

Refrigerated Centrifuge

1 K 15 OPERATING MANUAL

Dear customer,

Congratulations for purchasing a SIGMA laboratory centrifuge. You have selected a device which combines many advantages.

A wide spectrum of programming options and an electronic operation control allow a trouble-free use of the centrifuge. With its 3-phase drive, maintenance-free quiet operation without any carbon dust pollution is guaranteed.

Your device is equipped with user-friendly options which make the operation and standard settings easier for you. Built-in error-detecting functions keep the user from entering incorrect values and check the complete operation.

A special advantage is the storage capacity the centrifuge offers. The instrument has a program memory and is capable of keeping the last run program in its memory for an unlimited amount of time allowing the program to be restarted at any time - even if the centrifuge was turned off in between.

All settings are executed via the control panel the coated surface of which offers a clear arrangement and protects the device against moisture and dust at the same time. In addition, the interior of the centrifuge is also easy to clean. With that we are able to offer you a device that combines functional variety with practical applications.

We thank you for your confidence and wish you a successful application of the centrifuge

SIGMA Laborzentrifugen GmbH
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Hausadresse:
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Sigma Laborzentrifugen GmbH
An der Unteren Söse 50
D-37520 Osterode-Petershütte



Ihre Nachricht
Your letter

Ihre Zeichen
Your ref

Unsere Zeichen
Our ref.

Tel. Durchwahl 055 22 - 50 07 -
Direct line

Tag
Date

js-wg

25

24.08.95

Service-Bulletin for SIGMA 1K 15 based on some single events in the field

We have introduced a minor modification to the SIGMA 1K 15 centrifuge.

Investigations have shown that under certain environmental conditions,

especially high ambient temperature,
and high humidity,

and if the customer is running the instrument on a low preselected temperature, there is the risk of condensating water accumulating under the base plate of the barrier ring and dripping into the housing of the instrument. In some events the water drops have hit the power board and caused a short.

To avoid such events in future, we have added a dripping guard which is part of all new SIGMA 1K 15 centrifuges as of today.

For retrofit purposes in the field, we are shipping the necessary parts to your attention. We would recommend to retrofit with the next available service to the customer.

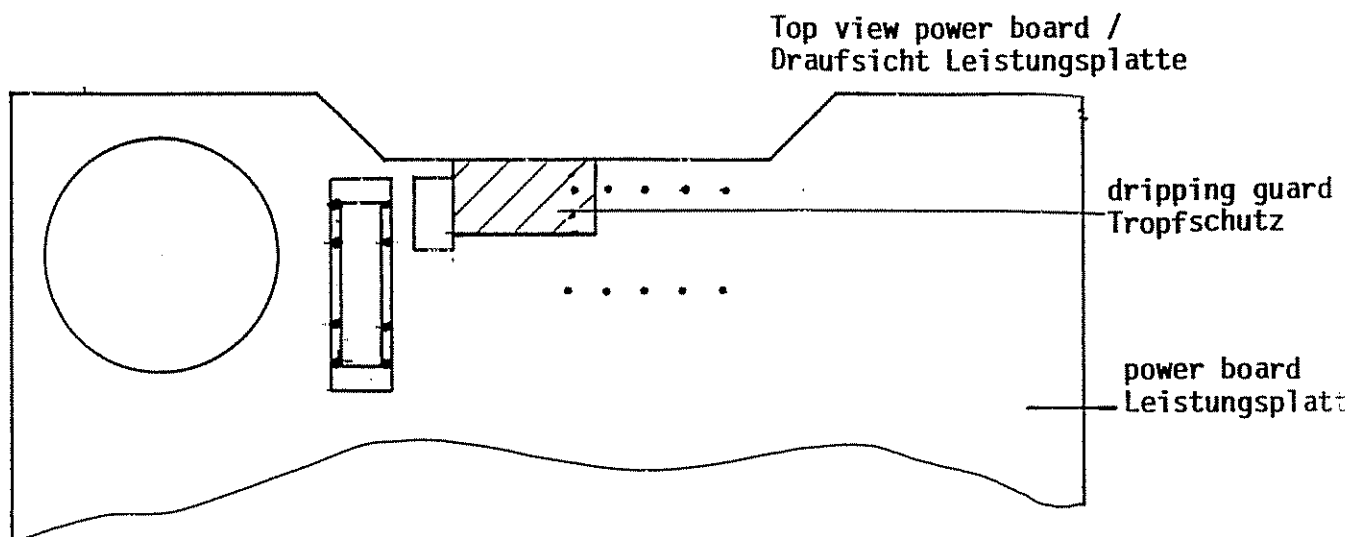
If you have further questions please do not hesitate to contact me directly.

With best regards,

SIGMA LABORZENTRIFUGEN GMBH

Jens Siebert,
Service

2.) Additional isolation -Power board-
Zusätzliche Isolation -Leistungsplatte-

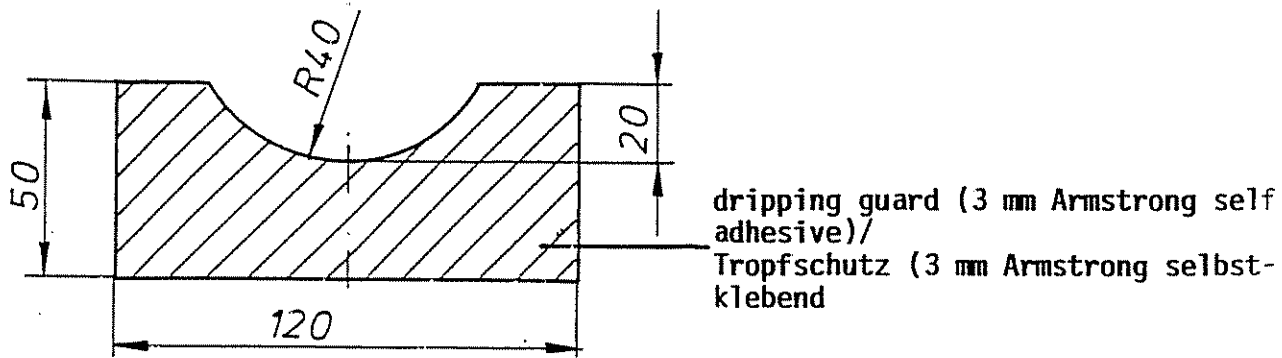


- Glue the dripping guard (self adhesive) on the power board conform the figure.
- Tropfschutz (selbstklebend) auf die Leistungsplatte kleben (siehe Abbildung).

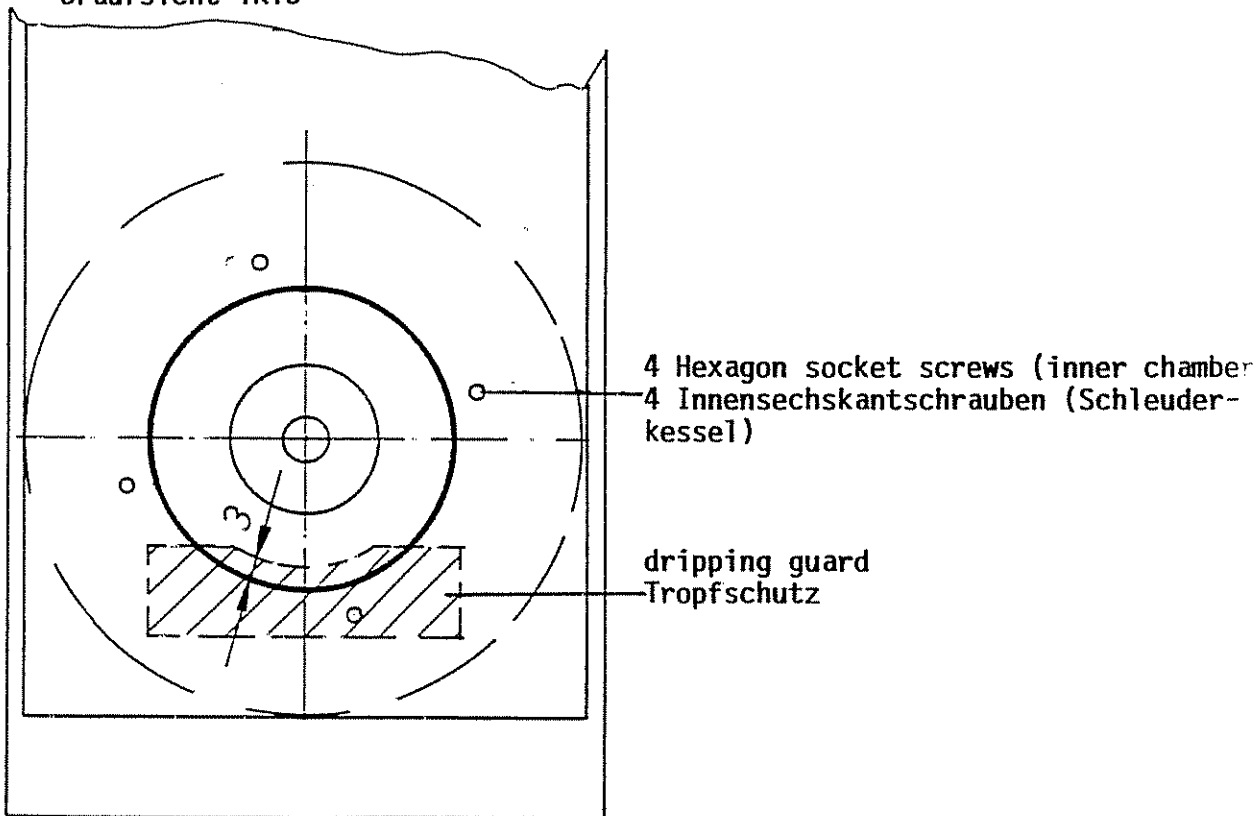
This modification is installed from serial no. 46479 realized by SIGMA.

Ab Fabrik-Nr. 46479 sind diese konstruktiven Veränderungen bereits bei SIGMA durchgeführt.

1.) Dripping guard/
Tropfschutz



Top view 1K15/
Draufsicht 1K15



- Remove the 4 Hexagon socket screws and seal it with a kind of silicon.
As well the 4 nuts (M4) at the end of the screws under the bottom of the chamber.
- Glue the dripping guard (3 mm Armstrong self adhesive) under the bottom of the chamber (see figure).
- Die 4 Innensechskantschrauben im Schleuderkessel lösen und mit Silikonkleber abdichten. Ebenso die 4 Muttern (M4) auf der Unterseite der Panzerkammer (siehe Abbildung).
- Den Tropfschutz auf die Unterseite der Panzerkammer aufkleben (siehe Abbildung).

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EC Statement of Conformity
in accordance with the EC Machine Directive 89/392/EWG
and the EC EMV-Directive 89/336/EWG

We, Sigma Laborzentrifugen GmbH
An der Unteren Söse 50
D-37520 Osterode am Harz

hereby declare that the following machine is in accordance with the relevant standard Safety and Health Regulations of the EC Directive due to its conception and design. In the event of an alteration which had not been agreed by the manufacturer this declaration will be invalid.

Machine:	Laboratory Centrifuge
Type:	1K 15
Machine No.:	10770, 10771
Relevant EC Directives:	EC Machine Directive (89/392/EWG) EC Low Voltage Directive (73/23/EWG) EC-EMC Directive (89/336/EWG)
Applied harmonized standards particularly:	EN 292-1, EN 292-2 EN 954-1 EN 61010-2-20 EN 50081-1, EN 55011, EN 55014 EN 50082-1
Applied national standards and technical specifications particularly:	DIN 349 VBG 4, VBG 7z, VBG 20
Date/Manufacturer's Signature:	28.05.1999 
Position:	Managing Director

Filing:

.....
Serial No.

SHORT INSTRUCTION

for SIGMA 1K 15

Important: Please pay attention to the notes in the detailed operation instructions

1. _____
Remove transport safety device if present (3.1.1).

2. _____
Check the name rating plate for the correct voltage and frequency, then plug the power cord into the wall receptacle (3.2).

3. _____
Press the power switch to on (3.4.1) (on rear panel). Close the lid.

The following displays are illuminated (basic program, if no program had been stored):

- Speed panel 2000/LED-Speed
- Time/temperature panel 002/LED-Time
- Program panel 0

- LED Lid
- LED Start
- LED Short

The run can be started with these parameters, if the rotor is installed and the lid is closed.

3.1 _____
Open the lid, install the rotor according to detailed operating instructions (3.4.2 and 3.4.3) and close the lid.

4. _____
Enter run parameters (3.4 and 4.2):

Press the Edit-key,
LED-Edit-Active is illuminated (4.2).

a) Press the parameter key in the speed panel until LED Rotor is illuminated (3.4.4). Select the rotor number using the alteration keys $\Delta\nabla$. The rotor number is displayed in the speed panel.

b) Press the parameter key in the speed panel until LED Speed is illuminated. The desired speed can be set in steps of 100 rpm using the alteration keys $\Delta\nabla$. The corresponding relative centrifugal field RCF is calculated from rotor number and speed.

c) Press the parameter key in the speed panel until LED RCF is illuminated. The relative centrifugal field of the rotor in use at the set speed is displayed. Another centrifugal field can be set using the alteration keys $\Delta\nabla$. The corresponding speed is calculated.

d) Press the parameter key in the program panel until LED Acceleration is illuminated. Select desired acceleration curve using the alteration keys $\Delta\nabla$ (0-19 available).

e) Press the parameter key in the program panel until LED Deceleration is illuminated. Select desired deceleration curve using the alteration keys $\Delta\nabla$ (0-19 available).

f) Press the parameter key in the time/temperature panel until LED Time is illuminated, the last digit will flash. Set desired run time using the alteration keys $\Delta\nabla$, the time is displayed in hours and minutes. If a run time of more than 9 hours and 59 minutes or less than 1 is selected and the alteration key is pressed again, continuous operation is activated. LED ∞ is illuminated.

g) Press the parameter key in the time/temperature panel until LED Temperature is illuminated. Set desired temperature in °C using the alteration keys $\Delta\nabla$.

If a temperature below 0 °C is desired, press the alteration key until the temperature below 0 °C is displayed with "-".

- h) Press the parameter key in the program panel 1x.
 Select desired program number using the alteration keys $\Delta\nabla$. 10 programs No. 0-9 are available.

Store entered data using the Enter-key.

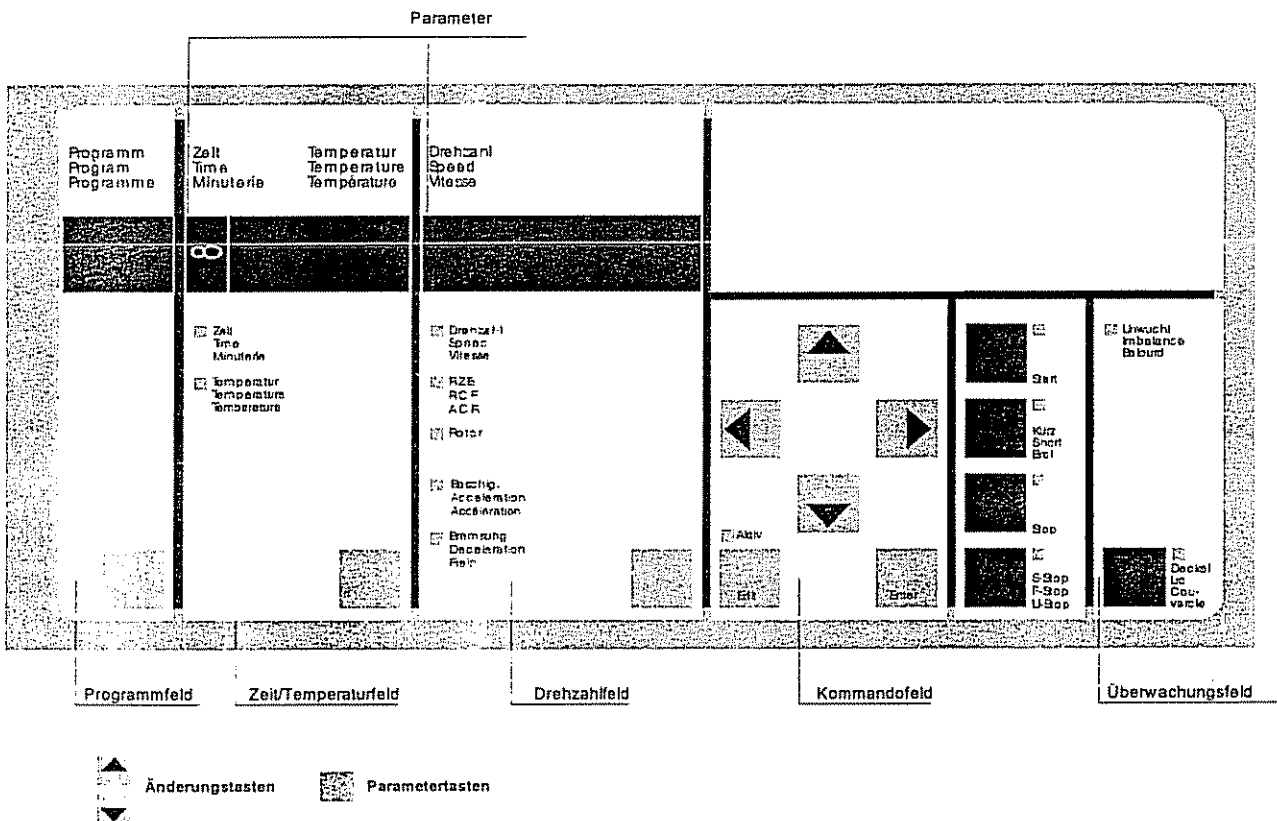
- 5.** _____
 Start the program using the Start-key.

- 6.** _____
 Alteration of program (during run; 5.6):

- a) Press the Edit-key.
 b) Select required panel using the parameter key. The parameter to be changed will flash.
 c) Change the value using the alteration keys $\Delta\nabla$.
 d) The changed parameters are used for the actual run by pressing the Enter-key.

- 7.** _____
 The run can be stopped at any time by pressing the Stop or Faststop-key.

Control Panel



(Subject to technical alterations)

1. General Information:

1.1 Technical Data	
Manufacturer:	S I G M A Laborzentrifugen GmbH 37520 Osterode
Type:	1K 15
Electr. connection:	230 V, 50/60 Hz
Power consumption (kVA):	0,66
Rated power (kW):	0,45
Rated power drive (kW):	0,15
Max. current consumption (A):	2,9
Power data:	
Max. speed (rpm):	15 300
Max. capacity (ml):	53
Max. gravitational field (x g):	20 937
Max. kin. energy (Nm):	4 980
Further parameters	
Time range:	9 h, 59 min/continuous operation
Temperature setting range:	-20 to +40 °C
Programs:	10 No 0 - 9
Acceleration curves:	10 linear No. 0 - 9 10 quadratic No. 10 - 19
Deceleration curves:	9 linear No. 1 - 9 1 brakeless No. 0 10 quadratic No. 10 - 19
Rotor part no.:	s. chapter 1.2
Dimensions:	
Depth (mm):	550
Width (mm):	310
Height (mm):	260
Weight (kg):	38
EMC (acc. to EN 55011):	Class B
Noise level (dBA):	< 58 (at max. speed) < 45 (during pre-cooling)
Regular checks acc. to UVV VBG 7z	no
Notes of user:	
Serial number:
Supply date:
Inventory number:
Location:
Responsibility:

The figures are valid for an ambient temperature of 23 °C +/- 2 °C and 230 Volt +/- 5 %. The minimum temperatures achieved during run are < +4 °C and depend on type of rotor, speed and ambient temperature. (Allowable ambient temperature 10 °C - 35 °C; max. humidity 80 %.)

1. General Information:

1.2 Accessories Suitable for SIGMA 1K 15

Part No.	Description	Max. speed (rpm)	Max. gravitational field (x g)
12024	Angle rotor 24 x 1,5 to 2,2 ml, incl. hermetic polycarbonate lid, max. radius 8,2 cm, min. radius 5 cm, angle 45°	15 300	21 460
12031	Angle rotor 40 x 0,4 ml, incl. hermetic polycarbonate lid, max. radius 8 cm, min. radius 5 cm, angle 45°	15 300	20 937

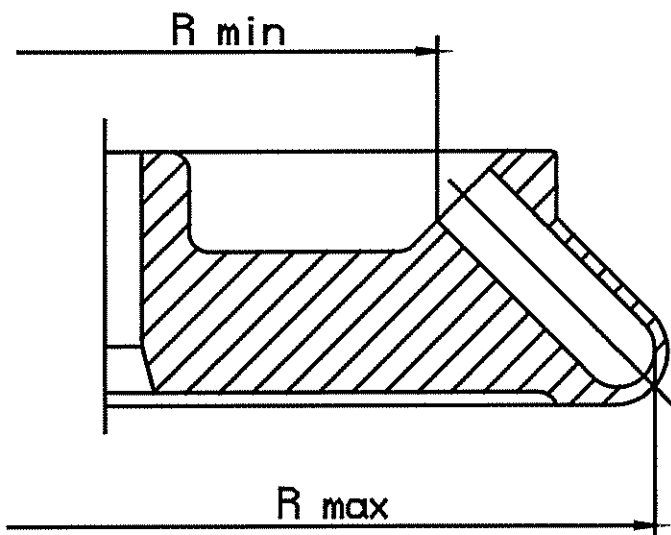
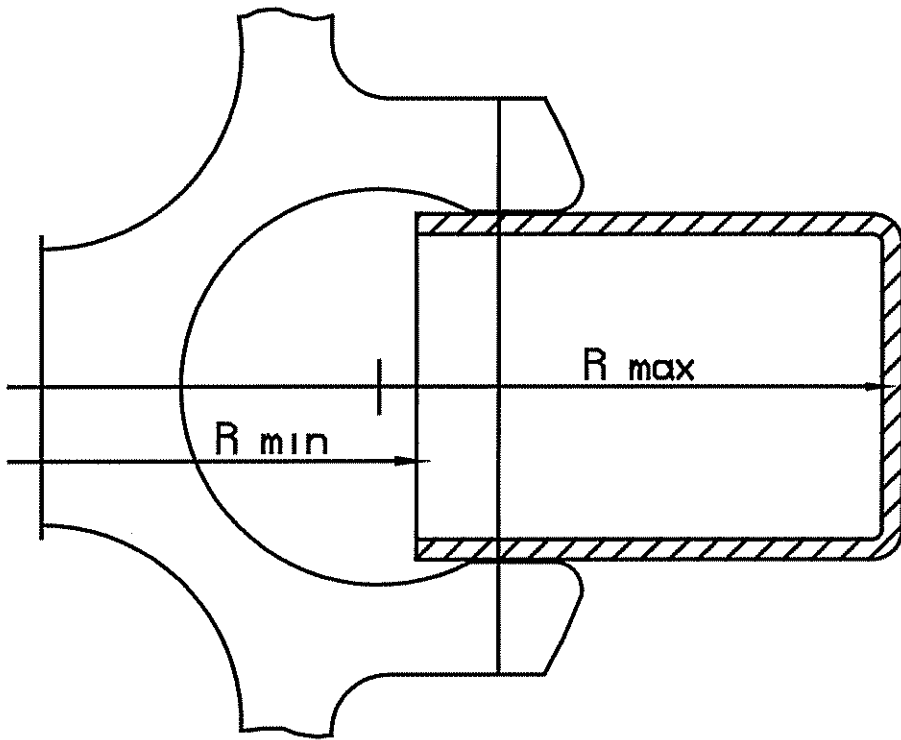
Adaptors and Plastic Vessels

13000	Adapter, POM, for reaction vials 0,25/0,4 ml, suitable for 12024
13002	Adapter, POM, for Eppendorf reaction vials 0,5/0,75 ml, Ø 7,9/10 x 28/31 mm, suitable for 12024
15005	Reaction vials 0,5 ml (Eppendorf system), polypropylene, Ø 7,9/10 x 28/31 mm, 1 pack contains 100 pcs., suitable for 13002
15008	Reaction vials 1,5 ml (Eppendorf system), polypropylene, 1 pack contains 100 pcs., suitable for 12024
15040	Reaction vials 2,2 ml (Eppendorf system), polypropylene, 1 pack contains 100 pcs., suitable for 12024
15014	Reaction vials 0,4 ml (Beckman system), polypropylene, 1 pack contains 100 pcs., suitable for 12031, 13000

Maximum speed for tubes

Some tubes, e.g. centrifuges glass tubes, microtubes, Falcon tubes, Teflon tubes and especially high volume tubes can be used in our rotors, buckets and adaptors at higher speeds than their breaking limit. We recommend to always fill up the tubes and to follow the recommendations of the manufacturer.

1. General Information:



1. General Information:

1.3 Scope of Supply

The following belongs to the centrifuge:

1 Connection cable	Part No. 269 010
1 Rotor spanner	Part No. 930 050
1 Tube grease for rotor trunnion pins	Part No. 70 284
20 ml slushing oil	Part No. 70 104

Documentation:

- 1 Short operating instructions
- 1 Operating instructions
- 1 "Rotor and Accessories, Operation and Use"
- 1 EU-Statement of Conformity
- 1 Equipment Decontamination Certificate

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

Rotor Part No.	Rotor No.
.....
.....
.....
.....
.....
.....
.....
.....

1. General Information:

1.4 Standards and Regulations

Please refer to the enclosed EU-Statement of Conformity.

1. General Information:

1.5 Safety Instructions

regarding operation of centrifuges with rotors of different max. speed, eg. angle rotors and swing-out rotors.

According to the German health and safety regulation UVV, VBG 7z the operator should take care of the following points:

1. According to § 19 of the UVV, VBG 7z the owner has to provide operating instructions based on those of the manufacturer and to inform the employees accordingly.
2. For safety reasons these operating instructions must clearly state that the stamped max. speed of the used rotor and the max. allowable filling quantity must not be exceeded.
3. If the density of the material exceeds 1.2 g/cm^3 , the max. speed of the centrifuge must be reduced (see formula chapter 8.4.2).
4. Operation of the centrifuge in hazardous locations is not allowed.
5. During operation the centrifuge must not be moved. Leaning against or resting on the centrifuge is not allowed.
6. Do not spin explosive or highly inflammable materials.
7. Substances which could damage the material of the centrifuge, the rotors or the buckets anyhow must not be centrifuged or only under consideration of special safety measures. Infectious, toxic, pathogene or radioactive substances must be centrifuged in suitable rotors only.
8. Keep a clearance of at least 30 cm around the centrifuge. Dangerous materials of any kind must not be put down or stored in that area.

2. Description of Centrifuge:

2.1 General Outlay

The new generation of SIGMA laboratory centrifuges is equipped with newest state-of-the-art electronics and is driven by brushless, silent and long-life asynchronous motors.

The problem of carbon brush change is no longer existent and as there is no carbon dust pollution, operation in clean rooms is possible if the appropriate accessories are used.

2.2 Construction and Constructive Safety Measures

The centrifuge is built into a solid steel housing. The centrifuge lid is also made of solid steel and cased with synthetic parts which provide the necessary thermal protection. From the back the lid is secured by a solid shaft and at the front by a separate cover lock.

The bottom of the barrier ring is a one-piece steel plate so that there is a solid safety case around the rotor chamber. The centrifuge stands on noise absorbing, elastic feet.

2.3 Drive

The drive motor is a well dimensioned asynchronous motor where the centrifuge rotor is directly connected to.

As there is no commutator, no carbon brush change is necessary, there is no carbon dust pollution and the noise level is low.

2.4 Data Input and Output

The input and output unit is a hermetically sealed foil keyboard with clearly distinguished keys. Easily readable displays and LEDs are available and lead the operator through the wide range of applications.

Option:

A connection for a serial interface is possible so that an external personal computer with printer can be connected for control or recording.

2. Description of Centrifuge:

2.5 Electronics

The electronics controlled by a microprocessor allows extensive adaptations of the centrifuge to the different tasks. The following parameters can be programmed and called among others:

- Speed in steps of 1 rpm
- RCF in steps of 1 x g
- Continuous and time operation (9 h, 59 min) in steps of 1 min
- Short-time operation
- Temperature setting range between -20 °C and +40 °C
- Fixed deceleration and acceleration curves
- Error messages recognized by the system and saved for service

2.6 Safety Devices

Apart from the passive safety devices due to the instrument's mechanical design there are the following active precautions for your safety:

2.6.1 Lid Lock, Cover Closing Device

The centrifuge can only be started when the lid is correctly closed. The cover lock must close. The lid can only be opened when the rotor has stopped. If the lid is opened by the emergency release during operation, the centrifuge will immediately switch off and decelerate brakeless. If the lid is open, the drive is completely separated from the mains supply, that means starting of the centrifuge is impossible (refer to point 8.5.4 "Emergency lid release").

2.6.2 Imbalance Monitoring System

In the event that uneven loading leads to imbalance, the drive is switched off during acceleration or during run.

2.6.3 Standstill Monitoring

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

2. Description of Centrifuge:

2.6.4 System Check

An internal system check monitors data transmission and the sensor signals with regard to plausibility. The diverse malfunctions are recognized with utmost sensitivity, displayed as error message together with an error number and saved for service.

3. Installation, Start-up:

3.1 Unpacking of the Centrifuge

Open cardboard. Take out box containing accessories. Remove upper foam cushions. Lift centrifuge upwards with two persons.

Please keep case for possible transport of centrifuge later.

3.1.1 Transport Safety Device

The SIGMA 1K 15 has two transport safety devices which must be removed before start-up! The transport safety devices are blocking the drive.

Procedure!

1. Remove transportation safety device in the bowl.
2. Remove the two safety screws from the bottom of the instrument using the supplied rotor spanner.

Lift the front of the centrifuge and put a suitable object between tabletop and centrifuge.

Attention: Risk of injuring!

The hexagon socket screws are visible and can be removed.

Align centrifuge and continue start-up.

The transport safety devices should be kept for possible transport of the centrifuge (service, repair).

3. Installation, Start-up:

3.2 Installation

3.2.1 Site

All energy consumed by the centrifuge is converted into heat and emitted into the ambient air. Therefore, sufficient ventilation is important. As the air-ducts in the unit must be open, keep a clearance of at least 30 cm around the centrifuge. Also, the centrifuge shouldn't be positioned near radiators and direct insulation should be avoided.

The table should have a solid, even top.

For normal operation the ambient temperature should not fall below 10 °C and not exceed 35 °C. The max. humidity of air is 80 %. During transport from cold to warmer places there will arise condensation water inside the centrifuge. It is important that there is enough time for drying before the centrifuge can be started again.

3.2.2 Connection

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

SIGMA laboratory centrifuges are units of safety class I, DIN VDE 0700, and include a three wire power cord 2,5 m long with shockproof right angle plug.

At the back, next to the mains supply, there is an additional ground wire connection where a separate ground wire can firmly be connected to ground any non-hazardous leakage current. The leakage current is harmless but secondary effects would occur.

3.2.3 Fuses on Site

The centrifuges must be protected typically with at least 16 A slow acting fuses.

3. Installation, Start-up:

3.3 Insertion of Rotors and Accessories

1. Open centrifuge lid by pressing Lid-key K5.
2. Unscrew rotor tie-down screw from motor shaft (anticlockwise).
3. Lower the rotor straight down onto the motor shaft.
4. Tighten the tie-down screw (clockwise) with the rotor spanner so that the disc spring, if existing, is pressed together.

Fastening torque: 110/112/113/203/204/1K 15/2-15/2K 15: approx. 5 Nm
3-15/3K 15/3K 18/3K 30: approx. 7,5 Nm
4-10/4K 10/6-10/6K 10: approx. 10 Nm

In the event of frequent use the tie-down screw must be loosened by some turns and fastened again. **This should be done once a day or after approx. 20 cycles.** This ensures a proper connection between rotor and shaft (please refer to chapter 7.2 "Care and cleaning of accessories" as well).

5. Use only appropriate vessels for the rotor (please refer to chapter 1.2 "Suitable accessories" as well).
6. Fill vessels external to the centrifuge.
7. Put or screw on covers of vessels.
8. Opposite places of the rotors must always be loaded with same accessories and same filling.
9. In angle rotors the plastic vessels must always be totally filled to avoid distortion of vessels and leakages or loosening of the caps in case of partial filling. **Attention**, follow the special comments of chapter 1.5.
10. Attention: The centrifuge will absorb smaller differences in weight when loading the rotors. But it is recommended to balance the vessels as accurately as possible in order to ensure a run with minimal vibrations. Should the centrifuge be operated with very uneven load, the imbalance device will switch off the drive and an error message appears on the display. The LED Imbalance (Ü3) of the monitoring panel illuminates (refer to 4.1 folding illustration at the end of the operating instructions).
11. Don't fix the rotor screw without a rotor. Otherwise you'll destroy the shaft.

3. Installation, Start-up:

3.3.1 Fastening of Angle Rotors with Hermetically Sealed Lid

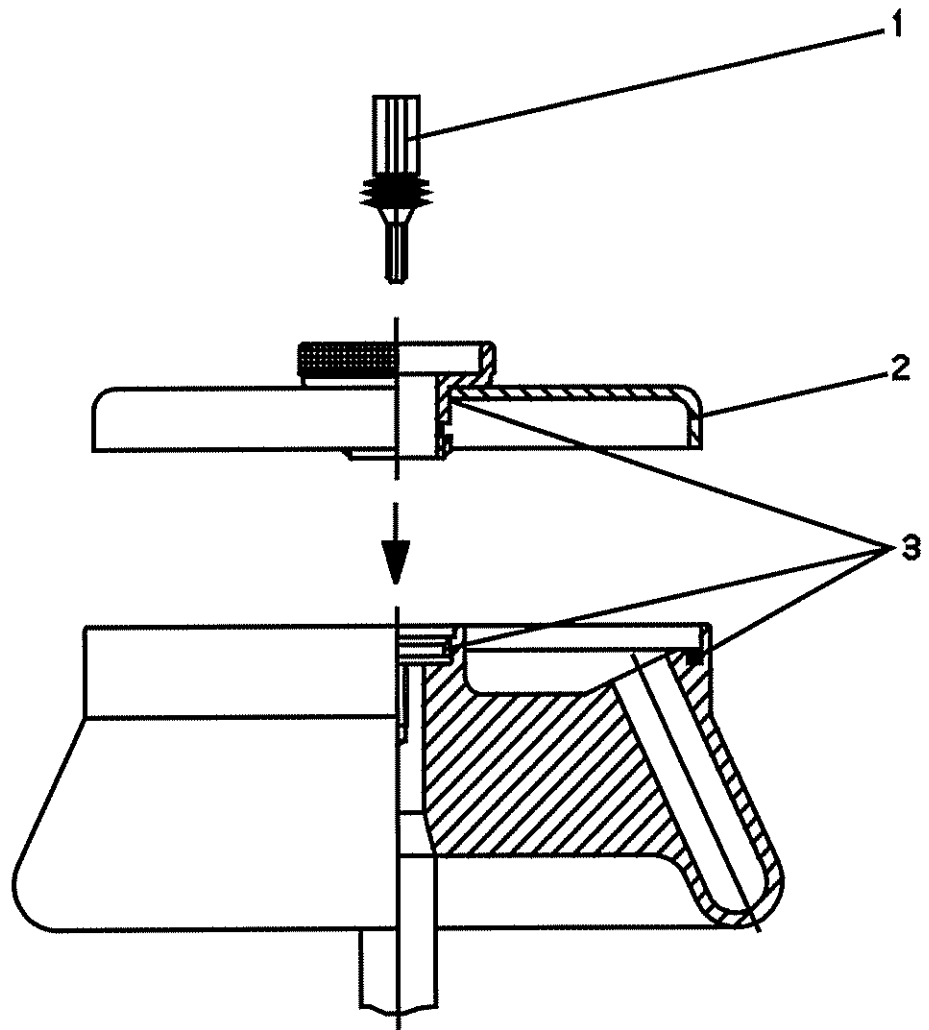
1. Screw rotor cover (2) onto rotor and tighten it.
2. Lower rotor with cover (2) onto motor shaft.
3. Put rotor tie-down screw (1) onto motor shaft and tighten using the spanner.
4. The rotor can be run without cover (2) as well.
5. The rotor and cover seals (3) must be greased after cleaning.
6. Special instructions for the use of hermetically sealed rotors:

The rotors can be installed or removed with closed cover after loosening the rotor tie-down screw. All rotors are autoclavable (refer to chapter 7.6 "Sterilization and disinfection of rotor chamber and accessories"). To increase life of rotors and seals the rotors must be greased with slushing oil and the seals and thread areas with vaseline or grease after cleaning.

Attention!

Please follow the special comments of chapter 1.5.

3. Installation, Start-up:



3. Installation, Start-up:

3.4 Initial Start-Up

Attention!

Before initial start-up please take care that your centrifuge is orderly installed (refer to chapter 3.2 "Installation").

3.4.1 Switching on of the Centrifuge

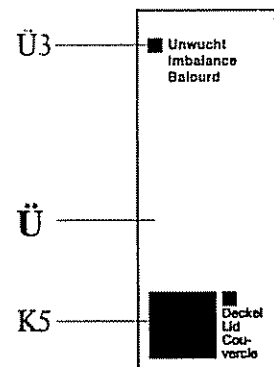
Press mains switch (at the back of the centrifuge). When power is applied for the initial use, default values will be displayed.

- The displays (PD, TD/ZD, DD) are illuminated.
- The speed display (DD) indicates "2000".
- The time display (ZD) indicates "2".
- A temperature of 20 °C is set.
- The program panel (PD) indicates "-", ie.
 - the centrifuge is to accelerate to 2000 rpm with curve no. 9,
 - the centrifuge operation is terminated after 2 minutes,
 - the cooling system is set to a temperature of 20 °C,
 - deceleration of the centrifuge is carried out with curve no. 9,
 - no program number has been allocated so far.

3.4.2 Opening Lid

Press Lid-key (K5).

- The lid opens.
- The display shows the set values.



3.4.3 Insertion of Rotor

Put a rotor onto the shaft and fasten it by screwing the rotor tie-down screw onto the shaft. Please use the supplied rotor spanner (refer to chapter 3.3 "Insertion of rotor and accessories"). Please pay attention to the fact that during tightening the disc spring of the rotor tie-down screw is pressed together and the screw is tightened.

3. Installation, Start-up:

3.4.4 Selecting a Rotor Number

Select LED "Rotor" (D3) by pressing the parameter key (DP) in the speed panel.

- LED "Rotor" (D3) is illuminated,
- a rotor part no. will appear on the speed display.

Pressing the Edit-key in the input panel activates the change mode (Edit-Aktiv-LED illuminated).

- Select the rotor number pressing the cursor keys until the correct number is displayed in the speed display,
- terminate input by pressing the Enter-key,
- with the new rotor number new set values may be displayed.

3.4.5 Starting and Stopping a Run

Close the lid, lock must audibly latch.

- The LEDs of the Start-key (K1) and the Short-key (K2) are illuminated, indicating that operation can be started.

Conditions

- Entries must be completed.
- No active faststop.

Press the Start-key (K1) (for optional methods please refer to chapter 4.3.1 "Key Short (K2)"),

- the LED of the Start-key (K1) will extinguish,
- the LEDs of the Stop and Faststop-keys (K3, K4) are illuminated,
- the motor accelerates to the set speed with the preselected curve, LED K5 will extinguish,
- the speed display (DD) indicates the current rotor speed.

Stopping a run in progress

Press the Stop-key (K3),

- the Start-key LED is illuminated again, indicating that the operation can be restarted by pressing the Start-key,
- the motor decelerates according to the set deceleration curve until it comes to a standstill,
- the display continues to indicate the current operational data.

3. Installation, Start-up:

Or:

Press the Faststop-key (K4),

- the Start-key LED will not light up,
- operation cannot be continued by pressing the Start-key,
- the motor decelerates with maximum deceleration to a standstill,
- the display continues to indicate the current operational data.

For starting please open and close the lid.

The run is over,

- the time display (ZD) changes to "0",
- the Start-key LED is illuminated, indicating that operation can be restarted by pressing the Start-key,
- the motor decelerates with the set deceleration curve up to standstill,
- the display continues indicating the current operational data.

Press the Lid-key (K5),

- the lid opens,
- the set values of the selected program are displayed again.

Note!

In the event of problems please refer to chapter 8.5 "Error correction".

4. Operating Elements:

4.1 Operating Panel (Folding Illustration at the End of the Operating Manual)

All settings of the centrifuge are accessed via the operating panel. The operating panel is divided into display panels and control panels.

4.2 Displays and Keys

- Speed panel (D)
- Temperature and time panel (T/Z)
- Program panel (P)

The individual panels contain the following operator controls and displays:

Displays

(Displays are labelled by two letters, the latter one being a D: DD, TD/ZD, PD). The displays are located at the upper part of the panel. Because of a high intensity contrast, they are easy to read and allow for a simultaneous presentation of important data of the centrifuge operation (eg. speed, time, temperature etc.).

Light Emitting Diodes (LED)

(The LEDs are labelled by the letter of the corresponding panel and numbered in sequential order: eg. D1, D2, ...). The LEDs are arranged vertically below the displays. One of the LEDs is constantly on. It identifies the selection in the corresponding display.

Parameter Keys

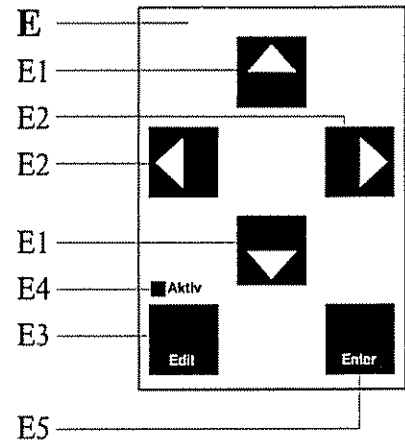
(The keys are labelled with two letters, the latter being a P: PP, TP/ZP, DP). The parameter key is located at the bottom right corner of each panel. Pressing a parameter key of an active panel changes to the next parameter of this group. By pressing a parameter key of another panel the cursor changes to this panel. In the alteration mode the cursor is activated.

4. Operating Elements:

Input Keys

The input keys are divided in:

- Alteration keys
- Cursor keys
- Edit-key
- Enter-key



Alteration Keys

The alteration keys are labelled with ▲▼.

With these keys values can be increased ▲ or decreased ▼ by depressing the ▲ or the ▼ key.

Short pressing of the key results in one single counting step, holding the key in continuous steps with increasing speed. Counting terminates at the end of the respective value but can be continued by pressing the counting key again, resulting in an overflow.

Cursor Keys

The cursor keys are labelled with ◀▶.

The cursor position through the displays can be selected using the cursor keys. This is particularly advantageous, if extensive value alterations are necessary.

Edit-Key

The Edit-key is labelled with "Edit".

The Edit-key switches to the alteration mode (Edit-Aktiv-LED on).

The display changes from actual value display to set value display. After pressing the Edit-key again the alteration mode is terminated, possible changes of parameters are not saved.

Enter-Key

The Enter-key is labelled with "Enter".

With the Enter-key the parameter values are read and saved. They are also available after power off. The alteration mode finishes by pressing the Enter-key.

4. Operating Elements:

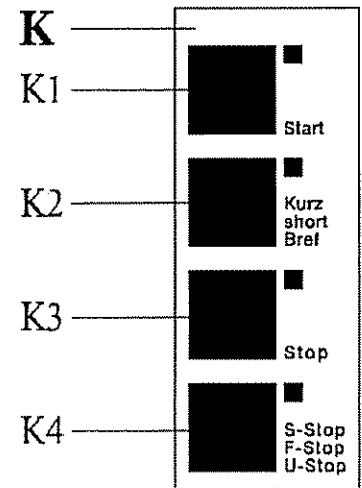
4.3 Command Panel (K)

The centrifuge operation is started via the command panel. Keys can be pressed when their LED is on.

Start-key (K1)

This key can be used for the following:

- starting centrifuge operation,
- terminating a previously started deceleration process and restarting centrifuge,
- shifting to short-run at preselected speed. Pressing Start-key continuously for the time of the short run leads to acceleration max. to the set speed **with the reselected acceleration curve** and after release deceleration **with the preselected deceleration curve**. Max. range 9 min 59 sec.



The centrifuge can be started when

- the lid is closed,
- no incorrect entries have been made,
- no LEDs are flashing,
- the Start-LED is on,
- the Faststop-key has not been previously pressed,
- entries are finished.

Key Short (K2)

With this key the centrifuge can be accelerated to the max. speed of the rotor **with max. acceleration** and decelerated **with the max. deceleration curve** after releasing the key. Max. range 9 min. 59 sec.

Stop-key (K3)

This key can be used to terminate a run. The centrifuge decelerates according to the preset curve to a standstill. Deceleration can be terminated by pressing the Start-key again.

4. Operating Elements:

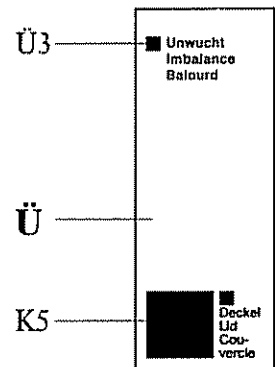
Faststop-key (K4)

Pressing this key decelerates the centrifuge as fast as possible. This deceleration process cannot be stopped, the centrifuge comes to a standstill in any case. Restarting is only possible after opening and closing the lid.

Lid-key (K5)

This key is used to open the lid. This can only be executed if

- the centrifuge has come to a standstill,
- the lid LED is on.



4. Operating Elements:

4.4 Display Panels

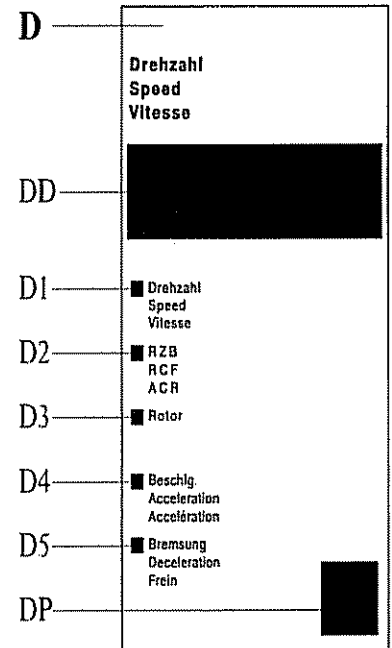
4.4.1 Speed Panel (D)

Speed (D1)

With entering a speed, the set value of the centrifuge speed is selected. After starting the centrifuge the current actual speed of the rotor is displayed.

RCF (D2)

The relative centrifugal force (abbrev. RCF) is an indication of the stress the sample is exposed to during a run. This value can be preset. The resulting speed is automatically calculated and displayed. After starting the run, the actual relative centrifugal force is displayed, if the RCF parameter is selected.



Rotors (D3)

All available rotors can be selected via the alteration keys. They are offered for selection in the display in sequential order. After selection of the desired rotor (in the speed panel) input is terminated by pressing the Enter-key.

Acceleration (D4)

The acceleration number selects an acceleration curve which the centrifuge will follow. Two different versions are available:

- 0 - 9 linear
- 10 - 19 quadratic in a speed range up to 1 000 rpm

The curves 0 - 19 are preset by the manufacturer and cannot be changed by the user. Their shape is further explained in chapter 8.1 "Slope of the specified curves, linear curves" and 8.2 "Quadratic curves". Curves 0 - 9 are linear, curves 0 - 19 quadratic in the speed range up to 1 000 rpm. In the speed range exceeding 1 000 rpm. acceleration is linear.

4. Operating Elements:

The acceleration is expressed by the curve slope. For example: curve no. 8 is steeper than curve no. 7, ie. the centrifuges reaches its final speed within a shorter period.

Curves 9 and 19 apply a maximum acceleration to the centrifuge. These curves represent an exception. The centrifuge accelerates with its maximum torque. The time necessary to reach this maximum is only dependent on the inertia of the rotor.

Deceleration (D5)

The deceleration number selects a deceleration curve that decelerates the centrifuge down to standstill. The deceleration curves are inverted images of the acceleration curves and are labelled with identical numbers. Curve no. 0 represents brakeless deceleration.

4. Operating Elements:

4.4.2 Time/Temperature Panel (T/Z)

Time (Z1)

During standstill, this display shows the programmed time. During the operation of the centrifuge, the remaining run time is displayed in hours and minutes.

The time is entered in hours and minutes. Time is defined as the period from the start of the centrifuge to the beginning of deceleration, maximum value is 9 h 59 min.

If a run time of less than 1 or more than 9 h 59 min is selected, continuous operation is activated. The time display is omitted and the LED "∞" for continuous operation left of the display is illuminated. By entering a specific run time, the continuous mode is deactivated. By pressing the Enter-key the values are stored and the alteration mode is left.

During continuous operation, the time elapsed since the run start is displayed. The centrifuge operation can only be terminated by pressing the Stop- or Fast-stop-key.

Temperature (T1)

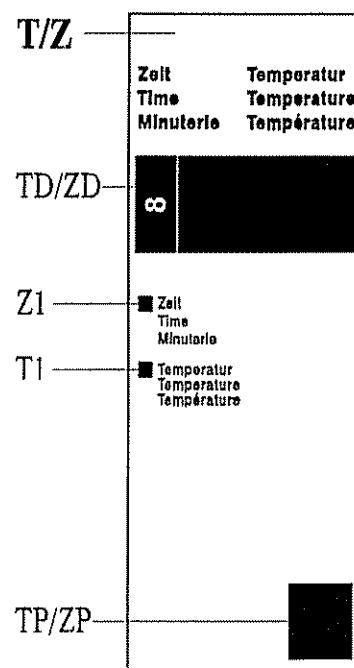
The centrifuge is temperature-controlled by a cooling system. When a run is started, there is a temperature difference between the sample and the rotor which is minimized after a certain operating period has passed.

During operation, the temperature display indicates the actual temperature inside the rotor. After depressing the Edit-key and the parameter key the set value is displayed on the temperature panel.

By entering a temperature, the desired temperature for the centrifuge chamber is set. Temperatures between -20 °C and +40 °C can be preselected.

As soon as the lid is opened, the cooling system is disconnected in order to avoid icing of the rotor chamber.

Precooling of the rotor below 0 °C during standstill is not recommendable. Differences between actual and displayed temperature and icing of the compressor would be the result. This would reduce life of the compressor. For lower rotor chamber temperatures we recommend precooling at 1 000 rpm.



4. Operating Elements:

With an ambient temperature of +23 °C the obtainable lowest temperature is < +4 °C at maximum speed.

(When changing the limits deviations might occur.) The actual run temperatures depend on rotor type, speed and ambient temperature.

4. Operating Elements:

4.4.3 Program Panel (P)

Loading a program

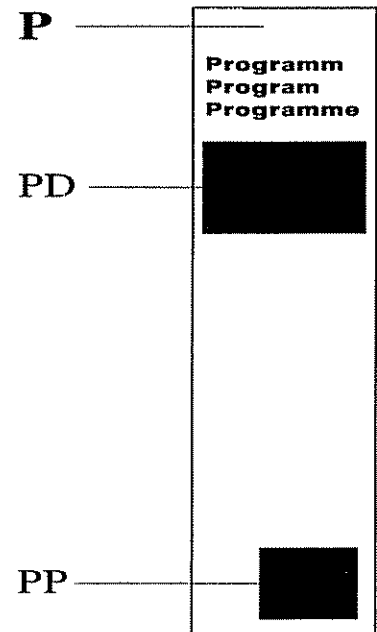
After activation of the alteration mode by depressing the Edit-key the stored programs are available.

Select the program number using the alteration keys. Not allocated program numbers are indicated through "--" in the temperature, time and speed panel. The program "--" could be loaded at any time during standstill of the centrifuge. It contains the last changed parameters. The program is loaded by pressing the Edit-key again. The program used last is automatically loaded after restarting.

If a stored program should be loaded (eg. program no. 6), set desired program number and load the program by depressing the Edit-key.

10 programs no. 0 - 9 are available.

For further details please refer to chapter 5. "Programming".



4. Operating Elements:

4.4.4 Monitoring Panel (Ü)

In this panel possible warning limits during operation are indicated by an illuminated or flashing monitoring and warning LED.

"Imbalance" (Ü3)

- The imbalance LED has two control functions:

Illuminated:

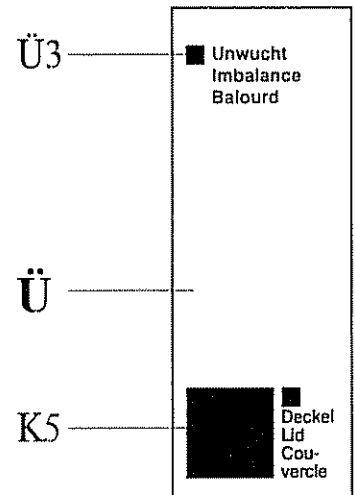
- Warning in the event of slight imbalance (warning limit < imbalance < cutoff limit). Run can be continued.

Flashing:

- Run cannot be continued due to excessive imbalance (imbalance > cutoff limit). Run is terminated with max. deceleration.

Reason:

Improper loading or malfunction during operation (eg. glass breakage) resulting in an uneven run.



Note!

Additional information and a detailed description of errors and their correction is given in chapter 8.5 "Error correction".

5. Programming:

What is considered a program?

A program contains all data that are required and can be selected for the operation of the centrifuge.

In other words, a program contains a sequence of key operations in a memory. This sequence of key operations can be loaded easily to run the centrifuge with these values. A program is useful if a defined centrifuge operation should be repeated under same conditions.

A program saves time and helps to avoid entry errors which could often occur with repeated entries.

5.1 Selection, Display and Alteration of Program Parameters

Set values

During standstill and with open cover, the centrifuge displays the last entered set values (PD, TD/ZD, DD) in the program, temperature, time, and speed panels.

Actual Values

During the operation, the displays indicate the actual values.

The LEDs (Z1, T1, D1-5) below the displays indicate the parameters which the displays are currently showing. As a standard, the upper LEDs are illuminated. The speed is displayed in the speed panel, the run time in the time panel, the temperature in the temperature panel and the program in the program panel.

The value of each of the parameters can be changed prior to a centrifuge operation by executing the following:

Press the Edit-key; the Edit-Aktiv-LED is illuminated. The third digit of the speed display is flashing.

You are in the alteration mode.

Select your parameter.

- This is executed by pressing the parameter key. The parameter values of the corresponding panel are displayed from top to bottom.
- The LED of the selected parameter illuminates.
- The digit of the display which should be changed is flashing, indicating that the user is still in the alteration mode.

Enter the new data via the alteration keys and save by pressing the Enter-key or recall existing data by renewed operation of the Edit-key.

5.2 Changing and Saving a Program

Each change of a parameter, eg. time, temperature, acceleration curve etc. is a program change. In the program display (PD) "-" is displayed instead of the program number. Saving of the parameters as a program is possible during standstill only.

1. Press the Edit-key.
2. Set cursor to program number:
 - Select desired program number using the alteration keys.
3. Press the Enter-key:
 - Saving the program, if no program was existing under the selected number.
 - Display of "quit" in the speed panel, if a program is already existing under the selected number with the following options:
 - Enter-key will overwrite the existing program.
 - Edit-key will terminate the storing process.

Note!

Invalid entries or such exceeding the allowed limits are not accepted (please refer to chapter 8.3 "Entry limitations").

5.3 Changing a Program During Centrifuge Operation

When the centrifuge is running, the following parameters can be changed:

- Speed
- RCF
- Run time
- Switching to continuous operation mode/time mode
- Deceleration curve while the centrifuge does not decelerate
- Acceleration curve while the centrifuge does not accelerate
- Temperature

Select the parameter to be changed using the parameter keys (TP/ZP, DP).

- The actual values are displayed.

Change the value using the alteration keys (please refer to chapter 5.2 "Selection, display and alteration of program parameters").

- The set values are displayed.

Press the Enter-key and then the Start-key.

- The actual values are displayed.

5.4 Programming the Relative Centrifugal Force

A change of these parameters automatically results in recalculation and change of other parameters, because there is a direct mathematical relation between them (please refer to chapter 8.4 "Mathematical relation").

Entry limits cannot be exceeded when using the alteration keys.

5.4.1 Specifying a Relative Centrifugal Force (RCF)

The relative centrifugal force, abbr. RCF, is a measure for the rotational force on the sample. Its magnitude depends on the radius and the speed (refer to chapter 8.4.1 "Relative centrifugal force (RCF)").

During the operation, the RCF value (actual value) is continuously calculated and can be displayed by calling the parameter. Therefore, a control over the actual force can be obtained.

During standstill, the RCF value (set value) is calculated when a speed or a rotor number is entered. The RCF can be preset. The resulting final speed is then calculated and displayed.

Example:

- Switch to the speed panel, activate RCF and enter the new RCF data (eg. a lower value than the one calculated from the final speed).
- Change to the speed panel.

The final speed has been recalculated.

5. Programming:

5.5 Special Time Preselection

5.5.1 Continuous Operation Mode

With activated continuous operation, the centrifuge run time is unlimited and must be manually stopped. The set values on the time panel are omitted, "∞" is illuminated.

The time elapsed since the run start is displayed.

Continuous operation mode can be activated when the centrifuge is running (refer to chapter 5.3 "Changing a program during centrifuge operation") or in standstill mode, if a run time of less than 1 or more than 9 hours and 59 minutes is selected. The run will continue until the Stop or Faststop-key is pressed

Deactivating

By entering a concrete run time, continuous operation changes to timed run; the run time depends on the values entered.

5.5.2 Short-Time Operation

Two options of short-time operation are available:

Short: The centrifuge accelerates until release of the Short-key with the max. deceleration curve to the max. allowable speed of the set rotor and then it decelerates **with the max. deceleration curve**.

Short run: Pressing the Start-key longer than 1 second changes to short run. On the time panel the run time is displayed in seconds. The centrifuge accelerates until release of the Start-key with the selected curve to the set speed and then it decelerates **with the selected curve**.

The run times are displayed in minutes and seconds and increase until release of the Start-key or Short-key.

6. Notes for Centrifugation:

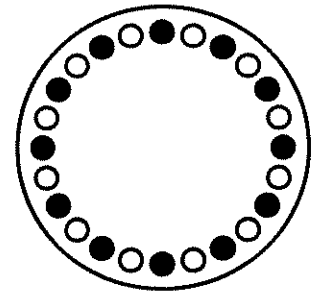
6.1 Practical Notes for Centrifugation

1. Locate centrifuge horizontally on a level surface.
2. Ensure safe location.
3. Keep at least 30 cm free space around the centrifuge.
4. Provide for sufficient ventilation.
5. Tighten rotor firmly onto motor shaft.
6. Avoid imbalance.
7. Load opposite buckets with same accessories.

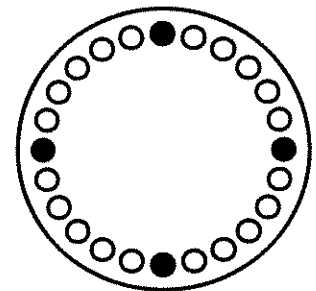
8. Centrifugation with low capacity:

An example is the fixed angle rotor 24 x 2,2 ml.

The vessels should be placed symmetrically so that the rotor is loaded evenly. Loading eg. only one position is not allowed.



9. Load all positions of swing-out rotors.
10. Load vessels outside the centrifuge.
11. Please pay attention to the max. speed. At speeds over 4 000 rpm there is an increased breaking glass hazard.



12. Fill vessels carefully to same weight. Imbalances would result in increased wear of bearings.
13. Grease joints of buckets and rotor pins in swing-out rotors.
14. Use perfect accessories only.
15. Avoid corrosion to accessories by careful maintenance.
16. Spin infectious material in sealed rotors and buckets only.
17. Do not spin explosive or highly inflammable materials.

6. Notes for Centrifugation:

18. Record all program data, refer to forms of appendix chapter 8.8.
19. When centrifuging substances with a density $> 1,2 \text{ g/cm}^3$ the allowable max. speed must be reduced (refer to chapter 8.4.2 "Density").

6. Notes for Centrifugation:

6.2 Forbidden Centrifuging Operations

1. Operation of not carefully installed centrifuge.
2. Operation without front or back panels.
3. Operation by non authorized personnel.
4. Operation with rotor not installed properly (refer to chapter 3.3).
5. Operation with incompletely loaded swing-out rotor or angle rotor with interchangeable buckets.

A rotor must always be loaded completely, empty places are not allowed!
Opposite buckets or carriers may nevertheless be empty. Mixed loading is allowed, if opposite places are loaded with same buckets and carriers of same weight.

6. Operation with overloaded rotors.

The load for a rotor is limited by its design and the max. speed (see rotor/bucket engraving) and must not be exceeded. The rotors are intended for liquids of max. homogeneous density of 1.2 g/cm³ if centrifuged at max. speed. If liquids of higher density are used, the speed must be reduced accordingly (refer to chapter 8.4 "Mathematical relation").
7. Operation with rotors, buckets and carriers showing corrosion or other defects.
8. Operation of very corrosive substances which can cause damages to material and effect mechanical strength of rotors, buckets and carriers.
9. Operation of rotors and accessories not allowed by the manufacturer, except commercial vessels of glass or synthetic materials. The use of poor commodity goods is not recommended. At high speeds breaking glass or bursting vessels can cause dangerous imbalances.
10. Operation in hazardous locations.
11. Operation with vessels of improper size.
12. Centrifugation of improper material.
13. Operation with partially filled plastic tubes in high-speed angle rotors.
14. Lifting or moving of the centrifuge during operation. Leaning against or resting on the centrifuge is not allowed.

6. Notes for Centrifugation:

15. Do not place potential dangerous material - eg. glass vessels containing liquids - near the centrifuge.
16. Attention: Do not open cover and/or reach into rotor chamber unless the rotor is at standstill. Never attempt to override the lid interlock system while the rotor is spinning.
17. Do not spin substances which could react upon the supply of high energy during centrifugation.
18. Do not spin explosive or highly inflammable materials.
19. Substances which could damage the material of the centrifuge, the rotors or the buckets anyhow must not be centrifuged or only under consideration of special safety measures. Infectious, toxic, pathogene or radioactive substances must be centrifuged in suitable rotors and vessels only.

7. Care and Maintenance:

7.1 Care and Cleaning of Centrifuge

Please use soap water or other water-soluble, mild agents for cleaning. Avoid corroding and aggressive substances. Do not use alkaline solutions or solvents or agents with abrasive particles. Remove product particles from the rotor chamber using a cloth or paper towel. It is recommended to open the cover when the centrifuge is not in use so that moisture can evaporate. **If there is the risk of toxic, radioactive or pathogene contamination, special safety measures must be kept.**

7.2 Care and Cleaning of Accessories

For care of accessories special safety measures must be considered as these are measures ensuring operational safety at the same time.

Buckets, trunnions and also synthetic buckets are produced exactly in order to withstand the permanent high stress with high gravitational fields.

Chemical reactions as well as stress-corrosion (combination of changing pressure and chemical reaction) can effect or destroy the metals. Hardly detectable cracks on the surface expand and weaken the material without visible signs. When detecting a visible damage of the surface, a crack, a mark or any other change, also corrosion, the part (rotor, bucket etc.) must be replaced immediately.

In order to avoid corrosion, rotor incl. tie-down screw and cover seal, buckets and carriers must be cleaned and greased regularly with the supplied slushing oil (part no.: 70104 for 20 ml slushing oil). The rotor tie-down screw must be greased using the supplied grease (part no.: 70284).

Cleaning of accessories should be carried out external to the centrifuge once a week or preferably after every use. The rubber cushions should be removed from buckets and carriers. After this the parts should be dried with a soft cloth or also in a drying chamber at approx. 50 °C. **If there is the risk of toxic, radioactive or pathogene contamination, special safety measures must be kept.**

Especially aluminium parts are extremely corrosive. A neutral cleaning agent with a pH-value between 6 and 8 should be used for such parts. Alkaline agents exceeding pH 8 must be avoided. Especially aluminium parts must be greased regularly with slushing oil. This procedure essentially increases life time and reduces corrosion.

Careful maintenance increases life time and avoids premature failure of the rotor. Corrosion or resultant damages which are caused by insufficient care do not constitute a warranty claim.

7. Care and Maintenance:

7.3 Rotor Pins

The trunnion pins of the rotor should always be greased as only this ensures evenly swinging of buckets and thus quiet run of the centrifuge (part no. 70284 Grease).

7.4 Glass Breakage

In case of glass breakage all glass particles must be carefully removed. Rubber inserts have to be cleaned carefully and possibly be replaced. If a problem has occurred, the following has to be considered:

Glass particles in the rubber cushion will cause glass breakage again.

Particles on the rotor pins prevent buckets and carriers from swinging evenly which will cause an imbalance.

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

In order to totally remove the glass particles and the metal dust from the rotor chamber, it is advisable to grease the upper part of the centrifuge chamber with eg. Vaseline. Then the rotor should rotate for some minutes at a moderate speed. The glass and metal particles will now collect at the greased part and can easily be removed with a cloth together with the grease. If necessary repeat this procedure.

7.5 Care and Cleaning of the Condenser

A lamellar condenser is used to cool the compressed refrigerant. It is cooled with air.

The location for the centrifuge should therefore be as clean as possible, ie. dirt, dust etc. should not prevent the air from streaming through the condenser and obstruct heat transfer. Dust on the condenser pipes and the lamella will reduce heat exchange and decrease the performance of the refrigerator.

The condenser should therefore be regularly checked for dirt and cleaned if necessary. Generally blowing of the lamella with compressed air from inside and outside is sufficient or a simple hoovering with a vacuum cleaner (for 1K 15 only through service).

7. Care and Maintenance:

7.6 Sterilization and Disinfection of Rotor Chamber and Accessories

All usual disinfectants like eg. Sagrotan, Buraton or Terralin (to obtain at chemist's shops) can be used. The centrifuges and the accessories consist of different materials. A possible incompatibility must be considered. For sterilization by steam resistance to temperature of the individual material must be checked (refer to point 7.6.1 "Autoclaving"). Please contact your laboratory safety officer regarding proper methods to use. **If dangerous materials are used, the centrifuge and the accessories must be disinfected.**

Principally we want to point out that for centrifuging of eg. infectious material hermetically sealed buckets should be used in order to avoid that the centrifuge is contaminated.

7. Care and Maintenance:

7.6.1 Autoclaving

The life of the accessories essentially depends on the frequency of autoclaving and use. When the parts are showing changes in colour or structure or in the event of leaks etc., the accessories have to be replaced.

During autoclaving the caps of the tubes must not be screwed on to avoid deformation of the tubes.

Autoclaving:

Accessories	max. temperature °C	min. time min	max. time min
Glass tubes	134-138	3	5
Polycarbonate tubes	115-118	30	40
Polypropylene tubes	115-118	30	40
Teflon tubes	126-129	10	15
Aluminium rotors	126-129	10	15
Polypropylene rotor 12034	115-118	30	40
Polypropylene rotor 12124	115-118	30	40
Polycarbonate/Polyallomer lids for angle rotors	115-118	30	40
Aluminium buckets	126-129	10	15
Polycarbonate caps for buckets	115-118	30	40
Polypropylene caps for buckets	115-118	30	40
Rubber adapters	115-118	30	40
Rubber cushions	115-118	30	40
Round carriers for 13104/ 13117, Polypropylene	115-118	30	40
ditto, Polyallomer and Polycarbonate	115-118	30	40
Round carriers for 13350/ 13550, Polypropylene	115-118	30	40
Rectangular carriers, Polypropylene	115-118	30	40
ditto, Polyallomer and Polycarbonate	115-118	30	40

7. Care and Maintenance:

7.7 Checks by Operator

The operator has to pay attention that important parts of the centrifuge necessary for safety are not damaged.

This especially refers to:

1. Motor suspension
2. Centricity of the motor shaft
3. Fastening of the trunnions in the rotor
4. Accessories, especially changes of structure like corrosion, cracks, material abrasion etc.
5. Screw connections

Furthermore, the earth wire must be checked regularly.

8. Appendix:

8.1 Slope of Specified Curves, Linear Curves

- The slope of a specified acceleration curve is defined as the time required to accelerate the rotor to 1000 rpm.
- With linear and quadratic slopes, curves are numbered in the direction of increasing acceleration (from right to left).
- The deceleration curves are inverted images of the acceleration curves with the same numbers (exception: curve 0).
- Curve 0 decelerates brakeless.

Comment: The acceleration time depends on the moment of inertia of the rotor.

Linear Curves (0 - 9)

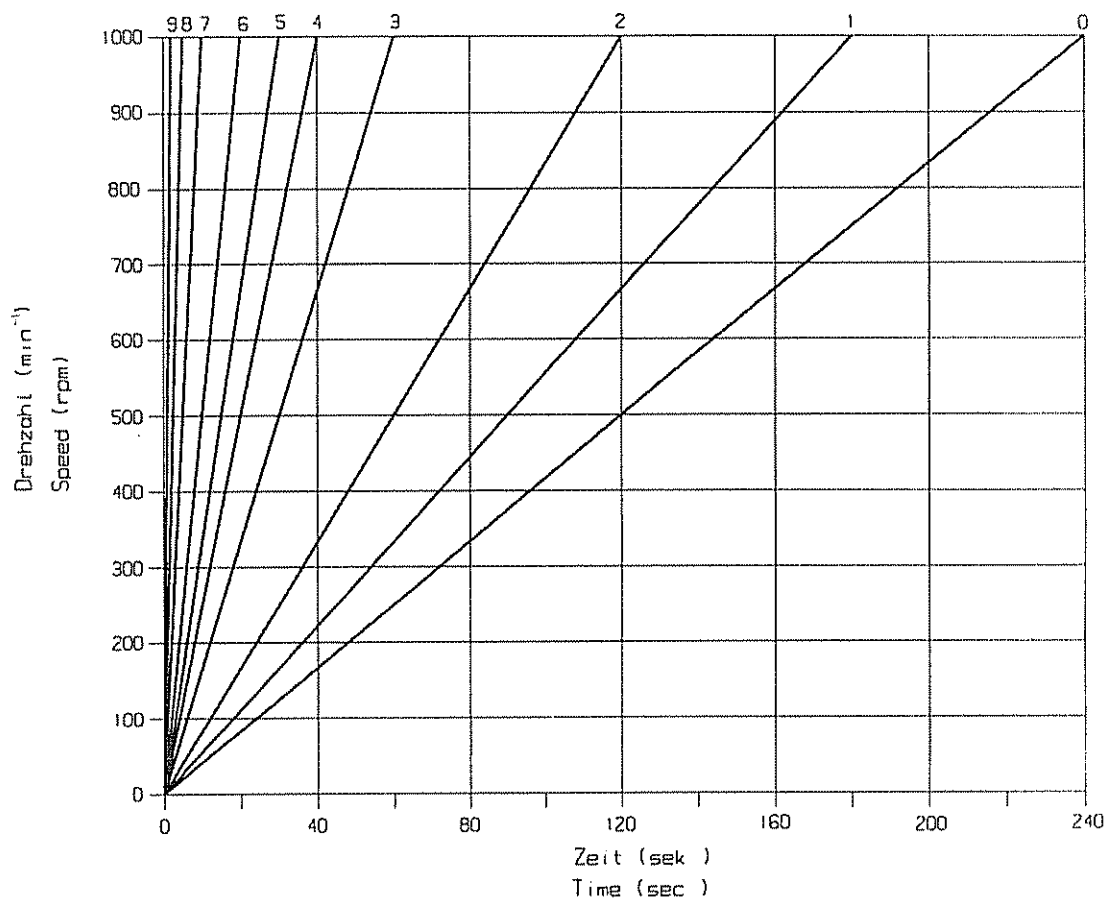


Figure 2

8. Appendix:

The curve 9 is a special case compared with the other curves. The centrifuge accelerates with max. torque. The acceleration time only depends on the moment of inertia of the rotor.

Linear curve no.	Slope
0	240 sec./1000 rpm.
1	180 sec./1000 rpm.
2	120 sec./1000 rpm.
3	60 sec./1000 rpm.
4	40 sec./1000 rpm.
5	30 sec./1000 rpm.
6	20 sec./1000 rpm.
7	10 sec./1000 rpm.
8	5 sec./1000 rpm.
9	0,9 sec./1000 rpm.

8.2 Quadratic Curves

- The deceleration curves are inverted images of the acceleration curves with the same numbers.

Quadratic Curves (10 - 19)

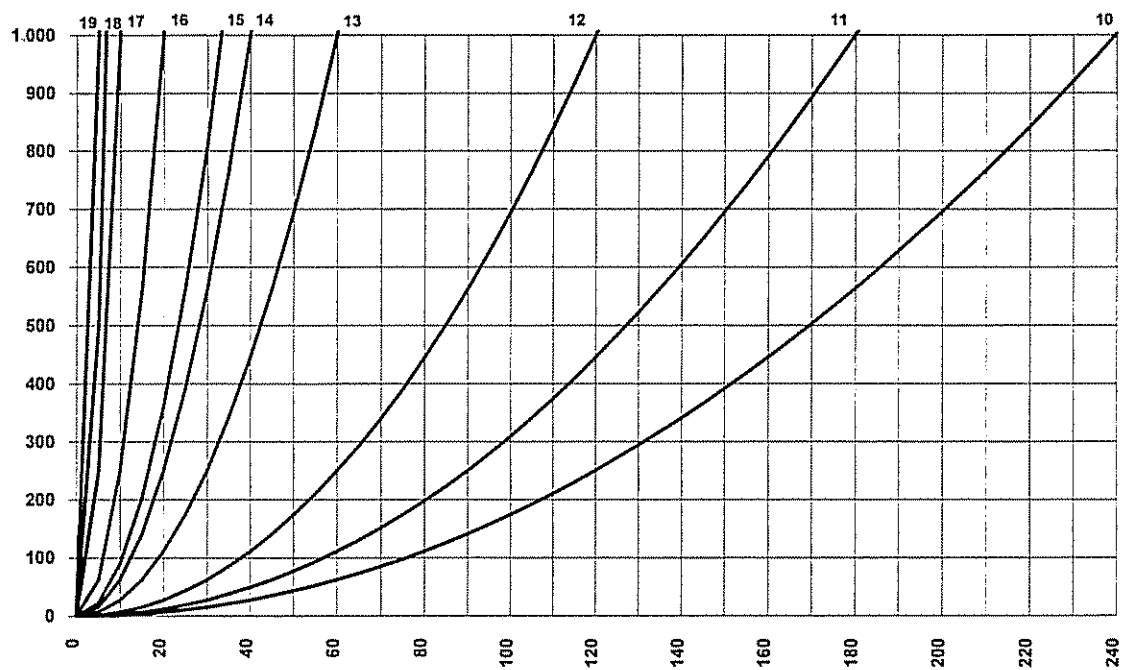


Figure 3

The curve 19 is a special case compared with the other curves. The centrifuge accelerates with maximum torque. The acceleration time only depends on the moment of inertia of the rotor.

8. Appendix:

Quadratic curve no.	Time up to 1000 rpm	Slope from 1000 rpm linear
10	240	120 sec./1000 rpm.
11	180	90 sec./1000 rpm.
12	120	60 sec./1000 rpm.
13	60	30 sec./1000 rpm.
14	40	20 sec./1000 rpm.
15	30	15 sec./1000 rpm.
16	20	10 sec./1000 rpm.
17	10	5 sec./1000 rpm.
18	5	2,5 sec./1000 rpm.
19	0,9	0,5 sec./1000 rpm.

8.3 Entry Limitations

Valid entries or area limits could depend on:

- Type of centrifuge
- Rotor
- interdependent parameters

All entry limits are automatically checked. When reaching a limit the counting operation is stopped. By pressing the corresponding alteration key again delimiting to the max. or min. value is executed when the limits are exceeded or fallen below for the first time, with the next underflow the maximal and with overflow the minimal value is displayed.

Interdependent parameters are limited further with a change of the corresponding parameter. When using the alteration keys, limit errors are impossible. With the alteration of a parameter, the corresponding parameter is recalculated. The recalculated parameter is indicated by a flashing parameter-LED. If the changed parameter is selected, the recalculated value is displayed.

8.4 Mathematical Relation

8.4.1 Relative Centrifugal Force (RCF)

The parameters speed, RCF and the diameter of the rotor are interrelated via the following formula:

$$\text{RCF} = 11,18 * 10^{-6} * r * n^2$$

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

r = radius in cm

n = speed in rpm

RCF without dimension

8.4.2 Density

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

$$n = n_{\text{max}} * \sqrt{1 / \text{Gamma}}$$

Gamma = density in g/cm³

8.5 Error Correction

Most of the errors can be reset by power off/on. In the event of a short power supply failure during a run, this run is interrupted and can be continued by pressing the Start-key.

No indication on the display: Actions:

- | | |
|---|--|
| – No voltage in the socket? | • Check fuse in mains supply. |
| – Power cord plugged in and line voltage present? | • Plug in power cord correctly. |
| – Input fuse ok? | • Replace input fuse (see nameplate for rating). |
| – Power switch on? | • Switch on power. |

8.5.1 Centrifuge cannot be Started

a) Start-key LED not illuminated:

- | | |
|---------------------------------|---|
| – Edit-Aktiv-LED illuminated. | • Edit-Active-Mode is left by pressing the Enter-key or the Edit-key. |
| – Lid-LED (Ü1) not illuminated. | • Close lid. Lid locks must close. |

- b) Start-key LED illuminated: • Power off/on. If error occurs again, call service.

8.5.2 Centrifuge Decelerates during Operation

a) Imbalance-LED (Ü3) flashing:

- | | |
|--|--|
| – Rotor is loaded unevenly. | • Balance loading. |
| – Centrifuge tilted. | • Align centrifuge. |
| – Drive error (mechanical damage). | • Call Service. |
| – Centrifuge was moved during operation. | • Restart after opening and closing lid. |
- Centrifuge displays an error 73 to 75 after power on. • These error numbers indicate an error in the internal program storage. This error is eg. generated when a power failure occurs during a storage procedure.

8.5.3 Lid cannot be Opened/Closed

When first trying to open the lid the lock is not released. Press the lid down with both hands until the yellow LED at the key K5 is illuminated.

8.5.4 Emergency Lid Release

In the event of eg. a power supply failure it is possible to manually open the lid. At the right panel there is a stopper which can be removed eg. with a screw driver. The lid can be released by pulling the visible string.

Attention!

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

8. Appendix:

8.6 Error Codes

Error no.	Kind of error	Measures	Comment
1-62	Internal error	<ul style="list-style-type: none">• let slow down• power off/on	
69-77	EEPROM error	<ul style="list-style-type: none">• let slow down• power off/on	ATTENTION: Saved curves and programs could have been deleted.
78	Lid does not close	<ul style="list-style-type: none">• power off/on• remove foreign matter	
79	Faulty log identification	<ul style="list-style-type: none">• press lid key• close lid rapidly• check log opening for impurities	
80	Lid electronics defective	<ul style="list-style-type: none">• contact Service	
81	Rotor spins with open cover	<ul style="list-style-type: none">• let slow down• close lid• power off/on	
82-83	Lid does not open	<ul style="list-style-type: none">• power off• emergency lid release	
84	Excess temperature heat sink	<ul style="list-style-type: none">• let cool down• provide for better ventilation• power off/on	
85	Excess temperature centrifuge chamber (> 50 °C)	<ul style="list-style-type: none">• let cool down• provide for better ventilation• power off/on	
87	Actual temperature > 45 °C resp. < -20 °C	<ul style="list-style-type: none">• provide for better ventilation	
88	Excess temperature switch activated (temp. > 70 °C)	<ul style="list-style-type: none">• provide for better ventilation• refrigerating machine defective	
90-96	Sensor defective	<ul style="list-style-type: none">• power off/on	
98	Faulty rotor identification	<ul style="list-style-type: none">• check rotor	
99	Incorrect rotor	<ul style="list-style-type: none">• check rotor and set rotor resp. bucket identification	

Should it not be possible to repair the failure, please contact Service.

Radius [cm]

120
100
80
60
45
35
30
25
20
18
16
14
12
10
9
8
6
5

Drehzahl-Schwerefeld-Diagramm in
Abhängigkeit vom Radius der Rotoren
Speed-gravitational field diagram
dependent on the radius of the rotors

5000
50 000

↑
c

1000
10 000

500
5 000

100
1 000

10
1000

50
50 000

100
10 000

g →

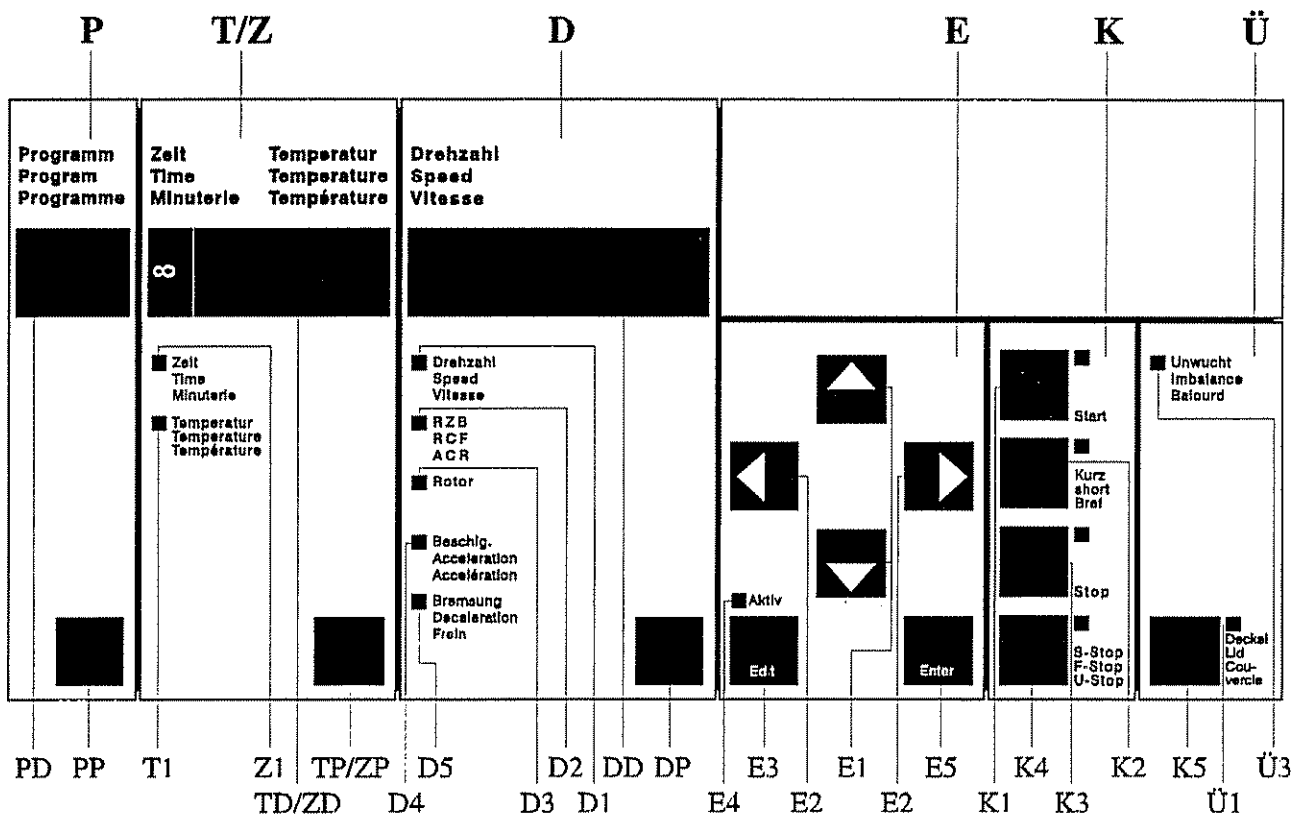
500
50 000

1000
100 000

2000
200 000

3000
300 000

4.1 Operating Panel



P	Program panel	E	Input panel
PP	Program parameter key	E1	Alteration keys
PD	Program display	E2	Cursor keys
		E3	Edit-key
T/Z	Temperature and time panel	E4	Edit-Aktiv-LED
TP/ZP	Temperature and time parameter key	E5	Enter-key
Z1	Time-LED	K	Command panel
T1	Temperature-LED	K1	Start-key
TD/ZD	Temperature and time display	K2	Short-key
		K3	Stop-key
D	Speed panel	K4	Faststop-key
DD	Speed display	Ü	Monitoring panel
DP	Speed parameter key	Ü3	Monitoring LED Imbalance
D1	Speed-LED	Ü1	Monitoring LED Lid
D2	RCF-LED	K5	Lid-key
D3	Rotor-LED		
D4	Acceleration-LED		
D5	Deceleration-LED		