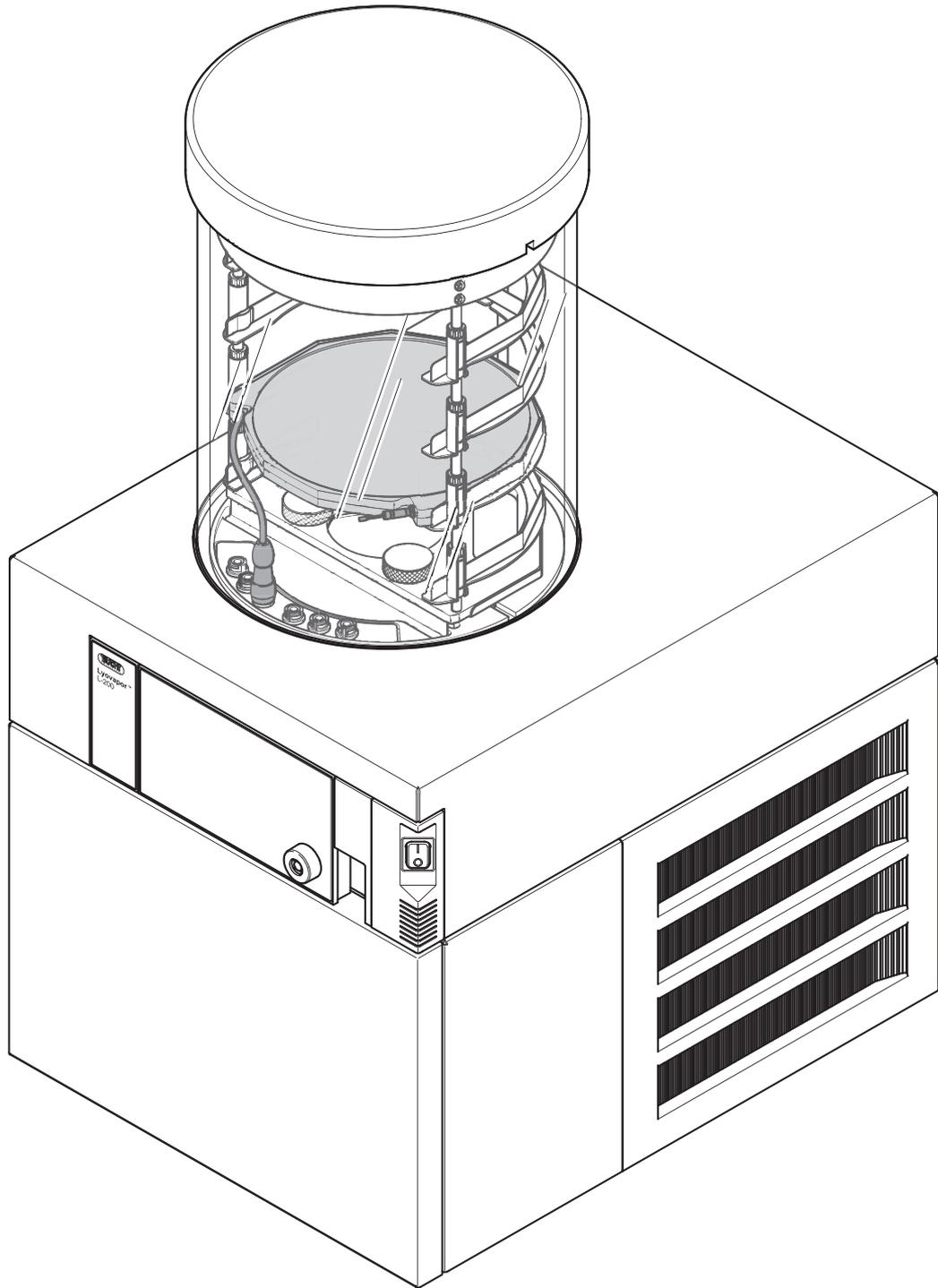




# Lyovapor™ L-200 Operation Manual



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BÜCHI reserves the right to make changes to the manual as deemed necessary in the light of experience, especially with respect to structure, illustrations and technical details.

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# 1 About this document

These operating instructions describe the Lyovapor™ L-200 at the time supplied. They are an integral part of the product and contain important information that is necessary for safe operation and maintenance.

These operating instructions apply to all variants of the Lyovapor™ L-200.

- ▶ To ensure safe and trouble-free operation, read these operating instructions before starting up the device and follow the guidance they contain.
- ▶ Keep the operating instructions somewhere near to the device.
- ▶ Pass on the operating instructions to any subsequent owner or user.

BÜCHI Labortechnik AG accepts no liability whatsoever for any faults or damages that result from the failure to follow these operating instructions.

- ▶ If you still have any questions after reading these operating instructions, please contact BÜCHI Labortechnik AG Customer Service. Contact details for your local agents can be found on the back cover of these operating instructions or on the Internet at <http://www.buchi.com>.

## 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.
IMPORTANT	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	Symbol	Meaning
	General warning		Corrosive substance
	Dangerous electrical voltage		Flammable substance
	Biological hazard		Potentially explosive atmosphere

Symbol	Meaning	Symbol	Meaning
	Breakable items		Dangerous gases
	Hot surface		Health-harming or irritant substances
	Risk of hand injury		Strong magnetism

### 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 Other 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.

## 1.4 Available languages

These operating instructions were originally produced in German and have been translated into several other languages. The translations are available on the enclosed CD or can be obtained as a PDF file via <http://www.buchi.com>.

## 1.5 Trademarks

Product names and registered or unregistered trademarks that are used in this instruction manual 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 is exclusively intended for that purpose. The Lyovapor™ L-200 can be used in laboratories for the following tasks:

- Sublimating and condensing water

### 2.2 Use other than that intended

Use of any kind other 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 Technical data) 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.

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.

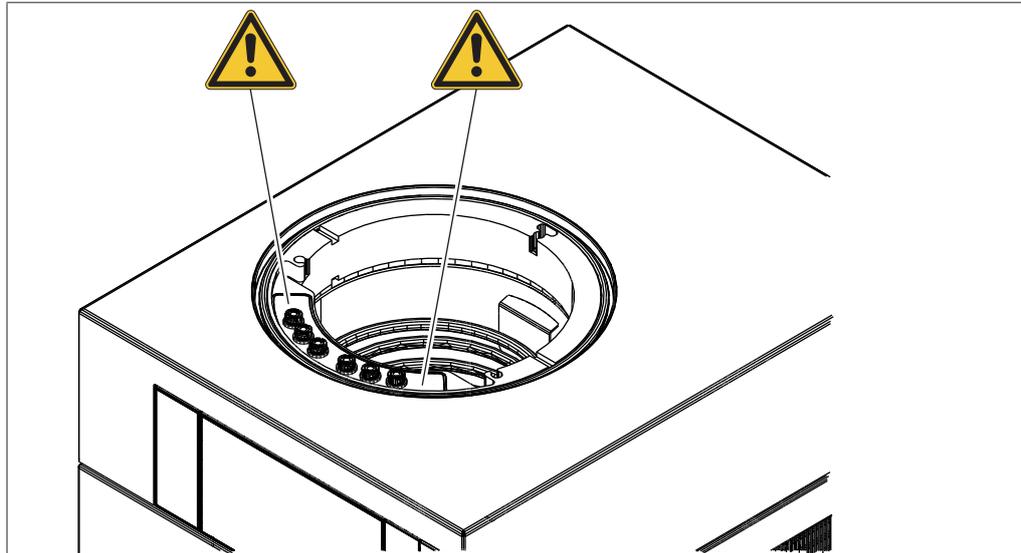


Fig. 1: Location of warning signs on the product

 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 sublimation 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 vacuum, 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

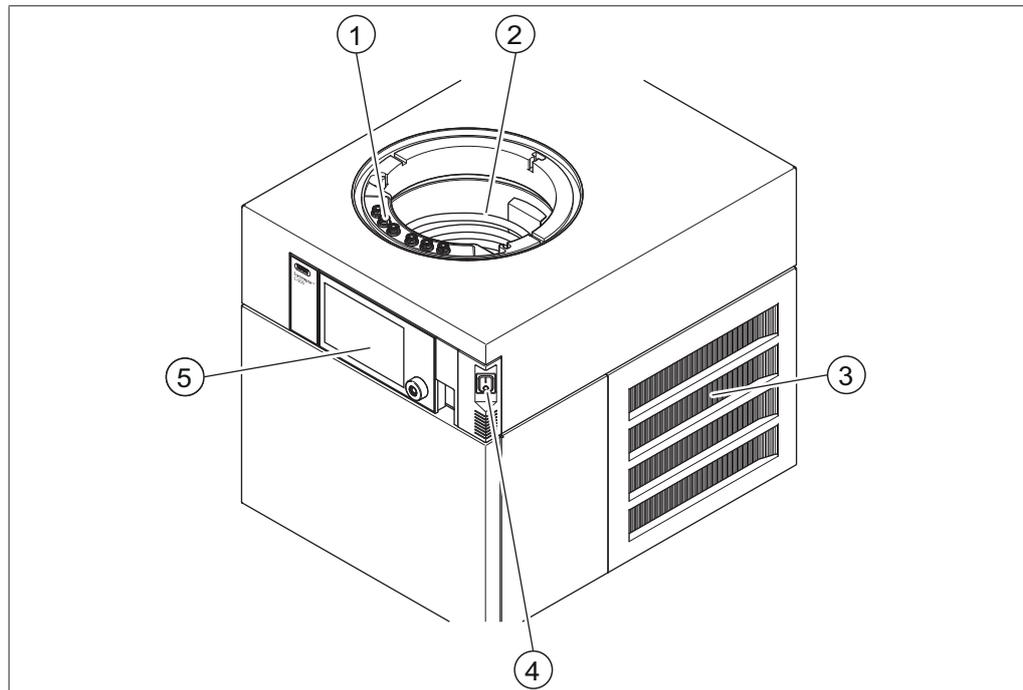


Fig. 2: Front view Lyovapor™ L-200

- |  |                        |
|--|------------------------|
| 1 Connections for heatable shelves<br>(Lyovapor™ L-200 Pro only) | 2 Ice condenser        |
| 3 Ventilation slots  | 4 On/Off master switch |
| 5 Control panel  |                        |

### 3.2.2 Rear view

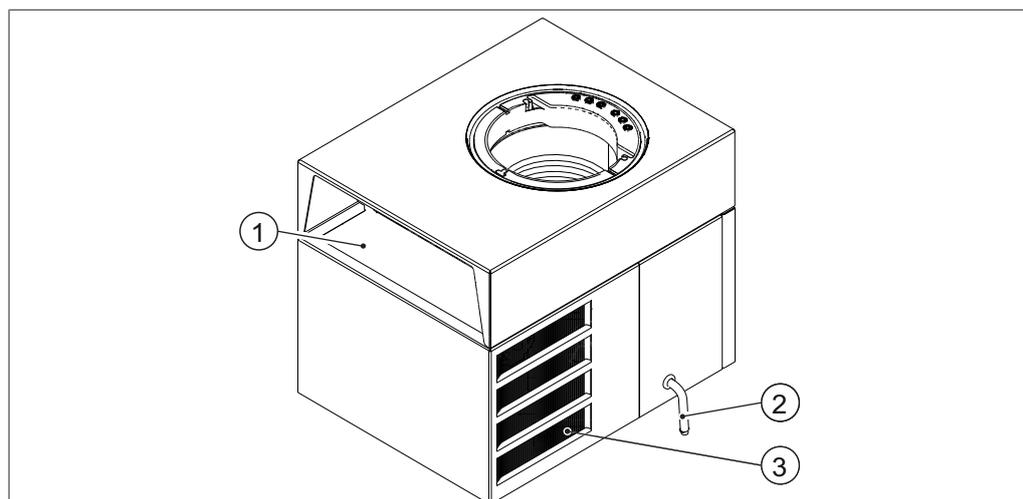


Fig. 3: Rear view Lyovapor™ L-200

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

### 3.2.3 Connections on the rear side

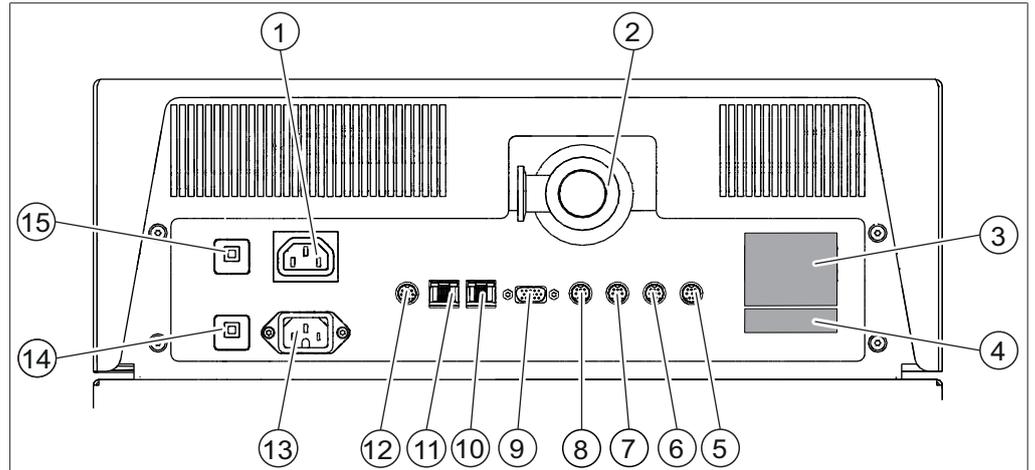


Fig. 4: Connections on the rear side

- |                                       |  |
|---------------------------------------|--|
| 1 Vacuum pump connection              | 2 Vacuum connection                    |
| 3 Type Plate                          | 4 Refrigerant specification            |
| 5 Main valve connection               | 6 Control valve connection             |
| 7 Aeration valve connection           | 8 Spare                                |
| 9 External pressure sensor connection | 10 Internal pressure sensor connection |
| 11 LAN port                           | 12 COM port                            |
| 13 Power supply connection            | 14 Fuse                                |
| 15 Fuse                               |  |

### 3.2.4 Basic control panel

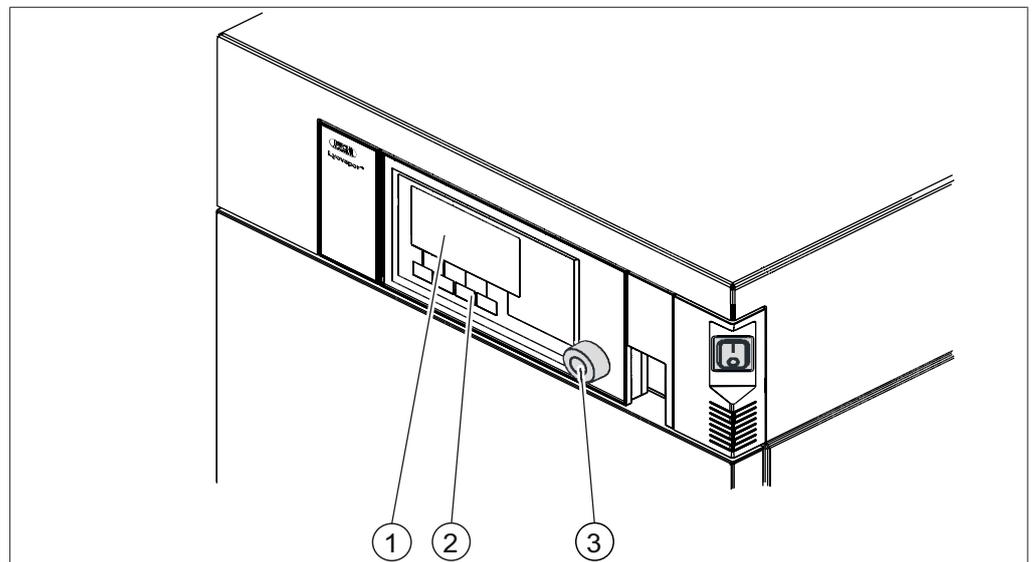


Fig. 5: Basic control panel

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

### 3.2.5 Pro control panel

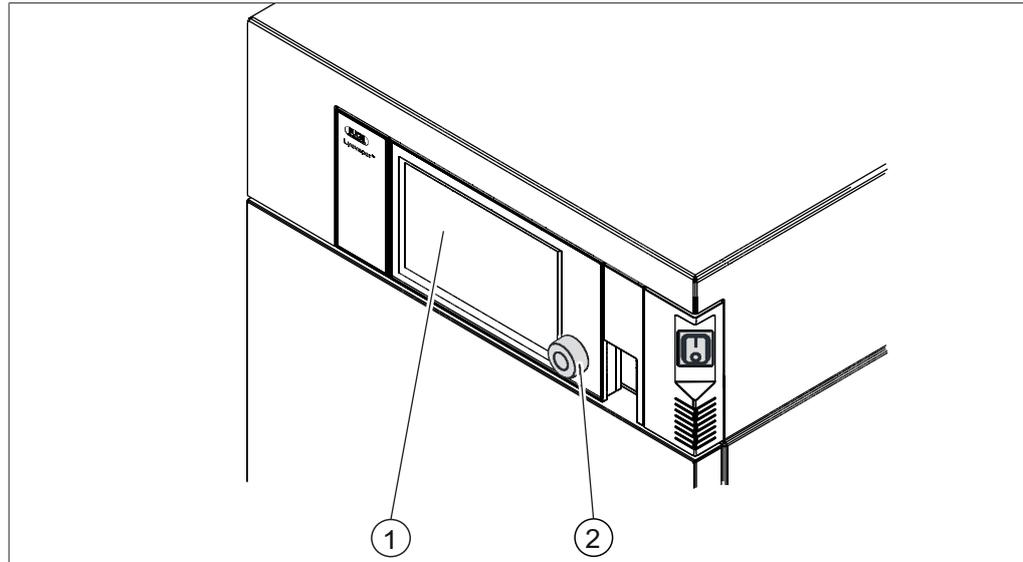


Fig. 6: Pro control panel

1 Touch-screen display

2 Navigation control

### 3.3 Type plate

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

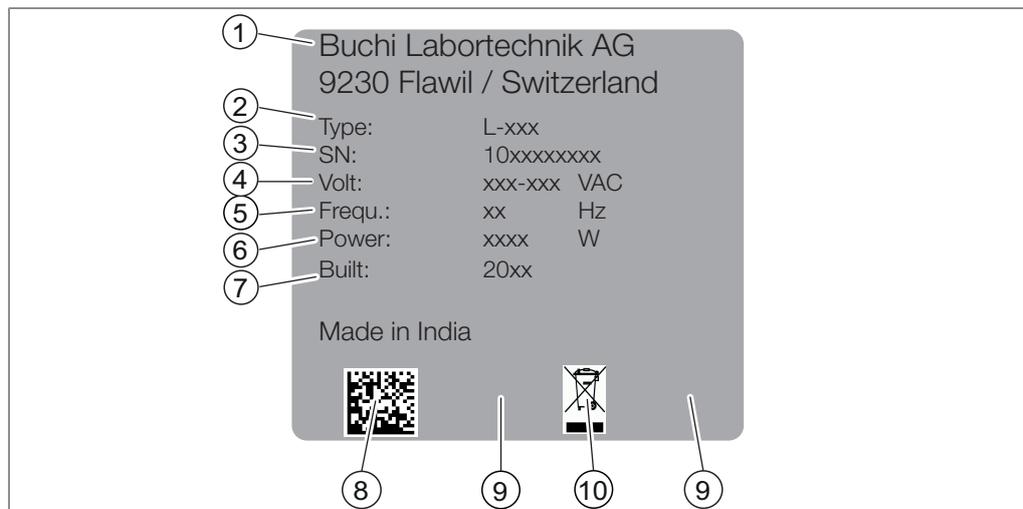


Fig. 7: Type Plate

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"

### 3.4 Refrigerant Specification

The refrigerant details are at the back of the instrument.

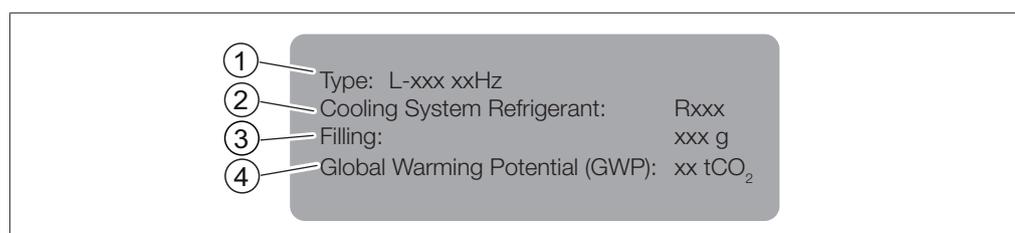


Fig. 8: Refrigerant details

- |                    |                            |
|--------------------|----------------------------|
| 1 Instrument name  | 2 Refrigerant details      |
| 3 Filling capacity | 4 Global warming potential |

### 3.5 Specifications supplied



#### 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.

#### Standard specifications supplied

Component	Article no.	Quantity supplied
Lyovapor™ L-200 or Lyovapor™ L-200 Pro		1
Power cord		1
Operation Manual		1
Technical data sheet		1
Cable for pump	11064934	1
Vacuum tubing	11063485	1
Seals, ISO-KF 16	11063455	1
Clamps, ISO-KF 16	11062220	1
Seals, ISO-KF 25	11063457	2
Clamps, ISO-KF 25	11062221	2
Vacuum tubing adaptor, ISO-KF 16 to ISO-KF 25	11064870	1
O-ring, dia. 300 mm	11063461	2

#### Options

Component	Article no.	Quantity supplied
Cross-pipe (inc. seals and clamps)	11064256	1
90° elbow, ISO-KF 16	11064257	2
Main valve (inc. seals and clamps)	11062223	1
Pressure-regulating valve (inc. seals and clamps)	11064725	1
Pressure sensor PPG010 (inc. seals and clamps)	11062228	1

Component	Article no.	Quantity supplied
Venting valve (inc. seals and clamps)	11064724	1

### 3.6 Technical Data

Dimensions without drying attachments (W x D x H)	460 x 585 x 510 mm
Weight without drying attachments	75 kg

#### 3.6.1 Electrical specifications for L-200 with 50Hz

Specification	Value
Power consumption	1800 W
Connection voltage	220–240 VAC
Safety shut off	10 A / 250 V
Frequency	50 Hz
Overvoltage category	II
Degree of protection	IP20
Pollution degree	2

#### 3.6.2 Electrical specifications for L-200 with 60Hz

Specification	Value
Power consumption	1800 W
Connection voltage	208-230 VAC
Safety shut off	10 A / 250 V
Frequency	60 Hz
Overvoltage category	II
Degree of protection	IP20
Pollution degree	2

#### 3.6.3 Ambient conditions

The Lyovapor™ may only be used in indoor areas.

Max. altitude above sea level	2000 m
Ambient temperature	15–30°C (25°C) No maximum performance above 25°C
Maximum relative humidity	80% for temperatures up to 30°C
Storage temperature	max. 45 °C

#### 3.6.4 Materials

Component	Material of construction
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

---

<b>Component</b>	<b>Material of construction</b>
Seals	Low-temperature silicon
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	Aluminium with FKM seal

---

## 4 Transport and storage

### 4.1 Transport

#### IMPORTANT

##### 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 Technical data).
- ▶ 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.

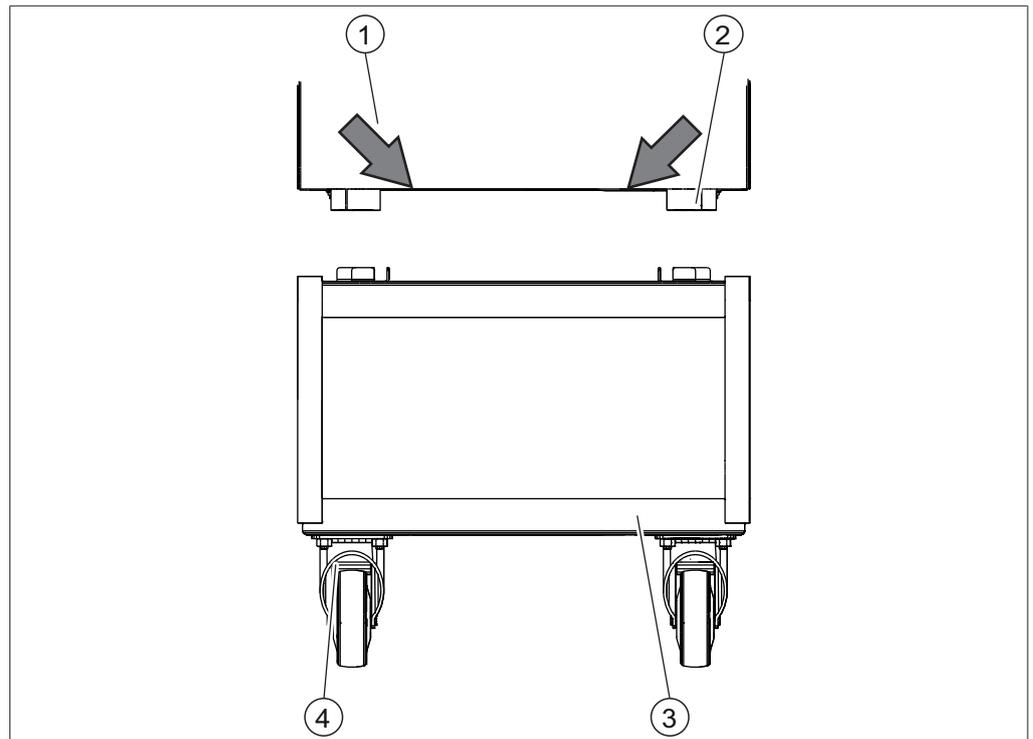


Fig. 9: Lifting the instrument

- |                     |                            |
|---------------------|----------------------------|
| 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

#### IMPORTANT

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

After transportation, wait twelve hours before switching on the instrument. The refrigerant requires twelve hours to be collected 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.

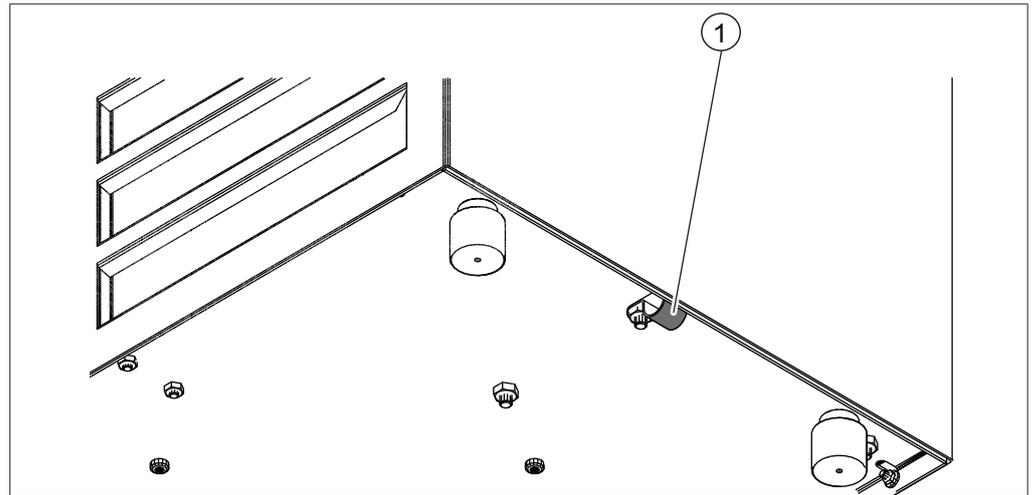


Fig. 10: Lyovapor™ L-200

1 Lashing mount

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

### 5.3 Putting the instrument in operation

#### IMPORTANT

##### 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 regulatory provisions when connecting the Lyovapor™ to power supply.

- ▶ Use external main switches (e.g., emergency off) in accordance with the standards IEC 60947-1 and IEC 60947-3.
- ▶ Use additional electrical safety features (e.g., residual-current circuit breakers) to comply with local laws and regulations.

The power supply must fulfill 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 a proper grounding.

## IMPORTANT

### **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 grounded.
  - ▶ 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.
  - ▶ Insert the power cable into the connection labeled **Power IN** on the back of the instrument.
  - ▶ Insert the power plug into the power socket.

### 5.3.3 Assembling the cross fitting (optional accessory)

The cross-pipe enables attachment of multiple additional valves to the instrument.

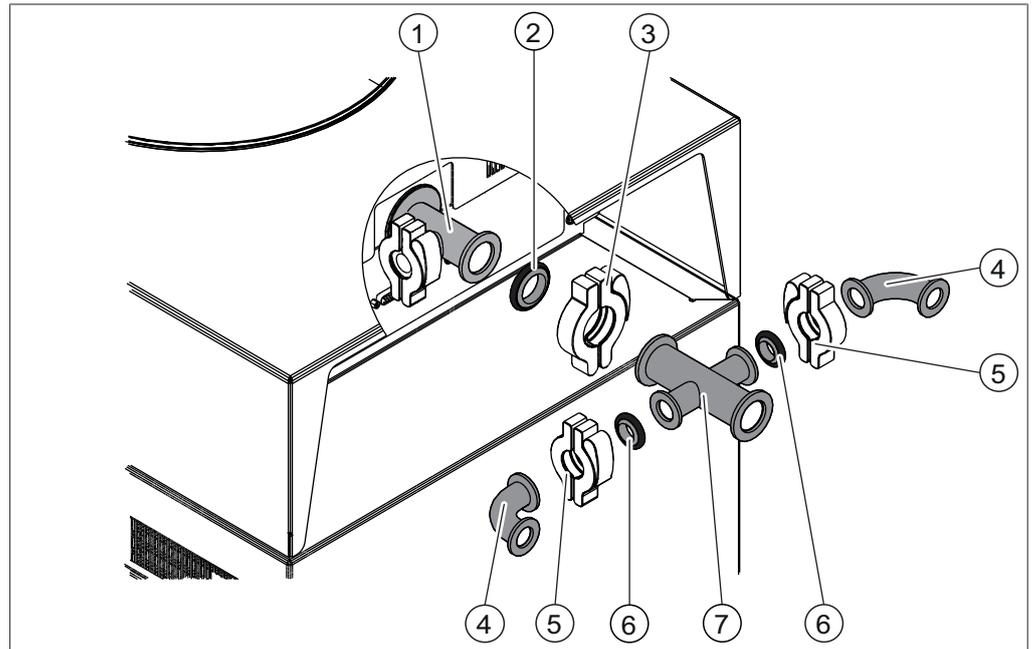


Fig. 11: Fitting the cross-pipe

- |                     |                   |
|---------------------|-------------------|
| 1 Vacuum connection | 2 Seal, ISO-KF 25 |
| 3 Clamp, ISO-KF 25  | 4 90° elbow       |
| 5 Clamp, ISO-KF 16  | 6 Seal, ISO-KF 16 |
| 7 Cross-pipe        |                   |

- ▶ Switch the On/Off master switch to Off.
- ▶ Fit the cross-pipe (7) and seal (2) to the vacuum connection (1) and fix with the clamp (3).
- ▶ Fit the 90° elbow (4) and seal (6) to a side connection of the cross-pipe (7) and fix with the clamp (5).
- ▶ Repeat Step 3 for the second side connection of the cross-pipe.

### 5.3.4 Assembling the main valve (optional accessory)

The main valve regulates the vacuum generated by the vacuum pump. The main valve is connected between the instrument and the vacuum pump.

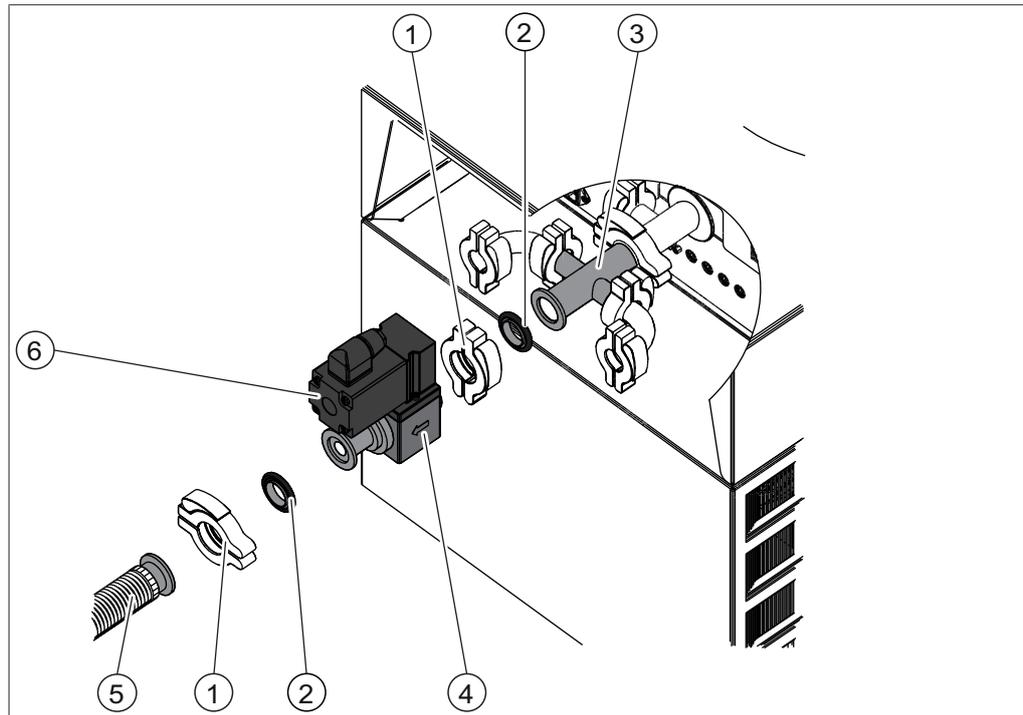


Fig. 12: Fitting the main valve

- |                                    |                             |
|------------------------------------|-----------------------------|
| 1 Clamp, ISO-KF 25                 | 2 Seal, ISO-KF 25           |
| 3 Cross-pipe, ISO-KF 25 (optional) | 4 Arrow (direction of flow) |
| 5 Vacuum tubing                    | 6 Main valve                |

- ▶ Switch the On/Off master switch to Off.
- ▶ Fit the main valve (6) with the arrow (4) pointing in the direction of flow (towards the vacuum pump) and seal (2) onto the cross-pipe (3) and fix it with the clamp (1).
- ▶ Fit the vacuum tubing (5) and seal (2) onto the main valve outlet and fix it with the clamp (1).
- ▶ Plug the main valve electrical connector into the socket marked **Main Valve**.



#### NOTE

The vacuum pump can also be connected directly to the Lyovapor™. If the vacuum pump is connected directly to the Lyovapor™, the vacuum cannot be regulated.

#### Manual switch on the main valve

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

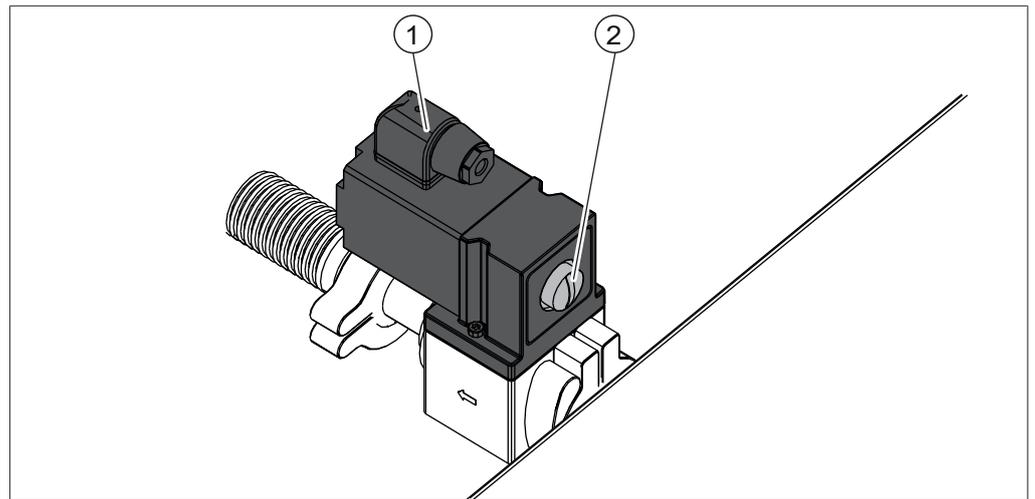
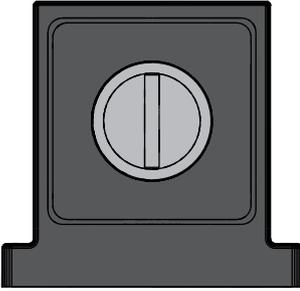
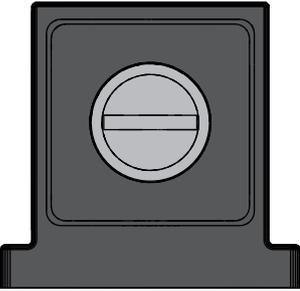
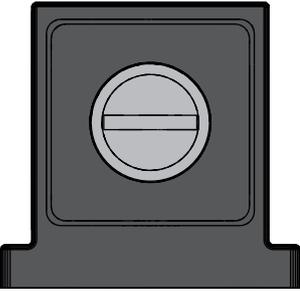


Fig. 13: Manual switch on main valve

1 Main valve

2 Manual switch on main valve

### Manual switch positions

Manual switch position	Meaning
	<ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Pressure-regulating valve and venting valve are connected.</li> <li>▶ The vacuum is regulated by the pressure-regulating valve and venting valve.</li> </ul>
	<ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Pressure-regulating valve and venting valve are not connected.</li> <li>▶ The vacuum is regulated by the main valve.</li> <li><input checked="" type="checkbox"/> The main valve manual switch is depressed.</li> <li>▶ As long as the main valve manual switch is depressed, vacuum regulation is deactivated.</li> </ul>
	<p>The vacuum is not regulated.</p>

### 5.3.5 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.

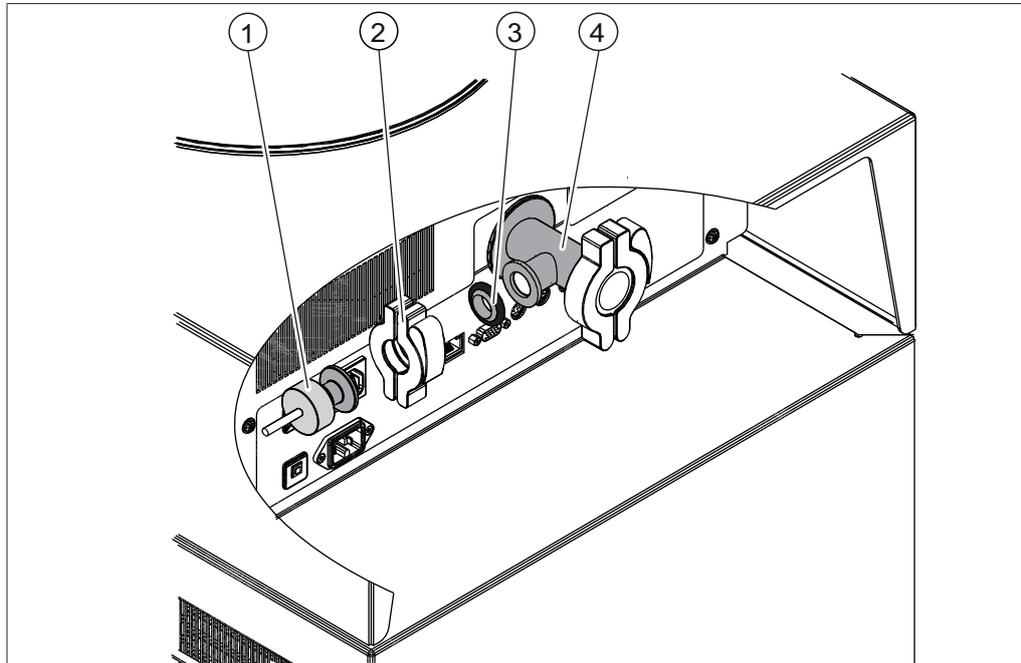


Fig. 14: Fitting the pressure sensor

- |                          |                         |
|--------------------------|-------------------------|
| 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.

### 5.3.6 Assembling the venting valve (optional accessory)

The venting valve vents the instrument after the freeze-drying process is completed.

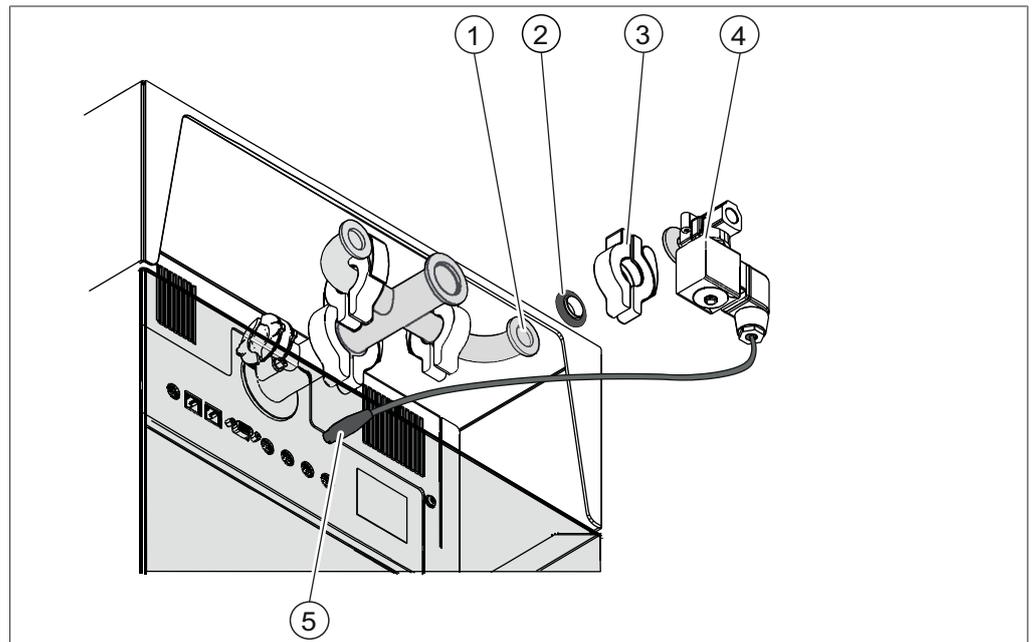


Fig. 15: Fitting the venting valve

- |                                      |                   |
|--------------------------------------|-------------------|
| 1 90° elbow, ISO-KF 16               | 2 Seal, ISO-KF 16 |
| 3 Clamp, ISO-KF 16                   | 4 Venting valve   |
| 5 Venting valve cable and connection |                   |
- ▶ Switch the On/Off master switch to Off.
  - ▶ Fit the cross-pipe and 90° elbow. See Chapter 5.3.3 "Assembling the cross fitting (optional accessory)", page 25
  - ▶ Fit the venting valve (4) and seal (2) to the 90° elbow (1) and fix with the clamp (3).
  - ▶ Plug the venting valve electrical connection (4) into the socket marked **Aeration Valve**.

### 5.3.7 Assembling the pressure regulating valve (optional accessory)

The pressure regulating valve provides additional pressure regulating capability during the freeze-drying process. It regulates the vacuum by the introduction of external air.

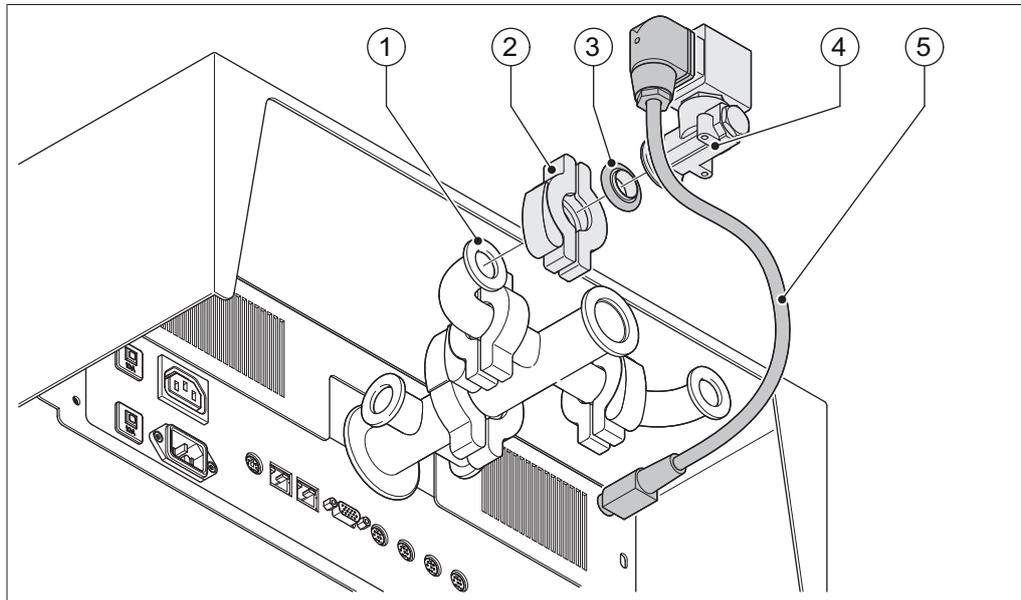


Fig. 16: Fitting the pressure-regulating valve

- |   |                             |
|---|-----------------------------|
| 1 90° elbow, ISO-KF 16                          | 2 Clamp, ISO-KF 16          |
| 3 Seal, ISO-KF 16                               | 4 Pressure regulating valve |
| 5 Pressure-regulating valve cable and connector |                             |

- ▶ Switch the On/Off master switch to Off.
- ▶ Fit the cross-pipe and 90° elbow (1). See Chapter 5.3.3 "Assembling the cross fitting (optional accessory)", page 25
- ▶ Fit the pressure-regulating valve (4) and seal (3) to the 90° elbow (1) and fix with the clamp (2).
- ▶ Plug the pressure-regulating valve electrical connector (5) into the socket marked **Regulation Valve**.

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

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

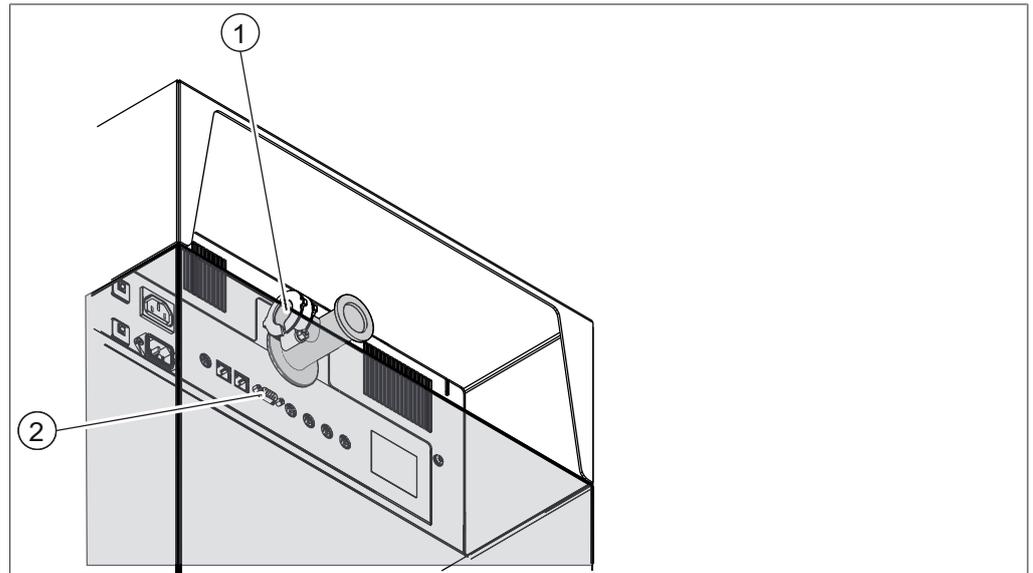


Fig. 17: Fitting alternative pressure sensor

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.

### 5.3.9 Preparing the condensate drain hose



#### ⚠ CAUTION

#### Risk of scalding by hot water

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

### IMPORTANT

#### 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.

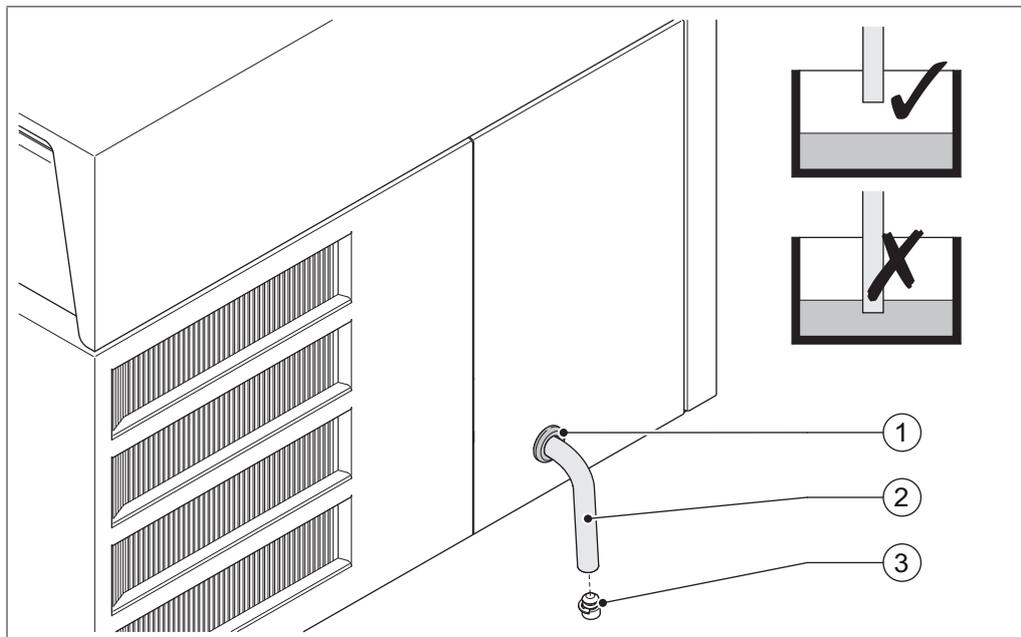


Fig. 18: Condensate drain hose

1 Rubber ring

2 Condensate drain hose

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.



### 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.

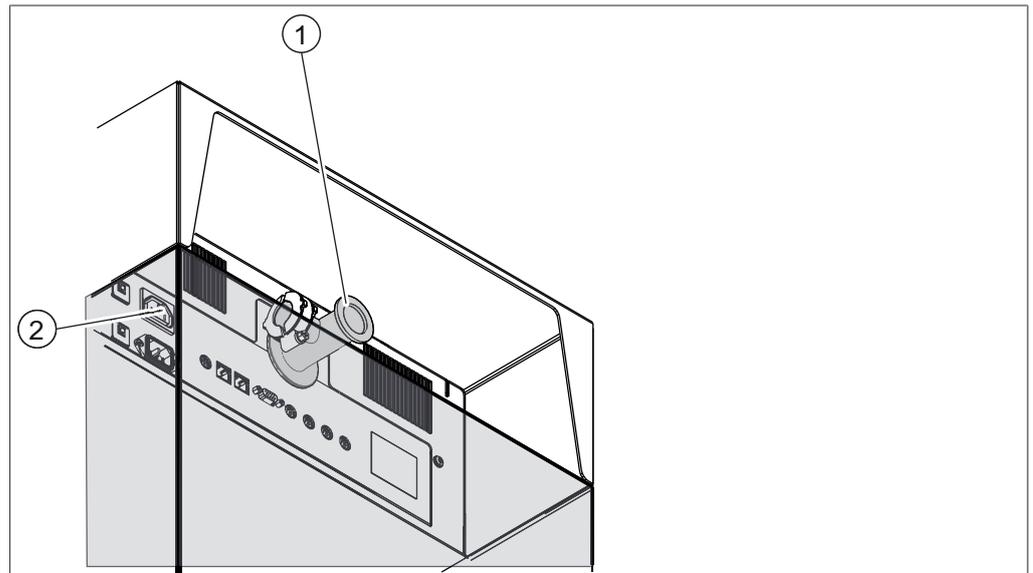


Fig. 19: Connections for vacuum pump

1 Vacuum tube connection,  
ISO-KF 25

2 Vacuum pump connection

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

## 5.5 Assembling the drying attachments

A top-mount drying rack completes the ice condenser, turning it into a ready-to-use freeze-dryer.

Do not use any sharp objects when fitting the top-mount drying racks.

### 5.5.1 Fitting the 300 mm dia. O-ring

Before fitting the top-mount drying racks, fit the 300 mm O-ring over the ice condenser.

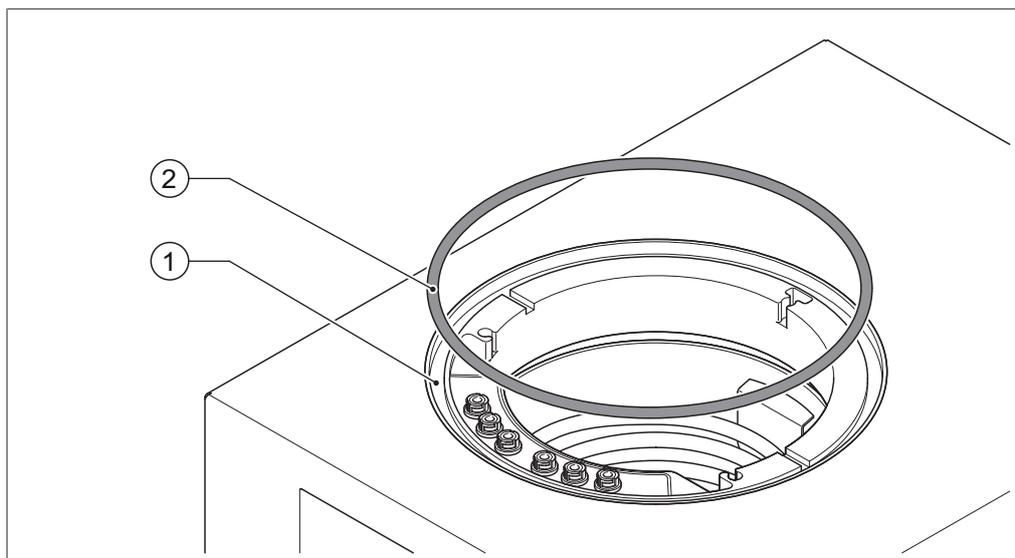


Fig. 20: Fitting the 300 mm dia. O-ring

1 Groove above ice condenser

2 O-ring, dia. 300 mm

- ▶ Make sure that the groove above the ice condenser (1) is clean, free of dust and not scratched.
- ▶ Check the 300 mm dia. O-ring (2) for damage and grease it with the vacuum grease supplied.
- ▶ Place the 300 mm dia. O-ring (2) in the groove above the ice condenser (1).

### 5.5.2 Fitting the acrylic drying chamber

The instrument can be completed with the acrylic drying chamber.

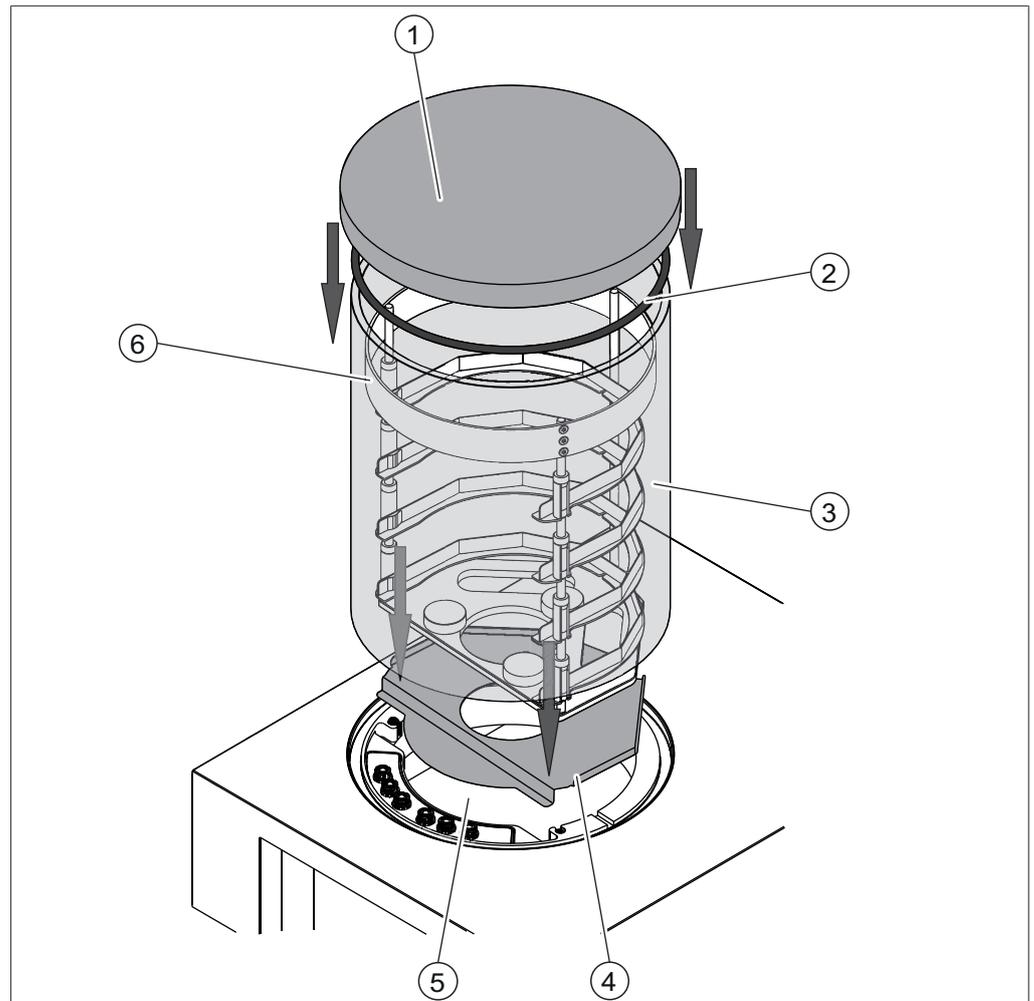


Fig. 21: Fitting the acrylic drying chamber

- |                 |                       |
|-----------------|-----------------------|
| 1 Cover         | 2 O-ring, dia. 300 mm |
| 3 Cylinder      | 4 Intermediate plate  |
| 5 Ice condenser | 6 Rack                |

**Precondition:**

The 300 mm O-ring is fitted in the groove above the ice condenser.

- ▶ Remove all parts of the drying chamber from the packaging and check for damage.
- ▶ Place the intermediate plate (4) on the ice condenser (5).
- ▶ Place the rack (6) on the ice condenser (5).
- ▶ Locate the cylinder (3) in the groove above the ice condenser (5).
- ▶ Check the 300 mm dia. O-ring (2) for damage and grease it with the vacuum grease supplied.
- ▶ Place the 300 mm dia. O-ring (2) in the groove in the lid.
- ▶ Place the lid (1) on the cylinder (3).

### 5.5.3 Fitting the manifold acrylic drying chamber

The instrument can be completed with the manifold acrylic drying chamber.

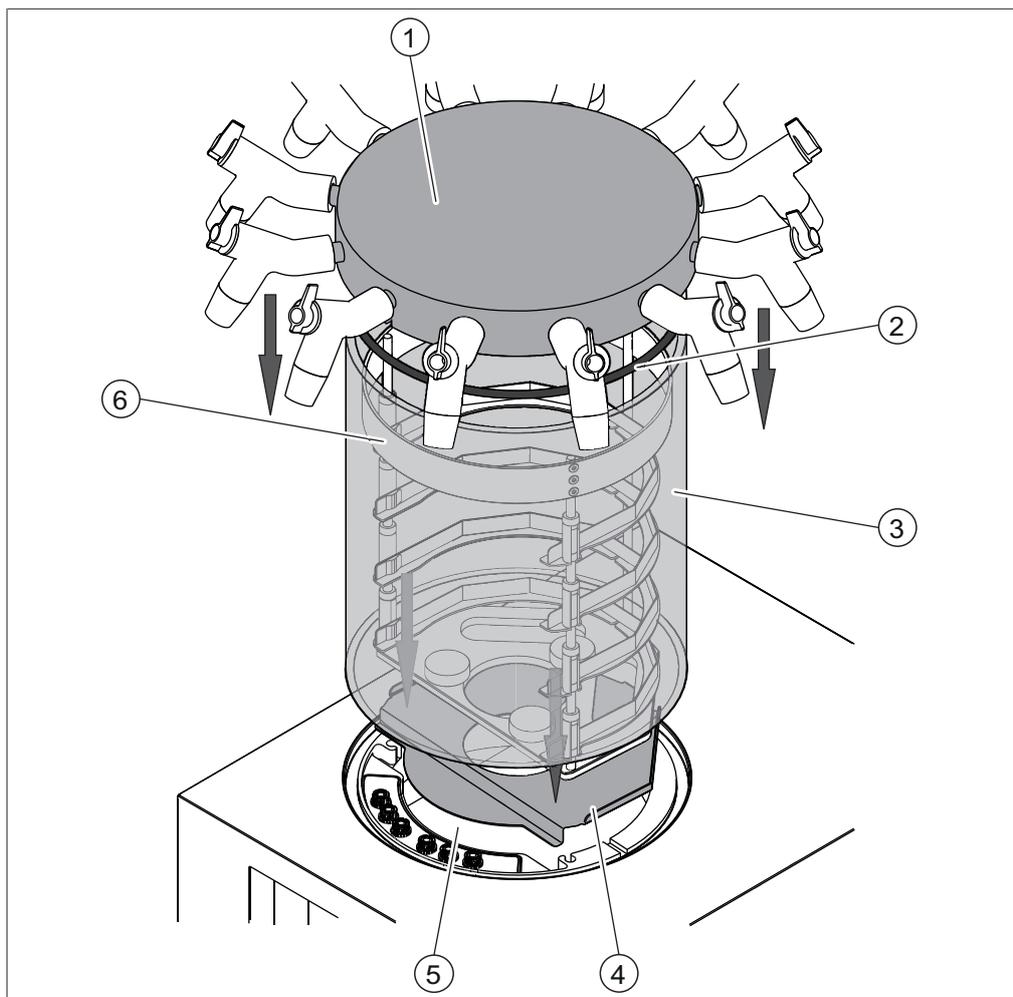


Fig. 22: Fitting the manifold acrylic drying chamber

- |                 |                       |
|-----------------|-----------------------|
| 1 Cover         | 2 O-ring, dia. 300 mm |
| 3 Cylinder      | 4 Intermediate plate  |
| 5 Ice condenser | 6 Rack                |

**Precondition:**

- ☑ The 300 mm O-ring is fitted in the groove above the ice condenser.
- ▶ Remove all parts of the drying chamber from the packaging and check for damage.
- ▶ Fit the manifold valves to the lid.
- ▶ Place the intermediate plate (4) on the ice condenser (5).
- ▶ Place the rack (6) on the ice condenser (5).
- ▶ Locate the cylinder (3) in the groove above the ice condenser (5).
- ▶ Check the 300 mm dia. O-ring (2) for damage and grease it with the vacuum grease supplied.
- ▶ Place the 300 mm dia. O-ring (2) in the groove in the lid.
- ▶ Place the lid (1) on the cylinder (3).

#### 5.5.4 Fitting the stopper acrylic drying chamber

The instrument can be completed with the stopper acrylic drying chamber.

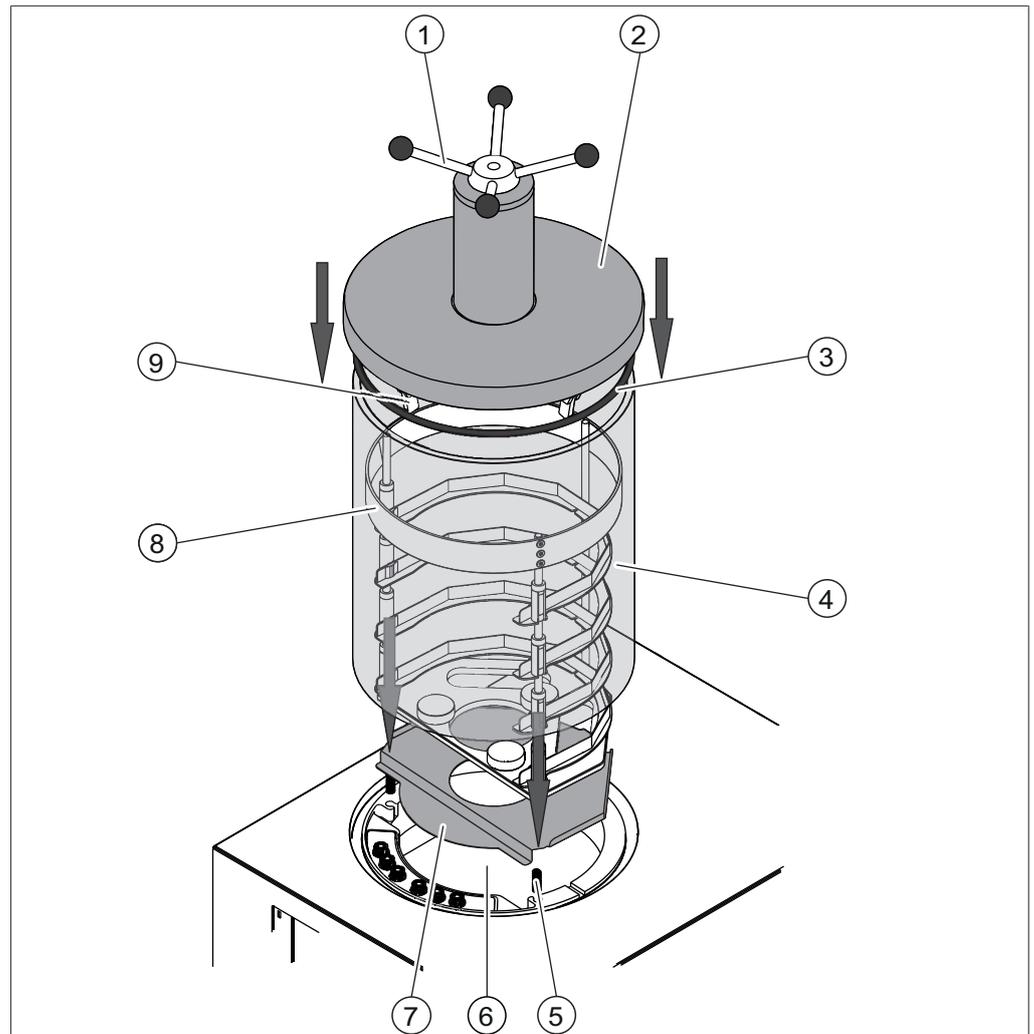


Fig. 23: Fitting the stopper acrylic drying chamber

- |                       |                 |
|-----------------------|-----------------|
| 1 Hand wheel          | 2 Cover         |
| 3 O-ring, dia. 300 mm | 4 Cylinder      |
| 5 Springs             | 6 Ice condenser |
| 7 Intermediate plate  | 8 Rack          |
| 9 Hooks               |                 |

Precondition:

- The 300 mm O-ring is fitted in the groove above the ice condenser.
- ▶ Remove all parts of the drying chamber from the packaging and check for damage.
- ▶ Locate the springs (5) in the holes on the ice condenser (6).
- ▶ Place the intermediate plate (7) on the ice condenser (6).
- ▶ Place the rack (8) on the ice condenser (6).
- ▶ Locate the cylinder (4) in the groove above the ice condenser (5).
- ▶ Screw the hand wheel (1) upwards until the plate inside the lid has pressed the hooks (9) all the way in.
- ▶ Check the 300 mm dia. O-ring (3) for damage and grease it with the vacuum grease supplied.
- ▶ Place the 300 mm dia. O-ring (3) in the groove in the lid (2).
- ▶ Place the lid (2) on the cylinder (4).

### 5.5.5 Assembling the manifold drying rack

The instrument can be completed with a manifold drying rack.

The manifold drying rack enables freeze-drying of samples in flasks. The manifold drying rack is a modular, expandable design.

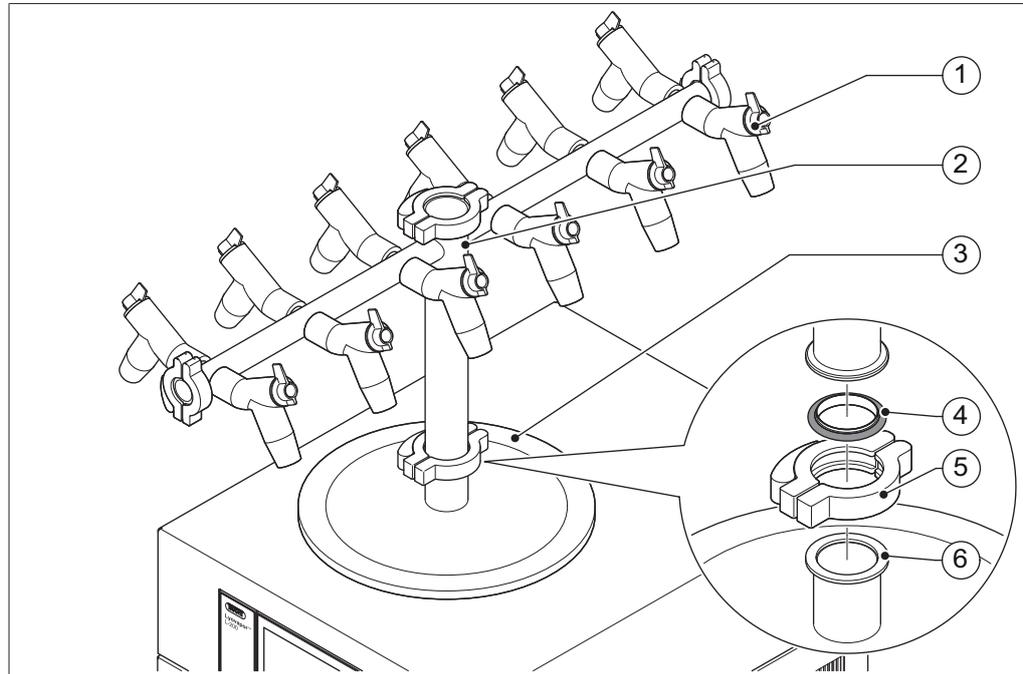


Fig. 24: Manifold drying rack

- |                    |                         |
|--------------------|-------------------------|
| 1 Manifold valve   | 2 Manifold drying rack  |
| 3 Base plate       | 4 Seal, ISO-KF 40       |
| 5 Clamp, ISO-KF 40 | 6 Connection, ISO-KF 40 |

#### Precondition:

- The 300 mm O-ring is fitted in the groove above the ice condenser.
- ▶ Remove all parts of the manifold drying rack from the packaging and check for damage.
- ▶ Fit the manifold valves (1). See Chapter 5.5.8 "Assembling manifold valves", page 43.
- ▶ Place the base plate (3) on the ice condenser.
- ▶ Place the seal (4) on the connection (6).
- ▶ Fit the manifold drying rack (2) onto the seal and fix it with the clamp (5).

### 5.5.6 Fitting the non-heatable shelf

Shelves can be fitted in the drying chambers. The shelves allow the freeze-drying of samples in vials or as loose samples. The shelves slide into a rack inside the drying chamber.

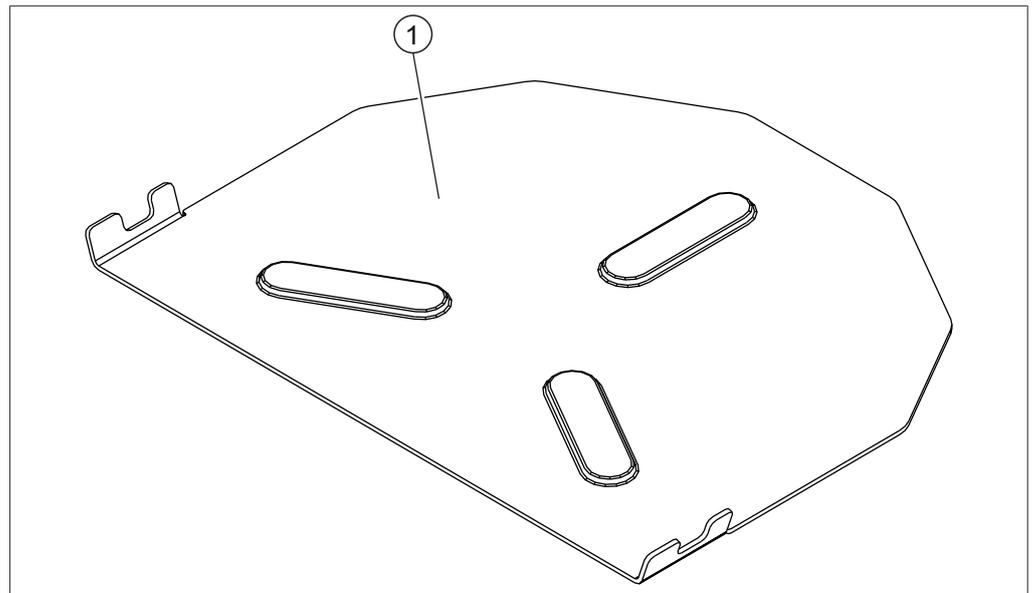


Fig. 25: Non-heatable shelf

1 Non-heatable shelf

- Non-heatable shelf.

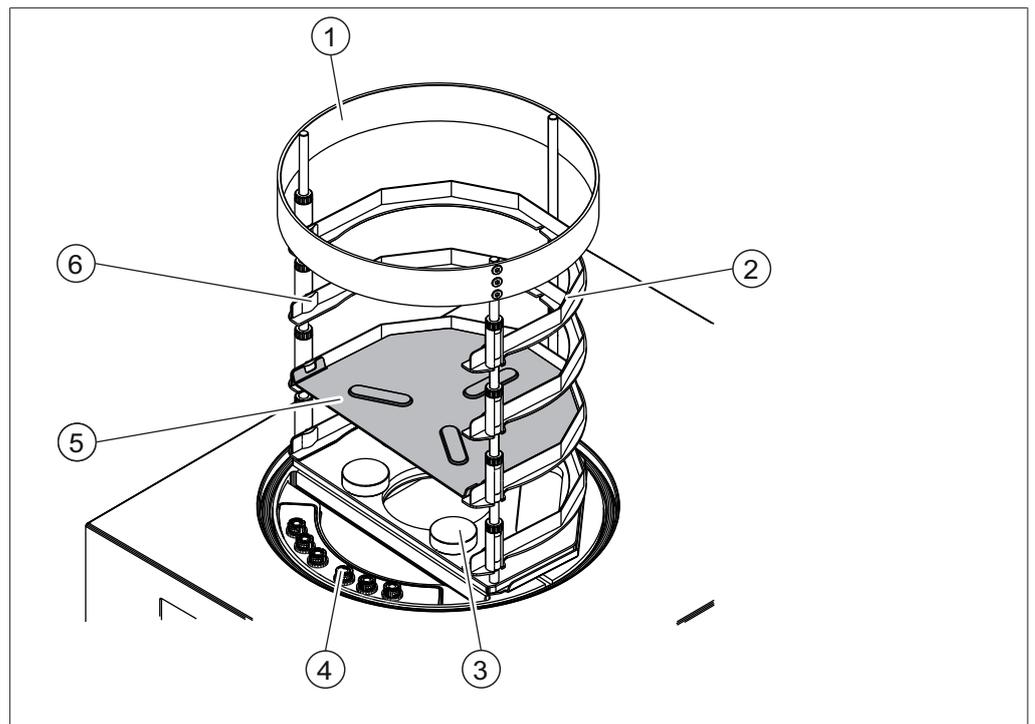


Fig. 26: Non-heatable shelf in rack

- |                      |                           |
|----------------------|---------------------------|
| 1 Rack               | 2 Slot for shelf          |
| 3 Stop               | 4 Connections for shelves |
| 5 Non-heatable shelf | 6 Lug                     |

Precondition:

The rack is mounted on top of the ice condenser.

- ▶ Slide the shelf (5) into a slot (2) in the rack (1).
- ▶ Make sure that the shelf (5) is secured by the lug (6).
- ▶ Fit the cylinder and the lid.

### 5.5.7 Fitting heatable shelves

Shelves can be fitted in the drying chambers. The shelves allow the freeze-drying of samples in vials or as loose samples. The shelves slide into a rack inside the drying chamber.

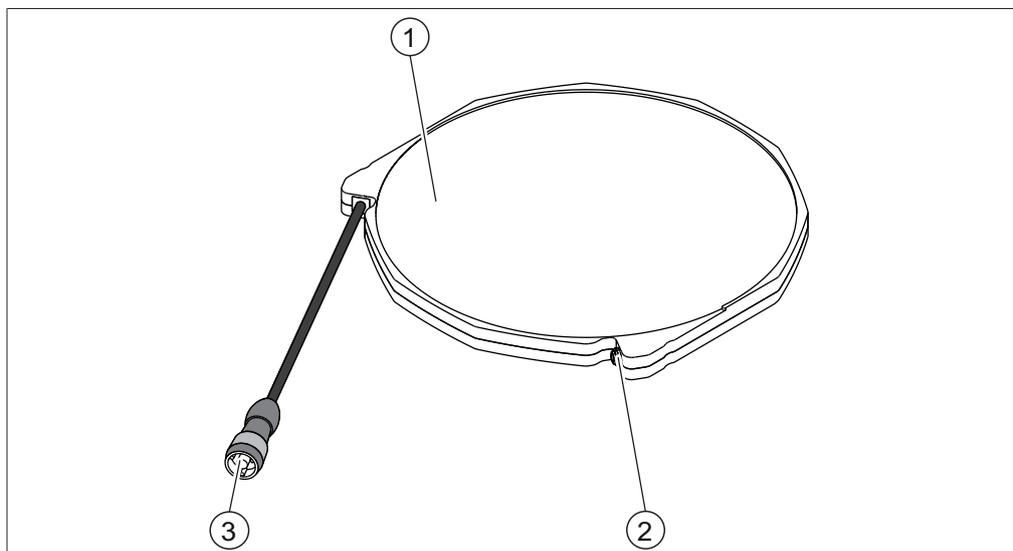


Fig. 27: Heatable shelf

1 Heatable shelf

2 Connection for temperature sensor

3 Electrical connector for heatable shelf

- Heatable shelves with controlled temperature.
  - The heatable shelves are connected to the instrument by a connecting lead.
  - As an additional option, a temperature sensor can be connected to the temperature sensor connection.

### Sliding the shelves into the rack

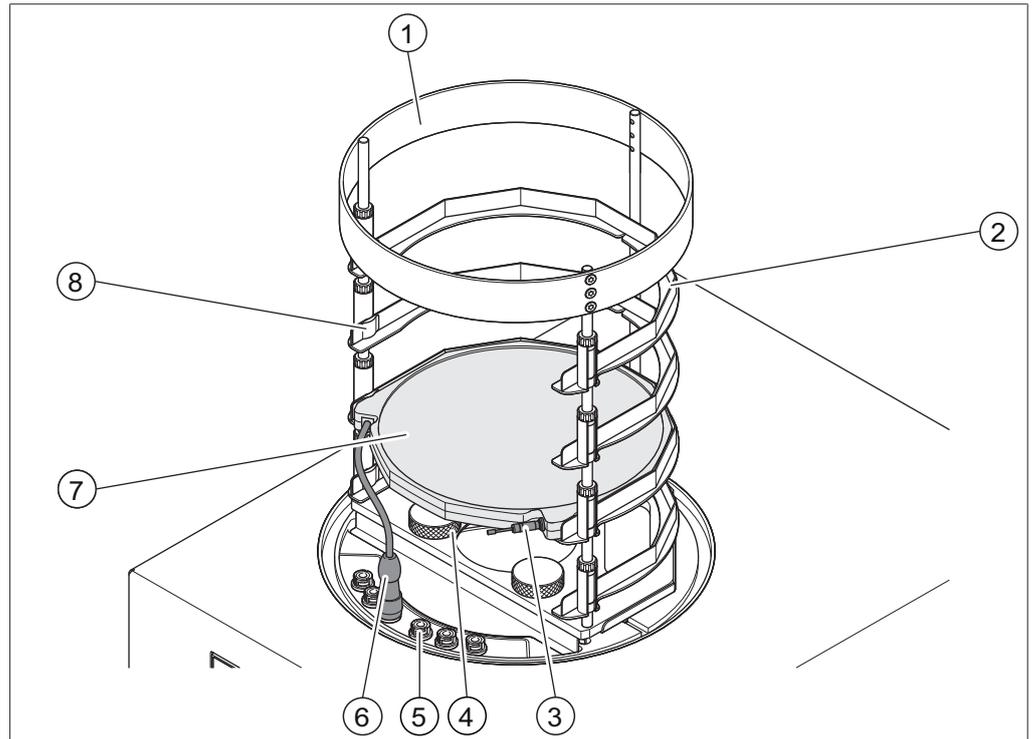


Fig. 28: Heatable shelf in rack

- |                           |   |
|---------------------------|---|
| 1 Rack                    | 2 Slot for shelf                          |
| 3 Stop                    | 4 Temperature sensor (option)             |
| 5 Connections for shelves | 6 Electrical connector for heatable shelf |
| 7 Heatable shelf          | 8 Lug                                     |

#### Precondition:

The rack is mounted on top of the ice condenser.

- ▶ Slide the shelf (7) into a slot (2) in the rack (1).
- ▶ Make sure that the shelf (7) is secured by the lug (8).
- ▶ Plug the connecting lead (6) into one of the supply sockets (5).
- ▶ Fit the cylinder and the lid.



### Temperature sensor connector

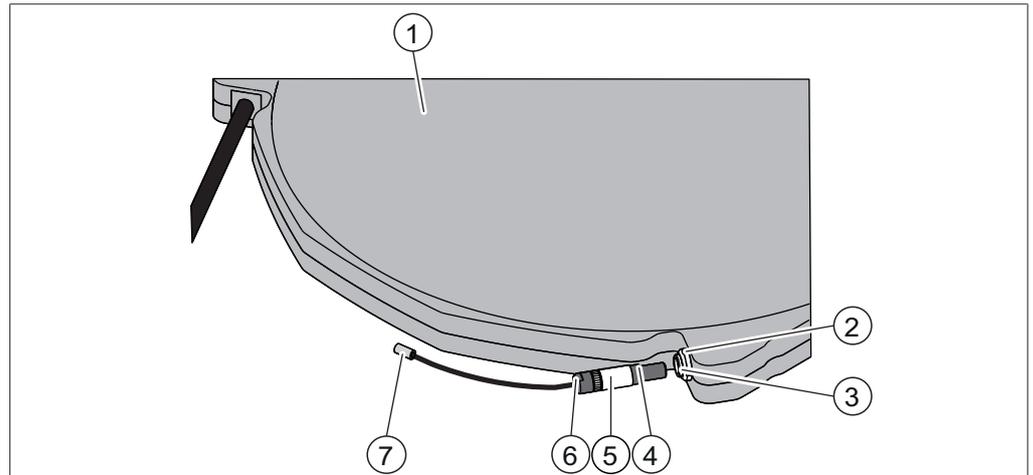


Fig. 31: Temperature sensor connector

- |  |   |
|--|---|
| 1 Heatable shelf                           | 2 Connection for temperature sensor       |
| 3 Marking on temperature sensor connection | 4 Marking on temperature sensor connector |
| 5 Ring                                     | 6 Temperature sensor connector            |
| 7 Temperature sensor                       |   |

Plugging in the temperature sensor connector:

- ▶ Twist the temperature sensor connector (4) so that the markings (3) and (4) are in line.
- ▶ Push the temperature sensor connector (4) onto the temperature sensor connection (2).

Unplugging the temperature sensor connector:

- ▶ Pull on the ring (5).

#### 5.5.8 Assembling manifold valves

The manifold valves are used for freeze-drying samples in flasks on the manifold acrylic drying chamber or on the manifold drying rack.

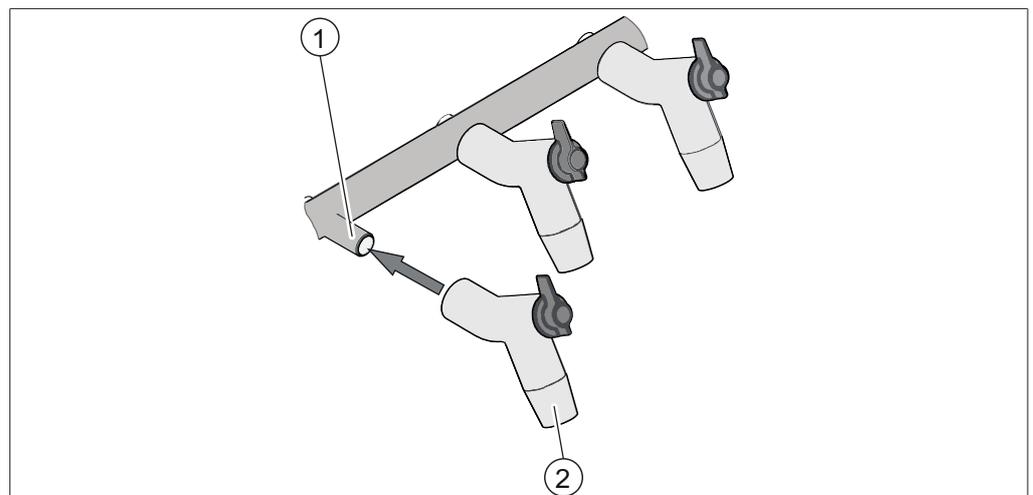


Fig. 32: Fitting manifold valves

- |                                       |                  |
|---------------------------------------|------------------|
| 1 Connection on top-mount drying rack | 2 Manifold valve |
|---------------------------------------|------------------|

- ▶ Remove manifold valve (2) from the packaging.
- ▶ Fit manifold valve (2) onto the connection on the top-mount drying rack (1).

### Manifold valve settings

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

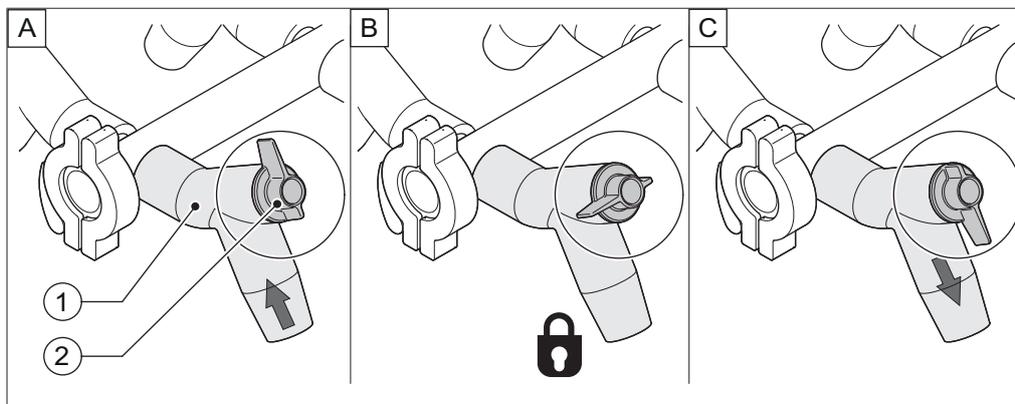


Fig. 33: Manifold valve

1 Manifold valve

2 Lever

Valve position	Function/Purpose
A: Lever pointing up	For fitting and evacuating flask
B: Lever pointing left	Valve closed
C: Lever pointing down	Opens valve for removing flask

Table 1: Manifold valve positions

## 6 Operating basic control panel

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

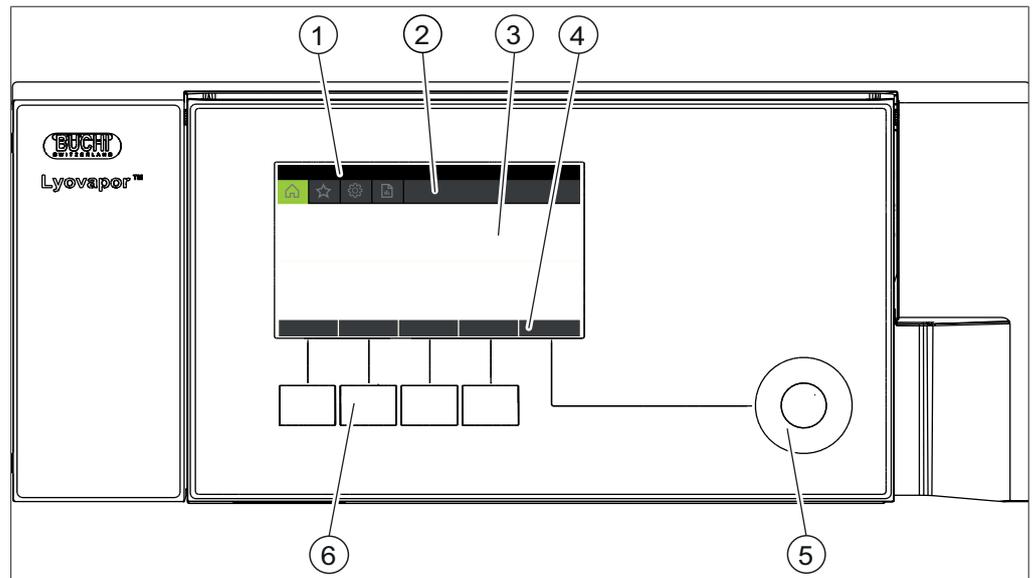


Fig. 34: Layout of basic control panel

No.	Description	Functionality
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 current operation.
5	Navigation control	Used for navigating the user interface. 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	<ul style="list-style-type: none"> <li>• Process control parameters</li> </ul>
	[Favourites] menu	<ul style="list-style-type: none"> <li>• Bookmarks for individual entry points</li> </ul>

Menu symbol	Meaning	Submenu/Action
	[Configuration] menu	<ul style="list-style-type: none"> <li>• Process settings</li> <li>• Settings</li> <li>• Servicing</li> <li>• Service</li> <li>• System information</li> </ul>
	[Messages] menu	<ul style="list-style-type: none"> <li>• Notifications</li> <li>• Logbook</li> </ul>

### 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
[Defrost before conditioning]	Off/On	Automatic condenser defrosting before the conditioning phase

#### Settings submenu

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

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

### Submenu Maintenance

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

<b>Action</b>	<b>Option</b>	<b>Explanation</b>
<i>[Leak test]</i>	Perform leak test	See section Chapter 9.2 "Performing a leak test", page 84

Action	Option	Explanation
<i>[Vacuum test]</i>	Perform vacuum test	See section Chapter 9.3 "Performing a vacuum test", page 84

### Submenu Service

The submenu *[Service]* contains information on the individual freeze-dryer components.

Action	Option	Explanation
<i>[Refrigerant circuit]</i>	View	The following information on the refrigerant circuit is available: <ul style="list-style-type: none"> <li>• Hours of duty</li> <li>• Compressor</li> <li>• Ice condenser inlet temperature</li> <li>• Ice condenser outlet temperature</li> <li>• High-pressure safety cut-out</li> <li>• Low-pressure safety cut-out</li> </ul>
<i>[Vacuum system]</i>	View	The following information on the vacuum pump is available: <ul style="list-style-type: none"> <li>• Pump hours of duty</li> <li>• Pump oil hours of duty</li> <li>• Pressure in the ice condenser</li> <li>• Main valve</li> <li>• Vacuum pump</li> <li>• Venting valve</li> <li>• Regulating valve</li> </ul>
<i>[Defrosting system]</i>	Display/entry of figures	The following information on the defrosting system is available: <ul style="list-style-type: none"> <li>• Hours of duty</li> <li>• Drain valve open/closed</li> </ul>

### Submenu System Information

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

Action	Option	Explanation
<i>[Control panel]</i>	View	The following information on the control panel is available: <ul style="list-style-type: none"> <li>• Serial number</li> <li>• Firmware version</li> <li>• Hours of duty</li> <li>• Status</li> <li>• PCB Temperature</li> <li>• 24V power supply</li> <li>• 5V power supply</li> </ul>

Action	Option	Explanation
[L-200]	View	<p>The following information on the L-200 is available:</p> <ul style="list-style-type: none"> <li>• Serial number</li> <li>• Firmware version</li> <li>• Hours of duty</li> <li>• Status</li> <li>• PCB Temperature</li> <li>• 48V power supply</li> <li>• 24V power supply</li> <li>• 5V power supply</li> <li>• 3.3V power supply</li> </ul>
[Network diagnostics]	Display/entry of figures	<p>The following network diagnosis information is available:</p> <ul style="list-style-type: none"> <li>• MAC address</li> <li>• Network interruptions</li> <li>• Event list</li> </ul>

#### 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 the currently pending messages.

- List of pending messages.
- The lists contains only unconfirmed messages together with date and time.

##### Submenu Logbook

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

Logbook:

- List of the last 30 messages.
- Every occurrence is shown with date and time.

The following status types are possible:

- x = Confirmed
- < = Sent
- > = Received

#### 6.4 Status bar

The status bar shows the status of the instrument.

The following statuses are possible:

**Indication on status bar**

<b>View</b>	<b>Status</b>
<b>Unload / Load</b>	Before the freeze-drying process: Load the top-mount drying rack with a frozen preparation.  After the freeze-drying process: Remove the dried preparation from the top-mount drying rack.
<b>Aerating</b>	The system is venting.
<b>Shutting down</b>	The instrument is shutting down.
<b>Defrosting</b>	The instrument is defrosting.
<b>Standby</b>	The instrument is in energy-saving mode.
<b>Conditioning</b>	The instrument is starting up.
<b>Warming up pump</b>	The vacuum pump is being brought up to operating temperature.
<b>Vacuum Test</b>	The instrument is performing a vacuum test.
<b>Leak Test</b>	The instrument is performing a leak test.
<b>Manual Drying</b>	The instrument is in the course of a manual freeze-drying process.
<b>Recovering</b>	The system is in the process of recovering from a power failure.

**Symbols on the status bar**

<b>Symbol</b>	<b>Status</b>
	The instrument is connected to the BUCHI Cloud.
	The instrument is defrosting.
	The instrument is starting up.
	The instrument is in energy-saving mode.
	Before the freeze-drying process: Load the top-mount drying rack with a frozen preparation.  After the freeze-drying process: Remove the dried preparation from the top-mount drying rack.
	The vacuum pump is being brought up to operating temperature.
	The instrument is performing a vacuum test.
	The instrument is in the course of a manual freeze-drying process.

## 6.5 Performing freeze-drying [Basic control panel]

### 6.5.1 Preparing the instrument

Time approx.  
re- 30min  
quired:



#### NOTE

The conditioning phase can be skipped by tapping *[Skip]* on the function bar.

#### 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 **Un-load / 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 5.5 "Assembling the drying attachments", page 33.
- ▶ Load the top-mount drying rack with frozen preparations.
- ▶ 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

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##### Navigation path

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→ Start

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Precondition:

- ☑ The preparation 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 preparation from the drying rack.

#### 6.5.5 Shutting down the instrument

Time 40min  
re-  
quired:

### IMPORTANT

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

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##### 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 32
  - ▶ Navigate to the *[Start]* menu via the navigation path.
  - ▶ Tap the function *[Shut down]* on the function bar.  
The instrument shuts down.  
The status bar shows the remaining time and the status **Shutting down**.  
After the instrument has shut down, the status bar shows the remaining time and the status **Defrosting**.

## 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

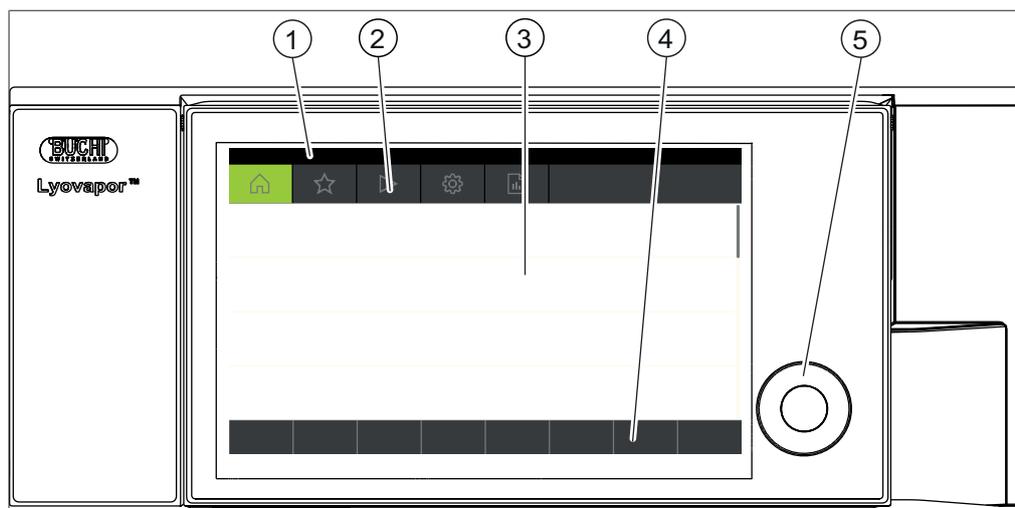


Fig. 35: Layout of Pro control panel

No.	Description	Functionality
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 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 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
	<i>[Cancel]</i>	Cancels an operation.
	<i>[Add to favourites]</i>	Adds the selected item to the <i>[Favourites]</i> menu.
	<i>[Remove from favourites]</i>	Removes the selected item from the <i>[Favourites]</i> menu.
	<i>[Confirm]</i>	Confirms an entry.
	<i>[Edit]</i>	Allows the selected item to be edited.
	<i>[Menu]</i>	Allows selection of a menu from the menu bar using the navigation control.
	<i>[Save]</i>	Saves the setting.

#### Process control function buttons

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

## 7.3 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	<ul style="list-style-type: none"> <li>• Process control parameters</li> </ul>
	Favourites menu	<ul style="list-style-type: none"> <li>• Bookmarks for individual entry points</li> </ul>
	Method menu	<ul style="list-style-type: none"> <li>• For saving freeze-drying methods.</li> </ul>
	Configuration menu	<ul style="list-style-type: none"> <li>• Process settings</li> <li>• Settings</li> <li>• End point determination</li> <li>• Servicing</li> <li>• Service</li> <li>• System information</li> </ul>
	Messages menu	<ul style="list-style-type: none"> <li>• Notifications</li> <li>• Logbook</li> </ul>

### 7.3.1 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.

### 7.3.2 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.

**7.3.3 Method menu**

The *[Method]* menu allows freeze-drying processes with multiple phases and steps to be saved. See Chapter 7.5 "Editing a method", page 62

**7.3.4 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
<i>[Vacuum test after conditioning]</i>	Off/On	Automatic vacuum test after the conditioning phase
<i>[Leak test after conditioning]</i>	Off/On	Automatic leak test after the conditioning phase
<i>[Defrost before conditioning]</i>	Off/On	Automatic condenser defrosting before the conditioning phase

**Settings submenu**

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

Action	Option	Explanation
<i>[Mobile connection password]</i>	View	The control panel shows a password for entry in the BUCHI Monitor app.
<i>[Mobile connection QR code]</i>	View	The control unit shows a QR code for reading by the BUCHI Monitor app.
<i>[Language]</i>	Choice of display language on the control panel	The following languages are available: German/English/French/Spanish/Chinese/Japanese/Italian/Portuguese/Russian
<i>[Temperature unit]</i>	Choice of unit for indication of temperatures	The following units are available: °C (Celsius)/°F (Fahrenheit)/K (Kelvin)
<i>[Pressure unit]</i>	Choice of unit for indication of the vacuum	The following units are available: hPa (hectopascals), mbar (millibars), torr (= torr), mTorr (= millitorr), mmHg (millimetres of mercury)

Action	Option	Explanation
[Date]	Date input	Enter in sequence: Year, month, day. 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: None, Inficon PPG010, Inficon Porter CDG020D, Inficon PSG 550
[Vacuum pump oil change]	Enter setting	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 setting	The following parameters can be edited: System name/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	Shows the current parameters for the pressure difference test.
Temperature difference test	View	Shows the current parameters for the temperature difference test.

### Submenu Maintenance

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

Action	Option	Explanation
[Leak test]	Perform leak test	See section Chapter 9.2 "Performing a leak test", page 84
[Vacuum test]	Perform vacuum test	See section Chapter 9.3 "Performing a vacuum test", page 84

### Submenu Service

The submenu *Service* contains information on the individual freeze-dryer components.

Action	Option	Explanation
<i>[Refrigerant circuit]</i>	View	The following information on the refrigerant circuit is available: <ul style="list-style-type: none"> <li>• Hours of duty</li> <li>• Compressor</li> <li>• Ice condenser inlet temperature</li> <li>• Ice condenser outlet temperature</li> <li>• High-pressure safety cut-out</li> <li>• Low-pressure safety cut-out</li> </ul>
<i>[Vacuum system]</i>	View	The following information on the vacuum pump is available: <ul style="list-style-type: none"> <li>• Pump hours of duty</li> <li>• Pump oil hours of duty</li> <li>• Pressure in the ice condenser</li> <li>• Main valve</li> <li>• Vacuum pump</li> <li>• Venting valve</li> <li>• Regulating valve</li> </ul>
<i>[Defrosting system]</i>	Display/entry of figures	The following information on the defrosting system is available: <ul style="list-style-type: none"> <li>• Hours of duty</li> <li>• Drain valve open/closed</li> </ul>
<i>[Shelves]</i>	Display/entry of figures	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
<i>[Control panel]</i>	View	The following information on the control panel is available: <ul style="list-style-type: none"> <li>• Serial number</li> <li>• Firmware version</li> <li>• Hours of duty</li> <li>• Status</li> <li>• PCB Temperature</li> <li>• 24V power supply</li> <li>• 5V power supply</li> </ul>

Action	Option	Explanation
[L-200]	View	<p>The following information on the L-200 is available:</p> <ul style="list-style-type: none"> <li>• Serial number</li> <li>• Firmware version</li> <li>• Hours of duty</li> <li>• Status</li> <li>• PCB Temperature</li> <li>• 48V power supply</li> <li>• 24V power supply</li> <li>• 5V power supply</li> <li>• 3.3V power supply</li> </ul>
[Network diagnostics]	Display/entry of figures	<p>The following network diagnosis information is available:</p> <ul style="list-style-type: none"> <li>• MAC address</li> <li>• Network interruptions</li> <li>• Event list</li> </ul>

### 7.3.5 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 the currently pending messages.

- List of pending messages.
- The lists contains only unconfirmed messages together with date and time.

#### Submenu Logbook

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

Logbook:

- List of the last 30 messages.
- Every occurrence is shown with date and time.

The following status types are possible:

- x = Confirmed
- < = Sent
- > = Received

## 7.4 Status bar

The status bar shows the status of the instrument.

The following statuses are possible:

**Indication on status bar**

<b>View</b>	<b>Status</b>
<b>Unload / Load</b>	Before the freeze-drying process: Load the top-mount drying rack with a frozen preparation.  After the freeze-drying process: Remove the dried preparation from the top-mount drying rack.
<b>Aerating</b>	The system is venting.
<b>Shutting down</b>	The instrument is shutting down.
<b>Defrosting</b>	The instrument is defrosting.
<b>Standby</b>	The instrument is in energy-saving mode.
<b>Conditioning</b>	The instrument is starting up.
<b>Warming up pump</b>	The vacuum pump is being brought up to operating temperature.
<b>Vacuum Test</b>	The instrument is performing a vacuum test.
<b>Leak Test</b>	The instrument is performing a leak test.
<b>Manual Drying</b>	The instrument is in the course of a manual freeze-drying process.
<b>Recovering</b>	The system is in the process of recovering from a power failure.
<b>Hold</b>	The instrument is in the holding phase.
<b>Primary drying</b>	The instrument is in the primary drying phase.
<b>Secondary drying</b>	The instrument is in the secondary drying phase.
<b>Tempering shelves</b>	The instrument is modulating the heatable shelves to the set temperature.

**Symbols on the status bar**

<b>Symbol</b>	<b>Status</b>
	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.
	Sample protection is active.

Symbol	Status
	<p>Before the freeze-drying process: Load the top-mount drying rack with a frozen preparation.</p> <p>After the freeze-drying process: Remove the dried preparation from the top-mount drying rack.</p>
	The vacuum pump is being brought up to operating temperature.
	The instrument is performing a vacuum test.

## 7.5 Editing a method

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

### 7.5.1 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.

### 7.5.2 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.

### 7.5.3 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.

#### 7.5.4 Setting the gas type

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##### 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.

#### 7.5.5 Setting the shelf loading temperature

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##### 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.

#### 7.5.6 Setting the steps of a method

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



##### 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
<i>[Step phase]</i>	Primary drying/Secondary drying	Sets the type of step phase.
<i>[Duration]</i>	Entry of value	Sets the duration of the step in minutes.
<i>[Shelf temperature]</i>	Entry of value	Sets the temperature of the heatable shelves for the duration of the step.
<i>[Pressure range]</i>	Regulated/Minimum	Regulated: the settings for pressure and pressure limits are applied.  Minimum: the maximum vacuum is applied to reach the lowest possible pressure.
<i>[Pressure]</i>	Entry of value	Set a target level for the regulated pressure.
<i>[Pressure limit]</i>	Entry of value	Maximum divergence from the set pressure before the sample protection function is activated.
<i>[Pressure duration]</i>	Entry of 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.

#### Adding a step

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

### 7.5.7 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
<i>[Primary drying]</i>	<i>[Pressure action]</i>	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.
	<i>[Temp. action]</i>	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.
<i>[Safety temperature]</i>		Entry of value	Maximum divergence from the set collapse temperature before the sample protection function is activated.
<i>[Sample protection time]</i>		Entry of value	Duration of sample protection status in minutes.
<i>[End point definition]</i>		More settings	See Chapter 7.7 "Setting end point definitions", page 67

Phase	Setting	Option	Meaning
<i>[Secondary drying]</i>	<i>[Pressure action]</i>	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.
	<i>[Temp. action]</i>	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.
	<i>[Safety temperature]</i>	Entry of value	Maximum divergence from the set collapse temperature before the sample protection function is activated.
	<i>[Sample protection time]</i>	Entry of value	Duration of sample protection status.
	<i>[End point definition]</i>	More settings	See Chapter 7.7 "Setting end point definitions", page 67
	<i>[Stopping]</i>	<i>[Pressure range]</i>	Regulated/Minimum
<i>[Pressure]</i>		Entry of value	Sets a target value for the regulated pressure.
<i>[Mode]</i>		None/Manual	None: no action is carried out. Manual: sealing is performed manually.
<i>[Hold]</i>	<i>[Pressure range]</i>	Regulated/Minimum	Regulated: the settings for pressure are applied. Minimum: the lowest possible vacuum pressure is applied.
	<i>[Pressure]</i>	Entry of value	Sets a level for the regulated pressure.
	<i>[Shelf temperature]</i>	Entry of 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.

## 7.6 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.

## 7.7 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.

### 7.7.1 Pressure difference test

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:

- The pressure sensor PPG010 has been installed. See Chapter 5.3.5 "Assembling pressure sensor PPG010 (optional accessory)", page 28.
- A capacitive pressure sensor (Inficon Porter CDG020D) is connected.
- ▶ Place the alternative pressure sensor in the drying chamber.
- ▶ 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
<i>[Pressure difference test]</i>	Yes/No	Switches the pressure difference test on or off.
<i>[Start time]</i>	Entry of value	Sets the time from which the pressure difference test is to be performed. The figure relates to the time before completion of the primary drying phase.

Setting	Option	Explanation
<i>[Pressure difference limit]</i>	Entry of value	Specifies the difference between the two sensor readings below which the end point is reached.
<i>[Duration]</i>	Entry of value	Specifies the length of time for which the pressure difference test is to be carried out.
<i>[Continue]</i>	Yes/No	Yes: the method switches to the next phase. No: the phase is ended when the set levels are reached.
<i>[Message]</i>	Yes/No	The control panel shows or does not show a message as soon as the pressure difference test is passed.

### 7.7.2 Temperature difference test

The temperature difference test establishes the difference between the readings from 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 5.5.7 "Fitting heatable shelves", page 40.
- The optional temperature sensor has been installed. See Chapter 5.5.7 "Fitting heatable shelves", page 40.
- ▶ 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
<i>[Temperature difference test]</i>	Yes/No	Switches the temperature difference test on or off.
<i>[Start time]</i>	Entry of value	Sets the time from which the temperature difference test is to be performed. The figure relates to the time before completion of the primary drying phase.

Setting	Option	Explanation
[Temperature difference limit]	Entry of value	Specifies the difference between the two sensor readings below which the end point is reached.
[Duration]	Entry of value	Specifies the length of time for which the temperature 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.
[Message]	Yes/No	The control panel shows or does not show a message as soon as the temperature difference test is passed.

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

### 7.8.1 Preparing the instrument

Time approx.  
re- 30min  
quired:



#### NOTE

The conditioning phase can be skipped by tapping *[Skip]* on the function bar.

#### 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 **Un-load / Load**.

### 7.8.2 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.

### 7.8.3 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

---

Precondition:

- The instrument is prepared.
- A method is selected.
- ▶ Fit a top-mount drying rack. See Chapter 5.5 "Assembling the drying attachments", page 33.
- ▶ Load the top-mount drying rack with frozen preparations.
- ▶ 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.

### 7.8.4 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.

### 7.8.5 Shutting down the instrument

---

Time 40min  
re-  
quired:

---

## IMPORTANT

**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 32
- ▶ Navigate to the *[Start]* menu via the navigation path.
- ▶ Tap the function *[Shut down]* on the function bar.

The instrument shuts down.

The status bar shows the remaining time and the status **Shutting down**.

After the instrument has shut down, the status bar shows the remaining time and the status **Defrosting**.

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

### 7.9.1 Preparing the instrument

Time approx.  
re- 30min  
quired:



#### NOTE

The conditioning phase can be skipped by tapping *[Skip]* on the function bar.

### 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 **Un-load / Load**.

### 7.9.2 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 is prepared.

- ▶ Fit a top-mount drying rack. See Chapter 5.5 "Assembling the drying attachments", page 33.
- ▶ Load the top-mount drying rack with frozen preparations.
- ▶ 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 colour 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.

**7.9.3 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.

**7.9.4 Ending freeze-drying**

---

**Navigation path**

---

→ Start

---

Precondition:

 The preparation 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 preparation from the drying rack.

### 7.9.5 Shutting down the instrument

---

Time 40min  
re-  
quired:

---

## IMPORTANT

**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 32
- ▶ Navigate to the *[Start]* menu via the navigation path.
- ▶ Tap the function *[Shut down]* on the function bar.  
The instrument shuts down.

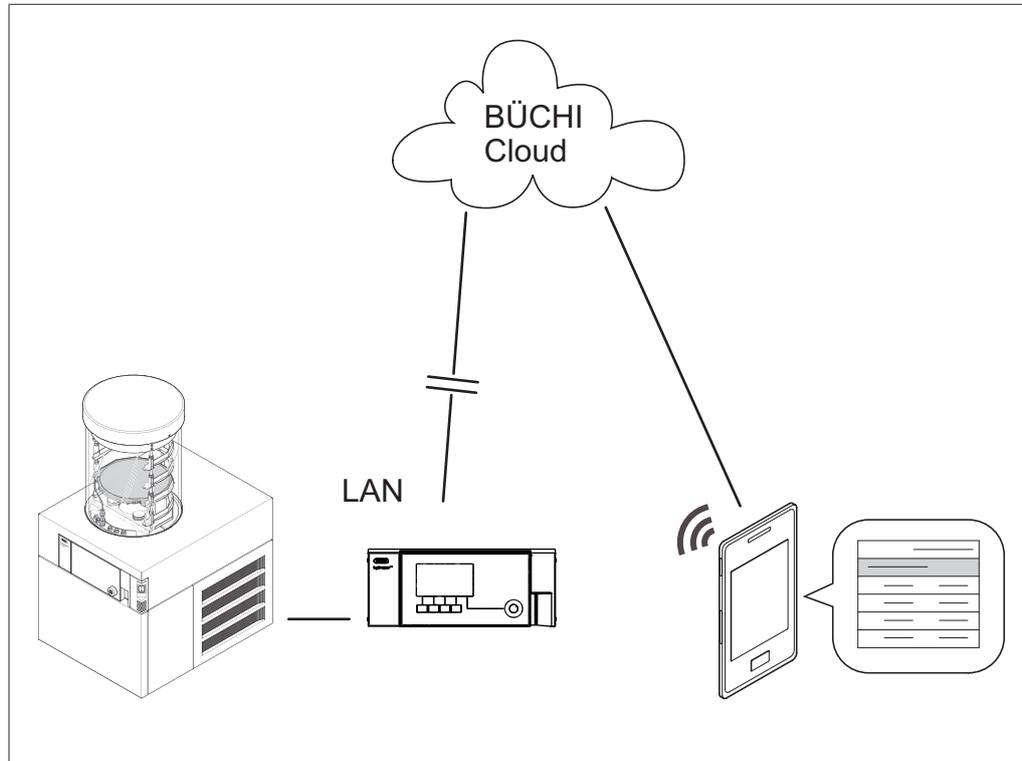
The status bar shows the remaining time and the status **Shutting down**.

After the instrument has shut down, the status bar shows the remaining time and the status **Defrosting**.

## 8 Mobile connection

### 8.1 Setting up BUCHI Connect Solution

The BUCHI Connect Solution is an IT solution for mobile monitoring of processes.



The BUCHI Connect Solution allows processes to be tracked and analysed from a mobile device while in progress.

Notifications keep the user informed of the status of the instrument.

Similar to the display on the control panel, the BUCHI Monitor app shows the current settings and actual readings. Depending on the control panel (Basic or Pro), the BUCHI Monitor app displays either the alphanumeric data only (Basic control panel) or the progression graphs as well (Pro control panel).

Setting up the BUCHI Connect Solution requires the following steps:

- ▶ Connect the instrument to the local network (LAN), see Chapter 8.3 "Connecting the instrument to the LAN", page 75.
- ▶ Assign dynamic IP addresses (DHCP), see Chapter 8.5 "Assigning a dynamic IP address", page 76.
- ▶ Enable the control panel for the BUCHI Cloud, see Chapter 8.6 "Enabling the control panel on the BUCHI Cloud", page 76.
- ▶ Enable ports on the Internet gateway, see .
- ▶ Install the BUCHI Monitor app, see Chapter 8.7 "Downloading the BUCHI Monitor app", page 76.
- ▶ Connect the instrument to the BUCHI Monitor app.
- ▶ Activate notifications, see Chapter 8.12 "Enabling notifications", page 80.

## 8.2 Handling data

The instrument sends the following data to the server via the LAN interface:

- Serial number and system name of the control panel
- Notifications that have been shown on the mobile device
- The following current process parameters with timestamp:
  - Process phase and step: actual reading
  - Condenser temperature: actual reading and specified setting
  - Condenser pressure: actual reading and specified setting
  - Drying chamber pressure: actual reading and specified setting
  - Shelf temperature 1 and 2: actual reading and specified setting
  - Product temperature 1, 2 and 3: actual reading
  - Events: phase transition

The process data is regularly deleted and not used for other purposes.

## 8.3 Connecting the instrument to the LAN

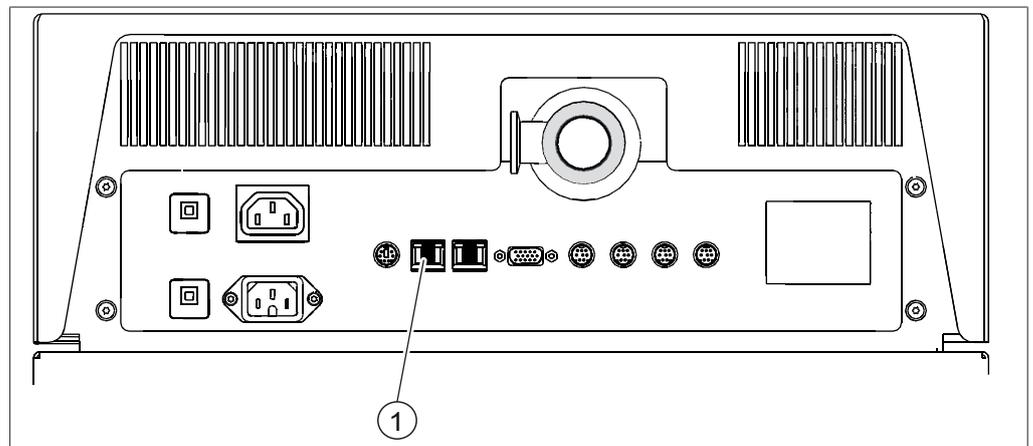


Fig. 36: Connection

1 LAN port

- ▶ Plug the network cable into the port marked **LAN** (1).



### NOTE

Do not unplug the LAN cable while the device is connected to the BUCHI Connect Solution.

## 8.4 Requirements for local network settings

- ▶ The following port has to be enabled in the firewall on the internet gateway:
  - Port 443 (HTTPS) open for TCP
- ▶ In order to use the BUCHI Cloud a DNS server must be configured on the interface unit.



### NOTE

If there is no DNS server available, the BUCHI Cloud connection must be configured by entering the IP address.



### NOTE

If there is no DHCP server available, the IP address, gateway subnet mask and DNS server can be configured manually on the interface unit.

## 8.5 Assigning a dynamic IP address

To use the BUCHI Monitor app, enable DHCP on the control panel.

---

### Navigation path

---

→ Configuration → Settings → Network → DHCP

---

- ▶ Navigate to the action [*DHCP*] via the navigation path.
- ▶ Select the option [*Yes*].
- The IP address will now be dynamically assigned.

## 8.6 Enabling the control panel on the BUCHI Cloud

To use the BUCHI Monitor app, enable access to the BUCHI Cloud on the control panel.

---

### Navigation path

---

→ Configuration → 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.

## 8.7 Downloading the BUCHI Monitor app

Precondition:

- Access to an app store.
- System requirements, see details in app store.
- ▶ Start the mobile device.
- ▶ Install the BUCHI Monitor app.
- ▶ Start the BUCHI Monitor app.

## 8.8 Layout of BUCHI Monitor app

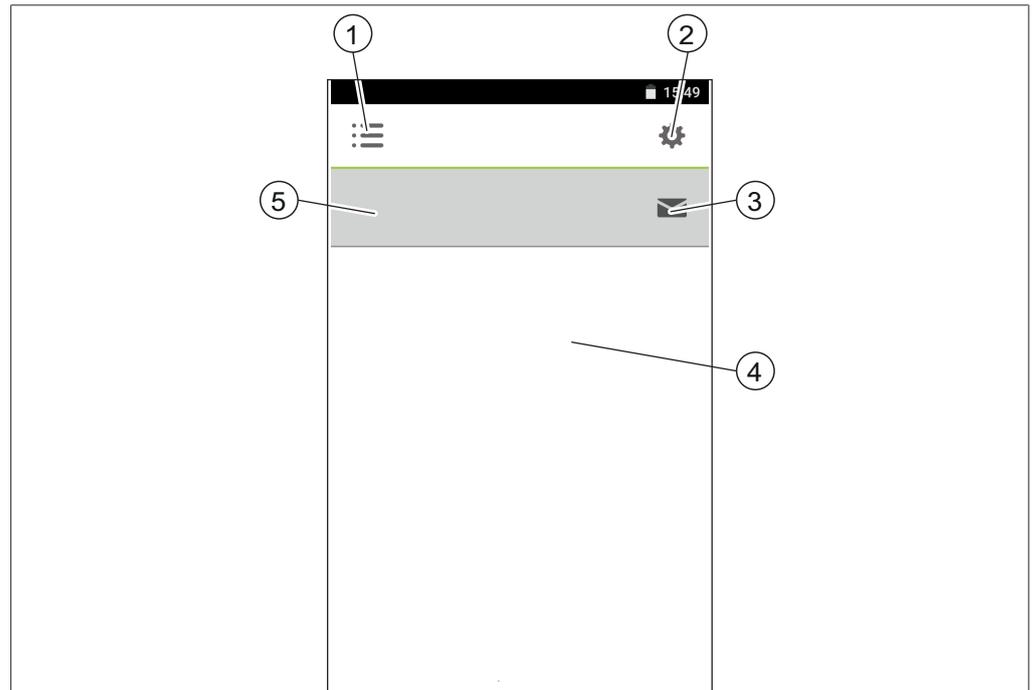


Fig. 37: BUCHI Monitor app layout

- |  |                |
|--|----------------|
| 1 List                                     | 2 Settings     |
| 3 Messages                                 | 4 Content area |
| 5 Details of current instrument and status |                |

## 8.9 Connecting the instrument and app using a QR code

Precondition:

- The BUCHI Monitor app is installed.

► Switch on the instrument.

### 8.9.1 Generating a QR code

To connect the BUCHI Monitor app to the instrument, generate a QR code on the instrument control panel.

---

#### Navigation path

---

→ Configuration → Settings → Mobile connection QR code

---

- Navigate to the action *[Mobile connection QR code]* via the navigation path.



- The control panel shows a QR code.

### 8.9.2 Scanning the QR code

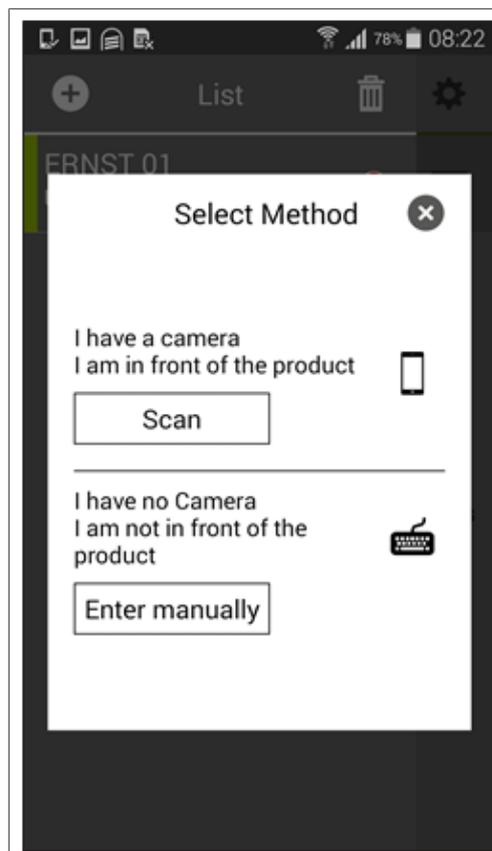


Fig. 38: Capturing the system in the BUCHI Monitor app

Precondition:

- The control panel shows the instrument's QR code.
- ▶ Start the BUCHI Monitor app on the mobile device.
- ▶ Tap the symbol *[List]*.  
The display shows a list of instruments that are connected to the BUCHI Monitor app.
- ▶ Tap the *[+]* sign in the top left corner.
- ▶ Tap the option *[Scan]*.  
The mobile device switches to camera mode.
- ▶ Scan the QR code shown on the control panel.
- ▶ Tap *[OK]* to confirm.

- The instrument is connected to the BUCHI Monitor app.

**NOTE**

The system name displayed is taken from the control panel.

## 8.10 Connecting the instrument and app using a password

Precondition:

- The BUCHI Monitor app is installed.

- ▶ Switch on the instrument.

### 8.10.1 Generating a password

To connect the BUCHI Monitor app to the instrument, generate a password on the instrument control panel.

---

#### Navigation path

---

→ Configuration → Settings → Mobile connection password

---

- ▶ Navigate to the action *[Mobile connection password]* via the navigation path. The control panel shows the instrument's password.

### 8.10.2 Entering the password

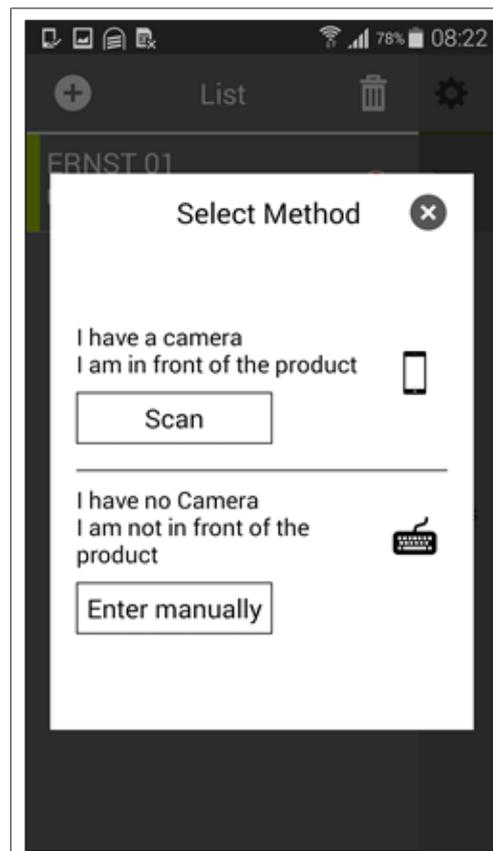


Fig. 39: Capturing the system in the BUCHI Monitor app

Precondition:

- The instrument password is available.

- ▶ Start the BUCHI Monitor app on the mobile device.

- ▶ Tap the symbol *[List]*.

The display shows a list of instruments that are connected to the BUCHI Monitor app.

- ▶ Tap the *[+]* sign in the top left corner.
  - ▶ Tap the option *[Manual entry]*.
  - ▶ Enter the password.
  - ▶ Tap *[Confirm]*.  
The password entered is applied.
  - ▶ Tap *[OK]* to confirm.
- The instrument is connected to the BUCHI Monitor app.

**NOTE**

The system name displayed is taken from the control panel.

### 8.11 Removing the instrument from the app

- ▶ Start the BUCHI Monitor app on the mobile device.
- ▶ Tap the symbol *[List]*.  
The display shows a list of instruments that are connected to the BUCHI Monitor app.
- ▶ Tap the instrument that you wish to remove.
- ▶ Tap the Remove symbol in the top right corner.
- ▶ Answer the confirmation question.  
The instrument is removed from the BUCHI Monitor app.

### 8.12 Enabling notifications

The BUCHI Monitor app offers a series of notifications that can be sent automatically to the mobile device while a process is running. The notifications inform the user of the current status of the process.

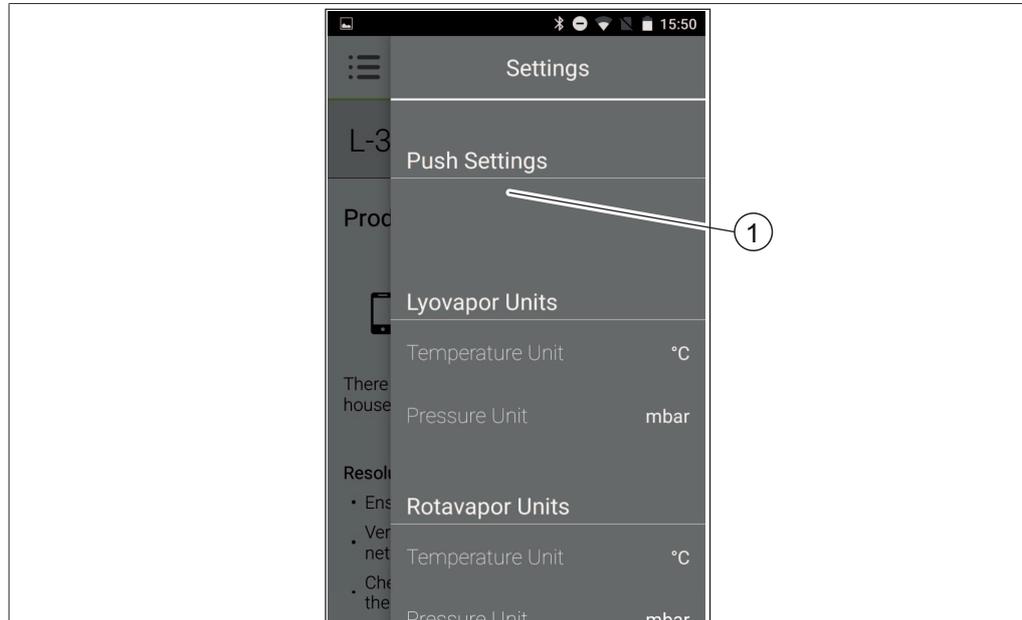


Fig. 40: Possible settings on the BUCHI Monitor app

1 Name of the active instrument

- ▶ Start the BUCHI Monitor app.
- ▶ Tap the symbol *[Settings]*.
- ▶ Tap the instrument for which you wish to enable notifications.  
The display shows a dialog box listing the notification types available.

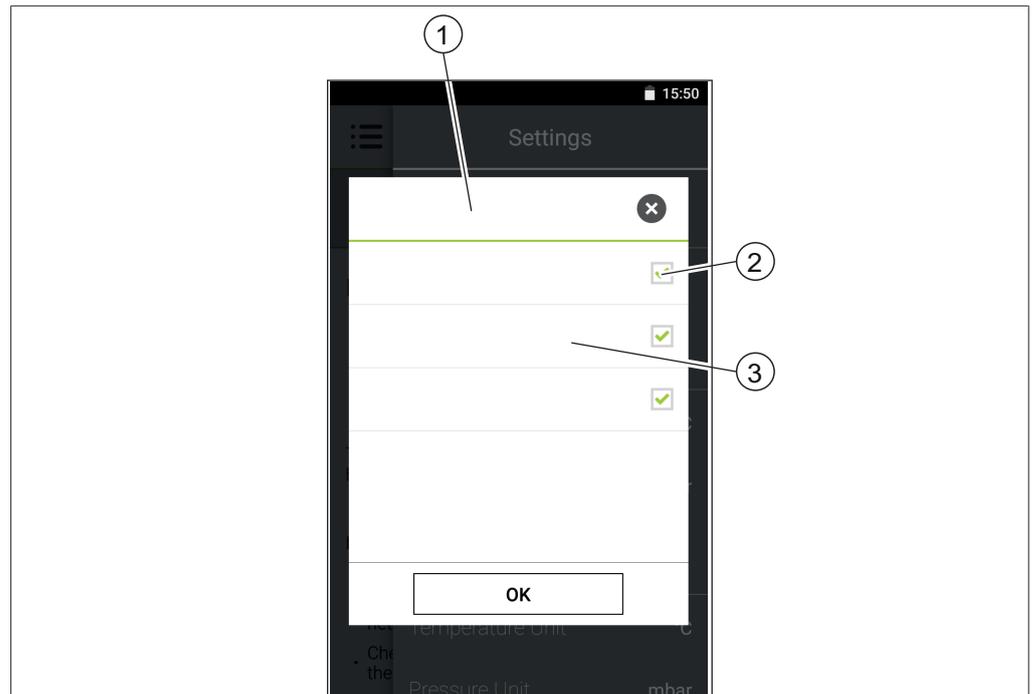


Fig. 41: Dialog box showing notification types

- 1 Name of the active instrument
- 2 Check-box
- 3 Possible notifications

- ▶ Select the desired notifications by tapping the relevant check-boxes (2). Notifications are enabled.
- ▶ Tap *[OK]* to save the settings.
- The display shows the *[Settings]* screen.

### 8.13 Remotely retrieving process data

The data for the process currently running can be retrieved on the BUCHI Monitor app.

Precondition:

- The BUCHI Monitor app is connected to the instrument.
- ▶ Start the BUCHI Monitor app and select the required instrument.  
The BUCHI Monitor app home screen is displayed showing a summary of the available process parameters.

## 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	Frequency
Vacuum pump	▶ Carry out maintenance according to 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. ▶ If heavily soiled, use ethanol or a mild detergent.	Daily
O-ring, dia. 300 mm	▶ Wipe down the 300 mm O-rings with a damp cloth. ▶ Check for scratches and other damage. ▶ Replace the 300 mm O-ring if it is damaged. ▶ Grease with vacuum grease if necessary.	Daily
	▶ Replace the 300 mm O-ring.	Annually
Seals ISO-KF 16	▶ Wipe down the seals with a damp cloth.	Annually
Seals ISO-KF 25	▶ Check for scratches and other damage. ▶ Replace seals if they are damaged.	
Vacuum tubing	▶ Wipe down the vacuum tube with a damp cloth. ▶ Check for scratches and other damage. ▶ Replace the vacuum tube if it is damaged.	Annually
Ice condenser	▶ Rinse out with clean water. ▶ If heavily soiled, use ethanol or a mild detergent.	Daily
Casing	▶ Wipe down the casing with a damp cloth. ▶ If heavily soiled, use ethanol or a mild detergent.	Weekly
Warning symbols	▶ Check that the warning symbols on the instrument are legible. ▶ If they are dirty, clean them.	Weekly
Heat exchanger	▶ Remove dust and foreign objects from the ventilation slots using compressed air or a vacuum cleaner.	Monthly

---

<b>Component</b>	<b>Action</b>	<b>Frequency</b>
View	▶ Wipe down the display with a damp cloth.	Monthly

---

## 9.2 Performing a leak test

The leak test checks the vacuum system for possible leaks.

Time 45 min  
re-  
quired:



### NOTE

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

### Navigation path

→ Configuration → Servicing → Leak test

Precondition:

A top-mount drying rack is fitted.

- ▶ Navigate to the action *[Leak test]* via the navigation path.
- ▶ On the Ice Condenser line, enter a required setting for the vacuum.
- ▶ On the Volume line, enter the actual volume of the system. The volume of the system is calculated from the volume of the ice condenser and the top-mount drying rack.
- ▶ Tap the function *[Start]* on the function bar.  
The leak test starts.

The status bar shows the status *Running*.

- 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.
300 mm dia. O-rings dirty	Wipe down the 300 mm O-rings with a damp cloth.
300 mm dia. O-rings damaged	Inspect 300 mm O-rings and replace as necessary.
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.

## 9.3 Performing a vacuum test

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

Time max. 10 min  
re-  
quired:

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### Navigation path

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→ Configuration → Servicing → Vacuum test

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Precondition:

A top-mount drying rack is fitted.

- ▶ 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 **Start** on the function bar.  
The vacuum test starts.

The **status** bar shows the status *Running*.

If the vacuum pressure is not below 500mbar after 30s, 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.
300 mm dia. O-rings dirty	Wipe down the 300 mm O-rings with a damp cloth.
300 mm dia. O-rings damaged	Inspect 300 mm O-rings and replace as necessary.
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.
The pump connected is not delivering sufficient performance	Carry out vacuum test with a different vacuum pump.

## 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. ▶ 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 22
	Too much ice in the ice condenser	Defrost the ice condenser.

### 10.2 Faults, possible causes and remedies

Fault	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 (option) or vacuum pump switches over frequently	Vacuum system is leaking.	▶ Carry out a leak test (see Chapter 9.2 "Performing a leak test", page 84). ▶ If necessary, replace tubing and/or seals.
Main valve (option) 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.
Vacuum is not achieved	Vacuum system is leaking.	▶ Carry out a leak test (see Chapter 9.2 "Performing a leak test", page 84). ▶ Carry out a vacuum test (see Chapter 9.3 "Performing a vacuum test", page 84). ▶ If necessary, replace tubing and/or seals.
	Vacuum pump is too weak.	▶ Use a vacuum pump with a capacity of at least 5m <sup>3</sup> /h. ▶ Carry out maintenance work according to the vacuum pump manufacturer's documentation.

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<b>Fault</b>	<b>Possible cause</b>	<b>Remedy</b>
Instrument is not vented	Main valve is incorrectly connected.	▶ Connect main valve correctly (see Chapter 5.3.4 "Assembling the main valve (optional accessory)", page 26).

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## 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>



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