

Operation Manual

# Lyovapor™ L-210 Basic / L-210 Pro



## **Imprint**

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# 1 About this document

This operation manual is applicable for all variants of the instrument.  
Read this operation manual before operating the instrument and follow the instructions to ensure safe and trouble-free operation.  
Keep this operation manual for later use and pass it on to any subsequent user or owner.

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

If you have any questions after reading this operation manual:

- Contact BÜCHI Labortechnik AG Customer Service.

<https://www.buchi.com/contact>

## 1.1 Mark-ups and symbols



### NOTE

This symbol draws attention to useful and important information.

- ☑ This character draws attention to a requirement that must be met before the instructions below are carried out.
- This character indicates an instruction that must be carried out by the user.
- ⇒ This character indicates the result of a correctly carried out instruction.

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

## 1.2 Trademarks

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

## 1.3 Connected instruments

In addition to this operation manual, follow the instructions and specifications in the documentation for the connected instruments.

## 2 Safety

### 2.1 Intended use

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

- Sublimating and re-sublimating water-based samples
- Sublimating and re-sublimating samples containing organic solvents, acids and bases

### 2.2 Use other than intended

Use of any other kind than that described in Chapter 2.1 “Intended use”, page 8 and any application that does not comply with the technical specifications (see Chapter 3.5 “Technical data”, page 19) constitutes use other than 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 samples not under a vacuum.
- Processing too many samples and overloading the instrument, see Chapter 3.5 “Technical data”, page 19.
- Processing with explosive gas mixtures.
- Drying samples with high solvent concentrations without special safety precautions.
- Use of acids and alkalis without first checking material compatibility.
- Use of solvents with a freezing point below the lowest condenser temperature, see Chapter 3.5 “Technical data”, page 19.

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 instrument must be operated by suitably qualified laboratory staff. These operating instructions are aimed at the following target groups:

#### Users

The users are persons that meet the following criteria:

- They have been instructed in the use of the instrument.
- 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 instrument.



## Operator

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

- The instrument must be correctly installed, commissioned, operated and serviced.
- Only suitably qualified staff must 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 instrument 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 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.

## 2.5 Warning notices in this document

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

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

## 2.6 Warning symbols

The following warning symbols are displayed in this operation manual or on the instrument.



General warning



Instrument damage



Breakable items



Explosive substances



Flammable substances



Hot surface



Low temperature



Wear safety goggles



Heavy weight, lifting requires more than one person



Wear laboratory coat



Wear protective gloves

### Location of the warning symbols on the instrument (front view)

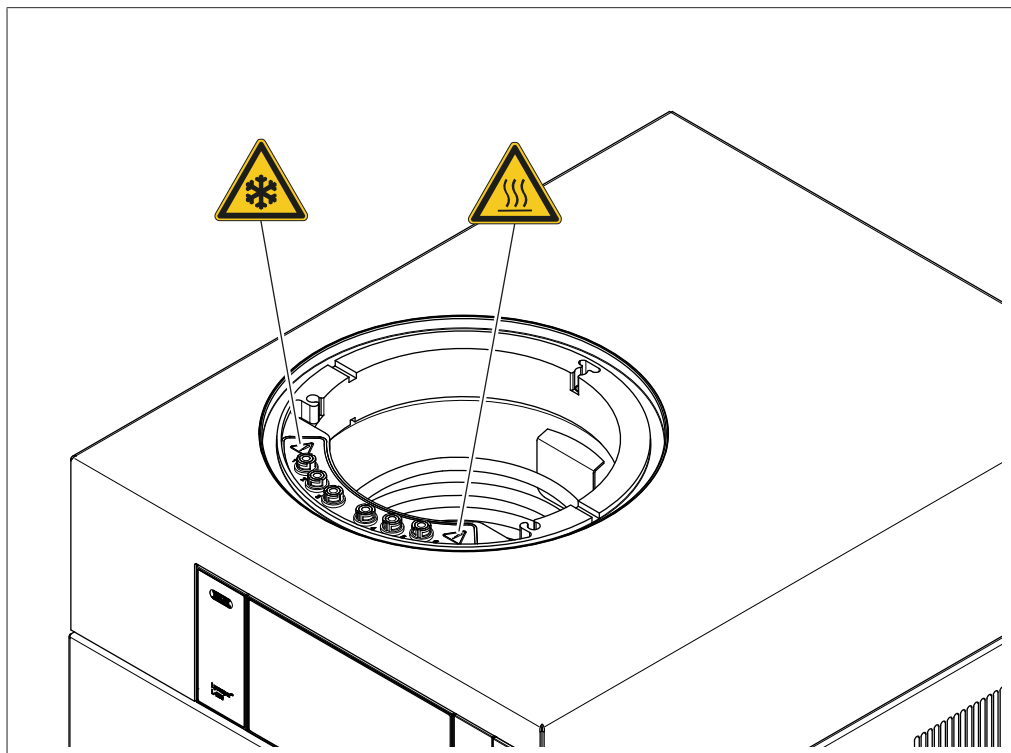


Fig. 1: Location of warning symbols on the instrument (front)

### Location of the warning symbols on the instrument (rear view)

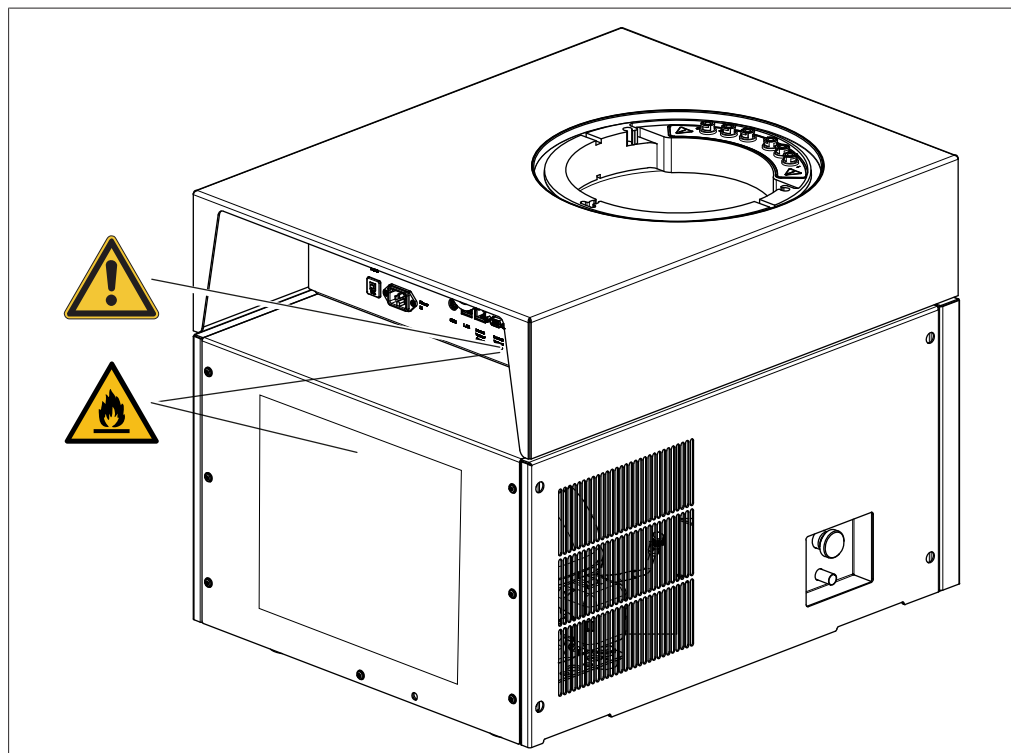


Fig. 2: Location of warning symbols on the instrument (rear)

## 2.7 Residual risks

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

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

### 2.7.1 Faults during operation

If an instrument is damaged, sharp edges, glass splinters, moving parts or exposed electrical wires can cause injuries.

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

### 2.7.2 Dangerous vapors

The use of the instrument can produce dangerous vapors that are capable of causing life-threatening toxic effects.

- ▶ Do not inhale any vapors produced during processing.
- ▶ Ensure that vapors are removed by a suitable fume hood.
- ▶ Only use the instrument in well ventilated areas.
- ▶ If vapors escape from connections, check the seals concerned and replace them if necessary.
- ▶ Do not process any unknown fluids.
- ▶ Observe the safety data sheets for all substances used.

### 2.7.3 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.

### 2.7.4 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 instrument.
- ▶ 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 or in poor condition.
- ▶ Always wear protective gloves when disposing of broken glass and acrylic.

### 2.7.5 Damage to the ice condenser

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

- ▶ Do not use mechanical means to remove ice from the ice condenser.
- ▶ Wait until the ice is completely thawed.
- ▶ Handle the ice condenser with care to avoid danger from flammable refrigerant.

### 2.7.6 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.

## 2.8 Modifications

Unauthorized modifications can affect safety and lead to accidents.

- ▶ Use only genuine BUCHI accessories, spare parts and consumables.
- ▶ Carry out technical changes only with prior written approval from BUCHI.
- ▶ Only allow changes to be made by BUCHI service technicians.

BUCHI accepts no liability for damage, faults and malfunctions resulting from unauthorized modifications.

## 3 Product description

### 3.1 Description of function

The instrument is a freeze-dryer in which frozen samples 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.

- A solvent such as water in a sample is frozen.
- The frozen solvent is transformed into the gaseous state under vacuum at a pressure below the triple point.

Thus, freeze-drying takes place in three phases:

1. **Freezing phase:** the sample is frozen at atmospheric pressure.
2. **Main drying phase:** heat is applied to the frozen sample 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 instrument consists of an ice condenser and one choice of various top-mount drying racks. The top-mount drying racks can be chosen to suit the availability of the sample 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 solvent 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 instrument 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.

As an example, for water that is less than 6.11 mbar.

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 solvent vapour escaping from the preparation therefore flows towards the ice condenser. The solvent 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 solvent is removed from the sample by desorption. The secondary drying function is performed by the heatable shelves in the drying chamber of the instrument.

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 sample is between 1% and 5% or the end point determination is succeeded.

## 3.2 Configuration

### 3.2.1 Front view

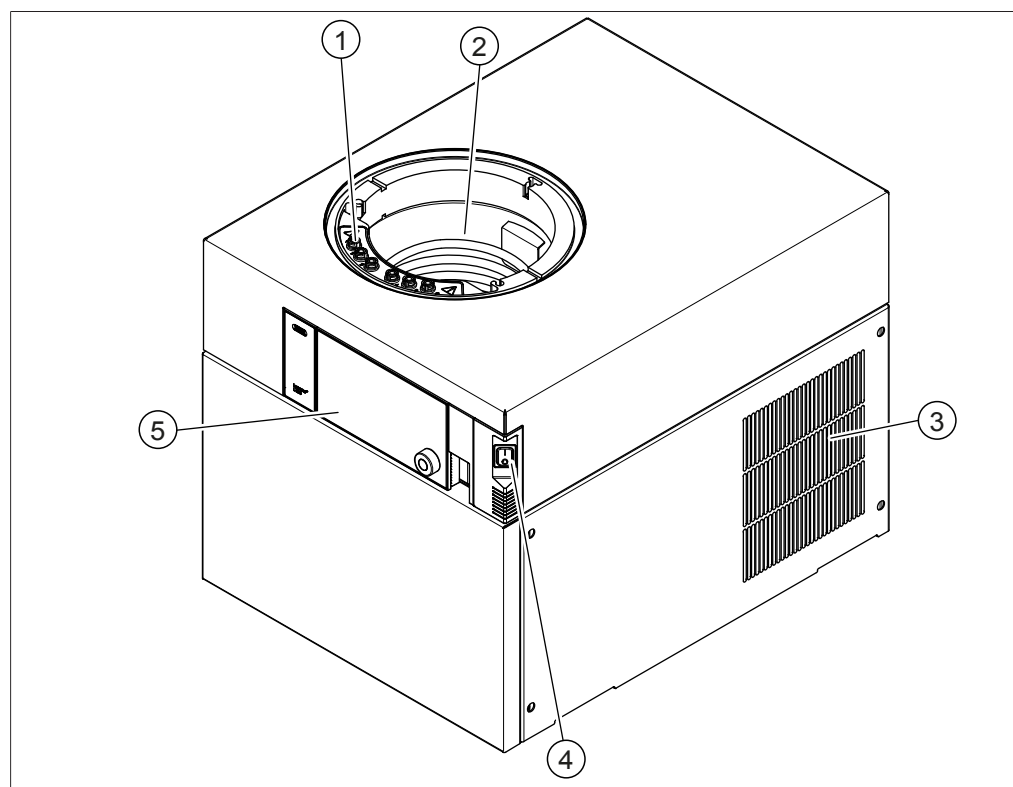


Fig. 3: Front view

- |   |  |   |                      |
|---|--|---|----------------------|
| 1 | Connections for heated shelves<br>(Lyovapor™ L-210 Pro only)<br>(48 V, max. 2 A) | 2 | Ice condenser        |
| 3 | Ventilation slots  | 4 | On/Off master switch |
| 5 | Control panel  |   |                      |

### 3.2.2 Rear view

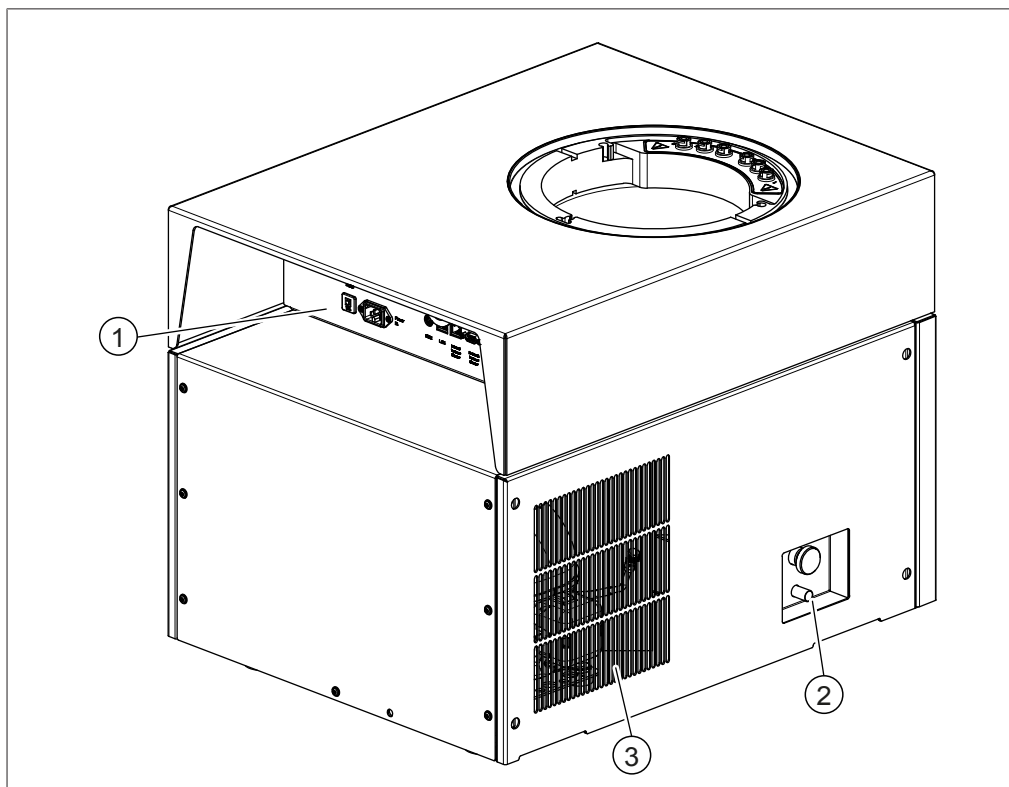


Fig. 4: Rear view

- |   |                              |   |             |
|---|------------------------------|---|-------------|
| 1   | Connections on the rear side | 2 | Drain valve |
| (See Chapter 3.2.3 “Connections on the rear side”, page 17) |                              |   |             |
| 3   | Ventilation slots            |   |             |



### 3.2.3 Connections on the rear side

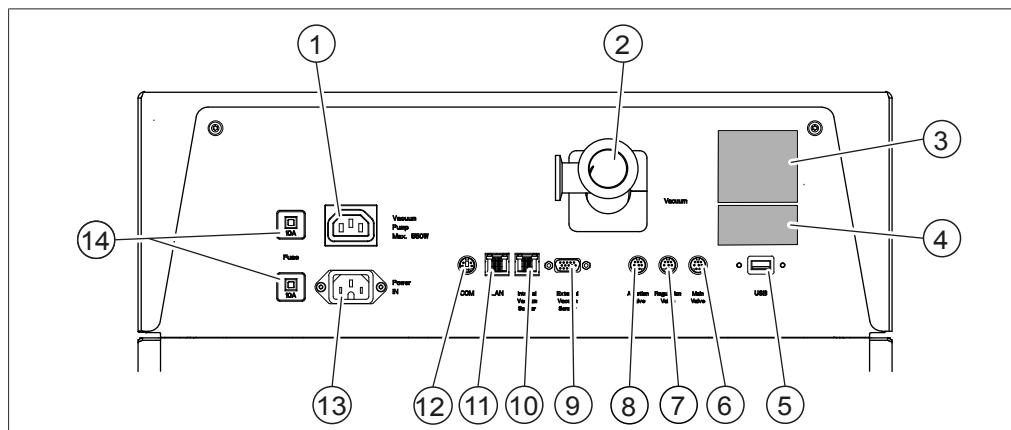


Fig. 5: Connections on the rear side

- |  |   |
|--|---|
| 1 Vacuum pump connection<br>(200 – 240 VAC, 550 W)             | 2 Vacuum connection                                 |
| 3 Type plate   | 4 Refrigerant specification                         |
| 5 USB 2.0 port   | 6 Main valve connection<br>(24 V, $\leq 0.4$ A)     |
| 7 Pressure regulation valve connection<br>(24 V, $\leq 0.4$ A) | 8 Aeration valve connection<br>(24 V, $\leq 0.4$ A) |
| 9 External vacuum sensor connection<br>(24 V, max. 0.125 A)    | 10 Vacuum sensor connection<br>(5 V, max. 0.125 A)  |
| 11 LAN connection  | 12 COM port<br>(24 V, $\leq 0.4$ A)                 |
| 13 Power supply connection                                     | 14 Fuses  |

### 3.2.4 Control panel

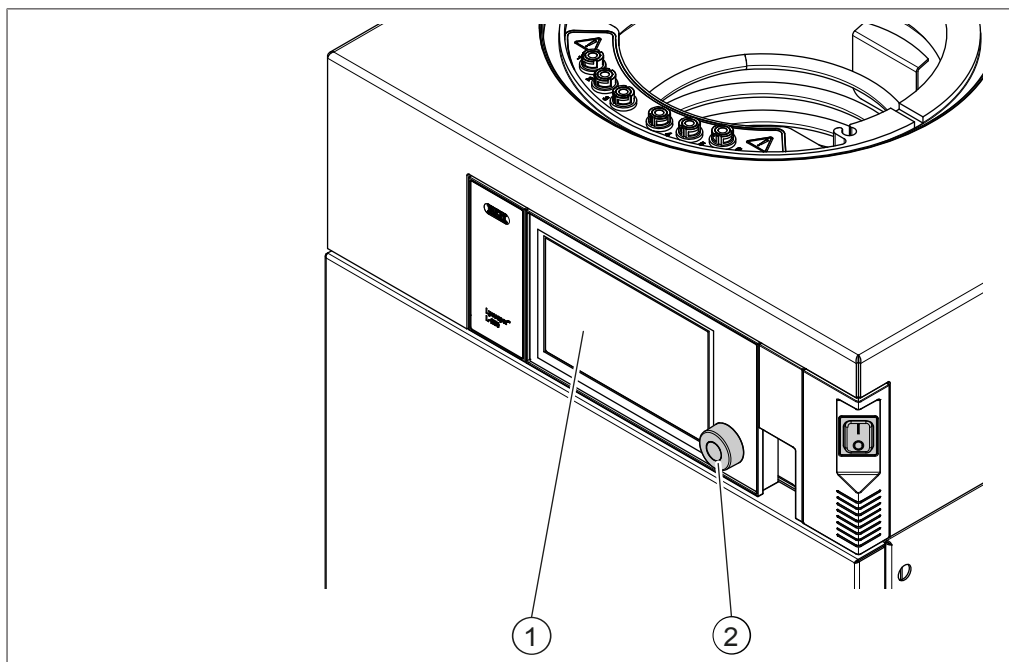


Fig. 6: Control panel

1 Touch screen display

2 Navigation control

### 3.3 Scope of delivery



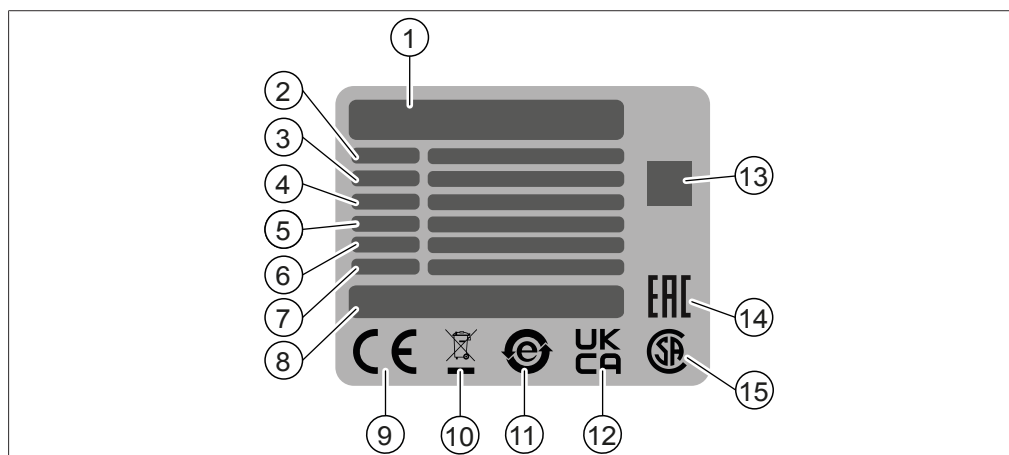
#### NOTE

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

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

### 3.4 Type plate

The type plate identifies the instrument. The following type plate is an example. For more details refer to the type plate on the instrument.  
The type plate is located at the rear of the instrument.



- |  |  |
|--|--|
| 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 origin                                     |
| 9 Symbol for "CE conformity"                     | 10 Symbol for "Do not dispose of as household waste" |
| 11 Symbol for "electronics recycling"            | 12 Symbol for "UK Conformity Assessed"               |
| 13 QR-Code contains "Item number, Serial number" | 14 Symbol for "Eurasian Conformity" (optional)       |
| 15 Symbol for "CSA certified" (optional)         |  |

### 3.5 Technical data

#### 3.5.1 Lyovapor™ L-210 Basic/L-210 Pro

| Specification                                     | L-210 Basic        | L-210 Pro          |
|---|--------------------|--------------------|
| Dimensions without drying attachments (W x D x H) | 503 x 645 x 510 mm | 503 x 645 x 510 mm |
| Weight  | 65.6 kg            | 67.4 kg            |
| Minimum clearance on all sides                    | 300 mm             | 300 mm             |
| Connection voltage                                | 200 – 240 VAC ±10% | 200 – 240 VAC ±10% |
| Rated power consumption                           | 1,300 VA           | 1,800 VA           |
| Fuse  | 10 A               | 10 A               |
| Frequency   | 50 / 60 Hz         | 50 / 60 Hz         |
| Overvoltage category                              | II                 | II                 |
| Protection rating                                 | IP20               | IP20               |
| Pollution degree                                  | 2                  | 2                  |
| Condensing capacity                               | 6 kg / 24 h        | 6 kg / 24 h        |
| Lowest condenser temperature                      | -55 °C             | -55 °C             |
| Temperature divergence                            | ±1.0 °C            | ±1.0 °C            |

| Specification                                     | L-210 Basic           | L-210 Pro             |
|---|-----------------------|-----------------------|
| Condenser capacity                                | ≤ 6 kg                | ≤ 6 kg                |
| Condenser surface area                            | 1,524 cm <sup>2</sup> | 1,524 cm <sup>2</sup> |
| Refrigerants                                      | R290, R600, R170      | R290, R600, R170      |
| Refrigerant quantity                              | < 100 g               | < 100 g               |
| Vacuum generation time to 0.1 mbar                | Typically ≤ 10 min    | Typically ≤ 10 min    |
| Volume-based leakage rate                         | < 10 mbar L/h         | < 10 mbar L/h         |
| Lowest system vacuum                              | 0.03 mbar             | 0.03 mbar             |
| Control range vacuum                              | 0.1 – 1 mbar          | 0.1 – 1 mbar          |
| Shelf heating setting                             |                       | max. 60 °C            |
| Shelf heating tolerance                           |                       | ±1.0 °C               |
| Certificates                                      | CE/CSA/CB             | CE/CSA/CB             |
| Drying attachments operating height               | 1,100 mm              | 1,100 mm              |
| Noise emission to DIN 45635 (without vacuum pump) | < 60 dB(A)            | < 60 dB(A)            |
| Inert gas connection (relative)                   | 0.5 bar               | 0.5 bar               |
| Marking on type plate                             | Bas / BasD            | Pro / ProD            |
| Defrosting (optional, D on type plate)            | Yes                   | Yes                   |

### 3.5.2 Ambient conditions

For indoor use only.

|                               |                                   |
|-------------------------------|-----------------------------------|
| Max. altitude above sea level | 2'000 m                           |
| Ambient temperature           | 5 - 30 °C <sup>1</sup>            |
| Maximum relative humidity     | 80 % for temperatures up to 30 °C |
| Storage temperature           | max. 70 °C                        |

### 3.5.3 Materials

|                               |  |
|-------------------------------|--|
| Housing                       | Steel 1.4301/304 with powder coating           |
| Vacuum chamber and components | Steel 1.4404                                   |
| Main connector                | PE-UHMW 1000                                   |
| Drying chamber tube and cover | PMMA GS  |
| General seals                 | FKM  |
| Drain valve seals             | PTFE   |
| Manifold drying rack          | Steel 1.4301/304                               |
| Manifold valves               | EPDM, PP                                       |
| Cooling medium circuit        | Copper for freezing applications to EN 12735-1 |
| Vacuum clips                  | Aluminum                                       |
| Condensate drain tube         | Steel 1.4301/304/Silicone                      |
| Ventilation                   | Brass with EPDM drain valve seals              |
| Main valve, control valve     | Brass with FKM seal                            |
| Condensate valve              | Steel with EPDM seals                          |

### 3.5.4 Installation site

The installation site must meet the following requirements:

- The installation site has a firm, level surface.
- The installation site has a fume hood.
- The installation site allows that the power supply can be disconnected at any time in an emergency.
- The installation site has enough space that cables / tubes can be routed safely.
- The installation site meets the requirements for the connected devices. See related documentation
- There is no loose paper or the like at the installation site that could drawn in the ventilation.
- The installation site meets the specifications according to the technical data (e.g. weight, dimension, etc.). See Chapter 3.5 “Technical data”, page 19
- The installation site is not exposed to external thermal loads, such as direct solar radiation.
- The installation site meets the safety requirements. See Chapter 2.2 “Use other than intended”, page 8.
- Make sure that the feet do not bend when installing the instrument.
- When mounting on an instrument cart, the feet of the instrument must be placed into the supports of the instrument cart.
- The installation site has enough space for the operating height of the drying attachments, see Chapter 3.5 “Technical data”, page 19.
- The installation site allows for a min. clearance of 300 mm on each side of the instrument. This clearance ensures air circulation and prevents the instrument from overheating.

### 3.6 Refrigerant specification

The instrument uses a refrigerant mixture to maintain the ice condenser temperature. For details see Chapter 3.5 “Technical data”, page 19.

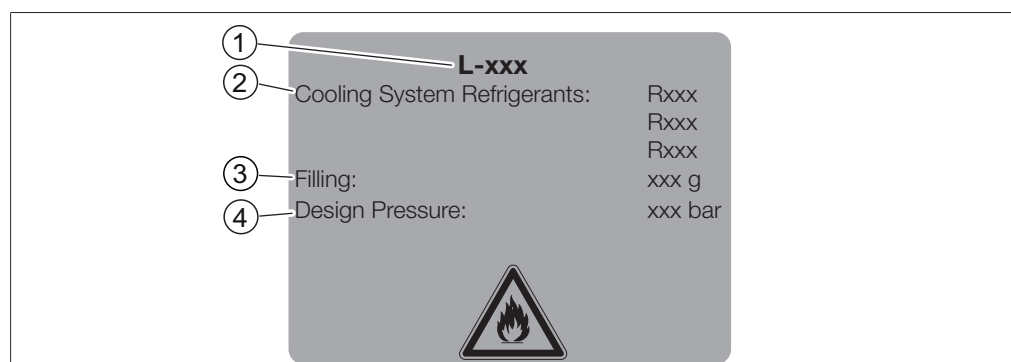


Fig. 7: Refrigerant details

- |   |                  |   |                     |
|---|------------------|---|---------------------|
| 1 | Instrument name  | 2 | Refrigerant details |
| 3 | Filling capacity | 4 | Design pressure     |

## 4 Transport and storage

### 4.1 Transport



#### NOTICE

##### **Risk of breakage due to incorrect transportation**

- ▶ Make sure that the instrument is fully dismantled.
  - ▶ Pack all instrument components properly to prevent breakage. Use the original packaging whenever possible.
  - ▶ Avoid sharp movements during transit.
- 
- ▶ After transporting, check the instrument and all glass components for damage.
  - ▶ Damage that has occurred in transit should be reported to the carrier.
  - ▶ Keep packaging for future transportation.

### 4.2 Storage

- ▶ Make sure that the ambient conditions are complied with (see Chapter 3.5 “Technical data”, page 19).
- ▶ Wherever possible, store the instrument in its original packaging.
- ▶ After storage, check the instrument, 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 two persons at the same time.
  - ▶ Lift the instrument at the points indicated.
-

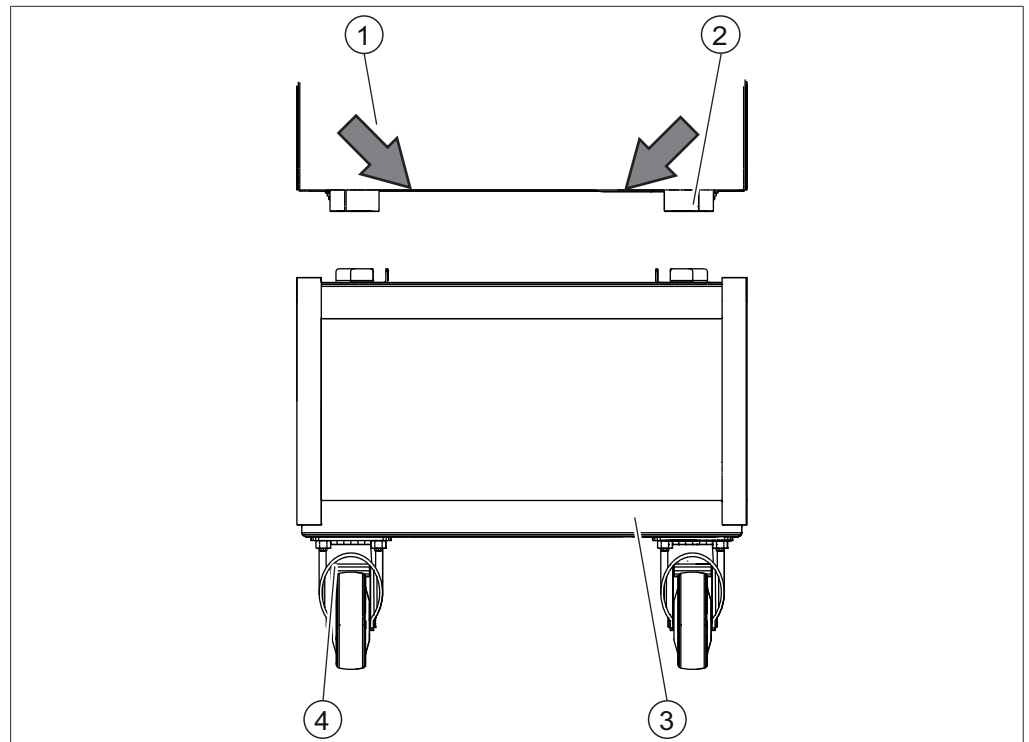


Fig. 8: Lifting the instrument

- |   |                   |   |                          |
|---|-------------------|---|--------------------------|
| 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 two persons each lifting at two of the points indicated on the front and rear of the instrument.
- ▶ Set the instrument down on the equipment trolley.

## 5 Installation

### 5.1 Before installation



#### **DANGER**

##### **Risk of explosion from flammable gas-and-air mixtures**

The potential consequences are death or extremely serious injury.

- ▶ Do not damage the refrigerant circuit piping.
- ▶ Store and operate the instrument in a room with a volume of at least 16.6 m<sup>3</sup> so that an ignitable gas-and-air mixture cannot develop.



#### **NOTICE**

##### **Product loss from power failure and unstable power supply.**

Power failures disrupt the operation and cause product loss.

- ▶ When working with expensive samples or if the power supply is unstable, use an Uninterruptible Power Supply.

### 5.2 Establishing electrical connections



#### **NOTICE**

##### **Risk of instrument damage because of not suitable power supply cables.**

Not suitable power supply cables can cause bad performance or an instrument damage

- ▶ Use only BUCHI power supply cables.



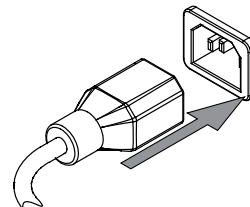
#### **NOTICE**

##### **The power supply cable is the disconnecting device.**

- ▶ Easy access must be guarantee to the mains plug at all times.

Precondition:

- ☒ The electrical installation is as specified on the type plate.
- ☒ The electrical installation is equipped with a proper grounding system.
- ☒ The electrical installation is equipped with suitable fuses and electrical safety features.
- ☒ The installation site is as specified in the technical data. See Chapter 3.5 "Technical data", page 19.
- ▶ Connect the power supply cable to the connection on the instrument. See Chapter 3.2 "Configuration", page 15.





- Connect the mains plug to an own mains outlet socket.

### 5.3 Securing against earthquakes

The instrument has an earthquake fixing point to protect the instrument against falling.

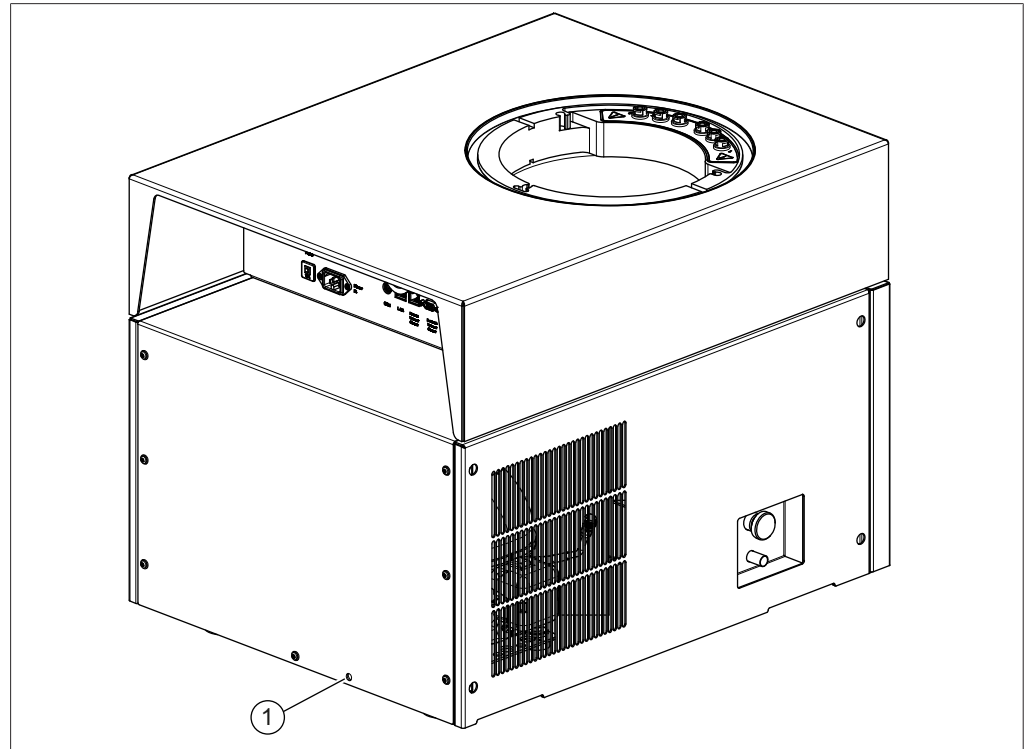


Fig. 9: Fixation hole

- 1 Fixation hole

- Tie a steel rope to the fixation hole to secure the instrument.

### 5.4 Putting the instrument in operation



#### NOTICE

##### Instrument damaged if restarted too early

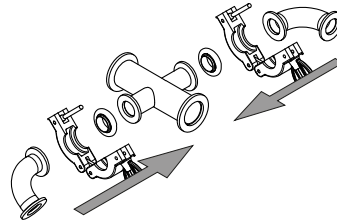
Wait ten minutes before restarting the instrument. The oil in the refrigerant compressor requires ten minutes to return to the collection tank.

#### 5.4.1 Preparing the instrument

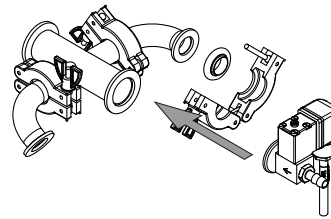
- Clean the instrument with a damp cloth before commissioning.
- Check all sealing surfaces for scratches, dust, and cleanliness.

### 5.4.2 Fitting the advanced vacuum control unit

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



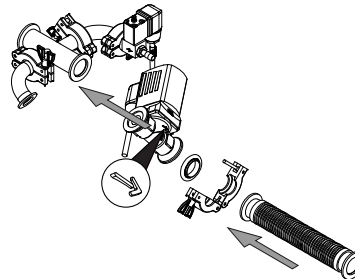
- Fit the pressure regulation valve onto the 90° elbow.



Choose one of the two following options to fit the vacuum tubing:

#### Option 1

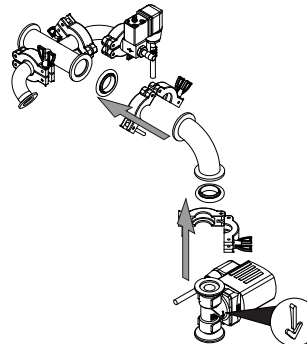
- Attach the main valve to the cross pipe.
- Fit the vacuum tubing to the main valve.
- Skip the next two steps to proceed.



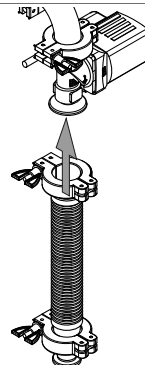
#### Option 2

Precondition:

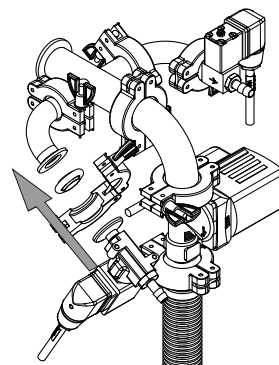
- ☒ The arrow is pointing downward.
- Fit the main valve onto the cross-pipe.



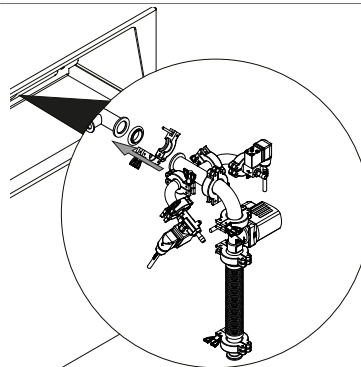
- Connect the tubing vertically to the 90° elbow.



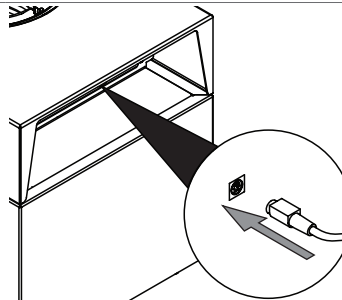
- Fit the aeration valve onto the 90° elbow.



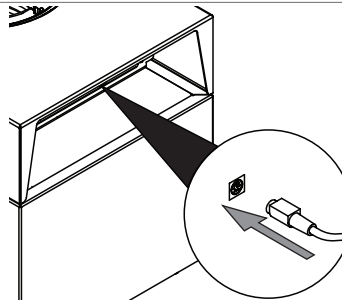
- Fit the assembled advanced vacuum control unit onto the instrument.



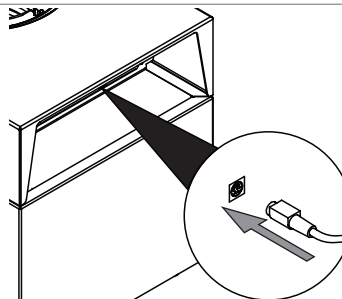
- Plug the aeration valve connector into the socket marked *Aeration Valve*.



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

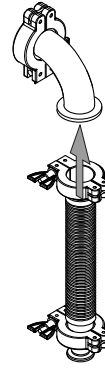


- Plug the main valve connector into the socket marked *Main Valve*.

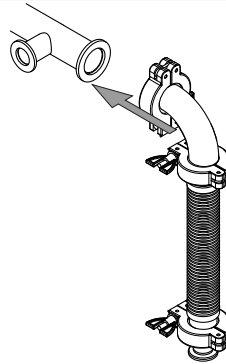


### 5.4.3 Fitting the coarse vacuum control unit

- Fit the vacuum tubing onto the 90° elbow.



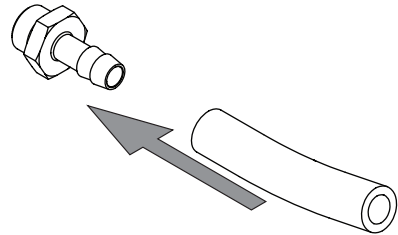
- Attach the 90° elbow to the vacuum connection on the instrument.



### 5.4.4 Connecting the inert gas (optional)

Precondition:

- ☒ Make sure that the pressure of the inert gas matches the technical specifications. See Chapter 3.5 “Technical data”, page 19.
- Fit the inert gas tube onto the gas connection on the pressure regulation valve and regulation valve.
- Fix the inert gas tube with the tube clip.



### 5.4.5 Assembling pressure sensor PPG011

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.

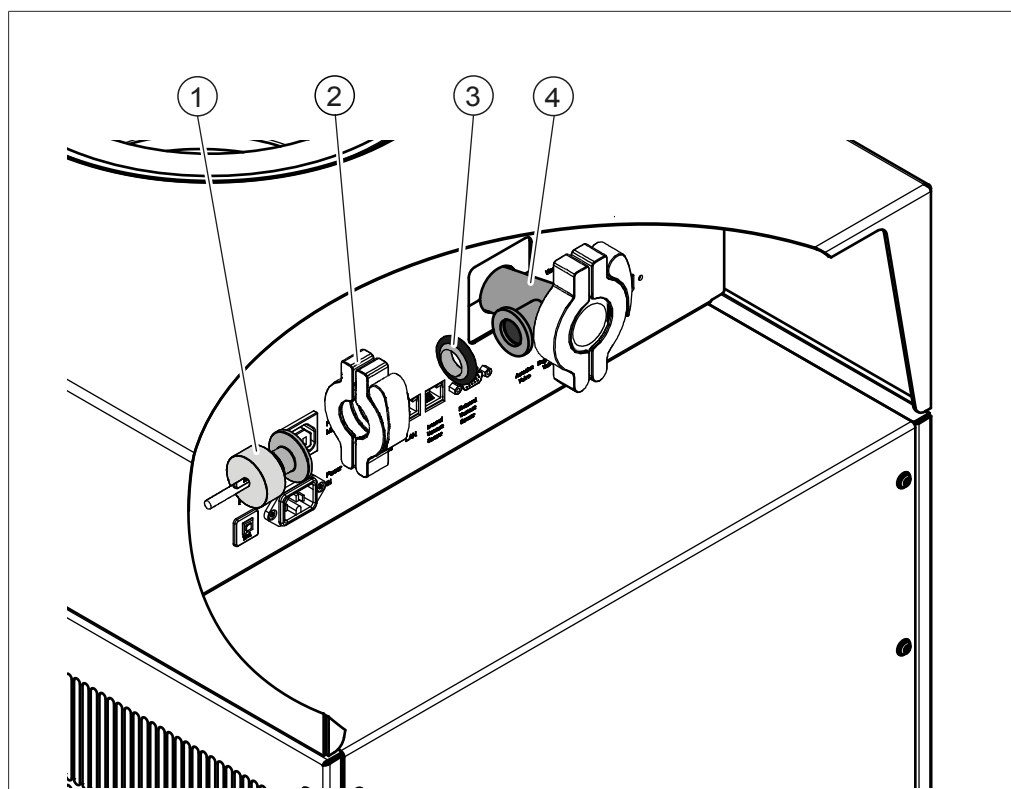


Fig. 10: Assembling pressure sensor PPG011

- |   |                        |   |                       |
|---|------------------------|---|-----------------------|
| 1 | Pressure sensor PPG011 | 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 *Vacuum Sensor*.
- ▶ Select the sensor from the submenu *[Settings]* on the control panel.

## 5.5 Commissioning the vacuum pump

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



### **⚠ DANGER**

**Risk of electric shock due to high leakage currents.**

Serious injuries or death can result.

- ▶ No additional earth connection is needed for safe operation of the following vacuum pumps:
  - Edwards nXDS6iC
  - Edwards RV5
  - Pfeiffer DUO 6M
- ▶ If a different vacuum pump is used, which must be a third party tested and NRTL certified type, an additional earthing connection is needed.
- ▶ Additional earthing connection must be installed by a qualified electrician between the earthing terminal provided on the vacuum pump and a safe on-site earth.



## NOTICE

### Open gas ballast valve.

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

- Open the gas ballast valve.



### NOTE

The equipment must be installed by trained staff.



### 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.

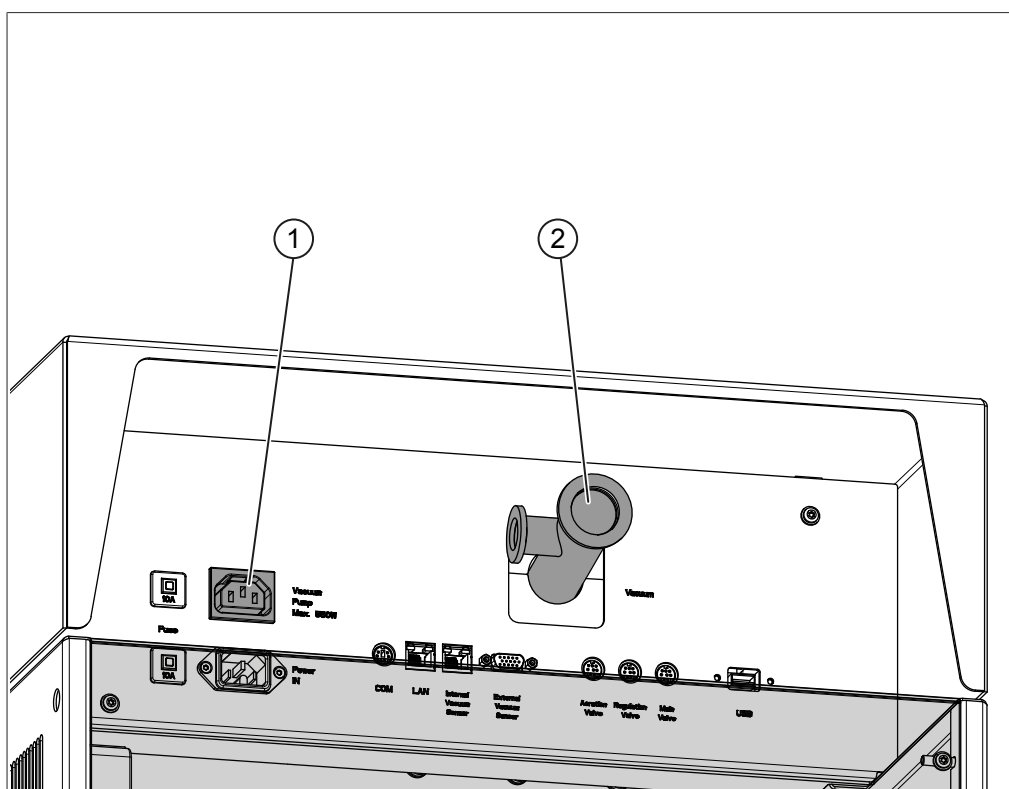


Fig. 11:

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

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

## 5.6 Establishing LAN connection

### 5.6.1 Requirements for local network settings

- ▶ The following port has to be enabled in the firewall settings on the internet gateway:
  - TCP (HTTPS) traffics through remote port 443
- ▶ In order to use the BUCHI Cloud a DNS server must be configured on the instrument.



#### NOTE

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



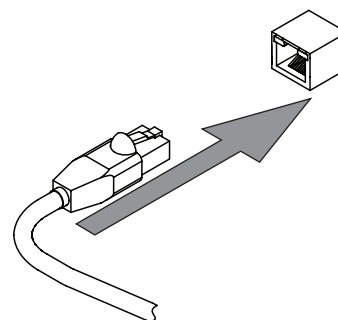
#### NOTE

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

### 5.6.2 Preparing the instrument for app using

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

- ▶ Connect the unit to the LAN (local area network).
- ▶ Restart the unit.



#### Navigation path

→  → [Settings] → [Network]

- ▶ Navigate to [Network].
  - ▶ Activate the function [DHCP].
- ⇒ The unit is now ready.

### 5.6.3 Enabling BUCHI Cloud access

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

#### Navigation path

→  → [Settings] → [Network] → [BUCHI Cloud]

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

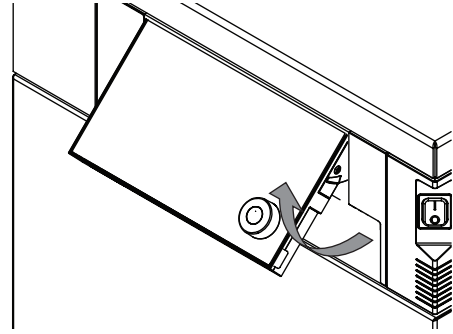
## 5.7 Inserting the SD card



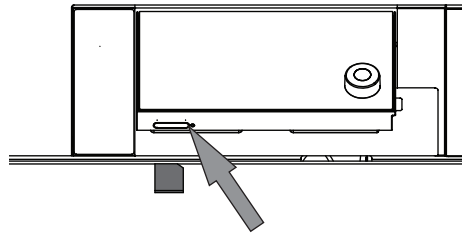
#### NOTE

Only insert or remove the SD card in Standby mode and in Power off mode

- Fold the control panel forward.



- Insert the SD card on the underside.



- Switch on the instrument.  
⇒ The status bar shows the SD card symbol.

The following data is stored on the SD card:

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

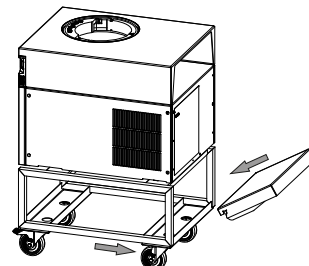
## 5.8 Installing the vacuum pump tray



### ⚠ CAUTION

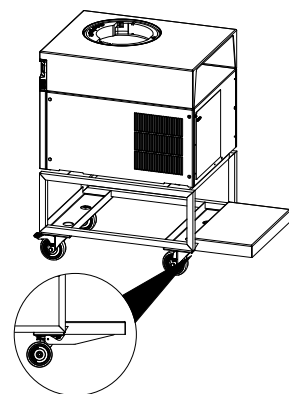
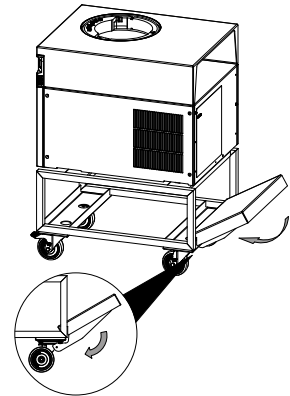
#### Risk of the trolley tipping over

- The vacuum pump must not weigh more than 30 kg.
  - The main device must stand on the trolley when the vacuum pump is placed on the tray.
- 
- Guide the tray at an angle to the metal strut on the trolley side where there are no brakes on the wheels.





- Turn the tray downwards until it is in a horizontal position.



## 6 Interface

### 6.1 Layout of the control panel

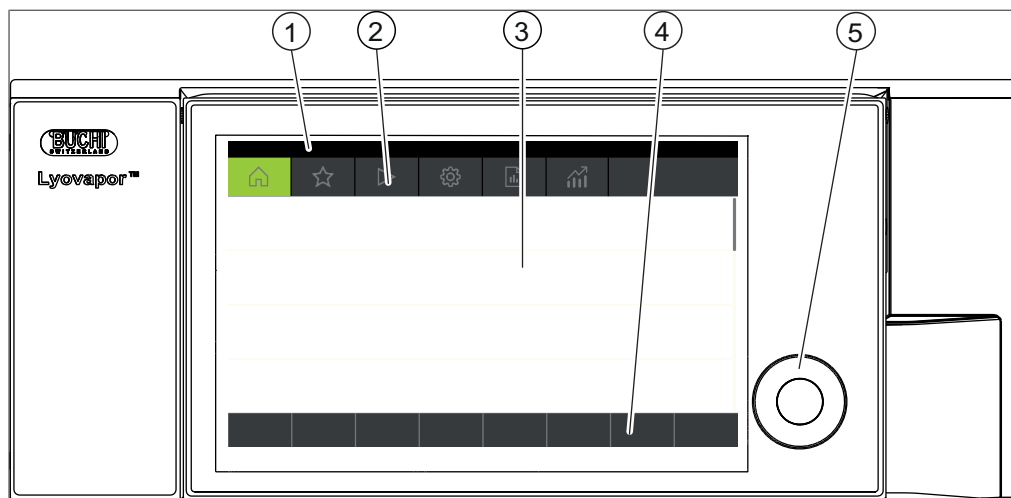


Fig. 12: Layout of the control panel

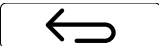





| No. | Description        | Function   |
|-----|--------------------|--|
| 1   | Status bar         | Shows the current status of the instrument.  |
| 2   | Menu bar           | Shows symbols representing the menus.  |
| 3   | Content area       | Shows current settings, submenus or actions depending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












### 6.2 Function bar

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


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

#### General function buttons

| Symbol  | Description                | Meaning  |
|---|----------------------------|--|
|  | <i>[Back]</i>              | The display reverts to the previous view.                                  |
|  | <i>[Cancel]</i>            | Cancels an operation.  |
|  | <i>[Add to favourites]</i> | Adds the selected item to 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. |

| Symbol  | Description                             | Meaning   |
|---|---|---|
| <b>SAVE</b>   | <i>[Save]</i>                           | Saves the setting.  |
| <b>Process control function buttons</b>   |   |   |
| Symbol  | Description                             | Meaning   |
| <b>AERATE</b>   | <i>[Aerate]</i>                         | Vents the system.   |
|  OFF   | <i>[Shut down]</i>                      | The instrument shuts down.  |
| <b>START</b>  | <i>[Start]</i>                          | Starts the freeze-drying process.   |
|  ON    | <i>[Start conditioning]</i>             | Starts the conditioning phase.  |
| <b>MANUAL</b>   | <i>[Manual]</i>                         | Switches to manual freeze-drying.   |
| <b>METHOD</b>   | <i>[Method]</i>                         | Switches to freeze-drying with programmable parameters.                           |
| <b>NEW</b>  | <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. |
| <b>ACTIVATE</b>   | <i>[Activate]</i>                       | Confirms selection of a method.   |
| <b>DELETE</b>   | <i>[Delete]</i>                         | Deletes the selected entry.   |
| <b>SKIP</b>   | <i>[Skip]</i>                           | Skips the current process.  |
| <b>UNPROT</b>   | <i>[[Deactivate sample protection]]</i> | Manually deactivates sample protection.   |
| <b>COPY</b>   | <i>[Copy]</i>                           | Copies the selected method.   |
| <b>OPEN</b>   | <i>[Open]</i>                           | Opens the selected valve.   |
| <b>CLOSE</b>  | <i>[Close]</i>                          | Closes the selected valve.  |
|  ON  | <i>[Vacuum pump ON]</i>                 | Switches on the vacuum pump.  |
|  OFF | <i>[Vacuum pump OFF]</i>                | Switches off the vacuum pump.   |
|  ON  | <i>[Start defrost]</i>                  | Starts the defrosting of the ice condenser.                                       |
|  OFF | <i>[Stop defrost]</i>                   | Stops the defrosting of the ice condenser.  |
|      | <i>[Extend time]</i>                    | Extends the defrosting by 30 min.   |
|      | <i>[Reduce time]</i>                    | Reduces defrosting time by 30 min.  |







## 6.3 Other symbols on the control panel

| Symbol  | Description     | Meaning  |
|---|-----------------|--|
|  | <i>[Closed]</i> | The assigned method is active and cannot be changed. |

## 6.4 Menu bar

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

The following menus are available:

| Menu symbol   | Meaning                     | Submenu/Action   |
|---|-----------------------------|--|
|    | <i>[Start]</i> menu         | <ul style="list-style-type: none"> <li>• Process control parameters</li> </ul>   |
|    | <i>[Favourites]</i> menu    | <ul style="list-style-type: none"> <li>• Bookmarks for individual entry points</li> </ul>  |
|    | <i>[Method]</i> menu        | <ul style="list-style-type: none"> <li>• For saving freeze-drying methods</li> <li>• Editing and activating freeze-drying method</li> </ul>  |
|   | <i>[Configuration]</i> menu | <ul style="list-style-type: none"> <li>• Process settings</li> <li>• Settings</li> <li>• End point determination</li> <li>• Maintenance</li> <li>• Service</li> <li>• System information</li> </ul>            |
|  | <i>[Messages]</i> menu      | <ul style="list-style-type: none"> <li>• Notifications</li> <li>• Journal</li> </ul>   |
|  | <i>[Graph]</i> menu         | Live graph displaying the current: <ul style="list-style-type: none"> <li>• Ice condenser temperature</li> <li>• Ice condenser pressure</li> <li>• Sample temperature</li> <li>• Shelve temperature</li> </ul> |

### 6.4.1 Start menu

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

#### Setting parameters using the navigation control

- ▶ Select a parameter by turning the navigation control.
  - ⇒ The control panel highlights the selected parameter in green.
- ▶ Tap the function *[Edit]* on the function bar.
  - ⇒ The control panel highlights the selected parameter in black.
- ▶ To increase or decrease the figure, use the dialog box with a numeric input.
- ▶ 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.

## 6.4.2 Favourites menu

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

### Adding a favourite

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

### Removing a favourite

- ▶ On the **[Favourites]** menu, navigate to the favourite you wish to remove.
- ▶ Tap the function **[Delete]** on the function bar.
  - ⇒ The favourite is removed.

## 6.4.3 Method menu

The **[Method]** menu allows freeze-drying processes with multiple phases and steps to be saved. See Chapter 7.2 “Editing a method”, page 43.

## 6.4.4 Configuration menu

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

## 6.4.5 Messages menu

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

The following message types are possible:

- I = Information: No immediate actions by customer are needed.
- W = Warning: Minor failures during operation. Customer action is required.
- E = Error: Major failures during operation due to defective system component. Usually service support is needed.

## 6.4.6 Graph menu

The **[Graph]** menu allows viewing the current freeze drying process via a live graph. The live graph displays the following parameters:

- Ice condenser temperature
- Ice condenser pressure
- Sample temperature
- Shelf temperature

## 6.5 Status bar

The status bar shows the status of the instrument.














The following statuses are possible:

### Indication on status bar

|                        |   |
|------------------------|---|
| <i>Unload / Load</i>   | <p>Conditioning is completed.</p> <p>Before the freeze-drying process:</p> <p>Load the top-mount drying rack with a frozen sample.</p> <hr/> <p>After the freeze-drying process:</p> <p>Remove the dried sample from the top-mount drying rack.</p>   |
| <i>Aerating</i>        | The system is venting.  |
| <i>Shutting down</i>   | <p>The instrument is shutting down.</p> <p>Place a container underneath the drain valve.</p> <p>Open the drain valve manually to drain the melted ice from the ice condenser.</p> <ul style="list-style-type: none"> <li>• The aeration valve is closed.</li> <li>• The status bar shows the remaining time.</li> </ul> |
| <i>Defrosting</i>      | <p>The instrument is defrosting.</p> <p>Place a container underneath the drain valve.</p> <p>Open the drain valve manually to drain the melted ice from the ice condenser.</p> <ul style="list-style-type: none"> <li>• The aeration valve is open.</li> <li>• The status bar shows the remaining time.</li> </ul>      |
| <i>Standby</i>         | Shutting down is completed.   |
| <i>Conditioning</i>    | <p>The instrument is starting up including starting refrigerant compressor and vacuum pump.</p> <p>Close the drain valve manually.</p>  |
| <i>Reconditioning</i>  | The instrument is restarting after a temporary power failure (< 15 min).  |
| <i>Warming up pump</i> | The vacuum pump is being brought up to operating temperature.   |
| <i>Vacuum Test</i>     | The instrument is performing a vacuum test.   |
| <i>Leak Test</i>       | The instrument is performing a leak test.   |
| <i>Manual Drying</i>   | The instrument is in the course of a manual freeze-drying process.  |
| <i>Recovering</i>      | <p>The system is in the process of recovering from a power failure (&gt; 15 min).</p> <p>The current parameters of the freeze-drying process are being re-established.</p>  |

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

### Symbols on the status bar

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

## 7 Operation



### ⚠ CAUTION

#### Cutting hazard from broken glass.

Broken flasks can cause cuts.

- ▶ Check the flasks for any damages, cracks or scratches before each use.
- ▶ Do not use any flasks that are not in optimal condition.
- ▶ Handle the flasks carefully.



### NOTICE

#### Instrument damage from glass splinters.

Sharp objects can damage the display.

- ▶ Keep sharp objects away from the display.



### NOTICE

#### Instrument damage from spilled liquids.

Liquid substances can cause stains and damage the instrument.

- ▶ Immediately wipe away any spilled liquids.



### NOTE

Empty the ice condenser before operation.

Processing does not work if the ice condenser is not empty before operation.

- ▶ Empty the ice condenser before processing.

## 7.1 Performing freeze-drying manually

### 7.1.1 Preparing the instrument

Time required: approx. 30 min



### NOTE

To minimize the condensation of moisture from the air in the condenser, place a drying rack. Remove any residual moisture from the ice condenser and close the drain valve.

#### Navigation path

→ [Start]

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



## Preparing the instrument with ultimate vacuum control unit

Time required: approx. 45 min

### Navigation path

→ *[Start]*

- ▶ Make sure, that the ice condenser is dry and the drain valve is closed.
- ▶ Navigate to the *[Start]* menu via the navigation path.
- ▶ Tap the function *[Start conditioning]* on the function bar.
- ▶ Install the manifold drying rack.
- ▶ As soon as the ice condenser temperature is reached, close the valves.
- ▶ Tap the *[Vacuum pump ON]* function on the function bar.
  - ⇒ The vacuum pump switches on.
- ▶ Consider the warm-up time manually.

### 7.1.2 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 7.9 “Operating top-mount drying racks”, page 57.
- ▶ Load the top-mount drying rack with frozen samples.
- ▶ Navigate to the *[Start]* menu via the navigation path.
- ▶ Tap the function *[Manual]* on the function bar.
- ▶ Enter the required settings for the process parameters.
- ▶ Tap the function *[Start]* on the function bar.
  - ⇒ The freeze-drying process starts.
  - ⇒ The background color of the *Start* menu changes from white to black.
  - ⇒ The status bar shows a clock counting up and the status *Manual Drying*.
  - ⇒ The system evacuates to the set pressure.

### 7.1.3 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.

### 7.1.4 Performing a pressure difference test for manifold drying rack



#### NOTE

The pressure difference test can only be carried out with a pressure difference test kit. See Chapter 11.1.1 “Accessories”, page 88.

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

→ **[Configuration]** → **[End point definition]**

| Setting          | Option      | Explanation   |
|------------------|-------------|---|
| <b>[Limit]</b>   | Enter value | Specifies the difference between the two sensor readings below which the end point is reached.<br><br>The threshold must be greater than the offset value from the vacuum test. See Chapter 7.4.3 “Determining offset value”, page 52 |
| <b>[Time]</b>    | Enter value | Specifies the length of time for which the pressure difference test is to be carried out until the endpoint is reached.   |
| <b>[Message]</b> | Yes/No      | A message that is displayed as soon as the pressure difference test is passed.  |

#### Precondition:

- ☒ A vacuum test has been carried out with a pressure equal to the pressure during the subsequent freeze-drying process. See Chapter 8.14 “Performing a vacuum test”, page 77
- ☒ The sensors for the pressure difference test have been fitted. See “Connecting the sensors for a pressure difference test”
- ☒ The offset value has been determined. See Chapter 7.4.3 “Determining offset value”, page 52
- ☒ All flasks have been attached to the manifold drying rack.
- ▶ Navigate to **[End point definition]** via the navigation path.
- ▶ Tap **[Pressure difference test]**.
- ▶ Set up the pressure difference test as desired.
- ▶ Tap **[Start]** to start the pressure difference test.

## 7.1.5 Ending freeze-drying

### Navigation path

---

→ Start

---

Precondition:

☒ The sample is dry.

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

### Ending freeze drying with ultimate vacuum control unit

### Navigation path

---

→ Start

---

Precondition:

☒ The sample is dry.

- ▶ Navigate to the *[Start]* menu via the navigation path.
- ▶ Tap the function *[Aerate]* on the function bar.
- ▶ Answer *YES* to the confirmation question.
  - ⇒ The system is vented.
  - ⇒ The status bar shows the status *Aerating*.
- ▶ As soon as the status bar shows the status *Unload / Load*, remove the flasks.
- ▶ Tap the *[Vacuum pump OFF]* function on the function bar.
  - ⇒ The vacuum pump switches off.

## 7.2 Editing a method

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

### 7.2.1 Creating a new method

There are two possible ways of creating a new method:

#### Creating a new method

### Navigation path

---

→ *[Method]*

---

- ▶ Navigate to the *[Method]* menu via the navigation path.
- ▶ Tap the function *[New]* on the function bar.
  - ⇒ The new method is created.

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

### Navigation path

---

→ *[Method]*

---

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

- ▶ Tap the function *[Copy]* on the function bar.
- ⇒ The new method is created.

## 7.2.2 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.

## 7.2.3 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.

## 7.2.4 Setting the gas type

### Navigation path

→ *[Method]*

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

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

## 7.2.5 Setting the shelf loading temperature

### Navigation path

→ *[Method]*

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

## 7.2.6 Setting the steps of a method

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



### NOTE

The maximum heating rate is 3 °C/min.



### NOTE

The settings for the action steps affect a single step in each case.

### Navigation path

→ *[Method]*

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

The following settings are available for each step:

| Setting                    | Option                              | Meaning  |
|----------------------------|-------------------------------------|--|
| <i>[Step phase]</i>        | Primary drying/<br>Secondary drying | Sets the type of step phase.                             |
| <i>[Term]</i>              | Enter value                         | Sets the duration of the step in minutes.                |
| <i>[Shelf temperature]</i> | Enter value                         | Set the temperature of the heatable shelves in one step. |

| Setting             | Option            | Meaning  |
|---------------------|-------------------|--|
| [Pressure zone]     | Regulated/Minimum | Regulated: the settings for pressure and pressure limits are applied.<br><br>Minimum: The maximum vacuum is applied to reach the lowest possible pressure. |
| [Pressure]          | Enter value       | Sets a target value for the regulated pressure.  |
| [Pressure limit]    | Enter value       | Absolute value for divergence from the set pressure before the sample protection function is activated.  |
| [Pressure duration] | Enter value       | Sets the period of time that the pressure is allowed to exceed the pressure limit before the sample protection function is activated.                      |

### Editing a step

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

### Add step

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

### Delete step

- ▶ Use the function *[Right]* or *[Left]* on the function bar to navigate to the step that you wish to delete.
  - ▶ Tap the function *[Delete]* on the function bar.
  - ▶ When asked to confirm, press *[OK]*.
- ⇒ The step is deleted.

## 7.2.7 Setting the phases of a method



### NOTE

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

### Navigation path

→ *[Method]*

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

The following phases of a method are available:

| Phase                  | Setting           | Option   | Meaning  |
|------------------------|-------------------|--|--|
| [Primary drying]       | [Pressure action] | None/Sample protection/<br>Message   | None: no action is carried out.  |
|                        |                   |  | Sample protection: if the pressure is too high, heating of the shelves is paused.    |
|                        |                   |  | Message: if the pressure is too high, the control panel displays a message.          |
|                        | [Temp. action]    | None/Sample protection/<br>Message   | None: no action is carried out.  |
|                        |                   |  | Sample protection: if the temperature is too high, heating of the shelves is paused. |
|                        |                   |  | Message: if the temperature is too high, the control panel displays a message.       |
| [Safety temperature]   | Enter value       | Maximum divergence from the set collapse temperature before the sample protection function is activated.           |  |
| [Safety temp. Time]    | Enter value       | Time as of which sample protection is inactive. The value relates to the time before completion of primary drying. |  |
| [End point definition] | More settings     | See Chapter 7.4 “Setting end point definitions”, page 48   |  |
| [Secondary drying]     | [Pressure action] | None/Sample protection/<br>Message   | None: no action is carried out.  |
|                        |                   |  | Sample protection: if the pressure is too high, heating of the shelves is paused.    |
|                        |                   |  | Message: if the pressure is too high, the control panel displays a message.          |
|                        | [Temp. action]    | None/Sample protection/<br>Message   | None: no action is carried out.  |
|                        |                   |  | Sample protection: if the temperature is too high, heating of the shelves is paused. |
|                        |                   |  | Message: if the temperature is too high, the control panel displays a message.       |
| [Safety temperature]   | Enter value       | Maximum divergence from the set shelf temperature before the sample protection function is activated.              |  |
| [End point definition] | More settings     | See Chapter 7.4 “Setting end point definitions”, page 48   |  |

| Phase               | Setting                    | Option                | Meaning  |
|---------------------|----------------------------|-----------------------|--|
| <i>[Stoppering]</i> | <i>[Pressure zone]</i>     | Regulated/<br>Minimum | Regulated: the settings for pressure and pressure limits are applied.<br><br>Minimum: The maximum vacuum is applied to reach the lowest possible pressure. |
|                     | <i>[Pressure]</i>          | Enter value           | Sets a target value for the regulated pressure.  |
|                     | <i>[&amp;Mode]</i>         | None/Manual           | None: no action is carried out.<br><br>Manual: sealing is performed manually.  |
| <i>[hold]</i>       | <i>[Pressure zone]</i>     | Regulated/<br>Minimum | Regulated: the settings for pressure are applied.<br><br>Minimum: The maximum vacuum is applied to reach the lowest possible pressure.                     |
|                     | <i>[Pressure]</i>          | Enter value           | Sets a target value for the regulated pressure.  |
|                     | <i>[Shelf temperature]</i> | Enter value           | Specifies a temperature for the shelves.   |

### Editing the settings for a phase

- ▶ Tap the phase that you wish to edit.
  - ⇒ The control panel highlights the selected phase in green.
- ▶ Tap the setting that you wish to edit.
- ▶ Edit the setting as required.
- ▶ Tap the function *[Save]* on the function bar.
  - ⇒ The setting is changed.

## 7.3 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.

## 7.4 Setting end point definitions

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

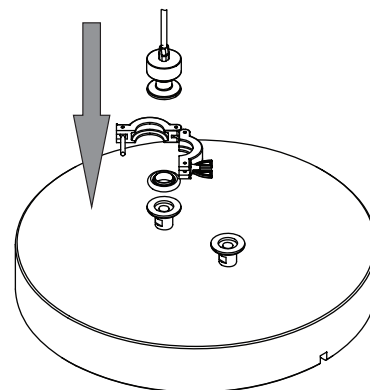
The end point can be defined by means of the temperature difference test or the pressure difference test.



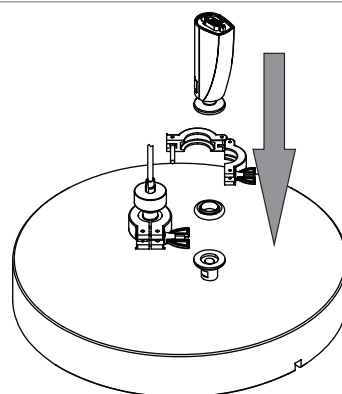
## 7.4.1 Performing a pressure difference test (option)

### Connecting the sensors for pressure difference test

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



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



For manifold drying rack:

- ▶ Fit the manifold drying rack onto the sensor.

### Performing a pressure difference test for drying chamber



#### NOTE

The pressure difference test can only be carried out with a pressure difference test kit. See Chapter 11.1.1 “Accessories”, page 88.

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

#### Navigation path

→ *[Method]*

Precondition:

- ☒ A vacuum test has been carried out with a pressure equal to the pressure during the subsequent freeze-drying process. See Chapter 8.14 “Performing a vacuum test”, page 77
- ☒ The sensors for the pressure difference test have been fitted. See Chapter “Connecting the sensors for pressure difference test”, page 49
- ☒ The offset value has been determined. See Chapter 7.4.3 “Determining offset value”, page 52
- ▶ 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>                | Enter value | Sets the time from which the pressure difference test is to be performed. The value relates to the time before completion of the primary drying phase.  |
| <i>[Pressure difference limit]</i> | Enter value | Specifies the difference between the two sensor readings below which the end point is reached.<br><br>The threshold must be greater than the offset value from the vacuum test. See Chapter 7.4.3 “Determining offset value”, page 52 |
| <i>[Term]</i>                      | Enter 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.<br><br>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.   |

## 7.4.2 Performing a pressure difference test for manifold drying rack (option)



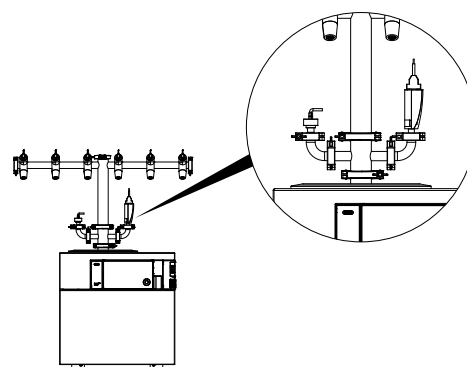
### NOTE

The pressure difference test can only be carried out with a pressure difference test kit. See Chapter 11.1.1 “Accessories”, page 88.

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.

## Connecting the sensors for a pressure difference test

- Fit the manifold drying rack onto the sensor kit (order no. 11080770).



### Navigation path

→ [Configuration] → [End point definition]

The following settings are available:

| Setting                     | Option      | Explanation   |
|-----------------------------|-------------|---|
| [Pressure difference limit] | Enter value | Specifies the difference between the two sensor readings below which the end point is reached.<br><br>The threshold must be greater than the offset value from the vacuum test. See Chapter 7.4.3 "Determining offset value", page 52 |
| [Time]                      | Enter value | Specifies the length of time for which the pressure difference test is to be carried out.   |

Precondition:

- ☒ A vacuum test has been carried out with a pressure equal to the pressure during the subsequent freeze-drying process. See Chapter 8.14 "Performing a vacuum test", page 77
  - ☒ The sensors for the pressure difference test have been fitted. See "Connecting the sensors for a pressure difference test"
  - ☒ The offset value has been determined. See Chapter 7.4.3 "Determining offset value", page 52
  - ☒ All flasks have been attached to the manifold drying rack.
- Navigate to [End point definition] via the navigation path.
  - Tap [Pressure difference test].
  - Set up the pressure difference test as desired.
  - Tap [Start] to start the pressure difference test.

### 7.4.3 Determining offset value

#### Navigation path

→ *[Configuration]* → *[End point determination]* → *[Pressure difference test]*

- ▶ Navigate to the *[Pressure difference test]* via the navigation path.
- ⇒ The control unit shows the offset figure.

### 7.4.4 Performing a temperature difference test



#### NOTE

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

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

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

#### Navigation path

→ *[Method]*

Precondition:

- ☒ The heatable shelves are fitted in the rack. See Chapter 7.9 “Operating top-mount drying racks”, page 57
- ☒ The optional temperature sensor has been installed. See Chapter 7.9 “Operating top-mount drying racks”, page 57
- ▶ 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>                   | Enter value | Sets the time from which the temperature difference test is to be performed. The value relates to the time before completion of the primary drying phase. |
| <i>[Temperature difference limit]</i> | Enter value | Specifies the difference between the two sensor readings below which the end point is reached.  |

| Setting    | Option      | Explanation  |
|------------|-------------|--|
| [Term]     | Enter value | The period of time during which the difference is not to be exceeded. If the threshold is not exceeded for the full period of time, the temperature difference test is passed. |
| [Continue] | Yes/No      | Yes : the method switches to the next phase.<br>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.   |

## 7.5 Performing freeze-drying using a method (Pro unit only)

### 7.5.1 Preparing the instrument

Time required: approx. 30min



#### NOTE

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

#### Navigation path

→ [Start]

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

### 7.5.2 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.

### 7.5.3 Starting freeze-drying



#### CAUTION

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

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



#### NOTE

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

#### Navigation path

→ *[Start]*

#### If a gas is being used

Precondition:

- ☒ The instrument has been prepared.
- ☒ A method is selected.
- ▶ Fit a top-mount drying rack. See Chapter 7.9 “Operating top-mount drying racks”, page 57.
- ▶ Load the top-mount drying rack with frozen samples.
- ▶ Navigate to the *[Start]* menu via the navigation path.
- ▶ Tap the function *[Start]* on the function bar.
- ▶ Make sure that the specified gas is being used.
- ▶ Answer *YES* to the confirmation question.
  - ⇒ The freeze-drying process starts.
  - ⇒ The control panel shows the *Start* menu with a black background.
  - ⇒ The system carries out the selected method.

#### If a gas is not being used

Precondition:

- ☒ The instrument has been prepared.
- ☒ A method is selected.
- ▶ Fit a top-mount drying rack. See Chapter 7.9 “Operating top-mount drying racks”, page 57.
- ▶ Load the top-mount drying rack with frozen samples.
- ▶ Navigate to the *[Start]* menu via the navigation path.
- ▶ Tap the function *[Start]* on the function bar.
  - ⇒ The freeze-drying process starts.
  - ⇒ The control panel shows the *Start* menu with a black background.
  - ⇒ The system carries out the selected method.

### 7.5.4 Changing parameters while the process is running



#### NOTE

Coming step can be deleted.

- ▶ Select the step you wish to delete.
- ▶ Tap the *[Delete]* button on the function bar.

## 7.5.5 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.



### NOTE

Shutting down after ending freeze-drying

For instructions on how to shut down the instrument after freeze drying, see Chapter 7.6 “Shutting down the instrument”, page 55.

## 7.6 Shutting down the instrument

Time required: 50 min



### NOTICE

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

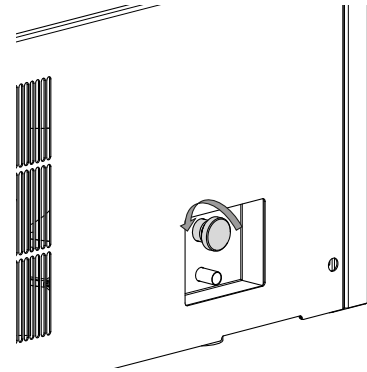
### Navigation path

→ [Start]

Precondition:

- ☑ The freeze-drying process has ended.
- ☑ No top mount drying rack is installed on the ice condenser.
- ☑ A container for draining is prepared.
- ☑ For instruments with ultimate vacuum control unit only: The vacuum pump is switched off.
- ▶ Navigate to the [Start] menu via the navigation path.
- ▶ Tap the function [Shut down] on the function bar.
  - ⇒ The instrument is shutting down.
  - ⇒ After the instrument has shut down, the status bar shows the remaining time and the status *Shutting down*.
- ▶ Wait until the ice is completely thawed.
- ▶ Place a container with sufficient capacity underneath the drain valve.

- ▶ Turn the adjusting knob counter clockwise to open the drain valve manually.
- ⇒ The liquids drain into the container
- ▶ Wait and make sure that the condensate drain tube is drained completely.
- ▶ Clean the ice condenser. See Chapter 8.11 “Cleaning the instrument”, page 76.
- ▶ Turn the adjusting knob counterclockwise to close the drain valve manually.



## 7.7 Defrosting the ice condenser coil by hot gas (optional)



### ⚠ CAUTION

**Health risk due to exposure to vapor or liquid solvents.**

- ▶ Keep an eye on defrosting progress inside the ice condenser chamber at any time.
- ▶ Avoid exposure to vapor.
- ▶ Avoid contact with the ice condenser materials containing liquid solvents at the end of the defrosting.

All operations and procedures in connection with the defrosting functionality of the instrument other than described in this chapter are not allowed and to be understood as misuse of the instrument.

Precondition:

- ☒ A fume hood or a sufficient air exhauster must be available to remove escaping vapors.
- ☒ Long defrosting periods must be avoided. Especially when aggressive solvents or acids are in the ice composition as these can lead to lifetime limitations because of corrosion or other material defects.
- ☒ The material stability of the drying chamber, seals, adapter plate and ice condenser exposed to liquid and vapor of defrosted solvents must be checked thoroughly to prevent long-term damage.
- ☒ Personal protection measurements like gloves, glasses and coat must be used while handling.
- ☒ The instrument is in standby mode.
- ▶ Remove the drying chamber.
- ▶ Place the drain hose in a solvent/acid resistant tank.
- ▶ Press defrosting icon to initiate the defrosting for 60 min.
- ▶ Visually check the ice quantity inside the condenser.
- ▶ Select feasible duration to avoid vapor development during defrosting.
- ▶ Pre-extend the defrosting time by additional 30 min by pressing the **[+30 MIN]** button.
- ⇒ The maximum extension is 8 x 30 min = 240 min (total of 300 min).
- ▶ Reduce the defrosting time by 30 min by pressing the **[-30 MIN]** button.
- ▶ If corrosive liquids are used in the ice condenser, open the drain valve during defrosting to release defrost water continuously.
- ▶ Interrupt the process at any time with the **[STOP]** button.
- ▶ Open the drain valve to release defrost liquid entirely.
- ▶ Wipe down the ice condenser and instrument to remove residual moisture.



## 7.8 Switching off the instrument

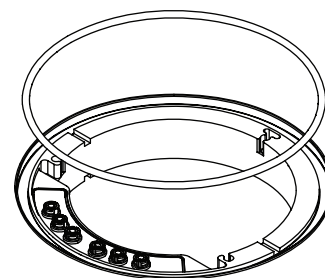
Precondition:

- ☑ The instrument has been shut down. See Chapter 7.6 “Shutting down the instrument”, page 55.
- ▶ Switch the On/Off master switch to Off.

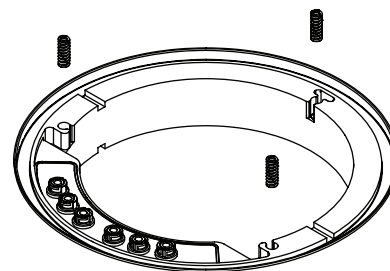
## 7.9 Operating top-mount drying racks

### 7.9.1 Operating stoppering acrylic drying chamber (heatable shelves)

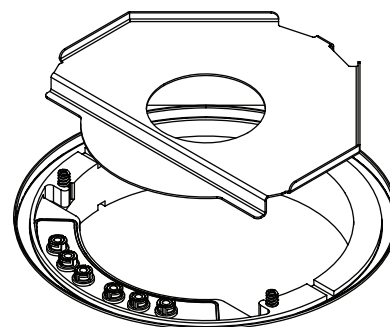
- ▶ Make sure that the groove above the ice condenser is clean, free of dust and not scratched.
- ▶ Check the 300 mm dia. O-ring for damage.
- ▶ Place the 300 mm dia. O-ring in the groove above the ice condenser.



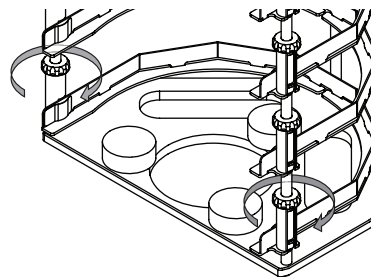
- ▶ Locate the springs in the holes on the ice condenser.



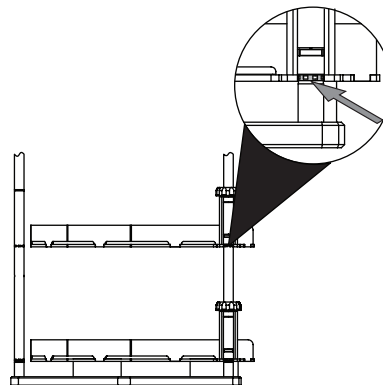
- ▶ Place the intermediate plate on the ice condenser.



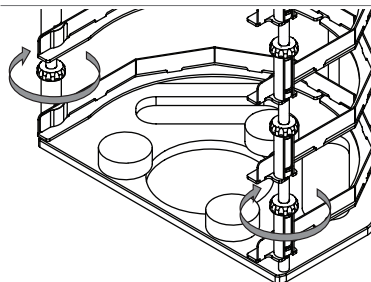
- Loosen all fixing screws.



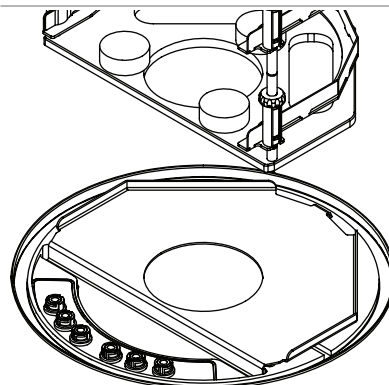
- Align the slots for the shelves.



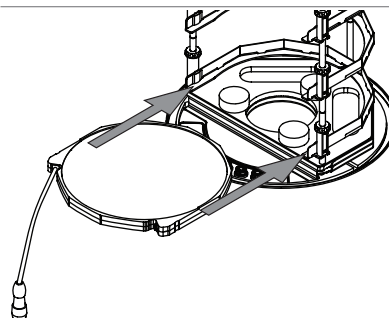
- Tighten the fixing screws.



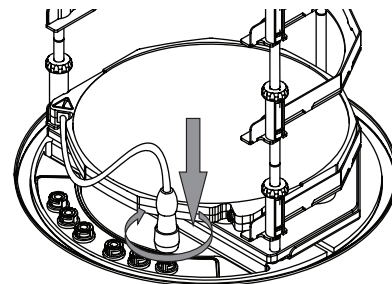
- Place the rack on the intermediate plate.



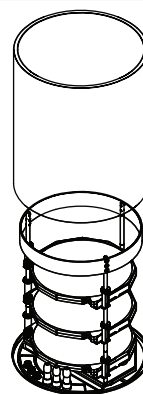
- Slide the shelves into the rack.



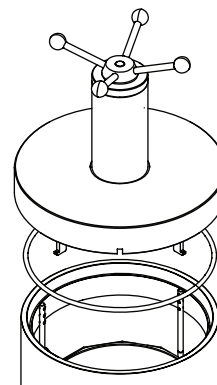
- ▶ Press the plug onto the shelf connection and turn the ring counterclockwise at the same time.



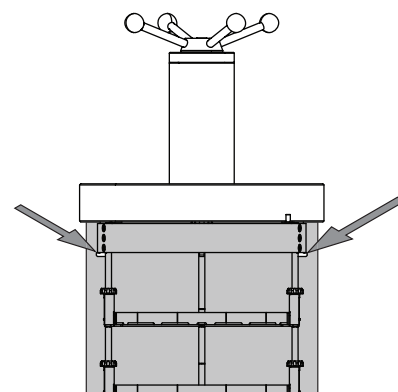
- ▶ Repeat the previous steps for additional shelves.
- ▶ Locate the cylinder in the groove above the main plate.



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



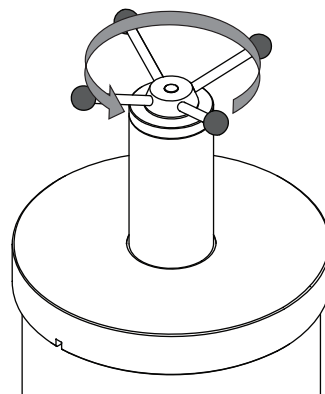
- ▶ Make sure that the hooks on the rack are engaged.



- ▶ Carry out freeze-drying.

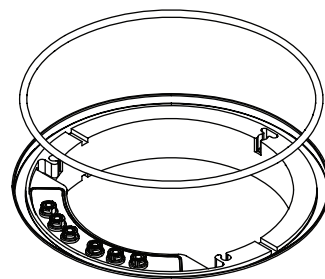
Precondition:

- ☑ The status bar shows the status *Stoppering*.
- ▶ Turn the hand wheel, until all samples are sealed.
- ▶ Confirm the verification question on the control panel.

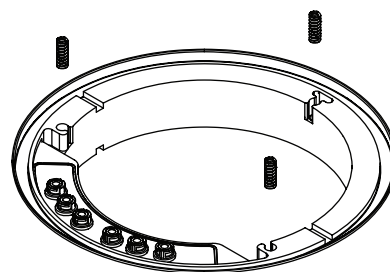


### 7.9.2 Operating stoppering acrylic drying chamber (non-heatable shelves)

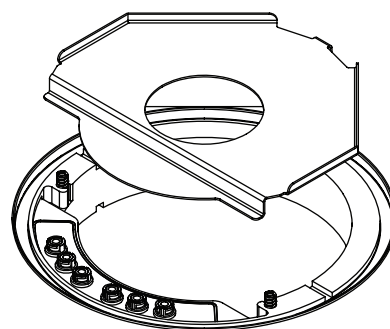
- ▶ Make sure that the groove above the ice condenser is clean, free of dust and not scratched.
- ▶ Check the 300 mm dia. O-ring for damage.
- ▶ Place the 300 mm dia. O-ring in the groove above the ice condenser.



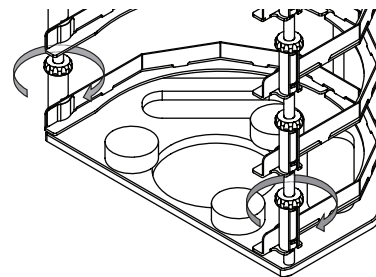
- ▶ Locate the springs in the holes on the ice condenser.



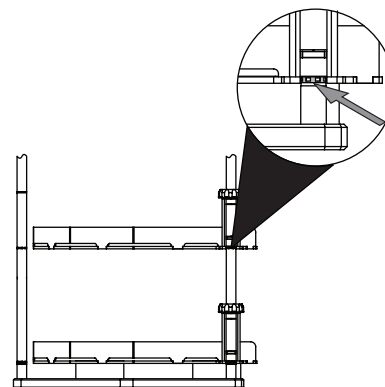
- ▶ Place the intermediate plate on the ice condenser.



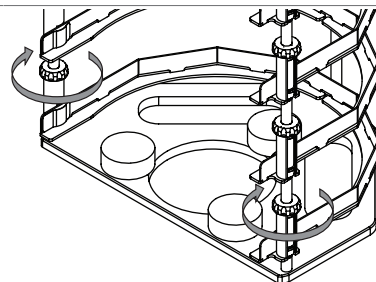
- Loosen all fixing screws.



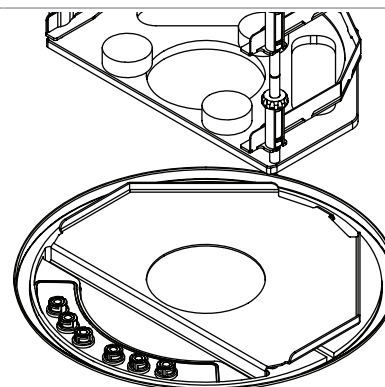
- Align the slots for the shelves.



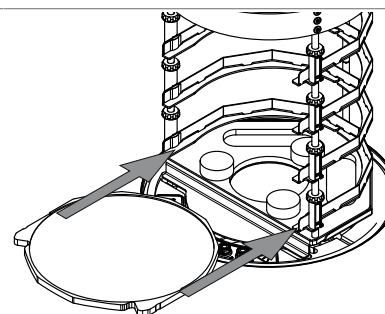
- Tighten the fixing screws.



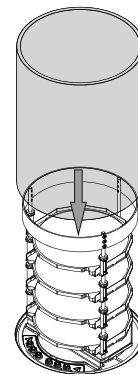
- Place the rack on the intermediate plate.



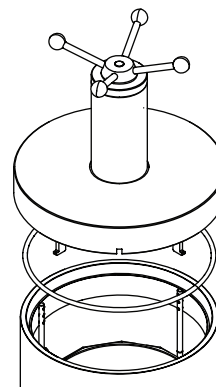
- Slide the shelves into the rack.



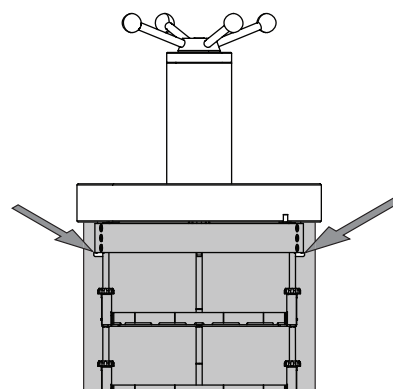
- Locate the cylinder in the groove above the main plate.



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



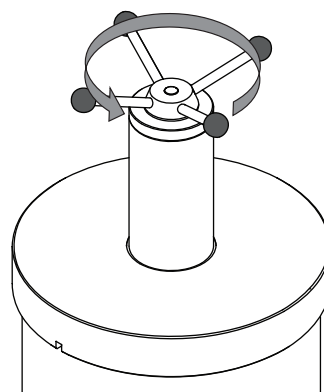
- Make sure that the hooks on the rack are engaged.



- Carry out freeze-drying.

Precondition:

- ☒ The status bar shows the status *Stoppering*.
- Turn the hand wheel, until all samples are sealed.
- Confirm the verification question on the control panel.



### 7.9.3 Determining the number of flasks for manifold drying chamber and rack


**NOTE**

Do not overfill flasks.

Maximum volume of the samples  $\leq$  half of the flask volume.


**NOTE**

Determine the number of flasks used individually for every process.


**NOTE**

The total volume of removing solvents should not exceed the ice capacity.

Maintain the pressure for a proper sublimation.

The number of flasks used is dependent on the following factors:

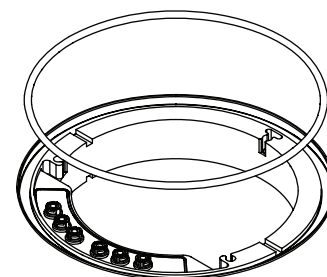
- The volume of the flask
- The method of freezing
- The concentration of the sample
- The composition of the solvent

Number of flasks using water as an example:

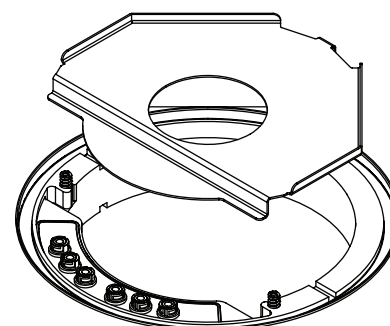
|                   | Flask volume 1000 mL | Flask volume 500 mL |
|-------------------|----------------------|---------------------|
| Rotating freezing | Max. 12 flasks       | Max. 24 flasks      |

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

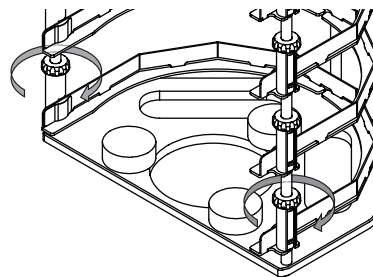
- ▶ Make sure that the groove above the ice condenser is clean, free of dust and not scratched.
- ▶ Check the 300 mm dia. O-ring for damage.
- ▶ Place the 300 mm dia. O-ring in the groove above the ice condenser.



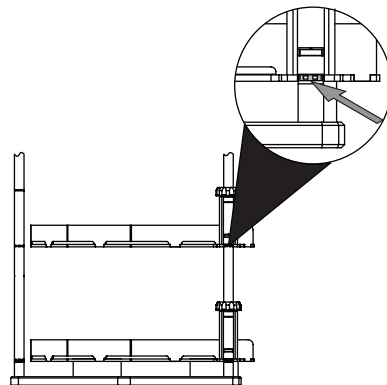
- ▶ Place the intermediate plate on the ice condenser.



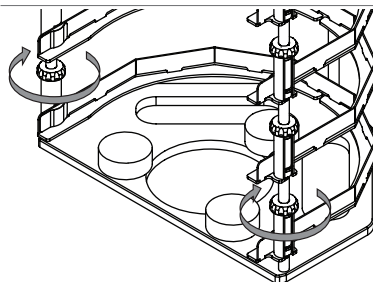
- Loosen all fixing screws.



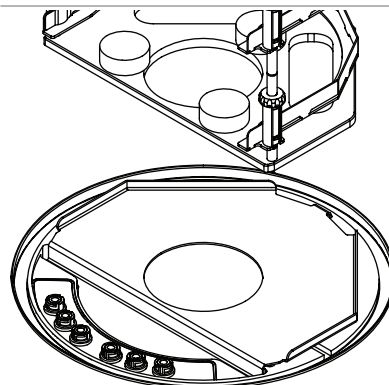
- Align the slots for the shelves.



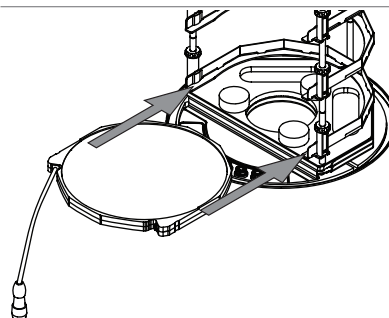
- Tighten the fixing screws.



- Place the rack on the intermediate plate.

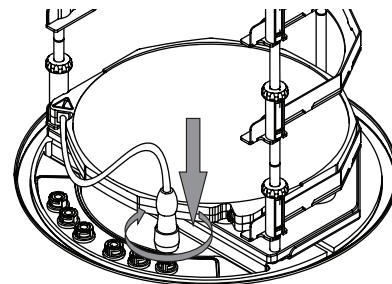


- Slide the shelves into the rack.



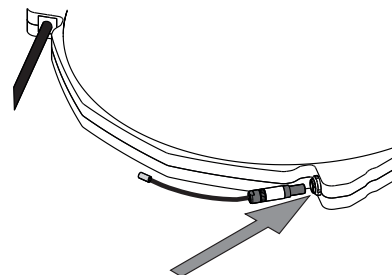


- ▶ Press the plug onto the shelf connection and turn the ring counterclockwise at the same time.

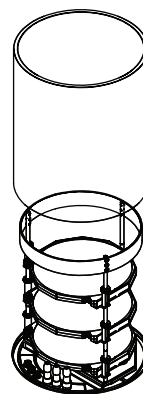


(option)

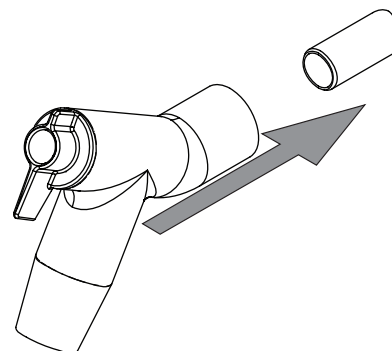
- ▶ Turn the temperature sensor electrical connector so that the marks on the connector and the heatable shelf are parallel
- ▶ Press the temperature sensor electrical connector onto the connection.



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



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

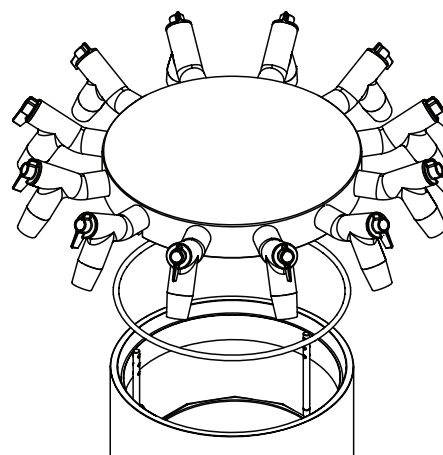


#### NOTE

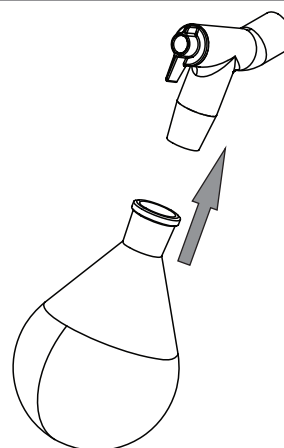
Optionally, add a filter paper set (order no. 11067334, 11066144) to the manifold adapter.

For certain applications, the use of a filter paper set is recommended to prevent cross-contamination or blockage.

- ▶ Check the O-ring for damage.
- ▶ Place the O-ring into the groove of the cover.
- ▶ Place the manifold cover on the cylinder.



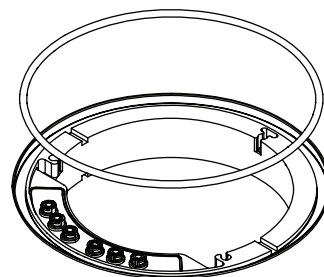
Load samples. See Determining the number of flasks for manifold drying chamber and rack.



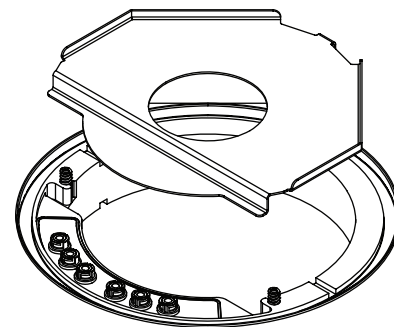
- ▶ Carry out freeze-drying.

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

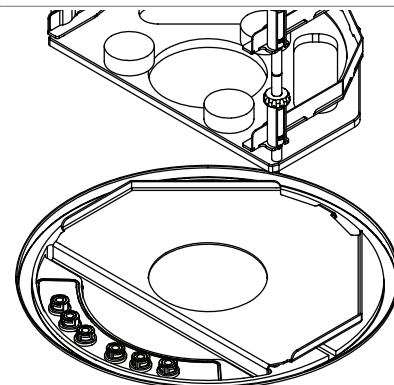
- ▶ Make sure that the groove above the ice condenser is clean, free of dust and not scratched.
- ▶ Check the 300 mm dia. O-ring for damage.
- ▶ Place the 300 mm dia. O-ring in the groove above the ice condenser.



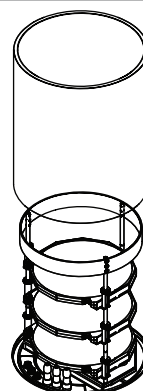
- Place the intermediate plate on the ice condenser.



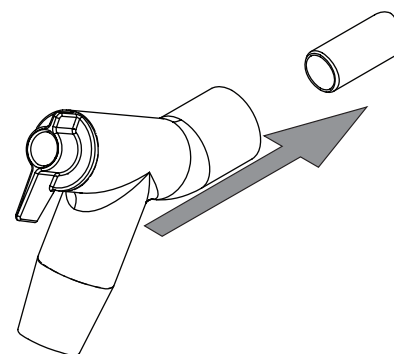
- Place the rack on the intermediate plate.



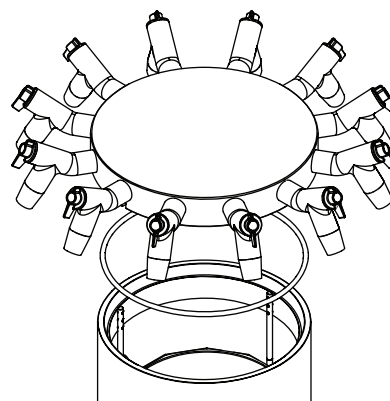
- Locate the cylinder in the groove above the main plate.



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



- ▶ Check the O-ring for damage.
- ▶ Place the O-ring into the groove of the cover.
- ▶ Place the manifold cover on the cylinder.

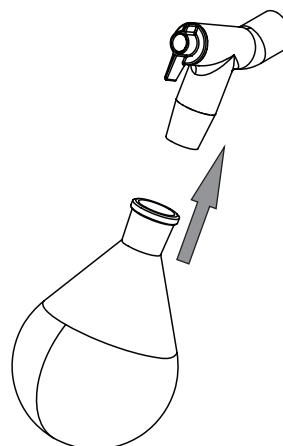


#### NOTE

Optionally, add a filter paper set (order no. 11067334, 11066144) to the manifold adapter.

For certain applications, the use of a filter paper set is recommended to prevent cross-contamination or blockage.

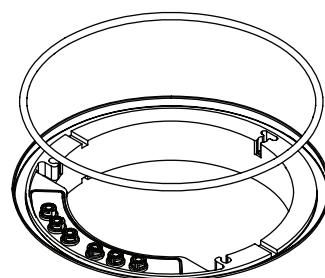
Load samples. See Determining the number of flasks for manifold drying chamber and rack.



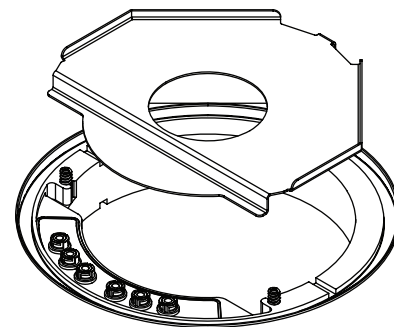
- ▶ Carry out freeze-drying.

### 7.9.6 Operating acrylic drying chamber (heatable shelf)

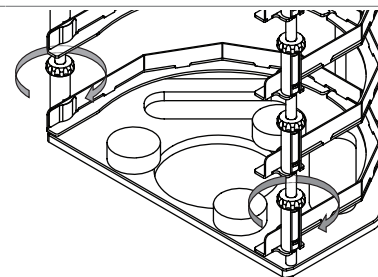
- ▶ Make sure that the groove above the ice condenser is clean, free of dust and not scratched.
- ▶ Check the 300 mm dia. O-ring for damage.
- ▶ Place the 300 mm dia. O-ring in the groove above the ice condenser.



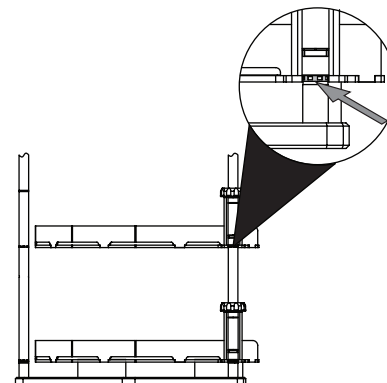
- Place the intermediate plate on the ice condenser.



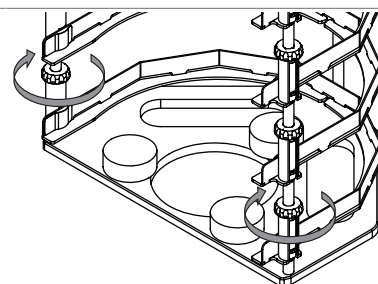
- Loosen all fixing screws.



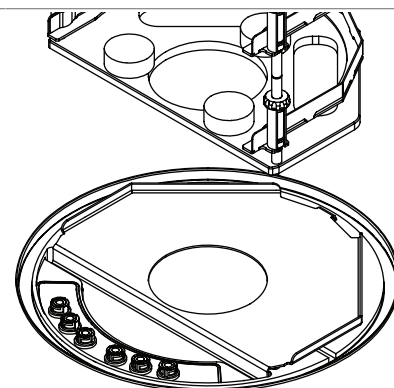
- Align the slots for the shelves.



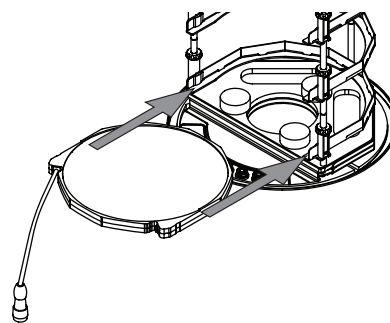
- Tighten the fixing screws.



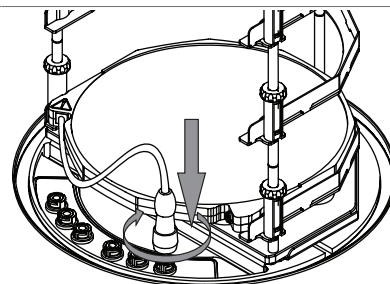
- Place the rack on the intermediate plate.



- Slide the shelves into the rack.

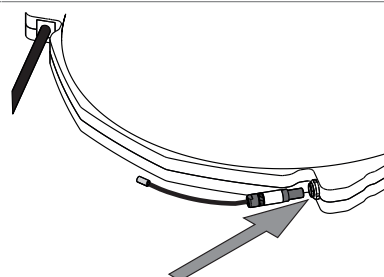


- Press the plug onto the shelf connection and turn the ring counterclockwise at the same time.

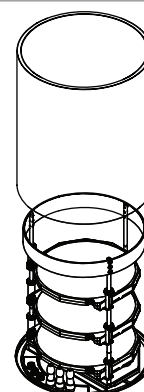


(option)

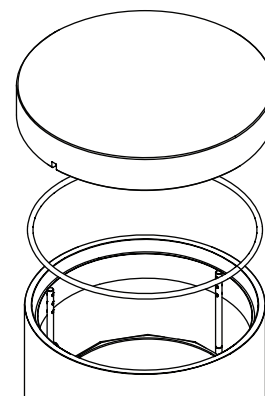
- Turn the temperature sensor electrical connector so that the marks on the connector and the heatable shelf are parallel
- Press the temperature sensor electrical connector onto the connection.



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



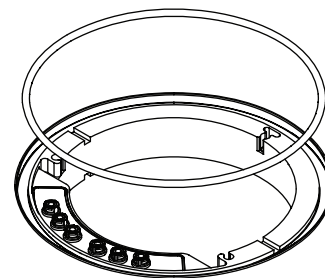
- Check the O-ring for damage.
- Place the O-ring into the groove of the cover.
- Place the cover on the cylinder.



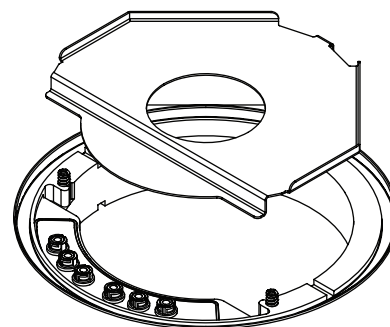
- Carry out freeze-drying.

### 7.9.7 Operating acrylic drying chamber (non-heatable shelf)

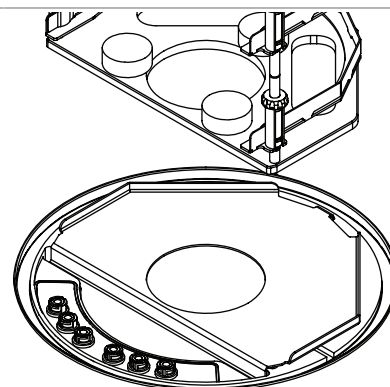
- ▶ Make sure that the groove above the ice condenser is clean, free of dust and not scratched.
- ▶ Check the 300 mm dia. O-ring for damage.
- ▶ Place the 300 mm dia. O-ring in the groove above the ice condenser.



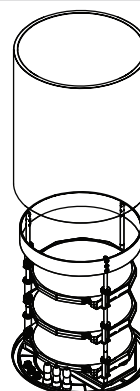
- ▶ Place the intermediate plate on the ice condenser.



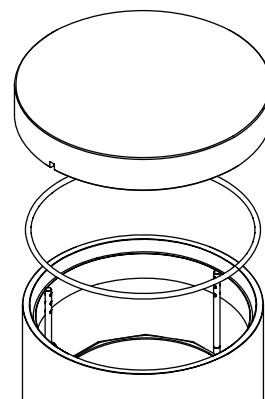
- ▶ Place the rack on the intermediate plate.



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



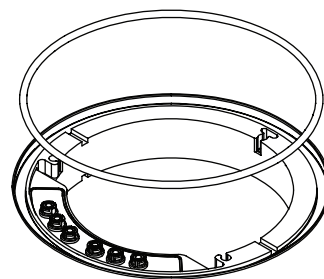
- ▶ Check the O-ring for damage.
- ▶ Place the O-ring into the groove of the cover.
- ▶ Place the cover on the cylinder.



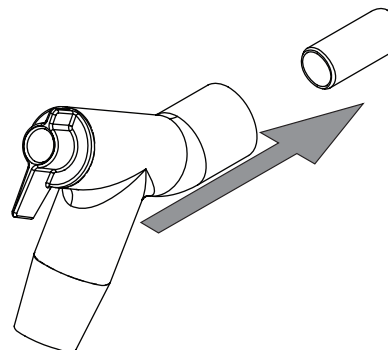
- ▶ Carry out freeze-drying.

### 7.9.8 Operating manifold drying rack

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



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



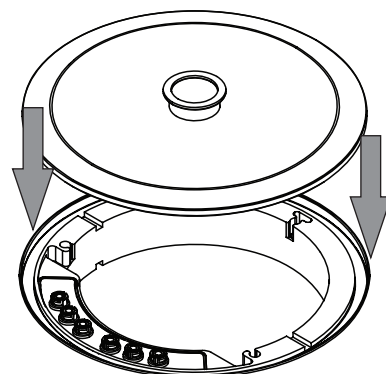
#### NOTE

Optionally, add a filter paper set (order no. 11067334, 11066144) to the manifold adapter.

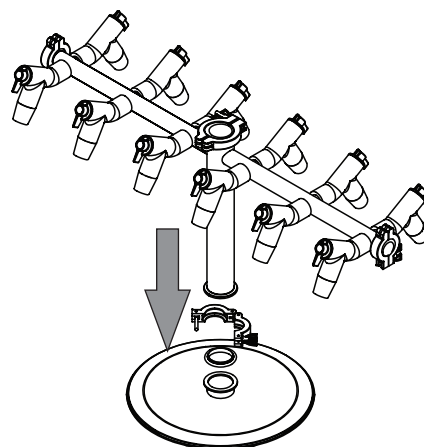
For certain applications, the use of a filter paper set is recommended to prevent cross-contamination or blockage.



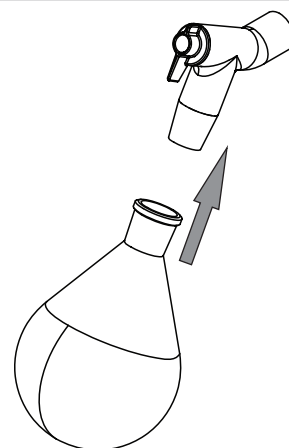
- Place the base plate on the ice condenser.



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



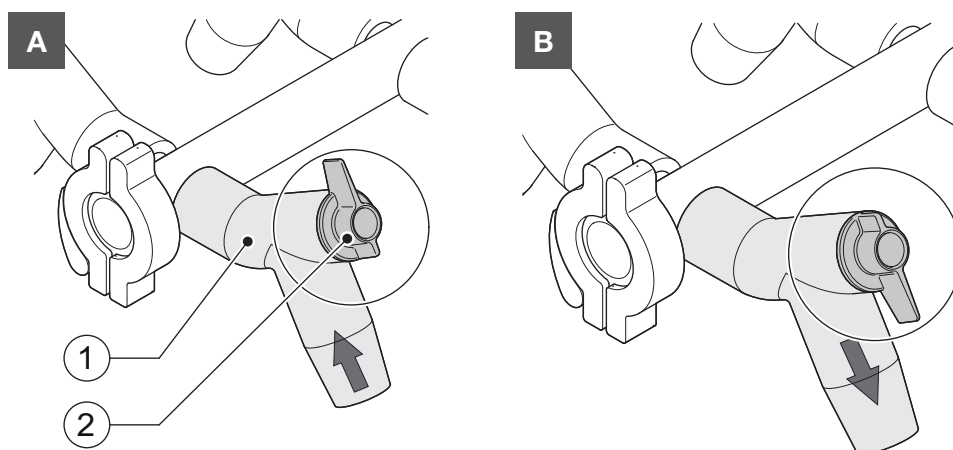
Load samples. See Determining the number of flasks for manifold drying chamber and rack.



- Carry out freeze-drying.

### 7.9.9 Operating manifold valves

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



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

## 8 Cleaning and servicing



### NOTE

- ▶ Carry out only the service and cleaning operations described in this section.
- ▶ Do not carry out any servicing and cleaning operations that involve opening the housing.
- ▶ Use only genuine BÜCHI spare parts in order to ensure correct operation and preserve the warranty.
- ▶ Carry out the service and cleaning operations described in this section to extend the lifetime of the instrument.

### 8.1 Maintenance work

| Action |  | Daily | Weekly | Monthly | Yearly | Additional information |
|--------|--|-------|--------|---------|--------|------------------------|
| 8.2    | Cleaning the 300 mm O-rings                              | 1     |        |         |        |                        |
| 8.3    | Cleaning the top-mount drying racks                      | 1     |        |         |        |                        |
| 8.9    | Checking and replacing glassware components              | 1     |        |         |        |                        |
| 8.4    | Cleaning the housing                                     |       | 1      |         |        |                        |
| 8.5    | Cleaning and servicing the warning and directive symbols |       | 1      |         |        |                        |
| 8.6    | Cleaning the drain valve rotary knob                     |       | 1      |         |        |                        |
| 8.7    | Cleaning the ventilation slots                           |       |        | 1       |        |                        |
| 8.8    | Cleaning the drain valve membrane                        |       |        | 1       |        |                        |
| 8.11   | Cleaning the instrument                                  |       |        | 1       |        |                        |
| 8.12   | Cleaning the vacuum tube                                 |       |        |         | 1      |                        |
| 8.13   | Cleaning the KF seals                                    |       |        |         | 1      |                        |

1 - Operator

### 8.2 Cleaning the 300 mm O-rings

- ▶ Wipe down the 300 mm O-rings with a damp cloth.
- ▶ Check for scratches and other damage.
- ▶ If damaged, replace the 300 mm O-rings.

### 8.3 Cleaning the top-mount drying racks

- ▶ Wipe down the top-mount drying racks with a damp cloth.
- ▶ If heavily soiled, use a mild detergent.

### 8.4 Cleaning the housing

- ▶ Wipe down the housing with a damp cloth.
- ▶ If heavily soiled, use ethanol or a mild detergent.

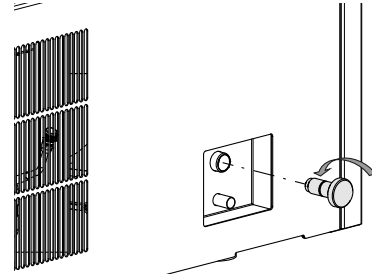
- ▶ Wipe down the display with a damp cloth.

## 8.5 Cleaning and servicing the warning and directive symbols

- ▶ Check that the warning symbols on the instrument are legible.
- ▶ If they are dirty, clean them with a damp cloth.

## 8.6 Cleaning the drain valve rotary knob

- ▶ Turn the rotary knob anti-clockwise until it can be removed from the instrument.



- ▶ Clean the rotary knob.
- ▶ Check the O-ring.
- ▶ Attach the rotary knob back on the instrument.

For applications containing alcohols and aggressive chemicals FFKM O-ring, spare part number 041639, should be used.

## 8.7 Cleaning the ventilation slots

- ▶ Remove dust and foreign objects from the ventilation slots using compressed air or a vacuum cleaner.

## 8.8 Cleaning the drain valve membrane

- ▶ Remove the drain valve from the instrument.
- ▶ Clean the drain valve with a mild detergent.
- ▶ Check the sealings for damages.
- ▶ If any damages are visible, replace the sealings.
- ▶ Attach the drain valve back on the instrument.

## 8.9 Checking and replacing glassware components

- ▶ Check glassware components for damages before each use.
- ▶ Do not use glassware components that show any signs of damage.
- ▶ Immediately replace glassware components that show any signs of damage.
- ▶ Periodically replace glassware components.

## 8.10 Servicing the vacuum pump

- ▶ Carry out the maintenance according to the pump manufacturer's instructions. See relevant documentation.

## 8.11 Cleaning the instrument

- ▶ Do not spray or pour liquid on the instrument.
- ▶ Wipe down the instrument with a damp cloth.

## 8.12 Cleaning the vacuum tube

- ▶ Wipe down the vacuum tube with a damp cloth.
- ▶ Check the vacuum tube for scratches and other damage.
- ▶ If the vacuum tube is damaged, replace it.

## 8.13 Cleaning the KF seals

The following KF seals are located on the instrument:

- Seals ISO-KF 16
- Seals ISO-KF 25
- ▶ Wipe down the KF seals with a damp cloth.
- ▶ Check the KF seals for scratches and other damage.
- ▶ If the KF seals are damaged, replace them.

## 8.14 Performing a vacuum test



### NOTE

This procedure can only be performed with the advanced vacuum control unit.

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

Time required: max. 10 min

### Navigation path

→ [Configuration] → [Servicing] → [Vacuum test]

Precondition:

- ☒ Conditioning of the instrument has been completed.
- ☒ A top-mount drying rack is fitted.
- ☒ The top-mount drying rack does not contain sample.
- ▶ Navigate to the action *[Vacuum Test]* via the navigation path.
- ▶ Specify a required setting for the vacuum to be achieved.
- ▶ Specify a required time within which the vacuum is to be reached.
- ▶ Tap the function *[Start]* on the function bar.
- ⇒ The vacuum test starts.
- ⇒ The status bar shows the status *Vacuum Test*.
- ⇒ If the vacuum pressure is not below 500 mbar after 30 s, the vacuum test automatically aborts.
- ⇒ After completion of the vacuum test, the *[Vacuum test]* line shows whether the vacuum test has been passed or not.

### Troubleshooting after failed vacuum test

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

## 8.15 Performing a leak test



### NOTE

This procedure can only be performed with the advanced vacuum control unit.

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

The leak test checks the vacuum system for possible leaks.

Time required: 45 min



### NOTE

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

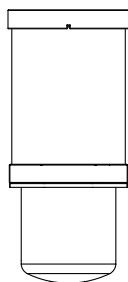
#### Navigation path

→ *[Configuration]* → *[Servicing]* → *[Leak test]*

Precondition:

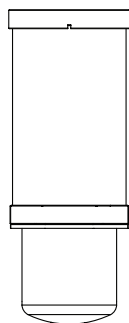
- ☒ Conditioning of the instrument has been completed.
- ☒ A top-mount drying rack is fitted.
- ☒ The top-mount drying rack does not contain sample.
- Navigate to the action *[Leak test]* via the navigation path.
- On the *[Ice Condenser]* line, enter a required setting for the vacuum.
- On the *[Shelf temperature]* line enter the required shelf temperature.
- On the *[Test scope]* line select the component to be tested.
- On the *[Drying shelf heating]* line switch the drying shelf heating on or off.
- On the *[Volume]* line enter the actual volume of the components to be tested.

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



36.46L

Acrylic drying chamber  
(with 4 drying shelves)



43.41L

Acrylic drying chamber  
(with 6 drying shelves)

- Tap the function *[Start]* on the function bar.
  - ⇒ The leak test starts.
  - ⇒ The status bar shows the status *Leak Test*.
  - ⇒ After completion of the leak test, the *[Leak test]* line shows whether the leak test has been passed or not.
  - ⇒ The leak test is passed if the measured leakage rate is less than the pre-set rate of 10.10 mbar\*L/h.

## Troubleshooting after failed leak test

| Possible cause  | Action   |
|---|--|
| Top-mount drying rack not correctly fitted                        | Fit the top-mount drying rack correctly.   |
| O-rings dirty   | Wipe down the O-ring with a damp cloth.  |
| O-rings damaged   | Check O-rings and replace if necessary.  |
| Groove of O-rings dirty   | Wipe groove of O-rings with a damp cloth.  |
| KF clamps not closed  | Close the KF clamps.   |
| KF seals dirty  | Wipe down the KF seals with a damp cloth.  |
| KF seals damaged  | Inspect KF seals and replace as necessary.   |
| Pump oil dirty  | Service according to manufacturer's instructions.  |
| Leaking manifold valves<br>(manifold acrylic drying chamber only) | Replace leaking manifold valve.<br>Locate leaking manifold valve. See Chapter 9.3 "Locating leaking manifold valve", page 85 |

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

The leak test checks the vacuum system for possible leaks.

Time required: 45 min



#### NOTE

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

#### Navigation path

→ *[Configuration]* → *[Servicing]* → *[Leak test]*

Precondition:

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

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



13.64L

- ▶ Tap the function *[Start]* on the function bar.
  - ⇒ The leak test starts.
  - ⇒ The status bar shows the status *Leak Test*.
- ⇒ When the leak test is completed, the *[Leak test]* tab indicates whether the leak test was successful.
- ⇒ The leak test is passed if the measured leakage rate is less than the pre-set rate of 10.10 mbar\*L/h.

**NOTE**

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

**Troubleshooting after failed leak test**

| Possible cause  | Action   |
|---|--|
| Top-mount drying rack not correctly fitted                          | Fit the top-mount drying rack correctly.   |
| O-rings dirty   | Wipe down the O-ring with a damp cloth.  |
| O-rings damaged   | Check O-rings and replace if necessary.  |
| Groove of O-rings dirty   | Wipe groove of O-rings with a damp cloth.  |
| KF clamps not closed  | Close the KF clamps.   |
| KF seals dirty  | Wipe down the KF seals with a damp cloth.  |
| KF seals damaged  | Inspect KF seals and replace as necessary.   |
| Pump oil dirty  | Service according to manufacturer's instructions.  |
| Leaking manifold valves<br>(only if manifold drying rack installed) | Replace leaking manifold valve.<br>Locate leaking manifold valve. See Chapter 9.3 "Locating leaking manifold valve", page 85 |



## 9 Help with faults

### 9.1 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 instrument.  |
|  | Compressor overheated                           | ► Allow the compressor to cool down.<br>► Check ambient conditions.   |
|  | Circuit-breaker has tripped                     | ► Reset circuit of instrument.  |
| Cooling temperature is not achieved                | Wrong ambient conditions                        | Adjust ambient conditions. See Chapter 3.5 "Technical data", page 19.   |
|  | Too much ice in the ice condenser               | Defrost the ice condenser.  |
| System shuts down automatically                    | Major fluctuations in line power                | ► Connect instrument to an Uninterrupted Power Supply line.   |
| Instrument does not work                           | Instrument is not connected to the power supply | ► Make sure that the power supply is connected and switched on.   |
| Main valve or vacuum pump switches over frequently | Vacuum system is leaking.                       | ► If necessary, replace tubing and/or seals.  |
| Main valve does not switch over                    | Main valve fitted wrong way round               | ► Fit main valve correct way round (arrow pointing towards vacuum pump).  |
|  | Main valve lead not plugged in                  | ► Make sure that the electrical lead of the main valve is plugged into the correct socket on the rear of the instrument.  |
| Vacuum is not achieved                             | Vacuum system is leaking                        | ► Clean the drain valve.<br>► Check manifold valve. See Chapter 9.3 "Locating leaking manifold valve", page 85<br>► Check pressure regulation valve and aeration valve. See Chapter 9.4 "Finding a leaking regulation valve or aeration valve", page 85<br>► If necessary, replace tubing and/or seals. |
|  |   | ► Use a vacuum pump with a capacity of at least 5m <sup>3</sup> /h.<br>► Carry out maintenance work according to the vacuum pump manufacturer's documentation.  |

| Problem                  | Possible cause                      | Action   |
|--------------------------|-------------------------------------|--|
| Instrument is not vented | Main valve is incorrectly connected | ► Connect the main valve properly (see Chapter 5.4.2 “Fitting the advanced vacuum control unit”, page 26). |

## 9.2 Error messages

| Error message | Possible cause                                  | Solution   |
|---------------|---|--|
| 6040          | Shelf set temperature is too high.              | ► Choose lower shelf set temperature.  |
| 6041          | Shelf set temperature is too high.<br>Leakages. | ► Resolve any leakages.<br>► Choose lower shelf set temperature.   |
| 6042          | Power failure has occurred.                     | Recovery of the latest process parameters is started automatically.<br>► Check samples.<br>► Consider using a UPS.   |
| 6072          | Safety underpressure shutdown.                  | ► Start recovery procedure.<br>► Wait for one hour and start the conditioning without applying vacuum (pump off).  |
|               | Unit was not in use for a long period.          | ► Let the unit run at -85°C without vacuum for 2-3 hours.<br>► Let the unit run at -85°C with vacuum and attach samples as soon as possible.               |
| 6170          | High sample load.<br>High ambient temperature.  | ► Remove samples.<br>► Check ambient temperature.<br>► Check fan.<br>► Clean ventilation slot. If needed, exchange filter.                                 |
| 6171          | High sample load.<br>High ambient temperature.  | ► Remove samples.<br>► Check ambient temperature.<br>► Check fan.<br>► Clean ventilation slot. If needed, exchange filter.                                 |
| 6172          | Safety underpressure shutdown.                  | ► Start recovery procedure.<br>► Wait for one hour and start the conditioning without applying vacuum (pump off).  |
|               | Instrument was not in use for a long period.    | ► Let the instrument run at -85 °C without vacuum for 2-3 hours.<br>► Let the instrument run at -85 °C with vacuum and attach samples as soon as possible. |

| Error message | Possible cause  | Solution   |
|---------------|---|--|
| 6175          | Separator inlet temperature sensor is disconnected.         | ▶ Check cable connection.<br>▶ Measure sensor resistance.                |
|               | Defective component (e.g. sensor, cable, connector).        | ▶ Compare sensor resistance to PT-1000 table.                            |
| 6176          | Inlet temperature sensor on ice condenser is disconnected.  | ▶ Check cable connection.<br>▶ Measure sensor resistance.                |
|               | Defective component (e.g. sensor, cable, connector).        | ▶ Compare sensor resistance to PT-1000 table.                            |
| 6177          | Outlet temperature sensor on ice condenser is disconnected. | ▶ Check cable connection.<br>▶ Measure sensor resistance.                |
|               | Defective component (e.g. sensor, cable, connector).        | ▶ Compare sensor resistance to PT-1000 table.                            |
| 6179          | Compressor outlet temperature sensor is disconnected.       | ▶ Check cable and connectors.<br>▶ Connect a functioning sensor.         |
|               | Defective component (e.g. sensor, cable, connector).        | ▶ Replace sensor.  |
| 6187          | Stepper chip overtemperature.                               | ▶ Check cable and connector.<br>▶ Connect a functioning expansion valve. |
|               | Undervoltage or short circuit at motor coil.                | ▶ Replace the expansion valve.   |
| 6188          | Stepper chip overtemperature.                               | ▶ Check cable and connector.<br>▶ Connect a functioning expansion valve. |
|               | Undervoltage or short circuit at motor coil.                | ▶ Replace the expansion valve.   |
| 6189          | Fan is not rotating.  | ▶ Check cable and connectors.  |
|               | Fan is disconnected or blocked.                             | ▶ Check if the fan rotates manually.                                     |
|               | Defective component (e.g. cable, connector).                | ▶ Contact BUCHI Customer Service.  |
| 6190          | High pressure sensor is disconnected.                       | ▶ Check cable and connectors.<br>▶ Connect a functioning sensor.         |
|               | Defective component (e.g. sensor, cable, connector).        | ▶ Replace sensor.  |
| 6191          | Low pressure sensor is disconnected.                        | ▶ Check cable and connectors.<br>▶ Connect a functioning sensor.         |
|               | Defective component (e.g. sensor, cable, connector).        | ▶ Replace sensor.  |
| 6195          | High sample load.   | ▶ Remove samples   |
|               | High ambient temperature.                                   | ▶ Check ambient temperature.   |
|               | Low air flow.   | ▶ Check fan.   |
| 6196          | High sample load.   | ▶ Remove samples   |
|               | High ambient temperature.                                   | ▶ Check ambient temperature.   |
|               | Low air flow.   | ▶ Check fan.   |

| Error message | Possible cause   | Solution  |
|---------------|--|---|
| 6197          | Compressor has no power.<br>Compressor is damaged.<br>Cable is broken.                             | ► Contact BUCHI Customer Service.   |
| 6198          | Compressor error (voltage, motor or temperature error).  | ► Contact BUCHI Customer Service.   |
| 6272          | Main valve is defective.<br>Regulation valve is defective.   | ► Check if the regulation valve can be opened.<br>► Check if the regulation and aeration valve are swapped.<br>► Check if the valves are installed correctly. |
| 6273          | Leaks after new flask attachment. Regulation valve is not closed or not tight.                     | ► Stop flask attachment, until pressure is below target pressure.<br>► Check if the vacuum regulation valve is closed correctly.<br>► Check for any leakages. |
| 6274          | Vacuum cannot be reached within given timeout.   | ► Resolve any leaks.<br>► Check oil condition.<br>► Check electrical connection of pump and fuses.  |
| 6275          | Pressure of 500 mbar cannot be reached within 30 s.  | ► Resolve any leaks.  |
| 6278          | Pressure increases above level of 1.5 mbar during leak test.<br>Leaks, moisture in the instrument. | ► Resolve any leaks.<br>► Clean and dry ice condenser chamber.<br>► Clean O-rings.  |
| 6279          | Leak test result is above allowed limit.<br>Leaks, moisture in the instrument.                     | ► Resolve any leaks.<br>► Clean and dry ice condenser chamber.<br>► Clean O-rings.  |
| 6280          | Regulation valve is disconnected.<br>Defective component (e.g. cable, solenoid).                   | ► Check cable connection and solenoid condition.<br>► Remove all vacuum valves to operate instrument with ultimate vacuum system.                             |
| 6281          | Aeration valve is disconnected.<br>Defective component (e.g. cable, solenoid).                     | ► Check cable connection and solenoid condition.<br>► Remove all vacuum valves to operate instrument with ultimate vacuum system.                             |
| 6282          | Main valve is disconnected.<br>Defective component (e.g. cable, solenoid).                         | ► Check cable connection and solenoid condition.<br>► Remove all vacuum valves to operate instrument with ultimate vacuum system.                             |

| Error message | Possible cause   | Solution   |
|---------------|--|--|
| 6283          | Pressure sensor is disconnected.<br>Defective component (e.g. cable, sensor).            | ▶ Check cable connection.<br>▶ Check condition of pressure sensor.                                   |
| 6570          | Heatable shelf is disconnected.<br>Defective component (e.g. heating coil, cable, plug). | ▶ Connect a functioning shelf at the same connector position.<br>▶ Contact BUCHI Customer Service.   |
| 6571          | Sample temperature sensor is disconnected.<br>Defective component (e.g. cable, plug).    | ▶ Connect a functioning PT-1000 at the same connector position.<br>▶ Contact BUCHI Customer Service. |
| 6670          | Stoppering is disconnected.  | ▶ Check cable connection.<br>▶ Contact BUCHI Customer Service.                                       |

### 9.3 Locating leaking manifold valve

#### Navigation path

→ **[Start]**

Precondition:

☒ The system does not evacuate to less than 0.1 mbar.

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

### 9.4 Finding a leaking regulation valve or aeration valve

#### Navigation path

→ **[Start]**

Precondition:

☒ The instrument has been prepared.

- ▶ Remove regulation or aeration valve.
- ▶ Seal the opening with KF16 cover.
- ▶ Fit a top-mount drying rack. See Chapter 7.9 "Operating top-mount drying racks", page 57.
- ▶ Navigate to the **[Start]** menu via the navigation path.
- ▶ Tap the function **[Manual]** on the function bar.
- ▶ Enter the specified settings for the vacuum.
- ▶ Tap the function **[Start]** on the function bar.
  - ⇒ The background color of the *Start* menu changes from white to black.
  - ⇒ The status bar shows a clock counting up and the status *Manual Drying*.
  - ⇒ The system evacuates to the set pressure.
  - ⇒ If the specified setting is not reached, the valve is leaking.

- Carry out the instructions for action on the other valve.

## 10 Taking out of service and disposal

### 10.1 Taking out of service

- ▶ Switch off the instrument and disconnect it from the mains power supply.
- ▶ Remove all tubing and communication cables from the instrument.

### 10.2 Disposal

The operator is responsible for proper disposal of the instrument.

- ▶ When disposing the equipment observe the local regulations and statutory requirements regarding waste disposal.
- ▶ When disposing, observe the disposal regulations of the materials used. Materials used see Chapter 3.5 "Technical data", page 19.



#### NOTICE

##### Environmental hazard from flammable refrigerant

The refrigerant used to operate the instrument is flammable.

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

### 10.3 Returning the instrument

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

<https://www.buchi.com/support/contact>

## 11 Appendix

### 11.1 Spare parts and accessories

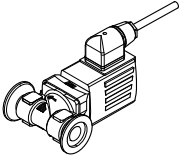
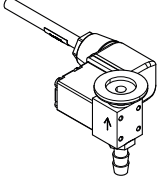
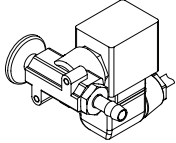
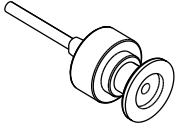


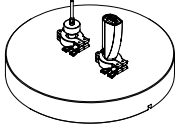
Use only genuine BUCHI consumables and spare parts in order to ensure correct, safe and reliable operation of the system.



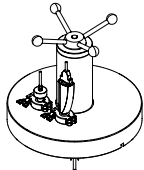
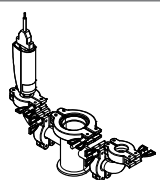
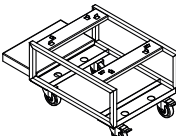
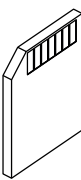
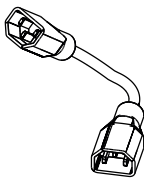
#### NOTE

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

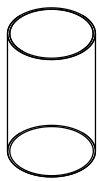
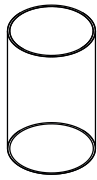
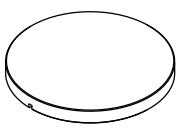
#### 11.1.1 Accessories

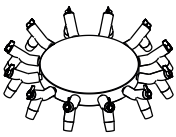
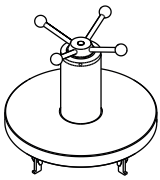
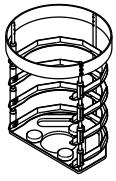
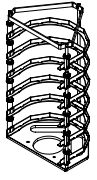

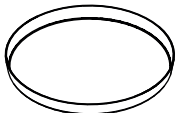
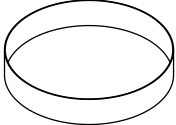
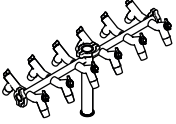
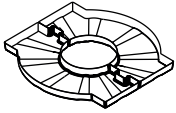
|   | Order no. | Image   |
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| Main valve  | 11076675  |    |
| Pressure regulation valve   | 11076679  |   |
| Aeration valve  | 11064724  |  |
| Pirani / Piezo pressure sensor  | 11062228  |  |
| Capacitive pressure sensor Inficon CDG 020 D  | 11062230  |  |
| PT1000 sample temperature sensor  | 11064031  |  |
| Set for pressure difference test<br>incl. extension cable for PPG011 and CDG 020D sensors, PMMA top cover, seals and clamps | 11067590  |  |

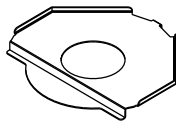
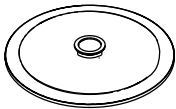
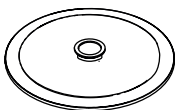
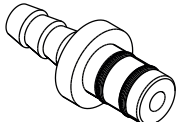
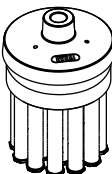


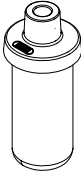



|   | Order no. | Image   |
|---|-----------|---|
| Set for pressure difference test<br>incl. extension cable of PPG011 and CDG 020D<br>sensors, stoppering top cover, seals and clamps | 11070102  |    |
| Set for pressure difference test<br>Only for manifold rack steel with 12 connections  | 11080770  |    |
| Trolley, stainless steel coated   | 11080440  |    |
| SD-Card 1 GB  | 11064730  |    |
| Connection cable, for vacuum pump   | 11064934  |  |
| Vacuum pump Edwards nXDS6iC   | 11068158  |   |
| Vacuum pump Edwards RV5   | 11084792  |   |

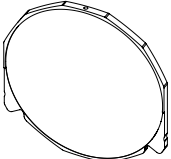
### 11.1.2 Top-mount drying rack accessories

|  | Order no. | Image   |
|--|-----------|---|
| Drying chamber tube, PMMA, for 4 shelves<br>L 368 mm, Ø 300 mm | 11063278  |  |
| Drying chamber tube, PMMA, for 6 shelves<br>L 480 mm, Ø 300 mm | 11065093  |  |
| Top cover, PMMA, without sealing<br>Ø 300 mm, H 50 mm          | 11062912  |  |


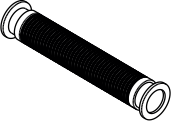
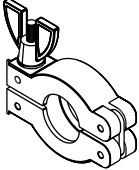
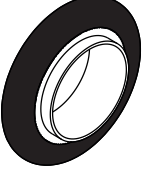
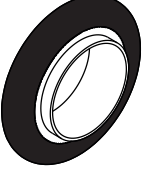
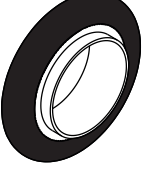
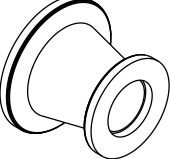
|  | Order no. | Image   |
|--|-----------|---|
| Top cover manifold, PMMA, with 12 valves,<br>without sealing<br>Ø 300 mm, W 546 mm, H 127 mm                                     | 11065595  |    |
| Top cover stoppering, without sealing<br>only for rack for 4 heatable and non- heatable<br>shelf<br>Ø 300 mm, H 330 mm, W 320 mm | 11064314  |    |
| Rack for 4 heatable shelves<br>H 356 mm, Ø 265 mm , shelf distance 30-75 mm  | 11065102  |    |
| Rack for 6 heatable shelves<br>H 468 mm, Ø 265 mm, shelf distance 30-75 mm   | 11065103  |   |
| Heatable shelf, aluminum coated, with<br>connection cable<br>Ø 219.5 mm, surface area 376 cm <sup>2</sup>                        | 11064095  |  |
| Sample tray, stainless steel<br>Ø 220 mm, H 18.5 mm  | 11061439  |  |
| Ferrule,<br>Ø 218 mm, H 40 mm  | 11065816  |  |
| Drying rack manifold, stainless steel, with 12<br>valves<br>H 340 mm, W 777 mm   | 11063664  |  |
| Drip pan, for manifold   | 11066358  |  |

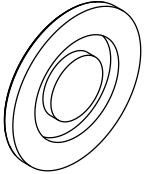
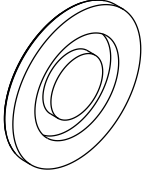
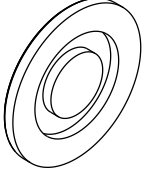
|   | Order no. | Image   |
|---|-----------|---|
| Support for rack, stainless steel<br>H 4 mm                                     | 11063789  |    |
| Baseplate, stainless steel, for manifold rack                                   | 11064953  |    |
| Baseplate, PMMA, for manifold rack  | 11065733  |    |
| Suction nipple<br>For manifold application to create vacuum in<br>sample flasks | 11065819  |    |
| Ampoule adapter for manifold<br>with 19 ampoule connections and cap adapter     | 11065725  |  |
| Manifold valve, EPDM/Silicone, with SJ 29/32                                    | 11062300  |  |
| Flask beaker for manifold 100 mL<br>with cap adapter and integrated filter      | 11066140  |  |
| Flask beaker for manifold 200 mL<br>with cap adapter and integrated filter      | 11066141  |  |
| Flask beaker for manifold 600 mL<br>with cap adapter and integrated filter      | 11066142  |  |

|  | Order no. | Image   |
|--|-----------|---|
| Flask beaker for manifold 800 mL<br>with cap adapter and integrated filter           | 11069474  |    |
| Flask beaker for manifold 1200 mL<br>with cap adapter and integrated filter          | 11066143  |    |
| Manifold flask adapter set<br>with 12 adapters, incl. filter paper                   | 11066144  |    |
| Manifold flask adapter set<br>with 6 adapters, incl. filter paper                    | 11067334  |    |
| Manifold flask adapter set, 24/40 joint size<br>with 12 adapters, incl. filter paper | 11066171  |  |
| Manifold flask adapter set, 24/40 joint size<br>with 6 adapters, incl. filter paper  | 11067333  |  |
| Filter round 20mm Set à 100pcs<br>Filter for manifold valve                          | 11065801  |  |
| Filter round 47mm Set à 100pcs<br>Beaker flasks with volume above 600 mL             | 11065731  |  |
| Filter round 30mm Set à 100pcs<br>Beaker flasks with volume below 600 mL             | 11065728  |  |

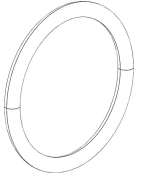
|                                 | Order no. | Image   |
|---------------------------------|-----------|---|
| Unheatable shelf for stoppering | 11079991  |  |

### 11.1.3 Spare parts

|  | Order no. | Image   |
|--|-----------|---|
| O-Ring Ø 300 mm  | 11065367  |    |
| Vacuum hose, KF 25, L 1000 mm                          | 11066031  |    |
| Vacuum clamp KF 16                                     | 11064939  |   |
| Vacuum seal KF 16                                      | 11063455  |  |
| Vacuum seal KF 25                                      | 11063457  |  |
| Vacuum seal KF 40                                      | 11063659  |  |
| Vacuum flange adapter, stainless steel, KF 16 to KF 25 | 11064870  |  |

|                    | Order no. | Image   |
|--------------------|-----------|---|
| Blind flange KF 16 | 11064902  |  |
| Blind flange KF 25 | 11063660  |  |
| Blind flange KF 40 | 11063661  |  |

#### 11.1.4 Wear parts

|  | Order no. | Image   |
|--|-----------|---|
| Mineral oil 1 L vacuum pump Pfeiffer DUO 6   | 11065664  |   |
| Tip seal kit for vacuum pump Edwards nXDS6iC | 11069617  |   |
| Seals for drain valve, PTFE                  | 11081336  |  |

#### 11.1.5 Software

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

#### 11.1.6 IQ/OQ kits

|                 | Order no. |
|-----------------|-----------|
| IQ/OQ set en    | 11081555  |
| Repeating OQ en | 11081556  |

#### 11.1.7 Maintenance kits

|   | Order no. |
|---|-----------|
| Customer kit for L-250 / L-210, with advanced vacuum control  | 11076718  |
| Frequently used wear and spare parts for self-servicing your device, conveniently gathered in one kit |           |
| Customer kit for L-250 / L-210, with ultimate vacuum control  | 11076719  |
| Frequently used wear and spare parts for self-servicing your device, conveniently gathered in one kit |           |





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