ROTANTA 460 Robotic

EN **Operating Instructions**

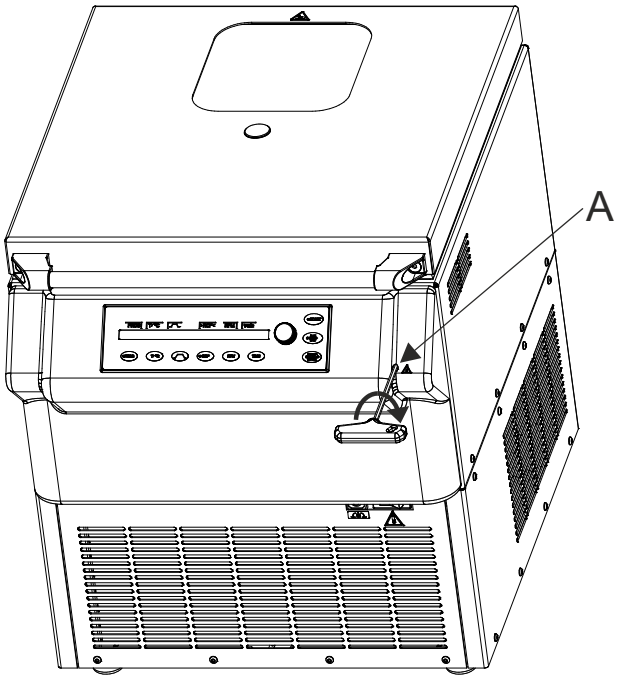

Fig. 1

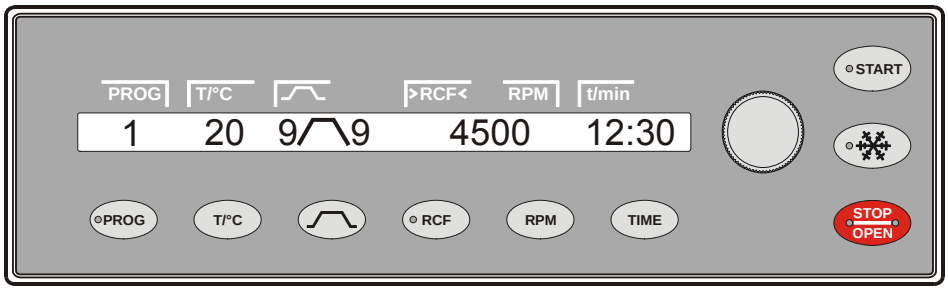

Fig. 2 ROTANTA 460 Robotic

Standards and regulations which apply to this device

The device is a high-end technical product. It is subject to extensive testing and certification procedures according to the following standards and regulations in their respectively valid version:

Electrical and mechanical safety for design and final testing:
Standard series: IEC 61010 (conform to standards of DIN EN 61010)

- IEC 61010-1 “Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements” (Pollution Degree 2, Excess-voltage category II)
- IEC 61010-2-010 „Safety requirements for electrical equipment for measurement, control and laboratory use - Part 2-010: Particular requirements for laboratory equipment for the heating of Materials” (only valid for centrifuges with heating)
- IEC 61010-2-011 „Safety requirements for electrical equipment for measurement, control and laboratory use - Part 2-011: Particular requirements for refrigerating equipment” (only valid for centrifuges with cooling)
- IEC 61010-2-020 “Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 2-020: Particular requirements for laboratory centrifuges”
- IEC 61010-2-101 ”Safety requirements for electrical equipment for measurement, control and laboratory use - Part 2-101: Particular requirements for in vitro diagnostic (IVD) medical equipment“

Electromagnetic Compatibility:

- EN 61326-1 “Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements“

Risk management:

- DIN EN ISO 14971 “Application of risk management to medical devices”

Restriction of Hazardous Substances (RoHS II):

- EN 50581 "Technical documentation for assessing electric and electronic devices with regard to the restriction of hazardous substances"

European directives applied for conformity assessment procedures:

- Regulation (EU) 2017/746 on in vitro diagnostic devices.
- Directive 2011/65/EU for the restriction of use of certain hazardous substances in electric and electronic devices. Carrying out the EC conformity assessment process is the sole responsibility of the manufacturer, without the involvement of a notified body.

Applied medical device regulations outside Europe:

- **USA:** QSR, 21CFR 820 “CFR Title 21 - Food and Drugs: TITLE 21- FOOD AND DRUGS, CHAPTER I - FOOD AND DRUG ADMINISTRATION DEPARTMENT OF HEALTH AND HUMAN SERVICES, SUBCHAPTER H - MEDICAL DEVICES, Part 820 QUALITY SYSTEM REGULATONS“
- **Canada:** CMDR, SOR/98-282 “Medical Devices Regulations”

Certified quality management system according to

- ISO 9001 “Quality management systems – Requirements”
- ISO13485 “Medical devices - Quality management systems - Requirements for regulatory purposes”

Environmental management system according to

- ISO 14001 “Environmental management systems - Requirements with guidance for use”

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AB5680EN_US / Rev. 02

Contents

1 Intended use

The centrifuge **ROTANTA 460 Robotic** is an in vitro diagnostic medical device according to the In Vitro Diagnostic Medical Devices Regulation (EU) 2017/746.
The device is used for centrifuging and enriching sample material of human origin for subsequent further processing for diagnostic purposes. The user can set each of the variable physical parameters within the limits set by the device.

The centrifuge may only be used by qualified personnel in closed laboratories. The centrifuge is only intended for the use referred to above. Intended use also includes observing all instructions in the Operating Manual and compliance with the required inspection and maintenance work.
Any other use or use beyond this is considered improper. Andreas Hettich GmbH & Co. KG shall not be liable for any damage arising from this.

If the centrifuge is installed in another device or integrated into a system, the manufacturer of the system as a whole is responsible for its safety.

2 Remaining risks

The device is built according to the state-of-the-art and the recognized safety regulations. If used and handled improperly, there could be life-threatening danger to the user or third parties, or the device could be impaired or there could be other property damage. The device is only to be used for its intended purpose and only when it is in safe working condition.

Malfunctions which could affect safety must be corrected immediately.

3 Technical specifications

Manufacturer	Andreas Hettich GmbH & Co. KG D-78532 Tuttlingen				
Model	ROTANTA 460 Robotic				
Basic-UDI-DI	4050674010017QF				
Type	5680-70	5680-78	5680-75	5680-71	5680-74
Mains voltage (± 10%)	230-240 V 1~	200-220 V 1~	127 V 1~	110-120 V 1~	100 V 1~
Mains frequency	50-60 Hz				
Connected load	max. 1800 VA				
Cooling medium	R452A				
Max. capacity	4 x 750 ml				
Allowed density	1.2 kg/dm^3				
Speed (RPM)	6200				
Force (RCF)	5845				
Kinetic energy	40000 Nm				
Obligatory inspection (DGUV Regel 100 – 500)	yes				
Ambient conditions (EN / IEC 61010-1)					
– Set-up site	Indoors only				
– Altitude	Up to 2000 m above sea level				
– Ambient temperature	5°C to 35°C				
– Humidity	Maximum relative humidity 80% for temperatures up to 31°C, linearly decreasing to 50% relative humidity at 40°C.				
– Excess-voltage category (IEC 60364-4-443)	II				
– Pollution degree	2				
Device protection class	I				
Not suitable for use in explosion-endangered areas.					
EMC					
– Emitted interference, Interference immunity	EN / IEC 61326-1, Class B; FCC Class B				
Noise level (dependent on rotor)	≤ 68 dB(A)				
Dimensions					
– Width	554 mm				
– Depth	697 / 762* mm (* with cables connected)				
– Height	693 mm				
Weight	approx. 154 kg				

Manufacturer	Andreas Hettich GmbH & Co. KG D-78532 Tuttlingen				
Model	ROTANTA 460 Robotic				
Basic-UDI-DI	4050674010017QF				
Type	5680 5680-RS232 5680-10 5680-10-RS232 5680-30-A 5680-30-D 5680-40	5680-08 5680-08-RS232 5680-18 5680-18-RS232 5680-38-A 5680-38-D 5680-48	5680-05 5680-05-RS232 5680-15 5680-15-RS232 5680-35-A 5680-35-D 5680-45	5680-01 5680-01-RS232 5680-11 5680-11-RS232 5680-31-A 5680-31-D 5680-41	5680-04 5680-04-RS232 5680-14 5680-14-RS232 5680-34-A 5680-34-D 5680-44
Mains voltage (± 10%)	230-240 V 1~	200-220 V 1~	127 V 1~	110-120 V 1~	100 V 1~
Mains frequency	50-60 Hz				
Connected load	max. 1800 VA				
Cooling medium	R452A				
Max. capacity	4 x 750 ml				
Allowed density	1.2 kg/dm^3				
Speed (RPM)	6200				
Force (RCF)	5845				
Kinetic energy	40000 Nm				
Obligatory inspection (DGUV Regel 100 – 500)	yes				
Ambient conditions (EN / IEC 61010-1)					
– Set-up site	Indoors only				
– Altitude	Up to 2000 m above sea level				
– Ambient temperature	5°C to 35°C				
– Humidity	Maximum relative humidity 80% for temperatures up to 31°C, linearly decreasing to 50% relative humidity at 40°C.				
– Excess-voltage category (IEC 60364-4-443)	II				
– Pollution degree	2				
Device protection class	I				
Not suitable for use in explosion-endangered areas.					
EMC – Emitted interference, Interference immunity	EN / IEC 61326-1, Class B; FCC Class B				
Noise level (dependent on rotor)	≤ 68 dB(A)				
Dimensions					
– Width	554 mm				
– Depth	697 / 762* mm (* with cables connected)				
– Height	654 mm				
Weight	approx. 154 kg				

TIP

No claim of warranty will be considered by the manufacturer unless ALL instructions in this manual have been followed.

TIP

Reports of serious incidents involving the device

Report any serious incidents involving the device to the manufacturer and, if necessary, to the competent authority.

To avoid serious or fatal injury, read and comply with the following safety precautions.

Before the initial operation

- Before the initial operation of your centrifuge you should read and pay attention to the operating instructions. Only personnel that has read and understood the operating instructions are allowed to operate the device.

Regulations

- Along with the operating instructions and the legal regulations on accident prevention, you should also follow the recognised professional regulations for working in a safe and professional manner. These operating instructions should be read in conjunction with any other instructions concerning accident prevention and environmental protection based on the national regulations of the country where the device is to be used.

country-specific requirements

- Meeting the country-specific requirements concerning occupational safety with regard to the use of laboratory centrifuges at the workplaces provided for this purpose by the user is the responsibility of the user.

safety regulations

The following safety regulations apply:

- EN / IEC 61010-1 and EN / IEC 61010-2-020 as well as their national deviations.

safe operation and reliability

The safe operation and reliability of the centrifuge can only be guaranteed if:

- the centrifuge is operated in accordance with the operating instructions,
- the electrical installation on the site where the centrifuge is installed conforms to the demands of EN / IEC stipulations.

Materials

The centrifuge must not be used with:

- inflammable or explosive materials
- materials that react with one another producing a lot of energy

highly corrosive substances

- The centrifuge must not be operated with highly corrosive substances which could impair the mechanical integrity of rotors, hangers and accessories.

hazardous materials or compounds contaminated with toxic, radioactive or pathogenic micro-organisms

- If users have to centrifuge hazardous materials or compounds contaminated with toxic, radioactive or pathogenic micro-organisms, they must take appropriate measures.
- For hazardous substances centrifuge containers with special screw caps must strictly be used. In addition to the screw cap centrifuge containers, for materials in hazard category 3 and 4 a biosafety system must be used (see the World Health Organisation's "Laboratory Biosafety Manual").
- No biosafety systems are available for this centrifuge.

Rotors and accessories

- Only the rotors and accessories approved by the manufacturer for this device may be used (see section "Anhang/Appendix, Rotoren und Zubehör/Rotors and accessories").
- Before centrifuge vessels are used which are not listed in the chapter "Appendix, Rotors and accessories", the user must make sure they can be used by asking the manufacturer.

Robotic

- With centrifuges for robotic use please pay attention the notes of the key operated switch.

Spare parts

- Only original spare parts and original accessories licensed by the Andreas Hettich GmbH & Co. KG company are allowed to be utilised.

Transport

- To avoid damage due to condensate, when changing from a cold to a warm room the centrifuge must either heat up for at least 3 hours in the warm room before being connected to the mains, or run hot for 30 minutes in the cold room.

5 Symbol meanings

Symbol on the device:
Attention, general hazard area.

Symbol on the device:
Observe operating instructions.
This symbol indicates that the user must observe the operating instructions provided.

Symbol in this document:
Attention, general hazard area.
This symbol refers to safety relevant warnings and indicates possibly dangerous situations.
The non-adherence to these warnings can lead to material damage and injury to personal.

Symbol on the device:
Beware of squeezing the hands.

Symbol on the device and in this document:
Beware of biohazard.

Symbol on the device:
Switch positions of the key-operated switch.

Symbol on the device:
RS232 interface (only for device with RS232 interface).

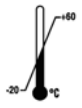
Symbol on the device:
Optical interface (only for device with optical interface).

Symbol in this document:
This symbol refers to important circumstances.

Symbol on the device and in this document:
Symbol for the separate collection of electric and electronic devices according to the guideline 2012/19/EU.
Applies in the countries of the European Union, as well as in Norway and Switzerland.

Symbol on the shipping carton label:
This way up.

Symbol on the shipping carton label:
The shipping packaging must be transported and handled within the indicated humidity range (10% - 80%).



Symbol on the shipping carton label:
The shipping packaging must be stored, transported and handled within the temperature range shown (-20°C - +60°C).

Symbol on the shipping carton label:
The shipping packaging must be kept away from rain and kept in a dry environment.

Symbol on the shipping carton label:
Fragile, handle with care.

Symbol on the shipping carton label:

Stack limit. Maximum number of identical packages which may be stacked on the bottom package, whereby “n“ stands for the number of permissible packages. The bottom package is not included in “n”.

6 Delivery checklist

	Centrifuge type	**5680, 5680-08, 5680-10, 5680-18**	**5680-01, 5680-04, 5680-05, 5680-11, 5680-14, 5680-15**	**5680-30-A, 5680-31-A, 5680-34-A, 5680-35-A, 5680-38-A,**	**5680-30-D, 5680-31-D, 5680-34-D, 5680-35-D, 5680-38-D**	**5680-40, 5680-41, 5680-44, 5680-45, 5680-48**	**5680-RS232 5680-01-RS232 5680-04-RS232 5680-05-RS232 5680-08-RS232**	**5680-10-RS232 5680-11-RS232 5680-14-RS232 5680-15-RS232 5680-18-RS232**	**5680-70, 5680-71, 5680-74, 5680-75, 5680-78**
Qty.l	**Designation**	**Cat. no.**	**Cat. no.**	**Cat. no.**	**Cat. no.**	**Cat. no.**	**Cat. no.**	**Cat. no.**	**Cat. no.**
1 *	German connecting cable, length 2,5 m	E979	E979	----		E979	E979	E979	E979
	Swiss connecting cable, length 4 m	E2036	E2036	----	----	----	E2036	E2036	----
	UK connecting cable, length 4 m	E2038	E2038	----	----	----	E2038	E2038	----
	US connecting cable, length 2,5 m	E1737	E1737	----	----	E1737	E1737	E1737	E1737
1 *	German connecting cable, length 4,5 m	----	----	----	----	----	----	E4466	----
1	US connecting cable, length 4 m	----	----	E1771	E1771	----	----	----	----
1	Hex. pin driver (5 mm)	E613-2	E613-2	E613-2	E613-2	E613-2	E613-2	E613-2	E613-2
1	Cranked hex. pin driver (2.5 mm)	E2403	E2403	E2403	E2403	E2403	E2403	E2403	E2403
1	Torx-offset screwdriver (size T10)	----	----	----	----	----	----	----	E1869
1	Opto-data-box	E1203	E1826	----	----	----	----	----	----
1	Fiber optic cable, length 5 m	E1464	E1464	----	----	----	----	----	----
1	Test programme Robot	ABE3375	ABE3375	----	----	----	----	----	----
1	Connecting cable, 9 pole, length 3 m	----	----	E3156	E3156	E3156	E3156	E3156	----
1	Angled adapter for RS232 interface	----	----	----	----	----	E3169	E3169	----
2	Key for key-operated switch	E1429-1	E1429-1	E1429-1	E1429-1	E1429-1	E1429-1	E1429-1	E1429-1

	Centrifuge type	5680, 5680-08, 5680-10, 5680-18	5680-01, 5680-04, 5680-05, 5680-11, 5680-14, 5680-15	5680-30-A, 5680-31-A, 5680-34-A, 5680-35-A, 5680-38-A,	5680-30-D, 5680-31-D, 5680-34-D, 5680-35-D, 5680-38-D	5680-40, 5680-41, 5680-44, 5680-45, 5680-48	5680-RS232 5680-01-RS232 5680-04-RS232 5680-05-RS232 5680-08-RS232	5680-10-RS232 5680-11-RS232 5680-14-RS232 5680-15-RS232 5680-18-RS232	5680-70, 5680-71, 5680-74, 5680-75, 5680-78
Qty.l	**Designation**	**Cat. no.**	**Cat. no.**	**Cat. no.**	**Cat. no.**	**Cat. no.**	**Cat. no.**	**Cat. no.**	**Cat. no.**
1	Lubricating grease for trunnions	4051	4051	4051	4051	4051	4051	4051	4051
2	Label for voltage and frequency	E2909	E2909	E2909	E2909	E2909	E2909	E2909	E2909
1	Manufacturing protocol	----	----	----	**204.290.04.00**	**204.270.04.00**	**204.270.04.00**	**204.270.04.00**	**204.270.04.00**
1	Notes on moving the equipment safely	AH5680XX	AH5680XX	AH5680XX	AH5680XX	AH5680XX	AH5680XX	AH5680XX	AH5680XX
1	Operating instructions	AB5680	AB5680	AB5680	AB5680	AB5680	AB5680	AB5680	AB5680

* The connecting cable is included in the delivery as ordered.

The rotor(s) and associated accessories are included in the delivery in the quantity ordered.

7 Transport and storage

7.1 Transport

NOTICE

Material damage due to lack of transport securing.

Damage to the centrifuge and its components.

➢ Install the transport securing device before each transport.

When the device and accessories are transported, the following ambient conditions must be complied with:

- Ambient temperature: -20°C to +60°C
- Relative humidity: 10% to 80%, non-condensing

7.2 Storage

NOTICE

Material damage due to lack of transport securing.

Damage to the centrifuge and its components.

➢ Install the transport securing device before each transport.

When the device and accessories are stored, the following ambient conditions must be complied with:

- Ambient temperature: -20°C to +60°C
- Relative humidity: 10% to 80%, non-condensing

8 Unpacking the centrifuge

CAUTION

Slight risk of injury from lifting heavy loads

➢ Use suitable aids.

➢ Lift the centrifuge with a suitable number of helpers.

NOTICE

Material damage due to lifting the centrifuge.

➢ Do not lift by the front panel.

- Lift the carton upward and remove the padding.
- With a suitable number of helpers, hold the centrifuge on both sides and lift down from the pallet.

9 Initial operation

- A type B residual current circuit breaker must be used if the device is additionally protected with a residual current circuit breaker in the building installation. When using a different type, the residual current circuit breaker may either not switch off the unit if there is a fault on the unit, or it may switch off the unit even though there is no fault on the unit.
- Remove the transport safety device (see instruction sheet on “Moving the equipment safely”).
- **Position the centrifuge in a stable and level manner in a suitable place. During set-up, the required safety margin of 300 mm around the centrifuge is to be kept according to EN / IEC 61010-2-020.**

WARNING

Risk of injury and material damage due to incorrect installation.

➢ When the centrifuge is running, according to EN / IEC 61010-2-020, no persons, dangerous substances or objects may be within the safety margin of 300 mm around the centrifuge.

➢ If the centrifuge will be built into another machine or will be integrated in a system the manufacturer of the complete system is responsible for its security.

- Ventilation openings may not be blocked.
  A distance of 300 mm must be maintained from the ventilation slots and openings of the centrifuge.
- Centrifuge with RS232 interface:
  Connect the RS232 centrifuge interface with an RS232 connecting cable (included in the scope of delivery for certain models) to the PC.
  Centrifuge with optical interface:
  Connect the optical centrifuge interface with a light-conducting cable (included in the scope of delivery for certain models) to the PC.
- Check whether the mains voltage tallies with the statement on the type plate.
- Connect the centrifuge with the power cord to a standard mains socket. For connection ratings refer to Chapter "Technical specifications".
- Switch on the power switch (switch position "I"). The LED's in the keys will flash.
  The following displays appear one after the other:
  1. The centrifuge model
  2. The program version
  3. The rotor code (Rotor), the maximum speed of the rotor (Nmax) and a centrifuging radius (R) of the last rotor detected by the rotor detector.
  4. The centrifugation data of the last used program or program 1.

10 Interface

The device is either equipped with an RS232 or an optical interface.

The RS232 interface is labeled with the IOIOI RS232 symbol.

The optical interface is labeled with the IOIOI OPTICAL symbol.

The centrifuge can be controlled and data queried via this interface.
The LED in the PROG key lights up during data communication.

11 Hatch for loading and unloading the device

There is a hatch in the lid of the device in order to be able to load and unload the device with a robot arm.

NOTICE

Material damage due to operation by unauthorised personnel.

When the key switch is in the "Teach" position, unauthorised personnel may cause damage to property.

- ➢ Only authorized skilled personnel may operate the device in the "TEACH" key position.
- ➢ The key is to be kept in a safe place so that it is protected from unauthorized access.

TIP

The hatch can only be opened and closed via the operating unit (key position "TEACH") or via the interface (key position "LOCK 2"). The functions of the various key positions are described in the "Key-operated switch" chapter.

The hatch opens and closes via the motor.

11.1 Opening the hatch

TIP

The hatch can only be opened if the rotor is stopped.

If the hatch is blocked during opening, the hatch drive stops.

Afterwards, **POS-ERROR 45 OVERCURRENT** is displayed (see "Malfunctions" chapter).

- Turn the key to the "TEACH" position. For example, **Teach Open =Close** might be displayed.
- Keep the key pressed until the hatch is completely open. **Teach =Open Close** is displayed (=: position of the hatch).

11.2 Closing the hatch

TIP

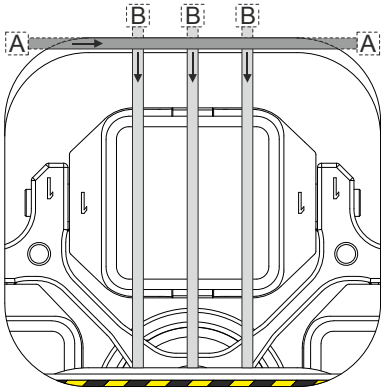
To prevent injuries to the hands of the operator and damage to the robot arm, the drive stops the hatch and opens it again completely if the hatch is blocked for a short time during closing.

Afterwards, **POS-ERROR 45 OVERCURRENT** is displayed (see "Malfunctions" chapter).

- Turn the key to the "TEACH" setting. **Teach =Open Close** is displayed, for example.
- Keep the RPM key pressed until the hatch is completely closed. **Teach Open =Close** is displayed (=: Position of the hatch).

11.3 Hatch with light barriers (only for centrifuges with light barriers)

Optionally, the hatch can be equipped with light barriers to protect the hands of the operator and robot arm.



Light barrier for protecting hands

This light barrier (A) is in the area right before the hatch is closed.

The hatch drive stops immediately if the operator reaches into the hatch with his hands in the light barrier area.
When controlling the centrifuge via the interface, **POS-ERROR 48.0 PHOTO SENSOR** is then displayed (see "Malfunctions" chapter).

Light barriers for protecting the robot arm

Up to 3 light barriers can be installed. The position of these light barriers (B) can be installed by Customer Service as needed.

If the hatch is opened or closed via the operating unit, the hatch drive stops immediately when the robot arm or operator's hand reaches into the hatch in the light barrier area.

If the hatch is opened via the interface, the hatch drive does not stop if the robot arm or operator's hand reaches into the hatch in the light barrier area.

If the hatch is closed via the interface, the hatch drive stops and opens the hatch completely again if the robot arm or operator's hand reaches into the hatch in the light barrier area.
In this case, **POS-ERROR 48.1 PHOTO SENSOR** is then displayed (see "Malfunctions" chapter).

12 Opening and closing the lid

12.1 Opening the lid

TIP

The lid can only be opened when the centrifuge is switched on and the rotor is at rest. If it cannot be opened under these circumstances, see the section on “Emergency release”.

- Press the button ◦OPEN / STOP◦. The lid unlocks via the motor and the left LED in the pushbutton ◦OPEN / STOP◦ extinguishes.

12.2 Closing the lid

CAUTION

Risk of injury due to trapping of limbs.

Squeezing or cutting off of the limb dimensions between the housing and the lid.

➢ Do not insert any limbs, such as finders, between the housing and the lid.

NOTICE

Material damage due to slamming of the lid

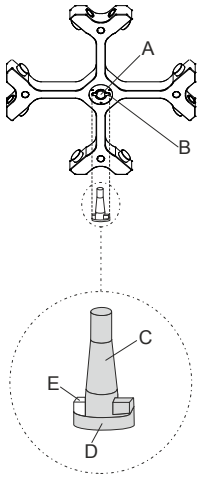
➢ Gently close the lid.

TIP

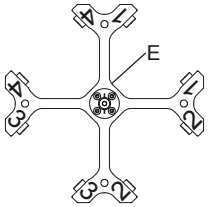
If the left LED in the ◦OPEN / STOP◦ button flashes, press the ◦OPEN / STOP◦ button so that the motor-driven lid lock goes into the basic position (opened).

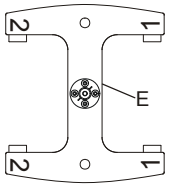
- Place the lid and lightly press down the front edge of the lid. The locking action is effected by motor. The left LED in the button ◦OPEN / STOP◦ lights up.

13 Installation and removal of the rotor



- Clean the motor shaft (C) and the rotor drilling (A), and lightly grease the motor shaft afterwards. Dirt particles between the motor shaft and the rotor hinder a perfect seating of the rotor and cause an irregular operation.
- Place the rotor vertically on the motor shaft. The motor shaft dog (D) must be in the rotor slot (B) and the white marking (E) on the dog (D) must be on the side of rotor position 1. The alignment of the groove is labelled on the rotor.





TIP

Rotor position 1 is already adjusted ex works. Rotor position 1 is the position where place 1 of the rotor must be located for loading and unloading.

The white marking (E) on the dog (D) must be on the side of rotor position 1 so that the position of rotor position 1 and the adjusted rotor position 1 agree. To adjust rotor position 1, see the chapter "Setting rotor position 1".

- Tighten the rotor tension nut with the supplied wrench by turning in a clockwise direction.
- Check the rotor for firm seating.

To ensure a tight fit of the rotor, the nut of the rotor must be hand-tightened.

- Loosening the rotor: Loosen the tension nut by turning in a counter clockwise direction, and turning until the working point for lifting. After passing the working point for lifting the rotor is loosened from the motor shaft cone. Turn the tension nut until the rotor is able to be lifted from the motor shaft.

14 Inserting and removing hangers into/from the rotor

NOTICE

Material damage due to improper loading.

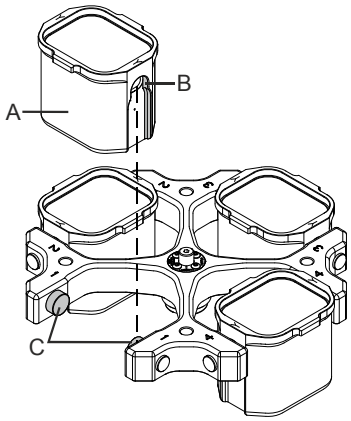
Uneven loading of the rotor can lead to imbalance.

➢ For swing-out rotors, all rotor places must be occupied with the same hangers.

TIP

Certain hangers are marked with the number of the rotor place. These hangers may only be inserted in the corresponding rotor place.

Hangers which are labelled with a set number, e.g. S001/4, may only be used in a set.



Inserting hangers in the rotor:

- Check the rotor to make sure it is seated firmly.
- Grease the lifting lug (C) (Hettich lubricating grease, no. 4051).
- Insert hangers (A) into the rotor. While doing so, make sure that the lifting lugs (C) are in the grooves (B) of the hangers.
- Push the hangers downward as far as they can go.

Removing hangers from the rotor:

- Pull the hangers (A) straight upward and out of the rotor.

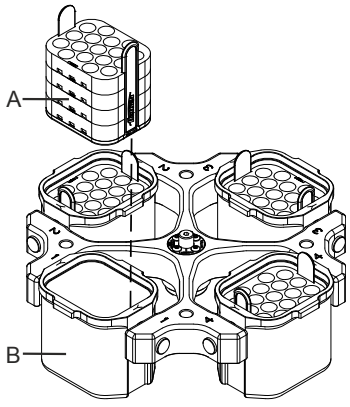
15 Inserting and removing the adapters into/from the hangers

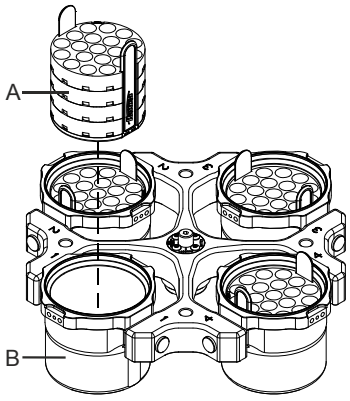
Inserting the adapters into the hangers:

- Insert the adapters (A) horizontally into the hangers (B).

Remove the adapters from the hangers:

- Remove the adapters (A) upward and out of the hangers (B).





16 Loading the rotor

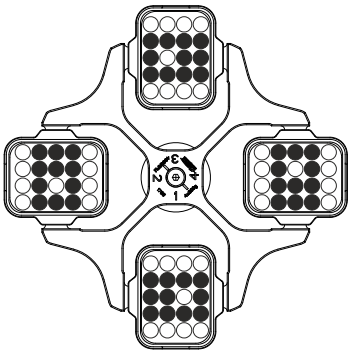
CAUTION

Injury and property damage due to containers of glass

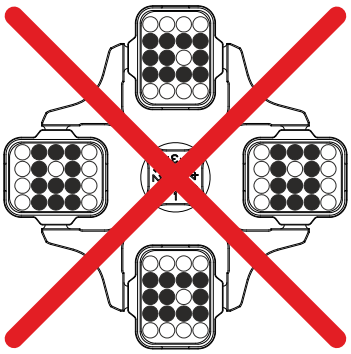
Standard centrifuge containers of glass will not stand RCF values exceeding 4000 (DIN 58970, pg. 2).

➢ Use centrifuge containers of a different material.

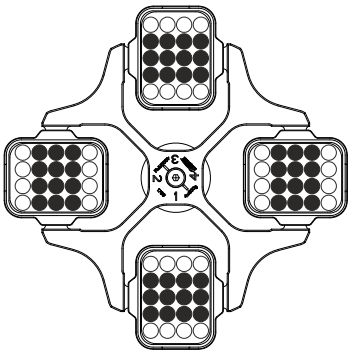
- Check the rotor for firm seating.
  With swing-out rotors all rotor positions must be lined with **identical** hangers. Certain hangers are marked with the number of the rotor position. These hangers may only be used in the respective rotor position. Hangers that are marked with a set number (e.g. S001/4) may only be used in the set.
- The rotors and hangers may only be loaded symmetrically. The centrifuge containers have to be distributed evenly on all rotor positions. For authorised combinations see Chapter "Anhang/Appendix, Rotoren und Zubehör/Rotors and accessories".



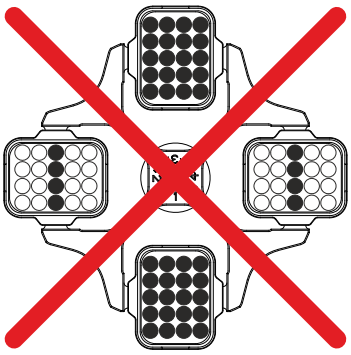
Rotor is loaded symmetrically.



Not permitted!
Rotor is loaded asymmetrically.



Rotor is evenly loaded

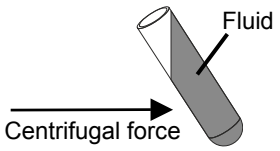


Not permitted!
Rotor is not evenly loaded

- On certain hangers, the weight of the maximum load or the weight of the maximum load and the maximum weight of the completely loaded hanger is specified. This weight may not be exceeded. In case of exception, see chapter " Centrifugation of materials or mixtures of materials with a density higher than 1.2 kg/dm^3".The weight specified for the maximum loading includes the total weight of adapter, frame, centrifuging container and content.
- In containers with rubber inserts, the same number of rubber inserts must always be among the centrifuge containers.
- The centrifuge containers may only be filled outside of the centrifuge.

- The maximum filling quantity for the centrifuge containers specified by the manufacturer must not be exceeded.

  In the case of angle rotors, the centrifuging vessels may only be filled so far that no fluid can be expelled from them while the centrifuge is running.



- When loading the hangers and when the hangers are swivelling out while the centrifuge is running, no liquid may enter the hangers or the centrifuging chamber.
- In order to maintain the weight differences within the centrifuge container as marginal as possible, a consistent fill level in the containers is to be heeded.

17 Control and display elements

See figure on page 2.

Fig. 2: Display and control panel

17.1 Control knob

For setting the individual parameters.
Turning anticlockwise reduces the value. Turning clockwise increases the value.

17.2 Keys and setting options

TIME

- Running time, parameters **t/hms**.
  h: hours. Adjustable from 1 h to 99 h, in 1 hour increments.
  m: minutes. Adjustable from 1 min to 59 min, in 1 minute increments.
  s: seconds. Adjustable from 1 s to 59 s, in 1 second increments.
- Continual running "∞"
- Set runtime timing This setting can only be made if the function "Dual time mode" is activated. See chapter "Activate or deactivate function "Dual time mode". This function is activated ex works.
  You can decide whether the runtime is timed immediately after the start of the centrifugation run or as soon as the set speed is reached.
  Timing begins at Start = The runtime begins to count immediately after the centrifugation run starts.
  Timing begins at Speed = The runtime only begins to count after the set speed is reached.
  This is indicated on the display by the symbol ⌜, to the left next to the time.

RPM

- Revolution, parameters **rpm**.
  Adjustable from 50 rpm to a maximum rotor speed of the rotor (Nmax), in increments of 10. For maximum rotor speed, see chapter "Anhang/Appendix, Rotoren und Zubehör/Rotors and accessories".

○ RCF

- Relative centrifugal force, parameter **RCF**.
  The RCF is shown in brackets 〉〈. The LED in the button lights up.
  The figure that is adjustable is the figure that produces a revolution speed between 50 rpm and the maximum rotor speed (Nmax). Adjustable in increments of 1.
- Centrifuging radius, parameters **RAD**.
  Adjustable from 10 mm to 330 mm in 1 millimeter increments. For centrifuging radius, see chapter "Anhang/Appendix, Rotoren und Zubehör/Rotors and accessories".
- Requesting information from integral RCF.
  You can only query integral RCF if the integral RCF display is activated. See chapter "Activate or deactivate integral RCF display".

Start-up and run-down parameters

- Run-in steps, parameters ⌜.
  Step 9 = shortest run-in time, ... Step 1 = longest run-in time.
- Start-up time, parameter ⌜t. Can be set in 1-second steps. The adjustable time range depends on the set speed.
  It is only possible to set start-up times if these have been activated. See the chapter "Activating or deactivating start-up and run-down times".
- Braking stages, parameter ⌝.
  1-9 = Linear braking curve
  Step 9 = shortest run-out time, ... Step 1 = long run-out time, step 0 = non-braked run-out.
- Run-down time, parameter ⌝t. Can be set in 1-second steps. The adjustable time range depends on the set speed.
  It is only possible to set run-down times if these have been activated. See the chapter "Activating or deactivating start-up and run-down times".
- Brake switch-off revolution, parameters **N Brake**.
  Adjustable from 50 rpm to the maximal rotor speed (Nmax) in increments of 10.
  Once the rotor speed has been reached, non-braked run-out begins.

T/°C

- Temperature
  Adjustable in degrees Celsius (°C) or in degrees Fahrenheit (°F). For setting the temperature unit, see chapter "Temperatur-Einheit einstellen/Setting the temperature unit".

  Parameters **T/°C** = degrees Celsius (°C).
  Adjustable from -20°C to +40°C, in 1°C increments.

  Parameters **T/°F** = degrees Fahrenheit (°F).
  Adjustable from 4°F to +104°F, in 1°F increments.

  The lowest temperature that can be reached depends on the rotor (see chapter "Anhang/Appendix, Rotoren und Zubehör/Rotors and accessories").
- Scroll backwards in the menus.

○PROG

- Call up programs and program linkages; parameter **RCL**.
  Programs: Program locations 1 to 99 (for centrifuge without cooling) and program locations 1 to 98 and PREC (for centrifuge with cooling). Program linkages: Program locations A to Z.
- Save programs and program linkages; parameter **STO**.
  99 programs can be saved (for centrifuges without refrigeration: program places 1 to 99, for centrifuges with refrigeration: program places 1 to 98 and PREC). The program place PREC (PRECOOLING) is reserved for the precooling program. Program place 0 is used for temporary storage for centrifuge data from the last centrifugation run. No programs can be saved at this program place.
  It is possible to save 25 program linkages (program locations A to Z; there is no program location J). A program linkage can consist of 20 programs.
- Link programs; parameter **EDIT**.
- Call up the "Machine menu" (keep the key press for 8 seconds).
- Scroll forwards in the menus.

○❄

- Start centrifugation run for pre-cooling the rotor (only for centrifuges with cooling). The LED in the key is lit during the centrifugation run, as long as the rotor is revolving.
  The centrifugation run for pre-cooling the rotor is done automatically with the program **PREC** (PRECOOLING).

○START

- Start centrifugation run. The LED in the key is lit during the centrifugation run, as long as the rotor is revolving.
- Short-time centrifugation.
  The centrifugation run occurs while the key is kept pressed. The LED in the key is lit during the centrifugation run, as long as the rotor is revolving.
- Saving entries and changes.
- In the "Machine Menu", call up the submenus.

STOP
○ ○
OPEN

- End centrifugation run.
  The rotor decelerates with the preset run-down parameters. The right-hand LED in the button lights up until the rotor is stationary. Once the rotor is stationary the left-hand LED flashes in the button. Pressing the button twice triggers the EMERGENCY STOP.
- Unlock the lid.
  The left-hand LED in the button goes out.
- Exit the parameter input and the menus.

18 Enter centrifugation parameters

TIP

Parameters can be input via the operating unit (key position "0") or via the interface (key position "LOCK 2"). The functions of the various key positions are described in the "Key-operated switch" chapter.

If no key is pressed for 8 seconds long after the selection or during the input of parameters, the previous values will be shown in the display. The input of parameter then has to be executed again.

If several parameters are input, the START key must be pressed after setting the last parameter in order to accept all changes.

If parameters are changed, the program place number is displayed in parentheses (). This means that the centrifugation data in the display no longer corresponds to the centrifugation data from the program place that has been saved.

You can no discontinue entering parameters at any time by pressing the key OPEN / STOP. In this case the adjustments are not saved.

18.1 Running time

TIP

In order to set continual running, the minutes, seconds and hours have to be set to zero.
Continual running is represented in the display by the following symbol, "∞".

- Press the TIME key. The parameters **t/hms** is displayed. The minutes (**m)** are shown in parentheses 〈〉, and can be changed.
- Use the adjusting knob ⟲ to set the value you want.
- Press the TIME key. The seconds (**s**) are shown in parentheses 〈〉and can be changed.
- Use the adjusting knob ⟲ to set the value you want.
- Press the TIME key. The hours (**h**) are shown in parentheses 〈〉 and can be changed.
- Use the adjusting knob ⟲ to set the value you want.
- To apply the setting to the display, either press the START key or press the TIME key as often as is required until the centrifugation data are displayed.

18.2 Starting runtime timing

TIP

The start to runtime timing can only be set if the function, "Dual time mode" has been activated. See chapter "Activate or deactivate function "Dual time mode". This function is activated ex works.

- Press the TIME key as often as is required until **Timing begins at start** or **Timing begins at speed** is displayed.
- Select the desired setting with the turning knob ⟲.
  Timing begins at Start = The runtime begins to count immediately after the centrifugation run starts.
  Timing begins at Speed = The runtime only begins to count after the set speed is reached.
  This is indicated on the display by the symbol ⌜, to the left next to the time.
- Press the TIME or START keys to apply the setting to the display.

18.3 Speed (RPM)

- Press the RPM key. The parameters **RPM** is displayed.
- Use the adjusting knob ⟲ to set the value you want.
- Press the RPM or START keys to apply the setting to the display

18.4 Relative centrifugal force (RCF) and centrifuging radius (RAD)

TIP

Relative centrifugal force (RCF) depends on the centrifugal radius (RAD). Before RCF is set, the centrifugal radius has to be set.

- Press the RCF key as often as is required until the parameters **RAD** and **RCF** are displayed and the value of the parameter, **RAD** is displayed in parentheses, 〈〉 e.g. **RAD =** 〈**146**〉 **RCF = 3695**. The LED is lit in the key.
- Use the adjusting knob to set the centrifuging radius you want.
  By changing the centrifuging radius, the value adjusts automatically to the RCF.
- Press the RCF key again. The value of the parameter, **RCF** is displayed in 〈〉 parentheses, e.g. **RAD = 146 RCF =** 〈**3695**〉.
- Press the PROG key to save the set RCF value. See the "Inputting or changing programs" chapter.
- Press the RCF or START keys to apply the setting to the display.

TIP

Only by storing (STO) the set RCF value will the RPM value resulting from that be accepted.

18.5 Start-up and run-down parameters

The set start-up and run-down parameters are displayed.

x: 1-9 = start-up stage, t = start-up time
y: 1-9 = braking stage, 0 = unbraked run-down, t = run-down time

18.5.1 Start-up stage and start-up time

TIP

It is only possible to set start-up times if these have been activated. See the chapter "Activating or deactivating start-up and run-down times".

- Press the key. The parameter or t is displayed.
  = start-up stage, t = start-up time
  Press the TIME key to switch between the start-up stage and start-up time.
- Set the desired stage or time with the rotary knob .
- If necessary, press the key to set the next parameter.
- To apply the setting to the display, either press the START key or press the key as often as is required until the centrifugation data are displayed.

18.5.2 Braking stage and run-down time

TIP

No B-brake stages can be set for this device. The activation of the B-brake stages in the "Settings" menu is not possible (parameter **B-Ramp = off**). B-brake stages are similar to an exponential braking curve.

It is only possible to set run-down times if these have been activated. See the chapter "Activating or deactivating start-up and run-down times".

- Press the ⏜ key until the parameter ⌥ or ⌥t is displayed.
  ⌥ = braking stage, ⌥t = run-down time
  Press the TIME key to switch between the braking stage and run-down time.
- Set the desired stage or time with the rotary knob ⟲.
- If necessary, press the ⏜ key to set the next parameter.
- To apply the setting to the display, either press the START key or press the ⏜ key as often as is required until the centrifugation data are displayed.

18.5.3 Brake switch-off speed

- Press the ⏜ key as often as necessary until the parameter **N Brake** is shown.
- Use the adjusting knob ⟲ to set the value you want.
- Press the ⏜ or START keys to apply the setting to the display.

18.6 Temperature (only for centrifuge with refrigeration)

TIP

The temperature can be entered in degrees Celsius (°C) or in degrees Fahrenheit (°F). For setting the temperature unit, see chapter "Set temperature unit".

If degrees Fahrenheit (°F) is set as the unit of temperature, the letter "F" appears after the temperature value on the display.

- Press the T/°C key. The following parameters are displayed: **T/°C** or **T/°F**.
- Use the adjusting knob ⟲ to set the value you want.
- Press the START key, to have the settings applied to the display.
- Press the T/°C or START keys to apply the setting to the display

19 Programming

TIP

Programming can be done via the operating unit (key position "0") or via the interface (key position "LOCK 2"). The functions of the various key positions are described in the "Key-operated switch" chapter.

If parameters are changed, the program place number is displayed in parentheses (). This means that the centrifugation data in the display no longer corresponds to the centrifugation data from the program place that has been saved.

19.1 Inputting or changing programs

- Set the parameters you want (see chapter "Enter centrifugation parameters").
- Press the PROG key as often as necessary until the **STO** parameter is shown.
- Use the adjusting knob ⥀ to set the program place you want.

TIP

If a "**+**" is shown after the program location, then this data is write-protected. In this case, the write protection has be removed first before saving (see the chapter on "Write protection for programs").

- Press the START key to have the settings saved to the program place you want. Briefly, **Program store ...** is displayed as confirmation.

TIP

The previous program location data will be overwritten when the new data is saved.

If "**Protected !!**" is displayed, then the data at the program location is write-protected and it will not be saved.

19.2 Calling up programs

- Press the PROG key. The parameters **RCL** is displayed.
- Use the adjusting knob ⥀ to set the program place you want.

TIP

If a "**+**" is shown after the program location, then this data is write-protected.

- Press the START key. Briefly, **Program recall ...** is displayed as confirmation.
  The centrifugation data of the selected program place is shown.

19.3 Write protection for programs

The programs can be protected against unintentional modification.

The write protection can be activated/deactivated as follows when the rotor is at a standstill:

- Call up the desired program (see the chapter on "Calling up programs").
- Press the PROG key. The parameters **RCL** is displayed.
- Press and hold the PROG button for eight seconds. The parameter **STO** is displayed.
  After eight seconds, **Set Protection = 1-** (for example) appears in the display.
- Set ⥀ "**+**" or "**-**" with the adjusting knob.
  + = program is write-protected,
  - = program is not write-protected.
- Press the START button to save the setting.

19.4 Program linkage

"Program linkage" can be used to link several centrifuge operations together.

TIP

A program linkage is only possible if this has been activated (parameter **Multi programs = on**; see the chapter on "Activating or deactivating program linkage").

19.4.1 Activating or deactivating program linkage

The program link can be activated/deactivated as follows when the rotor is at a standstill:

TIP

This setting can only be made via the operating unit (key position "0" or "LOCK 2"). The functions of the various key positions are described in the "Key-operated switch" chapter.

You can scroll backwards through the menu by pressing the T/°C key.

The operation can be cancelled at any time by pressing the OPEN / STOP key. In this case, the settings are not stored.

- Press and hold the PROG button for eight seconds.
  After eight seconds, ***** Machine Menu ***** appears in the display.
- Press the PROG key as often as necessary until the **->Settings** is displayed.
- Press the START key. The **SOUND / BELL = off/on** is displayed.
- Press the PROG key as often as necessary until the **Multi programs = off/on** is displayed.
- Set **off** or **on** with the adjusting knob ⥀ .
  off = program linkage deactivated,
  on = program linkage activated.
- Press the START key to save the setting.
  Briefly, **Store Settings ...** is displayed as confirmation, followed by **-> Settings**.
- Press the OPEN / STOP key once to exit the "Settings" menu or press the OPEN / STOP key twice to exit the "Machine Menu".

19.4.2 Linking programs or changing a program linkage

TIP

It is possible to save 25 program linkages (program locations A to Z; there is no program location J). A program linkage can consist of no more than 20 programs.

The speed adjustment from one program to the next one is always done in a program linkage with the start-up parameter of the next program.

No continuous run programs or programs with start-up and run-down times (parameters ⌟t and ⌝t) may be linked.

No centrifuge parameters may be modified in a program linkage. A parameter modification is only possible in the individual programs.

The TIME button can be used during the centrifuge operation to call up the total run time of the program linkage (e. g. **∑=00:05:30**) and the run time of the currently running program (e.g. **t B.02=00:01:00**).

1. Press the PROG button repeatedly until the parameter **EDIT A…Z** is displayed.
2. Use the ⥀ adjusting knob to set the desired program location where the program linkage is to be saved.
3. Press the START button. The program location of the program linkage and the first program of the program linkage will be shown (e.g. **EDIT B.01 = 01**).
4. Use the ⥀ adjusting knob to set the first program of the program linkage.
5. Press the PROG button. The next program of the program linkage will be shown (e.g. **EDIT B.02 = END**).
6. Use the ⥀ adjusting knob to set the next program of the program linkage.
7. Press the PROG button. The next program of the program linkage will be shown (e.g. **EDIT B.03 = END**).
8. Repeat steps 6 and 7 until all programs have been set.
9. Set **END** with the ⥀ adjusting knob (turn adjusting knob anti-clockwise).

TIP

For program linkages which consist of 20 programs, **END** cannot be set after the 20th program.

10. Press the START button. **STO B**, for example, is displayed.
11. Press the START button to save the program linkage.
    As confirmation, **Multi program store ..** will be shown briefly.

19.4.3 Calling up program linkage

- Press the PROG button repeatedly until the parameter **RCL A…Z** is displayed.
- Use the adjusting knob ⟲ to set the program place you want.
- Press the START key. Briefly, **Multi program recall ...** is displayed as confirmation.
  The centrifugation data of the first program of the program linkage as well as the total runtime of the program linkage are displayed.

19.5 Automatic temporary storage

The program place 0 serves as temporary storage for centrifugation data of the last centrifugation run that took place.

No programs can be saved at this program place.

After every start to a centrifugation run, the centrifugation data that is used for the run is automatically saved at program place "0" and can be accessed there.

20 Centrifugation

WARNING

Risk of injury and material damage due to incorrect installation.

- ➢ When the centrifuge is running, according to EN / IEC 61010-2-020, no persons, dangerous substances or objects may be within the safety margin of 300 mm around the centrifuge.
- ➢ If the centrifuge will be built into another machine or will be integrated in a system the manufacturer of the complete system is responsible for its security.

TIP

The centrifuge can be operated via the operating unit (key position "0") or controlled via the interface (key position "LOCK 2"). The functions of the various key positions are described in the "Key-operated switch" chapter.

A centrifugation run can be stopped at any time by pushing the key OPEN / STOP .

During a centrifugation run, parameters can be selected and modified (see chapter, "Change settings during centrifugation run").

One can toggle between the RPM and RCF display at any time via the interface or with the RPM and RCF keys. When working with program links, it is not possible to switch with the RPM and RCF keys. When working with the RCF display, the centrifuging radius must be input.

If **Enter max cycles =** ⟨**30000**⟩ is displayed, first of all the maximum permitted number of rotor cycles specified on the hanger is entered, before the centrifugation run can be restarted (see chapter "Cycle Counter").

If the rotor has been changed, no centrifugation run takes place and this display is shown, e.g. **Rotor 4 Nmax= 4500 R=184 mm** (see chapter "Rotor Identification").

Operation errors and malfunctions will be shown (see Chapter "Faults").

20.1 Centrifugation with preselected time

- Set the centrifugation parameters or call up a program or a program linkage (see the chapters on "Enter centrifugation parameters", "Calling up programs" or "Program linkage").
- Press the START key. The LED in the START key blinks until the rotor has been imported, it is subsequently lit.
- After the time expires or if the centrifugation run is aborted via the interface or by pressing the OPEN / STOP key, the run-down is done with the selected run-down parameter. The run-down parameter is displayed e.g. ⌥9. The right-hand LED in the OPEN / STOP key is lit. Once the rotor has come to a standstill, the LED in the START key and the right LED in the OPEN / STOP key switch off and the left LED in the OPEN / STOP key lights up.

During the centrifugation run, the rotor speed or the RCF value, the temperature in the centrifuging chamber (only for centrifuge with cooling), and the remaining time are displayed.

20.2 Continuous operation

- Set the minutes, seconds and hours to "0" or start a continual run program (see chapter "Enter centrifugation parameter" or " Calling up programs").
- Press the START key. The LED in the START key blinks until the rotor has been imported, it is subsequently lit. The time count starts from 00:00.
- End the centrifugation run via the interface or by pressing the OPEN / STOP key. Run- down is carried out with the selected run- down parameters. The run-down parameter is displayed e.g. ⌥9. The right-hand LED in the OPEN / STOP key is lit. Once the rotor has come to a standstill, the LED in the START key and the right LED in the OPEN / STOP key switch off and the left LED in the OPEN / STOP key lights up.

During the centrifugation run, the rotor speed or the RCF value, the temperature in the centrifuging chamber (only for centrifuge with cooling), and the elapsed time are displayed.

20.3 Short-time centrifugation

TIP

A short-time centrifugation is not possible if program linkages are being used.

- Keep the START key pressed. The LED in the START key blinks until the rotor has been imported, it is subsequently lit. The time count starts from 00:00.
- Release the START key again to end the centrifugation run. Run- down is carried out with the selected run- down parameters. The run-down parameter is displayed e.g. ⌥9. The right-hand LED in the OPEN / STOP key is lit. Once the rotor has come to a standstill, the LED in the START key and the right LED in the OPEN / STOP key switch off and the left LED in the OPEN / STOP key lights up.

During the centrifugation run, the rotor speed or the RCF value, the temperature in the centrifuging chamber (only for centrifuge with cooling), and the elapsed time are displayed.

21 Change the settings during the centrifugation run

TIP

The centrifugation parameters can be changed during the centrifugation run via the operating unit (key position "0") or via the interface (key position "LOCK 2"). The functions of the various key positions are described in the "Key-operated switch" chapter.

The runtime, speed, relative centrifugal force (RCF), start-up and run-out parameters as well as temperature (only in centrifuges with cooling) can be changed during the centrifugation run.

- Change the value of the desired parameter (see chapter, "Enter centrifugation parameter").
  The changed setting is saved at program place "0" (see chapter "Automatic temporary storage"). The original program is not overwritten. The program place number is displayed in parentheses ().This means that the centrifugation data in the display no longer corresponds to the centrifugation data from the program place that has been saved.

22 Integral RCF

The integral RCF is a measure for the effect of sedimentation ($\int n^2 dt$). This numerical value is used to compare centrifugation runs.

22.1 Query integral RCF

TIP

The integral RCF can be queried via the operating unit (key position "0") or via the interface (key position "LOCK 2"). The functions of the various key positions are described in the "Key-operated switch" chapter.

You can only query integral RCF if the integral RCF display is activated. See chapter "Activate or deactivate integral RCF display".

The integral RCF is not saved. After starting the next centrifugation run or after switching off the device, the integral RCF is deleted.

If the function, **"Timing begins at speed"** is selected, calculation of the integral RCF begins once the set speed has been reached.

- Press the ○ RCF key as often as is necessary until the integral RCF is displayed, e.g. **∑=4.8667e+05** (∑=4.8667e+05 = $4{,}8667 \times 10^5$ = 486670).
- Press the ○ RCF key. The centrifugation data are displayed again.
- If necessary, press the RPM key to switch over to the RPM display.

22.2 Activate or deactivate the integral RCF display

The integral RCF display is activated or deactivated as follows when the rotor is at rest:

TIP

This setting can only be made via the operating unit (key position "0" or "LOCK 2"). The functions of the various key positions are described in the "Key-operated switch" chapter.

You can scroll backwards through the menu by pressing the T/°C key.

The operation can be cancelled at any time by pressing the ◦OPEN / STOP◦ key. In this case, the settings are not stored.

- Keep the ◦PROG key held down for 8 seconds.
  After 8 seconds, ✱✱✱ **Machine Menu** ✱✱✱ appears in the display.
- Press the ◦PROG key as often as necessary until the **->Settings** is displayed.
- Press the ◦START key. The **SOUND / BELL = off/on** is displayed.
- Press the ◦PROG key as often as is required until **RCF Integral = off/on** is displayed.
- Use the adjusting knob to set ↻ **off** or **on**.
  off = integral RCF is deactivated,
  on = integral RCF is activated.
- Press the ◦START key to save the setting.
  Briefly, **Store Settings ...** is displayed as confirmation, followed by **-> Settings**.
- Press the ◦OPEN / STOP◦ key once to exit the "Settings" menu or press the ◦OPEN / STOP◦ key twice to exit the "Machine Menu".

23 Emergency Stop

TIP

An Emergency Stop can be executed via the operating unit (key position "0" or "LOCK 2") or via the interface (key position "LOCK 2"). The functions of the various key positions are described in the "Key-operated switch" chapter.

- Press the ◦OPEN / STOP◦ key twice.

During a not-stop, run-out is carried out with braking level 9 (shortest run-out). Braking level ⌥9 is displayed. If braking level 0 has been preselected, run-out is carried out with braking level ⌥9d. With braking level 9d, the run-out time is longer, technically speaking, than braking level 9.

24 Cycle counter

TIP

The settings can be made via the operating unit (key position "0" or "LOCK 2") or via the interface (key position "LOCK 2"). The functions of the various key positions are described in the "Key-operated switch" chapter.

Usage of the cycle counter only makes sense if you always use the same hanger set.

The centrifuge is fitted with a cycle counter, which counts the rotor cycles (centrifugation runs) of the different rotor codes (see also chapter, "Rotor recognition").

In the swing-out rotors, the cycle counter is used to determine the rotor cycles (centrifugation runs) of the hangers.

If a rotor is recognized the first time, the centrifugation run is canceled. After pressing any key, **Enter max cycles = ⟨30000⟩** is displayed. The maximum permitted number of rotor cycles specified on the hanger has to be entered before the centrifugation run can be restarted (see chapter "After starting the first centrifugation run, enter the maximum permitted number of rotor cycles or deactivate the cycle counter").

For rotors and hangers which are not labelled with the maximum permissible number of running cycles, the cycle counter can be deactivated (see chapters "After starting the first centrifugation run, enter the maximum permitted number of rotor cycles or deactivate the cycle counter" and "Activating or deactivating the cycle counter").

Each time the lid is opened, the number of rotor cycles (centrifugation runs) of the current rotor code is displayed, e.g. **CYCLES 5120 of 30000**

For centrifuges with a program version up to V01.17:

The control of the automated system must query the current number of run cycles after each centrifugation run via the interface and compare this with the input maximum permissible number of run cycles.

For details, see the instructions AH5680-01EN "Serial communication and PC parameters", chapter "4.9 Rotor cycles commands".

WARNING

Risk of injury and material damage due to flying parts.

If the specified number of running cycles of the Hangers is exceeded, injuries and material damage may occur due to flying parts.

- Once the maximum permissible number of run cycles of the hangers is reached, the hangers must be immediately replaced

Centrifuges with a program version from V01.18:

Once the entered maximum permissible number of run cycles of the hangers is reached, all subsequent centrifugation runs will be blocked as a precaution.

∗ MAX CYCLES PASSED ∗ is shown on the display and the START command is responded to with "NAK" via the interface. For details, see the instructions AH5680-01EN "Serial communication and PC parameters", chapter "4.9 Rotor cycles commands".

WARNING

Risk of injury and material damage due to flying parts.

If the specified number of running cycles of the Hangers is exceeded, injuries and material damage may occur due to flying parts.

- If **∗ MAX CYCLES PASSED ∗** is displayed, the hangers must be immediately replaced with new hangers for safety reasons. In this case, notify the manufacturer of the automation system.

After replacing the hanger, the cycle counter has to be reset to "0" when the rotor is at rest (see chapter "Reset cycle counter to "0" and enter maximum permitted number of rotor cycles").

24.1 After starting the first centrifugation run, enter the maximum permitted number of cycles or deactivate the cycle counter

- **Enter max cycles = ⟨30000⟩** is displayed.
  Use the knob ⥀ to set the maximum permitted number of rotor cycles specified on the hanger.
  For rotors and hangers which are not labelled with the maximum permissible number of running cycles, the cycle counter can be deactivated. Turn the knob ⥀ to the left until **disabled** is displayed (**disabled** = cycle counter is deactivated).
- Press the START key to save the setting.
  Briefly, **Store max cycles ...** is displayed as confirmation.

24.2 Reset cycle counter to "0" and enter the maximum permitted number of cycles

If the rotor is at standstill, this can be set as follows:

TIP

You can scroll backwards through the menu by pressing the T/°C key.

The operation can be cancelled at any time by pressing the OPEN / STOP key. In this case, the settings are not stored.

- Keep the PROG key held down for 8 seconds.
  After 8 seconds, ***** Machine Menu ***** appears in the display.
- Press the PROG key as often as necessary until the **->Operating Time** is displayed.
- Press the START key. The external operating hours are displayed, e.g. **OP Time ext = 0h25m**.
- Press the PROG key as often as is required until the rotor cycles are displayed, e.g. **Cycles = 30001 of 30000**.
- Press the RCF key. The number of rotor cycles is displayed in parentheses áñ , e.g. **Cycles = ⟨30001⟩ of 30000**.
- Turn the knob ⥀ to the left to reset the number of rotor cycles to "0".

TIP

If the rotor cycles are not reset to "0", press the START key, which causes **Max cycles ⟨= actual cycles** to be displayed and the setting is not saved.

- Press the RCF key. The maximum permitted number of rotor cycles is displayed in parentheses ⟨⟩, e.g. **Cycles = 0 of ⟨30000⟩**.
- Use the knob ⥀ to set the maximum permitted number of rotor cycles specified on the hanger.
- Press the START key to save the settings.
  In confirmation, **Store cycles ...** is displayed briefly. Next the rotor cycles are displayed, e.g. **Cycles = 0 of 30000**.
- Press the OPEN / STOP key twice to exit the "Operating Time" menu or press the OPEN / STOP key three times to exit the "Machine Menu".

24.3 Activating or deactivating the cycle counter

The cycle counter can be activated/deactivated as follows when the rotor is at a standstill:

TIP

You can scroll backwards through the menu by pressing the T/°C key.

The operation can be cancelled at any time by pressing the OPEN / STOP key. In this case, the settings are not stored.

- Keep the PROG key held down for 8 seconds.
  After 8 seconds, ***** Machine Menu ***** appears in the display.
- Press the PROG key as often as necessary until the **->Operating Time** is displayed.
- Press the START key. The external operating hours are displayed, e.g. **OP Time ext = 0h25m**.
- Press the PROG key as often as necessary until (with the cycle counter activated) the rotor cycles are displayed, e.g. **Cycles = 5120 of 30000,** and (with the cycle counter deactivated) until **Cycles = disabled** is displayed.
- Deactivating the cycle counter:
  - Press the RCF key as often as is required until the maximum permitted number of rotor cycles is displayed in parentheses 〈〉 , e.g. **Cycles = 5120 of 〈30000〉**.
  - Turn the knob ↻ to the left to reset the maximum permitted number of rotor cycles to "0".
  - Press the START key to save the setting.
    In confirmation, **Store cycles ...** and **Cycles = disabled** is displayed briefly.
- Activating the cycle counter:
  - Press the RCF key as often as is required until the maximum permitted number of rotor cycles is displayed in parentheses 〈〉 , e.g. **Cycles = 0 of 〈0〉**.
  - Use the knob ↻ to set the maximum permitted number of rotor cycles specified on the hanger.
  - Press the START key to save the setting.
    In confirmation, **Store cycles ...** is displayed briefly. Next the rotor cycles are displayed, e.g. **Cycles = 0 of 30000**.
- Press the OPEN / STOP key twice to exit the "Operating Time" menu or press the OPEN / STOP key three times to exit the "Machine Menu".

25 Activate or deactivate the function, "Dual time mode"

The function "Dual time mode" can be activated or deactivated as follows when the rotor is at a standstill:

TIP

This setting can only be made via the operating unit (key position "0" or "LOCK 2"). The functions of the various key positions are described in the "Key-operated switch" chapter.

You can scroll backwards through the menu by pressing the T/°C key.

The operation can be cancelled at any time by pressing the OPEN / STOP key. In this case, the settings are not stored.

- Keep the PROG key held down for 8 seconds.
  After 8 seconds, ***** Machine Menu ***** appears in the display.
- Press the PROG key as often as necessary until the **->Settings** is displayed.
- Press the START key. The **SOUND / BELL = off/on** is displayed.
- Press the PROG key as often as is required until **Dual time mode enabled/disabled** is displayed.
- Use the knob ↻ to set **enabled** or **disabled**.
  disabled = The function is deactivated,
  enabled = The function is activated.
- Press the START key to save the setting.
  Briefly, **Store Settings ...** is displayed as confirmation, followed by **-> Settings**.
- Press the OPEN / STOP key once to exit the "Settings" menu or press the OPEN / STOP key twice to exit the "Machine Menu".

26 Activating or deactivating start-up and run-down times

The start-up and run-down times can be activated or deactivated as follows with the rotor at a standstill:

TIP

This setting can only be made via the operating unit (key position "0" or "LOCK 2"). The functions of the various key positions are described in the "Key-operated switch" chapter.

You can scroll backwards through the menu by pressing the T/°C key.

The operation can be cancelled at any time by pressing the OPEN / STOP key. In this case, the settings are not stored.

- Keep the PROG key held down for 8 seconds.
  After 8 seconds, ***** Machine Menu ***** appears in the display.
- Press the PROG key as often as necessary until the **->Settings** is displayed.
- Press the START key. The **SOUND / BELL = off/on** is displayed.
- Press the PROG key as often as is required until **Ramp Unit = Steps / Steps / Time** is displayed.
- Use the adjusting knob to set **Steps** or **Steps / Time**.
  Steps = start-up and run-down times deactivated,
  Steps / Time = start-up and run-down times activated.
- Press the START key to save the setting.
  Briefly, **Store Settings ..** is displayed as confirmation, followed by **-> Settings**.
- Press the OPEN / STOP key once to exit the "Settings" menu or press the OPEN / STOP key twice to exit the "Machine Menu".

27 Acoustic signal

The acoustic signal sounds:

- After a disturbance occurs, in 2 second intervals.
- After completion of a centrifugation run and rotor standstill in 30 second intervals.

The acoustic signal is stopped by opening the lid or pressing any key.

The acoustical signal can be activated or deactivated as follows when the rotor is at a standstill:

TIP

This setting can only be made via the operating unit (key position "0" or "LOCK 2"). The functions of the various key positions are described in the "Key-operated switch" chapter.

You can scroll backwards through the menu by pressing the T/°C key.

The operation can be cancelled at any time by pressing the OPEN / STOP key. In this case, the settings are not stored.

- Keep the PROG key held down for 8 seconds.
  After 8 seconds, ***** Machine Menu ***** appears in the display.
- Press the PROG key as often as necessary until the **->Settings** is displayed.
- Press the START key. The **SOUND / BELL = off/on** is displayed.
  SOUND / BELL : Signal after the centrifugation run ends.
- Use the adjusting knob to set **off** or **on**.
- Press the PROG key. The **SOUND / BELL error = off/on** is displayed.
  SOUND / BELL error : Signal after a disturbance occurs.
- Use the adjusting knob to set **off** or **on**.
- Press the START key to save the setting.
  Briefly, **Store Settings ...** is displayed as confirmation, followed by **-> Settings**.
- Press the OPEN / STOP key once to exit the "Settings" menu or press the OPEN / STOP key twice to exit the "Machine Menu".

28 Displayed centrifugation data after switch-on.

After switch-on the centrifugation data from program 1, or from the last program that was used, is displayed.
If the rotor is at standstill, this can be set as follows:

TIP

This setting can only be made via the operating unit (key position "0" or "LOCK 2"). The functions of the various key positions are described in the "Key-operated switch" chapter.

You can scroll backwards through the menu by pressing the T/°C key.

The operation can be cancelled at any time by pressing the OPEN / STOP key. In this case, the settings are not stored.

- Keep the PROG key held down for 8 seconds.
  After 8 seconds, *** **Machine Menu** *** appears in the display.
- Press the PROG key as often as necessary until the **->Settings** is displayed.
- Press the START key. The **SOUND / BELL = off/on** is displayed.
- Press the PROG key as often as necessary until **Start program = Last/First** is displayed.
- Use the adjusting knob ⟲ to set **Last** or **First**.
  Last = the program used last, First = program 1.
- Press the START key to save the setting.
  Briefly, **Store Settings ...** is displayed as confirmation, followed by **-> Settings**.
- Press the OPEN / STOP key once to exit the "Settings" menu or press the OPEN / STOP key twice to exit the "Machine Menu".

29 Set temperature unit

The temperature can be entered in degrees Celsius (°C) or in degrees Fahrenheit (°F).
When the rotor is at standstill, the temperature unit must be set as follows:

TIP

This setting can only be made via the operating unit (key position "0" or "LOCK 2"). The functions of the various key positions are described in the "Key-operated switch" chapter.

You can scroll backwards through the menu by pressing the T/°C key.

The operation can be cancelled at any time by pressing the OPEN / STOP key. In this case, the settings are not stored

- Keep the PROG key held down for 8 seconds.
  After 8 seconds, *** **Machine Menu** *** appears in the display.
- Press the PROG key as often as necessary until the **->Settings** is displayed.
- Press the START key. The **SOUND / BELL = off/on** is displayed.
- Press the PROG key as often as necessary until **Temp Unit = Celsius/Fahrenheit** is displayed.
- Use the adjusting knob ⟲ to set **Celsius** or **Fahrenheit**.
- Press the START key to save the setting.
  Briefly, **Store Settings ...** is displayed as confirmation, followed by **-> Settings**.
- Press the OPEN / STOP key once to exit the "Settings" menu or press the OPEN / STOP key twice to exit the "Machine Menu".

30 Backlighting of the display

(only possible starting from program version V 01.18)
To save energy, it can be set that, after a centrifugation run, the backlighting of the display switches off after 2 minutes.

With the rotor at a standstill, this can be set as follows:

TIP

This setting can only be made via the operating unit (key position "0" or "LOCK 2"). The functions of the various key positions are described in the "Key-operated switch" chapter.

You can scroll backwards through the menu by pressing the T/°C key.

The operation can be cancelled at any time by pressing the ◦OPEN / STOP◦ key. In this case, the settings are not stored

- Keep the ◦PROG key held down for 8 seconds.
  After 8 seconds, ***** Machine Menu ***** appears in the display.
- Press the ◦PROG key as often as necessary until the **->Settings** is displayed.
- Press the ◦START key. The **SOUND / BELL = off/on** is displayed.
- Press the ◦PROG key as often as is required until **Power save = off/on** is displayed.
  Power save : Automatic shutdown of the backlighting.
- Use the adjusting knob to set ♁ **off** or **on**.
  off = Automatic shutdown deactivated,
  on = Automatic shutdown activated.
- Press the ◦START key to save the setting.
  Briefly, **Store Settings ..** is displayed as confirmation, followed by **-> Settings**.
- Press the ◦OPEN / STOP◦ key once to exit the "Settings" menu or press the ◦OPEN / STOP◦ key twice to exit the "Machine Menu".

31 Centrifuge address

TIP

Ex works, the address is] = 29. Address is set.

32 Query the operating hours, centrifugation runs and cycle counter

The operating hours are divided up into internal and external operating hours.
Internal operating hours: Total time the device was switched on.
External operating hours: Total time of previous centrifugation runs.

The query is performed as follows when the rotor is at a standstill:

TIP

The query can be made via the operating unit (key position "0" or "LOCK 2") or via the interface (key position "LOCK 2"). The functions of the various key positions are described in the "Key-operated switch" chapter.

You can scroll backwards through the menu by pressing the T/°C key.

- Keep the ◦PROG key held down for 8 seconds.
  After 8 seconds, ***** Machine Menu ***** appears in the display.
- Press the ◦PROG key as often as necessary until the **-> Operating Time** is displayed.
- Press the ◦START key. The external operating hours are displayed, e.g. **OP Time ext = 0h25m**.
- Press the ◦PROG key. The internal operating hours are displayed, e.g. **OP Time int = 1h36m**.
- Press the ◦PROG key. The number of all centrifugation runs is displayed, e.g. **Number of Starts = 10**.
- Press the ◦PROG key. The number of rotor cycles (centrifugation runs) of the current rotor code since the last time the cycle counter was reset to "0" and the permitted number of rotor cycles are displayed, e.g. **CYCLES = 5120 of 30000.**
- Press the ◦PROG key. The number of all rotor cycles (centrifugation runs) of the current rotor code is displayed, e.g. **Rotor cycles total = 37490**. This value cannot be set.
- Press the ◦OPEN / STOP◦ key twice to exit the "Operating Time" menu or press the ◦OPEN / STOP◦ key three times to exit the "Machine Menu".

33 Query the system information

The following system information can be queried:

- Centrifuge model
- Mains voltage
- Rotor information
- Program version of the centrifuge
- Program version of the frequency converter

The system information can be queried as follows when the rotor is at a standstill:

TIP

The query can be made via the operating unit (key position "0" or "LOCK 2") or via the interface (key position "LOCK 2"). The functions of the various key positions are described in the "Key-operated switch" chapter.

You can scroll backwards through the menu by pressing the T/°C key.

- Keep the PROG key held down for 8 seconds.
  After 8 seconds, ✱✱✱ **Machine Menu** ✱✱✱ appears in the display.
- Press the PROG key as often as necessary until the **->Info** is displayed.
- Press the START key. The centrifuge model is displayed.
- Press the PROG key. The mains voltage is displayed, e.g. **Mains Voltage : 230 V**.
- Press the PROG key. The rotor code (Rotor), the maximum speed of the rotor (Nmax) and a centrifuging radius (R) of the last rotor detected by the rotor detector are displayed. e.g.
  Rotor 4✱ : Nmax = 4500 R=184.
  The last recognized rotor is marked with a star (✱). Use the adjusting knob ⟲ to have the information of the rotors permitted in the centrifuge displayed.

TIP

The required centrifuging radius must be set according to the used accessories; see chapter "Entering centrifugation parameters".

- Press the PROG key. The program version of the centrifuge is displayed, e.g. **SW version = V01.00.**
- Press the PROG key. The program version of the frequency converter is displayed e.g. **FC-SW-Version = 4**.
- Press the OPEN / STOP key twice to exit the "Info" menu or press the OPEN / STOP key three times to exit the "Machine Menu".

34 Immediate display of centrifugation data after switch-on.

- Switch on the power supply. (Switch setting **I**).
- The first time the display changes optically, (inverse display) press any key and keep it held down. The centrifugation data is displayed immediately.

35 Cooling (only in centrifuges with cooling)

The temperature set-point can be adjusted from -20°C to +40°C / -4°F to +104°F. The lowest obtainable temperature is dependent on the rotor (see Chapter "Anhang/Appendix, Rotoren und Zubehör/Rotors and accessories").

35.1 Standby-cooling

When the rotor is at a standstill, with the lid and hatch closed, the centrifuging chamber is cooled to the preselected temperature if this is lower than 20°C / 68°F.

During the standby cooling, the preset temperature is displayed.

35.2 Precooling of the rotor

TIP

For quick precooling of the unloaded rotor and the accessories, it is a good idea to do a centrifugation run with the continuous operation setting and a speed of about 20% of the maximum rotor speed.

A centrifugation run for pre-cooling the rotor can be carried out via the operating unit (key position "0") or via the interface (key position "LOCK 2"). The functions of the various key positions are described in the "Key-operated switch" chapter.

The centrifugation run for pre-cooling the rotor is done automatically with the program **PREC** (PRECOOLING).

A centrifugation run for pre-cooling the rotor cannot be carried out if program linkages are used.

- Press the ❄ key. The LED in the ❄ key blinks until the rotor has been imported, it is subsequently lit.
- After the time expires or if the centrifugation run is aborted via the interface or by pressing the OPEN / STOP key, the run-down is done with the selected run-down parameter. The run-down parameter is displayed e.g. ⌥9. The right-hand LED in the OPEN / STOP key is lit. Once the rotor has come to a standstill, the LED in the ❄ key and the right LED in the OPEN / STOP key switch off and the left LED in the OPEN / STOP key lights up.

During the centrifugation run, the rotor speed or the RCF value, the temperature in the centrifuging chamber and the remaining or elapsed time are displayed.

35.3 Time-controlled cooling

If necessary it can be set so that cooling begins after a certain amount of time once centrifugation run has been started.
The delay time can be set in 1-second increments from 15 to 900 seconds. If no time delay is required, set to "0". No delay time is set ex works.
When the rotor is at a standstill, the delay time can be set as follows:

TIP

This setting can only be made via the operating unit (key position "0" or "LOCK 2"). The functions of the various key positions are described in the "Key-operated switch" chapter.

You can scroll backwards through the menu by pressing the T/°C key.

The operation can be cancelled at any time by pressing the OPEN / STOP key. In this case, the settings are not stored.

- Keep the PROG key held down for 8 seconds.
  After 8 seconds, ✱✱✱ **Machine Menu** ✱✱✱ appears in the display.
- Press the PROG key as often as necessary until the **->Settings** is displayed.
- Press the START key. The **SOUND / BELL = off/on** is displayed.
- Press the PROG key as often as is needed until the delay time is displayed, e.g. **Cool acc time = 0**.
- Use the adjusting knob ⟲ to set the value you want.
  0 = no delay time
- Press the START key to save the setting.
  Briefly, **Store Settings ...** is displayed as confirmation, followed by **-> Settings**.
- Press the OPEN / STOP key once to exit the "Settings" menu or press the OPEN / STOP key twice to exit the "Machine Menu".

35.4 Prevent cooling being switched on during run-out

If necessary it can be set so that at the end of the centrifugation run during run-out, once the specified speed has been attained, cooling is not switched on.
This avoids whirling up the sediment in the sample.
The speed can be set between 0 RPM and the maximum speed of the rotor (Nmax) in increments of 10.
When the rotor is at a standstill, the speed is set as follows:

TIP

This setting can only be made via the operating unit (key position "0" or "LOCK 2"). The functions of the various key positions are described in the "Key-operated switch" chapter.

You can scroll backwards through the menu by pressing the T/°C key.

The operation can be cancelled at any time by pressing the OPEN / STOP key. In this case, the settings are not stored.

- Keep the PROG key held down for 8 seconds.
  After 8 seconds, ✱✱✱ **Machine Menu** ✱✱✱ appears in the display.
- Press the PROG key as often as necessary until the **->Settings** is displayed.
- Press the START key. The **SOUND / BELL = off/on** is displayed.
- Press the PROG key as often as is needed until the **Cool dec speed = … rpm**.
- Use the adjusting knob ⟳ to set the value you want.
- Press the START key to save the setting.
  Briefly, **Store Settings ...** is displayed as confirmation, followed by **-> Settings**.
- Press the OPEN / STOP key once to exit the "Settings" menu or press the OPEN / STOP key twice to exit the "Machine Menu".

36 Key-operated switch

NOTICE

Material damage due to operation by unauthorised personnel.

When the key switch is in the "Teach" position, unauthorised personnel may cause damage to property.

- ➢ Only authorized skilled personnel may operate the device in the "TEACH" key position.
- ➢ The key is to be kept in a safe place so that it is protected from unauthorized access.

The following functions can be set with the key-operated switch when the rotor is at a standstill:

Key setting 	**Function**
0	No status display. The centrifuge can be operated via the control panel. The centrifuge cannot be controlled via the interface.
LOCK 2	**LOCK 2** is displayed in the "⌐¬" field. The centrifuge can be controlled via the interface. No programs can be called up or changed via the operating unit. A centrifugation run can be started via the operating unit. Settings can be made in the "Machine Menu" via the operating unit.
TEACH	Display e.g. **Teach** **Open** **=Close**  = : Position of the hatch ⌐¬ : Open the hatch (keep key pressed) RPM : Close the hatch (keep key pressed) PROG : Set rotor position 1. See the chapter "Setting rotor position 1".

37 Setting rotor position 1

NOTICE

Material damage due to operation by unauthorised personnel.

➢ Only authorized skilled personnel may set rotor position 1.

TIP

If the rotor was changed and if this has another rotor code than the previously used rotor, a rotor detection procedure must be carried out first before rotor position 1 is set (see chapter "Rotor recognition").

Every time the rotor is installed, rotor position 1 must be reset afterwards. Rotor position 1 is the position where place 1 of the rotor must be located for loading and unloading. Rotor position 1 can be set as follows when the rotor is at a standstill:

- Look through the window in the lid to make sure that the rotor is at a standstill.
- Turn the key to the "TEACH" setting. For example, **Teach Open =Close** might be displayed.
- Keep the ⌒ key pressed until the hatch is completely open. **Teach =Open Close** is displayed.
- Press the PROG key. The saved rotor position 1 is displayed, e.g. **Teach Pos 1 : 1812 <Start=ok>**.
- Turn the rotor slowly in an anti-clockwise direction until you hear an acoustic signal. Then continue turning until position 1 of the rotor is in the desired loading and unloading position.. Hold the rotor in this position.
- Press the START button to save the setting.
  As a confirmation, **store Pos 1 ...** is briefly displayed, and then e.g. **Goto 1/24 2826 0 2826 s**.

TIP

If "**no zero pulse !"** is briefly displayed, the rotor was turned to the loading/unloading position before the acoustic signal sounded. In this case, repeat the rotor position 1 setting.

If **Close the Lid !** is displayed briefly, the lid is open. In this case, close the lid.

- To test the positioning, set the desired rotor place with the rotary knob ⟲, and then press the START key. The rotor continues to turn until the set rotor place is in the loading/unloading position.
- Press the STOP / OPEN key to exit the menu. **Teach =Open Close** is displayed.
- Keep the RPM key pressed until the hatch is completely closed. **Teach Open =Close** is displayed.
- Turn the key back to the "LOCK 2" position.

38 Relative centrifugal force (RCF)

The relative centrifugal force (RCF) is given as a multiple of the acceleration of gravity (g). It is a unit-free value and serves to compare the separation and sedimentation performance.

These values are calculated using the formula below:

$$RCF = \left(\frac{RPM}{1000}\right)^2 \times r \times 1{,}118 \qquad \Rightarrow \qquad RPM = \sqrt{\frac{RCF}{r \times 1{,}118}} \times 1000$$

RCF = relative centrifugal force
RPM = rotational speed (revolutions per minute)
r = centrifugal radius in mm = distance from the centre of the turning axis to the bottom of the centrifuge container. For more on the centrifugal radius see the chapter “Anhang/Appendix,Rotoren und Zubehör/Rotors and accessories”.

TIP

The relative centrifugal force (RCF) stands in relation to the revolutions per minute and the centrifugal radius.

39 Centrifugation of materials or mixtures of materials with a density higher than 1.2 kg/dm^3

When centrifuging with maxim revolutions per minute the density of the materials or the material mixtures may not exceed 1.2 kg/dm^3.
The speed must be reduced for materials or mixtures of materials with a higher density.

The permissible speed can be calculated using the following formula:

$$\text{Reduced speed } (n_{red}) = \sqrt{\frac{1.2}{\text{Greater density [kg/dm}^3\text{]}}} \times \text{maximum speed [RPM]}$$

e.g.: maximum speed RPM 4000, density 1.6 kg/dm^3

$$n_{red} = \sqrt{\frac{1.2\ \text{kg/dm}^3}{1.6\ \text{kg/dm}^3}} \times 4000\ \text{RPM} = 3464\ \text{RPM}$$

In the exceptional case that the maximum loading indicated on the hanger is exceeded, the speed must also be reduced.

The permissible speed can be calculated using the following formula:

$$\text{Reduced speed } (n_{red}) = \sqrt{\frac{\text{maximum load [g]}}{\text{actual load [g]}}} \times \text{maximum speed [RPM]}$$

e.g.: maximum speed RPM 4000, maximum load 300 g, actual load 350 g

$$n_{red} = \sqrt{\frac{300\ \text{g}}{350\ \text{g}}} \times 4000\ \text{RPM} = 3703\ \text{RPM}$$

If in doubt you should obtain clarification from the manufacturer.

40 Rotor recognition

Rotor recognition is carried out after each start of the centrifugation run.

If the rotor has been changed, the centrifugation run is canceled after rotor recognition. The rotor code (Rotor), the maximum speed of the rotor (Nmax) and a centrifuging radius (R) of the newly detected rotor are displayed, e.g. **Rotor 4 Nmax= 4500 R=184 mm**.

TIP

If the maximum speed of the rotor being used is less than the set speed, the speed is limited to the rotor's maximum speed. In this case, the program place number is displayed in parentheses ().

- Press the OPEN / STOP key to open the lid, or press the START key to start the centrifugation run. For centrifuges with refrigeration, precooling of the rotor can also be started by pressing the ❄ key.

TIP

If the cycle counter is activated, the number of rotor cycles (centrifugation runs) of the current rotor code is displayed briefly when the lid is opened, e.g. **CYCLES 5120 of 30000** (see chapter "Cycle Counter").

41 Emergency release

During a power failure the lid cannot be unlocked by motor. An emergency release has to be executed by hand.

WARNING

Risk of injury and material damage due to flying parts and moving rotor.

If the device is opened while the rotor is still moving, components may fly out and there is a risk of injury from the moving rotor.

- ➢ For emergency release disconnect the centrifuge from the mains.
- ➢ Open the lid only during rotor standstill.

See figure on page 2.

- Switch off the mains switch (switch position "0").
- Look through the window in the lid to be sure that the rotor has come to a standstill.
- Insert the hexagonal wrench key into the bore hole (Fig. 1, A) and carefully rotate by half a turn in clockwise direction until the lid can be opened.
- Pull the hexagon socket head wrench out of the drilling again.
- If the left LED in the OPEN / STOP button flashes after the centrifuge is switched on again, press the OPEN / STOP button so that the motor-driven lid lock goes into the basic position (opened) again.

42 Maintenance and servicing

CAUTION

Risk of injury from contaminated components.

After using the device may be contaminated.

- ➢ Wear personal protective equipment.
- ➢ Clean the device with a suitable agent.
- ➢ If necessary, contact the service department.

NOTICE

Property damage due to cleaning agent

- ➢ Pull the mains plug before cleaning.
- ➢ Before any other cleaning or decontamination process other than that recommended by the manufacturer is applied, the user has to check with the manufacturer that the planned process does not damage the device.

- Centrifuges, rotors and accessories must not be cleaned in rinsing machines.
- They may only be cleaned by hand and disinfected with liquids.
- The water temperature must be between 20 – 25°C.
- Only detergents/disinfectants may be used which:
  - have a pH between 5 - 8
  - do not contain caustic alkalis, peroxides, chlorine compounds, acids and alkaline solutions
- In order to prevent appearances of corrosion through cleaning agents or disinfectants, the application guide from the manufacturer of the cleaning agent or disinfectant are absolutely to be heeded.

42.1 Centrifuge (housing, lid and centrifuging chamber)

42.1.1 Surface cleaning and care

- Clean the centrifuge housing and the centrifuging chamber regularly, using soap or a mild detergent and a damp cloth if required. For one thing, this services purposes of hygiene, and it also prevents corrosion through adhering impurities.
- Ingredients of suitable detergents:
  soap, anionic tensides, non-ionic tensides.
- After using detergents, remove the detergent residue by wiping with a damp cloth.
- The surfaces must be dried immediately after cleaning.
- In the event of condensation water formation, dry the centrifugal chamber by wiping out with an absorbent cloth.
- Lightly rub the rubber seal of the centrifuge chamber with a rubber care product after each cleaning.
- The centrifuging chamber is to be checked for damage once a year.

WARNING

Risk of injury due to damage to the centrifuge.

- ➢ If safety-relevant damage is detected, the centrifuge must no longer be operated.
- ➢ In this case, notify the customer service.

42.1.2 Surface disinfection

- If infectious materials penetrates into the centrifugal chamber this is to be disinfected immediately.
- Ingredients of suitable disinfectants:
  ethanol, n-propanol, ethyl hexanol, anionic tensides, corrosion inhibitors.
- After using disinfectants, remove the disinfectant residue by wiping with a damp cloth.
- The surfaces must be dried immediately after disinfecting.

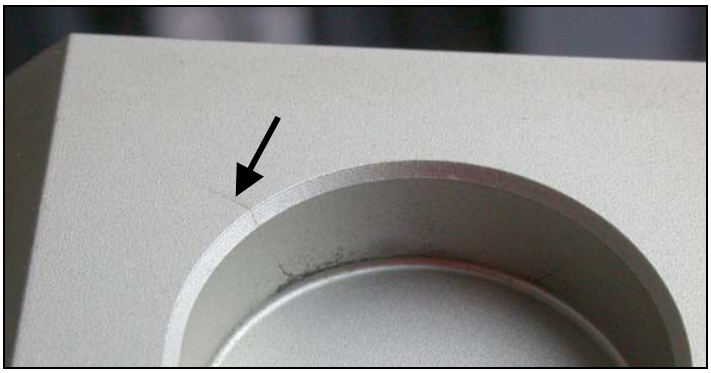
42.1.3 Removal of radioactive contaminants

- The agent must be specifically labelled as being an agent for removing radioactive contaminants.
- Ingredients of suitable agents for removing radioactive contaminants:
  anionic tensides, non-ionic tensides, polyhydrated ethanol.
- After removing the radioactive contaminants, remove the agent residue by wiping with a damp cloth.
- The surfaces must be dried directly after removing the radioactive contaminants.

42.2 Rotors and Attachments

42.2.1 Cleaning and care

- In order to avoid corrosion and changes in materials, the rotors and accessories have to be cleaned regularly with soap or with a mild cleaning agent and a moist cloth. Cleaning is recommended at least once a week. Contaminants must be removed immediately.
- Ingredients of suitable detergents:
  soap, anionic tensides, non-ionic tensides.
- After using detergents, remove detergent residue by rinsing with water (only outside of the centrifuge) or wipe off with a damp cloth.
- The rotors and accessories must be dried directly after cleaning.
- Angle rotors, container and hanger made of aluminium are to be lightly greased after drying using acid-free grease, e.g. vaseline.
- In order to prevent corrosion as a result of moisture between the rotor and the motor shaft, the rotor should be disassembled and cleaned at least once a month, and the motor shaft should be lightly greased.
- The rotors and accessories have to be checked weekly for wear and corrosion. For swing-out rotors, it is important to check the area of the lifting lugs, for hangers, the grooves and the base should be checked for cracks.
  Example: Crack in the groove area:



WARNING

Risk of injury and material damage due to flying parts and moving rotor.

If rotors and attachments show signs of wear or corrosion, injury may occur.

➢ Rotors and attachments may no longer be utilised upon indication of wear and tear or corrosion.

- Check the firm seating of the rotor on a weekly basis.

42.2.2 Disinfection

- If infectious material should get on the rotors or accessories, they must be appropriately disinfected.
- Ingredients of suitable disinfectants:
  ethanol, n-propanol, ethyl hexanol, anionic tensides, corrosion inhibitors.
- After using disinfectants, remove disinfectant residue by rinsing with water (only outside of the centrifuge) or wipe off with a damp cloth.
- The rotors and accessories must be dried directly after disinfection.

42.2.3 Removal of radioactive contaminants

- The agent must be specifically labelled as being an agent for the removal of radioactive contaminants.
- Ingredients of suitable agents for removing radioactive contaminants:
  anionic tensides, non-ionic tensides, polyhydrated ethanol.
- After removing the radioactive contaminants, remove agent residue by rinsing with water (only outside of the centrifuge) or wipe off with a damp cloth.
- The rotors and accessories must be dried directly after removing the radioactive contaminants.

42.2.4 Trunnions

With swing-out rotors the trunnions must be regularly lubricated (Hettich Lubricating Grease No. 4051) in order to ensure consistent swinging out of the hangers.

42.2.5 Rotors and accessories with limited service lives

The use of certain rotors, hangers and accessory parts is limited by time.
These are marked with the maximum permitted number of operating cycles or with an expiration date and the maximum permitted number of operating cycles or just with the expiration date; e.g.:

- "einsetzbar bis Ende: IV. Quartal 2011 / usable until end of: IV. Quarter 2011" or
  "einsetzbar bis Ende Monat/Jahr: 10/2011 / usable until end of month/year: 10/2011"
- "Max. Lauf Zyklen / max. cycles: 40000".

WARNING

Risk of injury and material damage due to flying parts.

➢ For safety reasons, rotors, hangers and accessory parts may no longer be used if either the indicated maximum number of operating cycles or the indicated expiration date has been reached.

The number of centrifuge operations can be queried; see the chapter on "Querying the operating hours and the number of centrifuge operations".

42.3 Autoclaving

The following accessory can be autoclaved at 121°C / 250°F (20 min):

- Swing-out rotors
- Hanger made of metal
- Stands
- Reductions

Otherwise you must ask the manufacturer.
No statement can be made about the degree of sterility.

NOTICE

Material damage due to autoclaving.

Autoclaving accelerates the ageing process of plastics. In addition, autoclaving may discolour plastics.

42.4 Centrifuge containers

- With leakiness or after the breakage of centrifuging containers broken container parts, glass splinters and leaked centrifugation material are to be completely removed.
- The rubber inserts as well as the plastic sleeves of the rotors are to be replaced after a glass breakage.

NOTICE

Material damage due to remaining glass fragments.

➢ Remove glass splinters completely from the device.

- If this concerns infectious material, a disinfection process is to be executed immediately.

43 Faults

If the fault cannot be eliminated with the help of the fault table, please inform Customer Service.

Please specify the type of centrifuge and the serial number. Both numbers can be found on the name plate of the centrifuge.

TIP

Perform a MAINS RESET:
- Switch off the mains switch (switch position "0").
- Wait at least 10 seconds and then switch on the mains switch again (switch position "I").

Message / fault		Cause	Remedy
No display		No voltage. Overvoltage protection tripped out.	– Check supply voltage. – Mains switch ON.
TACHO - ERROR	1, 2, 96	Faulty speedometer. Motor, electronics defective.	– Open the cover. – Switch off the mains switch (switch position "0"). – Wait at least 10 seconds. – Turn the rotor vigorously by hand. – Switch on the mains switch again (switch position "I"). The rotor must turn during switch-on.
IMBALANCE	3 *	The rotor is unevenly loaded.	– Open the lid or hatch. – Check the loading of the rotor, see chapter "Loading the rotor". – Repeat the centrifugation run.
CONTROL - ERROR	4.1 - 4.5, 6	Error in lid locking or lid closure.	– Perform a MAINS RESET.
CONTROL - ERROR	4.6 – 4.9	Error / defect hatch control	
N > MAX	5.0, 5.1	Rotation too fast	
N < MIN	13	Rotation too slow	
ROTORCODE	10.1, 10.3	Incorrect rotor coding	
MAINS INTERRUPT	11 *	Power failure during the centrifugation run. (The centrifugation run was not finished.)	– Open lid. – Push START button. – Repeat the centrifugation run if necessary.
VERSION-ERROR	12	Mismatch between electronic components Error / defect electronics	– Perform a MAINS RESET.
CONTROL-ERROR	22, 25.1-25.4	Error / defect electronics	
CRC ERROR	27.1	Error / defect electronics	
SER I/O - ERROR	31, 34, 36	Error / defect electronics	
POS-ERROR	40–49	Error / defect in positioning or hatch drive or light barrier	
° C * - ERROR	51, 53 - 55 97,98	Error / defect electronics	
° C * - ERROR	52.0, 52.1	Temperature is too high in overspeed room. Error / defect electronics	
LOCK_ERROR	57.0, 57.1	Error / defect key-operated switch	
FU / CCI - ERROR	58.0, 58.1	Temperature deviation too great.	
FU / CCI - ERROR	58.6, 58.7	Temperature deviation too great.	– Perform a MAINS-RESET. – Increase "Error 58 Temp" value. See the "Temperature monitoring" chapter.

* Error number does not appear in the display.

Message / fault		Cause	Remedy
FU / CCI - ERROR	60, 61.2-61.20, 61.128-61,131, 62	Error / defect electronics / motor	– Perform a MAINS RESET.
FU / CCI - ERROR	61.1	Supply voltage is too low Error / defect electronics / motor	– Check supply voltage. – Perform a MAINS RESET.
SENSOR-ERROR	90	Error / defect electronics	– Perform a MAINS RESET.
SENSOR-ERROR	91 - 93	Error / defect unbalance sensor	
NO ROTOR OR ROTORCODE ERROR	---	No rotor installed. Faulty speedometer.	– Open lid. – Install rotor.
N > ROTOR MAX	---	Speed in the selected program greater than the maximum speed of the rotor.	– Check the set speed. Reduce the set speed
		The rotor has been changed. The maximum speed of the installed rotor is higher than that of the rotor that was previously used and this has not yet been detected by rotor recognition.	– Set a speed up to the maximum speed of the rotor that was previously used. Press the ◦START key to run rotor recognition. See chapter, "Rotor Recognition".
N > ROTOR MAX in Prog : e.g. 3	---	There is a program in the displayed program location whose speed is higher than the maximum speed of the rotor.	– Check the set speed. Reduce the set speed
		The rotor has been changed. The maximum speed of the installed rotor is higher than that of the rotor that was previously used and this has not yet been detected by rotor recognition.	– Set a speed up to the maximum speed of the rotor that was previously used. Press the ◦START key to run rotor recognition. See chapter, "Rotor Recognition".
Runtime 00:00 in Prog : e.g. 3	---	There is a continuous operation program in the displayed program location.	– Replace the continuous operation program in the program linkage with a program with preset time.
Empty Program	---	There is no program linkage saved on the displayed program location.	– Call up a program linkage.
Ramp Unit Time in Prog : e.g. 3	---	A program with start-up and/or run-down time is located at the displayed program place.	– Replace the program in the program link with a program with start-up and braking stage.
Acc time > Run time	---	The set start-up time is longer than the run time.	– Set a start-up time which is shorter than the run time.
FC INIT ERROR	---	Error / defect electronics	– Perform a MAINS RESET.
FC VERSION ERROR	---	Error / defect electronics	
FATAL EEPROM ERROR	1 - 5	Error / defect electronics	
WATCHDOG RESET		Error / defect electronics	

44 Returning Devices

NOTICE

Material damage due to lack of transport securing.

Damage to the centrifuge and its components.

➢ Install the transport securing device before each transport.

If the device or its accessories are returned to Andreas Hettich GmbH & Co. KG, in order to provide protection for people, the environment and materials, it has to be decontaminated and cleaned before being shipped.

We reserve the right to refuse contaminated devices or accessories.

Costs incurred for cleaning and disinfection are to be charged to the customer.

We ask for your understanding in this matter.

45 Disposal

The device can be disposed of via the manufacturer.

A Return Material Authorisation (RMA) form must always be requested for a return.

If necessary, contact the Technical Service Department of the manufacturer:

Andreas Hettich GmbH & Co. KG
Föhrenstrasse 12
78532 Tuttlingen, Germany
Phone: +49 7461 705 1400
Email: service@hettichlab.com

Disposal costs may be incurred.

WARNING

Risk of pollution and contamination for people and the environment.

When disposing of the centrifuge, people and the environment may be polluted or contaminated by incorrect or improper disposal.

- Removal and disposal may be carried out only by a trained and authorized service personnel.

The device is intended for the commercial sector ("Business to Business" - B2B).
According to Directive 2012/19/EU, the devices may no longer be disposed of with household waste.
The appliances are assigned to the following groups according to the Stiftung Elektro-Altgeräte Register (EAR (German foundation under civil law)):

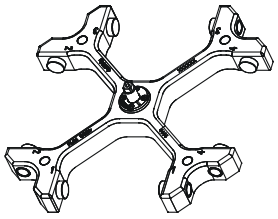
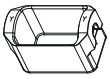
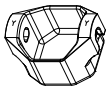
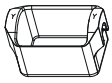
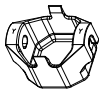
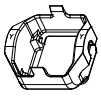
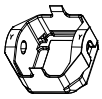
- Group 1 (heat exchangers)

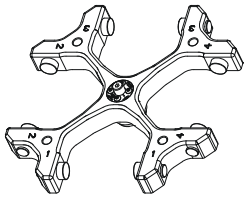
The crossed-out bin symbol indicates that the device must not be disposed of with household waste.

Regulations governing disposal of such devices may differ in individual countries. If necessary, contact the supplier.

46 Anhang / Appendix

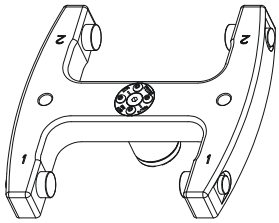
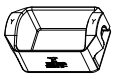
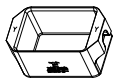
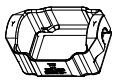
46.1 Rotoren und Zubehör / Rotors and accessories

4444		4426-R/4 4426-RA/4	4463-R/4	4464-R/4	4467-R/4 4467-RA/4	4486-R/4	4488-R/4	4490-R/4
Ausschwingrotor 4-fach / Swing out rotor 4-times  90° Max. Laufzyklen / max. cycles 400000								
Verwendungsdauer / service life	Jahre / years	5						
Max. Laufzyklen / max. cycles		200000	200000	200000	200000	200000	80000	200000
Max. Beladung / max. load	g [3]	550	800	800	700	800	400	650
Drehzahl / speed	RPM	4500						
RZB / RCF	[2]	4618	4460	4392	4369	4392	3871	4188
Radius / radius	mm	204	197	194	193	194	171	185
9 (97%)	sec	69						
9	sec	68						
Temperatur / temperature	°C [1]	10	8	6	6	6	4	4

5699-R		5632-R/4	4895-R/4				
Ausschwingrotor 4-fach / Swing out rotor 4-times  90° max. Laufzyklen / max. cycles 400 000							
		max. Laufzyklen / max. cycles: 200000	max. Laufzyklen / max. cycles: 70000				
		max. Beladung / max. load: 800 g [3]	max. Beladung / max. load: 1000 g [3]				
		Verwendungsdauer Jahre / service life years: 5					
			4449				
							
			Corning				
							
Kapazität / capacity	ml	---	500				
Maße / dimensions ∅ x L	mm	---	96 x 147				
Anzahl p. Rotor / number p. rotor		---	4				
Drehzahl / speed	RPM	4600	4600				
RZB / RCF	[2]	4258	4779				
Radius / radius	mm	180	202				
9 (97%)	sec	78					
9	sec	87					
Temperatur / temperature	°C [1]	6	4				

1) Tiefste erreichbare Temperatur bei maximaler Drehzahl, 1 h Laufzeit und 20°C Raumtemperatur
2) Angaben des Röhrchenherstellers beachten.
3) Maximal zulässige Beladung je Gehänge

1) Lowest possible temperature during maximum speed, 1 h running time and 20°C ambient temperature
2) Observe the tube manufacturer's instructions.
3) Maximum permissible load per hanger

5622		5631-R/2	5633-R/2	5636-R/2				
Ausschwingrotor 2-fach / Swing out rotor 2-times  ∠ 90° Max. Laufzyklen / max. cycles 400000								
Verwendungsdauer / service life	Jahre / years	5						
Max. Laufzyklen / max. cycles		70000	50000	60000				
Max. Beladung / max. load	g [3]	500	500	460				
Drehzahl / speed	RPM	6200						
RZB / RCF	[2]	max. 6446						
Radius / radius	mm	max. 150						
⌐ 9 (97%)	sec	52						
⌐ 9	sec	38						
Temperatur / temperature	°C [1]	9	8	9				

1) Tiefste erreichbare Temperatur bei maximaler Drehzahl, 1 h Laufzeit und 20°C Raumtemperatur
2) Angaben des Röhrchenherstellers beachten.
3) Maximal zulässige Beladung je Gehänge

1) Lowest possible temperature during maximum speed, 1 h running time and 20°C ambient temperature
2) Observe the tube manufacturer's instructions.
3) Maximum permissible load per hanger