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# Concentrator plus/ Vacufuge® plus

Operating manual

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# 1 Operating instructions









## 1.1 Using this manual

- ▶ Read this operating manual completely before using the device for the first time. Also observe the instructions for use of the accessories.
- ▶ This operating manual is part of the product. Thus, it must always be easily accessible.
- ▶ Enclose this operating manual when transferring the device to third parties.
- ▶ You will find the current version of the operating manual for all available languages on our webpage under [www.eppendorf.com](http://www.eppendorf.com).

## 1.2 Danger symbols and danger levels

The safety precautions in these instructions have the following danger symbols and danger levels:

### 1.2.1 Danger symbols

	<b>Biohazard</b>		<b>Explosion</b>
	<b>Electric shock</b>		<b>Hot surface</b>
	<b>Crushing</b>		<b>Toxic substances</b>
	<b>Hazard point</b>		<b>Material damage</b>

### 1.2.2 Danger levels

<b>DANGER</b>	<i>Will</i> lead to severe injuries or death.
<b>WARNING</b>	<i>Can</i> lead to severe injuries or death.
<b>CAUTION</b>	May lead to light to moderate injuries.
<b>NOTICE</b>	May lead to material damage.

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### 1.3 Symbols used

Depiction	Meaning
1. 2.	Actions in the specified order
▶	Actions without a specified order
•	List
<i>Text</i>	Display text or software text
<b>i</b>	Additional information

### 1.4 Abbreviations used

**ETFE**

Ethylene-tetrafluoroethylene copolymer

**FFKM**

Perfluorelastomer

**MTP**

Microplate

**PCR**

Polymerase chain reaction

**PMMA**

Polymethyl methacrylate

**PTFE**

Polytetrafluoroethylene

**RZB/rcf**

Relative centrifugal force – *g*-force in  $m/s^2$

**rpm**

Revolutions per minute – in rpm

**UV**

Ultraviolet radiation



2 Product description  
2.1 Main illustration

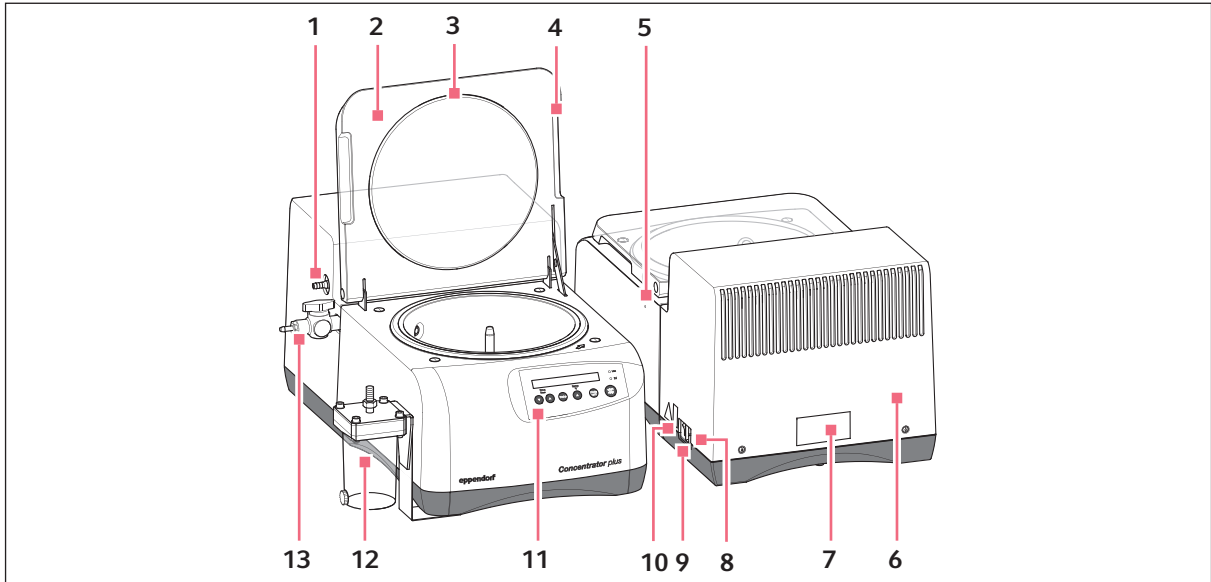


Fig. 2-1: Complete system with gel dryer connection

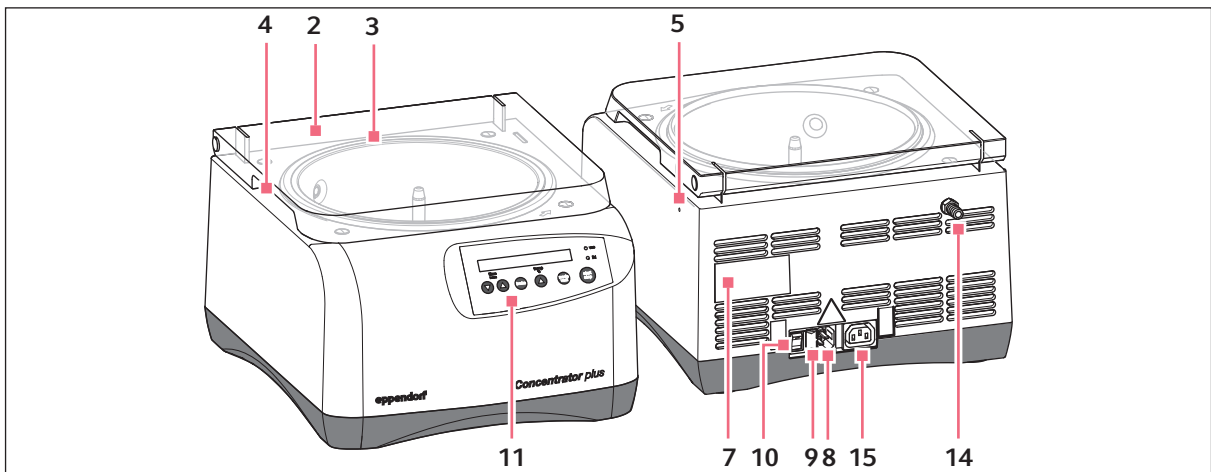


Fig. 2-2: Basic device

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- |  |  |
|--|--|
| <p><b>1 Pump outlet (complete system)</b><br/>Outlet of the integrated diaphragm vacuum pump, e.g., for hose connection to the emission condenser.</p> <p><b>2 PMMA lid</b></p> <p><b>3 Sealing ring</b></p> <p><b>4 Grip recess</b></p> <p><b>5 Emergency release</b></p> <p><b>6 Pump housing (complete system)</b></p> <p><b>7 Name plate</b></p> | <p><b>8 Mains/power connection</b></p> <p><b>9 Fuse holder</b></p> <p><b>10 Mains/power switch</b></p> <p><b>11 Operating controls and device display</b></p> <p><b>12 Emission condenser (complete system)</b></p> <p><b>13 Pump connection (basic device)</b><br/>For hose connection to external vacuum pump.</p> <p><b>14 Mains/power connection for external vacuum pump (basic device)</b></p> |
|--|--|

## 2.2 Features

The Concentrator plus/Vacufuge plus is a device for evaporating liquid or moist samples in micro test tubes, round-bottom tubes, conical tubes, flat-bottom tubes and various plates.

You can, for example, insert the following tubes and plates:

- 1.5 and 2.0 mL micro test tubes in a rotor with 70 places.
- 0.5 mL micro test tubes in a rotor with 72 places.
- 15 mL conical tubes in a rotor with 8 places.
- 50 mL conical tubes in a rotor with 6 places.
- MTP and PCR plates in a swing-bucket rotor.

A complete list can be found in the following chapter (see *Rotors on p. 12*).

The device is available as a complete system with integrated diaphragm vacuum pump or as a basic device without vacuum pump. The basic device can be connected to an external vacuum system.

Key practical functions of the Concentrator plus/Vacufuge plus have been optimized:

- 3 temperature levels can be set (30, 45, 60 °C). Alternatively, evacuation is carried out without temperature control.
- The evaporation of liquids can be carried out optimized in 3 functions. In addition to pure evacuation, aqueous and/or alcoholic solutions can be concentrated extra fast with 2 special functions.
- You can also operate the device as a pure desiccator.
- You can connect a solvent trap to the device behind the pump.

Due to the space-saving design, the device can be placed directly on the workstation. With its clearly laid-out control panel with only a few, clearly marked elements and a display that is easy to read, the device is a pleasant and reliable companion in your daily work.

## 2.3 Delivery package

The delivery package includes one of the following device/rotor combinations and the accessories listed below.

### 2.3.1 Complete system

Quantity	Order no. (International)	Order no. (North America)	Description
1	5305 000.304	-	<b>Concentrator plus/Vacufuge plus complete system</b> with rotor F-45-48-11
or	5305 000.312	5305000312	230 V/50 – 60 Hz, with integrated diaphragm vacuum pump
or	5305 000.347	-	120 V/50 – 60 Hz, with integrated diaphragm vacuum pump
			100 V/50 – 60 Hz, with integrated diaphragm vacuum pump
or	5305 000.509	-	<b>Concentrator plus/Vacufuge plus complete system</b> without rotor
or	5305 000.517	5305000517	230 V/50 – 60 Hz, with integrated diaphragm vacuum pump
or	5305 000.541	-	120 V/50 – 60 Hz, with integrated diaphragm vacuum pump
			100 V/50 – 60 Hz, with integrated diaphragm vacuum pump
or	5305 000.703	-	<b>Concentrator plus/Vacufuge plus complete system</b> with connection, e.g., for a gel dryer, without rotor
or	5305 000.711	5305000711	230 V/50 – 60 Hz, with integrated diaphragm vacuum pump
or	5305 000.746	-	120 V/50 – 60 Hz, with integrated diaphragm vacuum pump
			100 V/50 – 60 Hz, with integrated diaphragm vacuum pump
1	5301 850.249	022654403	<b>Fuse</b> 4.0 A T (230 V), 2 pieces
or	5417 341.007	022375831	6.3 A T UL (120 V/100 V), 2 pieces
1	-	-	<b>Mains power cable</b>
1	5305 900.038	-	<b>Operating Manual Concentrator plus/Vacufuge plus</b>
1	5301 330.008	022830309	<b>Emission condenser</b> without tube
1	5301 337.002	022830295	<b>Tube for emission condenser</b> length: 0.7 m
1	5301 110.032	5301110032	<b>Tube connection</b> Plastic

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## 2.3.2 Basic device

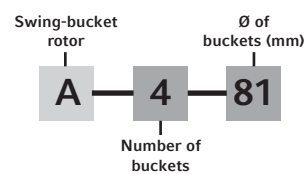
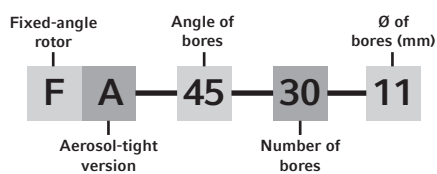
Quantity	Order no. (International)	Order no. (North America)	Description
1 or or	5305 000.100 5305 000.118 5305 000.142	- 5305000118 -	<b>Concentrator plus/Vacufuge plus basic device</b> with rotor F-45-48-11 230 V/50 – 60 Hz 120 V/50 – 60 Hz 100 V/50 – 60 Hz
1 or	5301 850.249 5417 341.007	022654403 022375831	<b>Fuse</b> 4.0 A T (230 V), 2 pieces 6.3 A T UL (120 V/100 V), 2 pieces
1	-	-	<b>Mains power cable</b>
1	5305 900.038	-	<b>Operating Manual Concentrator plus/Vacufuge plus</b>

## 2.4 Rotors





The device can be operated with the following rotors. Before using micro test tubes, note the manufacturer's recommended specifications on resistance to centrifugation (max. g-force).

**Rotor code:**

All Eppendorf® rotors are identified using a simple, alphanumeric format that represents the technical specifications in a uniform series of letters and numbers.




2.4.1 Fixed-angle rotors

Rotor	Tubes/Plates	Number of tubes Volume	Dimensions (mm) Ø × L or L × W × H	Max. g-force/ speed	Max. load per rotor bore <sup>(1)</sup>
F-45-72-8		72 micro test tubes 0.5 mL	8 × 31	Inner row: 202 × g, outer row: 224 × g/ 1400 rpm	10 g
F-45-70-11		70 micro test tubes 1.5/2.0 mL	11 × 41/ 11 × 47	Inner row: 153 × g, middle row: 202 × g, outer row: 248 × g/ 1400 rpm	15 g
F-45-48-11		48 micro test tubes 1.5/2.0 mL	11 × 41/ 11 × 47	Inner row: 217 × g, outer row: 239 × g/ 1400 rpm	15 g
F-45-24-12		24 round-bottom tubes 6.0/8.0 mL	12 × 67 – 100	234 × g/ 1400 rpm	35 g
F-50-8-16		8 round-bottom tubes 15.0/20.0 mL	16 × 105 – 120	230 × g/ 1400 rpm	70 g
F-50-8-18		8 round-bottom tubes 15.0/20.0 mL	18 × 105 – 128	230 × g/ 1400 rpm	70 g
F-35-6-30		6 conical tubes 15 mL	17 × 116 – 123	232 × g/ 1400 rpm	25 g
F-45-8-17		8 conical tubes 15 mL	17 × 118 – 123	239 × g/ 1400 rpm	70 g
F-35-6-30		6 conical tubes 50 mL	29.5 × 116 – 123	232 × g/ 1400 rpm	75 g


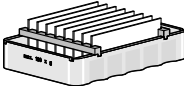
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Rotor	Tubes/Plates	Number of tubes Volume	Dimensions (mm) Ø × L or L × W × H	Max. g-force/ speed	Max. load per rotor bore <sup>(1)</sup>
F-40-36-12		36 flat-bottom tubes 1.5 mL	12 × 32	215 × g/ 1400 rpm	15 g
F-45-36-15		36 flat-bottom tubes 3.0/5.0 mL	15 × 45 – 48	217 × g/ 1400 rpm	20 g
F-45-16-20		16 flat-bottom tubes 6.5/10.0 mL	20 × 42 – 55	217 × g/ 1400 rpm	45 g
F-40-18-19		18 flat-bottom tubes 10.0 mL	19 × 66	228 × g/ 1400 rpm	35 g
F-45-12-31		12 flat-bottom tubes 20.0 mL	31 × 55	226 × g/ 1400 rpm	55 g
F-35-8-24		8 flat-bottom tubes 25.0 mL	24 × 86 – 90	232 × g/ 1400 rpm	90 g

(1) Maximum load per rotor bore for adapter + tube + contents.

#### 2.4.2 Swing-bucket rotor

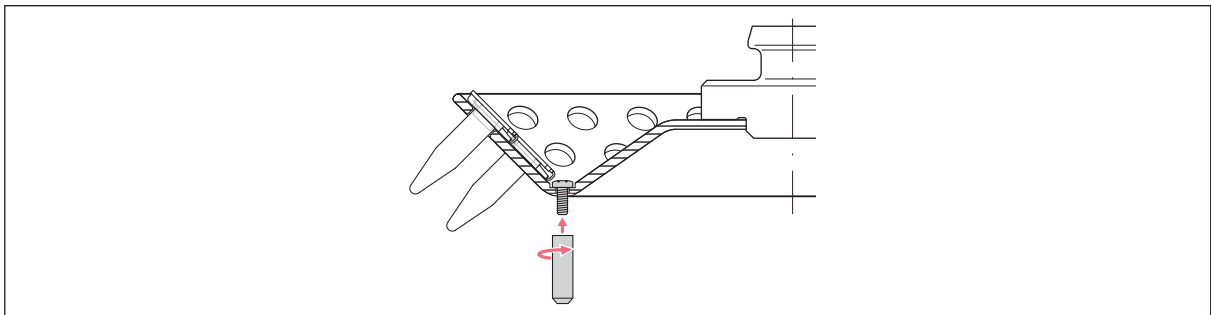
Rotor	Tubes/Plates	Number of tubes Volume	Dimensions (mm) Ø × L or L × W × H	Max. g-force/ speed	Max. load per rotor bore <sup>(1)</sup>
A-2-VC	  	Two buckets to hold: <ul style="list-style-type: none"> <li>• 0.2 mL PCR tubes</li> <li>• 5-tube or 8-tube PCR strips</li> <li>• PCR plates</li> <li>• Micro test plates</li> <li>• Cell culture plates</li> <li>• Deepwell plates (max. height = 27 mm)</li> <li>• Slide (with CombiSlide adapter)</li> </ul>	128 × 86 × 27  26 × 75	131 × g/ 1400 rpm	115 g per bucket

(1) Maximum load per rotor bore for adapter + tube + contents.

### 2.4.3 Special information for individual rotors

#### Rotor F-45-72-8 and Rotor F-45-48-11

- You can place two of these rotors on top of each other by using a spacer (order no. Int.: 5301 316.005 / North America: 022822101) and centrifuge them at the same time.  
Included with the accessories are rotor feet which can be screwed to the corresponding bores in the rotor. Their purpose is to prevent the samples from being pushed out of the bores when the rotor is put down on the work bench. The rotors can be centrifuged with the rotor feet. The screws must be checked monthly and re-tightened if required.
- For this combination, lower upper limits apply for the maximum load: Bottom rotor:  $\frac{2}{3}$  of the max. load, top rotor  $\frac{1}{3}$  of the max. load.



#### Rotor F-45-24-12

- Tube length  $\leq 75$  mm: max. capacity 24 tubes.
- Tube length  $> 75$  mm: max. capacity 12 tubes.

#### Rotor A-2-VC

- Tubes, PCR strips and plates without border can only be used with a suitable work plate (see *Adapters on p. 59*).
- Max. loading height: 27 mm.

#### Rotor F-35-6-30

- The recommended maximum filling volume for 50 mL conical tubes is 44 mL. If the tubes are filled up to the top, samples may spill due to the rotational movement.

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## 3 Safety

### 3.1 Intended use

The Concentrator plus and Vacufuge plus are designed for sample preparation. Only trained and skilled personnel may operate the devices.

The Concentrator plus and Vacufuge plus are only intended for indoor use and mainly serve to concentrate aqueous solutions of nucleic acids and proteins in approved micro test tubes.



**CAUTION! Poor safety due to incorrect accessories and spare parts.**

The use of accessories and spare parts other than those recommended by Eppendorf may impair the safety, functioning and precision of the device. Eppendorf cannot be held liable or accept any liability for damage resulting from the use of incorrect or non-recommended accessories and spare parts, or from the improper use of such equipment.

- ▶ Only use accessories and original spare parts recommended by Eppendorf.
- 

### 3.2 User profile

This device may only be operated by trained specialist staff. They must have carefully read the operating manual and be familiar with the function of the device.

### 3.3 Application limits



**CAUTION! Continuous delivery can affect safe operation of the device.**

When delivering liquids continuously, membranes and valves of the vacuum pump can be damaged.

- ▶ Only use the device for applications of limited duration.
- 

#### 3.3.1 Declaration concerning the ATEX directive (94/9/EC)



**DANGER! Risk of explosion.**

- ▶ Do not operate the device in areas where work is completed with explosive substances.
  - ▶ Do not use this device to process any explosive or highly reactive substances.
  - ▶ Do not use this device for processing any substances which could generate an explosive atmosphere.
- 

Because of the current design and the ambient conditions inside the devices, the Concentrator plus/ Vacufuge plus are not suitable for use in potentially explosive atmospheres.

The device only must be used in a safe environment, such as the open environment of a ventilated laboratory or fume hood. The use of substances which could create a potentially explosive atmosphere is not permitted. The final decision on the risks associated with the use of these types of substances is the responsibility of the user.

### 3.3.2 Maximum service life for accessories

The maximum service life for plastic adapters is 1 year from first commissioning. Do not use the adapter beyond this period!

For the rotors (see *Rotors on p. 12*) described here there is no limit for their service life, as long as the following conditions are met: proper use, recommended maintenance and undamaged condition.

## 3.4 Information on product liability

In the following cases, the designated protection of the device may be compromised. Liability for any resulting property damage or personal injury is then transferred to the operator:

- The device is not used in accordance with the operating manual.
- The device is used outside of its intended use.
- The device is used with accessories or consumables which are not recommended by Eppendorf.
- The device is maintained or repaired by people not authorized by Eppendorf.
- The user makes unauthorized changes to the device.

## 3.5 Warnings for intended use

Read the operating manual and observe the following general safety instructions before using the device.

### 3.5.1 Personal injury or damage to the equipment



**WARNING! Electric shock due to damage to device or mains cable.**

- ▶ Only switch on the device if the device and mains cable are undamaged.
- ▶ Only use devices that have been properly installed or repaired.
- ▶ In case of danger, disconnect the device from the mains supply by pulling the power plug from the device or the mains socket or, by using the isolating device intended for this purpose (e.g., emergency stop switch in the laboratory).



**WARNING! Lethal voltages inside the device.**

- ▶ Ensure that the housing is always closed and undamaged so that no parts inside the device can be contacted by accident.
- ▶ Do not remove the housing of the device.
- ▶ Do not allow any liquids to penetrate the inside of the housing.
- ▶ Do not allow the device to be opened by anyone except service personnel who have been specifically authorized by Eppendorf.



**WARNING! Risk from incorrect supply voltage**

- ▶ Only connect the device to voltage sources which correspond to the electrical requirements on the name plate.
- ▶ Only use sockets with a protective earth (PE) conductor and suitable power cable.



**WARNING! Damage to health due to infectious liquids and pathogenic germs.**

- ▶ When handling infectious liquids and pathogenic germs, observe the national regulations, the biological security level of your laboratory, the material safety data sheets, and the manufacturer's application notes.
- ▶ Wear personal protective equipment.
- ▶ For full instructions regarding the handling of germs or biological material of risk group II or higher, please refer to the "Laboratory Biosafety Manual" (Source: World Health Organization, current edition of the Laboratory Biosafety Manual).



**WARNING! Burns due to hot micro test tubes and device parts.**

If the heater is at full power, the wall of the rotor chamber, the rotor and the micro test tubes will be heated to over 60°C.

- ▶ Do not touch the wall of the rotor chamber.
- ▶ Use suitable protective clothing or auxiliary aids to remove the micro test tubes.



**NOTICE! Damage to device due to spilled liquids.**

1. Switch off the device.
2. Disconnect the device from the power supply.
3. Carefully clean the device and the accessories in accordance with the cleaning and disinfection instructions in the operating manual.
4. If a different cleaning and disinfecting method is to be used, contact Eppendorf AG to ensure that the intended method will not damage the device.



**NOTICE! Device damage due to organic solvents**

The use of organic solvents may affect some components, e.g., via discolorations.

- ▶ If this occurs, clean the device immediately using a mild cleaning agent.



**NOTICE! Damage to electronic components due to condensation.**

Condensate can form in the device after it has been moved from a cool environment to a warmer environment.

- ▶ After installing the device, wait at least for 3 h. Only then connect the device to the mains.

### 3.5.2 Incorrect handling of the device

---

**WARNING! Device lid can crush. Keep hands clear.**

- ▶ Do not reach between the device and lid when opening or closing the device lid.
- 

**NOTICE! Damage from knocking against or moving the device during operation.**

If the rotor bangs against the rotor chamber wall, it will cause considerable damage to the device and rotor.

- ▶ Do not move or knock against the device during operation.
- 

### 3.5.3 Incorrect handling of the rotors

---

**WARNING! Risk of injury from improperly attached rotors.**

- ▶ Only operate the device if the rotor has been mounted properly.
  - ▶ If there are any unusual noises when the device is started up, immediately press the **start/stop** key to stop concentrating.
- 

**CAUTION! Risk of injury due to asymmetric loading of a rotor.**

- ▶ Load rotors symmetrically with identical tubes or plates and buckets.
- ▶ Always load all positions of a swing-bucket rotor with buckets.
- ▶ Only load adapters with suitable tubes or plates.
- ▶ Always use tubes or plates of the same type (weight, material/density and volume).
- ▶ Ensure that tubes that are located opposite each other contain liquids with the same rate of evaporation. Otherwise an imbalance can occur and the concentration may automatically stop.
- ▶ Check that loading is symmetrical by balancing the adapters and tubes or plates used with scales.

The device automatically detects imbalances during operation and stops the run immediately with an error message and a signal tone. Check the loading, balance the tubes and re-start the centrifugation.

**CAUTION! Risk of injury from overloaded rotor.**

The device is designed for the concentration of substances with a max. density of 1.2 g/mL at maximum speed and volume.

- ▶ Observe the maximum load for each rotor (adapter, tube and contents) per rotor bore or per bucket, and do not exceed this limit.



**WARNING! Risk of injury from chemically or mechanically damaged accessories.**

Even minor scratches and cracks can lead to serious internal material damage.

- ▶ Protect all accessory parts from mechanical damage.
- ▶ Inspect the accessories for damage before each use. Replace any damaged accessories.
- ▶ Do not use rotors or buckets with signs of corrosion or mechanical damage (e.g. deformations).
- ▶ Do not use any accessories whose maximum service life has been exceeded.
- ▶ When inserting the buckets and rotors, ensure that they do not become scratched.



**NOTICE! Damage to rotors from aggressive chemicals.**

Rotors are high-quality components which withstand extreme stresses. This stability can be impaired by aggressive chemicals.

- ▶ Avoid using aggressive chemicals, including strong and weak alkalis, strong acids, solutions with mercury, copper and other heavy metal ions, halogenated hydrocarbons, concentrated saline solutions and phenol.
- ▶ If the rotor is contaminated by aggressive chemicals, clean it immediately using a neutral cleaning agent. This applies to the base plates of the rotors in particular.

### 3.5.4 Extreme strain on the micro test tubes



**CAUTION! Risk of injury from overloaded tubes.**

- ▶ Note the loading limits specified by the tube manufacturer.
- ▶ Only use tubes which are approved by the manufacturer for the required rcf.



**NOTICE! Risk from damaged tubes.**

Damaged tubes must not be used, as this could cause further damage to the device and the accessories and loss of the samples.

- ▶ Before use, visually check all of the tubes for damage.



**NOTICE! Hazard to plastic tubes from organic solvents.**

The density of plastic tubes is reduced when organic solvents (e.g., phenol, chloroform) are used, i.e. the tubes could become damaged.

- ▶ Observe the manufacturer's specifications for chemical resistance of the tubes.



**NOTICE! Micro test tubes are exposed to strong heat.**

- ▶ Please note the temperature resistance of the micro test tubes.

### 3.5.5 Vacuum

---

**WARNING! Risk of injury from direct contact with the vacuum.**

- ▶ Do not expose any body parts to the vacuum of the device.

**WARNING! Risk of injury from overpressure.**

An overpressure in the exhaust gas lines (e.g. caused by closed taps or blocked pipes) can lead to bursting.





- ▶ Only use pipes with a sufficiently large cross section.
- ▶ Keep the exhaust gas line open.
- ▶ Do not place any objects on the exhaust gas lines.
- ▶ Do not flex the exhaust gas lines.
- ▶ Do not fit any hose clamps or valves to the exhaust gas lines.
- ▶ Note the maximum pressures and differential pressures permitted (see p. 56).

**WARNING! Risk to health from escaping substances.**

No vapors from toxic liquids and pathogenic germs must escape.

- ▶ Ensure the required condensation and separation of vapors using suitable cold traps or chemical traps.
  - ▶ Please note the personal protective equipment (gloves, clothing, goggles, etc.), extraction and safety class required for the laboratory.
-

### 3.6 Safety instructions on the device

Symbol	Meaning	Location
	<p><b>General hazard point</b></p> <ul style="list-style-type: none"> <li>▶ Observe the operating manual.</li> </ul>	<p>Complete system: Device side next to mains/power connection.                      Basic device: Rear of device next to mains/power connection.</p>
	<p><b>Risk of explosion</b></p> <ul style="list-style-type: none"> <li>▶ Do not use this device to process any explosive, radioactive or highly reactive substances.</li> <li>▶ Do not use this device for processing any substances which could generate an explosive atmosphere.</li> </ul>	<p>Top of device.</p>
	<p><b>Risk of burns when the device lid is open</b></p> <p>If the heater is switched on, the surface temperature of the rotor chamber may be &gt; 60 °C.</p> <ul style="list-style-type: none"> <li>▶ Do not touch the wall of the rotor chamber.</li> </ul>	<p>Top of device.</p>
	<p><b>Risk of injury from overpressure</b></p> <p>The connection on the top of the emission condenser is only intended as an outlet.</p> <ul style="list-style-type: none"> <li>▶ Ensure that the emission condenser is connected correctly.</li> <li>▶ Never block this connection.</li> </ul>	<p>Top of emission condenser.</p>

**Safety**

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## 4 Installation

### 4.1 Selecting the location



**NOTICE! If an error occurs, the objects in the immediate proximity of the device will be damaged.**

- ▶ In accordance with the recommendations of EN 61010-2-020, leave a safety clearance of **30 cm** around the device during operation.
- ▶ Please remove all materials and objects from this area.



**NOTICE! Damage from overheating.**

- ▶ Do not install the device near to any heat sources (e.g., heating, drying cabinet).
- ▶ Do not expose the device to direct sunlight.
- ▶ Ensure unobstructed air circulation. Keep free a clearance of at least 30 cm around all ventilation grilles.

Select the device location according to the following criteria:

- Suitable power connection as per the name plate (230 V/120 V/100 V).
- Stable, horizontal and resonance-free lab bench.
- A well ventilated environment which is protected from direct sunlight to prevent the device from heating up more.
- Ambient temperature during operation: 15 to 35 °C.
- At altitudes 1000 m above MSL (risk of insufficient cooling air supply), measures in accordance with DIN EN 60034-1; VDE 0530-1 are required.

### 4.2 Preparing installation



The weight of the complete system is 31.5 kg. The weight of the basic device is 16.5 kg.

- The device has to be transported and installed by two people.
- Only transport the device in its original packaging.
- Use a transport aid for longer distances (e.g., a hand truck).
- Retain the packaging and the transport protection device for subsequent transport or storage. See also the instructions relating to transport (see p. 53).

#### 4.2.1 Opening the package

Carry out the following steps in the order described:

1. Cut the adhesive tape.
2. Open the four cardboard flaps.
3. Remove accessories and rotors.
4. Remove the cardboard cover.
5. Cut the strap retainers.

## Installation

Concentrator plus/Vacufuge® plus  
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### 4.2.2 Lifting the device out of the carton

1. Lift the device with the transport protection pad out of the carton.
2. Place the device with the transport protection pad on a stable, horizontal and resonance-free lab bench.

### 4.2.3 Complete system: Removing the transport protection screw

1. Carefully lay the device with the transport protection pad on its side.

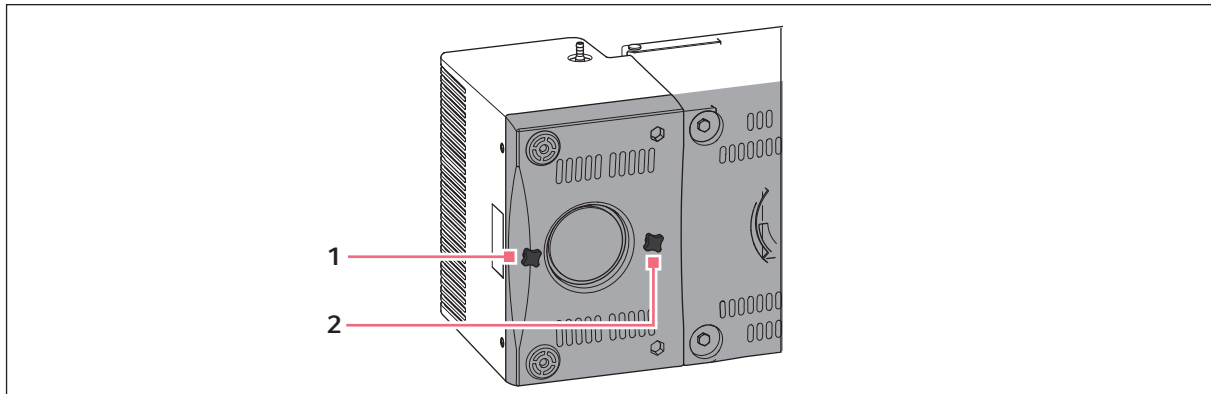


Fig. 4-1: Transport protection screws on the bottom of the device (complete system)

#### 1 Rear transport protection screw

#### 2 Front transport protection screw

2. Slide the rear transport protection pad on the bottom of the device slightly back until the rear transport protection screw (1) is visible.
3. Unscrew and remove both transport protection screws.
4. Return the rear transport protection pad to its original position.
5. Return the device with the transport protection pad to the upright position.

### 4.2.4 Positioning the device



#### **WARNING! Risk of injury due to operation of an incorrectly installed device.**

The device is not yet ready for operation after positioning. Some components still need to be installed.

- ▶ Read the following chapter before commissioning the device (see *Installing the instrument on p. 27*).

1. Remove the front and rear transport protection pads.
2. Remove the plastic covers from the device and lid.
3. Install the device in a well-ventilated location which is protected from direct sunlight to prevent it from overheating.

#### 4.2.5 Checking the delivery

1. Check that the delivery is complete (see *Delivery package on p. 11*).
2. Check all parts for any transport damage. Contact your dealer if any damage is found.

**i** To pack the device, perform the steps in reverse order.

### 4.3 Installing the instrument

#### 4.3.1 General installation



**WARNING! Risk from incorrect supply voltage**

- ▶ Only connect the device to voltage sources which correspond to the electrical requirements on the name plate.
- ▶ Only use sockets with a protective earth (PE) conductor and suitable power cable.



**WARNING! Risk to health from escaping substances.**

No vapors from toxic liquids and pathogenic germs must escape.

- ▶ Ensure the required condensation and separation of vapors using suitable cold traps or chemical traps.
- ▶ Please note the personal protective equipment (gloves, clothing, goggles, etc.), extraction and safety class required for the laboratory.



Select a setup for the collection and/or discharge of liquids and gases which corresponds to the applicable legal requirements and regulations for your application.

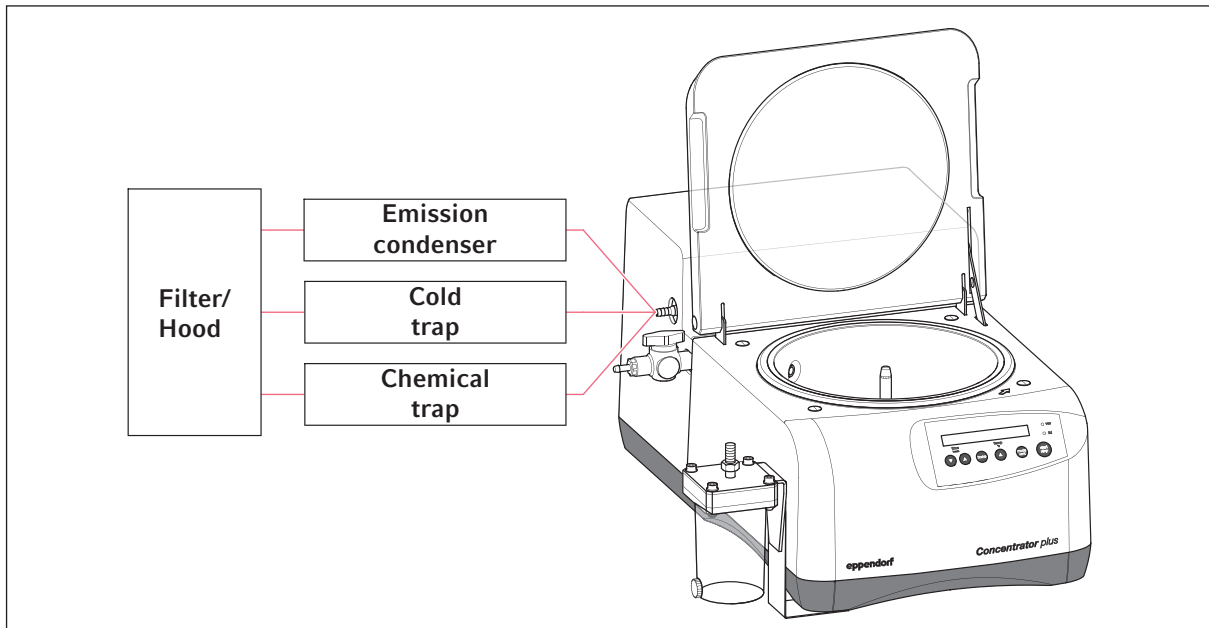


Fig. 4-2: Connection options of the complete system

## Installation

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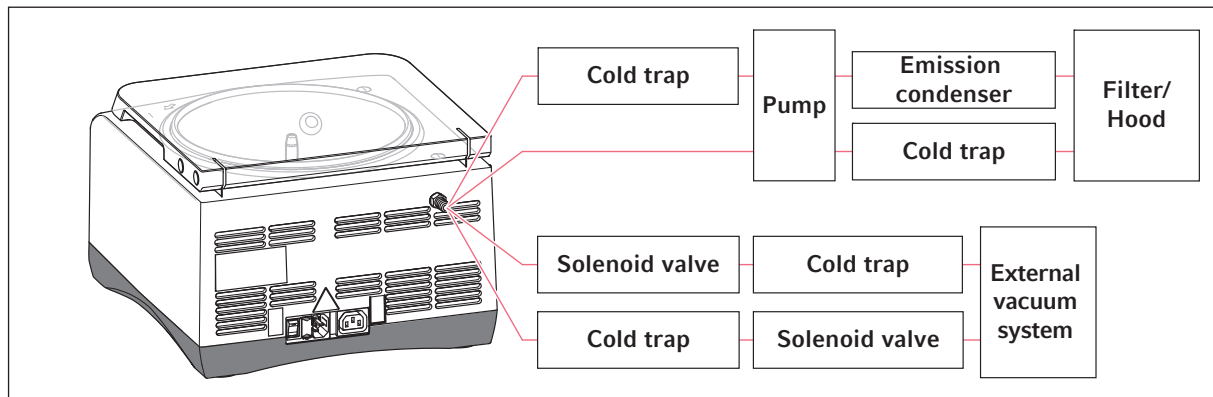


Fig. 4-3: Connection options of the basic device

Perform the following steps in the sequence described.

1. Place the device on a suitable lab bench.
2. Allow the device to warm up to ambient temperature for at least 3 hours to prevent damage to electronic components from condensation.
3. Connect the components according to your chosen configuration. Please note the relevant instructions in the following chapters.
  - Complete system: Connecting the emission condenser (see p. 29).
  - Complete system: Connecting the gel dryer (see p. 30).
  - Basic device: Connecting the vacuum pump (see p. 30).
4. Check that the mains/power supply voltage and frequency match the requirements on the device name plate.
5. Connect the device to the power supply and switch on with the mains/power switch on the right side of the device (basic device: on the rear of the device) (refer to front fold-out page).
  - The display is active.
  - The lid is unlocked (**lid** indicator light lights up).
  - You can now open the lid.

### 4.3.2 Complete system: Connecting the emission condenser



**WARNING! Risk of injury from overpressure.**

An overpressure in the exhaust gas lines (e.g. caused by closed taps or blocked pipes) can lead to bursting.

- ▶ Only use pipes with a sufficiently large cross section.
- ▶ Keep the exhaust gas line open.
- ▶ Do not place any objects on the exhaust gas lines.
- ▶ Do not flex the exhaust gas lines.
- ▶ Do not fit any hose clamps or valves to the exhaust gas lines.
- ▶ Note the maximum pressures and differential pressures permitted (see p. 56).



Check whether using the emission condenser is sufficient for the intended application. For the concentration of chemically aggressive or biologically hazardous substances one of the following measures must be taken:

- Replace the emission condenser with a suitable cold trap or chemical trap.
- In addition, place the emission condenser in an ice bath.
- Attach a hose to the upper connection of the emission condenser and connect it to an extraction system.
- Set up a series connection of cold trap or chemical trap and emission condenser.



The pump of the device is fully solvent resistant. Therefore the emission condenser can be placed behind the pump.

1. Unpack the emission condenser.
2. Remove the red cap from the upper connection.
3. Screw the angle connection to the side of the emission condenser.

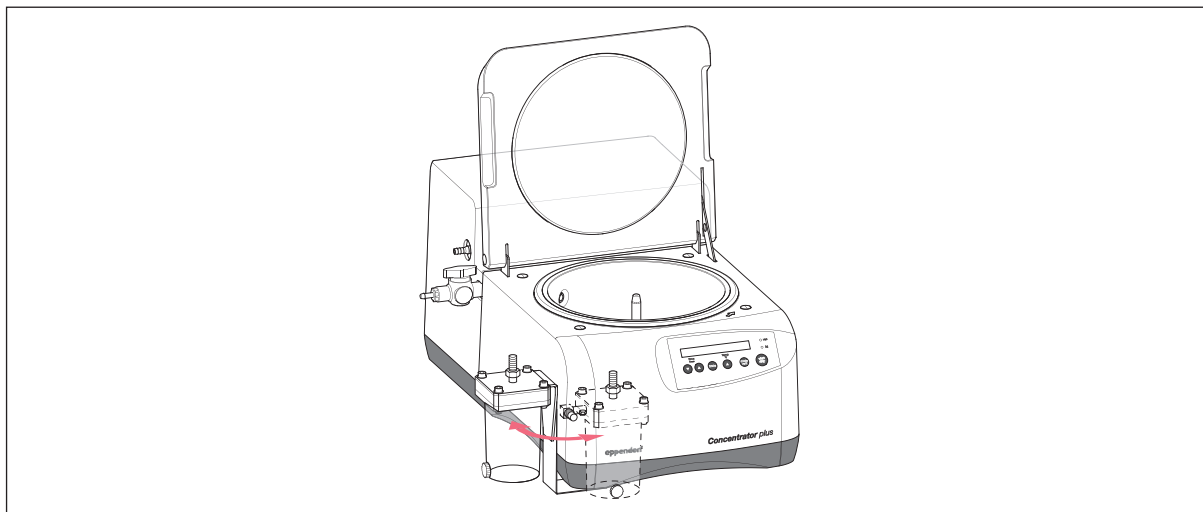


The emission condenser inlet needs to be lower than the pump outlet to prevent liquid from collecting in the hose.

4. Attach the hose to the pump outlet and the connection on the side of the emission condenser.
5. Attach the emission condenser from the side or from the front below the front left foot of the device.

## Installation

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6. You can install a filter at the upper connection of the emission condenser. The overpressure at the pump outlet of the complete system may not exceed 1 bar.

### 4.3.3 Complete system: Connecting the gel dryer

#### Prerequisites

- 1 connecting hose (length: max. 50 cm, inner diameter: 5 to 7 mm, chemical resistant and suitable for vacuum applications).

1. Screw the supplied barb (size: G1/4 ") into the thread of the stop valve on the left of the device.
2. Connect the gel dryer to the barb with the connecting hose.

### 4.3.4 Basic device: Connecting the vacuum pump



#### **WARNING! Danger of explosion from gas mixtures.**

When running several devices in parallel on a vacuum system or in combination with a gel dryer, an explosive gas mixture can develop in the vacuum system.

- ▶ Observe the solvent properties. Only carry out parallel operations with identical solvents or solvents that evaporate in a non-hazardous manner.

The basic device can be connected to an external vacuum pump.

#### Requirement

- The vacuum pump is approved in accordance with the applicable standards in your country.
- Condenser (e.g., emission condenser, cold trap or chemical trap) between the devices or behind the vacuum pump, depending on your application.
- Pump withstands an ultimate pressure of at least 20 mbar. Its suction capacity is at least 1.8 m<sup>3</sup>/h.

- i** Vacuum pumps which meet these requirements can for example be diaphragm or rotary vane pumps. The specifications can be found in the vacuum pump's technical data or requested from the manufacturer. If you have any other questions regarding the correct operation of the vacuum pump, e.g., handling, use, performance, service, troubleshooting or specification and connecting a cold trap, please also contact the manufacturer.
- i** Should you encounter any problems when connecting the vacuum pump, please contact Technical Service. The contact addresses can be found on the Internet at [www.ependorf.com](http://www.ependorf.com).

#### 4.3.4.1 Connecting a vacuum pump up to 350 W

##### Prerequisites

- Power consumption of the vacuum pump: max. 350 W or connected electrical load max. 400 VA.
- Special plug for control and power supply of the vacuum pump (see *Accessories on p. 58*).
- 1 connecting hose (length: max. 50 cm, inner diameter: 8 mm, chemical resistant and suitable for vacuum applications).

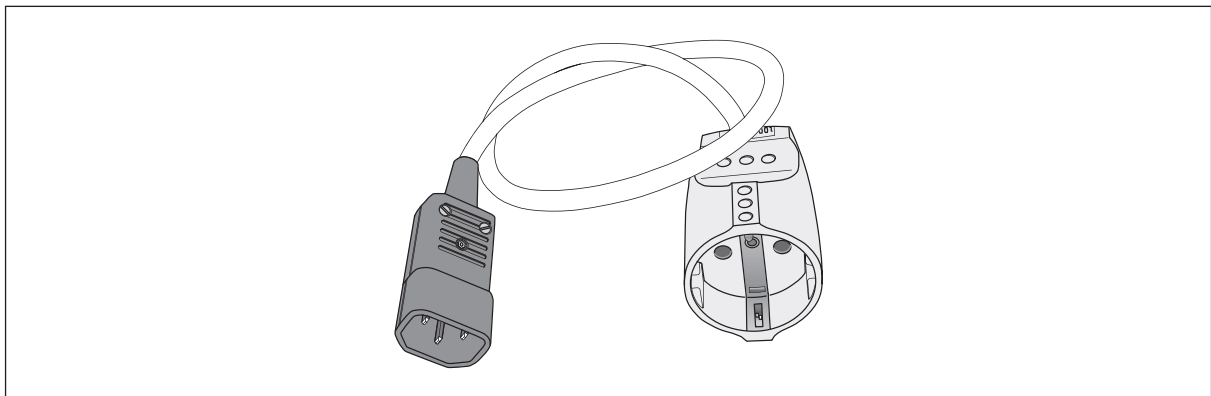


Fig. 4-4: Special plug for control and power supply of a vacuum pump with a power consumption of **up to 350 W**.

**Installation**

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English (EN)

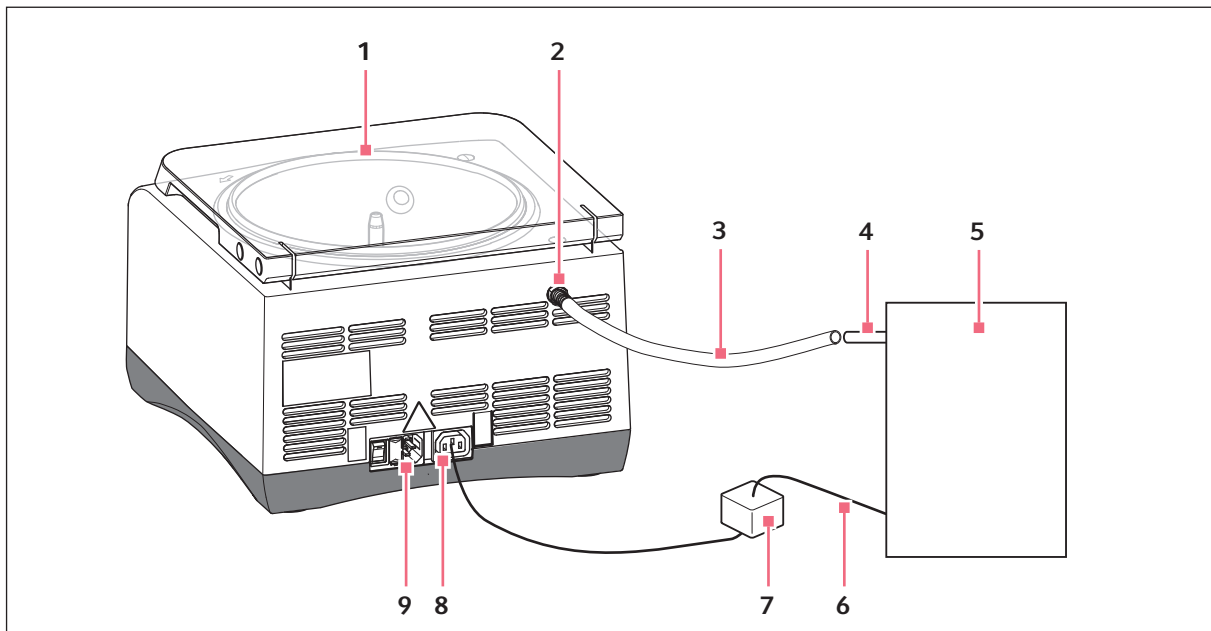


Fig. 4-5: Connecting a vacuum pump with a power consumption of **up to 350 W** to the Concentrator plus basic device.

1. Disconnect the basic device **1** and the vacuum pump **5** from the power supply.
2. Plug the power cable of the vacuum pump **6** into the special plug **7**.
3. Connect the special plug to the provided connector **8** on the rear of the basic device (connected mains/ power supply voltage!).
4. Install the connecting hose **3** between the pump inlet **4** and the pump connection **2** on the rear of the basic device.
5. Connect the basic device to the power supply **9**.



### 4.3.4.2 Connecting a vacuum pump with external power supply

#### Prerequisites

- Additional power source for the vacuum pump
- Solenoid valve to control the vacuum pump with the basic device (see *Accessories on p. 58*)
- 2 connecting hoses (length: max. 50 cm, inner diameter: 8 mm, chemical resistant and suitable for vacuum applications)

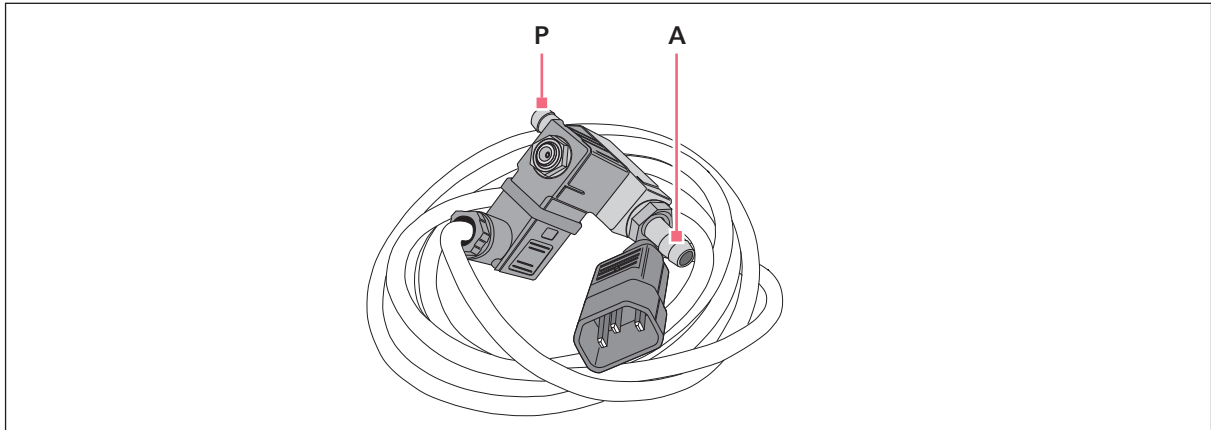


Fig. 4-6: Solenoid valve to control a vacuum pump with external power supply.

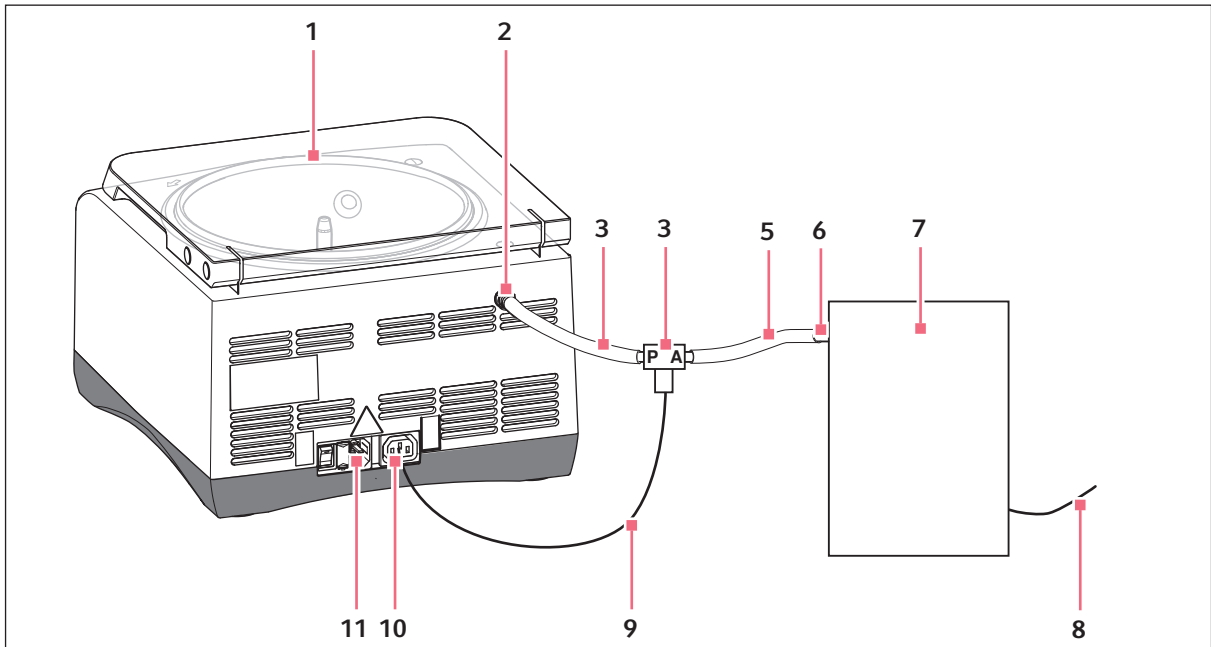


Fig. 4-7: Connecting a vacuum pump with external power supply to the Concentrator plus basic device.

**Installation**

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1. Disconnect the basic device **1** and the vacuum pump **7** from the power supply.
2. Connect barb **P** of the solenoid valve **4** to a connecting hose **3** and attach the other end of the connecting hose to the pump connection **2** on the rear of the basic device.
3. Connect barb **A** of the solenoid valve **4** to a connecting hose **5** and attach the other end of the connecting hose to the vacuum pump inlet **6**.
4. Connect the plug of the solenoid valve **9** to the provided connector on the rear of the basic device **10** (connected mains/power supply voltage!).
5. Connect the basic device to the power supply **11**.
6. Connect the vacuum pump to the power supply **8**.

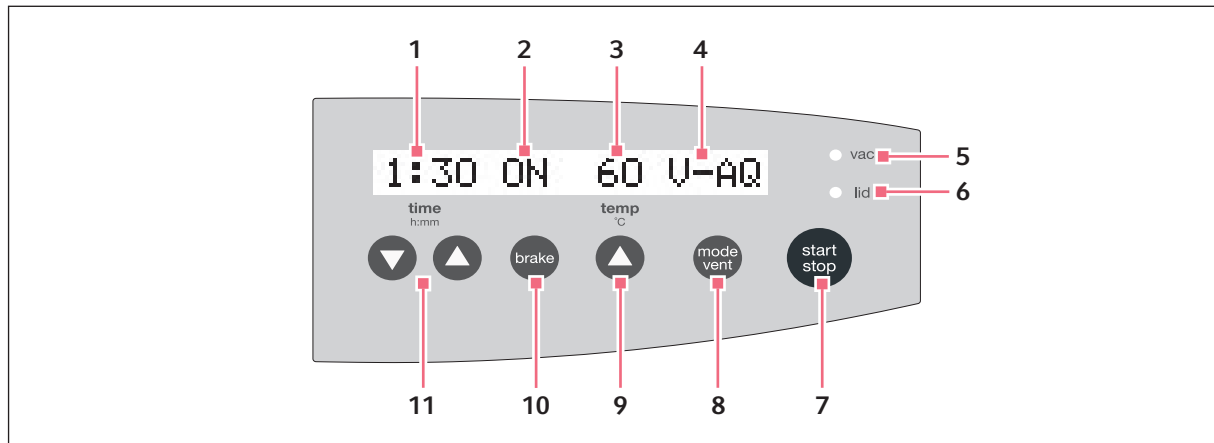


The vacuum pump is isolated from the device automatically before concentration is complete by closing the solenoid valve which is piloted by the concentrator. You can also isolate the vacuum pump from the device without a solenoid valve by manually closing an in-line valve (e.g., stop valve with ground-in stopper).

## 5 Operation

### 5.1 Overview of operating controls

Before using the device for the first time, familiarize yourself with the operating controls and the device display.



#### 1 Concentration run time

1 min to 9:59 h, unlimited (oo), adjustable in 1 min. increments.

#### 2 Braking function

*ON*: Braking function on. *OFF*: Braking function off.

#### 3 Temperature

--: Heating off. 30/45/60 °C: Heating on.

#### 4 Mode

(see *Functions on p. 36*)

#### 5 Status of the diaphragm vacuum pump (vac)

Off: Pump off. On: Pump running.

#### 6 Status of the device lid (lid)

Off: Lid locked. On: Lid unlocked.

#### 7 Start or stop concentration

#### 8 Set the mode

Manual ventilation of the rotor chamber during a concentrator/desiccator run while the key is pressed. *Ventilation* is displayed.

#### 9 Set the temperature

#### 10 Set the braking function

#### 11 Set the concentration run time

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## 5.2 Functions

Concentrator plus and Vacufuge plus can be used as a concentrator, a desiccator or a centrifuge. For the concentrator and desiccator functions, there are three different modes available for the quick concentration of different solvents:

Function	Mode	Suitable for
Concentrator	V-AQ (vacuum - aqueous)	aqueous solutions
	V-AL (vacuum - alcoholic)	alcoholic solutions
	V-HV (vacuum - high vapor)	solutions with high vapor pressure
Desiccator	D-AQ (desiccator - aqueous)	aqueous solutions
	D-AL (desiccator - alcoholic)	alcoholic solutions
	D-HV (desiccator - high vapor)	solutions with high vapor pressure and dry substances
Centrifuge	CEFU(centrifuge)	centrifugation at 1,400 min <sup>-1</sup>

- ▶ To set the desired function, press the **mode/vent** key before operation of the device.



Use the V-AQ, V-AL, D-AQ or D-AL modes if possible, or press the **mode/vent** key from time to time during the run.



During operation, you cannot change the set function. Instead, holding the **mode/vent** key during the concentrator or desiccator function ventilates the rotor chamber.

## 5.3 Preparation for concentration

### 5.3.1 Switching on the device



Please note before putting the device into service that the ambient temperature during operation must be between 15 and 35 °C.

At altitudes above 1000 m MSL (risk of insufficient cooling air supply), measures in accordance with DIN EN 60034-1; VDE 0530-1 are required.

- ▶ Switch on the device at the mains power switch.
  - Display is active.
  - Lid is released (**lid** indicator lamp lights up).
  - You can now open the lid.
  - The parameter settings of the last run are displayed.

### 5.3.2 Inserting the rotor



**WARNING! Risk of injury from chemically or mechanically damaged accessories.**

Even minor scratches and cracks can lead to serious internal material damage.

- ▶ Protect all accessory parts from mechanical damage.
- ▶ Inspect the accessories for damage before each use. Replace any damaged accessories.
- ▶ Do not use rotors or buckets with signs of corrosion or mechanical damage (e.g. deformations).
- ▶ Do not use any accessories whose maximum service life has been exceeded.
- ▶ When inserting the buckets and rotors, ensure that they do not become scratched.



First observe the rotor information (see p. 12) and the special notes on rotors F-35-6-30, F-45-72-8, F-45-48-11, F-45-24-12 and A-2-VC (see p. 15).

Rotor A-2-VC: remove the buckets before inserting the rotor and pick it up at the rotor cross, using both hands.

Proceed as follows when inserting the rotor:

1. Place rotor on the motor shaft.
2. Push rotor down using slight pressure until you encounter resistance.



The rotors do not need to be screwed in.

### 5.3.3 Warm-up phase

The diaphragm vacuum pump reaches the displayed output and the ultimate pressure (see p. 56) only after the device has gone through a 15 minute warm-up phase. The warm-up phase reduces the condensation of liquid in the pump and on the lid of the rotor chamber and therefore prolongs the service life of the pump.



**WARNING! Device lid can crush. Keep hands clear.**

- ▶ Do not reach between the device and lid when opening or closing the device lid.

1. **time** arrow keys: set time to 15 minutes.
2. **brake**: switch brake on or off.
3. **temp**: select temperature.
4. **mode/vent**: select *V-AQ*, *V-AL* or *V-HV* mode.
5. Close the lid of the device.
6. Press **start/stop** to start the warm-up phase.
  - The device lid is locked, and the green **lid** indicator lamp goes out.
  - The rotor starts up.
  - At 1,000 rpm, the vacuum pump switches on, and the **vac** indicator lamp lights up.
  - The vent valve is closed.
  - The rotor accelerates to the end point of 1,400 rpm.
  - On the display, the colon of the time display flashes while the rotor is turning.
  - The remaining run time is displayed in hours and minutes.

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**After the warm-up phase is completed**

- The device stops automatically.
- During braking the elapsed concentration time is displayed flashing.
- The rotor chamber is ventilated so that the pressure in the chamber increases slowly.
- After two seconds, the vacuum pump is switched off, and the **vac** indicator lamp goes out.
- Then the device brakes.
- When the rotor has come to a standstill, the **lid** indicator lamp lights up.
- The lid can be opened.

**5.3.4 Loading a fixed-angle rotor**

The following notes apply to fixed-angle rotors. Loading the rotor A-2-VC is described in the following chapter (see *Loading a swing-bucket rotor on p. 39*).

**CAUTION! Risk of injury due to asymmetric loading of a rotor.**

- ▶ Load rotors symmetrically with identical tubes or plates and buckets.
- ▶ Always load all positions of a swing-bucket rotor with buckets.
- ▶ Only load adapters with suitable tubes or plates.
- ▶ Always use tubes or plates of the same type (weight, material/density and volume).
- ▶ Ensure that tubes that are located opposite each other contain liquids with the same rate of evaporation. Otherwise an imbalance can occur and the concentration may automatically stop.
- ▶ Check that loading is symmetrical by balancing the adapters and tubes or plates used with scales.

The device automatically detects imbalances during operation and stops the run immediately with an error message and a signal tone. Check the loading, balance the tubes and re-start the centrifugation.

**CAUTION! Risk from damaged or overloaded tubes.**

- ▶ (see *Warnings for intended use on p. 18*) When loading the rotor, observe the safety precautions on dangers as a result of overloaded or damaged tubes .

Proceed as follows when loading the fixed-angle rotor:

1. Check the maximum payload (tube and content) per rotor bore. Detailed information can be found in this operating manual (see *Rotors on p. 12*).
2. Only load rotors with the tubes intended for this purpose.
3. Insert open tubes opposite each other in pairs into the rotor bores. For symmetrical loading, tubes that are opposite each other must be of the same type and contain the same filling quantity.

In order to minimize weight differences between filled sample tubes, we recommend taring with a scale. This will reduce wear on the drive and cut running noise.

### 5.3.5 Loading a swing-bucket rotor

#### Prerequisites

- A combination of rotor, bucket and adapter, approved by Eppendorf.
- **Two** inserted buckets.
- Matching and tested tubes and plates.
- Adapters and plates with a total height of  $\leq 27$  mm



#### **CAUTION! Risk of injury due to asymmetric loading of a rotor.**

- ▶ Load rotors symmetrically with identical tubes or plates and buckets.
- ▶ Always load all positions of a swing-bucket rotor with buckets.
- ▶ Only load adapters with suitable tubes or plates.
- ▶ Always use tubes or plates of the same type (weight, material/density and volume).
- ▶ Ensure that tubes that are located opposite each other contain liquids with the same rate of evaporation. Otherwise an imbalance can occur and the concentration may automatically stop.
- ▶ Check that loading is symmetrical by balancing the adapters and tubes or plates used with scales.

The device automatically detects imbalances during operation and stops the run immediately with an error message and a signal tone. Check the loading, balance the tubes and re-start the centrifugation.



#### **NOTICE! Filling the plates too high can cause overflowing.**

During the run the meniscuses in the tubes along the edges of the plates are at an angle. This is due to the centrifugal forces and cannot be avoided.

- ▶ Fill the plate wells to a maximum of 2/3 of the maximum filling volume.

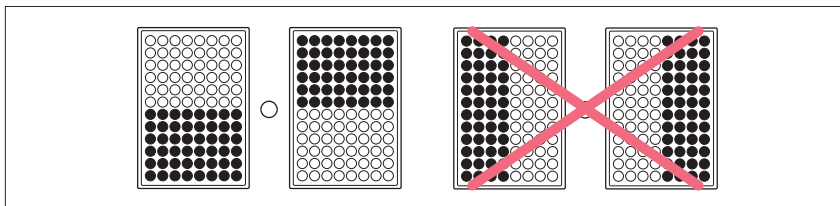
1. Check the bucket grooves for cleanliness and grease lightly with pivot grease (order no. int.: 5810 350.050 / North America: 022634330).

Dirty grooves and pivots prevent buckets from swinging out evenly.

2. Hang the buckets into the rotor.
3. Check that both buckets are hanging properly and can swing freely.
4. When using a plate type for the first time, carry out a manual loading and swing-out test.
5. Check maximum payload (adapter, plate and content) per bucket.

The relevant details can be found on the rotor and in this operating manual (see *Rotors on p. 12*).

6. Load the buckets symmetrically when inserting adapters and plates.



The plate arrangement shown on the right-hand side is incorrect, as the buckets will not swing properly. The plates have some play in the buckets.

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### 5.3.6 Closing the lid of the device

**WARNING! Device lid can crush. Keep hands clear.**

- ▶ Do not reach between the device and lid when opening or closing the device lid.

1. Check that the rotor is correctly positioned.
2. Close the lid of the device.

## 5.4 Concentration

Each of the applications described here must be preceded by the preparation described above (see *Preparation for concentration on p. 36*).

**WARNING! Risk of injury from improperly attached rotors.**

- ▶ Only operate the device if the rotor has been mounted properly.
- ▶ If there are any unusual noises when the device is started up, immediately press the **start/stop** key to stop concentrating.

**CAUTION! Risk from incorrectly loaded rotors and damaged/overloaded tubes!**

- ▶ Before commencing concentration, follow the safety instructions relating to risks from asymmetrically loaded and/or overloaded rotors and from overloaded and/or damaged tubes (see *Warnings for intended use on p. 18*).

**NOTICE! Overflowing of the emission condenser.**

The maximum filling volume of the emission condenser is 280 mL.

1. Check before each run whether the volume of the emission condenser is sufficient for your application.
2. Empty the emission condenser if necessary .



Unusual noise may occur when braking heavy rotors. This is construction-related and does not indicate a problem.



### 5.4.1 Concentration with time setting

Perform the following steps in the sequence described.

1. **time** arrow keys: Set the run time.
2. **brake**: Switch the brake on or off.
3. **temp**: Select the temperature (note the temperature resistance of the samples).
4. **mode/vent**: Select *V-AQ*, *V-AL* or *V-HV* mode.
5. **start/stop**: Start the concentration process.
  - The device lid is locked and the green **lid** indicator light goes out.
  - The rotor starts accelerating.
  - At 1,000 rpm the vacuum pump starts and the **vac** indicator light lights up.
  - The ventilation valve closes.
  - The rotor accelerates to its final speed of 1,400 rpm.
  - The colon in the time indicator on the display flashes as long as the rotor is turning.
  - The remaining run time is displayed in hours and minutes.

### 5.4.2 Concentration with continuous run



**CAUTION! Continuous delivery can affect safe operation of the device.**

When delivering liquids continuously, membranes and valves of the vacuum pump can be damaged.

- ▶ Only use the device for applications of limited duration.

Use the continuous run function if you do not want to set a fixed run time.

1. Use the **time** arrow keys to set the continuous run (oo); this can be achieved below 0:01 or above 9:59.
2. Set all other parameters as described above (see *Concentration with time setting on p. 41*).
3. Press **start/stop** to start the concentration process.  
The time is counted up in increments of 1 minute.
4. Press **start/stop** to stop the concentration process after the desired time period.



If the device runs for more than 9:59 h, 9:59 remains on the display.

### 5.4.3 During and after the concentration process

**While the device is running, you can:**

- Time setting: Change the total run time. The new parameters are adopted immediately. Please note that the shortest new total run time that can be set is the elapsed time plus 2 minutes.
- Change the braking function and temperature settings.
- Manually ventilate the rotor chamber by keeping the **mode/vent** key pressed. This will remove condensate from the device lid and flush the pump and the tubing.
- Determine how far the concentration has progressed using a stroboscope.
- Stop the concentration process even before the set run time has elapsed. To do so, press the **start/stop** key.

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### After completion of the concentration process

- The device stops automatically (time setting) or manually (continuous run).
- The elapsed concentration time will flash on the display during the braking process.
- The rotor chamber is ventilated so that the pressure in the rotor chamber increases slowly.
- After two seconds the vacuum pump switches off and the **vac** indicator light goes out.
- The device then decelerates.
- After the rotor has stopped the **lid** indicator light lights up.
- You can now open the lid and remove the samples.



If a temperature has been set, the rotor chamber is heated continuously, i.e. even when the rotor has stopped and the lid is open. Therefore switch the device off after completing the application or set the temperature to -- (no temperature set) if applicable.

#### 5.4.4 Completing the application

1. Let the device continue to run in *D-AQ* mode with an empty rotor for 15 minutes after completing the application.

#### 5.4.5 Removing the rotor and switching off the device



**Rotor A-2-VC:** First remove the buckets, then grip the rotor at the rotor cross with both hands to lift it out of the device.

1. Switch the heating off if applicable.
2. Remove the rotor.
3. Wipe up spilled liquid in the rotor chamber and on the device lid with an absorbent cloth.
4. Clean the rotor chamber and device lid as described separately.
5. Leave the device lid open and secure it against closing to allow any remaining liquid to evaporate.
6. Switch off the device at the mains/power switch.

#### 5.4.6 Emptying the emission condenser

1. There are two possibilities, depending on the design:
  - **The emission condenser is mounted to the side of the device:** Pull the tubing from the connection and empty the liquid into a collection vessel through the upper connection.
  - **The emission condenser is mounted to the front of the device:** Here you can remove the black plug in the vessel with a screwdriver and fit a special tap before using the device for the first time. Via this tap, you can then empty the liquid directly into a collection vessel.
2. Dispose of the liquid in accordance with the current legal requirements and regulations for your application.

## 5.5 User instructions on rotors

### 5.5.1 A-2-VC



**CAUTION! Wait for rotor to stop.**

During the post-run phase of Rotor A-2-VC, the device lid may open before the rotor has come to a stop if the plates are fully loaded.

- ▶ Always wait for a rotor stop to open the lid and remove the plates or tubes.



**NOTICE! If handled incorrectly, the rotor can fall over.**

The swing-bucket rotor may fall if the buckets are used as handles.

- ▶ Remove the buckets before inserting and/or removing a swing-bucket rotor.
- ▶ Always use both hands to carry the rotor cross.

## 5.6 Special function

### 5.6.1 Operation as a desiccator

With the desiccator function the rotor chamber is evacuated. However, the rotor is not turned.

You can place the sample tubes directly in the rotor chamber without a rotor or insert them into a rotor.

1. **mode/vent:** select the *D-AQ*, *D-AL* or *D-HV* mode.
2. Then proceed as with the concentrator function (see *Concentration on p. 40*).

### 5.6.2 Operation with gel dryer

On a complete system with a gel dryer connection, a gel dryer can be run in parallel to the operation as a concentrator and/or desiccator or used individually.



**WARNING! Danger of explosion from gas mixtures.**

When running several devices in parallel on a vacuum system or in combination with a gel dryer, an explosive gas mixture can develop in the vacuum system.

- ▶ Observe the solvent properties. Only carry out parallel operations with identical solvents or solvents that evaporate in a non-hazardous manner.

1. **mode/vent:** select the *V-AQ*, *V-AL*, *V-HV*, *D-AQ*, *D-AL* or *D-HV* mode.

We recommend the *V-HV* and *D-HV* modes.

If you use the gel dryer individually, you should use the *D-AQ*, *D-AL* or *D-HV* modes in order to protect the drive.

2. In contrast to the concentrator or desiccator function, open the tap of the gel dryer connection before operation ( knob points in flow direction) and close it again after operation.

When the gel dryer is operated without concentrator or desiccator function the device lid must also be closed as a vacuum cannot be generated otherwise.

3. Then proceed as with the concentrator function (see *Concentration on p. 40*).

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### 5.6.3 Operation as a centrifuge

With the centrifuge function, the rotor is turned. However, the rotor chamber is not evacuated.

1. **mode/vent**: select the *CEFU* mode.
2. Then proceed as with the concentrator function (see *Concentration on p. 40*).

As no vacuum is applied in this operating mode, the **mode/vent** key does not have any function during operation.

## 6 Maintenance

### 6.1 Maintenance

#### 6.1.1 Device

- ▶ Avoid the drying of saline, aqueous solutions on the material, and avoid long-term exposure of the material (aluminum) to acids and alkalis.
- ▶ Avoid the use of aggressive chemicals, including strong and weak alkalis, strong acids, solutions with mercury, copper and other heavy metal ions, halogenated hydrocarbons, concentrated saline solutions and phenol.
- ▶ For the frequent evaporation of corrosive liquids, apply a thin coat of pivot grease to the rotor and rotor chamber (order no. int.: 5810 350.050 / North America: 022634330).

#### 6.1.2 Pump

The chemical-resistant pump of the complete system does not need to be maintained by the user. However, the valves and diaphragms are subject to natural wear and tear.

- ▶ Regularly remove the condensation from the pump and the hose system. To do so, complete a 15 min run in *D-AQ* mode without samples.  
 This will prolong the service life of the consumables.
- ▶ Observe any changes in the time required for your application. If you notice any deterioration, have the valves and diaphragms checked by the authorized service.

### 6.2 Prepare cleaning/disinfection

- ▶ Clean all accessible surfaces of the device and the accessories at least weekly and when contaminated.
- ▶ Clean the rotor regularly. This way the rotor is protected and the durability is prolonged.
- ▶ Furthermore, observe the notes on decontamination (see *Decontamination before shipment on p. 48*) when the device is sent to the authorized Technical Service for repairs.

The procedure described in the following chapter applies to the cleaning as well as to the disinfection or decontamination. The table below describes the steps required on top of this:

Cleaning	Disinfecting/decontamination
<ol style="list-style-type: none"> <li>1. Use a mild cleaning fluid to clean the accessible surfaces of the device and the accessories.</li> <li>2. Carry out the cleaning as described in the following chapter.</li> </ol>	<ol style="list-style-type: none"> <li>1. Choose the disinfection method which corresponds to the legal regulations and guidelines in place for your range of application. For example, use alcohol (ethanol, isopropanol) or alcohol-based disinfectants.</li> <li>2. Carry out the disinfection or decontamination as described in the following chapter.</li> <li>3. Then clean the device and the accessories.</li> </ol>



If you have any further questions regarding the cleaning and disinfection or decontamination or regarding the cleaning fluid to be used, contact the Eppendorf AG Application Support. The contact details are provided on the back of this manual.

## 6.3 Cleaning/disinfection



### **DANGER! Electric shock as a result of penetration of liquid.**

- ▶ Switch off the device and disconnect the power plug before starting cleaning or disinfection work.
- ▶ Do not allow any liquids to penetrate the inside of the housing.
- ▶ Do not spray clean/spray disinfect the housing.
- ▶ Only plug the device back in if it is completely dry, both inside and outside.



### **NOTICE! Damage from the use of aggressive chemicals.**

- ▶ Do not use any aggressive chemicals on the device or its accessories, such as strong and weak bases, strong acids, acetone, formaldehyde, halogenated hydrocarbons or phenol.
- ▶ If the device has been contaminated by aggressive chemicals, immediately clean it by means of a mild cleaning agent.



### **NOTICE! Corrosion from aggressive cleaning agents and disinfectants.**

- ▶ Do not use corrosive cleaning agents, aggressive solvents or abrasive polishes.
- ▶ Do not incubate the accessories in aggressive cleaning agents or disinfectants for a longer period of time.



### **NOTICE! Damage from UV and other high-energy radiation.**

- ▶ Do not use UV, beta, gamma, or any other high-energy radiation for disinfecting.
- ▶ Avoid storage in areas with strong UV radiation



### **Autoclaving**

All rotors, buckets and adapters can be autoclaved (121 °C, 20 min.).

### 6.3.1 Cleaning and disinfecting the device

1. Inspect the device for corrosion and damage.
2. Open the lid. Switch the device off at the mains/power switch. Disconnect the power plug from the power supply.
3. Remove the rotor.
4. Clean and disinfect all accessible surfaces of the device, including the power cable, using a damp cloth and the recommended cleaning agents.
5. Thoroughly clean the rubber seals of the rotor chamber with water.
6. Rub the dry rubber seal with glycerol or talcum powder to prevent it from becoming brittle. Other components of the device, such as the motor shaft and rotor cone, must not be lubricated.
7. Check the motor shaft for damage.
8. Clean the motor shaft with a soft, dry and lint-free cloth. Do not lubricate the motor shaft.
9. Leave the centrifuge lid open when the device is not being used.
10. Only connect the device to the power supply if it is fully dry inside and out.

### 6.3.2 Cleaning and disinfecting the rotor

1. Inspect the rotor and accessories for damage and corrosion. Do not use any damaged rotors or accessories.
2. Clean and disinfect the rotors and accessories with the recommended cleaning agents.
3. Rinse the rotors and accessories thoroughly with water.
4. Place rotors and accessories on a towel to dry.
5. Inspect the rotor cone for damage.
6. Clean the rotor cone with a soft, dry and lint-free cloth. Do not lubricate the rotor cone.
7. Place the dry rotor onto the motor shaft.
8. Leave the rotor lid open when the rotor is not being used.

### 6.4 Breakage of glass

When using glass tubes there is a risk of glass breakage in the rotor chamber. The resulting glass splinters are swirled around in the rotor chamber during centrifugation and have a sandblasting effect on the rotor and accessories. The smallest glass particles become lodged in the rubber parts (e.g., the motor guide, the rotor chamber seal, and the rubber mats of adapters).



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**NOTICE! Glass breakage in the rotor chamber**

Glass tubes in the rotor chamber may break if the *g*-force is too high. Broken glass can damage the rotor, accessories and samples.

- ▶ Please note the manufacturer's information on the recommended centrifugation parameters (load and speed).
- 

**Effects of glass breakage in the rotor chamber:**

- Fine black metal abrasion in the rotor chamber (in metal rotor chambers)
- The surfaces of the rotor chamber and accessories are scratched.
- The chemical resistance of the rotor chamber is reduced.
- Contamination of samples
- Wear on rubber parts

**How to proceed in case of glass breakage**

1. Remove all splinters and glass powder from the rotor chamber and accessories.
2. Thoroughly clean the rotor and rotor chamber.
3. If required, replace the adapters to prevent any further damage.
4. Check the rotor regularly for residues or damage.

**Maintenance**

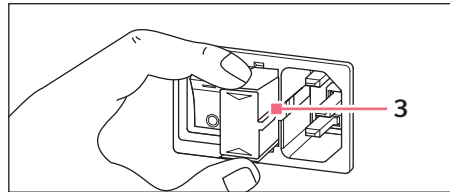
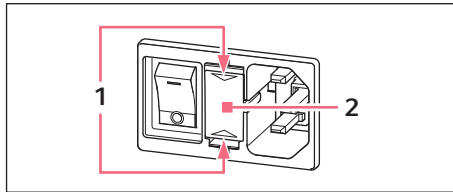
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## 6.5 Replacing fuses

**DANGER! Electric shock.**

- ▶ Switch off the device and disconnect the power plug before starting maintenance or cleaning work.

The fuse holder is located between the mains connection socket and the mains power switch.



1. Disconnect the power plug.
2. Press the upper and lower end of the plastic springs **1** together and pull the fuse holder **2** fully out.
3. Replace faulty fuses and reinsert the fuse holder. Make sure that the guiding rail **3** is positioned correctly.

## 6.6 Decontamination before shipment

If you are shipping the device to the authorized Technical Service for repairs or to your authorized dealer for disposal please note the following:

**WARNING! Risk to health from contaminated device**

1. Observe the notes on the decontamination certificate. You find it as a PDF file on our website ([www.eppendorf.com/decontamination](http://www.eppendorf.com/decontamination)).
2. Decontaminate all the parts you would like to dispatch.
3. Include the fully completed decontamination certificate in the package.



## 7 Troubleshooting

If you cannot remedy an error with the recommended measures, please contact your local Eppendorf partner. The contact address can be found online at: [www.eppendorf.com](http://www.eppendorf.com).

### 7.1 General errors

Symptom/message	Cause	Remedy
No display.	No mains connection.	▶ Check mains connection.
No display.	Power failure.	▶ Check the mains fuse of the device . ▶ Check the mains fuse of the laboratory.
Lid of the device cannot be opened.	Rotor is still running.	▶ Wait for rotor to stop.
Lid of the device cannot be opened.	Power failure.	1. Check the mains fuse of the device (see <i>Replacing fuses on p. 48</i> ). 2. Check the mains fuse of the laboratory. 3. Activate the emergency lid release (see p. 51).
Device cannot be started.	Lid of the device is not closed.	▶ Close device lid.
Device shakes when it starts up.	Rotor loaded unsymmetrically.	1. Stop the device and load symmetrically. 2. Restart device.
No noticeable evaporation.	Damaged sealing ring in the lid of the device.	▶ Insert new sealing ring (see <i>Other accessories on p. 59</i> ).
Pump does not start up.	Pump is overloaded. Thermo switch in the motor winding of the pump triggered.	▶ Let the pump cool down.
Pump does not start up.	Overpressure in the exhaust gas line.	▶ Open the exhaust gas line.
No output.	Long, thin hoses.	▶ Select short hoses with a large cross-section.
No output.	Condensation in the pump.	▶ Let pump run for a few minutes and press the <b>mode/vent</b> key several times.
Temperature value flashes.	Deviation from set value by $\pm 5$ °C.	▶ Let the remaining heat from the previous run cool down. ▶ Reduce the excessive ambient temperature, if applicable.
Temperature value flashes fast.	Deviation from set value by $+ 10$ °C.	▶ Switch off external heat sources (e.g., halogen lamp).
Liquid collects in the hoses.		▶ Activate the ventilation function. ▶ Check the fall of the hoses.

**Troubleshooting**


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## 7.2 Error messages

If one of the following error messages appears, proceed as follows:

1. Remove fault (see Remedy).
2. Press the **start/stop** key to clear the error message.

If required, continue concentration and/or repeat.

Symptom/message	Cause	Remedy
<i>Error 1</i>	Drive fault.	▶ Contact Service.
<i>Error 2</i> <i>Error 3</i> <i>Error 4</i>	Drive blocked or stiff.	▶ Move the rotor by hand, remove any obstructions. ▶ Check the max. load of rotor. ▶ Check the rotor mounting.
<i>Error 5</i>	Drive fault.	▶ Contact Service.
<i>Error 7</i>	Error in the lid latch.	▶ Contact Service.
<i>Error 8</i>	Temperature sensor error.	▶ Contact Service.
<i>Error 9</i>	Electronics fault.	 Caution! The rotor chamber temperature may be > 72°C. ▶ Contact Service.
<i>Error 10</i>	Heater defective.	▶ Contact Service.
<i>Error 12</i> <i>Error 14</i> <i>Error 16</i>	Electronics fault.	▶ Contact Service.
<i>IMBAL</i>	Rotor loaded unsymmetrically.	▶ Load the rotor symmetrically and balance it.

### 7.3 Opening the device in case of a power failure

If the device lid cannot be opened during a power failure, you can activate the emergency lid release manually.



**WARNING! Risk of injury from rotating rotor.**

If the emergency release of the lid is operated, the rotor may continue rotating for several minutes.

- ▶ Wait until the rotor stop before operating the emergency release.
- ▶ Check the monitoring glass in the centrifuge lid.



If there is a power failure, the vent valve will open. Before the rotor comes to a full stop, the standard pressure in the rotor chamber will be restored.

1. Disconnect the power plug.
2. Insert a wire (max. 2.5 mm thick, e.g., a paper clip) into the opening on the right-hand side of the housing (see point 5 in Fig. A and Fig. B on the front fold-out page), and push against the noticeable resistance.

This will release the device lid.

3. Open the device lid slightly.
4. Remove the wire.
5. Open the device lid fully.

**Troubleshooting**

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## 8 Transport, storage and disposal

### 8.1 Transport

- ▶ Only transport the device in its original packaging.

	Air temperature *	Rel. humidity	Atmospheric pressure
General transport	-25 to 60 °C / -10 to 60 °C	10 to 95%	30 to 106 kPa
Air freight	-40 to 55 °C / -10 to 55 °C	10 to 95%	30 to 106 kPa

\*) Basic device / complete system

### 8.2 Storage

	Air temperature *	Rel. humidity	Atmospheric pressure
Device in transport package	-25 to 55 °C / -10 to 55 °C	10 to 95%	70 to 106 kPa
Device without transport package	-5 to 45 °C	10 to 95%	70 to 106 kPa

\*) Basic device / complete system

### 8.3 Disposal

In case the product is to be disposed of, the relevant legal regulations are to be observed.

**Information on the disposal of electrical and electronic devices in the European Community:**

Within the European Community, the disposal of electrical devices is regulated by national regulations based on EU Directive 2002/96/EC pertaining to waste electrical and electronic equipment (WEEE).

According to these regulations, any devices supplied after August 13, 2005, in the business-to-business sphere, to which this product is assigned, may no longer be disposed of in municipal or domestic waste. To document this, they have been marked with the following identification:



Because disposal regulations may differ from one country to another within the EU, please contact your supplier if necessary.

In Germany, this is mandatory from March 23, 2006. From this date, the manufacturer has to offer a suitable method of return for all devices supplied after August 13, 2005. For all devices supplied before August 13, 2005, the last user is responsible for the correct disposal.

## 9 Technical data

### 9.1 Power supply

	<b>5305 Basic device</b>	<b>5305 Complete system</b>
Mains connection:	230 V, 50 to 60 Hz 120 V, 50 to 60 Hz 100 V, 50 to 60 Hz	230 V, 50 to 60 Hz 120 V, 50 to 60 Hz 100 V, 50 to 60 Hz
Current consumption:	2.1 A (230 V) 6.0 A (120 V) 5.2 A (100 V)	1.7 A (230 V) 5.6 A (120 V) 3.8 A (100 V)
Power consumption:	max. 500 W (230 V) max. 550 W (120 V) max. 520 W (100 V)	max. 350 W (230 V) max. 400 W (120 V) max. 380 W (100 V)
Overvoltage category:	II	
Fuses:	4.0 AT (230 V) 6.3 AT (120 V/100 V)	

### 9.2 Ambient conditions

Environment:	Only for use indoors.
Ambient temperature:	15 to 35 °C
Max. relative humidity:	75 %, non-condensing humidity
Atmospheric pressure:	79,5 kPa – 106 kPa
Degree of pollution	2

### 9.3 Weight/dimensions

	<b>Basic device</b>	<b>Complete system with connection for external device</b>
Dimensions:	Width: 330 mm (12.6 in.) Depth: 372 mm (14.5 in.) Height: 231 mm (9.1 in.)	Width: 330 mm (12.6 in.) Depth: 579 mm (20.9 in.) Height: 290 mm (11.7 in.)
Weight without rotor:	16.5 kg (37.5 lbs.)	31.5 kg (68.3 lbs.)
Noise level:	≤ 50 dB(A)	≤ 50 dB(A)

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#### 9.4 Diaphragm vacuum pump of the complete system

Max. current:	1.4/1.6 A (230 V, 50/60 Hz) 3.0 A (120 V, 50 Hz) 3.6/3.8 A (100 V, 50/60 Hz)
Max. power:	180 W (230/120/100 V)
Motor protection:	Thermal winding protection
Protection class according to IEC 529:	IP 54
Suction capacity (in accordance with DIN EN 60529; VDE 0470-1):	1.9/2.1 m <sup>3</sup> /h (50/60 Hz)
Achievable ultimate pressure (absolute):	<20 mbar
Max. permissible pressure at the outlet (absolute):	2 bar
Max. differential pressure between inlet and outlet:	1 bar
Maximum speed at 50/60 Hz:	1,500/1,800 rpm
Radio interference protection class:	B

#### Materials of the surfaces that are in contact with the medium

Inner part of housing cover:	PTFE, with carbon reinforcement
Head cover, diaphragm clamping disk:	ETFE, with carbon reinforcement
Valve:	FFKM
Diaphragm:	PTFE
Inlet:	ETFE
Outlet:	ETFE
Screw connection:	ETFE
Hose:	PTFE

#### 9.5 Application parameters

Run time:	1 min to 9:59 h, unlimited (∞), adjustable in 1 min. increments.
Rotational speed:	1,400 rpm, not adjustable
Max. relative centrifugal force (RZB or rcf):	248 x g, not adjustable
Max. load:	144 tubes/2 microplates (0.2 to 50 mL)
Permissible density of the material for centrifuging (at max. g-force/speed and max. load):	1.2 g/mL
Emission condenser volume:	280 mL



## 10 Ordering information

### 10.1 Complete system

Order no. (International)	Order no. (North America)	Description
5305 000.304 5305 000.312 5305 000.347	- 5305000312 -	<b>Concentrator plus/Vacufuge plus complete system</b> with rotor F-45-48-11 230 V/50 – 60 Hz, with integrated diaphragm vacuum pump 120 V/50 – 60 Hz, with integrated diaphragm vacuum pump 100 V/50 – 60 Hz, with integrated diaphragm vacuum pump
5305 000.509 5305 000.517 5305 000.541	- 5305000517 -	<b>Concentrator plus/Vacufuge plus complete system</b> without rotor 230 V/50 – 60 Hz, with integrated diaphragm vacuum pump 120 V/50 – 60 Hz, with integrated diaphragm vacuum pump 100 V/50 – 60 Hz, with integrated diaphragm vacuum pump
5305 000.703 5305 000.711 5305 000.746	- 5305000711 -	<b>Concentrator plus/Vacufuge plus complete system</b> with connection, e.g., for a gel dryer, without rotor 230 V/50 – 60 Hz, with integrated diaphragm vacuum pump 120 V/50 – 60 Hz, with integrated diaphragm vacuum pump 100 V/50 – 60 Hz, with integrated diaphragm vacuum pump

### 10.2 Basic device

Order no. (International)	Order no. (North America)	Description
5305 000.100 5305 000.118 5305 000.142	- 5305000118 -	<b>Concentrator plus/Vacufuge plus basic device</b> with rotor F-45-48-11 230 V/50 – 60 Hz 120 V/50 – 60 Hz 100 V/50 – 60 Hz

### 10.3 Fuses

Order no. (International)	Order no. (North America)	Description
5301 850.249 5417 341.007	022654403 022375831	<b>Fuse</b> 4.0 A T (230 V), 2 pieces 6.3 A T UL (120 V/100 V), 2 pieces

**Ordering information**Concentrator plus/Vacufuge® plus  
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## 10.4 Accessories

## 10.4.1 Rotors

Order no. (International)	Order no. (North America)	Description
5490 034.007	022822080	<b>Rotor F-45-72-8</b> 72 positions for 0.5 mL tubes
5490 032.004	022822047	<b>Rotor F-45-70-11</b> 70 positions for 1.5/2.0 mL tubes
5490 030.001	022822004	<b>Rotor F-45-48-11</b> 48 positions for 1.5/2.0 mL tubes
5490 036.000	022822144	<b>Rotor F-45-24-12</b> 24 positions for 6.0/8.0 mL round-bottom tubes (12 × 67-100 mm)
5490 041.003	022822233	<b>Rotor F-50-8-16</b> 8 positions for 15.0/20.0 mL round-bottom tubes (16 × 105-120 mm)
5490 042.000	022822179	<b>Rotor F-50-8-18</b> 8 positions for 15.0/20.0 mL round-bottom tubes (18 × 105-128 mm)
5490 038.002	022822225	<b>Rotor F-45-8-17</b> 8 positions for 15 mL conical tubes (17 × 118-123 mm)
5490 040.007	022822209	<b>Rotor F-40-36-12</b> 36 positions for 1.5 mL flat-bottom tubes (12 × 32 mm)
5490 035.003	022822128	<b>Rotor F-45-36-15</b> 36 positions for 3.0/5.0 mL flat-bottom tubes (15 × 48 mm)
5490 043.006	022822136	<b>Rotor F-45-16-20</b> 16 positions for 6.5/10.0 mL flat-bottom tubes (20 × 42-55 mm)
5490 037.006	022822161	<b>Rotor F-40-18-19</b> 18 positions for 10.0 mL flat-bottom tubes (19 × 66 mm)
5490 044.002	022822217	<b>Rotor F-45-12-31</b> 12 positions for 20.0 mL flat-bottom tubes (31 × 55 mm)
5490 039.009	022822187	<b>Rotor F-35-8-24</b> 8 positions for 25.0 mL flat-bottom tubes (24 × 86-90 mm)
5490 047.001	022822231	<b>Rotor F-35-6-30</b> 6 positions for 15 mL conical tubes (17 × 116-123 mm) and 50 mL conical tubes (29.5 × 116-123 mm)
5490 045.009	022822241	<b>Rotor A-2-VC</b> incl. 2 buckets

### 10.4.2 Adapters

Order no. (International)	Order no. (North America)	Description
0030 124.235	951010031	<b>Work tray</b> for 96 × 0.2 mL PCR tubes, 5-/8-PCR tube strips and plates without border set of 10 pieces
0030 124.243	951010049	<b>Frame for work tray</b> set of 5 pieces
5825 706.005	022638963	<b>Adapter</b> used in A-2-VC CombiSlide Adapter, set of 2
5425 715.005 5425 717.008 5425 716.001	022636260 022636243 022636227	<b>Adapter</b> used in F-45-48-11 and F-45-70-11 for 1 PCR tube (0.2 mL, max. Ø 6 mm), set of 6 for 1 sample tube (0.4 mL, max. Ø 6 mm), set of 6 for 1 sample tube (0.5 mL, max. Ø 6 mm) or 1 Microtainer (0.6 mL, max. Ø 8 mm), set of 6

### 10.4.3 Other accessories

Order no. (International)	Order no. (North America)	Description
5301 316.005	022822101	<b>Spacer for simultaneous operation of two rotors</b> for F-45-72-8 and F-45-48-11
5301 330.008	022830309	<b>Emission condenser</b> without tube
5301 337.002	022830295	<b>Tube for emission condenser</b> length: 0.7 m
5301 110.032	5301110032	<b>Tube connection</b> Plastic
5301 010.003 5301 033.003	- 022830110	<b>Special plug for external vacuum pump &lt; 400 W</b> 230 V (Germany), different options upon request 120 V, different options upon request
5301 030.004 5301 036.002	022830104 022830112	<b>Solenoid valve for external vacuum pump</b> Only suitable for aqueous and alcoholic solvents. 230 V, 50 – 60 Hz 120 V
5301 160.005	022830201	<b>Sealing ring</b> for lid
5810 350.050	022634330	<b>Pivot grease</b> Tube 20 mL
5490 030.800	022830520	<b>Rotor feet for F-45-72-8 and F-45-48-11</b> Set of 3

**Ordering information**

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# EG-Konformitätserklärung EC Conformity Declaration

Das bezeichnete Produkt entspricht den einschlägigen grundlegenden Anforderungen der aufgeführten EG-Richtlinien und Normen. Bei einer nicht mit uns abgestimmten Änderung des Produktes oder einer nicht bestimmungsgemäßen Anwendung verliert diese Erklärung ihre Gültigkeit.

The product named below fulfills the relevant fundamental requirements of the EC directives and standards listed. In the case of unauthorized modifications to the product or an unintended use this declaration becomes invalid.

Produktbezeichnung, Product name:

Concentrator plus / Vacufuge<sup>®</sup> plus basic device

Concentrator plus / Vacufuge<sup>®</sup> plus complete system

Produkttyp, Product type:

Vakuumkonzentrator / Vacuumconcentrator

einschließlich Zubehör / including accessories

Einschlägige EG-Richtlinien/Normen, Relevant EC directives/standards:

2006/95/EG, EN 61010-1, EN 61010-2-010, EN 61010-2-20

2004/108/EG, EN 61326-1/B, EN 61000-3-2, EN 61000-3-3, EN 61000-4-14

2011/65/EU



Vorstand, Board of Management:



Projektmanagement, Project Management:

01.08.2011

Hamburg, Date:

**eppendorf**



Eppendorf AG · Barkhausenweg 1 · 22339 Hamburg · Germany

# Certificate of Compliance

Certificate Number 20101104-E215059  
Report Reference E215059-A2-UL, 2010 September 17  
Issue Date 2010 November 4

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*Issued to:* **EPPENDORF A G**

BARKHAUSENWEG 1  
22339 HAMBURG GERMANY

*This is to certify that  
representative samples of*

**Laboratory Use Electrical Equipment**

Centrifuge  
Vacufuge plus and Vacufuge plus System, model 5305

*Have been investigated by Underwriters Laboratories Inc.® (UL) or any authorized  
licensee of UL in accordance with the Standard(s) indicated on this Certificate.*

*Standard(s) for Safety:*

UL 61010-1, Second Edition  
CAN/CSA-C22.2 No. 61010-1, Second Edition  
IEC 61010-2-010 - Edition 2 - Issue Date 2003/06/01  
IEC 61010-2-020 - Edition 2 - Issue Date 2006/05/01

*Additional Information:*

See UL On-Line Certification Directory at [www.UL.com](http://www.UL.com) for additional  
information

**Only those products bearing the UL Listing Mark for the US and Canada should be considered as being covered by  
UL's Listing and Follow-Up Service meeting the appropriate requirements for US and Canada.**

The UL Listing Mark for the US and Canada generally includes: the UL in a circle symbol with "C" and "US" identifiers:

 the word "LISTED"; a control number (may be alphanumeric) assigned by UL; and the product category name  
(product identifier) as indicated in the appropriate UL Directory.

**Look for the UL Listing Mark on the product**

William R. Carney Director,

North American Certification Programs

Underwriters Laboratories Inc.

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