sigma Laborzentrifugen Laboratory Centrifuges

Operating Manual

Refrigerated Centrifuge

2 - 1 6 K C

from Serial No. 134226

Please retain for later use!

Version 03/2010, Rev. 1.7 of 27/01/2012
Translation of the original operating manual

In case of inquiries please state the following number:

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Table of Contents

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, and maintanance of the centrifuge.

1.4 Copyright

The copyright concerning the operating manual remains Sigma Laborzentrifugen GmbH.

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

- duplicated,
- distributet, or
- communicated in any othe way

neither in full nor in parts.

Non-compliance may be prosecuted under criminal law.

1.5 Standards and Regulations

EC Declaration of Conformity (page 69).

1.6 Scope of Supply

The centrifuge comprises:

• 1 rotor wrench	Part no. 930 100
• 1 tube of grease for load bearing bolts	Part no. 70 284
• 20 ml slushing oil	Part no. 70 104
• 1 connection cable	depending on the voltage variant

Documentation:

Operating Manual incl. EC Declaration of Conformity (page 69)

Accessories

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

2 Design of the Centrifuge

2.1 Overview

1 Lid
2 Function knob
3 Display
4 Lid key
5 Stop key
6 Start key
7 Mains power switch

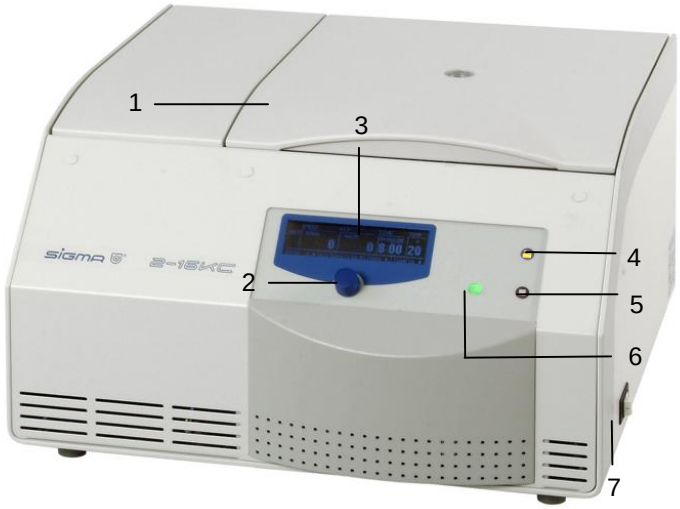


Fig. 2.1: Total view of the centrifuge

8 Name plate (see chapter 2.2)
9 Mains power input
10 Equipotential bonding screw

Fig. 2.2: Rear view of the centrifuge

2.2 Name Plate

1 Manufacturer and registered office
2 Type name
3 Serial number
4 Max. speed
5 Kinetic energy
6 Max. density
7 Nominal voltage
8 Input fuse
9 Symbol for special disposal (see chapter 9)
10 CE mark in accordance with the directive 94/9/EC
11 Part number
12 Year of manufacture
13 Power consumption

Fig. 2.3: Example of a name plate

3 Safety

3.1 Marking of the Unit

International symbols used for SIGMA centrifuges:

Gefährliche elektrische Spannung
Dangerous voltage
Courant haute tension

Achtung, Betriebsanleitung lesen
Attention, consult instruction manual
Attention, consulter mode d'emploi

I

Ein (Netzverbindung)
On (Power)
Marche (mise sous tension)

O

Aus (Netzverbindung)
Off (Power)
Arrêt (mise hors tension)

Schutzleiteranschluss
Protective earth (ground)
Liaison à la terre

Erde
Earth (ground)
Terre

Netzstecker ziehen
Unplug mains plug
Tirer la fiche de prise

Vorsicht Quetschgefahr
Caution! Risk of bruising
Attention! Danger de blessure

Drehrichtungspfeil
Arrow direction of rotation
Flèche sens de rotation

Heiße Oberfläche
Hot surface
Surface chaude

Nicht mit dem Hausmüll entsorgen
Do not dispose as part of domestic waste
Ne pas jeter avec les déchets ménager

3.2 Explanation of the Symbols and Notes

This operating manual uses the following names and symbols to indicate hazards:

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.

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.

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.

This symbol indicates a potentially hazardous situation.

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

This symbol indicates important information.

3.3 Responsibility of the Operator

The operator is responsible to authorise only qualified personnel to work on the machine (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", page 9 of this Operating Manual).
- 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 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.

3.6 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:

- Make sure the the wall socket is properly wired and earth-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 my 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

For safe operation of the centrifuge, observe the following:

- 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 service, 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 (see chapter 7 "Malfunctions and Error Correction") or contact the service of SIGMA Laborzentrifugen GmbH (see 7.3 "Service Contact").
- Ensure that all repairs are performed only by authorized and specialized personnel (see 7.3 "Service Contact").

- 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, adapter) in terms of visible structural changes. Defective parts must be replaced immediately.
- Open the centrifuge when it is not in use so moisture can evaporate.

3.6.3 Fire Prevention

- Always use fuses with the same type and rating specified.
- 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.

- Spin infectious material in sealed rotors and buckets only in order to prevent the material from leaking into the centrifuge.
- Infectious, toxic, pathogenic, and radioactive substances must be centrifuged in certified rotors and vessels. 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.

- 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).

3.6.5 Safety Instructions for Centrifugation

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

- 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 safety area of the centrifuge.
- 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 6.2.2 "Installation of Rotors and Accessories“).
- Observe the instructions on the installation of accessories (see 6.2.2.3).
- The rotor must be loaded symmetrically at equal weights.
- If liquids with a density > 1.2 g/cm^3 are used, reduce the speed (see 6.3.3.6 and 11.4.2).
- Do not use the centrifuge if the rotor is loaded asymmetrically.
- Do not use the centrifuge with tubes that are excessively long.

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.

- Refer to the resistance data (see chapter 11)!

3.6.7 Service Life of Rotors and Accessories

The rotors and accessories have a limited service life.

- 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 02/15” must be scrapped in Feburary 2015 at the latest (see fig. 3.1)!

Fig. 3.1: Different service life – engraving on the bucket/rotor

Info

- Refer to the table of rotors and accessories with a different service life (see chapter 11 “Appendix”)

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 7.1.1 "Emergency Lid Release").

3.7.2 Standstill Monitoring

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. Errors are detected with extreme sensitivity and displayed as error messages in a dialog box (see 7.2 "Error Codes").

3.7.4 Ground Wire Check

For the ground wire check, there is an equipotential bonding screw on the rear panel of the centrifuge. A ground wire check can be carried out by authorized and specialized personnel using a suitable measuring instrument. Please contact the head of our service team (see 7.3 "Service Contact").

3.7.5 Imbalance Monitoring System

A dialog box may pop up or emit a sound signal in order to indcate that the centrifuge is in the inadmissible imbalance range. If the rotor is loaded unevenly, the drive will be switched off in the acceleration phase or during the run.

3.8 Measures in the Event of Hazards and Accidents

- 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. 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 1.2) and
- only if it is in a perfect running state.
- Immediately eliminate any problems that can affect safety.

4 Storage and Transport

4.1 Dimensions and Weight

Height:	320 mm
Height with opened lid:	700 mm
Width:	550 mm
Depth:	570 mm
Weight:	60 kg

Fig. 4.1: Dimensions and weight

4.2 Storage Conditions

The centrifuge can be stored for up to a year without any problems.

- Store the centrifuge only in dry rooms.
- The storage temperature must be above –20°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 5.2).
- Always lift the centrifuge with a lifting device.
- When lifting the centrifuge, always reach under the centrifuge from the side.

The centrifuge weighs approx. 78 kg!

- For transport use a suitable packaging, and if at all possible, the original packaging (see 5.1 accordingly).

5 Set-up and Connection

5.1 Unpacking the Centrifuge

The centrifuge is packaged in a slip-lid box.

- Remove the upper part of the box.
- Take out the box containing the accessories.
- Remove the upper foam cushion.
- Remove 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.

The centrifuge weighs approx. 60 kg!

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

5.2 Transport Safety Device

The transport safety device consists of of a foamed plastic ring in the centrifuge chamber.

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 7.1.1).
- Remove the foamed plastic ring 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.

5.3 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 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 position the centrifuge 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.

5.4 Power Supply

5.4.1 Connection

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

SIGMA laboratory centrifuges are units of safety class I and have a three-wire power cord with a IEC C13 connector. They are equipped with temperature fuses.

- Switch the unit off by actuating the mains power switch.
- If they have tripped, let the fuses cool down for approximately 2 minutes.
- Switch the unit on. The fuses are reactivated.

5.4.2 Fuses

Typically, the centrifuges must be protected on-site with 16 Amp L or B fuses.

6 Using the Centrifuge

6.1 Initial Start-Up

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 on the right side of the front (see Fig. 2.1, page 11).

The centrifuge 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 (see 6.3.3.6 "Parameter Menu - Automatic Lid Opening Function ").

The centrifuge cannot be started if the lid is opened.

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

- Do not hold 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.

After frequent use, the rotor tie-down screw must be loosened by some turns, the rotor has to be lifted and fastened again. This must be done once a day or after 20 cycles. This ensures a proper connection between the rotor and the motor shaft.

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

- 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 in chapter 3!

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.
- Slightly grease the rotor and lid seals after cleaning.
- 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 in chapter 3!

1 Rotor tie down screw
2 Lid
3 Lid seals

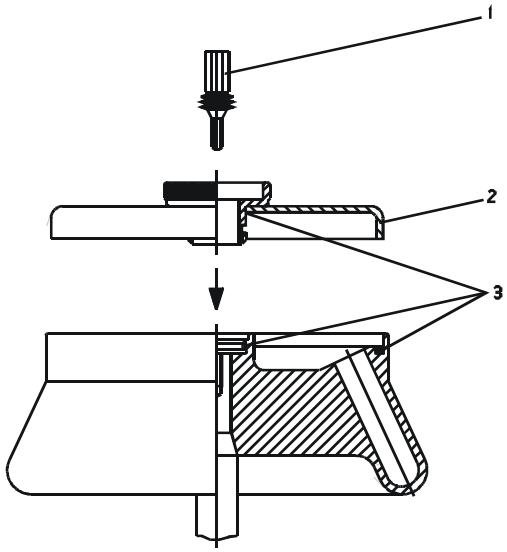


Fig. 6.1: Angel rotor with a hermetically sealed lid

6.2.2.3 Installation of Accessories

- Only use inserts that are suitable for the rotor (see 11.1 "Suitable Accessories").
- All four buckets of the swing-out rotor need to be installed when spinning.
- Always load the opposite 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 opposite inserts are identical (see Fig. 6.2).

Centrifugation with low capacity: The tubes must be installed symmetrically so that the buckets and their inserts are loaded evenly (see Fig. 6.3).

Fig. 6.2:
Permissible loading of the swing-out rotor with different tube sizes

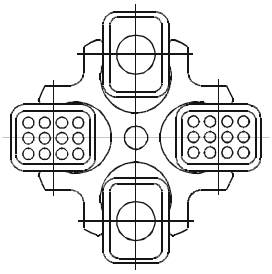
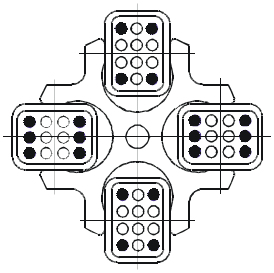


Fig. 6.3:
Permissible loading of the swing-out rotor



6.2.2.4 Adapters

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

- Load the opposite carriers 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.

6.2.2.5 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 tubes must be filled up to their useful volume (= the volume that is stated for the tube). 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-strengh glass tubes; please refer to the information provided by the manufacturer).
- Observe the instructions on safety and hazards in chapter 3!

6.3 Spincontrol Comfort

6.3.1 Operating Panel

1 Centrifuge display
2 Function key
3 Start key
4 Stop key
5 Lid key

Fig. 6.4: Operating Panel

The centrifuge is started directly via the operating panel. When the centrifuge is switched on, all of the operating keys and displays will be illuminated for a short time. It is now ready for operation.

6.3.2 Centrifuge Display

The centrifuge display has the following display fields:

1 Speed field
2 RCF field
3 Time field
4 Temperature field
5 Program field
6 Rotor field
7 Parameters
8 Configurations

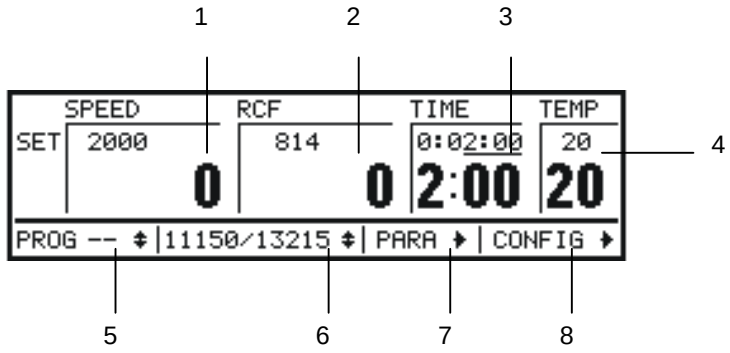


Fig. 6.5: Display Spincontrol Comfort

6.3.3 Manual Mode

6.3.3.1 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.

6.3.3.2 Interrupting a Centrifugation Run

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

Fast stop:

- Press the stop key for more than one second.

The centrifuge decelerates with the maximum deceleration curve. "Fast stop" appears in the display.

After a fast stop, the centrifuge lid must be opened before starting a new centrifugation run.

6.3.3.3 Interrupting a Deceleration Process

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

6.3.3.4 Selection, Display, and Modification of Data

The display is in its default state. No area is inverted.

- Select a parameter by pressing or turning the function knob. The selected field will be inverted.
- Press the function knob in order to activate the modification mode. "SET" and the selected area will be inverted.
- Turn the function knob until the desired value is displayed.
- Press the function knob to confirm the selected value and to quit the modification mode. "SET" and the selected area will be deactivated.

After 20 seconds, the modification mode will be left automatically. The current values will be saved.

All entries beyond the permissible limits, or incorrect entries, will not be accepted.

6.3.3.5 Standard Menu

Set

If this area is inverted, the alteration mode is active (here in combination with the speed).

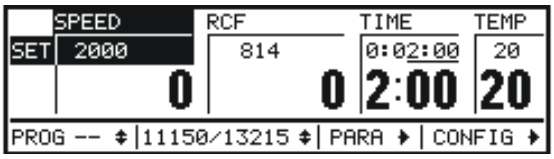


Fig. 6.6: "Set" function

Speed

In the upper section of the field, the set speed of the centrifuge is displayed. The actual speed is displayed below this value. The values are stated in revolutions per minute (rpm) and depend on the RCF values (see 11.5 "Formulae – Mathematical Relations "). The maximum speed values depend on the rotor that is used.

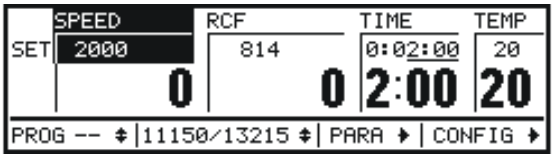


Fig. 6.7: Setting the speed

Relative Centrifugal Force (RCF)

The relative centrifugal force is the acceleration that the sample is subjected to. The set value of this parameter is displayed in the upper section of this field, with the actual value shown below. The values are stated in g (gravitational acceleration) and depend on the speed value (see 11.5 "Formulae – mathematical relation"). The maximum RCF values depend on the rotor that is used.

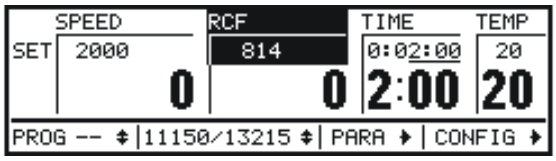


Fig. 6.8: Setting the rcf-value

Time

The set runtime is displayed in the upper section of this field, with the remaining runtime shown below. The runtime is defined as the period from the start of the centrifuge to the beginning of the deceleration phase. The maximum value is 9 h 59 min. The unit of the programmed centrifugation time is underlined.

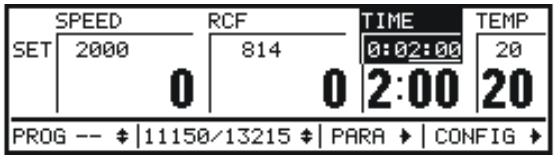


Fig.6.9: Setting the run time

The set value is indicated in hours, minutes, and seconds. The actual value has the same units as the set value and is displayed in hours:minutes, or in minutes:seconds if the value is below 10 minutes. Values greater than 59 will be automatically converted to the next higher unit.

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.

To start the continuous run of the centrifuge :

- Starting with the time setting 0:10 (see page 29), turn the knob counter-clockwise or
- Starting with the time setting 09:59, turn the knob clockwise to the next setting. "HOLD" will be displayed. After the start of the centrifuge, the elapsed time will be displayed.

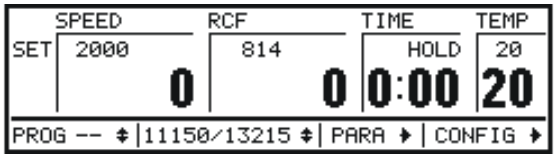


Fig. 6.10: Display of a continuous run

- Deactivate the continuous run by pressing the stop key or by entering a specific runtime.

Short Run

- Keep the start key pressed during the short run.

During the short run, the centrifuge accelerates with the maximum acceleration curve until the maximum speed of the rotor is reached.

When the start key is released, the centrifuge decelerates at maximum brake to a standstill.

Temperature

The set value is in the upper section of the area, underneath the actual temperature is displayed. Temperatures between -20 °C and +40 °C can be preselected.

In the centrifuges without an active heater, the temperatures above room temperature depend on the air friction of the turning rotor.

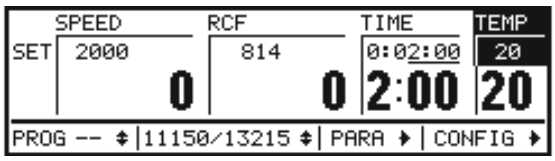


Fig. 6.11: Setting the temperature

The centrifuge 2-16KCH with a heater enables the preselection of temperatures up to +60°C. The maximum rotor temperature that can actually be reached is 40-60°C, depending on the rotor and speed.

Program

In this field, the number of the actual program is displayed.

- Select the double arrow (⇕) next to the program list and confirm the entry. An overview of all stored programs will be displayed (see 6.3.4 "Program Mode").

The rapid cooling program "RAPID_TEMP“ cannot be deleted (see 6.3.3.6 "Parameter Menu").

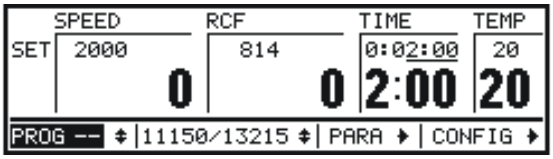


Fig. 6.12: Calling up the program list

Rotor Selection list / Automatical Rotor Identification

This field shows the rotor that is currently being used.

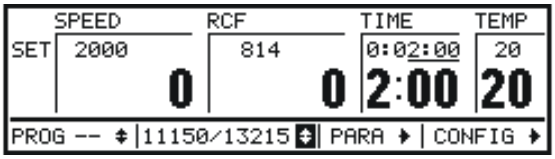


Fig. 6.13: Calling up the rotor selection list

Selection and change of the rotor number on a rotor selection list

- Select the double arrow (⇕) next to the rotor selection list and confirm the entry. An overview with the following data will be displayed:
  - Rotor number, and in some cases together with a bucket
  - max. speed
  - max. gravitational field
  - max. radius for calculation of the gravitational field
  - min. radius

NO	ROTOR	BUCKET	SPEED	RCF	RMAX	RMIN
3	11140	13127	5500	5648	167	80
4	11142		4500	3871	171	42
5	11144	13145	5000	2991	107	63
6	11148		13200	16363	84	44
7	11150	13215	5100	5292	182	88
8	11150	13220	4100	3007	160	113

Fig. 6.14: Rotor selection list

- Select the name of the rotor/bucket combination that is used and confirm it.

Selection of the rotor number in the main menu

- Select the rotor field and confirm it.
- Turn the knob. All of the possible rotor/bucket combinations will be displayed.
- Select a combination and confirm it. The selected combination will be loaded.

Identifying and adapting incorrectly set rotors

The centrifuge automatically identifies the rotor that is being currently used.

- If the system identifies a different rotor than the one that is set, if there are no different buckets for this rotor, and if the speed has not been adapted manually, the rotor input will be adapted automatically. The system will not display a message.
- If the system identifies a different rotor than the one that is set, and if there are different rotor/bucket combinations for this rotor, the system will automatically select the rotor with the lowest speed. The system will display a corresponding message so that the rotor can be selected manually.
- If the system identifies a different rotor than the one that is set, if the speed has been limited, and if there are no rotor/bucket combinations, a message will be displayed.

This prevents the maximum permissible speed from being exceeded.

6.3.3.6 Parameter Menu

For information on how to set the parameters, see 6.3.3.4 "Selection, Display, and Modification of Data".

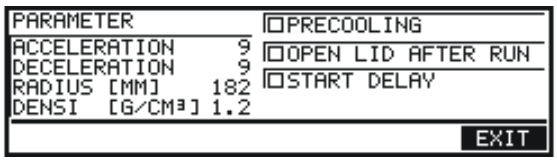


Fig. 6.15: Parameter menu

Acceleration

This function is used to select an acceleration curve. One can select a linear rise (curves 0-9) or a quadratic rise (curves 10-19). The acceleration curves 20-29 can be programmed as desired.

Their shape is explained in detail in 11.3.1 "Linear Curves" and 11.3.2 "Quadratic Curves".

Deceleration

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.

Radius

The radius determines the value of the relative centrifugal force (RCF) that the sample is subjected to. Normally, the maximum RCF value is displayed. If the value is reduced manually, a downward facing arrow (↓) will be displayed in the RCF field.

Density

If the density of the liquid is higher than 1.2 g/cm^3, the value must be adapted manually. This, in turn, reduces the maximum final speed (see 11.4.2 “Density“). A downward facing arrow (↓) will be displayed in the speed field. Values between 1.2 and 9.9 g/cm^3 are possible.

Standstill Cooling

Depending on the substances to be centrifuged, it may make sense to precool the centrifuge. The precooling prevents the cooled samples in the uncooled centrifuge from heating up to an inadmissible temperature.

If the standstill cooling is activated, the centrifuge starts to precool after it is switched on. The lid must be closed.

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

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

Rapid cooling program "RAPID TEMP"

Precooling at a standstill may distort the measurement results and subsequently cause increased wear of the mechanical components. This is why the centrifuge has a special program that precools the centrifuge rapidly under defined conditions:

- Select the option “Progr” in the “Standard” menu and confirm the selection. The program list will be displayed.
- Select the program "RAPID TEMP" on the program list and confirm the selection. The display shows 1/3 of the maximum rotor speed and the corresponding RCF value. The deceleration (brake) and acceleration curves correspond to curve 9 and the runtime field indicates “infinite” (continuous run).

The program will only be loaded if the actual temperature is above the set temperature.

The program runs until the set value is reached. Then, a sound signal is issued, and the standstill cooling is activated. The program that was set beforehand will be reloaded.

- Press the stop key to determinate the rapid cooling program prematurely.

The automatic lid opening function is suppressed after a rapid cooling phase in order to prevent the system from reheating.

Caution

An entry will interrupt the rapid cooling program. There will be no message when the set temperature is reached. If no new runtime is entered, the centrifuge will continue to run infinitely (continuous run).

Start Delay

If the start delay is activated, the centrifuge will not start until the preset time has elapsed.

Automatic Lid Opening Function

The Automatic-Lid-Open function must be activated so that the lid opens automatically when the rotor is at a standstill.

Caution

When the lid is open, the cooling is not active. Samples may warm up!

6.3.3.7 Configuration Menu

In the configuration mode, the default settings can be customised and the data can be read off.

Fig. 6.16: Configuration menu

Code

In order to prevent any unauthorised use of the centrifuge, the following functions can be blocked:

- Saving of programs
- Changing of parameters
- Loading of programs
- Start key

Blocking a function:

- Select the function that is to be blocked.
- Select the button "Activate code".
- Enter a four-digit code and confirm the entry.
- For safety reasons, the code must be entered a second time.

The blocking is now active.

If changes are made to a blocked function, the system will ask for the code prior to executing the change.

Unblocking a function

- Select the button "Delete code".
- Enter the code and confirm the entry.

The function is now unblocked.

Changing the code

- Select the button "Change code".
- Enter the old code and confirm the entry.
- Enter the new code.
- For safety reasons, the code must be entered a second time.

The code is now changed.

Language

The German or English languages can be selected as the menu language.

Screen

Various representation variants enable a zoomed representation of the display:

- RCF and speed in the standard size
- Speed enlarged (zoomed). The RCF display is eliminated.
- RCF enlarged (zoomed). The speed display is eliminated.

- Select the “Display” field in the configuration overview and confirm the selection. The display overview will be displayed.
- In order to set the display "SPEED - (ZOOM)“, select the corresponding line and confirm the selection.
- Quit the display by selecting and confirming “EXIT”. The system will return to the configuration overview.

After another confirmation, the standard menu will be displayed. The fields "SPEED“, "TIME“, and “TEMP“ are zoomed. The field “RCF” is eliminated.

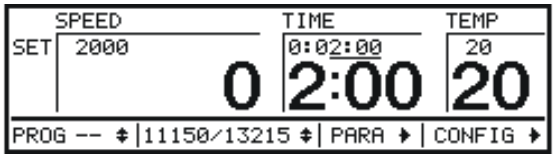


Fig. 6.17: Zoomed speed display

Fine Adjustment

This menu can be used to preselect the set speed in steps of 1 or 10 rpm, and the set time in steps of 1 min or 1 sec.

Info

Regardless of the fine adjustment, the interval will increase if the knob is turned quickly.

Cycles

For each rotor/bucket combination, the number of cycles and runtime are stored.

Buzzer

In this menu, a sound signal can be selected for

- the end of a centrifugation run
- an imbalance message
- an error message.

The duration of the buzzer signal can be specified.

Sensor

The sensor overview shows various system data. In the event of a malfunction, these data facilitate an immediate diagnosis.

Info

The Info overview shows information such as the type of centrifuge, and EPROM version, number of cycles, the total runtime, as well as software version and date.

In the menus "Cycles", “Info“, and “Sensor“, the values can neither be entered nor changed.

Reset

This function resets the centrifuge and restores the factory settings. All of the programs, parameters, curves, and configurations will be deleted.

Curves

In this submenu, the user-defined acceleration and deceleration curves can be created and edited (see 6.3.3.8).

6.3.3.8 Curves Menu

The Curves menu is a submenu of the configuration menu. The curves function can be used to create user-specific acceleration and deceleration curves. 10 storage locations (no. 20-29) are available for this purpose.

For the interval no. 1, either a linear (LIN) or quadratic (QUAD) acceleration can be selected. The other acceleration curves are always linear.

Creation of the curves for variable accelerations and decelerations

- In the configuration mode, select the field "Curves" and confirm the selection. The curve overview will be displayed.
- Select the time display and confirm the selection.

Enter the desired time for interval no. 1 and confirm the entry. The display for internal no. 2 will be displayed simultaneously.

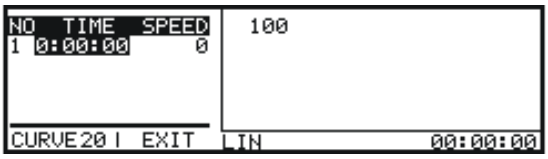


Fig. 6.18: Time value input into interval no. 1

- Select the speed field "SPEED" and confirm the selection.
- Select the speed value and confirm the selection. The curve that is created will be displayed together with the maximum curve speed.

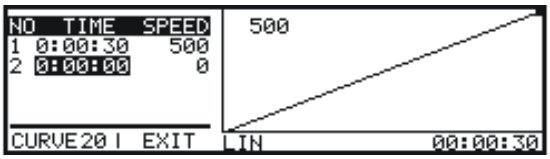


Fig. 6.19: Time value input into interval no. 2

- Activate the time display of the second interval and enter the desired time. The extended curve will be displayed.

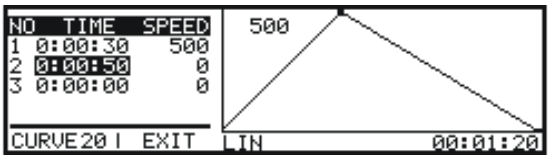


Fig. 6.20: Extended curve

- Select the speed field "SPEED" and enter a speed value. Confirm the entry.
- You can enter up to 10 intervals in this manner.
- Save the curve under a curve number between 20 and 29 together with the current operating parameters.
- Select “EXIT” and quit the curve mode by confirming the entry.

Only acceleration curves are programmed. The corresponding deceleration curves are generated by reflection.

If the curve speed of an interval exceeds the set speed in the operating mode, a dialog box will pop up.

Fig. 6.21: Dialog box concerning the curve speed

Cut:	The curve speed in an interval will automatically be limited to the set speed in the operating mode.
Admit:	The curve speed in an interval will be allowed.
Cancel:	A stop occurs. Starting is impossible without a change of the curve speed in an interval.

Modification of existing curves

- Activate the field “CURVES” in the configuration menu.
- Select the curve that is to be modified and change the individual values as described above.

Centrifugation curves

It is also possible to create centrifugation curves. The following conditions must be fulfilled:

- The preselected maximum final speed of an interval corresponds to the set speed for the centrifugation run.
- The sum of the intervals corresponds to the set time of the centrifugation run. The last speed checkpoint of an interval equals 0.

6.3.3.9 Modification of the Contrast

- Press the stop key and turn the function knob one notch to the left. A dialog box will be displayed.
- Modify the contrast of the centrifuge display and confirm the modification.

Fig. 6.22: Contrast dialog box

6.3.3.10 Imbalance Monitoring

An imbalance dialog box will be displayed in the event of an inadmissible imbalance. The centrifugation run cannot be continued and the centrifuge will be stopped with maximum deceleration power.

Fig. 6.23: Imbalance dialog box

Reason: Improper loading of the centrifuge or a malfunction during the operation (e.g. glass breakage) that in turn prevented the centrifuge from rotating steadily.

- Eliminate the cause of the imbalance (see chapter 1 "Malfunctions and Error Correction") and restart the centrifuge.

6.3.3.11 Modification of Parameter Values during the Centrifugation Run

(see 6.3.3.4 “Selection, Display, and Modification of Data"):

Modification possible	Modification impossible	(De-)Activation possible
Speed	Rotor	Continuous run
RCF	Program	Standstill cooling
Runtime	Radius	Start delay
Temperature	Density	Automatic lid opening function
Acceleration curve		
Deceleration curve		

6.3.4 Program Mode

A program includes all of the data that are required for a centrifugation run.

Attention: Temperature profiles cannot be created!

With a program, certain sedimentation results can be repeated under identical conditions.

Programs can be loaded, executed, modified, and deleted at any time.

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 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 a code (see 6.3.3.7 "Configuration Menu").

6.3.4.1 Loading a Program

1. Loading a program by entering a program number

- Select the program field ("PROG-") and confirm the selection.
- Turn the knob. As a result, all of the programs that have already been saved and the current ("--") setting will be displayed one after the other.
- Select a program and confirm the selection. A dialog box will be displayed (Fig. 6.25).
- Select "LOAD" and confirm the selection.

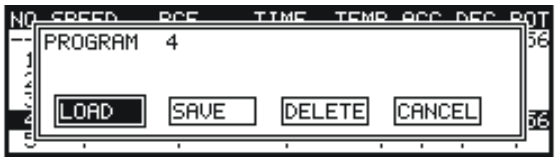


Fig. 6.24: Loading a program

2. Loading a program from the program selection list

- Select the double arrow (⇕) next to the program selection list and confirm the selection. An overview of all of the programs that have already been saved will be displayed. The current setting will be displayed under "-".
- Select a program and confirm the selection. A dialog box will be displayed (Fig. 6.25).
- Select "LOAD" and confirm the selection.

6.3.4.2 Saving a Program

- Enter the parameters that are to be included in the program.
- Select the double arrow (⇕) next to the program selection list and confirm the selection. An overview of all of the programs that have already been saved, and of the free program storage locations will be displayed.
- Select the desired program storage location from the program selection list and confirm the selection. A dialog box will be displayed.
- Select "SAVE" and confirm the selection.

The program is now saved.

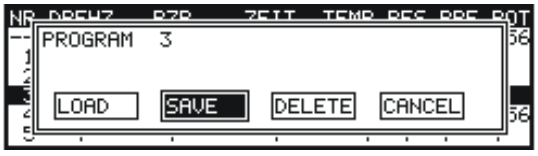


Fig. 6.25: Saving a program

6.3.4.3 Deleting a program

- Select the double arrow (⇕) next to the program selection list and confirm the selection. An overview with all of the programs that have already been saved will be displayed.
- Select the program that is to be deleted and confirm the selection. A dialog box will be displayed.
- Select "DELETE" and confirm the selection.

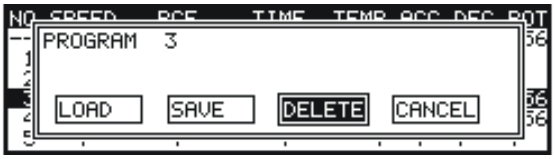


Fig. 6.26: Deleting a program

6.4 Switching the Centrifuge OFF

- Open the centrifuge when it is not in use so moisture can evaporate. This prevents the increased wear of the motor bearings.
- Press the mains power switch on the front of the right side.

7 Malfunctions and Error Correction

7.1 General Malfunctions

Malfunctions are indicated by a dialogue box. If the sound signal is activated, it sounds when the error message is displayed.

- Eliminate the source of the problem (see tables in fig. 7.1 and 7.3).
- Acknowledge the error messages by pressing the knob.

Error messages that are caused by the power circuit board are marked with a “P” in front of the error code.

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 temerature fuse (see 5.4.1 "Connection")
	Mains power switch off	Switch mains power switch on
	Lid is not closed correctly	Close lid.
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 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 dialogue box is displayed	- improper loading - Centrifuge is inclined - Drive problem - centrifuge was moved during run	Balance loading and restart the centrifuge. If the error occurs again, contact service
	- ungreased load-bearing bolts	Clean and grease load-bearing bolts
Lid cannot be opened	Lid lock has not released	Unlock the lid manually (see 7.1.1) and contact service
	Lid seal sticks	Clean the lid seal and apply talcum powder
Temperature value cannot be reached	Condenser dirty	Clean the condenser. If the error occurs again, contact service

Fig. 7.1: Possible error causes

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 (1) at the right side of the centrifuge, e.g. with a screw driver (see fig. 7.2).
- First, pull the red string to release the mechanism and then unlock the lid lock by pulling the white string.
- Then, reinsert the plug and quit the error message by switching the centrifuge off/on. Approximately 10 seconds after quitting the lid can be closed again.

The lid may only be unlocked and opened when the rotor is at a standstill.

If the lid is opened with the emergency lid release during operation, the centrifuge will be switched off immediately and decelerate without brake.

Fig. 7.2: Position of the opening for the emergency lid release

7.2 Error Codes

Error no.	Kind of error	Measure	Note
1-9	System error	• allow to slow down • power off/on	All these errors stop the centrifuge or cause it to decelerate brakeless
10-19	Speedometer error	• allow to slow down • power off/on	
20-29	Motor error	• power off/on • ensure ventilation	
30-39	EEPROM error	• allow to slow down • power off/on	With error 34, 35, 36, the centrifuge will stop; with error 37, 38 error message only
40-45	Temperature error (only for refrigerated centrifuges)	• allow to slow down • power off/on • allow to cool down • provide better ventilation	
46-49	Imbalance error	• allow to slow down • power off • eliminate the imbalance	
50-59	Lid error	• press lid key • close lid • remove foreign matter from the opening of the lid lock device	With error 50 and 51, the centrifuge will stop
60-69	Process error	• allow to slow down • power off/on	With error 60 message "power failure during run", with error 61, message "stop after power on"
70-79	Communication error	• allow to slow down • power off/on	
80-89	Parameter error	• allow to slow down • power off/on • provide for better ventilation	With error 83, error message only
90-99	Other errors	• check connections	

Fig. 7.3: Error codes

If it is impossible to eliminate the errors, contact the service (see 0)!

7.3 Service Contact

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

from Germany:

- use the service request form at www.sigma-zentrifugen.de → [Service Area]
- or contact

SIGMA Laborzentrifugen GmbH
An der Unteren Söse 50
37520 Osterode (Germany)
Tel. +49 (0) 55 22 / 50 07-84 25
Fax +49 (0) 55 22 / 50 07-94 25
E-mail: service@sigma-zentrifugen.de

outside Germany:

contact our agency in your country. All agencies are listed at www.sigma-zentrifugen.de → [Contacts] → [Foreign agencies]

- If you would like to utilise our service, please state the type of your centrifuge and its serial number.
- Make use of our service request on the Internet. Please use the request form (see above) on our website.

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.

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 the accessories.
- 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

- Disconnect the power cord from the wall outlet or instrument receptacle 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).

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).

8.1.2 Accessories

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 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. Rubber cushions should be removed, cleaned and dried.
- 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.

8.1.2.1 Plastic Accessories

The chemical resistance of plastic decreases with rising temperatures (e.g. during drying, see Resistance Data in chapter 11 "Appendix").

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

8.1.2.2 Aluminium Accessories

Especially aluminum parts are susceptible to corrosion.

- Acid-containing cleaning agents and alkaline cleaning agents must be avoided.
- Grease aluminum parts at least once a week with slushing oil for protection against corrosion (part no. 70104).

This essentially increases their service life and reduces susceptibility to corrosion.

8.1.3 Rotors, Buckets and Multiple Carriers

Rotors, buckets, and multiple carriers are produced with highest precision, in order to withstand the permanent high stress with 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 rotor, lid seal and adapters at least once a week with slushing oil (part no. 70104).
- Grease the rotor tie-down screw after cleaning with grease for load-bearing bolts (part no. 70284).

8.1.4 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 the buckets after each cleaning.

8.1.5 Glass Breakage

- 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. anodizing) 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.

<u>In order to completely remove the glass particles and the metal dust from the rotor chamber:</u>

- 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 (approximately. 2,000 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.

8.1.6 Condenser

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. 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 0 "Service Contact").

8.2 Sterilization and Disinfection of the Rotor Chamber and Accessories

- Use commercially-available disinfectants such as, for example, Sagrotan®, Buraton®, or Terralin® (available at chemist's shops or drugstores).
- The centrifuges 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 8.2.1 "Autoclaving").

Please contact us if you have any queries. (see 0 "Service Contact").

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 color 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.

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

Accessories	max. temp. (°C)	min. time	max. time	max. cycles
Glass tubes	134-138	3	40	-
Polycarbonate tubes	115-118	30	40	20
Polypropylene copolymer tubes	115-121	30	40	30
Teflon tubes	134-138	3	5	100
Aluminium rotors	134-138	3	20	-
Polycarbonate/Polyallomer lids for angle rotors	115-118	30	40	20
Polysulfone lids for angle rotors	134-138	3	5	100
Aluminium buckets	134-138	3	20	-
Polysulfone caps for buckets	134-138	3	5	100
Rubber adapter	115-118	30	40	-
Round carriers made of polypropylene	115-118	30	40	-
ditto, made of polyallomer and polycarbonate	115-118	30	40	-
Rectangular carriers made of polypropylene	115-118	30	40	-
ditto, made of polyallomer and polycarbonate	115-118	30	40	-

Fig. 8.1: Autoclaving table

8.3 Service

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 or a maximum of 15,000 cycles.

Information and appointments:

in Germany:

- use the service request form at www.sigma-zentrifugen.de → [Service Area]
- or contact

SIGMA Laborzentrifugen GmbH
An der Unteren Söse 50
37520 Osterode (Germany)
Tel. +49 (0) 55 22 / 50 07-84 25
Fax +49 (0) 55 22 / 50 07-94 25
E-mail: service@sigma-zentrifugen.de

outside Germany:

contact our agency in your country. All agencies are listed at www.sigma-zentrifugen.de → [Contacts] → [Foreign agencies]

Info

- If you would like to utilise our service, please state the type of your centrifuge and its serial number.
- Make use of our service request on the Internet. Please use the request form (see above) on our website.

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, and enclose them with the return package:

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.

Info

If no such declaration is enclosed in the return package, we will perform the decontamination at your expense!

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.

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 dispose of the parts or to return them to you both at your expense.

- Please note on the form if you would like to receive a cost estimate. Cost estimates are only prepared upon request and against charge. If an order is placed, these charges will be offset.

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 → [Service Area].

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 trash.

- You can return these centrifuges free of cost to SIGMA Laborzentrifugen GmbH.
- Ensure that the unit is decontaminated. Fill in a declaration of decontamination.
- 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

Manufacturer:	S I G M A Laborzentrifugen GmbH An der Unteren Söse 50 37520 Osterode (Germany)
Type:	2-16KC
Electr. Connection: Protection class: IP Code:	see name plate I 20
Connected load (kVA): Power consumption (kW): Max. current consumption (A):	1,05 0,72 4.0 (at 220-240 V / 50-60 Hz) 8.0 (at 120 V / 60 Hz)
Performance data Max. speed (rpm): Max. capacity (ml): Max. gravitational field (x g): Max. kin. energy (Nm):	 15 300 400 21 918 9 962
Other parameters Time range: Temperature range: Heater (Special equipment): Storage locations:	 short run, continuous run, 10 sec – 9 h 59 min -20 to +40°C -20 to +60°C 50
Physical data Height (mm): Height with opened lid (mm) : Width (mm): Depth (mm): Weight (kg): EMC as per EN 61326: Noise level (dBA):	 320 700 550 570 60 Class B < 65 (at max. speed)

Fig. 10.1: Technical Data

10.1 Ambient Conditions

- The figures are valid for an ambient temperature of +23°C ± 2 °C and a nominal voltage ± 10 %*. The minimum temperature is < +4 °C and depends on the rotor type, speed, and ambient temperature.
- Allowable ambient temperature +5°C to +35°C.
- Max. relative humidity of air 80% up to 31°C with a linear decrease to 67% relative humidity of air at 35°C.
- Special equipment Heater: In order to reach the stated final temperature, the rotor and buckets must be preheated by running at approximately 1,500 rpm. The maximum rotor temperature that can actually be reached is 40-60°C, depending on the rotor and speed.

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

11 Appendix

11.1 Suitable Accessories

Part no.	Description	Max. speed (rpm)	Max. gravitational field (x g)
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 radius max. 7.4 cm, radius min. 3.5 cm	14 000	16 215
11409	Microhematocritrotor 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, radius max. 9 cm, radius min. 1.5 cm	12 000	14 489
15001	Microhematocrite capillary tubes, heparinized, Ø 1.5 x 75 mm, 50 µl, 200 pcs. per pack		
17005	Capillary tube sealing putty (10 plates)		
17002	Reader for use with microhematocritrotor		
17029	Card reader for 1 capillary tube		
17004	Magnifying glass		
12139	Angle rotor 6 x 30 ml, for tubes no. 15029, 15030, 15032, incl. hermetic aluminium lid no. 17851, radius max. 7.8 cm, radius min. 2.2 cm, angle 30° **Attention!** Rotors from batch no. 201/00 can be operated with lid, rotors of older batches (e.g. 15/00 or ../99) must be inserted only without lid.	15 300	20 414
12141	Angle rotor 10 x 10 ml, for tubes no. 15000, 15010, 15039, incl. hermetic aluminium lid no. 17850, radius max. 7.6 cm, radius min. 2.9 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, radius max. 8.2 cm, radius min. 5 cm, angle 45°	15 300	21 460
12132	Angle rotor 30 x 1.5/2.0 ml, for e.g. reaction vials no. 15008, 15040, incl. hermetic aluminium lid no. 17849, radius max. 10 cm, radius min. 6.7 cm, angle 45°	14 000	21 913
12104	Angle rotor, for 12 PCR-strips with 8 tubes 0.2 ml, e.g no. 15042, incl. hermetic aluminium lid no. 17867, radius max. 9,8 cm, radius min. 7,2 cm, angle 45°	14 000	15 777 / 21 475
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, radius max. 13.9 cm, radius min. 8 cm, angle 33°	3 900	2 364

Part no.	Description	Max. speed (rpm)	Max. gravitational field (x g)
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° radius max. 13.9 cm, radius min. 8 cm, radius max. 11,6 cm, radius min. 5.8 cm	 3 900 3 900	 2 364 1 973
12071	Angle rotor for 12 x 15 ml culture, e.g. no. 15115 and 6 x 50 ml culture e.g no. 15151 angle 35°, radius max. 50 ml: 10.2 cm radius max. 15 ml: 12.6 cm	 4 000 4 000	 1 825 2 253
12151	Angle rotor for 6 x 50 ml culture, e.g no. 15151, incl. hermetic aluminium lid no. 17862, radius max. 9.5 cm, radius min. 3 cm, angle 28°	9 000	8 603
13060	Adapter for 1 culture tube 15 ml no. 15115, suitable for 12151, 13150, 19776, 1 set = 2 pcs.		
13079	Bottomadapter for 1 tube 50 ml, e.g. no. 15051, 15052, 15054, 1 set = 2 pcs.		
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, radius max. 13.5 cm, radius min. 5 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, 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; 13041 and 13152 for rotors from the year 2003 onwards only	5 000	3 773 / 3 745

Buckets and multiple carriers for 11192

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.		
13012	Multiple carrier for 4 tubes 5 - 15 ml, incl. rubber cushion no. 16015, max. Ø 17/19 x 90 - 105 mm, e.g no. 15015, 15020, 15023, 15024, Monovettes 9 - 10 ml incl. rubber cushion no. 16015, 07-2004: 15000, 15010, 15039, vacutainer tubes, 1 set = 2 pcs.		
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.		
17925	Adapter for 1 glass tube 25 ml no. 15025, 15026, 1 set = 2 pcs.		

Part no.	Description	Max. speed (rpm)	Max. gravitational field (x g)
17950	Adapter for 1 tube 50 ml no. 15049, 15050, 15056, 1 set = 2 pcs.		
13041	Round bucket for round carriers Ø 43.5 mm, no. 14029, 14030, 14031, 14032, 14033, 14034, 14035, incl. polysulfone screw cap no. 17130, max. tube length 110 mm, 1 set = 2 pcs.		
14028	Round carrier for 4 reaction vials 1.5/2.0 ml, max. Ø 11 mm, e.g. no. 15008, 15040, 1 set = 2 pcs.		
14029	Round carrier for 5 round bottom tubes approx. 7 ml, max. Ø 12,5/15 x 45 - 105 mm, e.g. no. 15007, 15027, Ria tube 15060, hemolyse 1 set = 2 pcs.		
14033	Round carrier for 4 round bottom tubes 5 - 7 ml, max. Ø 13.5/17.5 x 70 - 110 mm, e.g. no. RIA tube 15060, hemolyse, vacutainer, 1 set = 2 pcs.		
14034	Round carrier for 3 round bottom tubes approx. 15 ml, max. Ø 17.3/19 x 80 - 110 mm, e.g. no. 15015, 15020, 15022, 15023, 15024, or Monovettes 9 - 10 ml, 1 set = 2 pcs.		
14030	Round carrier for 4 round bottom tubes 10 - 15 ml, max. Ø 16.2/17.5 x 80 - 110 mm, e.g. no. 15000, 15010, 15015, 15024, 15039, 1 set = 2 pcs.		
14031	Round carrier for 1 round bottom tube 25 - 30 ml, max. Ø 25.3/30 x 70 - 105 mm, e.g. no. 15025, 15026, 15029, 15030, 15032, 15033, 1 set = 2 pcs.		
14035	Round carrier for 1 tube 30 ml, flat bottom or skirt, max. Ø 25/31 x 65 - 95 mm, e.g. Sterilin tube 30 ml, Barloworld Scientific Ltd., 1 set = 2 pcs.		
14032	Round carrier for 1 round bottom tube 50 ml, max. Ø 35/38 x 70 - 105 mm, e.g. no. 15049, 15050, 15056, 1 set = 2 pcs.		
17130	Round polysulfone sealing cap, clear, 1 set = 2 pcs.		
13150	Bucket incl. polysulfone screw cap no. 17151 for 1 culture tube 50 ml, e.g. no. 15151, 1 set = 2 pcs., radius max. 14.4 cm, radius min. 4.3 cm	5 000	4 024
17151	Round polysulfone sealing cap, clear, 1 set = 2 pcs.		
13060	Adapter for 1 culture tube 15 ml no. 15115, 1 set = 2 pcs.		
13152	Multiple carrier for 2 culture tubes 15 ml, e.g. no. 15115, 1 set = 2 pcs., radius max. 14.3 cm, radius min. 3.3 cm	5 000	3 996
11122	Swing-out rotor for microtiter plates, incl. 1 set carriers no. 13222 radius corner 12.3 cm, radius max. 10.5 cm, radius min. 6.5 cm, max. height of plates 56 mm	3 000	1 238 1 057 654

Part no.	Description	Max. speed (rpm)	Max. gravitational field (x g)
11123	Swing-out rotor for microtiter plates, incl. 1 set carriers no. 13223 radius corner 11.9 cm, radius max. 10 cm, radius min. 6.5 cm max. height of plates 50 mm	 4 000	 2 129 1 789 1 163

Adapters, steel tubes and plastic tubes

Part no.	Description
13000	Adapter for reaction vials 0.25/0.4 ml no. 15014, suitable for 11124, 12132, 12148, 1 set = 2 pcs.
13002	Adapter for reaction vials 0.5/0.75 ml, Ø 7.9/10 x 28/31 mm, e.g. no. 15005, suitable for 11124, 12132, 12148, 1 set = 2 pcs.
13021	Adapter for PCR-tube 0.2 ml, e.g no. 15042, suitable for 11124, 12132, 12148, 1 set = 2 pcs.
15014	Reaction vials made of polypropylene 0.4 ml, 100 pcs. per pack, suitable for 13000
15005	Reaction vials 0.5 ml, 100 pcs. per pack, suitable for 13002
15008	Reaction vials 1.5 ml, 100 pcs. per pack, suitable for 11124, 12132, 12148
15040	Reaction vials 2.0 ml, 100 pcs. per pack, suitable for 11124, 12132, 12148
15010	Polycarbonate tube 10 ml, Ø 16.1 x 81.1 mm,incl. screw cap, suitable for 12141, 13059
15000	Polyfluor tube 10 ml, Ø 16.1 x 81.1 mm, incl. screw cap, suitable for 12141, 13059
15039	Polypropylene Co-Polymer (PPCO) tube 10 ml, Ø 16.1 x 81.1 mm, incl. screw cap, suitable for 12141, 13059
15020	Polystyrene tube 14 ml, Ø 17 x 100 mm, max. 4.500 x g, suitable for 11191, 12072, 12073, 13012, 14034
15021	Polypropylene stopper for tubes no. 15020, 15023
15023	Polypropylene Co-Polymer (PPCO) tube 14 ml, Ø 17 x 100 mm, suitable for 12072, 12073, 13012, 14034
15115	Culture tube Nunc, 15 ml, pointed bottom, polypropylene, incl. screw cap Ø 23 mm, suitable for 12072, 12073, 13060
15029	Polyfluor tube 28 ml, Ø 25.3 x 96 mm, incl. screw cap, suitable for 12139
15030	Polycarbonate tube 30 ml, Ø 25.3 x 98 mm, incl. screw cap,, suitable for 12139, 14031
15032	Polypropylene Co-Polymer (PPCO) tube 27 ml, Ø 25.3 x 97 mm, incl. screw cap, suitable for 12139, 14031
13079	Bottomadapter for 1 tube 50 ml, e.g. no. 15051, 15052, 15054, suitable for 12151, 1 set = 2 pcs.
15049	Polycarbonate tube 65 ml, Ø 34 x 100 mm, graduated 1 up to 50 ml in 1 ml increments, suitable for 13047, 17950
15051	Polyfluor tube 38 ml, Ø 28.5 x 107 mm, incl. screw cap, suitable for 13079
15052	Polypropylene Co-Polymer (PPCO) tube 42 ml, Ø 28.8 x 107 mm, incl. screw cap, suitable for 13079

Part no.	Description
15054	Polycarbonate tube 42 ml, Ø 28.8 x 107 mm, incl. screw cap, suitable for 13079
15151	Culture tube Nunc, 50 ml, pointed bottom, polypropylene, incl. screw cap, suitable for 12151, 13150
15102	Polypropylene tube 120 ml, Ø 45 x 100 mm, suitable for 13097
15103	Polycarbonate tube 110 ml, Ø 45 x 100 mm, graduated 2 up to 100 ml in 2 ml increments, suitable for 13097

Centrifuge Glass Tubes

15007	Centrifuge glass tube 6 ml, max. 4.000 x g, Ø 12 x 100 mm, suitable for 13004, 14029
15027	Centrifuge glass tube 7 ml, max. 4.000 x g, Ø 12 x 100 mm, graduated 1 up to 7 ml in 0.5 ml increments, suitable for 13004, 14029
15015	Centrifuge glass tube 10 - 12 ml, max. 4.000 x g, Ø 16 x 100 mm, suitable for 12072, 12073, 13012, 14030
15024	Centrifuge glass tube 12 ml, max. 4.000 x g, Ø 16 x 100 mm, graduated 0.1 ml up to 10 ml in 0.1 ml increments, suitable for 12072, 12073, 13012, 14030
15025	Centrifuge glass tube 26 ml, max. 4.000 x g, Ø 24 x 100 mm, suitable for 13022, 14031, 17925
15026	Centrifuge glass tube 27 ml, max. 4.000 x g, Ø 24 x 100 mm, graduated 2 up to 25 ml in 0.5 ml increments, suitable for 13022, 14031, 17925
15050	Centrifuge glass tube 58 ml, max. 4.000 x g, Ø 34 x 100 mm, suitable for 13047, 14032, 17950
15056	Centrifuge glass tube 58 ml, max. 4.000 x g, Ø 34 x 100 mm, graduated 2 up to 50 ml in 2 ml increments, suitable for 13047, 14032, 17950
15100	Centrifuge glass tube 100 ml, max. 4.000 x g, Ø 44 x 100 mm, suitable for 11190, 13097
15106	Centrifuge glass tube 97 ml, max. 4.000 x g, Ø 44 x 100 mm, graduated 1 up to 97 ml in 1 ml increments, suitable for 11190, 13097

Further accessories available upon request.

11.2 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 adapterss 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-strengh glass tubes;please refer to the information provided by the manufacturer).

11.3 Grafical Representation of the Rotors

The graphical representation of the rotors shows the maximum and minimum radii of the accessories used. If necessary, the values must be manually calculated (see 11.4.1 "RCF“, page 62).

Fig 11.1:

Minimum and maximum radius of a swing-out rotor

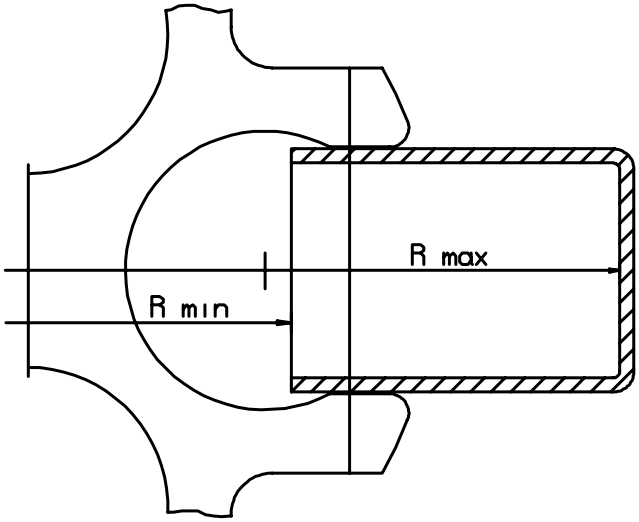
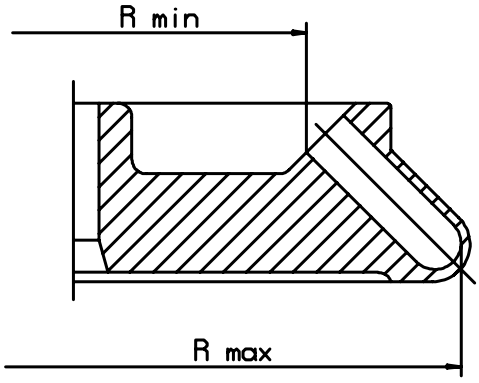


Fig. 11.2:

Minimum and maximum radius of an angle rotor



11.4 Acceleration and Deceleration Curves

11.3.1 Linear Curves

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

Linear as well as quadratic 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.

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

Linear slope (curves 0 - 9)

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.

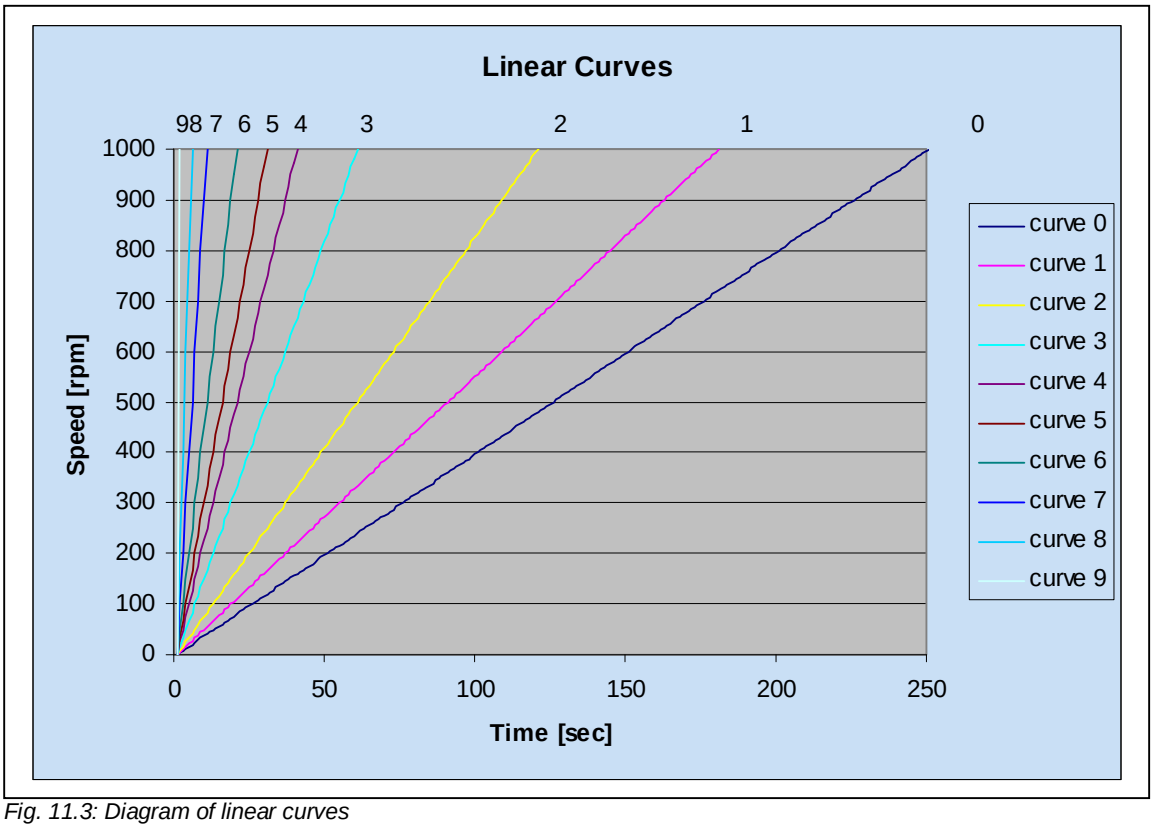


Fig. 11.3: Diagram of linear curves

Linear curve no.	Slope
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	1000 [rpm / sec]

Fig. 11.4: Slope of linear curves

11.3.2 Quadratic Curves

The deceleration curves are inverted images of the acceleration curves and are assigned the same numbers.

Quadratic slope (curves 10 - 19)

Curve 19 is a special case compared to the other curves. The centrifuge accelerates with maximum power. The runtime depends solely on the moment of inertia of the rotor.

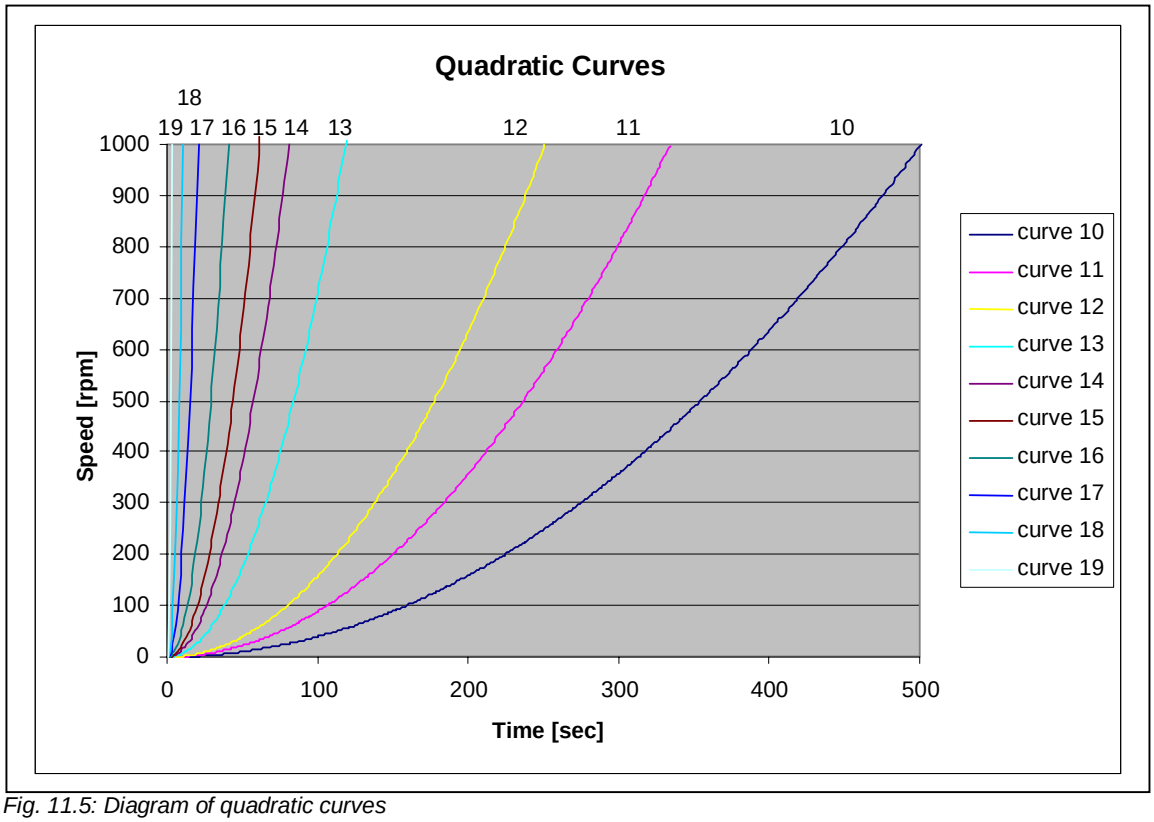


Fig. 11.5: Diagram of quadratic curves

Quadratic curve no.	Time until 1,000 rpm	Slope as of 1,000 rpm
10	500 sec	4 [rpm / sec]
11	333 sec	6 [rpm / sec]
12	250 sec	8 [rpm / sec]
13	118 sec	17 [rpm / sec]
14	80 sec	25 [rpm / sec]
15	60 sec	33 [rpm / sec]
16	40 sec	50 [rpm / sec]
17	20 sec	100 [rpm / sec]
18	10 sec	200 [rpm / sec]
19	2 sec	1000 [rpm / sec]

Fig. 11.6: Slope of quadratic curves

11.5 Formulae - Mathematical Relations

11.4.1 Relative Centrifugal Force (RCF)

The parameters speed, RCF, and the group rotor and radius cannot be specified independently. They are interrelated via the following formula:

$$RCF = 11.18 \times 10\text{-}6 \times r \times n2$$

If two values are given, the third value is determined by the equation. If then the speed or the rotation radius is changed, the resulting RCF will be recalculated. If the RCF is altered, the speed will be adapted accordingly under the consideration of the radius.

r = radius in cm

n = speed in rpm

RCF without dimension

11.4.2 Density

If the density of the liquid is higher than 1.2 g/cm3, the maximum permissible speed of the centrifuge is calculated according to the following formula:

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

Rho = density in g/cm3

11.4.3 Speed-Gravitational-Field-Diagram

Additional help can be found in the enclosed speed-gravitational-field-diagram (see fig. 11.7, next page).

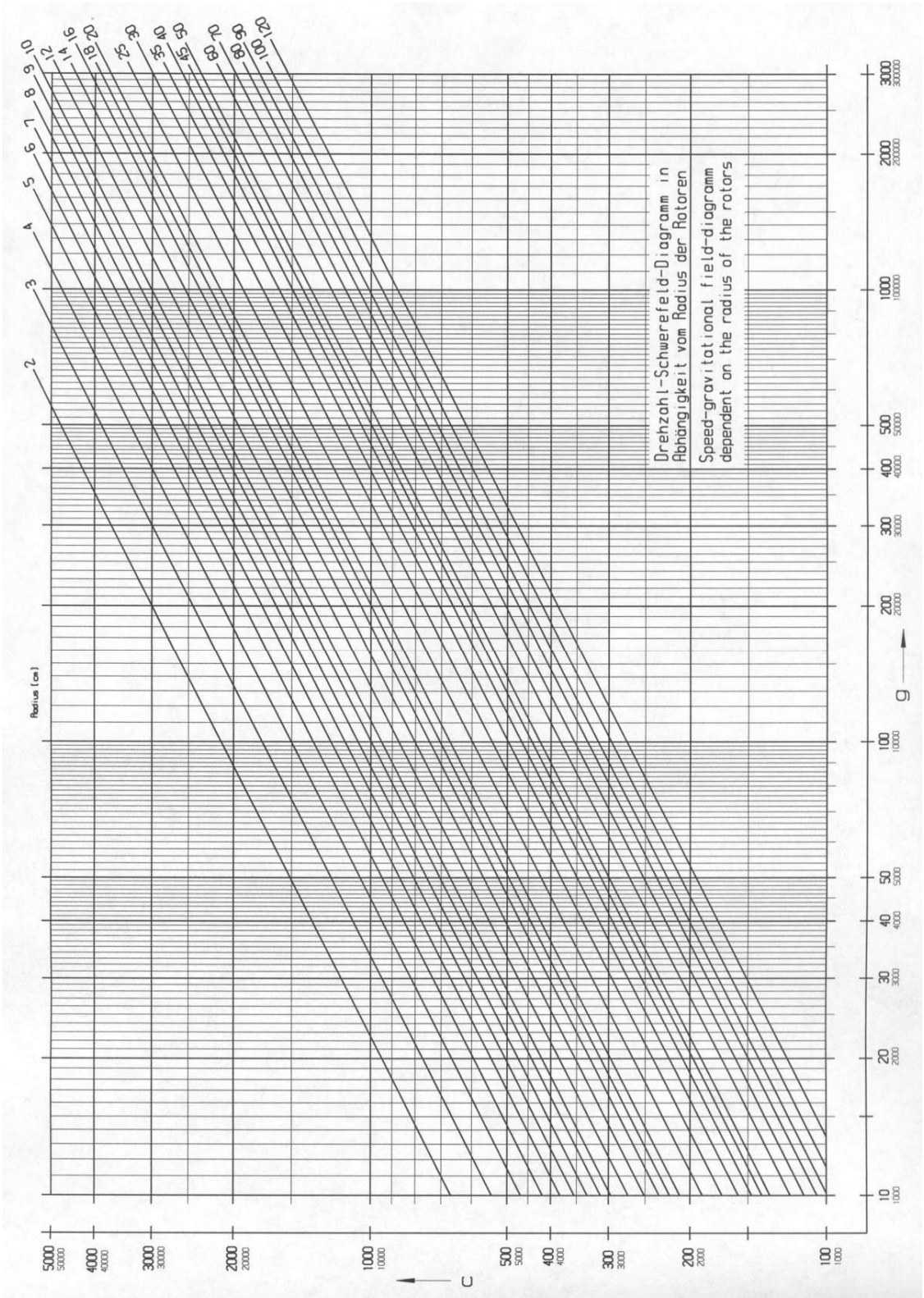


Fig. 11.7: Speed-Gravitational-Field Diagram

Rotors and accessories with a different service life

If other no data concerning the service life are engraved on the rotor or accessory, rotors and buckets must be checked by the manufacturer after 10,000 cycles. After 50,000 cycles, rotors must be scrapped for safety reasons.

Rotor / bucket	Cycles	Service life ("Exp.Date")	Autoclaving	Suitable for centrifuge	Remarks
11026		7 years		1-14, 1-14K	
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	
9100	15,000			4-15C, 4K15C, 4-16, 4-16K, 6-15, 6K15, 6-16, 6-16K	without engraving, only "spincontrol professional"
12500		7 years		6-15, 6K15, 6-16, 6-16K	
13218	20,000			4-16, 4-16K, 6-16, 6-16K	
13845	20,000			8K	
13850	10,000			8K	
13860	35,000			8K	
13864	1,000			8K	without engraving
13865	1,000			8K	without engraving

Resistance Data

Resistant at +20 °C

- no data 1 resistant 2 practically resistant 3 partially resistant 4 not resistant		Concentration	High Density Polyethylene	Polyamide	Polycarbonate	Polyoxymethylene	Polypropylene	Polysulfone	Polyvinyl chloride, hard	Polyvinyl chlorid, weak	Polytetrafluorethylene	Aluminum
Medium	**Formula**	**[%]**	**HDPE**	**PA**	**PC**	**POM**	**PP**	**PSU**	**PVC**	**PVC**	**PTFE**	**AL**
Acetaldehyde	C_2H_4O	40	3	2	4	2	3	4	4	-	1	1
Acetamide	C_2H_5NO	saturated	1	1	4	1	1	4	4	-	1	1
Acetone	C_3H_6O	100	1	1	4	1	1	4	4	-	1	1
Acrylonitrile	C_3H_3N	100	1	1	4	3	3	4	4	4	1	1
Allyl alcohol	C_3H_6O	96	1	3	3	2	2	2	2	4	1	1
Aluminum chloride	$AlCl_3$	saturated	1	3	2	4	1	-	1	-	1	4
Aluminum sulfate	$Al_2(SO_4)_3$	10	1	1	1	3	1	1	1	1	1	1
Ammonium chloride	$(NH_4)Cl$	aqueous	1	1	1	2	1	1	1	1	1	3
Ammonium hydroxide	$NH_3 + H_2O$	30	1	3	4	1	1	2	1	-	1	1
Aniline	C_6H_7N	100	1	3	4	1	2	4	4	4	1	1
Anisole	C_7H_8O	100	3	4	4	1	4	4	2	-	1	1
Antimony trichloride	$SbCl_3$	90	1	4	1	4	1	-	1	-	1	4
Benzaldehyde	C_7H_6O	100	1	3	4	1	1	3	4	4	1	1
Benzene	C_6H_6	100	3	2	4	1	3	4	4	-	1	1
Boric acid	H_3BO_3	aqueous	1	3	1	2	1	-	-	-	1	1
Butyl acrylate	$C_7H_{12}O_2$	100	1	2	4	2	3	4	4	4	1	1
Butyl alcohol, normal	$C_4H_{10}O$	100	1	1	2	1	1	2	2	4	1	1
Calcium chloride	$CaCl_2$	alcoholic	1	4	2	3	1	-	-	4	1	3
Carbon disulfide	CS_2	100	4	3	4	2	4	4	4	4	1	1
Carbon tetrachloride (TETRA)	CCl_4	100	4	4	4	2	4	4	4	4	1	1
Chlorine	Cl_2	100	4	4	4	4	4	4	4	4	1	3
Chlorine water	$Cl_2 \times H_2O$		3	4	4	4	3	-	3	3	1	4
Chlorobenzene	C_6H_5Cl	100	3	4	4	1	3	4	4	4	1	1
Chloroform	$CHCl_3$	100	3	3	4	4	3	4	4	4	1	3
Chromic acid	CrO_3	10	1	4	2	4	1	4	1	-	1	1
Chromic potassium sulfate	$KCr(SO_4)_2 \times 12H_2O$	saturated	1	2	1	3	1	-	1	-	1	3
Citric acid	$C_6H_8O_7$	10	1	1	1	2	1	1	1	1	1	1
Citric acid	$C_6H_8O_7$	50	1	3	1	2	1	-	-	-	1	1
Copper sulfate	$CuSO_4 \times 5H_2O$	10	1	1	1	1	1	1	1	1	1	4
Cyclohexanol	$C_6H_{12}O$	100	1	1	3	1	1	1	1	4	1	1
Decane	$C_{10}H_{22}$	100	-	1	2	1	3	-	-	-	1	1
Diaminoethane	$C_2H_8N_2$	100	1	1	3	1	1	-	3	4	1	1
Diesel fuel	—	100	1	1	3	1	1	-	1	3	1	1
Dimethyl formamide (DMF)	C_3D_7NO	100	1	1	4	1	1	4	3	-	1	1
Dimethyl sulfoxide (DMSO)	C_2H_6SO	100	1	2	4	1	1	4	4	-	1	1
Dimethylaniline	$C_8H_{11}N$	100	-	3	4	2	4	-	-	-	1	1

Resistant at +20 °C

- no data 1 resistant 2 practically resistant 3 partially resistant 4 not resistant		Concentration	High Density Polyethylene	Polyamide	Polycarbonate	Polyoxymethylene	Polypropylene	Polysulfone	Polyvinyl chloride, hard	Polyvinyl chlorid, weak	Polytetrafluorethylene	Aluminum
Medium	**Formula**	**[%]**	**HDPE**	**PA**	**PC**	**POM**	**PP**	**PSU**	**PVC**	**PVC**	**PTFE**	**AL**
Dioxane	$C_4H_8O_2$	100	2	1	4	1	3	2	3	4	1	1
Dipropylene glycol (mono)methyl ether	$C_4H_{10}O$	100	3	1	4	1	4	4	4	4	1	1
Ethyl acetate	$C_4H_8O_2$	100	1	1	4	1	1	4	4	4	1	1
Ethylene chloride	$C_2H_4Cl_2$	100	3	3	4	1	3	4	4	4	1	1
Ferrous chloride	$FeCl_2$	saturated	1	3	1	3	1	1	1	1	1	4
Formaldehyde solution	CH_2O	30	1	3	1	1	1	-	-	-	1	1
Formic acid	CH_2O_2	100	1	4	3	4	1	3	3	1	1	1
Furfural	$C_5H_4O_2$	100	1	3	3	2	4	-	-	-	1	1
Gasoline	C_5H_{12} - $C_{12}H_{26}$	100	2	1	3	1	3	3	2	-	1	1
Glycerol	$C_3H_8O_3$	100	1	1	3	1	1	1	1	2	1	1
Heptane, normal	C_7H_{16}	100	2	1	1	1	2	1	2	4	1	1
Hexane, n-	C_6H_{14}	100	2	1	2	1	2	1	2	4	1	1
Hydrogen chloride	HCl	5	1	4	1	4	1	1	1	-	1	4
Hydrogen chloride	HCl	concentrated	1	4	4	4	1	1	2	3	1	4
Hydrogen peroxide	H_2O_2	3	1	3	1	1	1	1	1	-	1	3
Hydrogen peroxide	H_2O_2	30	1	4	1	4	1	1	1	-	1	3
Hydrogen sulfide	H_2S	10	1	1	1	1	1	1	1	3	1	1
Iodine, tincture of	I_2		1	4	3	1	1	-	4	4	1	1
Isopropyl alcohol	C_3H_8O	100	1	1	1	1	1	1	1	4	1	2
Lactic acid	$C_3H_6O_3$	3	1	3	1	2	1	1	2	-	1	1
Magnesium chloride	$MgCl_2$	10	1	1	1	1	1	1	1	1	1	1
Mercuric chloride	$HgCl_2$	10	1	4	1	3	1	1	1	1	1	4
Mercury	Hg	100	1	1	1	1	1	1	1	3	1	3
Methyl acetate	$C_3H_6O_2$	100	1	1	4	2	1	-	4	4	1	1
Methyl alcohol	CH_4O	100	1	2	4	1	1	3	1	3	1	1
Methyl benzene	C_7H_8	100	3	1	4	1	3	4	4	4	1	1
Methyl ethyl ketone (MEK)	C_4H_8O	100	1	1	4	1	1	4	4	4	1	1
Methylene chloride	CH_2Cl_2	100	4	3	4	3	3	4	4	4	1	1
Mineral oil	—	100	1	1	1	1	1	1	1	-	1	1
Nitric acid	HNO_3	10	1	4	1	4	1	1	1	-	1	3
Nitric acid	HNO_3	100	4	4	4	4	4	-	4	-	1	1
Nitrobenzene	$C_6H_5NO_2$	100	3	4	4	3	2	4	4	4	1	1
Oleic acid	$C_{18}H_{34}O_2$	100	1	1	1	2	1	-	1	-	1	1
Oxalic acid	$C_2H_2O_4 \times 2H_2O$	100	1	3	1	4	1	1	1	1	1	1
Ozone	O_3	100	3	4	1	4	3	1	1	-	1	2
Petroleum	—	100	1	1	3	1	1	1	1	3	1	1
Phenol	C_6H_6O	10	1	4	4	4	1	4	1	3	1	1
Phenol	C_6H_6O	100	2	4	4	4	1	3	4	3	1	1
Phosphoric acid	H_3PO_4	20	1	4	2	4	1	-	-	-	1	4
Phosphorus pentachloride	PCl_5	100	-	4	4	4	1	-	4	4	1	1

Resistant at +20 °C

- no data
1 resistant
2 practically resistant
3 partially resistant
4 not resistant

Medium	Formula	Concentration [%]	High Density Polyethylene HDPE	Polyamide PA	Polycarbonate PC	Polyoxymethylene POM	Polypropylene PP	Polysulfone PSU	Polyvinyl chloride, hard PVC	Polyvinyl chlorid, weak PVC	Polytetrafluorethylene PTFE	Aluminum AL
Potassium hydrogen carbonate	$CHKO_3$	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_3	10	1	1	1	1	1	-	-	-	1	1
Potassium permanganate	$KMnO_4$	100	1	4	1	1	1	-	1	-	1	1
Pyridine	C_5H_5N	100	1	1	4	1	3	4	4	4	1	1
Resorcinol	$C_6H_6O_2$	5	1	4	2	3	1	4	2	-	1	2
Silver nitrate	$AgNO_3$	100	1	1	1	1	1	1	1	1	1	4
Sodium bisulfite	$NaHSO_3$	10	1	1	2	4	1	-	-	-	1	1
Sodium carbonate	Na_2CO_3	10	1	1	1	1	1	-	-	-	1	3
Sodium chloride	NaCl	30	1	1	1	1	1	1	1	1	1	3
Sodium hydroxide	NaOH	30	1	1	4	1	1	1	1	1	1	4
Sodium hydroxide	NaOH	50	1	1	4	1	1	1	1	-	1	4
Sodium sulfate	Na_2SO_4	10	1	1	1	1	1	1	1	1	1	1
Spirits	C_2H_6O	96	1	1	1	1	1	1	1	3	1	1
Styrene	C_8H_8	100	4	1	4	1	3	-	4	4	1	1
Sulfuric acid	H_2SO_4	6	1	4	1	4	1	1	1	-	1	3
Sulfuric acid	H_2SO_4	fuming	4	4	4	4	4	4	4	4	1	3
Tallow	—	100	1	1	1	1	1	-	1	1	1	1
Tetrahydrofuran (THF)	C_4H_8O	100	3	1	4	1	3	4	4	4	1	1
Tetrahydronaphthalene	$C_{10}H_{12}$	100	3	1	4	1	4	4	4	4	1	1
Thionyl chloride	Cl_2SO	100	4	4	4	2	4	4	4	4	1	3
Transformer oil	—	100	1	1	3	3	1	1	1	-	1	1
Trichloroethane	$C_2H_3Cl_3$	100	3	3	4	2	4	4	4	4	1	4
Urea	CH_4N_2O	10	1	1	1	1	1	-	-	-	1	1
Urine	—	100	1	1	1	1	1	-	1	1	1	2
Vinegar	$C_2H_4O_2$	10	1	4	1	1	1	1	1	1	1	1
Vinegar	$C_2H_4O_2$	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_8H_{10}	100	3	1	4	1	4	4	4	4	1	1
Zinc chloride	$SnCl_2$	10	1	4	2	2	1	-	-	-	1	4

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.

Product name:	Laboratory Centrifuge
Product type:	Sigma 2-16KC
	Sigma 2-16KCH
Order number:	10167, 10168, 10169, 10170, 10171
Directives:	2006/42/EG Machinery Directive
	2006/95/EG Low Voltage Directive
	2004/108/EG EMC Directive
Normes:	EN 61010-2-020:2006
	EN 61000-3-2:2006, A1:2009, A2 :2009
	EN 61000-3-3:2008
	EN 61326-1:2006

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Osterode, 01.09.2011

Michael Sander
General Manager

12 Index

Info

Pay attention to the detailed Operating Manual, especially to the safety instructions in chapter 3!

1 Lid
2 Function knob
3 Display
4 Lid key
5 Stop key
6 Start key
7 Mains power switch

Total view of the centrifuge

8 Name plate
9 Mains power input
10 Equipotential bonding screw

Rear view of the centrifuge

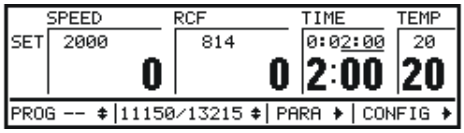
1. Before the initial start-up, please ensure that your centrifuge is properly set up and installed (see chapter 5).

2. Press the mains power switch on the right side of the front to switch on the centrifuge.

3. Open the lid and install the rotor according to the detailed operating instructions (see chapter 6.2.2).

4. Close the lid.

5. Enter run parameters:

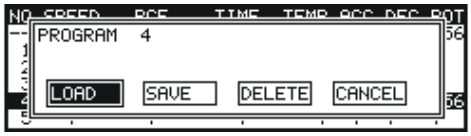


Manual Mode

- Select a parameter by pressing or turning the function knob. The selected field will be inverted.
- Press the function knob in order to activate the modification mode. "SET" and the selected area will be inverted.
- Turn the function knob until the desired value is displayed.
- Press the function knob to confirm the selected value and to quit the modification mode. "SET" and the selected area will be deactivated.

Program Mode

- Select the program field ("PROG-") and confirm the selection.
- Turn the knob. As a result, all of the programs that have already been saved and the current ("--") setting will be displayed one after the other.
- Select a program and confirm the selection. A dialog box will be displayed.
- Select "LOAD" and confirm the selection.



6. Press the start key to start a centrifugation run.

7. Parameter values can be modified during the centrifugation run as described under "Manual Mode" in this document.

8. The centrifugation run can be interrupted at any time by pressing the stop key.