

# diagenode

Innovating Epigenetics Solutions

## Bioruptor<sup>®</sup> Pico Sonication System



USER GUIDE

Version 3 01\_2020

# Guarantee

## Limited 5 years global warranty

Diagenode guarantees the Bioruptor Pico from any manufacturing defects as we rigorously test it to meet strict quality standards. Diagenode warrants that all standard components of the instrument will be free of defects in materials and workmanship for a period of five (5) years or for maximum 210 hours of total running time\* from the date that the warranty period begins, unless the original quotation or accompanying documentation states a different warranty period. The warranty period begins on the date of delivery and apply only to the first purchaser of the product. The warranty period expires when one of the two above conditions ends (5 years or 210 hours of total running time\*). If a manufacturing defect arises and a valid claim is received within the warranty period, Diagenode, at its discretion, will repair or replace the product in accordance with the warranty terms and conditions stated herein. In case of repair or replacement of a product under warranty, Diagenode will cover the expenses to return the repaired or replacement product.

This warranty covers only manufacturing defects and does not cover any damage caused by misuse, lack of compliance to recommendations stated in the manual, neglect, accidents, abrasion, or exposure to extreme temperatures, chemical solvents, or acids. Improper or incorrectly performed maintenance or repairs will void the warranty.

\*The total running time corresponds to total sonication time ON + total sonication time OFF that compose the cycles of the shearing process.

## Technical assistance & ordering information

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<https://www.diagenode.com/en/pages/support>

Looking for the manual of the previous version? Follow this link :

[https://www.diagenode.com/files/products/shearing\\_technology/bioruptor/Bioruptor\\_pico\\_cooler\\_manual.pdf](https://www.diagenode.com/files/products/shearing_technology/bioruptor/Bioruptor_pico_cooler_manual.pdf)

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BIORUPTOR® PICO

# Critical steps for maintenance and efficient shearing

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## General warnings

### DON'T

- ❌ Turn on the instrument without water
- ❌ Exceed 30 min of total sonication
- ❌ Tilt the sonication unit

### DO

- ✅ Change water at least once every month
- ✅ Use deionized or distilled water
- ✅ QC your system with our DNA QC Kit

## Sonication bath temperature

- Optimal temperature for sonication is 4°C. Sample temperature should not exceed 8°C.
- The Bioruptor Cooler (Cat. No. B02010010, B02010011, B02010012) has to be used to guarantee the automatic temperature control of the sonication bath during the entire sonication process.

## Validated tubes for the Bioruptor® Pico

- DNA shearing: 0.2 ml (Cat.No. C30010020) and 0.65 ml (New Cat. No. C30010011; Old Cat. No. WA-005-0500) Bioruptor® Microtubes for DNA shearing.
- Chromatin shearing: 0.2 ml (Cat.No. C30010020) and 1.5 ml (Cat.No. C30010016) Bioruptor® Microtubes and 15 ml (Cat.No. C01020031) Bioruptor® Tubes & sonication beads.

## Fitting tubes in the tube holder

- Place the tubes in the corresponding tube holder. Never leave empty spaces in the tube holder. Fill the empty spaces with tubes containing the same volume of water. Screw the lid on the tube holder without over-tightening it.
- Carefully place the tube holder on the holding plate.
- During sonication, samples must remain at the bottom of the tube. If needed, briefly centrifuge samples during sonication after pausing the run.

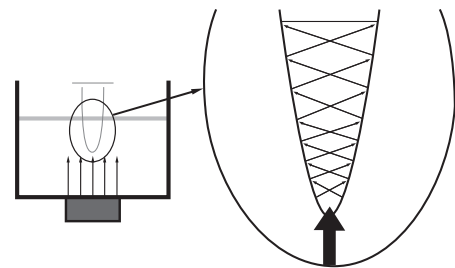
# Introduction

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Diagenode's Bioruptor Pico uses a gentle method of sonication to retain the integrity of DNA and/or biological complexes, including chromatin, protein-protein binding, protein-DNA complexes and other biochemical and biological assay systems. The Bioruptor Pico sonication system uses a sonication bath to generate indirect sonication waves, which emanate from an ultrasound element below the water tank. Because the system is gentler than other sonicators, the Bioruptor Pico produces better and more consistent results than with harsher sonication methods. Up to 16 closed tubes can be sonicated in parallel and the continuous rotation of tubes allows even distribution of the energy for efficient sonication. The Bioruptor Pico enables automation of sonication, guaranteeing higher reproducibility of results.

## The effect of ultrasound on biological sample

The Bioruptor Pico sonication system uses ultrasound to create focused mechanical stress to shear chromatin or DNA, remove paraffin from FFPE samples, disrupt cells and homogenize tissue, or disperse chemical component, or reduce the size of liposomes. Ultrasound waves pass through the sample expanding and contracting the liquid. During expansion, negative pressures pull the molecules away from one another to form a cavity or bubble. This process is called cavitation. The bubble continues to absorb energy until it can no longer sustain itself and implodes. This produces intense focused shearing forces, that disperse and break biomolecules. The fragmentation of chromatin or DNA takes place as a consequence of this mechanical stress or shear. With the Bioruptor Pico, the entire volume of water present in the sonication bath is exposed to ultrasound, allowing all the samples to be efficiently sonicated in parallel.



## Use of Bioruptor® Pico by pregnant women

Exposure to 20-60 kHz sound waves has not been shown to be harmful to human health. However, we would recommend avoiding unnecessary exposure. Diagenode recommends that pregnant women should not be exposed to 20-60 kHz wave lengths for a long period of time.

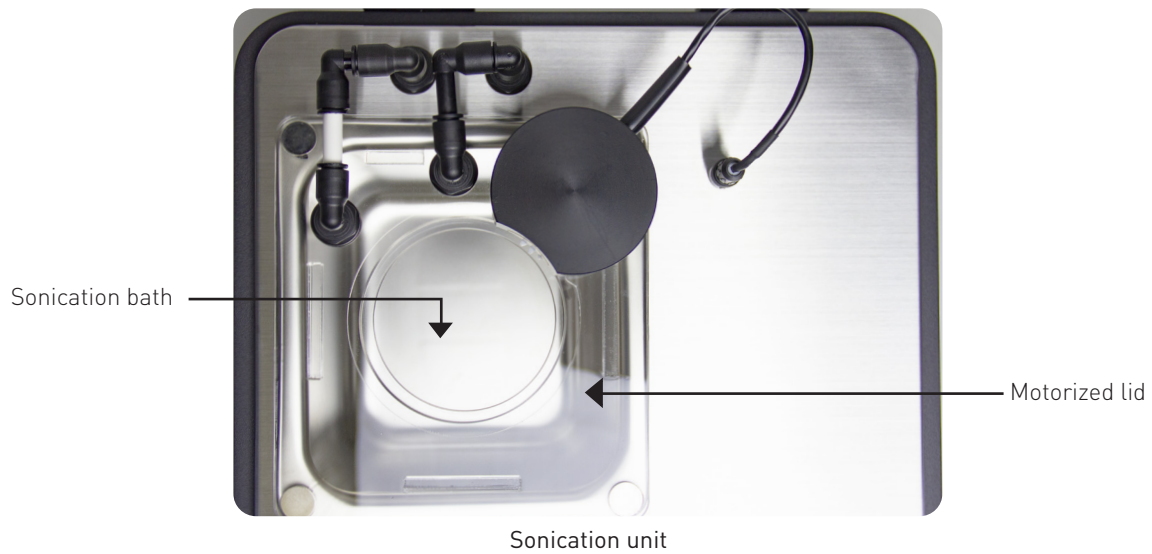
# Bioruptor Pico technical specifications

BIORUPTOR® PICO	
Input Voltage Range	100 - 240 V
Input Frequency Range	50 - 60 Hz
Maximum Electrical Consumption	4.2 A
Ultrasonic Wave Frequency	20 - 60 kHz
Unit Dimensions <ul style="list-style-type: none"> <li>• The sonicator</li> <li>• The cooler</li> </ul>	380 (W) x 315 (D) x 275 (H) mm 200 (W) x 390 (D) x 495 (H) mm
Weight <ul style="list-style-type: none"> <li>• The sonicator</li> <li>• The cooler</li> </ul>	9 kg 26.9 kg
Placement	Indoor areas
Ambient Temperature Range	15 - 25°C
Maximum Relative Humidity	80%
Altitude	Up to 2,000 meters
Degree of protection	IP31
Shearing Accessories	<ul style="list-style-type: none"> <li>• Tube holder for 0.2 ml tubes <i>Cat. No. B01201144</i></li> <li>• Tube holder for 0.65 ml tubes <i>Cat. No. B01201143</i></li> <li>• Tube holder for 1.5 ml tubes <i>Cat. No. B01201140</i></li> <li>• 15 ml sonication accessories <i>Cat. No. B01200016</i></li> </ul>
Shearing Consumables	<ul style="list-style-type: none"> <li>• 0.2 ml Bioruptor Pico Microtubes Cat. No. C30010020</li> <li>• 0.65 ml Bioruptor Pico Microtubes Cat. No. C30010011</li> <li>• 1.5 ml Bioruptor Pico Microtubes Cat. No. C30010016</li> <li>• 15 ml Bioruptor Pico Tubes Cat. No. C30010017</li> <li>• 15 ml Bioruptor Pico Tubes &amp; sonication beads Cat. No. C01020031</li> </ul>
Throughput	<ul style="list-style-type: none"> <li>• 0.2 ml microtubes - 16 samples</li> <li>• 0.65 ml microtubes - 12 samples</li> <li>• 1.5 ml microtubes - 6 samples</li> <li>• 15 ml tubes - 6 samples</li> </ul>
Sample Volume Range	<ul style="list-style-type: none"> <li>• 0.2 ml microtubes - 20-100 µl</li> <li>• 0.65 ml microtubes - 100 µl</li> <li>• 1.5 ml microtubes - 100-300 µl</li> <li>• 15 ml tubes - 500 µl - 2 ml</li> </ul>
Fragment Length Range Achievable	150 - 1,000 bp
Working Temperature Range	2 - 20°C
Variable Parameters	Time ON, Time OFF, # cycles, level of frequency
User Interface	Touchscreen with Bioruptor Pico software



# Getting to know your Bioruptor Pico system

## Bioruptor Pico components overview



Power cable (EU)



Power cable (US)



Tube holder

## Bioruptor Cooler (detailed instructions page 21)



## Sonication bath

The sonication bath is a critical component of the instrument. The generators below the tank produce ultrasonic waves which are then transferred through water. The sonication bath requires special handling and care as described below.

### Handling

The sonication unit must remain upright at all times, especially when moved. Tilting the sonication unit or handling roughly may damage the ultrasound emitter component, resulting in a substantial drop in sonication efficiency. If transportation of the apparatus is required after initial set-up, it is imperative to keep the sonication unit at a right angle to the ground during the transport at all times.

### Water quality

The water bath must be filled with purified water according to specification (see table) to the fill line. Change water at least every month and clean sonication tank with a soft tissue.

	<b>GRADE OF WATER</b>	<b>COMPATIBILITY WITH THE BIORUPTOR</b>
Ultrapure water	Type 1 or Type 1+	No
Deionized water	Type 2+ or Type 2	Yes
Distilled water	Type 3	Yes
Tap water	N/A	No

### Water temperature

The water in the sonication bath must be kept at 4°C. Ultrasonic waves produced by the Bioruptor Pico generate heat. Drop off in sonication efficiency will occur above 8°C. To ensure preservation of the samples and to prevent damage to the instrument, it is necessary to start the sonication process with cold water and to keep it at 4°C during the sonication process.

### Automatic temperature control

The Bioruptor Cooler (Cat. No. B02010010, B02010011, B02010012) to guarantee the automatic temperature control of the sonication bath during the entire sonication process. The cooling system produces a regular water flow to maintain a constant water level in the

tank. The integrated regulating valve ensures that water will only be replaced during the off cycle to avoid any interference between the water flow and the sonication process.



### Motorized lid

The motorized lid, along with the gear plate accessory, keeps the sample tubes in constant rotation and ensures optimal position in the sonication bath during sonication. Avoid the immersion of the motor into the water.



### Tube holders

Several sizes of tubes can be used with the Bioruptor Pico.

The minimum and maximum sample volume to be used with each tube is given in the table below.

TUBE SIZE	MINIMUM	MAXIMUM
0.2 ml	20 µl	100 µl
0.65 ml	100 µl	100 µl
1.5 ml	100 µl	300 µl
15 ml	500 µl	2 ml

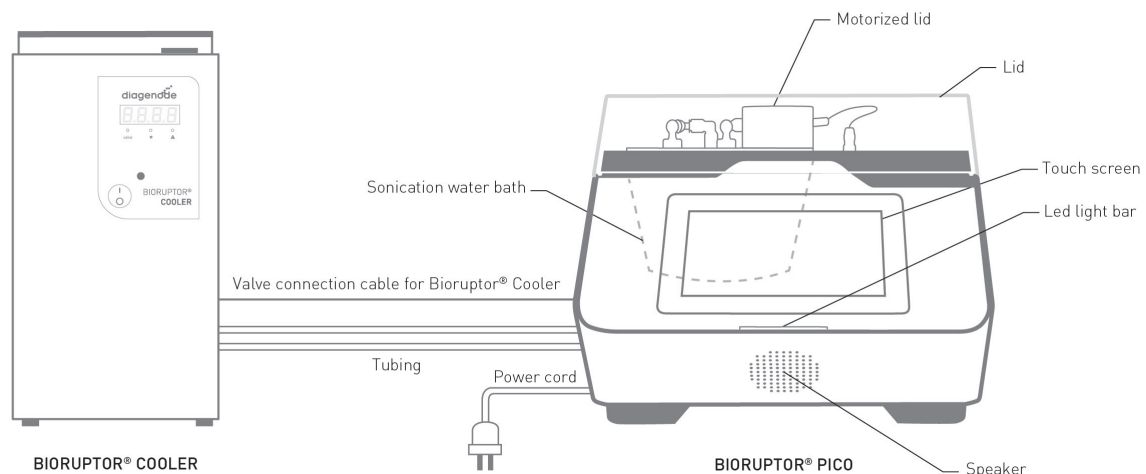
# Equipment installation

The following pages contain information on installing your particular Bioruptor Pico model. This equipment must only be installed by personnel after reading this section. Consider all hazards even though no particular hazards have been identified during installation. Before starting installation work, turn the main switch off and secure the unit against being re-energized. No special tools are required. One square meter is needed to set-up the Bioruptor Pico.

Devices are designed to be safe under the following conditions:

- Indoor use
- Altitude up to 2,000 meters
- Operating external temperature 15°C to 25°C **(do not install the Bioruptor in a cold room)**
- Maximum relative humidity 80%
- Transient overvoltage typically present on the MAINS supply
- Degree of protection: IP31
- Power plug must be grounded
- POLLUTION DEGREE 2 (Normally only non-conductive pollution occurs. However, occasionally a temporary conductivity caused by condensation is expected)
- Never install this equipment in a place where environmental conditions and warnings mentioned above are infringed

## Installation overview



*Fig. Schematic installation overview of the Bioruptor Pico System in combination with the Bioruptor Cooler.*

# Installing the Bioruptor Pico system

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Before starting the installation, turn the main switches off and make sure that the unit is not plugged into an electrical outlet.

1. Open the boxes and unpack all components.



Bioruptor® Pico



Bioruptor® Cooler

2. Place the Bioruptor on a bench.
  - **Important Note:** Please make sure that the Bioruptor Pico is always placed on a level surface.
3. Place the Bioruptor Cooler on the bench or below the Bioruptor.
4. Connect the Bioruptor Pico to the Bioruptor Cooler with the cooling long red and blue isolated tubing by inserting them into the connectors (Optional: Cut the length you need for the output and input flow. Make sure there is enough slack).
5. Fill the tank of the Bioruptor Cooler with 2 - 3 liter and the sonication bath of the Bioruptor with 700 ml.
6. Plug the valve connection cable into the outlet on the back side of the Bioruptor Cooler and on the Bioruptor Pico.
7. Plug the power cord into the outlet and switch on the power switch on the back side of the sonication unit.
8. Plug the power cord into the outlet of the Bioruptor Cooler.
9. Press main switch on the front side of the Bioruptor Cooler.
10. Set the temperature to 4°C.
11. Detailed operating instructions for the Bioruptor Cooler are available at page 21.

# System operation

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Touch screen: Allows the user to easily program the sonication of samples.

## INTERFACE



**Go & Shear:** Start a new shearing protocol



**User Protocols:** Record your protocol



**Guidelines:** Read Diagenode recommendations for your applications



**Good Practices:** Critical steps for Bioruptor maintenance and efficient shearing



**Maintenance:** Access for administrators



**Information:** General information about your Bioruptor Pico



**Edit:** Edit the parameter



**Question mark:** Some notes to guide you



**Settings:** Visualize and change the parameters of your Bioruptor Pico



**Sound:** Adjust the sound level



**Brightness:** Adjust the brightness of the screen



**Language:** Choose your voice language



**Diagenode dots:** Go back to the top menu



**Technical Support:** Diagenode contact information for technical questions



**Commercial Support:** Diagenode contact information for commercial questions

## LED LIGHT BAR

The LED light bar allows the tracking of the processing of your samples.

The **blue light** means the system is waiting for the operator.

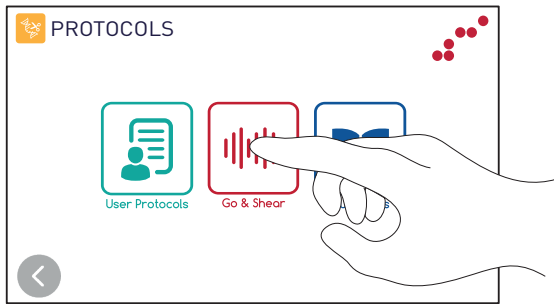
The **progressive green light** indicates the progression of the shearing process.

The **green light** indicates the end of the shearing process.

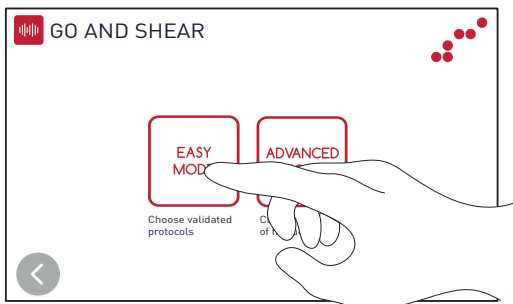
The **orange light** means the protocol is on pause.

The **red light** indicates an alert message.

## START SHEARING EXPERIMENT

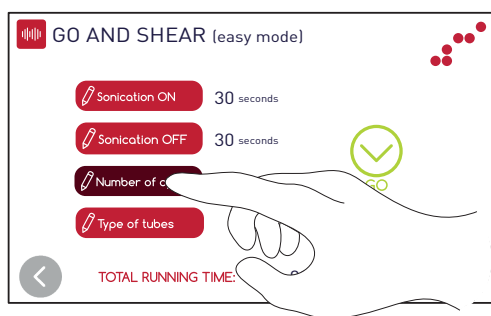


1. Click on '**Protocols**' icon of the top menu.
2. Click on '**Go & Shear**' icon to start a new protocol or click on '**User Protocols**' icon to find your pre-recorded shearing protocol.



3. Select your mode. Find validated parameters on the **Easy Mode** or optimize your protocol with different levels of frequency on the **Advanced Mode**.

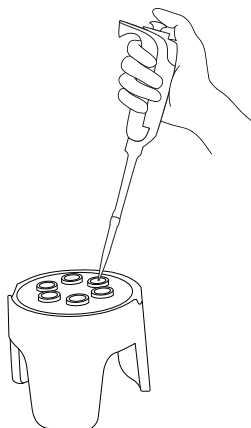
## ENTER PARAMETERS




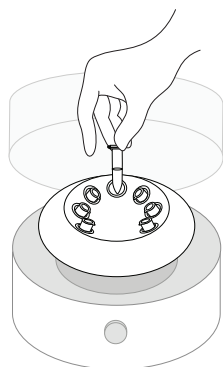
1. Enter the sonication **time ON**, the sonication **time OFF** and the number of **cycles**. These are the parameters controlling the shearing process:
  - the **time ON** is the time during which there is sonication;
  - the **time OFF** is the time during which there is no sonication but water circulation;
  - the **cycle** is made up of a **time ON** and a **time OFF**.
2. If **Easy Mode** was selected, select the tube type you plan to use. The Bioruptor will automatically swap to the correct frequency for optimal shearing of your samples. If **Advanced Mode** was selected, choose your level of frequency that is the most convenient for your application.



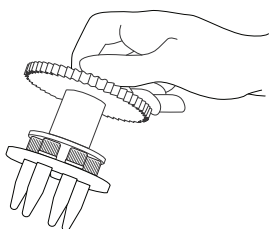
## PREPARE SAMPLES



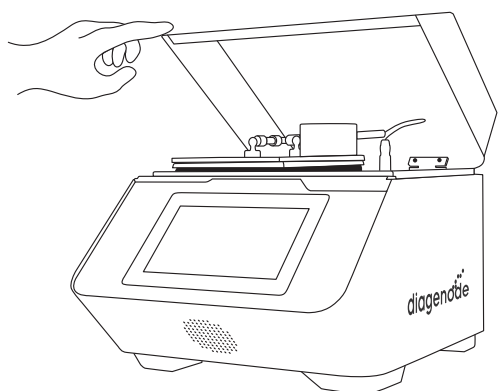
1. Fill the sonication tubes with same volume of sample. Use the recommended tubes and sample volumes for optimal shearing efficiency. Visit our Guidelines folder  for more information.



2. Vortex and then spin your samples.

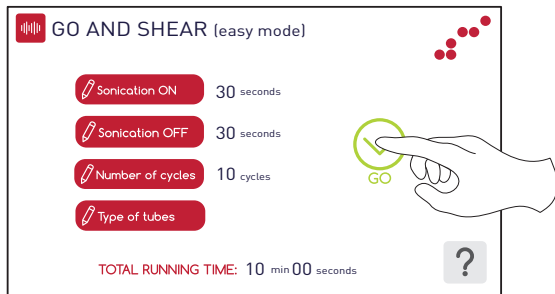


3. Fill all positions of the tube holder with your samples (or with water of same volume) and place it on the motorized lid.

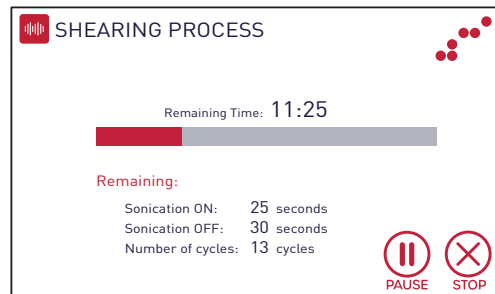


4. Close the lid to start the run. The sonication only starts when the cover is closed. The cover also prevents from any noise disturbance.

## START PROCESSING & MONITOR PROGRESS



1. Click “Go” to start the shearing process. You will then be asked to check water temperature and right setting of your samples.

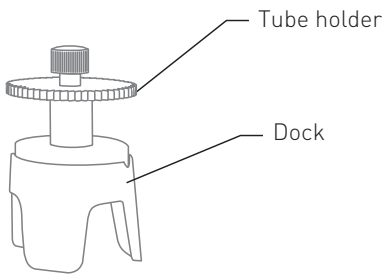


2. Once the run started, the running screen appears. The running screen indicates the elapsed time ON, time OFF and the number of cycles. A progress bar and the remaining time will be displayed on the screen. The led indicator lights up in green.

You can pause or interrupt the shearing process by pressing the button **pause** or **stop**, respectively. If the cover will be opened during a run the sonication will automatically pause. Once the cover is again closed the machine continues with the sonication process.

3. You will get a notification on the screen once the shearing process ends successfully. Click “OK” to go back to the menu.

# Tube holders & tubes



The holder is made up of a tube holder and its specific dock.

To guarantee homogeneity of chromatin or DNA shearing, the tube holders should always be completely filled with tubes. Never leave empty spaces in the tube holder. Fill the empty spaces with tubes containing the same volume of distilled water.



**Tube holder for 0.2 ml tubes**  
(Cat. No. B01201144)

**Tube holder for 0.65 ml tubes**  
(Cat. No. B01201143)

**Tube holder for 1.5 ml tubes**  
(Cat. No. B01201140)



**15 ml sonication accessories**  
(Cat. No. B01200016)



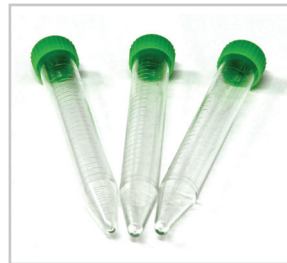
**0.2 ml Bioruptor® Microtubes**  
(Cat. No. C30010020)



**0.65 ml Bioruptor® Microtubes**  
(Cat. No. C30010011)



**1.5 ml Bioruptor® Microtubes**  
(Cat. No. C30010016)



**15 ml Bioruptor® Tubes**  
(Cat. No. C30010017)



**15 ml Bioruptor® Tubes & sonication beads**  
(Cat. No. C01020031)



E100

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diag

BIORUPTOR® COOLER



# Safety

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## General safety instructions

- The equipment must only be operated for the intended use under the conditions stated in this operating manual. Any other type of operation is considered to be not-intended use and can impair the protection provided by the device.
- The operating manual is part of the device. The information in this operating manual must therefore be available in close vicinity to the device. Also store this copy of the operating manual carefully.

Any hazards (electrical shock, fire, contact with movable parts, etc.) caused by the use of the device must be eliminated as much as possible by the design in accordance with the appropriate standards. Residual hazards are reduced using any of the following measures:

- If relevant, there are safety devices for the device. These devices are essential for the safety of the device. Their functionality must be ensured with appropriate maintenance activities.
- If relevant, there are warning symbols on the device. These symbols must always be observed.
- There are safety instructions in this operating manual. These instructions must always be observed.
- There are additional specific requirements for the personnel and for the personal protective equipment.

## Intended use

The present device is exclusively permitted to be used for tempering and delivering non-flammable heat transfer liquids to the Bioruptor®.

## Non-intended use

The following applications are considered to be not-intended:

- in potentially explosive areas
- for tempering foodstuffs
- with a glass reactor without overpressure protection
- medical use.

## Foreseeable misuse

Misuse of the device must always be prevented.

Among other things, the following uses are considered to be foreseeable misuse:

- Operation of the device without heat transfer liquid

- Incorrect connection of tubes.

## Modifications to the device

Any technical modifications to the machine are prohibited. Service works may be carried out only by qualified personal.

## Heat transfer liquid

The device is exclusively designed for nonflammable heat transfer liquids in Class I according to DIN 12876-1.

Heat transfer liquids are used for the temperature control.

In each case, the heat transfer liquids cover a specific temperature range. This temperature range must match the temperature range of your application.

The use of heat transfer liquids can cause hazards from high or low temperatures and fire if certain temperature thresholds are exceeded or undercut or if the container breaks and there is a reaction with the heat transfer liquid.

The heat transfer liquid safety data sheet specifies all possible hazards and appropriate safety measures for handling the liquid. The safety data sheet must therefore be consulted for the intended use of the device.

## Materials

All parts coming into contact with the heat transfer liquid are made of high quality materials suitable for the operating temperature. Stainless steel and temperature-resistant plastics are used.

## Hoses

When selecting suitable hoses for the application, the permissible temperature range and the maximum permissible pressure must be particularly observed.

## Application area

The device is exclusively permitted to be used in the following areas.

- Room temperature (+15 – 25°C)?
- Indoor use, no outdoor installation



## Personnel qualification

### Operating personnel

Operating personnel are employees that have been instructed by technical staff in the intended use of the device according to the operating manual.

## Personal protective equipment

### Protective clothing

- Protective clothing is required for certain activities. This protective clothing must comply with the legal requirements for personal protective equipment. Protective clothing should have long sleeves. Safety footwear is additionally required.

### Protective gloves

- CE protective gloves are required for certain activities. These protective gloves must comply with the legal requirements for personal protective equipment of the European Union.

### Protective goggles

- Protective goggles are required for certain activities. These protective goggles must comply with the legal requirements for personal protective equipment of the European Union.

## Structure of the safety instructions

### Danger

- A safety instruction of the type “Danger” indicates an immediately hazardous situation.
- This results in death or severe, irreversible injuries if the safety instruction is disregarded.

### Warning

- A safety instruction of the type “Warning” indicates a potentially hazardous situation.
- This can result in death or severe, irreversible injuries if the safety instruction is disregarded.

### Caution

- A safety instruction of the type “Caution” indicates a potentially hazardous situation.
- This can result in minor, reversible injuries if the safety instruction is disregarded.

### Notice

- A “notice” warns about possible property or environmental damage.
-

# Unpacking

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Personnel: Operating personnel

1. Unpack the device.

*Keep the original packaging of the device for later transport.*

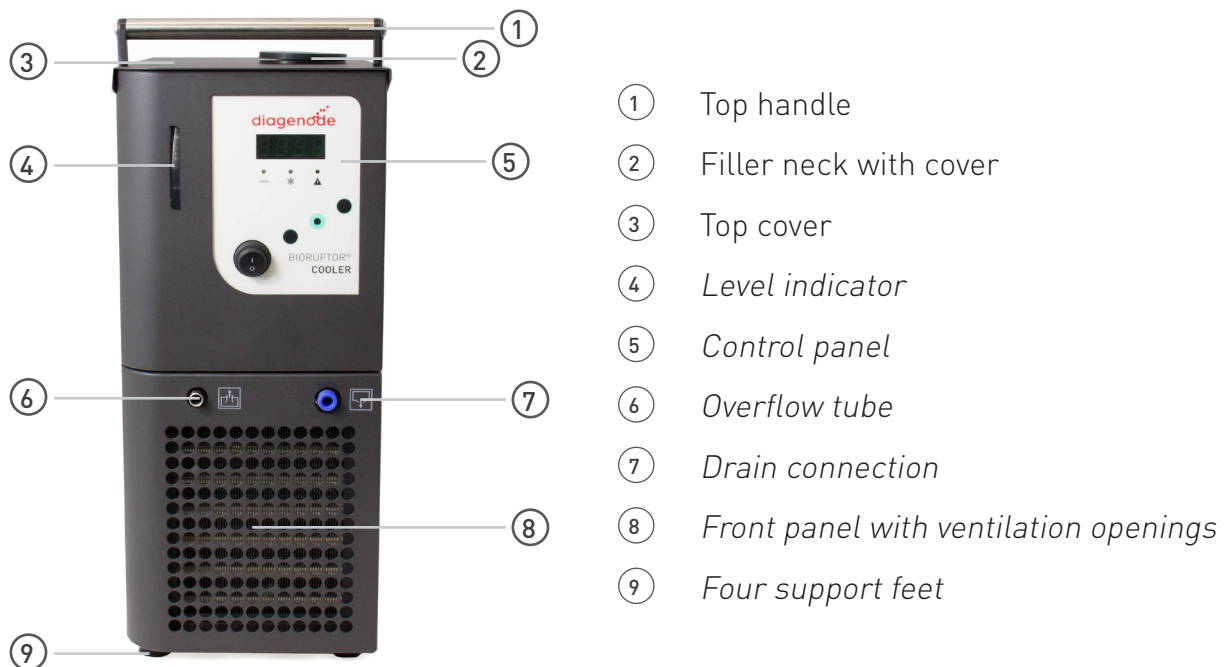
2. Inspect the device and the accessories immediately after delivery for completeness and transport damage.

*If there is unexpected damage to the device or accessories, inform the carrier immediately so that a damage report is produced and a check of the transport damage can be made.*

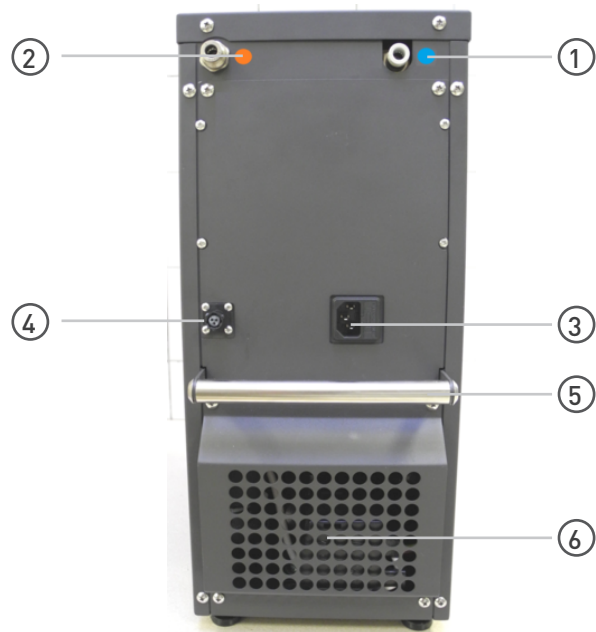
## Design and function

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Design of the circulation chiller - Front side



## Design of the circulation chiller - Back side



- ① Supply water connection (blue)
- ② Return water connection (red)
- ③ Mains power socket with fuse
- ④ 24Vdc socket (to be connected to the Bioruptor®)
- ⑤ Back handle
- ⑥ Ventilation openings

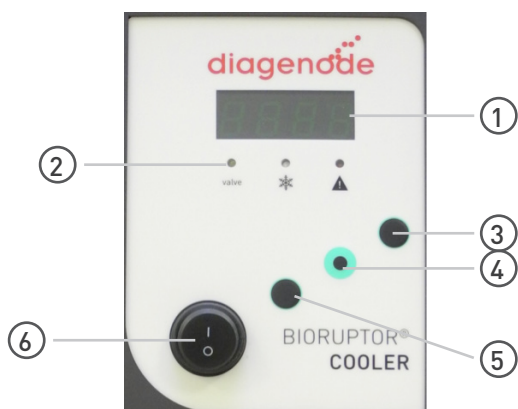
## Controls

### Mains power switch

The mains power switch can be put in the following positions:

- In position [I], the device is switched on.
- In position [0], the device is switched off.

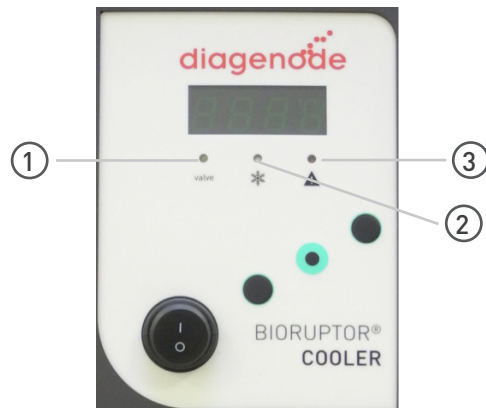
### Control Panel and display buttons



- ① Display
- ② LEDs
- ③ UP arrow button
- ④ ENTER button
- ⑤ DOWN arrow button
- ⑥ Mains power switch

## Function elements

### LEDs for function display



- ① Yellow LED: valve
- ② Blue LED: refrigeration
- ③ Red LED: fault

Each device has three LEDs with the following functions:

- The yellow LED lights if the 24 Vdc signal from the Bioruptor is present (open solenoid valve).
- The blue LED indicates whether the refrigeration unit is active.
- The red LED lights in the event of device faults.

## Hydraulic circuit

### Hydraulic circuit

The hydraulic circuit designates the circuit through which the heat transfer liquid flows.

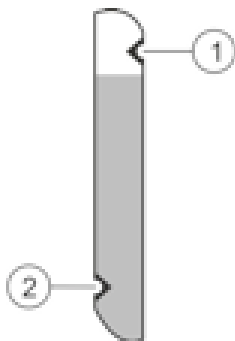
The circuit basically consists of the following components:

- internal storage bath with heat transfer liquid
- pumps for conveying the heat transfer liquid into the external consumer via the pumps connections

### Pumps

The devices are equipped with a pressure pump for the supply and a membrane suction pump for the return.

### Level indicator



The fill level of the heat transfer liquid in the circuit can be read using the level indicator.

The top arrow indicates the maximum liquid level of the machine.

The bottom arrow indicates the minimum liquid level of the machine.

- 1 Maximum level (approx. 3 liters)
- 2 Minimum level (approx. 2 liters)

### 3.3.5 Refrigeration unit

The refrigeration unit includes the following components

#### **Compressor**

A hermetically sealed compressor is used in the refrigeration unit. The compressor is equipped with overload protection which trips on the compressor temperature and compressor current consumption.

#### **Condenser**

An air-cooled condenser is used in the refrigeration unit. The condensation heat is discharged to the environment. The fresh air is sucked in through the front of the device using a fan, heated and discharged on the rear of the device.

#### **Evaporator**

In the internal bath, heat is discharged using a pipe coil evaporator.

### 3.4 Rating plate

The rating plate information is explained in detail in the following table.

SPECIFICATION	DESCRIPTION
Type	Device type
Order No.	Order number of the device
Serial No.	Serial number of the device <i>(Manufacturing year indicated with two digits after the letter "S")</i>
Voltage	Device must only be connected to this voltage and frequency
Refrigerant I	Refrigerant that is used in the compressor of the device <i>(GWP-value indicated in brackets)</i>
Fill quantity I	Fill quantity of the refrigerant <i>(tons of CO2 equivalent in brackets)</i>
PS high pressure I	maximum permitted operating pressure on the refrigerant high pressure side (compressor, condenser)
PS low pressure I	maximum permitted operating pressure on the refrigerant low pressure side (expansion, evaporation)
Current consumption	Current consumption of the device during operation
Protection class	IP protection class of the device
Fuse	Fuse used in the device
Class according to DIN 12876-1	German standard for electrical laboratory equipment

# Before commissioning

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## EMC classification

### Approval of the equipment according to EMC classification

COUNTRIES	EMC CLASS
Europe	Class B, oder? This classification has been made according to the EMC standard DIN EN 61326-1 (corresponds to VDE 0843-20-1).
USA	Class A This classification has been made according to the FCC (Federal Communications Com- mission) regulations, Section 15.
Canada	Class A This classification has been made according to the ICES-003 (Interference Causing Equipment Standards) and NMB-003 regulations.

### Instructions for machines, Europe

EMC classification of the equipment:

- Class A: Operation only on mains power supplies without connected residential areas.
- • Class B: Operation on mains power supplies with connected residential areas.

In the case of unfavorable mains conditions, disruptive voltage fluctuations can occur.

### Instructions for Class A digital device, USA

“This equipment has been tested and found to comply with the limits for Class A digital device, pursuant to Part 15 of the FCC (Federal Communication Commission) Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.”

## Instructions for Class A digital device, Canada

This Class A digital apparatus complies with Canadian ICES-003” (ICES = Interference Causing Equipment Standards).

« Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada ».

## Device Placement

Very specific placement conditions are applicable for the equipment. These placement conditions are specified in the technical data of the device for the most part.

Additional placement conditions are described below.

- Toxic vapors can be produced depending on the heat transfer liquid used and type of operation. Ensure sufficient extraction of the vapors.
- Observe the requirements of the device for electromagnetic compatibility (EMC).
- Do not cover the ventilation openings.

### **WARNING!**

Rolling away, falling over of the device

Impact, crushing

- Do not tilt the device.
- Place the device on a level, non-slip surface with sufficient load bearing capacity.
- Engage the castor brake when setting up the device.
- Do not place any heavy parts on the device.

1. Place the device at a suitable location in the room. Place tabletop devices on a suitable table. Support the device for this by reaching under the device.
2. The device requires 20 cm of clearance at the front and rear side in order to allow proper airflow through the refrigeration unit.
3. The device must be installed at RT (10C – 25°C) and can be placed bellow or at the same level of the Bioruptor



# Commissioning

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## Heat transfer liquids

Note the following:

- The heat transfer liquids each cover a recommended temperature range and must be suitable for the temperature range of your application.
- Never use contaminated or degenerated heat transfer liquid.

## Heat transfer liquid water

- The alkaline earth ions content (hardness) of the water must be between 0.71 mmol/l and 1.42 mmol/l (equivalent to 4.0 and 8.0 °dH). Harder water results in lime deposits in the device.
- The pH value of the water must be between 6.0 and 8.5.
- Distilled, deionized, demineralized (DM) water or seawater must not be used due to the corrosive properties. Ultra-pure water and distillates are suitable as medium after addition of 0,1 g soda (Na<sub>2</sub>CO<sub>3</sub>, sodium carbonate) per liter of water.
- Any chlorine content in the water must be strictly avoided. Do not add any chlorine to the water. Chlorine is contained, for example, in cleaning agents and disinfectants
- The water must be free of impurities. Water containing iron is unsuitable due to rust formation and untreated river water is unsuitable due to algae formation.
- The addition of ammonia is not permitted.

## Establishing power supply

Personnel: Operating personnel

### **NOTICE!**

Use of unauthorized mains voltage or mains frequency

Device damage

- Compare the rating plate with available mains voltage and mains frequency.

Also note the following:

- The mains plug of the device provides a mains power disconnection component. The mains plug must be easily recognizable and easily accessible.
- Only connect the device to an earthed (PE) power socket.

## Switching on device and filling with water

### Filling mode

The device has a software program (starting from and including software version 61.15) that supports the operator for filling the temperature control device. If the fill level is too low, the Fill mode is started immediately after switching on the device. FILL is shown on the display and the level indicator is illuminated. The pumps and the refrigerant unit are not started. When the minimum level has been reached, the pumps are automatically started.

Personnel: Operating personnel

#### **NOTICE!** Overheating of the compressor

Device damage

- Never operate water cooled device without cooling water.

#### **DANGER!** Use of incorrect heat transfer liquid

Fire

- Select a heat transfer liquid with a temperature range 20 K above the temperature range of the application

#### **WARNING!** Overflow of heat transfer liquid

Electric shock

- Ensure that the device is not overfilled. Note the level indicator and the thermal volume expansion of the heat transfer liquid

#### **WARNING!** Spraying of heat transfer liquid

Electric shock

- Avoid spraying heat transfer liquid. Use a funnel for filling

### Fill level sufficient

1. Switch on the device using the mains power switch. A signal tone sounds. The software version is shown on the display. The actual temperature is shown on the display afterwards. The temperature control device starts operation; the pumps are started. Depending on the specified set point temperature, the refrigerant unit is started after 2 minutes at the earliest. The blue LED lights if the refrigerant unit is activ

### Fill level too low (Low Level)

2. Switch on the device using the mains power switch. A signal tone sounds. The software version is shown on the display. FILL is shown on the display afterwards. In the case of Low Level, the pumps and the refrigerant unit are not started. Fill the device with heat transfer liquid.
3. Carefully pull up the cover of the filler neck; do not turn.
4. Fill the heat transfer liquid into the filler neck carefully. Monitor the level indicator. Fill the device up to the maximum fill level. The pumps start when the minimum level is reached.

*If necessary, use a funnel for the filling.*

*The level indicator must not be above the maximum fill level.*

### Fill level drops

5. Top up the heat transfer liquid carefully as the consumer is now being filled. If the fill level drops too far, the device automatically goes into the FILL mode and the pump and refrigerant unit are switched off. Continue with the filling until operation without problems is possible. Monitor the level indicator for this.
6. Press the cover carefully into the filler neck.

# Operation

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## Switching on the device

Personnel: Operating personnel

### **NOTICE!** Overheating of the compressor

Device damage

- Never operate water cooled device without cooling water.

1. Switch on the device using the mains power switch. A signal tone sounds. The software version is shown on the display. The actual temperature is shown on the display afterwards. The temperature control device starts operation; the pumps are started. Depending on the specified set point temperature, the refrigerant unit is started after 2 minutes at the earliest. The blue LED lights if the refrigerant unit is active.
2. Depending on the water level, heat transfer liquid must be refilled if necessary. Monitor the level indicator for this.

## Default display and set point temperature

1. Press the ENTER button to reach set point menu from the default display of the actual temperature.

*If no button has been pressed for longer than 4 seconds, you exit from the set point menu.*

2. Select a set point temperature (between 2°C and 20°C) using the arrow buttons.
3. The changed value or setting is applied immediately by pressing the ENTER button

## Standby mode

The Display shows: "STBY" alternating with the bath temperature.

The device goes into Standby mode if no 24V signal from the Bioruptor is received for a period of time of more than 2 hours.

In Standby mode the compressor and the pumps are turned off.

If during Standby mode the bath temperature reaches a value higher than 10 K above the set point, the compressor and the pumps turn on automatically to cool down to set point. The

compressor and the pumps turn off again when the set point is reached.

If a display button is pushed during Standby mode, the device goes into normal operation mode.

## Sleep mode

The Display shows: "SLEP" alternating with the bath temperature.

The device goes into Sleep mode if no 24V signal from the Bioruptor is received for a period of time of more than 16 hours.

In Sleep mode the compressor and the pumps are turned off.

If a display button is pushed during Sleep mode, the device goes into normal operation mode.

# Maintenance

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## General safety instructions

**DANGER!** Contact with live or moving parts

Electric shock, impact, cutting, crushing

- The device must be disconnected from the mains power supply before any maintenance work.
- Repairs must only be carried out by specialists.

**CAUTION!** Contact with hot / cold device parts, accessories and heat transfer liquid.

Burns, scalding, frostbite

- Ensure device parts, accessories and heat transfer liquid are at room temperature before touching them

Also note the following:

Before all maintenance work, you should ensure that decontamination of the device has been performed if it came into contact with hazardous materials.

## Maintenance intervals

The maintenance intervals described in the following table must be complied with. The following maintenance work is mandatory before every longer unsupervised operation.

INTERVAL	MAINTENANCE WORK
daily	Inspection of the drain plug by visual inspection from the outside
monthly	Inspection of the external hoses for material fatigue Cleaning of the condenser Inspection of the heat transfer liquid

## Cleaning the device

Personnel: Operating personnel

### **WARNING!** Ingress of cleaning agents in the device

Electric shock

- Use a moist cloth for cleaning.

Also note the following:

Only clean the control panel with water and detergent. Do not use acetone or solvents. The consequence would be permanent damage of the plastic surfaces.

## Cleaning air-cooled condenser

Personnel: Operating personnel

1. Switch off the device.
2. Remove the front cover by holding underneath with both hands and pulling the grating to the front. Remove the front cover slowly and carefully to prevent damage.
3. Brush off or vacuum the condenser.
4. Remount the front cover carefully.

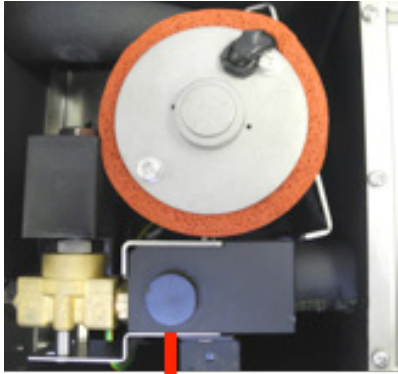
## Checking the heat transfer liquid

Soiled or degenerated heat transfer liquid must be replaced.

## Replace fuse

1. Switch off the device.
2. Remove power cord from the main power socket at the back of the device.
3. Remove fuse holder from the main power socket at the back of the device.
4. Replace fuse T10AH (10 ampere time delay fuse with high breaking capacity).
5. Remount fuse holder in the main power socket.

## Cleaning the mesh filter



1. Switch off the device.
2. Remove the top cover by dismounting the top handle and unscrewing the two screws at the back of the device.
3. Unscrew mesh filter holder (counter-clockwise).
4. Remove the metallic mesh filter and clean it.
5. Mount the mesh filter back in the holder and screw it back in the by-pass block (clockwise).
6. Mount top cover and top handle back in the device.



# Faults

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## Alarms, errors and warnings

Any alarms, error signals and warnings triggered on the device are shown on the display as 7-segment text.

### Procedure in the event of alarms

Alarms can be cancelled using the ENTER button after rectification of the cause of the fault.

### Procedure in the event of warnings

Warnings can be cancelled using the ENTER button after rectification of the cause of the fault.

### Procedure in the event of errors

A two-tone signal is output if any error occurs. The red LED on the device also lights.

In the case of an error, switch off the device at the mains power switch. If the error occurs again after restarting the device, note the error code and contact the Service partner.

*Errors are symbolized with an E and a sequential three- digit number.*

# Decommissioning

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## Draining the device

Personnel: Operating personnel

**WARNING!** Contact with cold heat transfer liquid

Frostbite

- Bring the heat transfer liquid to room temperature before draining.

Also note the following:

Observe the regulations for disposal of the used heat transfer liquid.

1. Switch off the device.
2. Connect the end of an 8 mm exterior diameter pipe to the self-closing drain connector of the device. Place the other end of the pipe in a container with appropriate capacity under the level of the device.
3. Let the water flow until the device is completely empty.

# Disposal

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## Disposing of refrigerant

The refrigerant must be disposed of in accordance with EC Directive 303/2008/EC in combination with 842/2006/EC.

**CAUTION!** Uncontrolled escape of refrigerant.

Impact, cutting

- Do not dispose of any pressurized refrigerant circuit.
- The decommissioning is only permitted by a specialist.

*Global Warming Potential (GWP), comparisons CO<sub>2</sub> =1.0*

*according to IPCC IV - time horizon 100 years - also basis for EU Fluoride Gases Directive 517/2014/EC*

*Type and fill quantity of the refrigerant can be seen on the rating plate.*

## Device disposal



The following applies for Europe: The device must be disposed of according to EU Directive 2012/19/EC.

## Disposing of packaging

The packaging must be disposed of in accordance with EU Directive 94/62/EC.

# Technical data

## General data

The device sound pressure level is below 70 dB. According to EC Directive 2006/42/EC the sound pressure level of the devices is therefore not specified further.

SPECIFICATION	VALUE	UNIT
Placement	Indoor areas	
Placement height above sea level	up to 2,000	m
Humidity	Maximum relative humidity 80%	
Ambient temperature range	15 - 25	°C
IP protection rating	IP 32	
Degree of soiling	2	
Clearance from surroundings (front and rear sides)	20	cm
Overvoltage	Overvoltage category II and transient overvoltages according to category II	
Protection class for electrical operating equipment DIN EN 61 140 (VDE 0140-1)	1	
Classification according to DIN 12 876-1 (class designation / identification)	I/NFL (non-flammable liquids, only)	
Display	7-segment, LED	
Display resolution	1	°C
Adjustment resolution	1	°C
Temperature stability	+ - 2	K
Storage temperature range	5 - 40	°C
Transport temperature range	-20 - 60	°C

	WORKING TEMPERATURE RANGE	DIMENSIONS (W X D X H)	WEIGHT
	°C	mm x mm x mm	kg
BC 100	2 - 20	200 x 390 x 495	26,9

## Cooling capacity

		<b>BC 100</b>
<i>Cooling capacity (at 20 °C)</i>	<i>W</i>	<i>250</i>
<i>Cooling capacity (at 4 °C)</i>	<i>W</i>	<i>120</i>
<i>Refrigerant</i>	<i>--</i>	<i>R-134A</i>

The cooling capacity is measured for a specified temperature of the heat transfer liquid. Information is provided in brackets. The ambient temperature for the measurement is 20 °C; water was used as heat transfer liquid.

## Hydraulic circuit

		<b>BC 100</b>
<i>Fill capacity</i>	<i>l</i>	<i>2 - 3</i>
<i>Maximum flow rate</i>	<i>l/min (water 20 °C)</i>	<i>2</i>
<i>Supply and return connections</i>	<i>Quick connector (ext. hose diameter in mm)</i>	<i>8</i>
<i>Drain connector</i>	<i>Self-closing quick connector (ext. hose diameter in mm)</i>	<i>8</i>
<i>Overflow tube</i>	<i>Tube (int. hose diameter in mm)</i>	<i>10</i>

## Maximum power consumption

	<b>BC 100</b>
	<i>kW</i>
<i>230 V; 50 Hz</i>	<i>0.29</i>
<i>115 V; 60 Hz</i>	<i>0.29</i>
<i>100 V; 50/60 Hz</i>	<i>0.29</i>





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