



# Sigma 2-16KHL

from serial no. 147260



Refrigerated Centrifuge  
with Heating System

## Operating Manual

Please retain for later use!



In case of inquiries, please state the following numbers:

Order number:

Serial number:

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## **1 General information**

### **1.1 Importance of the operating manual**

A fundamental requirement for the safe and trouble-free operation of the centrifuge is to be familiar with the fundamental safety instructions and all possible hazards.

The operating manual includes important information concerning the safe operation of the centrifuge.

This operating manual and, in particular, the notes on safety and hazards must be observed by all persons operating the centrifuge.

In addition, the local rules and regulations for the prevention of accidents must be complied with.

### **1.2 Intended use**

Centrifuges are power-driven machines that separate liquids from solid matter, liquid mixtures, or solid mixtures by centrifugal force. They are solely intended for this purpose. Any other use beyond this area of application is regarded as improper use. Sigma Laborzentrifugen GmbH cannot be held liable for any damage resulting from such improper use.

The intended use also includes

- observation of all the notes and instructions included in the operating manual and
- compliance with the care, cleaning, and maintenance instructions.

### **1.3 Warranty and liability**

The warranty and liability are subject to our "General Conditions" that were distributed to the operator upon the conclusion of the contract.

Warranty and liability claims are excluded if they are due to:

- improper use.
- non-compliance with the safety instructions and hazard warnings in the operating manual.
- improper installation, start-up, operation, or maintenance of the centrifuge.

## 1 General information

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### 1.4 Copyright

The copyright concerning the operating manual remains with Sigma Laborzentrifugen GmbH.

The operating manual is solely intended for the operator and their personnel. It includes instructions and information that must not be

- duplicated,
- distributed, or
- communicated in any other way.

Non-compliance may be prosecuted under criminal law.

### 1.5 Standards and regulations

EC declaration of conformity  
(see chapter 11.6 - "EC declaration of conformity")

### 1.6 Scope of supply

#### The centrifuge comprises:

- |   |                                  |
|---|----------------------------------|
| • 1 rotor wrench, size 13                 | Part no. 930 100                 |
| • 1 tube of grease for load bearing bolts | Part no. 70 284                  |
| • 1 connection cable                      | depending on the voltage variant |

#### Documentation:

Operating manual incl. EC declaration of conformity  
(see chapter 11.6 - "EC declaration of conformity")

#### Accessories

According to your order, our order confirmation, and your delivery note.

## 2 Layout and mode of operation

### 2.1 Layout of the centrifuge

#### 2.1.1 Functional and operating elements

- 1 Lid
- 2 User interface (see chapter 6.3.1 - "User interface")
- 3 Mains switch



Fig. 1: Total view of the centrifuge

- 4 Name plate (see chapter 2.1.2 - "Name plate")
- 5 Mains power input
- 6 Equipotential bonding screw



Fig. 2: Rear view of the centrifuge

## 2 Layout and mode of operation

### 2.1.2 Name plate

- 1 Manufacturer and registered office
- 2 Type
- 3 Serial number
- 4 Max. speed
- 5 Max. kinetic energy
- 6 Max. density
- 7 Nominal voltage
- 8 Input fuse
- 9 Symbol for special disposal (see chapter 9 - "Disposal")
- 10 CE mark in compliance with the directive 2006/42/EC
- 11 Part number
- 12 Year of manufacture
- 13 Power consumption



Fig. 3: Example of a name plate

## **2.2 Mode of operation**

### **2.2.1 Centrifugation principle**

Centrifugation is a process for the separation of heterogeneous mixtures of substances (suspensions, emulsions, or gas mixtures) into their components. The mixture of substances, which rotates on a circular path, is subject to centripetal acceleration that is several times greater than the gravitational acceleration.

Centrifuges use the mass inertia inside the rotor chamber for separating the substances. Due to their higher inertia, particles or media with a higher density travel outwards. In doing so, they displace the components with a lower density, which in turn travel towards the centre.

The centripetal acceleration of an object inside a centrifuge, as the effect of centripetal force, depends on the distance between the object and the axis of rotation as well as on the angular velocity. It increases linearly as a function of the distance with regard to the axis of rotation and quadratically as a function of the angular velocity. The bigger the radius in the rotor chamber is and the higher the speed is, the higher the centripetal acceleration is. However, the forces acting on the rotor also increase.

### **2.2.2 Area of application**

Depending on the area of application of the centrifuge and also on the particle size, solids content, and volume throughput of the mixture of substances that is to be centrifuged, there are different types of centrifuges. The areas of application go from household use as a salad spinner or honey separator up to specialised technical applications in the clinical, biological, or biochemical context:

- For numerous clinical examinations, cellular material must be separated from the liquid to be analysed. The normal separation process can be sped up considerably by using laboratory centrifuges.
- In the metal-working industry, centrifuges are used for separating oil from metal cuttings. Dairies use centrifuges in order to separate cow's milk into cream and low-fat milk.
- Particularly big centrifuges are used in the sugar industry for separating the syrup from the crystalline sugar.
- Ultracentrifuges are predominantly used in biology and biochemistry in order to isolate particles, e.g. viruses. They are specifically designed for high speeds up to 500,000 rpm. The rotor moves in a vacuum in order to avoid air friction.

## 2 Layout and mode of operation

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### 2.2.2.1 Speed, radius, and relative centrifugal force

The acceleration  $g$ , which the samples are subject to, can be increased by increasing the radius in the rotor chamber and by increasing the speed. These three parameters are interdependent and linked with each other via the following formula:

$$\text{Relative centrifugal force RCF} = 11.18 \times 10^{-6} \times r \times n^2$$

$r$  = radius in cm

$n$  = speed in rpm

RCF without any dimension

If two values are entered, the third value is determined by way of the stated formula. If, afterwards, the speed or the radius is changed, the resulting relative centrifugal force will be recalculated automatically by the control unit. If the RCF is changed, the speed will be adapted while the specified radius is maintained.

The speed-gravitational-field-diagram provides an overview of the relationship between speed, radius, and RCF (see chapter 11.2 - "Speed-gravitational-field-diagram").

### 2.2.2.2 Density

The laboratory centrifuge is suitable for the separation of constituents of different densities in mixtures with a maximum density of  $1.2 \text{ g/cm}^3$ . All information concerning the speed of rotors and accessories refers to liquids with a density corresponding to this specification. If the density is above this value, the maximum permissible speed of the centrifuge must be reduced based on the following formula:












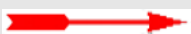




$$n = n_{\max} \times \sqrt{(1.2 / \text{Rho})}$$

$\text{Rho}$  = density in  $\text{g/cm}^3$

### 3 Safety

#### 3.1 Marking of the unit

The following symbols are used for all types of centrifuges manufactured by Sigma:

|   |  |   |   |
|---|--|---|---|
|    | Dangerous voltage                          |    | On (Power)  |
|    | Hot surface                                |    | Off (Power)   |
|    | Caution! Risk of bruising                  |    | Name plate (see chapter 2.1.2 - "Name plate")       |
|    | Protective earth (ground)                  |   | CE mark in compliance with the directive 2006/42/EC |
|   | Earth (ground)                             |   | Do not dispose as part of domestic waste            |
|  | Unplug the mains plug                      |  | GS mark (tested safety; only for Germany)           |
|  | Arrow indicating the direction of rotation |  | NRTL mark (only for the USA and Canada)             |
|  | 4°C Guarantee                              |  | RCM mark (only for Australia)                       |
|  | Centrifuge with heating system             |   |   |

**i**  
**NOTE**

Safety indications on the centrifuge must be kept readable at all times. If necessary, they must be replaced.

**i**  
**NOTE**

Not all of the symbols/labels are used for this centrifuge type.

### 3 Safety

#### 3.2 Explanation of the symbols and notes

In this operating manual, the following names and symbols to indicate hazards are used:



**DANGER**

This symbol stands for a **direct** hazard to the life and health of persons.

Non-observance of these symbols **causes** serious health problems up to life-endangering injuries.



**DANGER**

This symbol stands for a **direct** hazard to the life and health of persons due to electrical voltage.

Non-observance of these symbols **causes** serious health problems up to life-endangering injuries.



**WARNING**

This symbol stands for a **potential** hazard to the life and health of persons.

Non-observance of these symbols **can** cause serious health problems up to life-endangering injuries.



**CAUTION**

This symbol indicates a potentially hazardous situation

Non-observance of these notes can cause minor injuries or damage to property.



**NOTE**

This symbol indicates important information.



### **3.3 Responsibility of the operator**

The operator is responsible for authorising only qualified personnel to work on the centrifuge (see chapter 3.4 - "Operating personnel").

The areas of responsibility of the personnel concerning the operation, maintenance, and care of the unit must be clearly defined.

The safety-conscious work of the personnel in compliance with the operating manual and the relevant EC and national health and safety regulations as well as with the accident prevention regulations must be checked at regular intervals (e.g. every month).

Under the international rules for health and safety at work, the operator is obliged to:

- take measures in order to prevent all danger to life or health during work.
- ensure that centrifuges are operated properly and entirely as intended (see chapter 1.2 - "Intended use").
- take protective measures against fire and explosion when working with hazardous substances.
- take measures for the safe opening of centrifuges.

### **3.4 Operating personnel**

Persons operating the unit must

- be familiar with the fundamental regulations concerning workplace safety and accident prevention
- have read and understood this operating manual (and in particular the safety sections and warning notes) and confirmed this with their signature.

### **3.5 Informal safety instructions**

- This operating manual is a part of the product.
- The operating manual must be kept at the location of use of the centrifuge. Ensure that it is accessible at all times.
- The operating manual must be handed over to any subsequent owner or operator of the centrifuge.
- Any changes made must be added to the operating manual.
- In addition to the operating manual, the general and local rules and regulations concerning the prevention of accidents and the protection of the environment must also be supplied.
- Safety and danger indications on the centrifuge must be kept readable at all times. If necessary, they must be replaced.

### 3 Safety

## 3.6 Safety instructions

### 3.6.1 Electrical safety

To reduce the risk of electrical shock, the centrifuge uses a three-wire electrical cord and plug to connect the equipment to earth-ground. To preserve this safety feature:



**DANGER**

- Ensure that the wall socket is properly wired and grounded.
- Check that the mains voltage agrees with the nominal voltage listed on the name plate.
- Do not place vessels containing liquid on the centrifuge lid or within the safety distance of 30 cm around the centrifuge. Spilled liquids may get into the centrifuge and damage electrical or mechanical components.
- Work on the power supply system must only be performed by certified electricians.
- Inspect the electrical equipment of the unit regularly. Defects such as loose or burnt cables must be eliminated immediately.

### 3.6.2 Mechanical safety

In order to ensure the safe operation of the centrifuge, observe the following:



**WARNING**

- Do not open the lid when the rotor is in motion!
- Do not reach into the rotor chamber when the rotor is in motion!
- Do not use the centrifuge if it was installed incorrectly.
- Do not use the centrifuge without panels.
- Do not use the centrifuge if the rotors and inserts show signs of corrosion or other defects.
- Only use the centrifuge with rotors and accessories that have been approved by the manufacturer. In case of doubt, contact the manufacturer (see chapter 7.3 - "Service contact").
- Do not hold your fingers between the lid and the housing when closing the lid. Risk of crushing!
- Defective lid relieving devices could cause the centrifuge lid to fall (contact the service department, if necessary). Risk of crushing!
- Do not hit or move the centrifuge during its operation.
- Do not lean against or rest on the centrifuge during its operation.
- Do not spin any substances that could damage the material of the rotors and buckets of the centrifuge in any way. Highly corrosive substances, for example, damage the material and affect the mechanical strength of the rotors and buckets.
- Stop the centrifuge immediately in the event of a malfunction. Eliminate the malfunction (see chapter 7 - "Malfunctions and error correction") or inform the service department of the manufacturer (see chapter 7.3 - "Service contact").
- Ensure that all repairs are performed only by authorised and specialised personnel.

**WARNING**

- Prior to any start-up, check the centrifuge, rotor, and accessories for signs of damage that can be discerned from the outside. Special attention must be paid to all of the rubber parts (e.g. motor cover, lid seal, and adapters) in terms of visible structural changes. Defective parts must be replaced immediately.
- Open the centrifuge when it is not in use so that moisture can evaporate.

### 3.6.3 Fire prevention

**DANGER**

- Do not spin explosive or inflammable substances.
- Do not use the centrifuge within hazardous locations.

### 3.6.4 Chemical and biological safety

If pathogenic, toxic, or radioactive samples are intended to be used in the centrifuge, it is in the responsibility of the user to ensure that all necessary safety regulations, guidelines, precautions, and practices are adhered to accordingly.

**DANGER**

- Infectious, toxic, pathogenic, and radioactive substances may only be used in special, certified containment systems with a bio-seal in order to prevent the material from being released.
- Take suitable precautions for your own safety if there is a risk of toxic, radioactive, or pathogenic contamination
- Materials that chemically react with each other with a high level of energy are prohibited.

**WARNING**

- Keep informed about local measures to avoid harmful emissions (depending on the substances to be centrifuged).
- Protective clothing is not required for the operation of the centrifuge. The materials to be centrifuged may, however, require special safety measures (e.g. centrifugation of infectious, toxic, radioactive, or pathogenic substances).

## 3 Safety

### 3.6.5 Safety instructions for centrifugation

For safe operation, observe the following before starting the centrifuge:



**WARNING**

- Ensure that the centrifuge was set up properly (see chapter 5 - "Set-up and connection").
- Maintain a safety distance of at least 30 cm (12 inches) around the centrifuge.
- Do not store any dangerous goods in the centrifuge area.
- Do not stay in the safety area longer than what is absolutely necessary for the operation of the centrifuge.
- Only use the centrifuge with rotors and accessories that have been approved by the manufacturer. We explicitly warn against the use of equipment of poor quality. Breaking glass or bursting vessels can cause dangerous imbalances at high speeds
- Ensure that rotor and buckets are correctly fitted (see chapter 6.2.2.1 - "Installation of the rotor").
- Observe the instructions on the installation of accessories (see chapter 6.2.2.4 - "Installation of accessories").
- The rotor must be loaded axial symmetrically at equal weights.
- If liquids with a density  $> 1.2 \text{ g/cm}^3$  are used, reduce the speed (see chapter 2.2.2.2 - "Density").
- Do not use the centrifuge if the rotor is loaded asymmetrically.
- Do not use the centrifuge with tubes that are excessively long.



**WARNING**

### 3.6.6 Resistance of plastics

Chemical influences have a strong effect on the polymeric chains of plastics, and, therefore, on their physical properties. Plastic parts can be damaged if solvents, acids, or alkaline solutions are used.



**NOTE**

- Refer to the resistance data (see chapter 11.5 - "Resistance data")!

### 3.6.7 Service life of rotors and accessories

The rotors and accessories have a limited service life.



**WARNING**

- Perform regular checks (at least once per month) for safety reasons!
- Pay special attention to changes, such as corrosion, cracks, material abrasion, etc.
- After 10 years, they must be inspected by the manufacturer.
- After 50,000 cycles, the rotor must be scrapped for reasons of safety.
- If other data concerning the service life are engraved on the rotor or bucket, these data shall apply accordingly. For example, a bucket with the engraving "max. cycles = 10,000" has a service life of 10,000 cycles, and a rotor with the engraving "Exp. date 02/20" must be scrapped in February 2020 at the latest (see figure).



Fig. 4: Different service life – engraving on the bucket/rotor



**NOTE**

- Refer to the table of rotors and accessories with a different service life (see chapter 11.4 - "Table of the service life of rotors and accessories")!

## 3 Safety

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### 3.7 Safety devices

#### 3.7.1 Lid lock device

The centrifuge can only be started when the lid is properly closed. The electrical lock must be locked. The lid can only be opened when the rotor has stopped. If the lid is opened by way of the emergency release system during operation, the centrifuge will immediately switch off and decelerate brakeless. If the lid is open, the drive is completely separated from the mains power supply, i.e. the centrifuge cannot be started (see chapter 7.1.1 - "Emergency lid release").

#### 3.7.2 Standstill monitoring system

Opening of the centrifuge lid is only possible if the rotor is at a standstill. This standstill is checked by the microprocessor.

#### 3.7.3 System check

An internal system check monitors the data transfer and sensor signals with regard to plausibility. The system continuously performs a self-check and identifies malfunctions. Error messages are displayed as "Error" followed by a code number (see chapter 7.2 - "Table of error codes").

#### 3.7.4 Earth conductor check

For the earth conductor check, there is an equipotential bonding screw on the rear panel of the centrifuge (see chapter 2.1.1 - "Functional and operating elements"). An earth conductor check can be carried out by authorized and specialized personnel using a suitable measuring instrument. Please contact the service department (see chapter 7.3 - "Service contact").

#### 3.7.5 Imbalance monitoring system

The indication "Imbalance" in the rotor field and, in some cases, also a sound signal indicate that the centrifuge is in the impermissible imbalance range. The drive will be switched off in the acceleration phase or during the run.

#### 3.7.6 Temperature monitoring system

If the temperature inside the rotor chamber rises above 50°C, the drive system will be switched off automatically. The centrifuge cannot be restarted until it has cooled.

#### 3.7.7 Rotor monitoring system

When a rotor number and, if applicable, a bucket number are selected, the computer will automatically check whether the entered speed or the entered gravitational field are permissible for the selected rotor.

### 3.8 Measures in the event of hazards and accidents



**DANGER**

- If an emergency arises, switch off the centrifuge immediately!
- If in doubt, call the emergency doctor!

### 3.9 Remaining hazards

The unit was built state- of- the- art and according to the accepted safety rules. However, danger to life and limb of the operator, or of third parties, or impairments of the unit or other material assets cannot be completely excluded when the unit is being used.

- Use the unit only for the purpose that it was originally intended for (see chapter 1.2 - "Intended use").
- Use the unit only if it is in a perfect running state.
- Immediately eliminate any problems that can affect safety.

## 4 Storage and transport

# 4 Storage and transport

## 4.1 Dimensions and weight

|                       | Sigma 2-16KHL |
|-----------------------|---------------|
| Height:               | 310 mm        |
| Height with open lid: | 705 mm        |
| Width:                | 550 mm        |
| Depth:                | 570 mm        |
| Weight:               | 60 kg         |

## 4.2 Storage conditions

The centrifuge can be stored in its original packaging for up to a year.

- Store the centrifuge only in dry rooms.
- The permissible storage temperature is between -20°C and +60°C.
- If you would like to store it for more than one year, or if you intend to ship it overseas, please contact the manufacturer.

## 4.3 Notes on transport

- Install the transport safety device (see chapter 4.5 - "Transport safety device")
- Always lift the centrifuge with a lifting device or with a sufficient number of people helping you.
- When lifting the centrifuge, always reach under the centrifuge from the side.



### CAUTION

The centrifuge weighs approx. 60 kg!

- For transport use suitable packaging and, if at all possible, the original packaging (see chapter 4.4 - "Packaging").



#### 4.4 Packaging

The centrifuge is packaged in a threepart slip-lid box.

- Take off the lid.
- Remove the box containing the accessories and the packaging material.
- Remove the ring of the slip-lid box.
- Lift the centrifuge upwards with a lifting device or with a sufficient number of people to lift it safely. When lifting the centrifuge, always reach under the centrifuge from the side.



**CAUTION**

The centrifuge weighs approx. 60 kg!

- Retain the packaging for any possible future transport of the centrifuge.

#### 4.5 Transport safety device

The transport safety device consists of a foamed plastic piece in the rotor chamber.



**CAUTION**

The transport safety device must be removed prior to start-up!

##### **Removal**

- Open the lid by pressing the lid key. If the centrifuge is not connected to the power supply, use the emergency release of the lid (see chapter 7.1.1 - "Emergency lid release").
- Unscrew the rotor tie-down screw.
- Remove the foamed plastic piece from the rotor chamber by lifting it carefully on one side.
- Retain the transport safety device for the possibility of the return of the centrifuge.

## 5 Set-up and connection

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# 5 Set-up and connection

## 5.1 Installation site

Operate the centrifuge only in closed and dry rooms.

All the energy supplied to the centrifuge is converted into heat and emitted to the ambient air.

- Ensure sufficient ventilation.
- Keep a safety distance of at least 30 cm around the centrifuge so that the vents in the centrifuge remain fully effective.
- Do not subject the centrifuge to thermal stress, e.g. by positioning it near heat generators.
- Avoid direct sunlight (UV radiation).
- The table must be stable and have a solid, even surface.
- Attention: During transport from cold to warmer places, condensational water will collect inside the centrifuge. It is important to allow sufficient time for drying (min. 24 h) before the centrifuge can be used again.

## 5.2 Power supply

### 5.2.1 Type of connection



**DANGER**

The operating voltage on the name plate must correspond to the local supply voltage!

Sigma centrifuges are units of protection class I. The centrifuges of this model series have a three-wire power cord with an IEC C13 connector. They are equipped with a mains power switch with an integrated thermal circuit breaker.

- Switch the unit off by actuating the mains power switch.
- If it has tripped, let the circuit breaker cool for approximately 2 minutes.
- Switch the unit on.

The centrifuge is now ready for operation.

### 5.2.2 Customer-provided fuses

Typically, the centrifuge must be protected with 16 Amp L or B fuses that are to be provided by the customer.

## 6 Using the centrifuge

### 6.1 Initial start-up



**DANGER**

- Before the initial start-up, please ensure that your centrifuge is properly set up and installed (see chapter 5 - "Set-up and connection").

### 6.2 Switching the centrifuge on

- Press the mains power switch.

The display then illuminates. The centrifuge is ready for operation.

#### 6.2.1 Opening and closing the lid

The lid can be opened if the centrifuge is at a standstill and if the lid key is illuminated.

- Press the lid key in order to open the lid.

The centrifuge cannot be started if the lid is opened.

- To close, press with both hands slightly on the lid until the electrical lock is locked.



**WARNING**

Do not place your fingers between the lid and the housing when closing the lid. Risk of crushing!

#### 6.2.2 Installation of rotors and accessories

##### 6.2.2.1 Installation of the rotor

- Open the centrifuge lid by pressing the lid key.
- Unscrew the rotor tie-down screw from the motor shaft (counter-clockwise).
- Lower the rotor with its central bore straight down onto the motor shaft.
- Tighten the rotor tie-down screw clockwise with the supplied rotor wrench with 5 Nm. In doing so, hold the rotor at its outer rim.



**WARNING**

Once a day or after 20 cycles, the rotor tie-down screw must be loosened by some turns, and the rotor must be lifted and fastened again. This ensures a proper connection between the rotor and the motor shaft.

## 6 Using the centrifuge



### CAUTION

When using rotors for microtiter plate formats:  
Ensure that the plate holders are inserted together with the plates into the buckets.



### NOTE

The lid screw serves for the fastening of the lid onto the rotor only, not for the fastening of the rotor onto the motor shaft.

- Follow the safety instructions and hazard warnings (see chapter 3 - "Safety")!

### 6.2.2.2 Installation of angle rotors with a hermetically sealed lid

- Screw the rotor cover onto the rotor and tighten it.
- Lower the rotor with the cover onto the motor shaft .
- Insert the rotor tie-down screw into the motor shaft. Tighten the rotor tie-down screw with 5 Nm using the supplied rotor wrench so that the spring washer assembly is compressed tightly.
- The rotor can also be used without a cover.
- The rotors can be installed or removed with a closed lid after loosening the rotor tie-down screw.
- Follow the safety instructions and hazard warnings (see chapter 3 - "Safety")!

- 1 Rotor tie down screw
- 2 Lid
- 3 Rotor

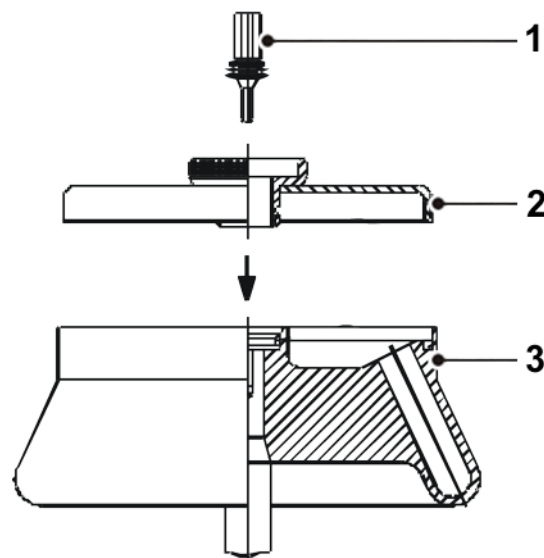


Fig. 5: Angle rotor with a hermetically sealed lid

**6.2.2.3 Installation of the microhaematocrit rotor**

- Open the centrifuge lid by pressing the lid key.
- Replace the rotor tie-down screw with the rotor tie-down screw of the microhaematocrit rotor (part no. 81543, included in the scope of supply of the microhaematocrit rotor), and tighten it loosely.
- Lower the rotor with its central bore straight down onto the motor shaft.
- Tighten the rotor tie-down screw clockwise with 5 Nm using the supplied rotor wrench. In doing so, hold the microhaematocrit rotor with one hand and tilt it slightly in order to prevent the motor shaft from slipping through.
- Check the rotor for a correct and tight fit.
- Follow the safety instructions and hazard warnings (see chapter 3 - "Safety")!

**CAUTION**

Please consider the maximum permissible gravitational field of 12,000 x g. An excess gravitational field will result in an increased risk of glass breakage!

**Operation**

- Fill the capillary tubes with blood and seal them at one end with putty or by fusion.
- Place the capillary tubes into the recesses of the rotor with the sealed end against the rubber ring. Ensure that the capillary tubes fit tightly against the rubber ring. The opposite places must be loaded.
- Screw on the rotor cover.
- Close the centrifuge lid.
- Enter the following parameters: RCF 12,000 x g, runtime approx. 5 minutes.
- Start the centrifuge.
- Open the centrifuge lid when the rotor has stopped.
- Unlock the rotor cover and lift it off.

**Evaluation**

- Put the reader onto the microhaematocrit rotor.
- Turn the reader and perform a fine adjustment with the aid of the central eccentric mechanism in order to localize the O-point and the maximum liquid point in the capillary tubes. You can now read the percentage value.
- Remove the capillary tubes. Some of the tubes can also be evaluated with the reader outside of the rotor (see the instructions for use on the back of the reader).

## 6 Using the centrifuge

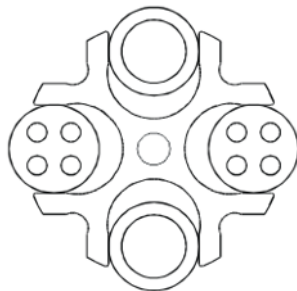
### 6.2.2.4 Installation of accessories

- Only use inserts that are suitable for the rotor (see chapter 11.1 - "Range of accessories").
- All buckets of the swing-out rotor need to be installed when spinning.
- Always load the axial symmetrical inserts/buckets of the rotors with the same accessories and fill to avoid imbalance.

#### Centrifugation with different tube sizes

Working with different tube sizes is possible. In this case, however, it is very important that axial symmetrical inserts are identical.

correct



incorrect

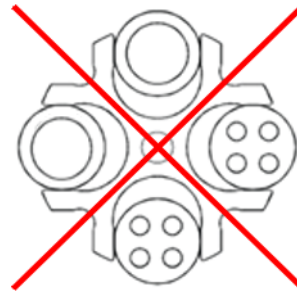
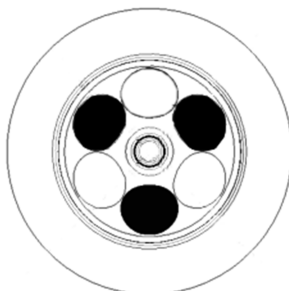


Fig. 6: Permissible and impermissible loading of a swing-out rotor with different tube sizes (example illustrations)

#### Centrifugation with low capacity

- Install the tubes axial symmetrically so that the buckets and their inserts are loaded evenly.
- It is not permissible to load angle rotors on only one axis.

correct



incorrect

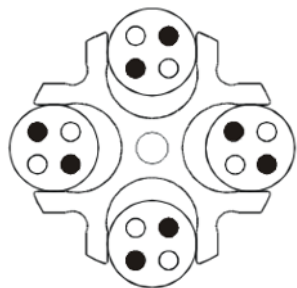
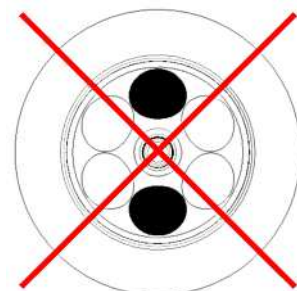


Fig. 7: Permissible and impermissible loading of an angle rotor and a swing-out rotor (example illustrations)

**6.2.2.5 Adapters**

In order to ensure easy handling, even if vessels of various sizes are used, carrier systems were developed.

- Load the opposite adapters with the same number of vessels and with the same weights in order to avoid imbalance.
- If all of the compartments of a carrier are not used, the buckets must be loaded evenly. Loading the edges of a bucket only is not permissible.

**6.2.2.6 Tubes**

- Load the tubes outside of the centrifuge. Liquids in the buckets or multiple carriers cause corrosion .
- Fill the tubes carefully and arrange them according to their weight. Imbalances result in the excessive wear of the bearings.
- In high-speed angle rotors, the vessels must be filled up to their useful volume (= the volume stated for the vessel). If the vessels are only partially filled, they will deform. This may result in leaks at the seals that may become loose.
- When using glass tubes, the maximum value of 4,000 x g must not be exceeded (except special high-strength glass tubes; please refer to the information provided by the manufacturer).
- Follow the safety instructions and hazard warnings (see chapter 3 - "Safety")!

## 6 Using the centrifuge

### 6.3 Control system "Spincontrol L"

#### 6.3.1 User interface

The centrifuge is operated via three buttons with integrated light-emitting diodes and one function knob. The display is divided into several different fields. The various functions of the system can be called up by pressing and turning the function knob.

- 1 Start key
- 2 Function knob
- 3 Display
- 4 Stop key
- 5 Lid key



Fig. 8: User interface of the Spincontrol L control system

#### Display

The centrifuge display has the following display fields:

- 1 Speed/RCF field
- 2 Several display fields (e.g. for rotor, deceleration curve or program selection)
- 3 Time field
- 4 Temperature field

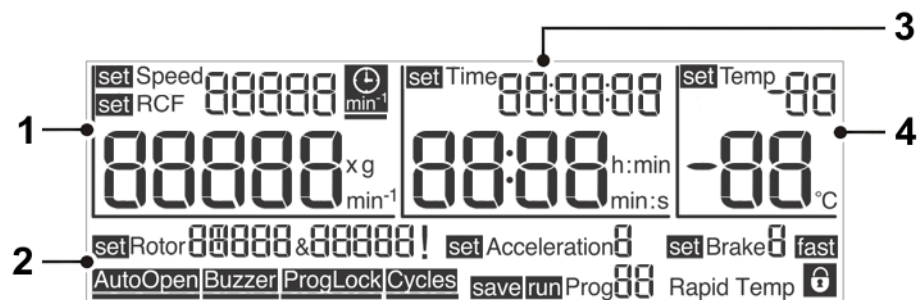


Fig. 9: Display of the Spincontrol L control system



**6.3.2 Manual mode****6.3.2.1 Starting a centrifugation run**

The centrifuge is ready for operation when the start key is illuminated.

- Press the start key in order to start a centrifugation run.

**6.3.2.2 Interrupting a centrifugation run**

- Press the stop key in order to interrupt a centrifugation run. The centrifugation run will be terminated prematurely.

**Quick stop**

- Press the stop key for more than two seconds.

The centrifuge decelerates with the maximum deceleration curve.

After a quick stop, the centrifuge lid must be opened before a new centrifugation run can be started.

A quick stop can also be triggered during a normal deceleration, e.g. in order to speed up the deceleration.

When a quick stop is triggered, "fast" will be displayed in the lower right-hand corner of the display.

**6.3.2.3 Interrupting a deceleration process**

- Press the start key during a deceleration process in order to interrupt it and to restart the centrifuge.

**6.3.2.4 Selection, display, and modification of data**

- Turn the function knob in order to select a field. The selected field will be preceded by the indication "set", "run", or "save".
- Press the function knob. The indication ("set", "run", or "save") flashes and the modification mode is active.
- Turn the function knob in order to modify the set value of the selected field.
- Press the function knob again to confirm the input and to quit the modification mode
- The process will be interrupted if the stop key is pressed or after 60 seconds without any further input.

## 6 Using the centrifuge

### 6.3.2.1 Speed / relative centrifugal force (RCF)

The set speed of the centrifuge is displayed in the upper area of the Speed/RCF field. The actual value is displayed right below. The speed is stated as the number of revolutions per minute ( $\text{min}^{-1} = \text{rpm}$ ) and the RCF values as a multiple of the gravitational acceleration ( $\times g$ ). The values are interdependent (see chapter 2.2.2.1 - "Speed, radius, and relative centrifugal force"). The maximum speed/RCF values depend on the rotor that is used.

The parameters speed and RCF can be changed during the centrifugation.



Fig. 10: Setting the speed value or the RCF value

### 6.3.2.2 Runtime

The set runtime is displayed in the upper section of this field, with the remaining runtime shown below. The runtime is counted down from the set value, starting with the start of the centrifuge and ending with the start of the deceleration phase. The maximum runtime is 99 h:59 min:59 sec. As of 59 min:59 sec, the unit switches from "h:min" to "min:s".

The parameter runtime can be changed during the centrifugation.

#### **i** NOTE

If the runtime is changed during an active centrifugation run, the time that has already elapsed will not be taken into consideration. The centrifuge will perform a complete run with the new runtime.



Fig. 11: Setting the runtime, here in the time unit "min:s"

### Runtime as of the set speed

If the runtime is to be counted as of the moment when the set speed is reached, the symbol (see the illustration) behind the set speed value must be activated:

- Select the clock symbol with the cursor and confirm the selection. The symbol and the bar under the symbol start to flash.
- Activate the function by turning the function knob. The symbol remains displayed in a permanent manner and the bar continues to flash.
- Further turning of the function knob will deactivate the function. In this case, the symbol disappears but the bar continues to flash.
- Press the function knob in order to activate the desired setting. The bar remains visible as long as the cursor is placed on the symbol.



Fig. 12: The function "Runtime as of the set speed" is activated

### Continuous run

During the continuous run, the runtime of the centrifuge is unlimited and must be stopped manually. The centrifuge accelerates during the continuous run until the set speed is reached.

- Select the "Time" field and press the function knob. The indication "set" flashes in the activated status.
- Turn the function knob from the time 0:00:10 anti-clockwise or from the time 99:59:59 clockwise. The indication "Cont" will be displayed in the "Time" field. During the centrifugation run, the elapsed time will be displayed.
- Deactivate the continuous run by pressing the stop key or by entering a specific runtime.



Fig. 13: Indication "Cont" during a continuous run

## 6 Using the centrifuge

### Short run

A short run can be started if no run is active.

- Keep the start key pressed during the short run.

During the short run, the centrifuge accelerates with the acceleration curve 9 (maximum) until the maximum permissible speed of the rotor is reached. The runtime is counted and in the "Time" field the indication "Short" is displayed.

When the start key is released, the centrifuge decelerates to a standstill based on the maximum deceleration curve.

When the short run is completed, the original parameters (curves, runtime, and final speed) are restored and displayed.



Fig. 14: Indication "Short" during a short run

### 6.3.2.3 Temperature ("Temp")

The set value is displayed in the upper area of the field and the actual temperature in the rotor chamber is displayed in the lower area. Temperatures between -10 °C and +60 °C can be preselected.



Fig. 15: Setting the temperature

### Temperature control

Depending on the substances to be centrifuged, it may make sense to perform a temperature control of the centrifuge. The temperature control prevents the temperature-controlled samples in the non-temperature-controlled centrifuge from heating or cooling to an inadmissible temperature.



Unmoved air in the rotor chamber distorts the measuring and control behavior and causes the compressor to freeze over. At temperatures below 0°C, aqueous liquids will freeze, making sedimentation impossible.

- Ensure that the rotor temperature will not fall below 0 °C when the rotor is at a standstill!

**Program "Rapid Temp"**

The centrifuge has a special "Rapid Temp" program that brings the centrifuge rapidly to a specified temperature under defined conditions.

- Select the program with the aid of the menu item "run Prog" (see chapter 6.3.3.2 - "Loading a program"). The speed display shows  $\frac{1}{3}$  of the maximum rotor speed, the deceleration (brake) and acceleration curves correspond to curve 9 and the runtime field indicates "Cont" (continuous run). "Rapid Temp" will flash next to the "run" display.



Fig. 16: "Rapid Temp" program

- Press the start button in order to start the temperature control process.
- During the temperature control process, only the set temperature can be modified.

The "Rapid Temp" program will be stopped under the following conditions:

- The set value is reached. The program will stop with a sound signal if this function is activated.
- The stop button is pressed. The program will be stopped prematurely.
- A parameter is changed (except for the temperature and rotors/buckets). In this case, the program will be aborted.
- A short run is started. In this case, the program will also be aborted.

After the stop, the previous program will be reloaded or the changed parameters will be adopted as the new settings.



**NOTE**

The automatic lid opening function ("AutoOpen") is suppressed after a temperature control run in order to prevent the system from reheating or cooling down.



**NOTE**

If the "Rapid Temp" program is used, the temperature of the unloaded aluminium bucket will be displayed. If samples, which have not been precooled, are placed into the buckets after a "Rapid Temp" run, the displayed temperature will deviate from the actual sample temperature.

## 6 Using the centrifuge

### 6.3.2.4 Rotor selection

This field shows the rotor that is currently being used.



#### NOTE

The rotor selection can only be changed when the centrifuge is at a standstill.

- Select the "Rotor" field and confirm the selection. The indication "set" flashes in the activated status.
- Select the desired rotor. If there are rotors with several different types of possible buckets, the various combinations will be displayed one after the other.
- Confirm the input. The selected rotor or rotor/bucket combination will be adopted.



Fig. 17: Preselection of a rotor or a rotor/bucket combination

#### Automatic rotor identification system

If the centrifuge is equipped with an automatic rotor identification system, the input mode will be activated automatically if the system detects a different rotor with several different types of possible buckets than the rotor that is set. The bucket that is displayed is the bucket with the lowest maximum speed. You can only select different types of buckets for the identified rotor. If the input mode is aborted, this bucket will be stored nonetheless.

This prevents the maximum permissible speed from being exceeded.

**6.3.2.5 Acceleration and deceleration curves**
**Acceleration**

This function is used to select an acceleration curve. The system offers 10 fixed, programmed acceleration curves (curves 0-9).

**Brake**

This function is used in order to select a curve that decelerates the centrifuge to a standstill. Deceleration curves are inverted images of the acceleration curves and are labelled with identical numbers. Deceleration curve no. 0 represents a brakeless deceleration.



Fig. 18: Preselection of a curve; here: preselection of an acceleration curve


**NOTE**

Details concerning the acceleration and deceleration curves can be found in .

**6.3.2.6 Automatic lid opening function ("AutoOpen")**

The automatic lid opening function must be activated so that the lid opens automatically at the end of the operation.

In order to activate the automatic lid opening function:

- Select the "Auto Open" symbol with the cursor and confirm the selection. The symbol and the bar under the symbol start to flash.
- Activate the function by turning the function knob. The symbol remains displayed in a permanent manner and the bar continues to flash.
- Turning the function knob further will deactivate the function. In this case, the symbol disappears but the bar continues to flash.
- Press the function knob in order to activate the desired setting. The bar remains visible as long as the cursor is placed over the symbol.



Fig. 19: The automatic lid opening function "Auto Open" is activated



## 6 Using the centrifuge

### 6.3.2.7 Sound signal ("Buzzer")

This function is used to set an acoustic warning signal that sounds at the end of the centrifugation run and also in the event of an imbalance or error message.

In order to activate the sound signal:

- Select the "Buzzer" symbol with the cursor and confirm the selection. The symbol and the bar under the symbol start to flash.
- Activate the function by turning the function knob. The symbol remains displayed in a permanent manner and the bar continues to flash.
- Turning the function knob further will deactivate the function. In this case, the symbol disappears but the bar continues to flash.
- Press the function knob in order to activate the desired setting. The bar remains visible as long as the cursor is placed over the symbol.



Fig. 20: The sound signal "Buzzer" is activated

### 6.3.2.8 Program lock ("ProgLock")

When the program lock is active, it is impossible to save any new programs. In this case, the function "save program" is disabled.

In order to activate the program lock:

- Select the "ProgLock" symbol with the cursor and confirm the selection. The symbol and the bar under the symbol start to flash.
- Activate the function by turning the function knob. The symbol remains displayed in a permanent manner and the bar continues to flash.
- Turning the function knob further will deactivate the function. In this case, the symbol disappears but the bar continues to flash.
- Press the function knob in order to activate the desired setting. The bar remains visible as long as the cursor is placed over the symbol.



Fig. 21: The program lock "ProgLock" is activated



**6.3.2.9 Cycle display ("Cycles")**

In order to activate the cycle display:

- Select the "Cycles" symbol with the cursor and confirm the selection. The symbol is displayed and "set" flashes in front of the rotor display.
- All of the rotors and buckets can be selected by turning the function knob. The cycles of the selected rotor and, if applicable, also of the selected bucket are displayed.
- Press the function knob in order to quit the cycle display.



Fig. 22: Cycle display for rotor 11650 and bucket 13421

**Reaching the maximum number of cycles**

When the maximum number of cycles is reached for a rotor or bucket, a corresponding warning signal will be displayed every time that the centrifuge is started: the start key, lid key, and entire display will flash.

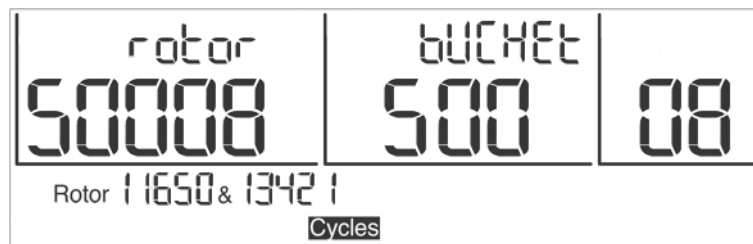


Fig. 23: Display when the maximum number of cycles is reached (flashing)

When the start key is pressed, "CYCLES" will be displayed. The centrifuge will not be started and the display will not return to its normal state until the start key is pressed again.



**WARNING**

When the maximum number of cycles of the rotor or bucket is reached, the parts must be replaced immediately for safety reasons (see chapter 3.6.7 - "Service life of rotors and accessories").

The cycle display will be reset after the rotor and buckets have been replaced by the service department of Sigma Laborzentrifugen GmbH (see chapter 7.3 - "Service contact").

## 6 Using the centrifuge

### 6.3.2.10 Input lock

In order to prevent the centrifuge from being manipulated by unauthorised persons, inputs can be disabled via the menu. Inputs via the keypad, i.e. for starting or stopping a centrifugation run or for opening the lid, are enabled.

#### Activating a simple input lock:

- Position the cursor over the symbol "🔒" in the lower right-hand corner of the display.

As long as the symbol is displayed, the parameters of the centrifuge cannot be changed.

#### Activating a permanent input lock:

- Press the start key three times and hold for approximately 2 seconds when pressing it for the third time.

After the activation of this function, the padlock symbol flashes. The input lock is activated.

- Proceed in the same manner in order to deactivate the permanent input lock.



Fig. 24: "Padlock" symbol indicating an activated input lock

### 6.3.3 Program mode

A program contains all the data that are required for a centrifuge run. Certain sedimentation results can be repeated under identical conditions. Programs can be saved, loaded, executed, and edited when the centrifuge is at a standstill.

A maximum of 50 programs can be stored under the numbers 1 - 50. The rapid cooling program "Rapid Temp" does not occupy any storage location and cannot be deleted. It is used to cool the centrifuge without any vessels. "--" means that the values that are currently set are not a stored program. The programs can be protected against unauthorised use, modification, or deletion with the aid of an input lock (see chapter 6.3.2.10 - "Input lock").

**6.3.3.1 Saving a program**

**NOTE**

This function is only available if the centrifuge is at a standstill.

- Enter the parameters that are to be included in the program.
- Select the menu item "save Prog" and confirm the selection. The indication "save" flashes in the activated status.
- Select a random storage location from the program selection list. Free storage locations are indicated by a flashing display. Any storage locations that are already occupied will be overwritten during the saving process.
- Save the program in the the desired location.

The program is now saved.


**NOTE**

The functions "Auto Open", "Buzzer", "ProgLock", and "Cycles" cannot be entered as part of a program.



Fig. 25: Saving a program

**6.3.3.2 Loading a program**

- Select the menu item "run Prog" and confirm the selection. The indication "run" flashes in the activated status.
- Select the desired program and confirm the selection by pressing the function knob.

The program is now loaded.



Fig. 26: Loading a program

## 6 Using the centrifuge

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### 6.4 Switching the centrifuge off

- Open the centrifuge when it is not in use so moisture can evaporate.
- Switch the centrifuge off by pressing the mains power switch.

## 7 Malfunctions and error correction

### 7.1 General malfunctions

Error messages are displayed as "Error" followed by a code number. If the acoustic signal is activated, it sounds when the error message is displayed.

- Eliminate the source of the problem (see table below).
- Acknowledge the error messages by pressing the lid key.


**NOTE**

Error messages can be eliminated by pressing the lid key. The error itself will not be eliminated, but the centrifuge can be operated again.

| Type of error   | Possible reason  | Correction   |
|---|--|--|
| No indication on the display  | No power in the mains supply   | Check fuse in the mains supply   |
|   | Power cord is not plugged in   | Plug in power cord correctly   |
|   | Fuses have tripped   | Reactivate temperature fuse (see chapter 5.2.1 - "Type of connection")   |
|   | Mains power switch off   | Switch mains power switch on   |
| Centrifuge cannot be started: start key LED is not illuminated          | Several  | Power off/on. If the error occurs again, contact service   |
| Centrifuge cannot be started: lid key LED flashes                       | The lid lock is not closed correctly   | Open and close the lid. If the error occurs again, contact service   |
| Centrifuge decelerates during operation                                 | Brief mains power failure  | Press start key in order to restart the centrifuge   |
|   | System error   | Power off/on. If the error occurs again, contact service   |
| Centrifuge decelerates during operation, imbalance message is displayed | <ul style="list-style-type: none"> <li>– Improper loading</li> <li>– Centrifuge is inclined</li> <li>– Drive problem</li> <li>– Centrifuge was moved during run</li> </ul> | Balance load and restart the centrifuge. If the error occurs again, contact service(see chapter 7.1.1 - "Emergency lid release") |
|   | – Ungreased load- bearing bolts  | Clean and grease load- bearing bolts   |
| Lid cannot be opened  | Lid lock has not released  | Unlock the lid manually and contact service  |
|   | Lid seal sticks  | Clean the lid seal and apply talcum powder   |
| Temperature value cannot be reached (only for refrigerated centrifuges) | Condenser dirty (only air-cooled units)  | Clean the condenser. If the error occurs again, contact service  |

## 7 Malfunctions and error correction

### 7.1.1 Emergency lid release

In the event of a power failure, it is possible to manually open the centrifuge lid.

- Switch off the mains power switch and disconnect the power cord from the socket.
- Remove the plug (see figure, item 1) from the opening at the side panel, e.g. with a screwdriver.



Fig. 27: Position of the opening for the emergency lid release

- The plug is connected with a string. Pull the string in order to release the lid.
- Then, reinsert the stopper into the opening.



**WARNING**

Do not unlock or open the lid unless the rotor is at a standstill.

If the lid is opened via the emergency lid release system during a centrifuge run, the centrifuge will be switched off immediately and decelerate in an unbraked manner.

**7 Malfunctions and error correction**
**7.2 Table of error codes**

| Error no. | Kind of error   | Measures   | Note  |
|-----------|---|--|---|
| 1-9       | System error  | <ul style="list-style-type: none"> <li>Allow to slow down</li> <li>Power off/on</li> </ul>   | All these errors stop the centrifuge or cause it to decelerate brakeless                                      |
| 10-19     | Speedometer error                                     | <ul style="list-style-type: none"> <li>Allow to slow down</li> <li>Power off/on</li> </ul>   |   |
| 20-29     | Motor error   | <ul style="list-style-type: none"> <li>Power off</li> <li>Ensure ventilation</li> </ul>  |   |
| 30-39     | EEPROM error  | <ul style="list-style-type: none"> <li>Allow to slow down</li> <li>Power off/on</li> </ul>   | With error 34, 35, and 36, the centrifuge will stop; with error 37 and 38 only an error message will be given |
| 40-45     | Temperature error (only for refrigerated centrifuges) | <ul style="list-style-type: none"> <li>Allow to slow down</li> <li>Power off</li> <li>Allow to cool down</li> <li>Provide better ventilation (only air cooled centrifuges)</li> <li>Provide sufficient water throughput (only water cooled centrifuges)</li> </ul> |   |
| 46-49     | Imbalance error                                       | <ul style="list-style-type: none"> <li>Allow to slow down</li> <li>Power off</li> <li>Eliminate the imbalance</li> </ul>   |   |
| 50-59     | Lid error   | <ul style="list-style-type: none"> <li>Press lid key</li> <li>Close lid</li> <li>Remove foreign matter from the opening of the lid lock device</li> </ul>  | With error 50 and 51, the centrifuge will stop  |
| 60-69     | Process error   | <ul style="list-style-type: none"> <li>Allow to slow down</li> <li>Power off/on</li> </ul>   | With error 60 message "power failure during run", with error 61, the message "stop after power on"            |
| 70-79     | Communication error                                   | <ul style="list-style-type: none"> <li>Allow to slow down</li> <li>Power off/on</li> </ul>   |   |
| 80-89     | Parameter error                                       | <ul style="list-style-type: none"> <li>Power off</li> <li>Allow to cool down</li> <li>Provide for better ventilation</li> </ul>  | With error 83, error message only   |
| 90-99     | Other errors  | <ul style="list-style-type: none"> <li>Check connections</li> <li>Provide sufficient water throughput (only water cooled centrifuges)</li> </ul>   |   |


**NOTE**

If it is impossible to eliminate the errors, contact the service!

## 7 Malfunctions and error correction

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### 7.3 Service contact

In the event of queries, malfunctions, or spare part enquiries:

**From Germany:**

Contact

Sigma Laborzentrifugen GmbH  
An der Unteren Söse 50  
37520 Osterode (Germany)  
Tel. +49 (0) 55 22 / 50 07-44 44  
E-mail: support.lab@sigma-zentrifugen.de

**Outside Germany:**

Contact our agency in your country. All agencies are listed at  
[www.sigma-zentrifugen.de](http://www.sigma-zentrifugen.de) → [Sales Partners]



**NOTE**

- If you would like to utilise our service, please state the type of your centrifuge and its serial number.



## 8 Maintenance and service

The centrifuge, rotor, and accessories are subject to high mechanical stress. Thorough maintenance performed by the user extends the service life and prevents premature failure.



### CAUTION

If corrosion or other damage occurs due to improper care, the manufacturer cannot be held liable or subject to any warranty claims.

- Use soap water or other water-soluble, mild cleaning agents with a pH value between 6 and 8 for cleaning the centrifuge and accessories (see also ).
- Avoid corrosive and aggressive substances.
- Do not use solvents.
- Do not use agents with abrasive particles.
- Do not expose the centrifuge and rotors to intensive UV radiation or thermal stress (e.g. by heat generators).

### 8.1 Maintenance

#### 8.1.1 Centrifuge

- Unplug the mains power plug before cleaning.
- Carefully remove all liquids, including water and particularly all the solvents, acids, and alkaline solutions from the rotor chamber using a cloth in order to avoid damage to the motor bearings.
- If the centrifuge has been contaminated with toxic, radioactive, or pathogenic substances, clean the rotor chamber immediately with a suitable decontamination agent (depending on the type of contamination).



### WARNING

Take suitable precautions for your own safety if there is a risk of toxic, radioactive, or pathogenic contamination.

- Grease the motor shaft slightly after cleaning (grease for load-bearing bolts part no. 70284).

## 8 Maintenance and service

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### 8.1.2 Condenser (only refrigerated centrifuges)

In order to cool the refrigerant that is compressed by the refrigeration unit, a lamellar condenser is used. It is cooled by air.

Dust and dirt obstruct the cooling flow of air. The dust on condenser pipes and lamellas reduces the heat exchange and thus the performance of the refrigeration unit.

This is why the installation site should be as clean as possible.

- Check the condenser at least once a month for dirt and clean it if necessary.
- If you have any queries, please contact service (see chapter 7.3 - "Service contact").

### 8.1.3 Accessories



#### CAUTION

For the care of the accessories, special safety measures must be considered as these are measures that will ensure operational safety at the same time!

- Immediately rinse off the rotor, buckets, or accessories under running water if they have come into contact with any liquids that may cause corrosion. Use a brush for test tubes in order to clean the bores of angle rotors. Turn the rotor upside down and allow it to dry completely.
- Clean the accessories outside the centrifuge once a week or preferably after each use. Adapters should be removed, cleaned and dried.



#### CAUTION

#### **Do not clean the accessories in a dishwasher!**

Cleaning in a dishwasher removes the anodised coating; the result is cracking in areas that are subject to stress.

- If the rotors or accessories have been contaminated with toxic, radioactive, or pathogenic substances, clean them immediately with a suitable decontamination agent (depending on the type of contamination). Take suitable precautions for your own safety if there is a risk of toxic, radioactive, or pathogenic contamination.
- Dry the accessories with a soft cloth or in a drying chamber at approx. 50°C.

#### 8.1.3.1 Plastic accessories

The chemical resistance of plastic decreases with rising temperatures (see chapter 11.5 - "Resistance data").

- If solvents, acids, or alkaline solutions have been used, clean the plastic accessories thoroughly.

**WARNING**

Plastic accessories must not be greased!

#### **8.1.4 Rotors, buckets and carriers**

Rotors, buckets and carriers are produced with the highest precision, in order to withstand the permanent high stress from high gravitational fields. Chemical reactions as well as stress-corrosion (combination of oscillating pressure and chemical reaction) can affect or destroy the metals. Barely detectable cracks on the surface can expand and weaken the material without any visible signs.

- Check the material regularly (at least once a month) for
  - cracks
  - visible damage of the surface
  - pressure marks
  - signs of corrosion
  - other changes.
- Check the bores of the rotors and multiple carriers.
- Replace any damaged components immediately for your own safety.
- Grease the rotor tie-down screw after cleaning with grease for load bearing bolts (part no. 70284) and spread the grease with a cloth.

#### **8.1.5 Microhaematocrit rotor**

- Remove the microhaematocrit rotor for cleaning.
- Wipe the centrifuge chamber clean.
- Replace the rubber ring in the event of wear or glass breakage (part no. 16001 for rotor 11409).

#### **8.1.6 Load bearing bolts**

Only greased load bearing bolts ensure the even swinging of the buckets and, therefore, the quiet run of the centrifuge. Non-greased bolts can lead to a system shut-down due to imbalances.

Apply a small quantity of grease (part no. 70284) to the load bearing bolts of the rotor and buckets after each cleaning.

## 8 Maintenance and service

### 8.1.7 Glass breakage



#### CAUTION

In the case of glass breakage, immediately remove all glass particles (e.g. with a vacuum cleaner). Replace the rubber cushions since even thorough cleaning will not remove all glass particles.

Glass particles will damage the surface coating (e.g. anodising) of the buckets, which will then lead to corrosion.

Glass particles in the rubber cushions of the buckets will cause glass breakage again.

Glass particles on the pivot bearing of the load-bearing bolts prevent the buckets and carriers from swinging evenly, which will cause an imbalance.

Glass particles in the rotor chamber will cause metal abrasion due to the strong air circulation. This metal dust will not only pollute the rotor chamber, rotor, and materials to be centrifuged but also damage the surfaces of the accessories, rotors, and rotor chamber.

#### **In order to completely remove the glass particles and metal dust from the rotor chamber:**

- Grease the upper third of the rotor chamber with e.g. Vaseline.
- Then, let the rotor rotate for a few minutes at a moderate speed (approx. 2000 rpm). The glass and metal particles will now collect at the greased part.
- Remove the grease with the glass and metal particles with a cloth.
- If necessary, repeat this procedure.

## 8.2 Sterilisation and disinfection of the rotor chamber and accessories

- Use commercially-available disinfectants such as, for example, Sagrotan<sup>®</sup>, Buraton<sup>®</sup>, or Terralin<sup>®</sup> (available at chemist's shops or drugstores).
- The centrifuge and the accessories consist of various materials. A possible incompatibility must be considered.
- Before using cleaning or decontamination agents that were not recommended by us, contact the manufacturer to ensure that such a procedure will not damage the centrifuge.
- For autoclaving, consider the continuous heat resistance of the individual materials (see chapter 8.2.1 - "Autoclaving").

Please contact us if you have any queries (see chapter 7.3 - "Service contact").



#### DANGER

If dangerous materials (e.g. infectious and pathogenic substances) are used, the centrifuge and accessories must be disinfected.

### 8.2.1 Autoclaving

The service life of the accessories essentially depends on the frequency of autoclaving and use.

- Replace the accessories immediately when the parts show changes in colour or structure or in the occurrence of leaks etc.
- During autoclaving, the caps of the tubes must not be screwed on in order to avoid the deformation of the tubes.


**NOTE**

It cannot be excluded that plastic parts, e.g. lids or carriers, may deform during autoclaving.

| Accessories  | Max. temp. (°C) | Min. time (min) | Max. time (min) | Max. cycles |
|--|-----------------|-----------------|-----------------|-------------|
| Aluminium buckets                                    | 134-138         | 3               | 5               | -           |
| Aluminium rotors                                     | 134-138         | 3               | 5               | -           |
| Glass tubes  | 134-138         | 3               | 40              | -           |
| Polyallomer / polycarbonate rectangular carriers     | 115-118         | 30              | 40              | -           |
| Polyallomer / polycarbonate round carriers           | 115-118         | 30              | 40              | -           |
| Polyamide buckets                                    | 115-118         | 30              | 40              | 10          |
| Polycarbonate / polyallomer lids for angle rotors    | 115-118         | 30              | 40              | 20          |
| Polycarbonate tubes                                  | 115-118         | 30              | 40              | 20          |
| Polyphenylsulfone (PPSU) caps for buckets            | 134-138         | 3               | 5               | 100         |
| Polypropylene balance adapter for blood-bag systems  | 115-118         | 30              | 40              | n.s.        |
| Polypropylene copolymer tubes                        | 115-121         | 30              | 40              | 20          |
| Polypropylene rectangular carriers                   | 115-118         | 30              | 40              | -           |
| Polypropylene rotors                                 | 115-118         | 30              | 40              | 20          |
| Polypropylene round carriers                         | 115-118         | 30              | 40              | -           |
| Polysulfone caps for buckets                         | 134-138         | 3               | 5               | 100         |
| Polysulfone lids for angle rotors                    | 134-138         | 3               | 5               | 100         |
| Rubber adapters                                      | 115-118         | 30              | 40              | -           |
| Stainless-steel balance weight for blood-bag systems | 121             | 30              | 30              | n.s.        |
| Teflon tubes   | 134-138         | 3               | 5               | 100         |

## 8 Maintenance and service

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### 8.3 Service



**DANGER**

In the event of service work that requires the removal of the panels, there is a risk of electric shock or mechanical injury. Only qualified specialist personnel is authorised to perform this service work.

The centrifuge is subject to high mechanical stress. In order to be able to withstand this high level of stress, high-quality components were used during the production of the centrifuge. Nevertheless, wear cannot be excluded and it may not be visible from the outside. Especially the rubber parts that are – among other things – part of the motor suspension, are subject to ageing.

This is why we recommend having the centrifuge checked by the manufacturer during an inspection once per year in the operating state and once every three years in the dismantled state. Rubber parts should be replaced after three years.

Information and appointments:

#### **In Germany:**

Contact

Sigma Laborzentrifugen GmbH

An der Unteren Söse 50

37520 Osterode (Germany)

Tel. +49 (0) 55 22 / 50 07-44 44

E-mail: support.lab@sigma-zentrifugen.de

#### **Outside Germany:**

Contact our agency in your country. All agencies are listed at [www.sigma-zentrifugen.de](http://www.sigma-zentrifugen.de) → [Sales Partners]



**NOTE**

- If you would like to utilise our service, please state the type of your centrifuge and its serial number.

## 8.4 Return of defective parts

Although we exercise great care during the production of our products, it may be necessary to return a unit or accessory to the manufacturer.

In order to ensure the quick and economical processing of returns of centrifuges, spare parts, or accessories, we require complete and extensive information concerning the process. Please fill in the following forms completely, sign them, enclose them with the return package, and send them together with the product to:

Sigma Laborzentrifugen GmbH  
An der Unteren Söse 50  
37520 Osterode (Germany)

### 1. Declaration of decontamination

As a certified company and due to the legal regulations for the protection of our employees and of the environment, we are obliged to certify the harmlessness of all incoming goods. For this purpose, we require a declaration of decontamination.

- The form must be filled in completely and signed by authorised and specialised personnel only.
- Affix the original form in a clearly visible manner to the outside of the packaging.



#### NOTE

We will return the unit if no declaration of decontamination is provided!

### 2. Form for the return of defective parts

This form is for the product-related data. They facilitate the assignment, and they enable the quick processing of the return. If several parts are returned together in one packaging, please enclose a separate problem description for every defective part.

- A detailed problem description is necessary in order to perform the repair quickly and economically.



#### NOTE

If the form does not include a description of the malfunction, neither a refund nor a credit note can be issued. In this case, we reserve the right to return the parts to you at your expense.

- Upon request, we will prepare and submit to you a cost estimate prior to performing the repair. Please confirm such cost estimate within 14 days. If the cost estimate has still not been confirmed after 4 weeks, we will return the unit. Please note that you must bear the incurred costs.

## 8 Maintenance and service

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The unit must be packaged in a transport-safe manner. Please use the original packaging, if at all possible.  
If the product is dispatched to us in unsuitable packaging, you will be charged the cost for returning it to you in new packaging.

The forms can be downloaded online from  
[www.sigma-zentrifugen.de](http://www.sigma-zentrifugen.de) → [Service] → [Overhaul and repair].



## 9 Disposal

### 9.1 Disposal of the centrifuge



In accordance with the directive 2002/96/EC, SIGMA centrifuges are marked with the symbol shown to the left. This symbol means that it is not permissible to dispose of the unit among household waste.

- You can return these centrifuges free of cost to Sigma Laborzentrifugen GmbH.
- Ensure that the unit is decontaminated. Fill in a declaration of decontamination (see chapter 8.4 - "Return of defective parts").
- Comply with any other applicable local rules and regulations.

### 9.2 Disposal of the packaging

- Use the packaging to return the centrifuge for disposal or
- dispose of the packaging, after having separated the individual materials.
- Comply with all local rules and regulations.

## 10 Technical data

### 10 Technical data

|                                 |  |
|---------------------------------|--|
| <b>Manufacturer</b>             | <b>Sigma Laborzentrifugen GmbH<br/>An der Unteren Söse 50<br/>37520 Osterode (Germany)</b> |
| Type:                           | 2-16KHL  |
| <u>Connection requirements</u>  |  |
| Electr. connection:             | see name plate   |
| Protection class:               | I  |
| IP code:                        | 20   |
| Connected load (kVA):           | 1.01   |
| Power consumption (kW):         | 0.95   |
| Max. current consumption (A):   | 4.5 (at 220-240 V / 50 Hz)   |
| Input fuse (AT):                | 6.0 (at 220-240 V / 50 Hz), temperature fuses  |
| <u>Performance data</u>         |  |
| Max. speed (rpm):               | 15,300   |
| Max. capacity (ml):             | 400  |
| Max. gravitational field (x g): | 21,913   |
| Max. kin. energy (Nm):          | 9,962  |
| <u>Other parameters</u>         |  |
| Time range:                     | 10 sec – 99 h 59 min, short run, continuous run  |
| Temperature range:              | -10°C to +60°C   |
| Storage locations:              | 50   |
| <u>Physical data</u>            |  |
| Height (mm):                    | 310  |
| Height with open lid (mm):      | 705  |
| Width (mm):                     | 550  |
| Depth (mm):                     | 570  |
| Weight (kg):                    | 60   |
| Noise level (dB(A)):            | 65 (at maximum speed)  |

#### 10.1 Ambient conditions

- The figures are valid for an ambient temperature of  $+23^{\circ}\text{C} \pm 2^{\circ}\text{C}$  and a nominal voltage  $\pm 10\%$ . The minimum temperature is  $< +4^{\circ}\text{C}$  and depends on the rotor type, speed, and ambient temperature.



#### NOTE

At a nominal voltage of 100V or 200V, a tolerance of +10% / -5% applies.

- For indoor use only.
- Allowable ambient temperature  $+5^{\circ}\text{C}$  to  $+35^{\circ}\text{C}$ .
- Max. relative humidity of air 80% up to  $31^{\circ}\text{C}$  with a linear decrease to 67% relative humidity of air at  $35^{\circ}\text{C}$ .
- Maximum altitude 2,000 m above sea level.

## **10.2 Technical documentation**

For environmental reasons, the comprehensive technical documentation of the centrifuge (e.g. circuit diagrams) and the safety data sheets of the manufacturers of refrigerant and lubricants are not attached to this documentation.

You can order these documents from our service department.

## 11 Appendix

# 11 Appendix

## 11.1 Range of accessories

| Part no. | Description  | Max. speed (rpm) | Max. gravitational field (x g) |
|----------|--|------------------|--------------------------------|
| 11122    | Swing-out rotor for microtiter plates, incl. 1 set carriers no. 13222, max. height of plates 56 mm, max. load per bucket approx. 335 gram<br>Radius max. 12.1 cm, radius min. 4.8 cm   | 3 000            | 1 218                          |
| 11123    | Swing-out rotor for microtiter plates, incl. 1 set carriers no. 13223, max. height of plates 50 mm, max. load per bucket approx. 345 gram<br>Radius max. 11.8 cm, Radius min. 4.8 cm   | 4 000            | 2 111                          |
| 11124    | Swing-out rotor 24 x 1.5 / 2.0 ml, incl. 3 sets buckets no. 13124, for e.g. reaction vials no. 15008, 15040, incl. hermetic aluminium lid no. 17878<br>Radius max. 7.4 cm, radius min. 3.5 cm  | 14 000           | 16 215                         |
| 11170    | Swing-out rotor, 4 place, for bucket no. 13299, suitable for software version 32 or higher<br>Radius max. 14.2 cm, radius min. 3.8 cm  | 5 000            | 3 969                          |
| 11190    | Swing-out rotor 4 x 100 ml complete, no. 11192, incl. 2 sets bucket no. 13097 and 4 glass tubes 100 ml no. 15100<br>Radius max. 13.5 cm, radius min. 5.0 cm  | 5 000            | 3 773                          |
| 11191    | Swing-out rotor 16 x 15 ml complete, no. 11192, incl. 2 sets carriers no. 13012 and 16 PS-tubes 15 ml no. 15020<br>Radius max. 13.4 cm, radius min. 5.1 cm   | 5 000            | 3 745                          |
| 11192    | Swing-out rotor, 4 place, for buckets no. 13009, 13012, 13041, 13042, 13097, 13150, 13152  | 5 000            |                                |
| 11194    | Swing-out cytology rotor complete, incl. 2 sets buckets no. 13224, 4 inserts no. 15223. The buckets with the microscope slides can be locked in a 90° position at a standstill.<br>Radius max. 11.3 cm, Radius min. 6.9 cm   | 3 000            | 1 137                          |
| 11409    | Microhaematocrit rotor suitable for 24 capillary tubes Ø 1.5 x 75 mm, 50 µl no. 15001, incl. reader no. 17029, usable with reader 17002, incl. rotor screw 81543<br>Radius max. 9,0 cm, radius min. 1,5 cm   | 12 000           | 14 489                         |
| 12071    | Angle rotor for 12 x 15 ml culture tubes, e.g. no. 15115 and 6 x 50 ml culture tubes, e.g. no. 15151, angle 35°,<br>Radius max. 50 ml: 10.2 cm<br>Radius max. 15 ml: 12.6 cm   | 4 000<br>4 000   | 1 825<br>2 254                 |
| 12072    | Angle rotor 20 x 15 ml complete, incl. 10 sets buckets no. 13011, for tubes Ø 17 x up to 120 mm, e.g. no. 15015, 15020, 15023, 15024, Monovettes and culture tubes 15 ml no. 15115<br>Radius max. 13.9 cm, radius min. 8.0 cm, angle 33°   | 4 000            | 2 486                          |
| 12073    | Angle rotor 30 x 15 ml complete, incl. 15 sets buckets no. 13011, for tubes Ø 17 x up to 120 mm, e.g. no. 15015, 15020, 15023, 15024, Monovettes and culture tubes 15 ml no. 15115, angle 33°<br>Radius max. 13.9 cm, radius min. 7.8 cm,<br>Radius max. 11.6 cm, radius min. 5.8 cm | 4 000<br>4 000   | 2 486<br>2 075                 |
| 12104    | Angle rotor, for 12 PCR-strips with 8 tubes 0.2 ml, e.g. no. 15042, incl. hermetic aluminium lid no. 17867<br>Radius max. 9.8 cm, radius min. 7.2 cm, angle 45°  | 14 000           | 15 777 /<br>21 475             |

## 11 Appendix

| Part no. | Description  | Max. speed (rpm) | Max. gravitational field (x g) |
|----------|--|------------------|--------------------------------|
| 12132    | Angle rotor 30 x 1.5/2.0 ml, for e.g. reaction vials no. 15008, 15040, incl. hermetic aluminium lid no. 17849<br>Radius max. 10.0 cm, radius min. 6.7 cm, angle 45°  | 14 000           | 21 913                         |
| 12138    | Angle rotor 4 x 80/85 ml, for tubes e.g. no. 15076, 15080, incl. hermetic aluminium lid no. 17897<br>Radius max. 9.6 cm, radius min. 2.0 cm, angle 44°   | 9 400            | 9 484                          |
| 12139    | Angle rotor 6 x 30 ml, for tubes no. 15029, 15030, 15032, incl. hermetic aluminium lid no. 17851<br>Radius max. 7.8 cm, radius min. 2.1 cm, angle 29°  | 15 300           | 20 414                         |
| 12141    | Angle rotor 10 x 10 ml, for tubes no. 15000, 15010, 15039, incl. hermetic aluminium lid no. 17850<br>Radius max. 7.6 cm, radius min. 2.8 cm, angle 35°   | 15 300           | 19 890                         |
| 12148    | Angle rotor 24 x 1.5/2.0 ml, for e.g. reaction vials no. 15008, 15040, incl. hermetic aluminium lid no. 17864<br>Radius max. 8.2 cm, radius min. 4.9 cm, angle 45°   | 15 300           | 21 460                         |
| 12180    | Angle rotor 12 x 5 ml, Eppendorf reaction caps, incl. hermetic aluminium lid no. 17180, suitable for software version 32 or higher,<br>Radius max. 8.0 cm, radius 3.9 cm, angle 40°  | 15 000           | 20 124                         |
| 12181    | Angle rotor for 6 x 50 ml culture tubes, e.g. no. 15151, incl. hermetic aluminium lid no. 17931<br>Radius max. 9.5 cm, radius min. 3.0 cm, angle 28°   | 12 000           | 15 294                         |
| 13009    | Multiple carrier for 5 tubes 5 ml, round and flat bottom, incl. rubber cushion no. 16005, max. Ø 12. 8/16.5 x 65 - 85 mm, e.g. no. RIA tube 15060, vacutainer, hemolyse tubes, 1 set = 2 pcs.<br>Radius max. 11.3 cm, radius min. 5.6 cm                                 | 5 000            | 3 158                          |
| 13012    | Multiple carrier for 4 tubes 5 - 15 ml, round bottom, incl. rubber cushion no. 16015, max. Ø 17/19 x 90 - 105 mm, e.g. no. 15015, 15020, 15023, 15024, Monovettes 9 - 10 ml, 1 set = 2 pcs.<br>Radius max. 13.4 cm, radius min. 5.1 cm                                   | 5 000            | 3 745                          |
| 13041    | Round bucket for round carriers Ø 43.5 mm, no. 14028 -14035, incl. polysulfone screw cap no. 17130, max. tube length 110 mm, 1 set = 2 pcs.<br>Radius max. 14.0 cm, radius min. 3.0 cm   | 5 000            | 3 913                          |
| 13042    | Multiple carrier for 6 tubes 5 to 15 ml, round bottom, max. Ø 17/19 x 80 - 105 mm, e.g. no. 15000, 15010, 15015, 15020, 15023, 15024, 15039, Monovettes 9 - 10 ml, Vacutainer, incl. rubber cushion no. 16020, 1 set = 2 pcs.<br>Radius max. 13.3 cm, radius min. 4.9 cm | 5 000            | 3 717                          |
| 13097    | Round bucket for 1 tube 100 ml, incl. rubber cushion no. 16051, max. Ø 45.5 x 95 - 105 mm, e.g. no. 15100, 15102, 15103, 15106 and adapters no. 17925, 17950, 1 set = 2 pcs.<br>Radius max. 13.5 cm, min Radius 5.0 cm   | 5 000            | 3 773                          |
| 13150    | Bucket incl. polysulfone screw cap no. 17151 for 1 culture tube 50 ml, e.g. no. 15151, 1 set = 2 pcs.<br>Radius max. 14.4 cm, radius min. 4.3 cm   | 5 000            | 4 025                          |
| 13152    | Multiple carrier for 2 culture tubes 15 ml, e.g. no. 15115, 1 set = 2 pcs.<br>Radius max. 14.3 cm, radius min. 3.3 cm  | 5 000            | 3 997                          |
| 13299    | Round bucket, sealable with cap no. 17299, for round carriers no. 14299 - 14310, 1 set = 2 pcs.  |                  |                                |

## 11 Appendix

### Adapters

| Part no. | Description  |
|----------|--|
| 13000    | Adapter for reaction vials 0.25/0.4 ml no. 15014, 1 set = 2 pcs., suitable for 11124, 12133, 12148                                   |
| 13002    | Adapter for reaction vials 0.5/0.75 ml, Ø 7.9/10 x 28/31 mm, e.g. no. 15005, 1 set = 2 pcs., suitable for 11124, 12133, 12148        |
| 13021    | Adapter for PCR-tube 0.2 ml, e.g. no. 15042, 1 set = 2 pcs., suitable for 11124, 12133, 12148  |
| 13059    | Adapter for 1 round bottom tube 10 ml, max. Ø 16.2/19 x 75 - 85 mm, e.g. no. 15000, 15010, 15039, 1 set = 2 pcs., suitable for 12139 |
| 13060    | Adapter for 1 culture tube 15 ml no. 15115, 1 set = 2 pcs.   |
| 13079    | Bottom adapter for 1 tube 50 ml, e.g. no. 15051, 15052, 1 set = 2 pcs.   |

The complete list of accessories can be downloaded from [www.sigma-zentrifugen.de](http://www.sigma-zentrifugen.de).

#### 11.1.1 Maximum speed for tubes

Some tubes, such as centrifuge glass tubes, microtubes, culture tubes, fluoropolymer tubes and especially high-volume tubes can be used in our rotors, buckets, and adapters at higher speeds than their breaking limit.

- Always fill the tubes up to their useful volume (= the volume that is stated for the tube).
- When using glass tubes, the maximum value of 4,000 x g must not be exceeded (except special high-strength glass tubes; please refer to the information provided by the manufacturer).

### 11.1.2 Rotor radii

The information in the accessories table concerning the radius refers to the values of the respective rotor as shown below. The radius calculation is described in chapter 2.2.2.1 - "Speed, radius, and relative centrifugal force".

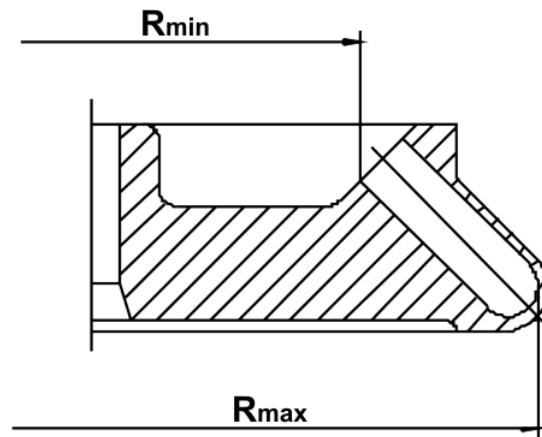


Fig. 28: Minimum and maximum radius of an angle rotor

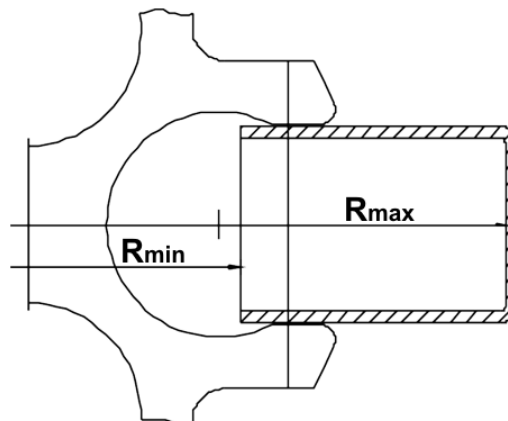


Fig. 29: Minimum and maximum radius of a swing-out rotor

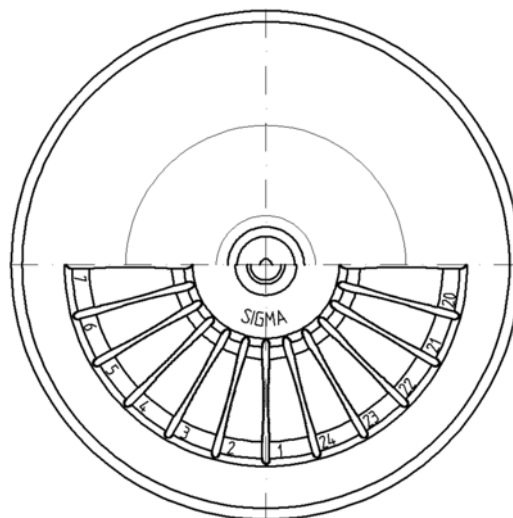


Fig. 30: Microhaematocrit rotor



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11.2 Speed-gravitational-field-diagram

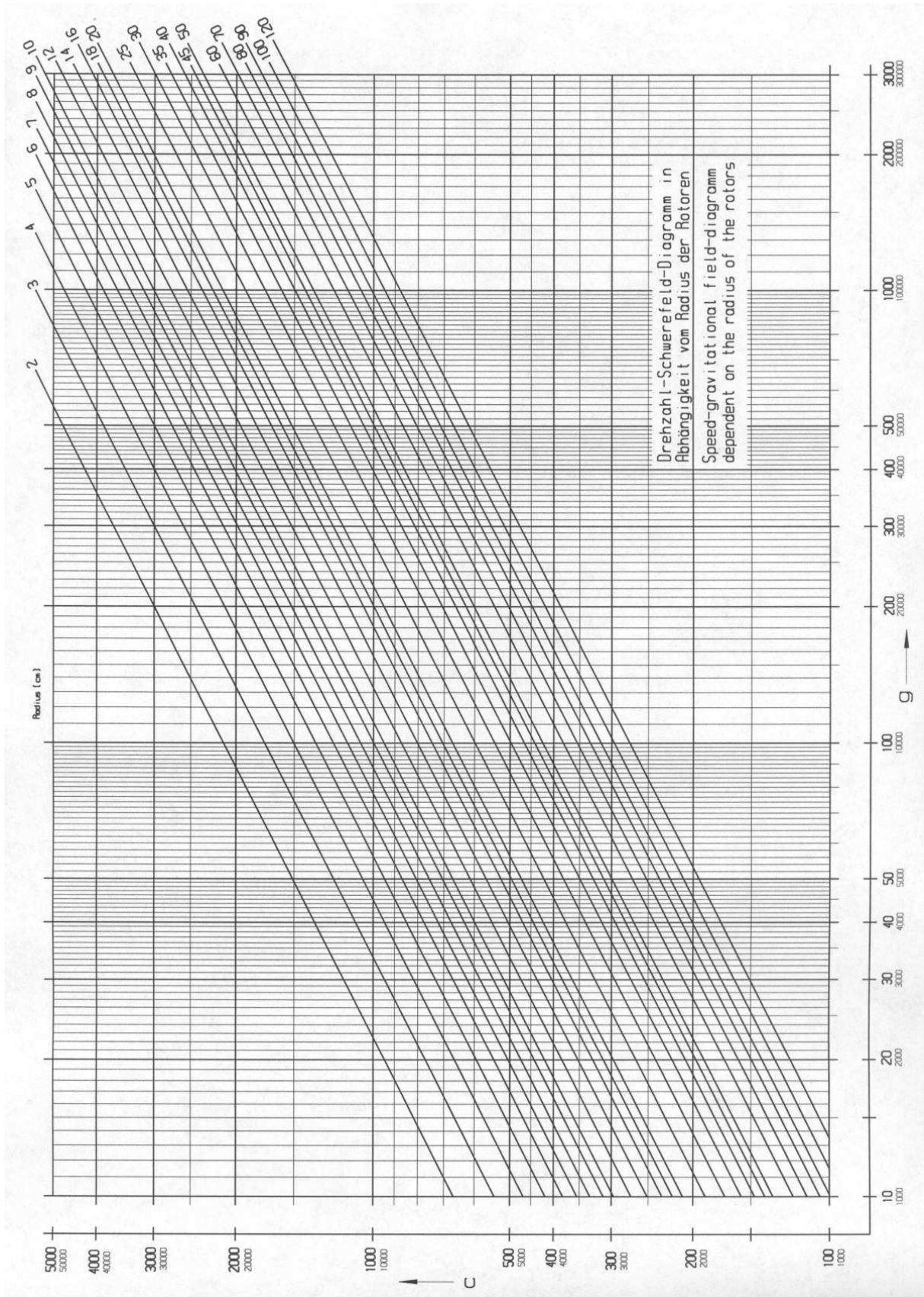


Fig. 31: Speed-gravitational-field-diagram



### 11.3 Acceleration and deceleration curves

Linear curves are numbered in the direction of increasing acceleration (from right to left).

The deceleration curves are inverted images of the acceleration curves and are assigned the same numbers. An exception is curve 0. It decelerates brakeless (spin-out).

In general, the runtime, until the set speed is reached, depends on the moment of inertia of the rotor.

#### Linear curves

The slope of the fixed acceleration curves defines the time that is required to accelerate the rotor by 1,000 rpm.

Curve 9 is a special case compared to the other curves. The centrifuge accelerates with maximum power. The runtime, until the set speed is reached, depends solely on the moment of inertia of the rotor.

| Linear curve no. | Slop            |
|------------------|-----------------|
| 0                | 4 [rpm/sec]     |
| 1                | 6 [rpm/sec]     |
| 2                | 8 [rpm/sec]     |
| 3                | 17 [rpm/sec]    |
| 4                | 25 [rpm/sec]    |
| 5                | 33 [rpm/sec]    |
| 6                | 50 [rpm/sec]    |
| 7                | 100 [rpm/sec]   |
| 8                | 200 [rpm/sec]   |
| 9                | 1.000 [rpm/sec] |

Fig. 32: Slope of linear curves

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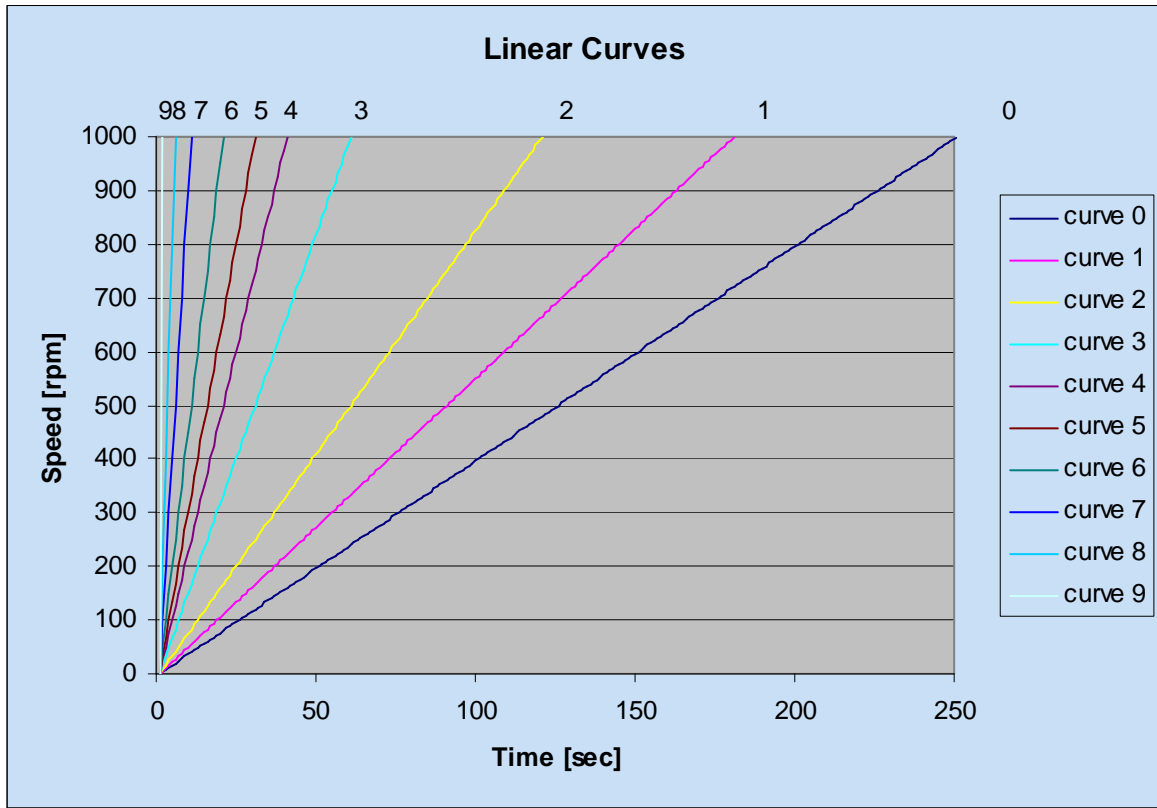



Fig. 33: Diagram of linear curves

## 11.4 Table of the service life of rotors and accessories

| Rotors and accessories with a different service life   |        |  |             |   |  |
|--|--------|--|-------------|---|--|
| If no other data concerning the service life are engraved on the rotor or accessory, rotors and buckets must be checked by the manufacturer after 10 years. After 50,000 cycles, rotors must be scrapped for safety reasons. |        |  |             |   |  |
| Rotor / bucket   | Cycles | Service life ("Exp.Date")  | Autoclaving | Suitable for centrifuge   | Remarks  |
| 9100   | 15,000 |  |             | 4-15C, 4K15C, 4-16, 4-16S, 4-16K, 4-16KS, 6-15, 6K15, 6-16, 6-16K | without engraving, only "spincontrol professional" and "spincontrol S" |
| 11026  |        | 7 years  |             | 1-14, 1-14K   |  |
| 12033  |        | 5 years  |             | 1-16 Edition, 1-16K Edition                                       |  |
| 12082  |        | 7 years  |             | 1-14, 1-14K   |  |
| 12083  |        | 7 years  |             | 1-14, 1-14K   |  |
| 12084  |        | 7 years  |             | 1-14, 1-14K   |  |
| 12085  |        | 7 years  |             | 1-14, 1-14K   |  |
| 12092  |        | 5 years  | 20x         | 1-14, 1-14K   |  |
| 12093  |        | 5 years  | 20x         | 1-14, 1-14K   |  |
| 12094  |        | 5 years  | 20x         | 1-14, 1-14K   |  |
| 12096  |        | 5 years  | 20x         | 1-14, 1-14K   |  |
| 12101  |        | 5 years  | 20x         | 1-15, 1-15K, 1-15P, 1-15PK  |  |
| 12124  |        | 5 years  | 20x         | 1-15, 1-15K, 1-15P, 1-15PK  |  |
| 12126  |        | 5 years  | 20x         | 1-15, 1-15K, 1-15P, 1-15PK  |  |
| 12134  |        | 5 years  | 20x         | 1-16, 1-16K   |  |
| 12135  |        | 5 years  | 20x         | 1-16, 1-16K   |  |
| 12137  |        | 5 years  | 20x         | 1-16, 1-16K   |  |
| 12500  |        | 7 years  |             | 6-15, 6K15, 6-16, 6-16K   |  |
| 12600  |        | 7 years  |             | 6-16S, 6-16KS   |  |
| 13218  | 20,000 |  |             | 4-16, 4-16S, 4-16K, 4-16KS, 6-16, 6-16S, 6-16K, 6-16KS            |  |
| 13296  |        | 5 years  | 10x         | 2-6, 2-6E, 2-7  |  |
| 13299  |        | 5 years  | 10x         | 2-6, 2-6E, 2-7, 2-16P, 2-16KL, 2-16KHL                            |  |
| 13635  | 25,000 |  |             | 6-16, 6-16K, 6-16S, 6-16KS  |  |
| 13845  | 20,000 |  |             | 8K, 8KS   |  |
| 13850  | 10,000 |  |             | 8K, 8KS, 8KBS   |  |
| 13860  | 35,000 |  |             | 8K, 8KS, 8KBS   |  |
| 13864  | 1,000  |  |             | 8K, 8KS   | without engraving  |
| 13865  | 1,000  |  |             | 8K, 8KS   | without engraving  |
| 13866  | 1,000  |  |             | 8K, 8KS   | without engraving  |

## 11 Appendix

### 11.5 Resistance data


**NOTE**

The data refer to resistance at 20°C.

| - no data<br>1 resistant<br>2 practically resistant<br>3 partially resistant<br>4 not resistant | Medium                          | Formula   | Concentration<br>[%] | High Density<br>Polyethylene | Polyamide | Polycarbonate | Polyoxymethylene | Polypropylene | Polysulfone | Polyvinyl chloride, hard | Polyvinyl chloride, weak | Polytetrafluorethylene | Acrylonitrile-butadiene-<br>caoutchouc | Aluminium |
|---|---------------------------------|---|----------------------|------------------------------|-----------|---------------|------------------|---------------|-------------|--------------------------|--------------------------|------------------------|--|-----------|
|   |                                 |   |                      | HDPE                         | PA        | PC            | POM              | PP            | PSU         | PVC                      | PVC                      | PTFE                   | NBR                                    | AL        |
|   | Acetaldehyde                    | C <sub>2</sub> H <sub>4</sub> O                 | 40                   | 3                            | 2         | 4             | 2                | 3             | 4           | 4                        | -                        | 1                      | 4                                      | 1         |
|   | Acetamide                       | C <sub>2</sub> H <sub>5</sub> NO                | saturated            | 1                            | 1         | 4             | 1                | 1             | 4           | 4                        | -                        | 1                      | -                                      | 1         |
|   | Acetone                         | C <sub>3</sub> H <sub>6</sub> O                 | 100                  | 1                            | 1         | 4             | 1                | 1             | 4           | 4                        | -                        | 1                      | 4                                      | 1         |
|   | Acrylonitrile                   | C <sub>3</sub> H <sub>3</sub> N                 | 100                  | 1                            | 1         | 4             | 3                | 3             | 4           | 4                        | 4                        | 1                      | 4                                      | 1         |
|   | Allyl alcohol                   | C <sub>3</sub> H <sub>6</sub> O                 | 96                   | 1                            | 3         | 3             | 2                | 2             | 2           | 2                        | 4                        | 1                      | 1                                      | 1         |
|   | Aluminium chloride              | AlCl <sub>3</sub>                               | saturated            | 1                            | 3         | 2             | 4                | 1             | -           | 1                        | -                        | 1                      | 1                                      | 4         |
|   | Aluminium sulfate               | Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> | 10                   | 1                            | 1         | 1             | 3                | 1             | 1           | 1                        | 1                        | 1                      | 1                                      | 1         |
|   | Ammonium chloride               | (NH <sub>4</sub> )Cl                            | aqueous              | 1                            | 1         | 1             | 2                | 1             | 1           | 1                        | 1                        | 1                      | 1                                      | 3         |
|   | Ammonium hydroxide              | NH <sub>3</sub> + H <sub>2</sub> O              | 30                   | 1                            | 3         | 4             | 1                | 1             | 2           | 1                        | -                        | 1                      | -                                      | 1         |
|   | Aniline                         | C <sub>6</sub> H <sub>7</sub> N                 | 100                  | 1                            | 3         | 4             | 1                | 2             | 4           | 4                        | 4                        | 1                      | 4                                      | 1         |
|   | Anisole                         | C <sub>7</sub> H <sub>8</sub> O                 | 100                  | 3                            | 4         | 4             | 1                | 4             | 4           | 2                        | -                        | 1                      | 4                                      | 1         |
|   | Antimony trichloride            | SbCl <sub>3</sub>                               | 90                   | 1                            | 4         | 1             | 4                | 1             | -           | 1                        | -                        | 1                      | -                                      | 4         |
|   | Benzaldehyde                    | C <sub>7</sub> H <sub>6</sub> O                 | 100                  | 1                            | 3         | 4             | 1                | 1             | 3           | 4                        | 4                        | 1                      | 4                                      | 1         |
|   | Benzene                         | C <sub>6</sub> H <sub>6</sub>                   | 100                  | 3                            | 2         | 4             | 1                | 3             | 4           | 4                        | -                        | 1                      | 4                                      | 1         |
|   | Boric acid                      | H <sub>3</sub> BO <sub>3</sub>                  | aqueous              | 1                            | 3         | 1             | 2                | 1             | -           | -                        | -                        | 1                      | 1                                      | 1         |
|   | Butyl acrylate                  | C <sub>7</sub> H <sub>12</sub> O <sub>2</sub>   | 100                  | 1                            | 2         | 4             | 2                | 3             | 4           | 4                        | 4                        | 1                      | -                                      | 1         |
|   | Butyl alcohol, normal           | C <sub>4</sub> H <sub>10</sub> O                | 100                  | 1                            | 1         | 2             | 1                | 1             | 2           | 2                        | 4                        | 1                      | 1                                      | 1         |
|   | Calcium chloride                | CaCl <sub>2</sub>                               | alcoholic            | 1                            | 4         | 2             | 3                | 1             | -           | -                        | 4                        | 1                      | 1                                      | 3         |
|   | Carbon disulfide                | CS <sub>2</sub>                                 | 100                  | 4                            | 3         | 4             | 2                | 4             | 4           | 4                        | 4                        | 1                      | 3                                      | 1         |
|   | Carbon tetrachloride<br>(TETRA) | CCl <sub>4</sub>                                | 100                  | 4                            | 4         | 4             | 2                | 4             | 4           | 4                        | 4                        | 1                      | 3                                      | 1         |
|   | Chlorine                        | Cl <sub>2</sub>                                 | 100                  | 4                            | 4         | 4             | 4                | 4             | 4           | 4                        | 4                        | 1                      | -                                      | 3         |
|   | Chlorine water                  | Cl <sub>2</sub> x H <sub>2</sub> O              |                      | 3                            | 4         | 4             | 4                | 3             | -           | 3                        | 3                        | 1                      | -                                      | 4         |
|   | Chlorobenzene                   | C <sub>6</sub> H <sub>5</sub> Cl                | 100                  | 3                            | 4         | 4             | 1                | 3             | 4           | 4                        | 4                        | 1                      | 4                                      | 1         |
|   | Chloroform                      | CHCl <sub>3</sub>                               | 100                  | 3                            | 3         | 4             | 4                | 3             | 4           | 4                        | 4                        | 1                      | 4                                      | 3         |

| - no data<br>1 resistant<br>2 practically resistant<br>3 partially resistant<br>4 not resistant | Medium                                | Formula  | Concentration<br>[%] | High Density Polyethylene | Polyamide | Polycarbonate | Polyoxymethylene | Polypropylene | Polysulfone | Polyvinyl chloride, hard | Polyvinyl chloride, weak | Polytetrafluorethylene | Acrylonitrile-butadiene-caoutchouc | Aluminium |
|---|---------------------------------------|--|----------------------|---------------------------|-----------|---------------|------------------|---------------|-------------|--------------------------|--------------------------|------------------------|------------------------------------|-----------|
|   |                                       |  |                      | HDPE                      | PA        | PC            | POM              | PP            | PSU         | PVC                      | PVC                      | PTFE                   | NBR                                | AL        |
|   | Chromic acid                          | CrO <sub>3</sub>   | 10                   | 1                         | 4         | 2             | 4                | 1             | 4           | 1                        | -                        | 1                      | 4                                  | 1         |
|   | Chromic potassium sulphate            | KCr(SO <sub>4</sub> ) <sub>2</sub> x 12H <sub>2</sub> O          | saturated            | 1                         | 2         | 1             | 3                | 1             | -           | 1                        | -                        | 1                      | -                                  | 3         |
|   | Citric acid                           | C <sub>6</sub> H <sub>8</sub> O <sub>7</sub>                     | 10                   | 1                         | 1         | 1             | 2                | 1             | 1           | 1                        | 1                        | 1                      | 1                                  | 1         |
|   | Citric acid                           | C <sub>6</sub> H <sub>8</sub> O <sub>7</sub>                     | 50                   | 1                         | 3         | 1             | 2                | 1             | -           | -                        | -                        | 1                      | 1                                  | 1         |
|   | Copper sulphate                       | CuSO <sub>4</sub> x 5H <sub>2</sub> O                            | 10                   | 1                         | 1         | 1             | 1                | 1             | 1           | 1                        | 1                        | 1                      | 1                                  | 4         |
|   | Cyclohexanol                          | C <sub>6</sub> H <sub>12</sub> O                                 | 100                  | 1                         | 1         | 3             | 1                | 1             | 1           | 1                        | 4                        | 1                      | 2                                  | 1         |
|   | Decane                                | C <sub>10</sub> H <sub>22</sub>                                  | 100                  | -                         | 1         | 2             | 1                | 3             | -           | -                        | -                        | 1                      | 2                                  | 1         |
|   | Diaminoethane                         | C <sub>2</sub> H <sub>8</sub> N <sub>2</sub>                     | 100                  | 1                         | 1         | 3             | 1                | 1             | -           | 3                        | 4                        | 1                      | 1                                  | 1         |
|   | Diesel fuel                           | —  | 100                  | 1                         | 1         | 3             | 1                | 1             | -           | 1                        | 3                        | 1                      | 1                                  | 1         |
|   | Dimethyl formamide (DMF)              | C <sub>3</sub> D <sub>7</sub> NO                                 | 100                  | 1                         | 1         | 4             | 1                | 1             | 4           | 3                        | -                        | 1                      | 3                                  | 1         |
|   | Dimethyl sulfoxide (DMSO)             | C <sub>2</sub> H <sub>6</sub> SO                                 | 100                  | 1                         | 2         | 4             | 1                | 1             | 4           | 4                        | -                        | 1                      | -                                  | 1         |
|   | Dimethylaniline                       | C <sub>8</sub> H <sub>11</sub> N                                 | 100                  | -                         | 3         | 4             | 2                | 4             | -           | -                        | -                        | 1                      | -                                  | 1         |
|   | Dioxane                               | C <sub>4</sub> H <sub>8</sub> O <sub>2</sub>                     | 100                  | 2                         | 1         | 4             | 1                | 3             | 2           | 3                        | 4                        | 1                      | 3                                  | 1         |
|   | Dipropylene glycol (mono)methyl ether | C <sub>4</sub> H <sub>10</sub> O                                 | 100                  | 3                         | 1         | 4             | 1                | 4             | 4           | 4                        | 4                        | 1                      | -                                  | 1         |
|   | Ethyl acetate                         | C <sub>4</sub> H <sub>8</sub> O <sub>2</sub>                     | 100                  | 1                         | 1         | 4             | 1                | 1             | 4           | 4                        | 4                        | 1                      | 4                                  | 1         |
|   | Ethylene chloride                     | C <sub>2</sub> H <sub>4</sub> Cl <sub>2</sub>                    | 100                  | 3                         | 3         | 4             | 1                | 3             | 4           | 4                        | 4                        | 1                      | -                                  | 1         |
|   | Ferrous chloride                      | FeCl <sub>2</sub>  | saturated            | 1                         | 3         | 1             | 3                | 1             | 1           | 1                        | 1                        | 1                      | -                                  | 4         |
|   | Formaldehyde solution                 | CH <sub>2</sub> O  | 30                   | 1                         | 3         | 1             | 1                | 1             | -           | -                        | -                        | 1                      | 2                                  | 1         |
|   | Formic acid                           | CH <sub>2</sub> O <sub>2</sub>                                   | 100                  | 1                         | 4         | 3             | 4                | 1             | 3           | 3                        | 1                        | 1                      | 2                                  | 1         |
|   | Furfural                              | C <sub>5</sub> H <sub>4</sub> O <sub>2</sub>                     | 100                  | 1                         | 3         | 3             | 2                | 4             | -           | -                        | -                        | 1                      | 4                                  | 1         |
|   | Gasoline                              | C <sub>5</sub> H <sub>12</sub> - C <sub>12</sub> H <sub>26</sub> | 100                  | 2                         | 1         | 3             | 1                | 3             | 3           | 2                        | -                        | 1                      | 1                                  | 1         |
|   | Glycerol                              | C <sub>3</sub> H <sub>8</sub> O <sub>3</sub>                     | 100                  | 1                         | 1         | 3             | 1                | 1             | 1           | 1                        | 2                        | 1                      | 1                                  | 1         |
|   | Heptane, normal                       | C <sub>7</sub> H <sub>16</sub>                                   | 100                  | 2                         | 1         | 1             | 1                | 2             | 1           | 2                        | 4                        | 1                      | 1                                  | 1         |
|   | Hexane, n-                            | C <sub>6</sub> H <sub>14</sub>                                   | 100                  | 2                         | 1         | 2             | 1                | 2             | 1           | 2                        | 4                        | 1                      | 1                                  | 1         |
|   | Hydrogen chloride                     | HCl  | 5                    | 1                         | 4         | 1             | 4                | 1             | 1           | 1                        | -                        | 1                      | 2                                  | 4         |
|   | Hydrogen chloride                     | HCl  | concentrated         | 1                         | 4         | 4             | 4                | 1             | 1           | 2                        | 3                        | 1                      | 4                                  | 4         |
|   | Hydrogen peroxide                     | H <sub>2</sub> O <sub>2</sub>                                    | 3                    | 1                         | 3         | 1             | 1                | 1             | 1           | 1                        | -                        | 1                      | 3                                  | 3         |
|   | Hydrogen peroxide                     | H <sub>2</sub> O <sub>2</sub>                                    | 30                   | 1                         | 4         | 1             | 4                | 1             | 1           | 1                        | -                        | 1                      | 3                                  | 3         |
|   | Hydrogen sulphide                     | H <sub>2</sub> S   | 10                   | 1                         | 1         | 1             | 1                | 1             | 1           | 1                        | 3                        | 1                      | 3                                  | 1         |
|   | Iodine, tincture of                   | I <sub>2</sub>   |                      | 1                         | 4         | 3             | 1                | 1             | -           | 4                        | 4                        | 1                      | 1                                  | 1         |

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| - no data<br>1 resistant<br>2 practically resistant<br>3 partially resistant<br>4 not resistant | Medium                          | Formula  | Concentration<br>[%] | High Density<br>Polyethylene | Polyamide | Polycarbonate | Polyoxymethylene | Polypropylene | Polysulfone | Polyvinyl chloride, hard | Polyvinyl chloride, weak | Polytetrafluorethylene | Acrylonitrile-butadiene-<br>caoutchouc | Aluminium |
|---|---------------------------------|--|----------------------|------------------------------|-----------|---------------|------------------|---------------|-------------|--------------------------|--------------------------|------------------------|--|-----------|
|   |                                 |  |                      | HDPE                         | PA        | PC            | POM              | PP            | PSU         | PVC                      | PVC                      | PTFE                   | NBR                                    | AL        |
|   | Isopropyl alcohol               | C <sub>3</sub> H <sub>8</sub> O                                  | 100                  | 1                            | 1         | 1             | 1                | 1             | 1           | 1                        | 4                        | 1                      | -                                      | 2         |
|   | Lactic acid                     | C <sub>3</sub> H <sub>6</sub> O <sub>3</sub>                     | 3                    | 1                            | 3         | 1             | 2                | 1             | 1           | 2                        | -                        | 1                      | 1                                      | 1         |
|   | Magnesium chloride              | MgCl <sub>2</sub>  | 10                   | 1                            | 1         | 1             | 1                | 1             | 1           | 1                        | 1                        | 1                      | 1                                      | 1         |
|   | Mercuric chloride               | HgCl <sub>2</sub>  | 10                   | 1                            | 4         | 1             | 3                | 1             | 1           | 1                        | 1                        | 1                      | 1                                      | 4         |
|   | Mercury                         | Hg   | 100                  | 1                            | 1         | 1             | 1                | 1             | 1           | 1                        | 3                        | 1                      | 1                                      | 3         |
|   | Methyl acetate                  | C <sub>3</sub> H <sub>6</sub> O <sub>2</sub>                     | 100                  | 1                            | 1         | 4             | 2                | 1             | -           | 4                        | 4                        | 1                      | -                                      | 1         |
|   | Methyl alcohol                  | CH <sub>4</sub> O  | 100                  | 1                            | 2         | 4             | 1                | 1             | 3           | 1                        | 3                        | 1                      | 2                                      | 1         |
|   | Methyl benzene                  | C <sub>7</sub> H <sub>8</sub>                                    | 100                  | 3                            | 1         | 4             | 1                | 3             | 4           | 4                        | 4                        | 1                      | 4                                      | 1         |
|   | Methyl ethyl ketone<br>(MEK)    | C <sub>4</sub> H <sub>8</sub> O                                  | 100                  | 1                            | 1         | 4             | 1                | 1             | 4           | 4                        | 4                        | 1                      | 4                                      | 1         |
|   | Methylene chloride              | CH <sub>2</sub> Cl <sub>2</sub>                                  | 100                  | 4                            | 3         | 4             | 3                | 3             | 4           | 4                        | 4                        | 1                      | -                                      | 1         |
|   | Mineral oil                     | —  | 100                  | 1                            | 1         | 1             | 1                | 1             | 1           | 1                        | -                        | 1                      | 1                                      | 1         |
|   | Nitric acid                     | HNO <sub>3</sub>   | 10                   | 1                            | 4         | 1             | 4                | 1             | 1           | 1                        | -                        | 1                      | 4                                      | 3         |
|   | Nitric acid                     | HNO <sub>3</sub>   | 100                  | 4                            | 4         | 4             | 4                | 4             | -           | 4                        | -                        | 1                      | 4                                      | 1         |
|   | Nitrobenzene                    | C <sub>6</sub> H <sub>5</sub> NO <sub>2</sub>                    | 100                  | 3                            | 4         | 4             | 3                | 2             | 4           | 4                        | 4                        | 1                      | 4                                      | 1         |
|   | Oleic acid                      | C <sub>18</sub> H <sub>34</sub> O <sub>2</sub>                   | 100                  | 1                            | 1         | 1             | 2                | 1             | -           | 1                        | -                        | 1                      | 3                                      | 1         |
|   | Oxalic acid                     | C <sub>2</sub> H <sub>2</sub> O <sub>4</sub> x 2H <sub>2</sub> O | 100                  | 1                            | 3         | 1             | 4                | 1             | 1           | 1                        | 1                        | 1                      | 2                                      | 1         |
|   | Ozone                           | O <sub>3</sub>   | 100                  | 3                            | 4         | 1             | 4                | 3             | 1           | 1                        | -                        | 1                      | 4                                      | 2         |
|   | Petroleum                       | —  | 100                  | 1                            | 1         | 3             | 1                | 1             | 1           | 1                        | 3                        | 1                      | 1                                      | 1         |
|   | Phenol                          | C <sub>6</sub> H <sub>6</sub> O                                  | 10                   | 1                            | 4         | 4             | 4                | 1             | 4           | 1                        | 3                        | 1                      | 3                                      | 1         |
|   | Phenol                          | C <sub>6</sub> H <sub>6</sub> O                                  | 100                  | 2                            | 4         | 4             | 4                | 1             | 3           | 4                        | 3                        | 1                      | 3                                      | 1         |
|   | Phosphoric acid                 | H <sub>3</sub> PO <sub>4</sub>                                   | 20                   | 1                            | 4         | 2             | 4                | 1             | -           | -                        | -                        | 1                      | 2                                      | 4         |
|   | Phosphorus<br>pentachloride     | PCl <sub>5</sub>   | 100                  | -                            | 4         | 4             | 4                | 1             | -           | 4                        | 4                        | 1                      | -                                      | 1         |
|   | Potassium hydrogen<br>carbonate | CHKO <sub>3</sub>  | saturated            | 1                            | 1         | 2             | 1                | 1             | -           | -                        | -                        | 1                      | -                                      | 4         |
|   | Potassium hydroxide             | KOH  | 30                   | 1                            | 1         | 4             | 3                | 1             | 1           | 1                        | 1                        | 1                      | -                                      | 4         |
|   | Potassium hydroxide             | KOH  | 50                   | 1                            | 1         | 4             | 3                | 1             | 1           | 1                        | 1                        | 1                      | -                                      | 4         |
|   | Potassium nitrate               | KNO <sub>3</sub>   | 10                   | 1                            | 1         | 1             | 1                | 1             | -           | -                        | -                        | 1                      | 1                                      | 1         |
|   | Potassium<br>permanganate       | KMnO <sub>4</sub>  | 100                  | 1                            | 4         | 1             | 1                | 1             | -           | 1                        | -                        | 1                      | 3                                      | 1         |
|   | Pyridine                        | C <sub>5</sub> H <sub>5</sub> N                                  | 100                  | 1                            | 1         | 4             | 1                | 3             | 4           | 4                        | 4                        | 1                      | 4                                      | 1         |
|   | Resorcinol                      | C <sub>6</sub> H <sub>6</sub> O <sub>2</sub>                     | 5                    | 1                            | 4         | 2             | 3                | 1             | 4           | 2                        | -                        | 1                      | -                                      | 2         |
|   | Silver nitrate                  | AgNO <sub>3</sub>  | 100                  | 1                            | 1         | 1             | 1                | 1             | 1           | 1                        | 1                        | 1                      | 2                                      | 4         |

## 11 Appendix

| - no data<br>1 resistant<br>2 practically resistant<br>3 partially resistant<br>4 not resistant | Concentration         | High Density Polyethylene                     | Polyamide | Polycarbonate | Polyoxymethylene | Polypropylene | Polysulfone | Polyvinyl chloride, hard | Polyvinyl chloride, weak | Polytetrafluorethylene | Acrylonitrile-butadiene-caoutchouc | Aluminium |        |         |
|---|-----------------------|---|-----------|---------------|------------------|---------------|-------------|--------------------------|--------------------------|------------------------|------------------------------------|-----------|--------|---------|
|   |                       |   |           |               |                  |               |             |                          |                          |                        |                                    |           | Medium | Formula |
|   | Sodium bisulphite     | NaHSO <sub>3</sub>                            | 10        | 1             | 1                | 2             | 4           | 1                        | -                        | -                      | -                                  | 1         | 1      | 1       |
|   | Sodium carbonate      | Na <sub>2</sub> CO <sub>3</sub>               | 10        | 1             | 1                | 1             | 1           | 1                        | -                        | -                      | -                                  | 1         | -      | 3       |
|   | Sodium chloride       | NaCl  | 30        | 1             | 1                | 1             | 1           | 1                        | 1                        | 1                      | 1                                  | 1         | 1      | 3       |
|   | Sodium hydroxide      | NaOH  | 30        | 1             | 1                | 4             | 1           | 1                        | 1                        | 1                      | 1                                  | 1         | 2      | 4       |
|   | Sodium hydroxide      | NaOH  | 50        | 1             | 1                | 4             | 1           | 1                        | 1                        | 1                      | -                                  | 1         | 2      | 4       |
|   | Sodium sulfate        | Na <sub>2</sub> SO <sub>4</sub>               | 10        | 1             | 1                | 1             | 1           | 1                        | 1                        | 1                      | 1                                  | 1         | 1      | 1       |
|   | Spirits               | C <sub>2</sub> H <sub>6</sub> O               | 96        | 1             | 1                | 1             | 1           | 1                        | 1                        | 1                      | 3                                  | 1         | -      | 1       |
|   | Styrene               | C <sub>8</sub> H <sub>8</sub>                 | 100       | 4             | 1                | 4             | 1           | 3                        | -                        | 4                      | 4                                  | 1         | 4      | 1       |
|   | Sulphuric acid        | H <sub>2</sub> SO <sub>4</sub>                | 6         | 1             | 4                | 1             | 4           | 1                        | 1                        | 1                      | -                                  | 1         | 2      | 3       |
|   | Sulphuric acid        | H <sub>2</sub> SO <sub>4</sub>                | fuming    | 4             | 4                | 4             | 4           | 4                        | 4                        | 4                      | 4                                  | 1         | 4      | 3       |
|   | Tallow                | —   | 100       | 1             | 1                | 1             | 1           | 1                        | -                        | 1                      | 1                                  | 1         | 1      | 1       |
|   | Tetrahydrofuran (THF) | C <sub>4</sub> H <sub>8</sub> O               | 100       | 3             | 1                | 4             | 1           | 3                        | 4                        | 4                      | 4                                  | 1         | 3      | 1       |
|   | Tetrahydronaphthalene | C <sub>10</sub> H <sub>12</sub>               | 100       | 3             | 1                | 4             | 1           | 4                        | 4                        | 4                      | 4                                  | 1         | -      | 1       |
|   | Thionyl chloride      | Cl <sub>2</sub> SO                            | 100       | 4             | 4                | 4             | 2           | 4                        | 4                        | 4                      | 4                                  | 1         | -      | 3       |
|   | Tin chloride          | SnCl <sub>2</sub>                             | 10        | 1             | 4                | 2             | 2           | 1                        | -                        | -                      | -                                  | 1         | 1      | 4       |
|   | Transformer oil       | —   | 100       | 1             | 1                | 3             | 3           | 1                        | 1                        | 1                      | -                                  | 1         | 1      | 1       |
|   | Trichloroethane       | C <sub>2</sub> H <sub>3</sub> Cl <sub>3</sub> | 100       | 3             | 3                | 4             | 2           | 4                        | 4                        | 4                      | 4                                  | 1         | 4      | 4       |
|   | Urea                  | CH <sub>4</sub> N <sub>2</sub> O              | 10        | 1             | 1                | 1             | 1           | 1                        | -                        | -                      | -                                  | 1         | 1      | 1       |
|   | Urine                 | —   | 100       | 1             | 1                | 1             | 1           | 1                        | -                        | 1                      | 1                                  | 1         | -      | 2       |
|   | Vinegar               | C <sub>2</sub> H <sub>4</sub> O <sub>2</sub>  | 10        | 1             | 4                | 1             | 1           | 1                        | 1                        | 1                      | 1                                  | 1         | 2      | 1       |
|   | Vinegar               | C <sub>2</sub> H <sub>4</sub> O <sub>2</sub>  | 90        | 1             | 4                | 4             | 4           | 1                        | 3                        | 1                      | 4                                  | 1         | -      | 1       |
|   | Wax                   | —   | 100       | -             | 1                | 1             |             | 1                        | -                        | -                      | -                                  | 1         | -      | 1       |
|   | Wines                 | —   | 100       | 1             | 1                | 1             | 2           | 1                        | 1                        | 1                      | 1                                  | 1         | -      | 4       |
|   | Xylene                | C <sub>8</sub> H <sub>10</sub>                | 100       | 3             | 1                | 4             | 1           | 4                        | 4                        | 4                      | 4                                  | 1         | 4      | 1       |

## 11 Appendix

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## 11.6 EC declaration of conformity



### EC – DECLARATION OF CONFORMITY

The product named hereinafter was developed, designed, and manufactured in compliance with the relevant, fundamental safety and health requirements of the listed EC directives and norms.

In the event of modifications that were not authorised by us or if the product is used in a manner that is not in line with the intended purpose, this declaration will be rendered void.

|                      |   |
|----------------------|---|
| <i>Product name:</i> | Laboratory centrifuge   |
| <i>Product type:</i> | Sigma 2-16KL, Sigma 2-16KHL   |
| <i>Order number:</i> | 10350, 10351, 10352, 10353, 90903, 91277  |
| <i>Directives:</i>   | 2006/42/EC Machinery Directive<br>2014/35/EU Low Voltage Directive<br>2014/30/EU EMC Directive<br>2011/65/EU RoHS Directive |
| <i>Normes:</i>       | EN 61010-2-020:2006<br>EN 61000-3-2:2006, A1:2009, A2:2009<br>EN 61000-3-3:2013<br>EN 61326-1:2013                          |

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Eckhard Tödteberg

Osterode, 01/03/2016



General Manager

CE\_2-16KL\_2016-03-01\_en

## 11 Appendix

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