectopascals), mbar (millibars), torr (= torr), mTorr (= millitorr), mmHg (millimetres of mercury) |
| *[Date]* | Date input | Enter in sequence: Day, month, year. Apply the settings by pressing *[Save]*. |
| *[Time]* | Time input | Enter in sequence: Minutes, hours. Apply the settings by pressing *[Save]*. |
| *[Pressure sensor]* | Pressure sensor selection | The following pressure sensors are available:<br>None, Inficon PPG010, Inficon Porter CDG020D, Inficon PSG 550 |
| *[Vacuum pump oil change]* | Enter value | Enter the oil change interval recommended by the manufacturer. |
| *[Button tone]* | Off/On | Setting for audible signal in response to input controls. |
| *[Display brightness]* | Enter setting | Display illumination level in %: 0 - 100 |
| *[Network]* | Enter value | The following parameters can be edited:<br>Device name/MAC address/DHCP/ System IP address/Subnet mask/ Gateway/DNS server/BUCHI Cloud/ Server IP address |
| *[Delete app connection]* | Confirmation question | Resets external connections to the instrument. |

**Submenu End point determination**

| Action | Option | Explanation |
|---|---|---|
| *[Pressure difference test]* | View | • Actual and specified settings<br>• Result |
| *[Temperature difference test]* | View | • Actual and specified settings<br>• Result |

### Submenu Maintenance

The submenu *[Maintenance]* contains tests for maintaining the instrument.

| Action | Option | Explanation |
|---|---|---|
| *[Vacuum test]* | Perform vacuum test | See Chapter 9.2 "Performing a vacuum test", page 79 |
| *[Leak test]* | Perform leak test | See Chapter 9.3.1 "Performing a leak test with a drying chamber", page 80 |

### Submenu Service

**NOTE**

While freeze-drying is in progress, no settings can be changed on the Service submenu.

| Action | Option | Explanation |
|---|---|---|
| *[Refrigerant circuit]* | View | The following information on the refrigerant circuit is available:<br>• Hours of duty<br>• Compressor<br>• Ice condenser inlet temperature<br>• Ice condenser outlet temperature<br>• High-pressure safety cut-out<br>• Low-pressure safety cut-out |
| *[Vacuum system]* | View | The following information on the vacuum pump is available:<br>• Pump hours of duty<br>• Pump oil hours of duty<br>• Pressure in the ice condenser<br>• Main valve<br>• Vacuum pump<br>• Venting valve<br>• Regulating valve |
| *[Defrosting system]* | Display/entry of figures | The following information on the defrosting system is available:<br>• Hours of duty<br>• Drain valve open/closed |
| *[Drying shelves]* | View | Switches heating for the individual shelves on and off (where available). |

### Submenu System Information

The submenu *[System information]* contains details of the connected devices and information on network connection diagnosis.

| Action | Option | Explanation |
|---|---|---|
| *[Control panel]* | View | The following information on the control panel is available:<br>• Serial number<br>• Firmware version<br>• Hours of duty<br>• Status<br>• PCB Temperature<br>• 24V power supply<br>• 5V power supply |
| *[L-200]* | View | The following information on the L-200 is available:<br>• Serial number<br>• Firmware version<br>• Hours of duty<br>• Status<br>• PCB Temperature<br>• 48V power supply<br>• 24V power supply<br>• 5V power supply<br>• 3.3V power supply |
| *[Network diagnostics]* | View/Enter settings | The following network diagnosis information is available:<br>• Network interruptions<br>• Event list |

### 7.4.5 Messages menu

The *[Messages]* menu shows the current instrument messages and the instrument's message history.

The following message types are possible:

- I = Information
- W = Warning
- E = Error

#### Submenu Notifications

The submenu *[Notifications]* shows a list of unacknowledged and unresolved notifications together with date and time in each case.

#### Submenu Logbook

The submenu *[Logbook]* shows the instrument's message history.

Logbook:

- List of the last 100 messages.
- Every occurrence is shown with date and time.

The following status types are possible:

| Symbol | Description | Meaning |
|---|---|---|
| **x** | Acknowledged | The message has been be processed and acknowledged. |
| **<** | Sent | The message initiator is no longer present. |
| **>** | Received | The display shows a message. |

## 7.5 Status bar

The status bar shows the status of the instrument.

The following statuses are possible:

| Indication on status bar | |
|---|---|
| **Unload / Load** | Before the freeze-drying process:<br>Load the top-mount drying rack with a frozen sample. |
| | After the freeze-drying process:<br>Remove the dried sample from the top-mount drying rack. |
| **Aerating** | The system is venting. |
| **Shutting down** | The instrument is shutting down.<br>• The aeration valve and the drain valve are closed.<br>• The status bar shows the remaining time. |
| **Defrosting** | The instrument is defrosting.<br>• The aeration valve and the drain valve are open.<br>• The status bar shows the remaining time.<br>• Manual defrosting with water possible. |
| **Standby** | The instrument is in energy-saving mode. |
| **Conditioning** | The instrument is starting up. |
| **Reconditioning** | The instrument is restarting after a temporary power failure. |
| **Warming up pump** | The vacuum pump is being brought up to operating temperature. |
| **Vacuum Test** | The instrument is performing a vacuum test. |
| **Leak Test** | The instrument is performing a leak test. |
| **Manual Drying** | The instrument is in the course of a manual freeze-drying process. |
| **Recovering** | The system is in the process of recovering from a power failure.<br>The current parameters of the freeze-drying process are being re-established. |

| | |
|---|---|
| **Hold** | The instrument is in the holding phase. |
| **Primary drying** | The instrument is in the primary drying phase. |
| **Secondary drying** | The instrument is in the secondary drying phase. |
| **Tempering shelves** | The instrument is modulating the heatable shelves to the set temperature. |
| **Stoppering** | The instrument is ready for stoppering. |

**Symbols on the status bar**

| Symbol | Status |
|---|---|
|  | The instrument is defrosting. |
|  | The instrument is in energy-saving mode. |
|  | The instrument is in the course of a freeze-drying process using a method. |
|  | The instrument is starting up. |
|  | The instrument is in the course of a manual freeze-drying process. |
|  | The instrument is connected to the BUCHI Cloud. |
|  | Before the freeze-drying process:<br>Load the top-mount drying rack with a frozen sample. |
| | After the freeze-drying process:<br>Remove the dried sample from the top-mount drying rack. |
|  | The instrument is performing a vacuum test or a leak test. |
|  | The system evacuates to the set pressure. |
|  | The memory card has been inserted. |

## 7.6 Editing a method

The Pro control panel can save up to 35 methods. The methods enable the freeze-drying process to be automated.

### 7.6.1 Creating a new method

There are two possible ways of creating a new method:

**Creating a new method**

| Navigation path |
|---|
| ➔ Method |

▶ Navigate to the *[Method]* menu via the navigation path.

▶ Tap the function *[New]* on the function bar.

⇨ The new method is created.

**Creating a new method by copying an existing method**

**Navigation path**

➔ Method

▶ Navigate to the *[Method]* menu via the navigation path.
▶ Tap the name of the method that you wish to copy.
▶ Tap the function *[Copy]* on the function bar.

⇨ The new method is created.

### 7.6.2 Changing the name of a method

**Navigation path**

➔ Method

▶ Navigate to the *[Method]* menu via the navigation path.
▶ Tap the name of the method that you wish to edit.

⇨ The control panel highlights the selected method in green.

▶ Tap the action *[Information]*.

⇨ The control panel shows the action Information.

▶ Tap the setting *[Name]*.

⇨ The control panel shows a blank box with an alphanumeric input box.

▶ Enter a name for the method.
▶ Tap the function *[Save]* on the function bar.

⇨ The new name is saved.

⇨ The dialog box closes.

### 7.6.3 Setting the sample collapse temperature

**Navigation path**

➔ Method

▶ Navigate to the *[Method]* menu via the navigation path.
▶ Tap the name of the method that you wish to edit.

⇨ The control panel highlights the selected method in green.

▶ Tap the action *[General]*.

⇨ The control panel shows the action *[General]*.

▶ Tap the setting *[Sample collapse temperature]*.

⇨ The control panel shows a dialog box with a numeric input box.

▶ Enter the value in the numeric input box.

▶ Tap the function *[Save]* on the function bar.
⇨ The setting is saved.
⇨ The dialog box closes.

### 7.6.4 Setting the gas type

**Navigation path**

➔ Method

▶ Navigate to the *[Method]* menu via the navigation path.
▶ Tap the name of the method that you wish to edit.
⇨ The control panel highlights the selected method in green.
▶ Tap the action *[General]*.
⇨ The control panel shows the action *[General]*.
▶ Tap the setting *[Gas type]*.
⇨ The control panel shows a dialog box with an alphanumeric input box.
▶ Enter the gas type.
▶ Tap the function *[Save]* on the function bar.
⇨ The setting is saved.
⇨ The dialog box closes.

### 7.6.5 Setting the shelf loading temperature

**Navigation path**

➔ Method

▶ Navigate to the *[Method]* menu via the navigation path.
▶ Tap the name of the method that you wish to edit.
⇨ The control panel highlights the selected method in green.
▶ Tap the action *[General]*.
⇨ The control panel shows the action *[General]*.
▶ Tap the action *[Shelf load temp.]*
⇨ The control panel shows a dialog box with a numeric input box.
▶ Enter the value in the numeric input box.
▶ Tap the function *[Save]* on the function bar.
⇨ The setting is saved.
⇨ The dialog box closes.

### 7.6.6 Setting the steps of a method

The Pro control panel can save up to 30 steps for each method.

**NOTE**
The maximum heating rate is 3 °C/min.

**NOTE**
The settings for the action Steps affect a single step in each case.

**Navigation path**

➔ Method

▶ Navigate to the *[Method]* menu via the navigation path.
▶ Tap the name of the method that you wish to edit.
⇨ The control panel highlights the selected method in green.
▶ Tap the action *[Steps]*.
⇨ The control panel shows the action Steps.

The following settings are available for each step:

| Setting | Option | Meaning |
|---|---|---|
| *[Step phase]* | Primary drying/Secondary drying | Sets the type of step phase. |
| *[Term]* | Enter value | Sets the duration of the step in minutes. |
| *[Shelf temperature]* | Enter value | Set the temperature of the heatable shelves in one step. |
| *[Pressure zone]* | Regulated/Minimum | Regulated: the settings for pressure and pressure limits are applied. |
| | | Minimum: The maximum vacuum is applied to reach the lowest possible pressure. |
| *[Pressure]* | Enter value | Sets a target value for the regulated pressure. |
| *[Pressure limit]* | Enter value | Absolute value for divergence from the set pressure before the sample protection function is activated. |
| *[Pressure duration]* | Enter value | Sets the period of time that the pressure is allowed to exceed the pressure limit before the sample protection function is activated. |

**Editing a step**

▶ Use the function *[Right]* or *[Left]* on the function bar to navigate to the step that you wish to edit.
▶ Using the navigation control, navigate to the setting that you wish to change.
▶ Tap the function *[Edit]* on the function bar.
▶ Edit the setting as required.
▶ Tap the function *[Save]* on the function bar.
⇨ The setting is changed.

**Add step**

▶ Use the function *[Right]* or *[Left]* on the function bar to navigate to the position at which you wish to add a step.
▶ Tap the function *[New]* on the function bar.
⇨ The new step is created.

**Delete step**

▶ Use the function *[Right]* or *[Left]* on the function bar to navigate to the step that you wish to delete.
▶ Tap the function *[Delete]* on the function bar.

▶ When asked to confirm, press *[OK]*.
⇨ The step is deleted.

### 7.6.7 Setting the phases of a method

**NOTE**
The settings in the Phase view affect all steps of a phase.

**Navigation path**

➔ Method

▶ Navigate to the *[Method]* menu via the navigation path.
▶ Tap the name of the method that you wish to edit.
⇨ The control panel highlights the selected method in green.
▶ Tap the action *[Phase]*.
⇨ The control panel shows the Phase view.

The following phases of a method are available:

| Phase | Setting | Option | Meaning |
|---|---|---|---|
| *[Primary drying]* | *[Pressure action]* | None/Sample protection/ Message | None: no action is carried out. |
| | | | Sample protection: if the pressure is too high, heating of the shelves is paused. |
| | | | Message: if the pressure is too high, the control panel displays a message. |
| | *[Temp. action]* | None/Sample protection/ Message | None: no action is carried out. |
| | | | Sample protection: if the temperature is too high, heating of the shelves is paused. |
| | | | Message: if the temperature is too high, the control panel displays a message. |
| | *[Safety temperature]* | Enter value | Maximum divergence from the set collapse temperature before the sample protection function is activated. |
| | *[Safety temp. Time]* | Enter value | Time as of which sample protection is inactive. The value relates to the time before completion of primary drying. |
| | *[End point definition]* | More settings | See Chapter 7.8 "Setting end point definitions", page 56 |

| Phase | Setting | Option | Meaning |
|---|---|---|---|
| *[Secondary drying]* | *[Pressure action]* | None/Sample protection/ Message | None: no action is carried out. |
| | | | Sample protection: if the pressure is too high, heating of the shelves is paused. |
| | | | Message: if the pressure is too high, the control panel displays a message. |
| | *[Temp. action]* | None/Sample protection/ Message | None: no action is carried out. |
| | | | Sample protection: if the temperature is too high, heating of the shelves is paused. |
| | | | Message: if the temperature is too high, the control panel displays a message. |
| | *[Safety temperature]* | Enter value | Maximum divergence from the set shelf temperature before the sample protection function is activated. |
| | *[End point definition]* | More settings | See Chapter 7.8 "Setting end point definitions", page 56 |
| *[Stoppering]* | *[Pressure zone]* | Regulated/Minimum | Regulated: the settings for pressure and pressure limits are applied. |
| | | | Minimum: The maximum vacuum is applied to reach the lowest possible pressure. |
| | *[Pressure]* | Enter value | Sets a target value for the regulated pressure. |
| | *[&Mode]* | None/Manual | None: no action is carried out. |
| | | | Manual: sealing is performed manually. |
| *[hold]* | *[Pressure zone]* | Regulated/Minimum | Regulated: the settings for pressure are applied. |
| | | | Minimum: The maximum vacuum is applied to reach the lowest possible pressure. |
| | *[Pressure]* | Enter value | Sets a target value for the regulated pressure. |
| | *[Shelf temperature]* | Enter value | Specifies a temperature for the shelves. |

**Editing the settings for a phase**

▶ Tap the phase that you wish to edit.

⇨ The control panel highlights the selected phase in green.

▶ Tap the setting that you wish to edit.

▶ Edit the setting as required.

▶ Tap the function *[Save]* on the function bar.
⇨ The setting is changed.

## 7.7 Deleting a method

**Navigation path**

➔ Method

▶ Navigate to the *[Method]* menu via the navigation path.
▶ Tap the name of the method that you wish to edit.
⇨ The control panel highlights the selected method in green.
▶ Tap the function *[Delete]* on the function bar.
▶ Select *[Confirm]* to confirm the action in response to the confirmation question.
⇨ The method is deleted.

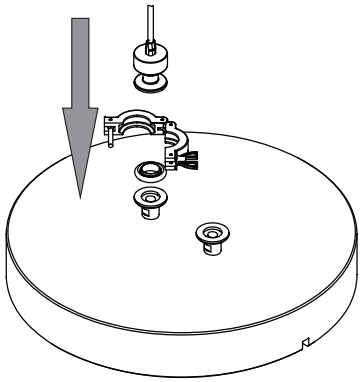
## 7.8 Setting end point definitions

The end of a phase can be automatically set for each preparation by defining an end point.

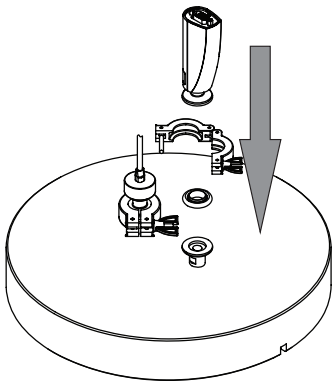
The end point can be defined by means of the temperature difference test or the pressure difference test.

### 7.8.1 Connect the sensors for pressure difference test (optional feature)

▶ Fit the pressure sensor, seal to the connection and fix with the clamp.
▶ Plug the pressure sensor electrical connector into the socket marked **Internal Vacuum Sensor** .



▶ Fit the pressure sensor, seal to the connection and fix with the clamp.
▶ Plug the pressure sensor electrical connector into the socket marked **External Vacuum Sensor**.
▶ On the control panel, select the sensor Inficon Porter CDG020 D on the *[Settings]* submenu.



### 7.8.2 Pressure difference test (optional feature)

**NOTE**

The pressure difference test can only be carried out with a pressure difference test kit. See Chapter 12.1.1 "Accessories", page 87

The pressure difference test establishes the difference between the readings from two pressure sensors in the drying chamber. If the difference between the two sensor readings is below a threshold, the freeze-drying phase can be ended.

**Navigation path**

➔ Method

Precondition:

☑ A vacuum test has been carried out with a pressure equal to the pressure during the subsequent freeze-drying process. See Chapter 9.2 "Performing a vacuum test", page 79

☑ The sensors for the pressure difference test have been fitted. See Chapter 7.8.1 "Connect the sensors for pressure difference test (optional feature)", page 56

☑ The offset value has been determined. See Chapter 7.8.4 "Determining offset value", page 59

▶ Navigate to the *[Method]* menu via the navigation path.
▶ Tap the name of the method that you wish to edit.
⇨ The control panel highlights the selected method in green.
▶ Tap the action *[Phase]*.
⇨ The control panel shows the action Phase.
▶ Tap the setting *[End point definition]*.
⇨ The control panel shows the setting End point definition.
▶ Tap *[Pressure difference test]*.
⇨ The control panel shows the pressure difference test.

The following settings are available:

| Setting | Option | Explanation |
|---|---|---|
| *[Pressure difference test]* | Yes/No | Switches the pressure difference test on or off. |
| *[Start time]* | Enter value | Sets the time from which the pressure difference test is to be performed. The value relates to the time before completion of the primary drying phase. |
| *[Pressure difference limit]* | Enter value | Specifies the difference between the two sensor readings below which the end point is reached. |
| | | The threshold must be greater than the offset value from the vacuum test. See Chapter 7.8.4 "Determining offset value", page 59 |
| *[Term]* | Enter value | Specifies the length of time for which the pressure difference test is to be carried out. |
| *[Continue]* | Yes/No | Yes : the method switches to the next phase. |
| | | No: the phase is ended when the set levels are reached. |

| Setting | Option | Explanation |
|---|---|---|
| *[Message]* | Yes/No | The control panel shows or does not show a message as soon as the pressure difference test is passed. |

### 7.8.3 Temperature difference test

**NOTE**

The temperature test is successfully completed if all drying shelves are below the threshold.

The samples on a drying shelf have different drying times. Take account of the different drying times in the *[Duration]* setting.

The temperature difference test establishes the difference between the readings from the temperature sensor for the heatable shelf and the temperature sensor in the sample. If the difference between the two sensor readings is below a threshold, the freeze-drying phase can be ended.

**Navigation path**

➔ Method

Precondition:

☑ The heatable shelves are fitted in the rack. See Chapter 8 "Operating top-mount drying racks", page 65

☑ The optional temperature sensor has been installed. See Chapter 8 "Operating top-mount drying racks", page 65

▶ Place the optional temperature sensor in the sample.
▶ Navigate to the *[Method]* menu via the navigation path.
▶ Tap the name of the method that you wish to edit.
  ⇨ The control panel highlights the selected method in green.
▶ Tap the action *[Phase]*.
  ⇨ The control panel shows the action Phase.
▶ Tap the setting *[End point definition]*.
  ⇨ The control panel shows the setting End point definition.
▶ Tap *[Temperature difference test]*.
  ⇨ The control panel shows the temperature difference test.

The following settings are available:

| Setting | Option | Explanation |
|---|---|---|
| *[Temperature difference test]* | Yes/No | Switches the temperature difference test on or off. |
| *[Start time]* | Enter value | Sets the time from which the temperature difference test is to be performed. The value relates to the time before completion of the primary drying phase. |
| *[Temperature difference limit]* | Enter value | Specifies the difference between the two sensor readings below which the end point is reached. |

| Setting | Option | Explanation |
|---|---|---|
| *[Term]* | Enter value | The period of time during which the difference is not to be exceeded. If the threshold is not exceeded for the full period of time, the temperature difference test is passed. |
| *[Continue]* | Yes/No | Yes : the method switches to the next phase. |
| | | No: the phase is ended when the set levels are reached. |
| *[Message]* | Yes/No | The control panel shows or does not show a message as soon as the temperature difference test is passed. |

### 7.8.4 Determining offset value

**Navigation path**

➔ Configuration ➔ End point determination ➔ Pressure difference test

▶ Navigate to the Pressure Difference Test view via the navigation path.
  ⇨ The control unit shows the offset figure.

## 7.9 Performing freeze-drying using a method [Pro control panel]

### 7.9.1 Preparing the instrument

| | |
|---|---|
| Time required: | approx. 30min |

**NOTE**

To minimize the condensation of moisture from the air in the condenser, place a drying rack.

**Navigation path**

➔ Start

▶ Navigate to the *[Start]* menu via the navigation path.
▶ Tap the function *[Start conditioning]* on the function bar.
  ⇨ The temperature in the ice condenser decreases to operating temperature.
  ⇨ The vacuum pump is brought up to operating temperature.
  ⇨ After completion of the conditioning phase, the status bar shows the status **Unload / Load**.

### 7.9.2 Selecting a method

**Navigation path**

➔ Method

▶ Navigate to the *[Method]* menu via the navigation path.
▶ Tap the function *[Method]* on the function bar.

▶ Tap the method that you wish to use.
▶ Tap the function *[Activate]* on the function bar.
⇨ The status bar shows the method activated.

### 7.9.3 Starting freeze-drying

**⚠ CAUTION**

**Risk of skin burns from touching parts of the ice condenser after completion of conditioning.**

▶ Wear protective gloves when working on the instrument after the conditioning phase.

**NOTE**

The freeze-drying process can be cancelled by tapping the functions *[Manual]* and *[Aerate]* on the *[Start]* menu.

**Navigation path**

➔ Start

**If a gas is being used**

Precondition:
☑ The instrument has been prepared.

☑ A method is selected.

▶ Fit a top-mount drying rack. See Chapter 8 "Operating top-mount drying racks", page 65.
▶ Load the top-mount drying rack with frozen samples.
▶ Navigate to the *[Start]* menu via the navigation path.
▶ Tap the function *[Start]* on the function bar.
▶ Make sure that the specified gas is being used.
▶ Answer **YES** to the confirmation question.
⇨ The freeze-drying process starts.
⇨ The control panel shows the *Start* menu with a black background.
⇨ The system carries out the selected method.

**If a gas is not being used**

Precondition:
☑ The instrument has been prepared.

☑ A method is selected.

▶ Fit a top-mount drying rack. See Chapter 8 "Operating top-mount drying racks", page 65.
▶ Load the top-mount drying rack with frozen samples.
▶ Navigate to the *[Start]* menu via the navigation path.

▶ Tap the function *[Start]* on the function bar.
⇨ The freeze-drying process starts.
⇨ The control panel shows the *Start* menu with a black background.
⇨ The system carries out the selected method.

### 7.9.4 Ending freeze-drying

**Navigation path**

➔ Start

Precondition:
☑ The status bar is showing the status **Hold**.

▶ Navigate to the *[Start]* menu via the navigation path.
▶ Tap the function *[Aerate]* on the function bar.
▶ Answer **YES** to the confirmation question.
⇨ The system is vented.
⇨ The status bar shows the status **Aerating**.
▶ Wait until the status bar shows the status **Unload / Load**.
▶ Remove the dried preparation from the top-mount drying rack.

### 7.9.5 Shutting down the instrument

| | |
|---|---|
| Time re-quired: | 40min |

**NOTICE**

**Do not use force to remove the ice from the ice condenser.**

**Navigation path**

➔ Start

Precondition:
☑ The freeze-drying process has ended.

▶ Position the condensate drain hose so that the condensate can be drained off. See Chapter 5.3.9 "Preparing the condensate drain hose", page 27
▶ Navigate to the *[Start]* menu via the navigation path.
▶ Tap the function *[Shut down]* on the function bar.
⇨ The instrument is shutting down.
⇨ The status bar shows the remaining time and the status **Defrosting**.
⇨ After the instrument has shut down, the status bar shows the remaining time and the status **Shutting down**.

### 7.9.6 Switching off the instrument

Precondition:
☑ The instrument has been shut down. See Chapter 7.9.5 "Shutting down the instrument", page 61

▶ Switch the On/Off master switch to Off.

## 7.10 Performing freeze-drying manually [Pro control panel]

### 7.10.1 Preparing the instrument

| | |
|---|---|
| Time required: | approx. 30min |

**NOTE**

To minimize the condensation of moisture from the air in the condenser, place a drying rack.

**Navigation path**

➔ Start

- ▶ Navigate to the *[Start]* menu via the navigation path.
- ▶ Tap the function *[Start conditioning]* on the function bar.
  - ⇨ The temperature in the ice condenser decreases to operating temperature.
  - ⇨ The vacuum pump is brought up to operating temperature.
  - ⇨ After completion of the conditioning phase, the status bar shows the status **Unload / Load**.

### 7.10.2 Starting freeze-drying

**⚠ CAUTION**

**Risk of skin burns from touching parts of the ice condenser after completion of conditioning.**

- ▶ Wear protective gloves when working on the instrument after the conditioning phase.

**Navigation path**

➔ Start

Precondition:
☑ The instrument has been prepared.

- ▶ Fit a top-mount drying rack. See Chapter 8 "Operating top-mount drying racks", page 65.
- ▶ Load the top-mount drying rack with frozen samples.
- ▶ Navigate to the *[Start]* menu via the navigation path.
- ▶ Tap the function *[Manual]* on the function bar.
- ▶ Enter the required settings for the process parameters.

▶ Tap the function *[Start]* on the function bar.
⇨ The freeze-drying process starts.
⇨ The background color of the *Start* menu changes from white to black.
⇨ The status bar shows a clock counting up and the status **Manual Drying**.
⇨ The system evacuates to the set pressure.

### 7.10.3 Editing parameters while the process is running

**Navigation path**

➔ Start

Precondition:
☑ The process has been started.

▶ Navigate to the *[Start]* menu via the navigation path.
▶ Using the navigation control, navigate to the parameter that you wish to change.
▶ Tap the function *[Edit]* on the function bar.
⇨ The control panel shows a dialog box with a numeric input box.
⇨ The control panel highlights the selected parameter in white.
▶ Enter the value in the numeric input box.
▶ Tap the function *[Save]* on the function bar.
⇨ The setting is saved.
⇨ The dialog box closes.

### 7.10.4 Ending freeze-drying

**Navigation path**

➔ Start

Precondition:
☑ The sample is dry.

▶ Navigate to the *[Start]* menu via the navigation path.
▶ Tap the function *[Aerate]* on the function bar.
▶ Answer **YES** to the confirmation question.
⇨ The system is vented.
⇨ The status bar shows the status **Aerating**.
▶ As soon as the status bar shows the status **Unload / Load**, remove the dried sample from the drying rack.

### 7.10.5 Shutting down the instrument

| | |
|---|---|
| Time required: | 40min |

**NOTICE**

**Do not use force to remove the ice from the ice condenser.**

**Navigation path**

➔ Start

Precondition:
☑ The freeze-drying process has ended.

▶ Position the condensate drain hose so that the condensate can be drained off. See Chapter 5.3.9 "Preparing the condensate drain hose", page 27
▶ Navigate to the *[Start]* menu via the navigation path.
▶ Tap the function *[Shut down]* on the function bar.
  ⇨ The instrument is shutting down.
  ⇨ The status bar shows the remaining time and the status **Defrosting**.
  ⇨ After the instrument has shut down, the status bar shows the remaining time and the status **Shutting down**.

### 7.10.6 Switching off the instrument

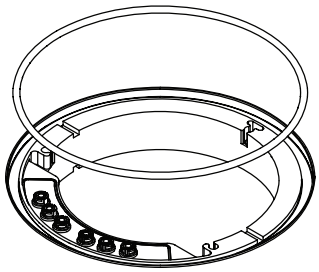
Precondition:
☑ The instrument has been shut down. See Chapter 7.10.5 "Shutting down the instrument", page 63

▶ Switch the On/Off master switch to Off.

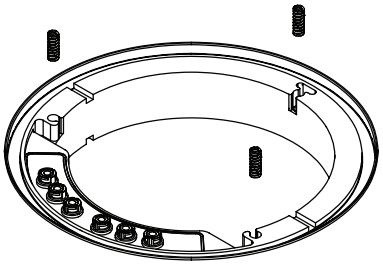
# 8 Operating top-mount drying racks

## 8.1 Operating stoppering acrylic drying chamber

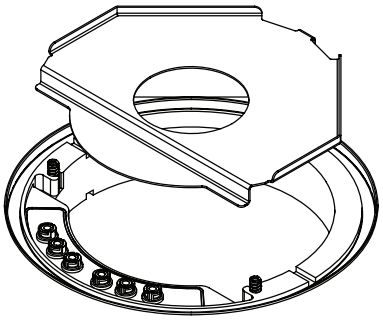
- ▶ Make sure that the groove above the ice condenser is clean, free of dust and not scratched.
- ▶ Check the 300 mm dia. O-ring for damage and grease it with vacuum grease.
- ▶ Place the 300 mm dia. O-ring in the groove above the ice condenser.



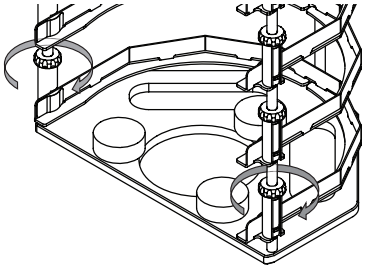
- ▶ Locate the springs in the holes on the ice condenser.



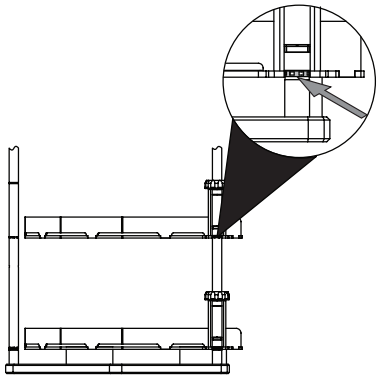
- ▶ Place the intermediate plate on the ice condenser.



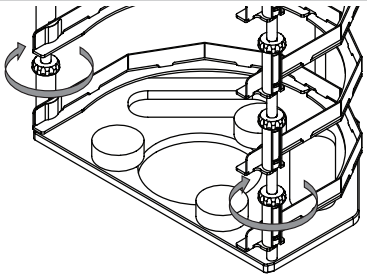
- ▶ Loosen all fixing screws.



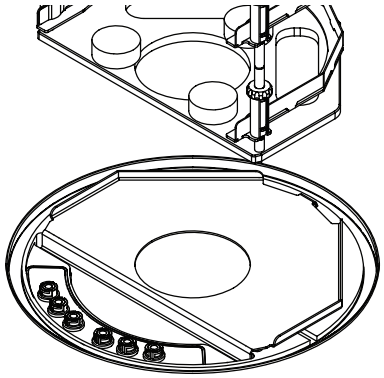
▶ Align the slots for the shelves.



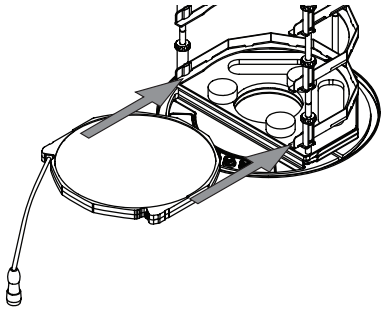
▶ Tighten the fixing screws.



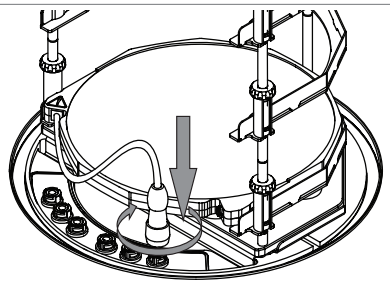
▶ Place the rack on the intermediate plate.



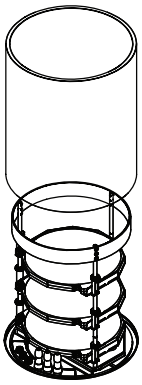
▶ Slide the shelves into the rack.



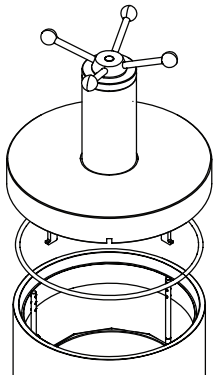
▶ Press the plug onto the shelf connection and turn the ring counterclockwise at the same time.



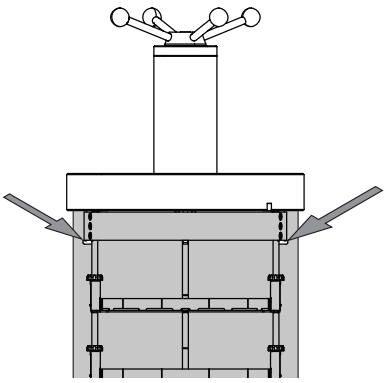
▶ Locate the cylinder in the groove above the main plate.



▶ Check the O-ring for damage and grease it with vacuum grease.
▶ Screw the hand wheel upwards until the plate inside the lid has pressed the hooks all the way in.
▶ Place the O-ring into the groove of the cover.
▶ Place the cover on the cylinder.



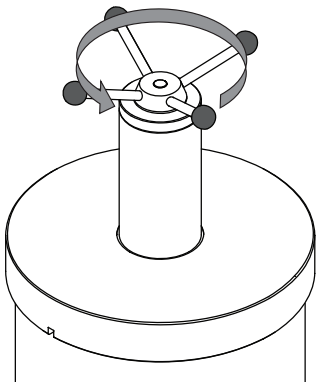
▶ Make sure that the hooks on the rack are engaged.



▶ Carry out freeze-drying.

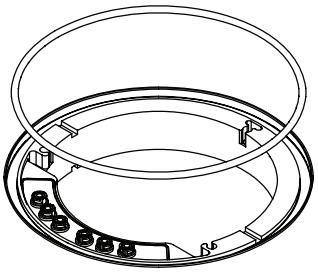
Precondition:
☑ The status bar shows the status **Stoppering**.

▶ Turn the hand wheel, until all samples are sealed.
▶ Confirm the verification question on the control panel.

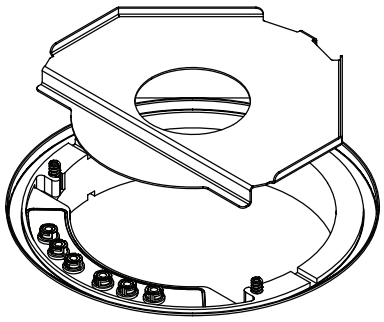


## 8.2 Operating manifold acrylic drying chamber (heatable shelves)

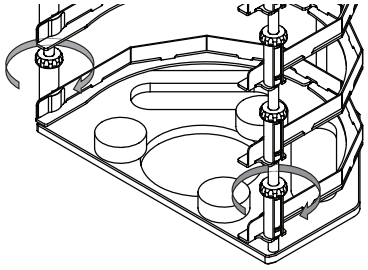
- ▶ Make sure that the groove above the ice condenser is clean, free of dust and not scratched.
- ▶ Check the 300 mm dia. O-ring for damage and grease it with vacuum grease.
- ▶ Place the 300 mm dia. O-ring in the groove above the ice condenser.



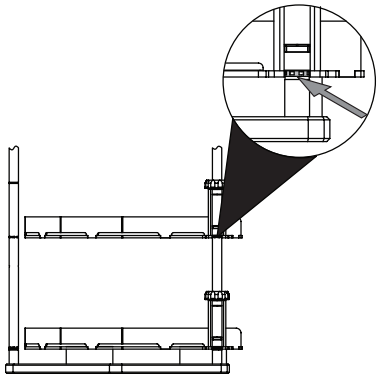
- ▶ Place the intermediate plate on the ice condenser.



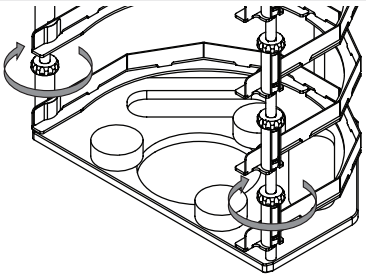
- ▶ Loosen all fixing screws.



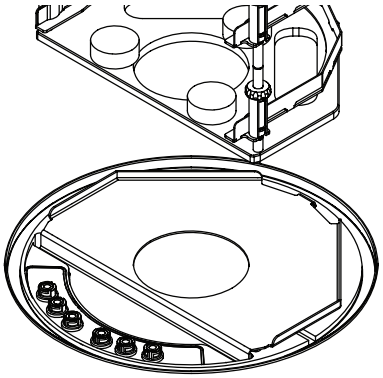
- ▶ Align the slots for the shelves.



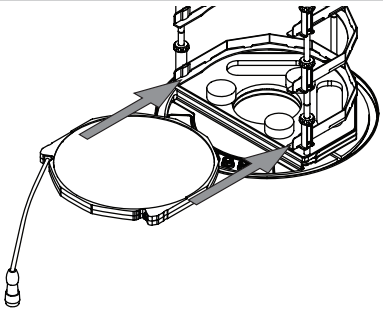
- ▶ Tighten the fixing screws.



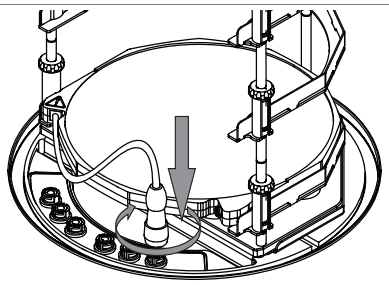
▶ Place the rack on the intermediate plate.



▶ Slide the shelves into the rack.



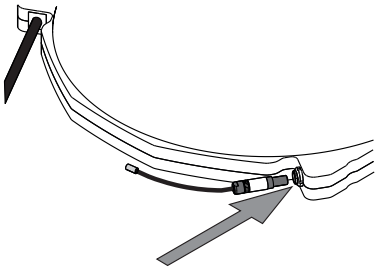
▶ Press the plug onto the shelf connection and turn the ring counterclockwise at the same time.



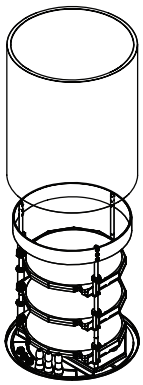
(option)

▶ Turn the temperature sensor electrical connector so that the marks on the connector and the heatable shelf are parallel

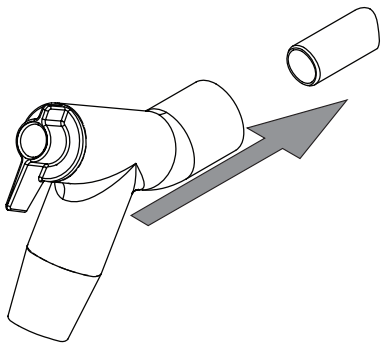
▶ Press the temperature sensor electrical connector onto the connection.



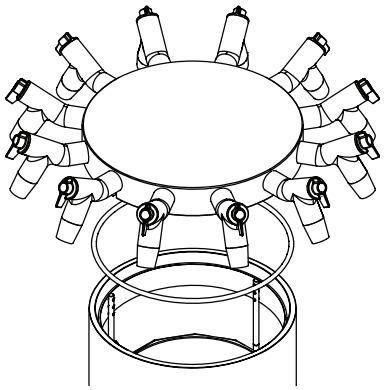
▶ Locate the cylinder in the groove above the main plate.

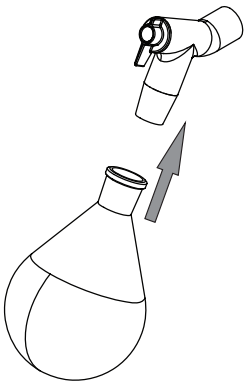


- ▶ Fit manifold valve onto the connection on the top-mount drying rack.



- ▶ Check the O-ring for damage and grease it with vacuum grease.
- ▶ Place the O-ring into the groove of the cover.
- ▶ Place the manifold cover on the cylinder.

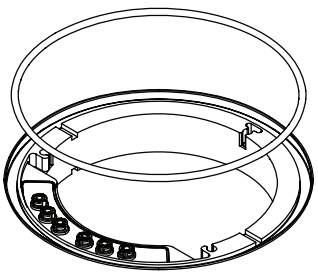




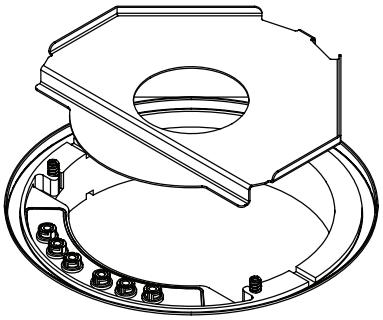
- ▶ Carry out freeze-drying.

## 8.3 Operating manifold acrylic drying chamber (non-heatable shelf)

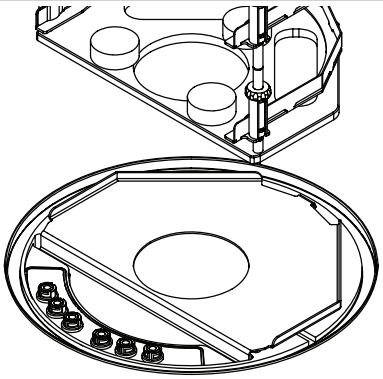
- ▶ Make sure that the groove above the ice condenser is clean, free of dust and not scratched.
- ▶ Check the 300 mm dia. O-ring for damage and grease it with vacuum grease.
- ▶ Place the 300 mm dia. O-ring in the groove above the ice condenser.



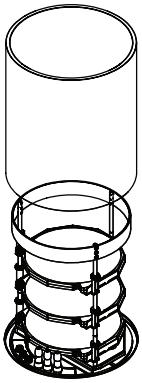
▶ Place the intermediate plate on the ice condenser.



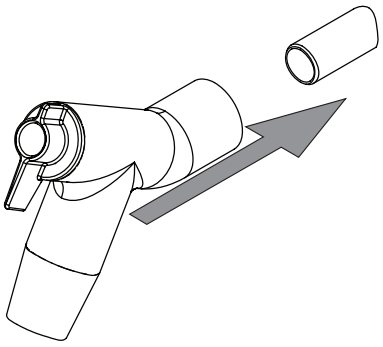
▶ Place the rack on the intermediate plate.



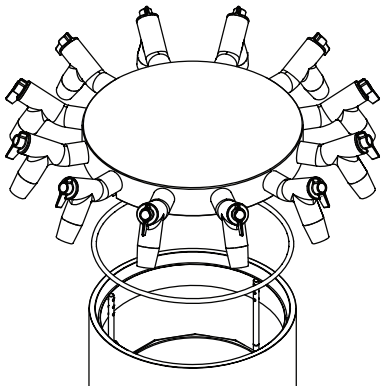
▶ Locate the cylinder in the groove above the main plate.

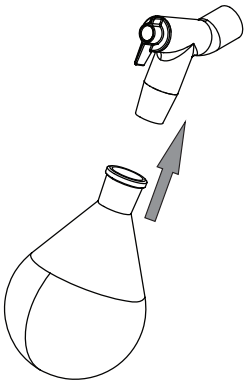


▶ Fit manifold valve onto the connection on the top-mount drying rack.



- ▶ Check the O-ring for damage and grease it with vacuum grease.
- ▶ Place the O-ring into the groove of the cover.
- ▶ Place the manifold cover on the cylinder.

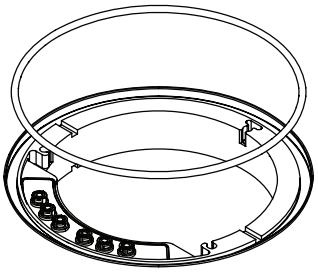




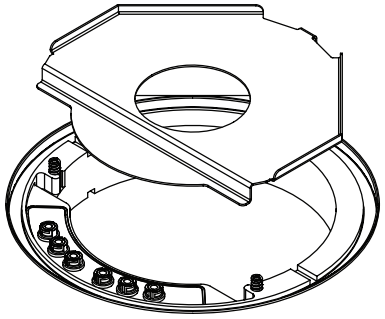
- ▶ Carry out freeze-drying.

## 8.4 Operating acrylic drying chamber (heatable shelf)

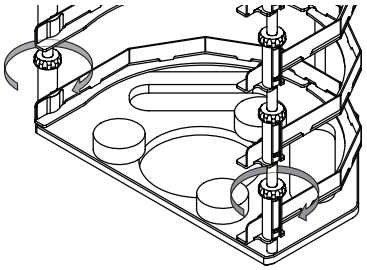
- ▶ Make sure that the groove above the ice condenser is clean, free of dust and not scratched.
- ▶ Check the 300 mm dia. O-ring for damage and grease it with vacuum grease.
- ▶ Place the 300 mm dia. O-ring in the groove above the ice condenser.



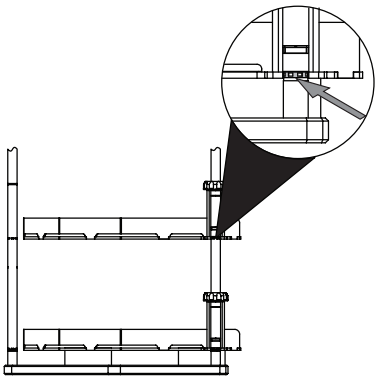
- ▶ Place the intermediate plate on the ice condenser.



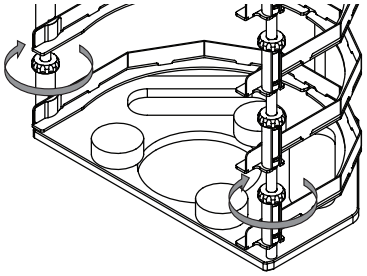
▶ Loosen all fixing screws.



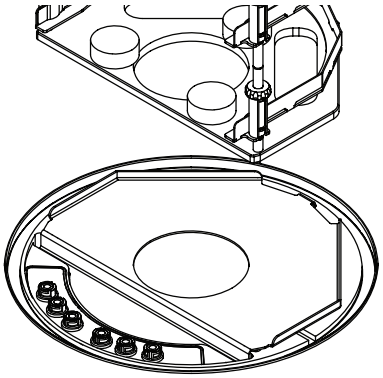
▶ Align the slots for the shelves.



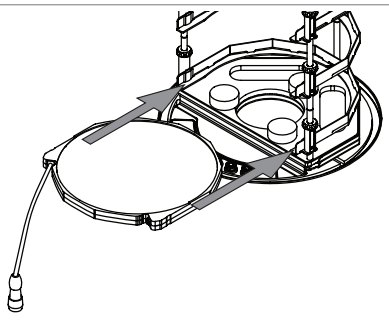
▶ Tighten the fixing screws.



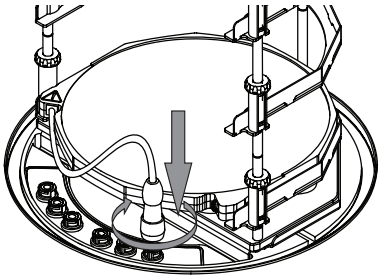
▶ Place the rack on the intermediate plate.



▶ Slide the shelves into the rack.

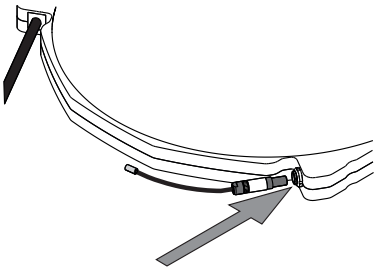


- ▶ Press the plug onto the shelf connection and turn the ring counterclockwise at the same time.

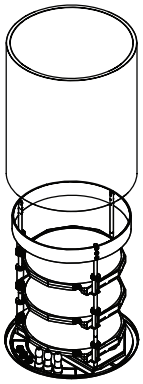


(option)

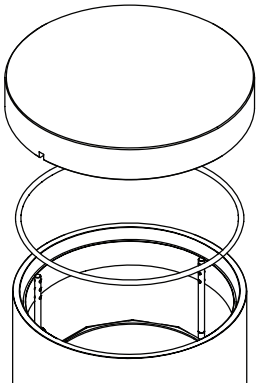
- ▶ Turn the temperature sensor electrical connector so that the marks on the connector and the heatable shelf are parallel
- ▶ Press the temperature sensor electrical connector onto the connection.



- ▶ Locate the cylinder in the groove above the main plate.



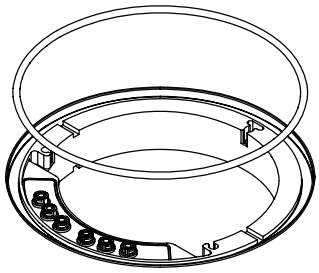
- ▶ Check the O-ring for damage and grease it with vacuum grease.
- ▶ Place the O-ring into the groove of the cover.
- ▶ Place the cover on the cylinder.



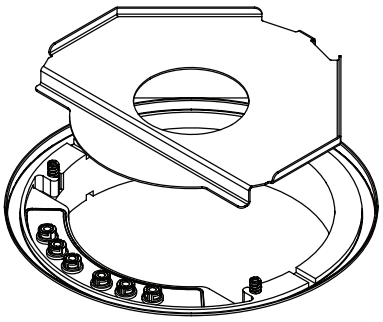
- ▶ Carry out freeze-drying.

## 8.5 Operating acrylic drying chamber (on-heatable shelf)

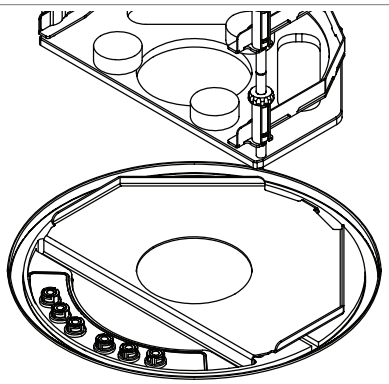
- ▶ Make sure that the groove above the ice condenser is clean, free of dust and not scratched.
- ▶ Check the 300 mm dia. O-ring for damage and grease it with vacuum grease.
- ▶ Place the 300 mm dia. O-ring in the groove above the ice condenser.



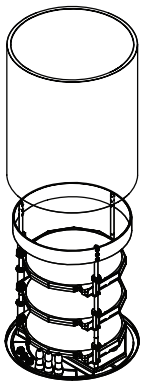
- ▶ Place the intermediate plate on the ice condenser.



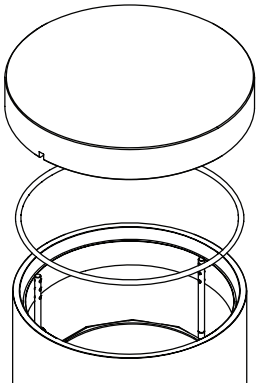
- ▶ Place the rack on the intermediate plate.



- ▶ Locate the cylinder in the groove above the main plate.



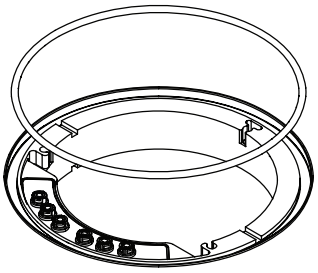
- ▶ Check the O-ring for damage and grease it with vacuum grease.
- ▶ Place the O-ring into the groove of the cover.
- ▶ Place the cover on the cylinder.



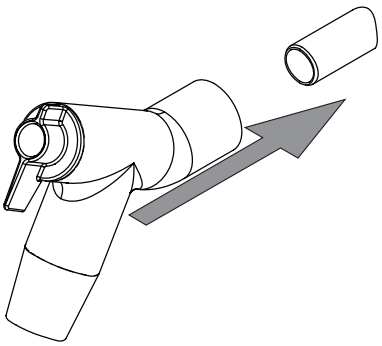
- ▶ Carry out freeze-drying.

## 8.6 Operating manifold drying rack

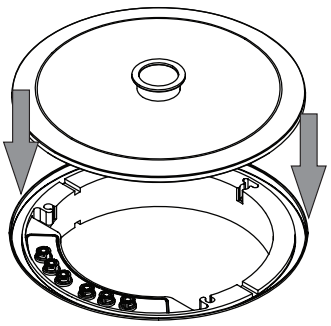
- ▶ Make sure that the groove above the ice condenser is clean, free of dust and not scratched.
- ▶ Check the 300 mm dia. O-ring for damage and grease it with vacuum grease.
- ▶ Place the 300 mm dia. O-ring in the groove above the ice condenser.



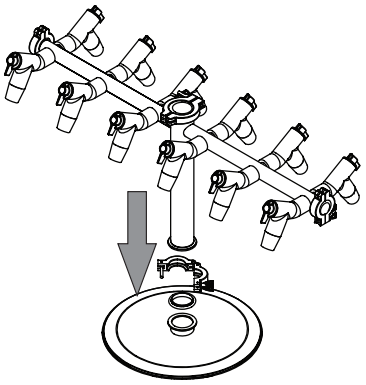
- ▶ Fit manifold valve onto the connection on the top-mount drying rack.

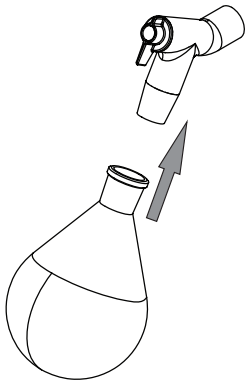


- ▶ Place the base plate on the ice condenser.



- ▶ Place the seal on the connection.
- ▶ Fit the manifold drying rack onto the seal and fix it with the clamp.

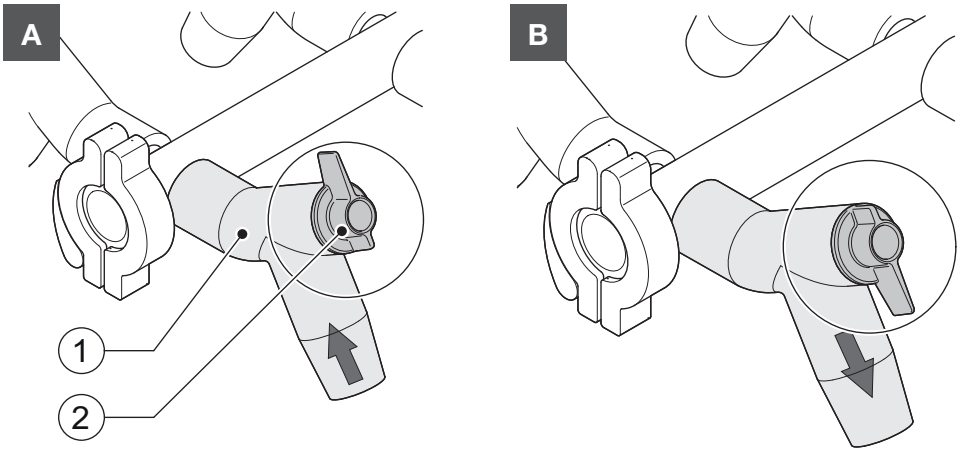




- ▶ Carry out freeze-drying.

## 8.7 Operating manifold valves

The lever on a manifold valve can be set to the following positions:




| Position | Function |
|---|---|
| A: Lever pointing up | The connected vessel is evacuated. |
| B: Lever pointing down | The connected vessel is vented. |

# 9 Cleaning and servicing

**NOTE**

Users may only carry out the servicing and cleaning operations described in this section.

Any servicing and repair work which involves opening up the casing may only be carried out by BUCHI service technicians.

## 9.1 Regular maintenance work

| Component | Action | Interval |
|---|---|---|
| Vacuum Pump | ▶ Carry out maintenance according to the manufacturer's instructions. See relevant documentation. | See manufacturer's instructions |
| Top-mount drying racks | ▶ Wipe down the top-mount drying racks with a damp cloth.<br>▶ If heavily soiled, use a mild detergent. | Daily |
| O-ring, dia. 300 mm | ▶ Wipe down the 300 mm O-rings with a damp cloth.<br>▶ Check for scratches and other damage.<br>▶ Replace the 300 mm O-ring if it is damaged.<br>▶ Grease with vacuum grease if necessary. | Daily |
| | ▶ Replace the 300 mm O-ring. | Annually |
| Seals, ISO-KF 16<br>Seals, ISO-KF 25 | ▶ Wipe down the seals with a damp cloth.<br>▶ Check for scratches and other damage.<br>▶ Replace seals if they are damaged. | Annually |
| Vacuum tubing | ▶ Wipe down the vacuum tube with a damp cloth.<br>▶ Check for scratches and other damage.<br>▶ Replace the vacuum tube if it is damaged. | Annually |
| Ice condenser | ▶ Rinse out with water.<br>▶ If heavily soiled, use ethanol or a mild detergent. | Daily |
| Drain valve strainer | ▶ Clean the strainer. | Daily |
| Casing | ▶ Wipe down the casing with a damp cloth.<br>▶ If heavily soiled, use ethanol or a mild detergent. | Weekly |
| Warning symbols | ▶ Check that the warning symbols on the instrument are legible.<br>▶ If they are dirty, clean them. | Weekly |

| Component | Action | Interval |
|---|---|---|
| Draining valve | ▶ Remove the strainer.<br>▶ Fill ice condenser with water.<br>▶ Open the drain valve manually.<br>▶ Loosen deposits from drain valve using compressed air. | Weekly |
| Heat exchanger | ▶ Remove dust and foreign objects from the ventilation slots using compressed air or a vacuum cleaner. | Monthly |
| View | ▶ Wipe down the display with a damp cloth. | Monthly |

## 9.2 Performing a vacuum test

The vacuum test checks the performance capacity of the vacuum system.

| | |
|---|---|
| Time required: | max. 10 min |

**Navigation path**

➜ Configuration ➜ Servicing ➜ Vacuum test

Precondition:

☑ Conditioning of the instrument has been completed.

☑ A top-mount drying rack is fitted.

☑ The top-mount drying rack does not contain sample.

▶ Navigate to the action *[Vacuum Test]* via the navigation path.
▶ Specify a required setting for the vacuum to be achieved.
▶ Specify a required time within which the vacuum is to be reached.
▶ Tap the function *[Start]* on the function bar.

⇨ The vacuum test starts.

⇨ The status bar shows the status **Vacuum Test**.

⇨ If the vacuum pressure is not below 500 mbar after 30 s, the vacuum test automatically aborts.

⇨ After completion of the vacuum test, the *[Vacuum test]* line shows whether the vacuum test has been passed or not.

**Troubleshooting after failed vacuum test**

| Possible cause | Action |
|---|---|
| Top-mount drying rack not correctly fitted | Fit the top-mount drying rack correctly. |
| Top-mount drying rack is damaged | Check function of PMMA parts, replace manifold valves, clean drain valve. |
| O-rings dirty | Wipe down the O-rings with a damp cloth. |
| O-rings damaged | Check O-rings and replace if necessary. |
| Groove of O-rings dirty | Wipe groove of O-rings with a damp cloth. |
| KF clamps not closed | Close the KF clamps. |

| Possible cause | Action |
|---|---|
| KF seals dirty | Wipe down the KF seals with a damp cloth. |
| KF seals damaged | Inspect KF seals and replace as necessary. |
| The pump connected is not delivering sufficient performance | Carry out vacuum test with a different vacuum pump. |

## 9.3 Performing a leak test

### 9.3.1 Performing a leak test with a drying chamber

The leak test checks the vacuum system for possible leaks.

| | |
|---|---|
| Time required: | 45 min |

**NOTE**

The leak test can be aborted by tapping *[Stop]* on the function bar.

Precondition:

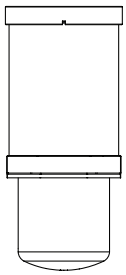
☑ Conditioning of the instrument has been completed.

☑ A top-mount drying rack is fitted.

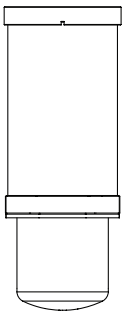
☑ The top-mount drying rack does not contain sample.

▶ Navigate to the action *[Leak test]* via the navigation path.
▶ On the *[Ice Condenser]* line, enter a required setting for the vacuum.
▶ On the *[Shelf temperature]* line enter the required shelf temperature.
▶ On the *[Test scope]* line select the component to be tested.
▶ On the *[Drying shelf heating]* line switch the drying shelf heating on or off.
▶ On the *[Volume]* line enter the actual volume of the components to be tested.

The volume of the system is calculated from the volume of the ice condenser and the top-mount drying rack.



36.46L
Acrylic drying chamber
(with 4 drying shelves)



43.41L
Acrylic drying chamber
(with 6 drying shelves)

▶ Tap the function *[Start]* on the function bar.
  ⇨ The leak test starts.
  ⇨ The status bar shows the status **Leak Test**.

⇨ After completion of the leak test, the *[Leak test]* line shows whether the leak test has been passed or not.

⇨ The leak test is passed if the measured leakage rate is less than the pre-set rate of 10.10 mbar*L/h.

**Troubleshooting after failed leak test**

| Possible cause | Action |
|---|---|
| Top-mount drying rack not correctly fitted | Fit the top-mount drying rack correctly. |
| O-rings dirty | Wipe down the O-ring with a damp cloth. |
| O-rings damaged | Check O-rings and replace if necessary. |
| Groove of O-rings dirty | Wipe groove of O-rings with a damp cloth. |
| KF clamps not closed | Close the KF clamps. |
| KF seals dirty | Wipe down the KF seals with a damp cloth. |
| KF seals damaged | Inspect KF seals and replace as necessary. |
| Pump oil dirty | Service according to manufacturer's instructions. |
| Leaking manifold valves<br>(manifold acrylic drying chamber only) | Replace leaking manifold valve.<br>Locate leaking manifold valve. See Chapter 10.3 "Locating leaking manifold valve", page 84 |

### 9.3.2 Performing leak test with a manifold drying rack

The leak test checks the vacuum system for possible leaks.

| | |
|---|---|
| Time required: | 45 min |

**NOTE**

The leak test can be aborted by tapping *[Stop]* on the function bar.

Precondition:

☑ Conditioning of the instrument has been completed.

- ▶ Fit the base plate with a KF 40 blind flange, an ISO-KF 40 seal and an ISO-KF 40 clamp.
- ▶ Navigate to the action *[Leak test]* via the navigation path.
- ▶ On the *[Ice Condenser]* line, enter a required setting for the vacuum.
- ▶ On the *[Shelf temperature]* line enter the required shelf temperature.
- ▶ On the *[Test scope]* line select the component to be tested.
- ▶ On the *[Drying shelf heating]* line switch the drying shelf heating on or off.
- ▶ On the *[Volume]* line enter the actual volume of the components to be tested.

The volume of the system is calculated from the volume of the ice condenser and the top-mount drying rack.

13.64L

▶ Tap the function *[Start]* on the function bar.

⇨ The leak test starts.

⇨ The status bar shows the status **Leak Test**.

⇨ When the leak test is completed, the *[Leak test]* tab indicates whether the leak test was successful.

⇨ The leak test is passed if the measured leakage rate is less than the pre-set rate of 10.10 mbar*L/h.

**NOTE**

To test the leak-tightness of the manifold drying rack, carry out another leak test with the manifold drying rack installed.

**Troubleshooting after failed leak test**

| Possible cause | Action |
|---|---|
| Top-mount drying rack not correctly fitted | Fit the top-mount drying rack correctly. |
| O-rings dirty | Wipe down the O-ring with a damp cloth. |
| O-rings damaged | Check O-rings and replace if necessary. |
| Groove of O-rings dirty | Wipe groove of O-rings with a damp cloth. |
| KF clamps not closed | Close the KF clamps. |
| KF seals dirty | Wipe down the KF seals with a damp cloth. |
| KF seals damaged | Inspect KF seals and replace as necessary. |
| Pump oil dirty | Service according to manufacturer's instructions. |
| Leaking manifold valves<br>(only if manifold drying rack installed) | Replace leaking manifold valve.<br>Locate leaking manifold valve. See Chapter 10.3 "Locating leaking manifold valve", page 84 |

# 10 Help with faults

## 10.1 Troubleshooting

| Problem | Possible cause | Action |
|---|---|---|
| Compressor fails to start or switches off | No power supply to compressor | ▶ Check the power supply and switch on the device. |
| | Compressor overheated | ▶ Allow the compressor to cool down.<br>▶ Check ambient conditions. |
| | Circuit-breaker has tripped | ▶ Reset circuit of L-200. |
| Cooling temperature is not achieved | Wrong ambient conditions | Adjust ambient conditions. See Chapter 5.1 "Installation site", page 21 |
| | Too much ice in the ice condenser | Defrost the ice condenser. |

## 10.2 Faults, possible causes and remedies

| Malfunction | Possible cause | Remedy |
|---|---|---|
| Instrument does not work | Instrument is not connected to the power supply. | ▶ Make sure that the power supply is connected and switched on. |
| Main valve or vacuum pump switches over frequently | Vacuum system is leaking. | ▶ If necessary, replace tubing and/or seals. |
| Main valve does not switch over | Main valve fitted wrong way round. | ▶ Fit main valve correct way round (arrow pointing towards vacuum pump). |
| | Main valve lead not plugged in. | ▶ Make sure that the electrical lead of the main valve is plugged into the correct socket on the rear of the instrument. |

| Malfunction | Possible cause | Remedy |
|---|---|---|
| Vacuum is not achieved | Vacuum system is leaking. | ▶ Clean the drain valve.<br>▶ Check manifold valve. See Chapter 10.3 "Locating leaking manifold valve", page 84<br>▶ Check regulating valve and aeration valve. See Chapter 10.4 "Finding a leaking regulating valve or aeration valve", page 84<br>▶ If necessary, replace tubing and/or seals. |
| | Vacuum pump is too weak. | ▶ Use a vacuum pump with a capacity of at least 5m$^3$/h.<br>▶ Carry out maintenance work according to the vacuum pump manufacturer's documentation. |
| Instrument is not vented | Main valve is incorrectly connected. | ▶ Connect the main valve properly (see Chapter 5.3.3 "Fitting the advanced vacuum control unit", page 23). |

## 10.3 Locating leaking manifold valve

**Navigation path**

➔ Start

Precondition:
☑ The system does not evacuate to less than 0.1 mbar.

▶ Navigate to the *Start* view via the navigation path.
▶ Set the vacuum to 0.5 mbar.
▶ Tap the function *[Start]* on the function bar.
▶ Turn each manifold valve individually while checking the display to see if the actual pressure changes.
▶ If the vacuum decreases in the case of one of the manifold valves, then that valve is the one that is leaking.
▶ Tap the function *[Aerate]* on the function bar.
▶ Replace the manifold valve concerned.

## 10.4 Finding a leaking regulating valve or aeration valve

**Navigation path**

➔ Start

Precondition:
☑ The instrument has been prepared.

▶ Remove regulating or aeration valve.
▶ Seal the opening with KF16 cover.

- ▶ Fit a top-mount drying rack. See Chapter 8 "Operating top-mount drying racks", page 65.
- ▶ Navigate to the *[Start]* menu via the navigation path.
- ▶ Tap the function *[Manual]* on the function bar.
- ▶ Enter the specified settings for the vacuum.
- ▶ Tap the function *[Start]* on the function bar.
  - ⇨ The background color of the *Start* menu changes from white to black.
  - ⇨ The status bar shows a clock counting up and the status **Manual Drying**.
  - ⇨ The system evacuates to the set pressure.
  - ⇨ If the specified setting is not reached, the valve is leaking.
- ▶ Carry out the instructions for action on the other valve.

# 11 Taking out of service and disposal

## 11.1 Disposal

The operator is responsible for proper disposal of the Lyovapor™.

**⚠ CAUTION**

**Potential environmental hazard**

The device uses refrigerant R507. This refrigerant is toxic and must not be allowed to enter the soil or groundwater.

- ▶ Dispose of the appliance properly, if necessary using a professional disposal service.

- ▶ When disposing of equipment observe the local regulations and statutory requirements regarding waste disposal.

## 11.2 Returning the instrument

Before returning the instrument, contact the BÜCHI Labortechnik AG Service Department.

https://www.buchi.com/contact

# 12 Appendix

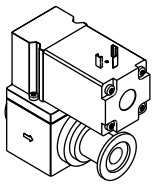
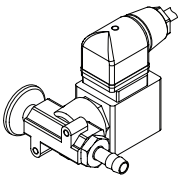
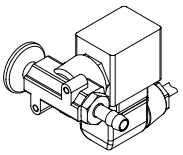
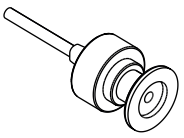
## 12.1 Spare parts and accessories

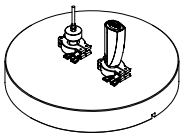
Use only genuine BUCHI consumables and spare parts in order to ensure correct, safe and reliable operation of the system.

**NOTE**

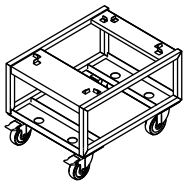
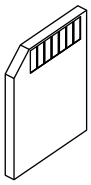
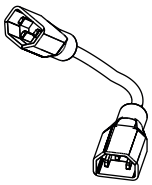
Any modifications of spare parts or assemblies are only allowed with the prior written permission of BUCHI.

### 12.1.1 Accessories

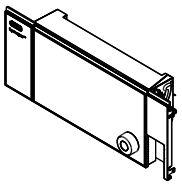
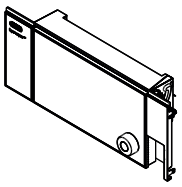
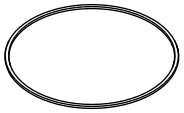
| Description | Order no. | Image |
|---|---|---|
| Main valve | 11062223 |  |
| Pressure regulation valve | 11064725 |  |
| Aeration valve | 11064724 |  |
| Pirani / Piezo pressure sensor PPG010 | 11062228 |  |
| Capacitive pressure sensor Inficon CDG 020 D | 11066564 |  |
| PT1000 sample temperature sensor | 11064031 |  |

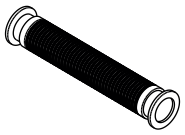
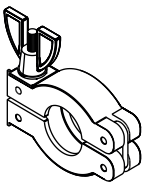
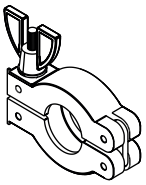
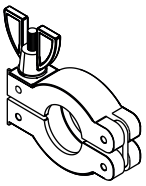
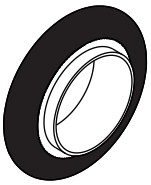
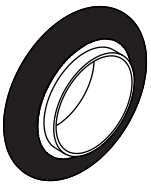
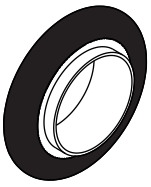
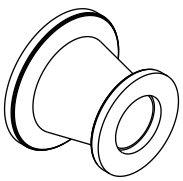
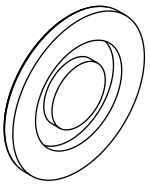
| Description | Order no. | Image |
|---|---|---|
| Set for pressure difference test at L-200<br>incl. PPG010 and CDG 020D sensors, PMMA top cover, seals and clamps | 11067590 |  |

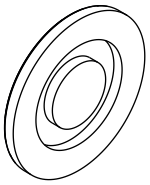
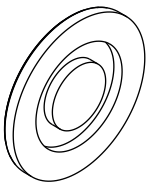
### 12.1.2 Further accessories

| Description | Order no. | Image |
|---|---|---|
| Trolley L-200, stainless steel coated | 11063692 |  |
| SD-Card 1 GB | 11064730 |  |
| Connection cable, for vacuum pump | 11064934 |  |

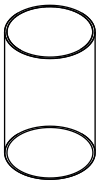
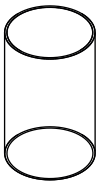
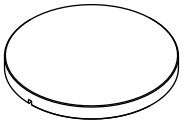
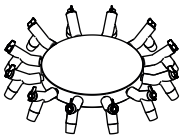
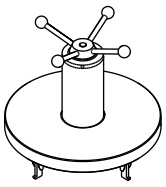
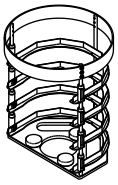
### 12.1.3 Spare parts

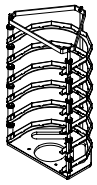
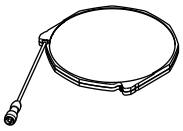
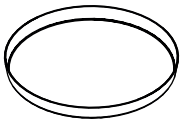
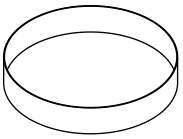
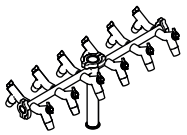
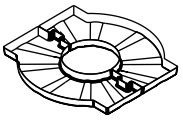
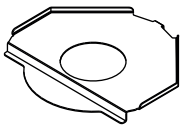
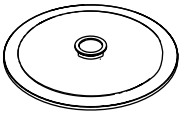
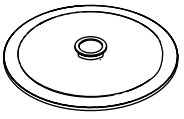
| Description | Order no. | Image |
|---|---|---|
| User interface | 11063580 |  |
| User interface Pro | 11063581 |  |
| O-Ring Ø 300 mm | 11065367 |  |

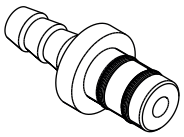
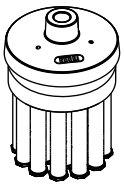
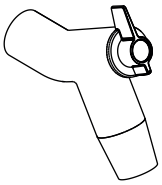
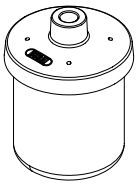
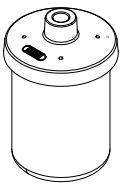
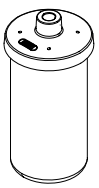
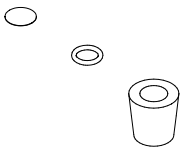
| Description | Order no. | Image |
|---|---|---|
| Vacuum hose, KF 25, L 1000 mm | 11066031 |  |
| Vacuum clamp KF 16 | 11064939 |  |
| Vacuum clamp KF 25 | 11063662 |  |
| Vacuum clamp, KF 40 | 11063663 |  |
| Vacuum seal KF 16 | 11063455 |  |
| Vacuum seal KF 25 | 11063457 |  |
| Vacuum seal KF 40 | 11063659 |  |
| Vacuum flange adapter, stainless steel, KF 16 to KF 25 | 11064870 |  |
| Blind flange KF 16 | 11064902 |  |

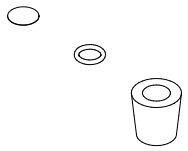
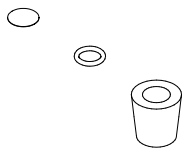
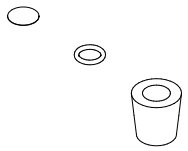
| Description | Order no. | Image |
|---|---|---|
| Blind flange KF 25 | 11063660 |  |
| Blind flange KF 40 | 11063661 |  |

### 12.1.4 Top-mount drying rack accessories

| Description | Order no. | Image |
|---|---|---|
| Drying chamber tube, PMMA, for 4 shelves<br>L 368 mm, Ø 300 mm | 11063278 |  |
| Drying chamber tube, PMMA, for 6 shelves<br>L 480 mm, Ø 300 mm | 11065093 |  |
| Top cover, PMMA, without sealing<br>Ø 300 mm, H 50 mm | 11062912 |  |
| Top cover manifold, PMMA, with 12 valves, without sealing<br>Ø 300 mm, W 546 mm, H 127 mm | 11065595 |  |
| Top cover stoppering, without sealing<br>only for rack for 4 heatable shelves<br>Ø 300 mm, H 330 mm, W 320 mm | 11064314 |  |
| Rack for 4 heatable shelves<br>H 356 mm, Ø 265 mm , shelf distance 30-75 mm | 11065102 |  |

| Description | Order no. | Image |
|---|---|---|
| Rack for 6 heatable shelves<br>H 468 mm, Ø 265 mm, shelf distance 30-75 mm | 11065103 |  |
| Heatable shelf, aluminum coated, with connection cable<br>Ø 219.5 mm, surface area 376 cm² | 11064095 |  |
| Sample tray, stainless steel<br>Ø 220 mm, H 18.5 mm | 11061439 |  |
| Ferrule,<br>Ø 218 mm, H 40 mm | 11065816 |  |
| Drying rack manifold, stainless steel, with 12 valves<br>H 340 mm, W 777 mm | 11063664 |  |
| Drip pan, for manifold | 11066358 |  |
| Support for rack, stainless steel<br>H 4 mm | 11063789 |  |
| Baseplate, stainless steel, for manifold rack | 11064953 |  |
| Baseplate, PMMA, for manifold rack | 11065733 |  |

| Description | Order no. | Image |
|---|---|---|
| Suction nipple<br>For manifold application to create vacuum in sample flasks | 11065819 |  |
| Ampoule adapter for manifold<br>with 19 ampoule connections and cap adapter | 11065725 |  |
| Manifold valve, natural ruber, with SJ 29/32 | 11062300 |  |
| Flask beaker for manifold 100 mL<br>with cap adapter and integrated filter | 11066140 |  |
| Flask beaker for manifold 200 mL<br>with cap adapter and integrated filter | 11066141 |  |
| Flask beaker for manifold 600 mL<br>with cap adapter and integrated filter | 11066142 |  |
| Flask beaker for manifold 800 mL<br>with cap adapter and integrated filter | 11069474 |  |
| Flask beaker for manifold 1200 mL<br>with cap adapter and integrated filter | 11066143 |  |
| Manifold flask adapter set<br>with 12 adapters, incl. filter paper | 11066144 |  |

| Description | Order no. | Image |
|---|---|---|
| Manifold flask adapter set<br>with 6 adapters, incl. filter paper | 11067334 |  |
| Manifold flask adapter set, US joint size<br>with 12 adapters, incl. filter paper | 11066171 |  |
| Manifold flask adapter set, US joint size<br>with 6 adapters, incl. filter paper | 11067333 |  |

### 12.1.5 Software

| | Order no. |
|---|---|
| Lyovapor™ software licence | 11065668 |
| Lyovapor™ software DVD | 11065667 |

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