sigma ®

*Laborzentrifugen*

# Konformitätserklärung

(73/23/EWG; 89/336/EWG; 98/37/EWG)

# Statement of Conformity

(73/23/CEE; 89/336/CEE; 98/37/CEE)

# Déclaration de conformité

(73/23/CEE; 89/336/CEE; 98/37/CEE)

Die nachfolgend bezeichnete Maschine wurde in Übereinstimmung mit den Richtlinien 73/23/EWG; 89/336/EWG und 98/37/EWG hergestellt und geprüft.
The following machine is manufactured and tested in compliance with directions 73/23/CEE; 89/336/CEE and 98/37/CEE.
La machine désignée ci-dessous est produit et examiné conforme aux directives 73/23/CEE; 89/336/CEE et 98/37/CEE

| | |
|---|---|
| Bezeichnung der Maschine:<br>Machine:<br>Désignation de la machine: | Laborzentrifuge<br>Laboratory Centrifuge<br>Centrifugeuse de laboratoire |
| Maschinentyp :<br>Type:<br>Type de la machine: | 2 K 15 |
| Bestell Nr. :<br>Part No.:<br>Réf. usine: | 10710, 10711, 10712, 10713, 10715, 10716 |
| Normen:<br>Standards:<br>Normes : | EN 61010-2-020<br>EN 61000-3-2 ; EN 61000-3-3<br>EN 61326 |

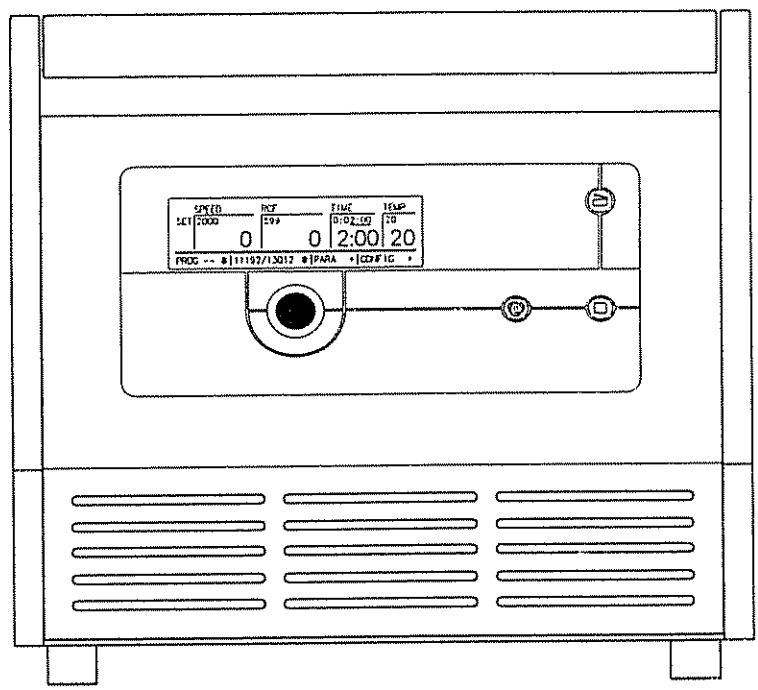
**Sigma Laborzentrifugen**
An der Unteren Söse 50
D-37520 Osterode

01.02.2002

Geschäftsführer
Managing Director
Directeur Gérant

Fabr Nr. Serial No Numero de fabrique

sigma®



## Refrigerated Centrifuge

# 2K 15C

# OPERATING MANUAL

# Preface:

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 which can store up to 50 data sets 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 important operation parameters can be seen at a glance.

The settings are executed via the knob in the control panel which has a coated surface protecting the device against moisture and dust. In addition, the interior of the centrifuge is also easy to clean. 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.

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# SHORT INSTRUCTION

## for SIGMA 2K15C, 3K18, 3K30, 4K15C, 6K15C

**with free programming of the operation parameters**

**Important: Please pay attention to the notes in the detailed operating 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 keys are illuminated:

- Lid-key 
- Start-key 

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

- Speed **2000**
- RCF **814**
- Time **0:02:00**
- Temp **20**

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 (5.1):

a) Select the area of the rotor selection list (⇕) by turning the knob. After pressing the knob, you get a view over all available rotor types. Select the number of the actual rotor or rotor/bucket combination by turning the knob and confirm the entry by pressing the knob (5.1.6).

b) Select **SPEED** by turning the knob. Press the knob once and set speed value by turning the knob. Confirm entry by pressing the knob again. The corresponding relative centrifugal field RCF is calculated from rotor number and speed (5.1.1)

c) The RCF area shows the relative centrifugal field value at the preselected speed. For changing this value select **RCF** by turning the knob. Press the knob once and set RCF value by turning the knob. Confirm entry by pressing the knob again. The corresponding speed is calculated (5.1.2).

d) Select the parameter area **PARA** by turning the knob. Press the knob once and select **ACCELERATION** by turning the knob. Press the knob once and select the desired acceleration curve by turning the knob. Confirm entry by pressing the knob (5.1.5)

e) Select **DECELERATION** by turning the knob Press the knob once and select the desired decelaration curve by turning the knob. Confirm entry by pressing the knob (5.1.5) Select **EXIT** by turning the knob. After pressing the knob you return to the main display

f) Select **TIME** by turning the knob Press the knob once and set time value by turning the knob. If the value exceeds 9 h 59 min and the knob is turned further, continuous run is activated and "HOLD" is displayed Confirm entry by pressing the knob again (5.1.3).



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Postfach 1713 An der Unteren Söse 50 D-37507 Osterode am Harz Telefon (05522) 5007-0 Telefax (05522) 5007-12 Telex 965101 crist d

g) Select the temperature area **TEMP** by turning the knob. Press the knob once and select the desired temperature value in °C by turning the knob. Confirm entry by pressing the knob (5.1.4).

h) Instead of selecting individual run parameters, a stored program can be retrieved. (Possible if a program number had been allocated.) Select the area of the program selection list **PROG --** by turning the knob. Press the knob once and select the desired program number by turning the knob. Confirm the entry by pressing the knob again (6.1.1).

## 5.

Start the program using the Start-key.

## 6.

Alteration of parameters (during run; 5.1.7 and 5.1):

a) Select desired area by turning the knob.

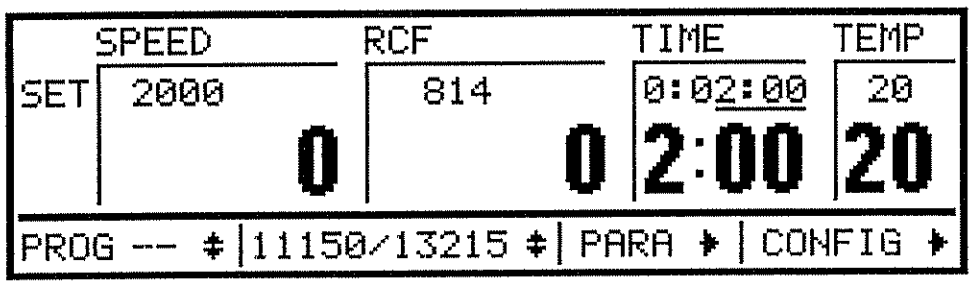
b) Press the knob once.

c) Change the value by turning the knob.

d) The changed parameters are used for the actual run by pressing the knob again.

## 7.

The run can be stopped at any time by pressing the Stop-key.




(Subject to technical alterations)

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# 1. General Information:

## 1.1 Technical Data

| | |
|---|---|
| Manufactuer: | S I G M A<br>Laborzentrifugen GmbH<br>D-37520 Osterode<br>Germany |
| Type: | 2K 15C |
| Electr. connection: | 230 V, 50 Hz/240 V, 60 Hz |
| Power consumption (kVA): | 0,94 |
| Rated power (kW): | 0,52 |
| Max. current (A): | 4 |
| Power data: | |
| Max. speed (rpm): | 15 300 |
| Max. capacity (l): | 0,4 |
| Max. gravitational field (x g): | 21 918 |
| Max. kin. energy (Nm): | 9 962 |
| Further parameters | |
| Time range: | 9 h, 59 min/continuous operation |
| Temperature setting range: | -20 to + 40 °C |
| Programs: | 50 No. 1 - 50 |
| Acceleration curves: | 10 linear No 0 - 9<br>10 quadratic No. 10 - 19<br>10 freely programmable No 20 - 29 |
| Deceleration curves: | 9 linear No. 1 - 9<br>1 brakeless No. 0<br>10 quadratic No. 10 - 19<br>10 freely programmable No. 20 – 29 |
| Radius: | max./min. s. 1.2 |
| Rotor part no.: | s. chapter 1.2 |
| Dimensions: | |
| Depth (mm): | 655 |
| Width (mm): | 380 |
| Height (mm): | 345 |
| Weight (kg): | 59 |
| EMC (acc to EN 55011): | Class B |
| Noise level (dBA): | 66<br>63 ( during precooling) |
| | |
| 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 % ) Subject to technical alterations.

## 1.2 Accessories Suitable for SIGMA 2K 15C

| Part No. | Description | Max. speed (rpm) | Max. gravitational field (x g) |
|---|---|---|---|
| 11124 | Swing-out rotor 24 x 1,5/2,2 ml, max. radius 7,4 cm, min. radius 3,5 cm | 14 000 | 16 219 |
| 11411 | Drum rotor for microtubes (max. 60/120 pcs.), incl. cover, for carriers 14000 and 14002, max. radius 7,1 cm, min. radius 3,0 cm. Attention: At speeds exceeding 13 000 rpm the vessels could be damaged. | 13 700 | 14 898 |
| 14000 | Cassette, PA6, for 20 reaction vials 0,25/ 0,4 ml | | |
| 14002 | ditto, for 10 reaction vials 1,5/2,2 ml | | |
| 12139 | Angle rotor 6 x 30 ml, max. radius 7,8 cm, min. radius 2,2 cm, angle 30° | 15 300 | 20 414 |
| 12141 | Angle rotor 10 x 10 ml, max. radius 7,6 cm, min. radius 2,9 cm, angle 35° | 15 300 | 19 890 |
| 12148 | Angle rotor 24 x 1,5/2,2 ml, incl. lid, max. radius 8,2 cm, min. radius 5,0 cm, angle 45° | 15 300 | 21 460 |
| 12132 | Angle rotor 30 x 1,5/2,2 ml, incl. hermetic aluminium lid, max. radius10,0 cm, min. radius 6,7 cm, angle 45° | 14 000 | 21 913 |
| 12104 | Angle rotor, aluminium, for 12 strips with 8 PCR-tubes 0,2 ml each, max. radius 9,8 cm, min. radius 8 cm | 14 000 | 18 845/21 475 |
| 12105 | Angle rotor, aluminium, for 16 strips with 5 PCR-tubes 0,2 ml each, max. radius 9,6 cm, min. radius 8 cm | 14 000 | 18 625/20 598 |
| 12072 | Angle rotor 20 x 15 ml, for round or conical tubes, max. ∅ 17 up to 120 mm, e.g. 15015, 15020, 15023, 15024, Monovettes, Falcon tubes 15 ml 15115, max. radius 13,6 cm, min. radius 7,5 cm | 3 900 | 2 313 |

| Part No. | Description | Max. speed (rpm) | Max. gravitational field (x g) |
|---|---|---|---|
| 12073 | Angle rotor 30 x 15 ml, for round or conical tubes, max. ∅ 17 up to 120 mm, e.g. 15015, 15020, 15023, 15024, Monovettes, Falcon tubes 15 ml 15115, 2 lines, | | |
| | max. radius 13,6 cm, min. radius 7,5 cm, | 3 900 | 2 313 |
| | max. radius 11,6 cm, min. radius 5,4 cm | 3 900 | 1 973 |
| 12151 | Angle rotor for 6 Falcon tubes 50 ml, max. radius 9,5 cm, min. radius 3,0 cm, angle 28° | 9 000 | 8 603 |
| 11409 | Microhematocrite rotor for 24 capillary tubes 1,5 x 75 mm, 50 µl, incl. reader for 1 capillary tube, max. radius 9,0 cm, min. radius 1,5 cm | 12 000 | 14 489 |
| 15001 | Microhematocrite capillary tubes, heparinized, 1,5 x 75 mm, 50 µl, 200 pcs. per pack | | |
| 17002 | Reader for use with microhematocrite rotor | | |
| 17003 | Reader for 1 capillary tube | | |
| 17004 | Magnifying glass | | |
| 17005 | Capillary sealing putty (6 plates) | | |
| 17029 | Reader card for 1 capillary tube | | |
| 11190 | Swing-out rotor 4 x 100 ml, complete, consisting of rotor 11192, 4 buckets 13097, 4 glass tubes 15100 und 4 rubber cushions 16051, max. radius 13,5 cm, min. radius 5,0 cm | 5 000 | 3 773 |
| 11191 | Swing-out rotor 16 x 15 ml, complete, consisting of rotor 11192, 4 buckets 13012, 16 PS-tubes 15020 and 16 rubber cushions 16015, max. radius 13,4 cm, min. radius 5,1 cm | 5 000 | 3 745 |
| 11192 | Swing-out rotor for 4 buckets | 5 000 | 3 773/3 745 |
| 13004 | Aluminium bucket 5 x 7 ml | | |

| Part No. | Description | Max. speed (rpm) | Max. gravitational field (x g) |
|---|---|---|---|
| 13009 | Aluminium bucket for 5 RIA-tubes ∅ 12 x 75 mm long | | |
| 13012 | Aluminium bucket 4 x 15 ml | | |
| 13022 | Aluminium bucket 1 x 25 ml | | |
| 13047 | Aluminium bucket 1 x 50 ml | | |
| 13097 | Aluminium bucket 1 x 100 ml | | |
| 13040 | Sealed bucket, incl. screw cap, max. tube length 110 mm, suitable for 11192, max. radius 13,98 cm | 5 000 | 3 907 |
| 17140 | Sealing cap for 13040 | | |
| 17205 | Round carrier for 4 Vacutainer-tubes, suitable for 13040 | | |
| 17215 | Round carrier for 3 tubes (round and pointed bottom) 15 ml, suitable for 13040 | | |
| 17225 | Round carrier for 1 glass tube 25 ml, suitable for 13040 | | |
| 17250 | Round carrier for 1 tube 50 ml, suitable for 13040 | | |
| 13150 | Sealed bucket, incl. screw cap, for 50 ml Falcon tube, suitable for 11192 | | |
| 17151 | Sealing cap for 13150 | | |
| 11122 | Swing-out rotor for 2 – 6 microtiter plates 86 x 130 mm, incl. 2 carriers 13222,<br>radius edge 12,1 cm,<br>radius max. 10,5 cm,<br>radius min. 6,5 cm | 3 000 | <br>1 218<br>1 057<br>654 |

| Part No. | Description | Max. speed (rpm) | Max. gravitational field (x g) |
|---|---|---|---|
| 11123 | Swing-out rotor for 2 – 6 micro liter plates 86 x 130 mm, incl. 2 carriers 13 223,<br>radius edge 11,9 cm,<br>radius max. 10,0 cm,<br>radius min. 6,5 cm | 4 000 | 2 129<br>1 789<br>1 163 |

## Adaptors and Plastic Vessels

| | |
|---|---|
| 13000 | Adapter, POM, for reaction vials 0,25/0,4 ml, suitable for 12132, 12148, 14002, 11124 |
| 13002 | Adapter, POM, for Eppendorf reaction vials 0,5/0,75 ml, Ø 7,9/10 x 28/31 mm, suitable for 12132, 12148, 14002, 11124 |
| 13021 | Adapter for PCR-tube 0,2 ml, Ø 5,85/6,95 x 20/23,4 mm, suitable for 12132, 12148, 14002, 11124 |
| 13059 | Adapter 1 x 10 ml (15000, 15010, 15019), suitable for 12139 |
| 13060 | Adapter, polypropylene, for 1 Falcon tube 15 ml, suitable for 13150, 12151 |
| 19890 | Sealing cap, polycarbonate, suitable for 13061 |
| 15005 | Reaction vials 0,5 ml (Eppendorf system), polypropylene, Ø 7,9/10 x 28/31 mm,<br>1 pack contains 100 pcs., suitable for 13002 |
| 15008 | Reaction vials 1,5 ml (Eppendorf system), polypropylene, 1 pack contains 100 pcs., suitable for 12132, 12148, 14002, 11124 |
| 15040 | Reaction vials 2,2 ml (Eppendorf system), polypropylene, 1 pack contains 100 pcs., suitable for 12132, 12148, 14002, 11124 |

| Part No. | Description |
|---|---|
| 15010 | Polycarbonate bucket 12 ml, ∅ 16,1 x 81,1 mm, incl. screw cap, suitable for 11412, 12141, 13059, autoclavable |
| 15019 | ditto, polyallomer, autoclavable |
| 15000 | ditto, Teflon, autoclavable |
| 15039 | ditto, polypropylene, autoclavable |
| 15014 | Reaction vials 0,4 ml (Beckman system), polypropylene, 1 pack contains 100 pcs., suitable for 13000, 14000 |
| 15020 | Polystyrene bucket 15 ml, ∅ 17 x 100 mm, suitable for 13012 |
| 15021 | Polypropylene stopper for 15020, 15023 |
| 15023 | Polypropylene bucket 15 ml, ∅ 17 x 100 mm, suitable for 13012 |
| 15115 | Falcon tube 15 ml, incl. screw cap, suitable for 13060, 12072, 12073 |
| 15029 | Teflon bucket 28 ml, ∅ 25,3 x 92 mm, incl. screw cap, suitable for 12139, autoclavable |
| 15030 | Polycarbonate bucket 32 ml, ∅ 25,3 x 92 mm, incl. screw cap, suitable for 12139, autoclavable |
| 15032 | Polypropylene bucket 28 ml, ∅ 25,3 x 92 mm, incl. screw cap, suitable for 12139, autoclavable |
| 15049 | Polycarbonate bucket 50 ml, graduated, ∅ 34 x 100 mm, suitable for 13047 |
| 15151 | Falcon tube 50 ml, incl. screw cap, suitable for 13150, 12151 |
| 15102 | Polypropylene bucket 100 ml, ∅ 45 x 100 mm, suitable for 13097 |

| Part No. | Description |
|---|---|
| 15103 | ditto, poly carbonate, graduated |

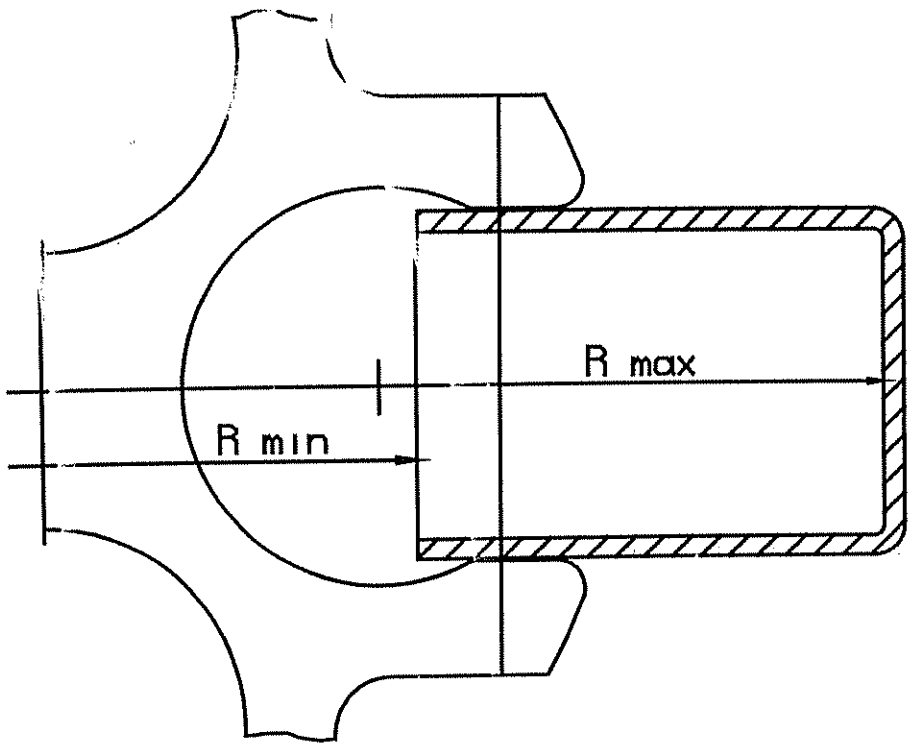
## Centrifuge Glass Tubes

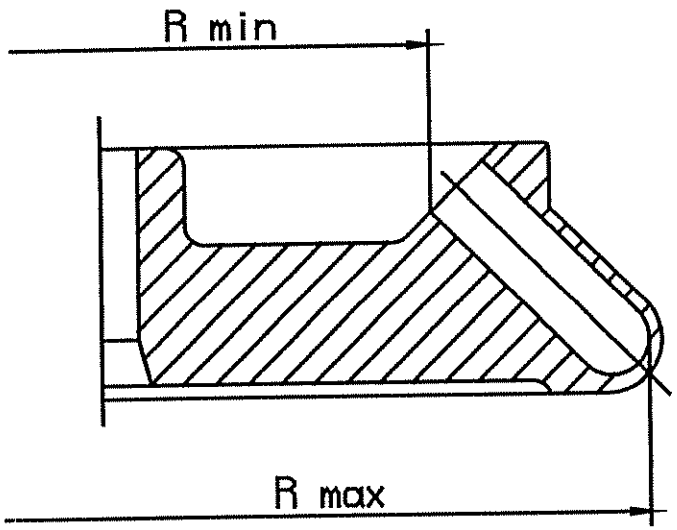
| | |
|---|---|
| 15007 | Centrifuge glass tube 7 ml, ∅ 12 x 100 mm, suitable for 13004 |
| 15027 | ditto, graduated |
| 15015 | Centrifuge glass tube 15 ml, ∅ 16 x 100 mm, suitable for 13012, 17215 |
| 15024 | ditto, graduated |
| 15025 | Centrifuge glass tube 25 ml, ∅ 24 x 100 mm, suitable for 13022, 17225 |
| 15026 | ditto, graduated |
| 15050 | Centrifuge glass tube 50 ml, ∅ 34 x 100 mm, suitable for 13047, 17250 |
| 15056 | ditto, graduated |
| 15100 | Centrifuge glass tube 100 ml, ∅ 44 x 100 mm, suitable for 13097 |
| 15106 | ditto, graduated |
| 17914 | Table for centrifuge made of chipboards with 2 doors and space for accessories, movable on lock-type castors, dimensions: w 650, d 680, h 470 mm |
| 17913 | Fasteners for table 17914 |

Further accessories available on request.

## 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 adapters at higher speeds than their breaking limit. We recommend to always fill up the tubes and to follow the recommendations of the manufacturer.


R max
R min


R min
R max

## 1.3 Scope of Supply

The following belongs to the centrifuge:

| | |
|---|---|
| 1 Rotor wrench SW 13 | Part No. 930 102 |
| 1 Square wrench "Emergency lid release" | Part No. 80 054 |
| 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 Manual
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. |
|---|---|
| | |
| | |
| | |
| | |
| | |
| | |
| | |

## 1.4 Standards and Regulations

Please refer to the enclosed EU-Statement of Conformity.

## 1.5 Safety Instructions

regarding operation of centrifuges with rotors of different max. speed, e.g. 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 max. speed engraved on the rotor and/or the bucket 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.

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.

9. Attention!
   Defective lid relieving devices could cause the centrifuge lid to fall down (contact Service). Risk of bruising!

# 2. Description of Centrifuge:

## 2.1 General Outlay

The new generation of SIGMA laboratory centrifuges is equipped with two microprocessors which guarantee independently the control of the rotor recognition and the overspeed signal. A further optimization and increase of the instrument's safety could be maintained. The long-life asynchronous motor is silent and brushless. 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 sheet steel housing. The armoured chamber, the sheet steel lid, the motorized lid lock device and the hinge system are providing optimum safety. At the back the lid is secured by solid hinges and at the front twice by a motorized lid lock. Due to these elements there is a solid safety case around the rotor chamber.

The centrifuge stands on elastic feet.

## 2.3 Drive

The drive motor is a well dimensioned asynchronous motor

## 2.4 Operation and Display

The grafical LCD display is hermetically sealed. A single knob only allows any data input. The backlit display indicates any operating status and guides 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.

## 2.5 Electronic Control

The electronics controlled by two microprocessors allows extensive adaptations of the centrifuge to the different tasks. The following parameters can be programmed and displayed among others:

- Speed (by activation of FINE steps of 1 or 10 rpm possible)
- RCF in steps of 1 or 10 x g
- Time preselection (9 h, 59 min max.), in steps of 1 min or 1 sec
- Continuous operation
- Short-time operation
- Temperature setting range between –20 °C and +40 °C
- Fixed deceleration and acceleration curves
- Free creation of deceleration and acceleration curves
- Saving, recalling and alteration of programs
- Input and measurement of the time integral
- Start delay
- Precooling
- Continuous self-monitoring and recognition of errors which are displayed 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 power switch is switched to "ON" and when the lid is correctly closed. After closing the lid the motorized lid locks are automatically locked. The lid can only be opened when the rotor has completely stopped. If the lid is opened by the emergency release during operation, the centrifuge will immediately switch off and decelerate brakeless up to standstill of the rotor. If the lid is open, the drive is completely separated from the mains supply, that means starting of the centrifuge is impossible (refer to chapter 9.5.4 "Emergency lid release").

### 2.6.2 Imbalance Monitoring System

In the event that uneven loading leads to imbalance, the drive is switched off and an imbalance warning message is displayed.

### 2.6.3 Excess Temperature in the Centrifuge Chamber

Once the temperature in the centrifuge chamber exceeds 50 °C, e. g. due to a failure of the cooling device, the drive switches off. Restarting the centrifuge is only possible after cooling down (refer to chapter 9.6 "Error codes").

### 2.6.4 Rotor Monitoring

During programming the rotor part no. and if required the bucket part no. must be entered. Two microprocessors check, if the entered speed or the gravitational field is allowed for the rotor. Input errors are impossible (refer to point 9.3 "Entry limitations"). After starting, during the start-up phase, the computer additionally checks the identification of the rotor.

**Attention: Please take care to enter the correct bucket part no. as the max. allowable speed could be exceeded by entering an incorrect bucket. This is not allowed.**
If the rotor doesn't correspond to the programmed rotor no., STOP is carried out and an error message is displayed. Restarting the centrifuge is only possible after reset and when the correct rotor number has been selected.

### 2.6.5 Standstill Monitoring

Opening of the centrifuge lid is only possible, if the rotor is at standstill. This standstill is checked by the computer and also by an additional hardware circuit.

### 2.6.6 System Check

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

### 2.6.7 Ground Wire Check

For ground wire check there is a ground screw at the rear panel of the centrifuge. A ground wire check can be carried out using an appropriate measuring instrument.

# 3. Installation, Start-up:

## 3.1 Unpacking of the Centrifuge

Open carton. Take out the box containing accessories. Remove packaging material. Lift centrifuge upwards with a lifting device or with several persons. When lifting or carrying the centrifuge please always reach under the instrument from the side.

**Attention: The instrument is heavy!**

Please keep carton for possible transport of centrifuge later.

### 3.1.1 Transport Safety Device

The SIGMA 2K 15C has no transport safety device.

## 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. The air-ducts in the unit must be open. Also, the centrifuge shouldn't be positioned near radiators and should not be directly exposed to sunshine.

A clearance of at least 30 cm around the centrifuge is necessary.

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 water will condensate inside the centrifuge. It is important that there is enough time for drying before the centrifuge can be started again.

### 3.2.2 Connection/Fuse

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. The instrument has thermal fuses. In case of a disconnection through the thermal fuses, allow a cool-down phase of two minutes, after which they could be reactivated by a switch.

### 3.2.3 Fuses / Emergency Circuit Breaker on Site

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

An emergency circuit breaker to cut the power to the centrifuge in the event of a malfunction is required on site. This switch should be located away from the centrifuge, preferably outside the room where the centrifuge is used or at the exit of this room.

## 3.3 Installation of Rotors and Accessories

1. Open centrifuge lid by pressing Lid-key.

2. Unscrew rotor tie-down screw from motor shaft (anticlockwise).

3. Lower the rotor straight down onto the motor shaft.

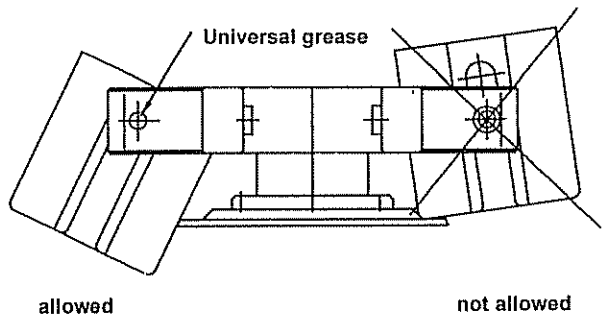
4. Tighten the tie-down screw (clockwise) with the rotor wrench so that the disc spring is pressed together.

| | | |
|---|---|---|
| Fastening torque: | 1-6/1-13/1-15/2-3/2-4/1K 15/2-15/2K 15: | approx. 5 Nm |
| | 3-15/3K 15/3K 18/3K 30: | approx. 7,5 Nm |
| | 4-15/4K 15/6-15/6K 15: | 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 (please refer to chapter 5.1.4 "Alteration of the Configuration" – Cycles).** This ensures a proper connection between rotor and shaft (please refer to chapter 8.2 "Care and cleaning of accessories" as well).

5. Fill all positions of swing-out rotors with buckets. Make sure that all buckets are inserted correctly.

6. Use only appropriate vessels for the rotor (please refer to chapter 1.2 "Suitable accessories" as well).




7. Fill vessels external to the centrifuge.

8. Put or screw on covers of vessels.

9. Opposite places of the rotors must always be loaded with same accessories and same filling.

10. In angle rotors the plastic vessels must always be totally filled to avoid cracks of vessels and leakages or loosening of the caps in case of partial filling.

**Attention, follow the special comments of chapter 1.5.**

11. **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 monitoring will switch off the drive and an imbalance warning would be displayed.

12. Rotors with lid should always be run with their lid. The rotor lid is tightened by hand. Correct fastening must be ensured. **Attention: The lid screw serves for fastening of the lid onto the rotor only, not for fastening of the rotor onto the drive!** Before installation of the lid, the correct fastening of the rotor fixing screw must always be checked using a wrench.

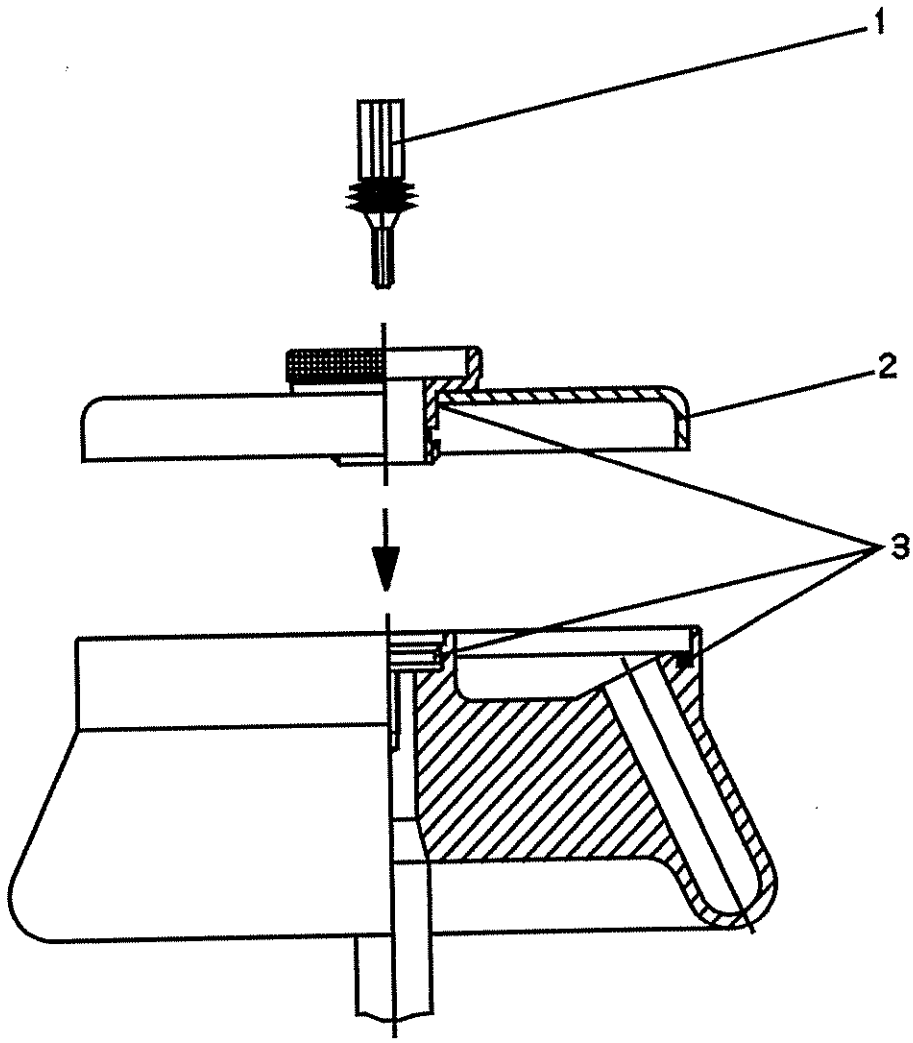
### 3.3.1 Fastening of Angle Rotors with Hermetically Sealed Lid

(Please refer to drawing on next page.)

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

   All rotors can be installed or removed with closed lid after loosening the rotor tie-down screw. All rotors are autoclavable (refer to chapter 8.6 "Sterilization and disinfection of rotor chamber and accessories").
   To increase life of rotors and seals the rotors must be cleaned 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.


1
2
3

## 3.4 Initial Start-Up

Attention!

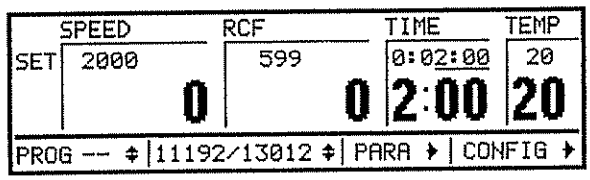
Before initial start-up please take care that your centrifuge is orderly installed (refer to chapter 3.2 "Installation").

### 3.4.1 Switching on of the Centrifuge

Press mains switch (at the back of the centrifuge). When power is applied the first time, default values will be displayed:

- The command panel illuminates.
- The speed display indicates "2000".
- The time display indicates "2".
- A temperature of 20 °C is set.
- The program display indicates "--", i.e.

  - the centrifuge will accelerate to 2000 rpm,
  - the centrifuge operation is terminated after 2 minutes,
  - the cooling system is set to a temperature of 20 °C,
  - no program number has been allocated so far.




### 3.4.2 Opening Lid

Press Lid-key

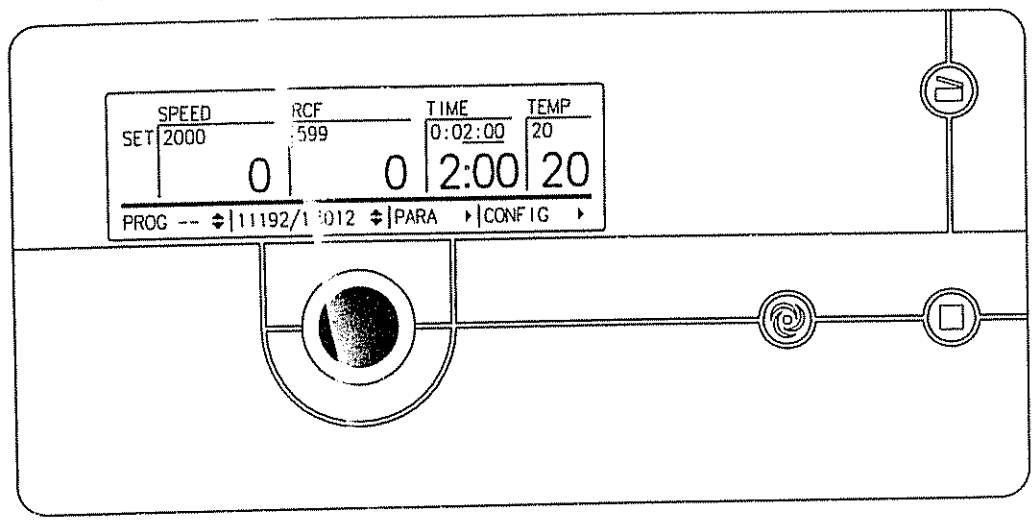
- The lid opens.

### 3.4.3 Installation of a Rotor

Put a rotor onto the shaft and fasten it by screwing the rotor tie-down screw clockwise onto the drive shaft. Please use the supplied rotor wrench (refer to chapter 3.3 "Installation 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.

# 4. Operating Elements:

## 4.1 Operating Panel




Operating panel

The centrifuge can be operated via the operating panel. Keys can be pressed when their LED is on.

### 4.1.1 Start-key 

This key can be used for the following:

- starting centrifuge operation,
- terminating a previously started deceleration process and restarting centrifuge,
- shifting into short-run at preselected speed. Pressing Start-key continuously for longer than one second leads to acceleration to the maximum speed with the maximum acceleration curve and after release deceleration with the maximum deceleration curve.

The centrifuge can be started when

- the lid is closed
- the Start-key is illuminated.

## 4.1.2 Stop-key 

This key can be used

- to early terminate a run: The centrifuge decelerates with the preset curve to a complete stop. Deceleration can be terminated by pressing the Start-key again.
- to carry out a faststop: Push Start-key for longer than one second. The centrifuge decelerates with the maximum deceleration curve.

## 4.1.3 Lid-key 

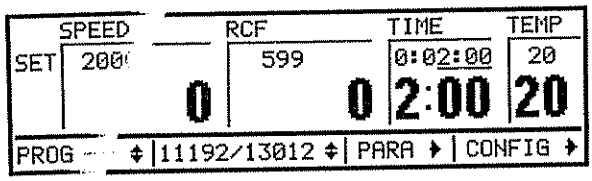
This key is used to open the lid. This can only be executed if

- the centrifuge has come to a complete stop
- the Lid-key is illuminated.

## 4.1.4 Knob

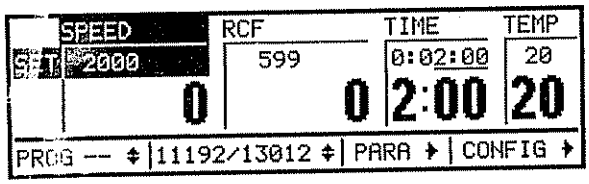
This knob can be used for selecting and alterating parameters and figures/ numbers.

## 4.2 Display



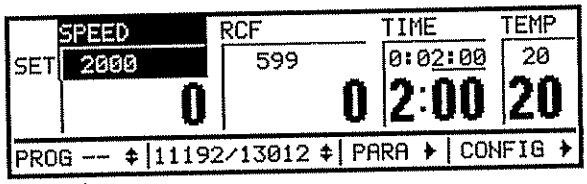

Default values

### 4.2.1 Set




If this area is illuminated, you are in the change mode which you can exit by pressing the knob (here in combination with the speed).

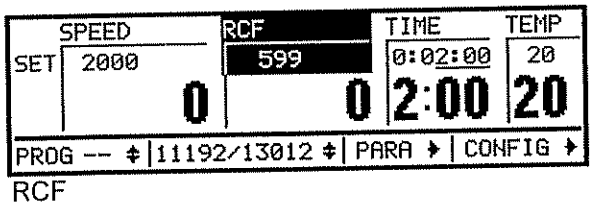
### 4.2.2 Speed




Speed

In the upper section of the area the set speed of the centrifuge is displayed. Underneath is the actual speed. The maximum speed values are rotor dependent.

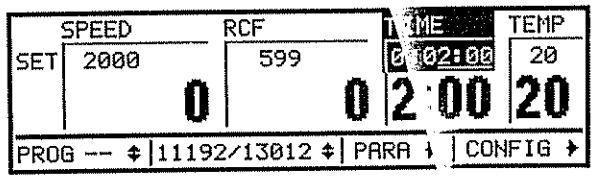
### 4.2.3 Relative Centrifugal Force (RCF)




RCF

The relative centrifugal force is the acceleration which the sample is exposed to. The set value of this parameter is in the upper section of this area, underneath is the actual value. The maximal RCF-values are rotor dependent.
(Refer to chapter 9.4 "Mathematical relations")

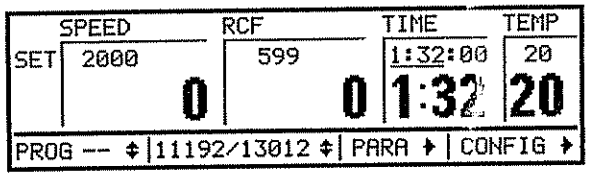
## 4.2.4 Time



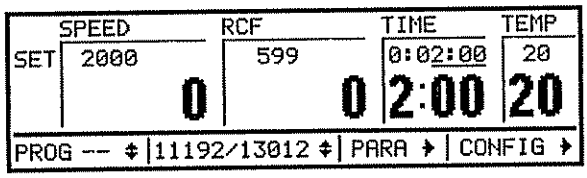
Time

The set run time is displayed in the upper section of this area, underneath the remaining run time is displayed. Time is defined as the period from the start of the centrifuge to the beginning of deceleration, maximum value is 9 h 59 min. The set time is underlined (here: 2 minutes).

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 set value is below 10 minutes.

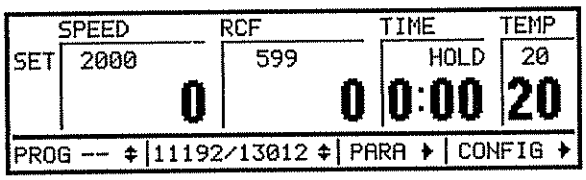


h:m



m:s

If the highest possible time of 9 h 59 min is exceeded or below the minium adjustable time range, continuous operation is activated. The word "HOLD" is displayed instead of the set value. After the start of a continuous run, the elapsed time is displayed instead of the remaining run time. By entering a specific run time the continuous mode is deactivated. It can be terminated by pressing the Stop-key as well.



Continuous run

## 4.2.5 Temperature (TEMP)

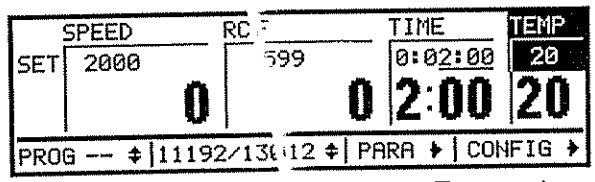



Fig 11 Temperature

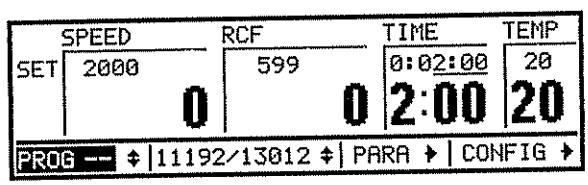
By entering a temperature, the desired temperature for the centrifuge chamber is set. Temperatures between -20 °C and +40 °C can be preselected. If an optional heating is included in the instrument, temperatures up to +60 °C can be set. To obtain this temperature the rotor incl. buckets has to be preheated at approx. 1500 rpm. The set value is in the upper section of the area, underneath the actual time is displayed.
When a run is started, there is a temperature difference between the sample and the rotor which is minimised after a certain operating period has passed.

As soon as the lid is opened, the cooling system is disconnected in order to avoid icing of the rotor chamber. With optional heating facilities the chamber surface could reach temperatures of 120 °C hot. In such case there is an increased risk of burning oneself.

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

With an ambient temperature of +23 °C the obtainable lowest temperature is < +4 °C at maximum speed. The actual run temperatures depend on rotor type, speed and ambient temperature.

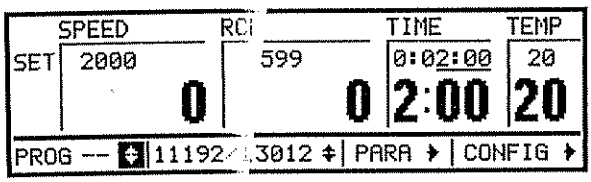
## 4.2.6 Program (PROG)



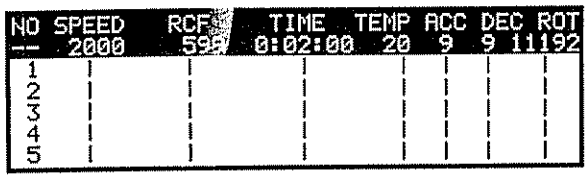

Program

In this area the number of the actual program is displayed. If the program is not saved yet, "--" is displayed.
By activating this area you are able to load stored programs without calling the selection list.
The program used last is automatically loaded after restarting.

Program Selection List (⇕)

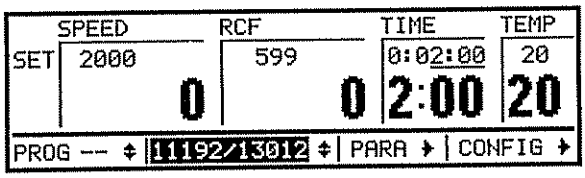



Program selection list




The area marked with arrows for the program selection list presents the view of the programs already saved. Storage space for fifty programs - No. 1 - 50- from which you can select and load a program is at your disposal. The actual loaded program is indicated by "--".

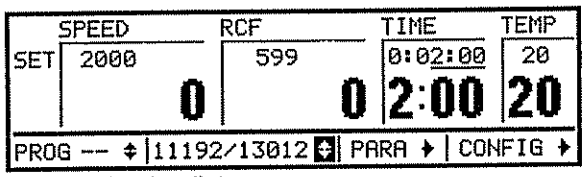
## 4.2.7 Rotor (here: 11192/13012)



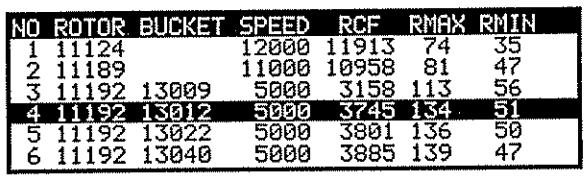

Rotor

In this area the actually selected rotor or a rotor/bucket combination are displayed.

Rotor Selection List (⇕)

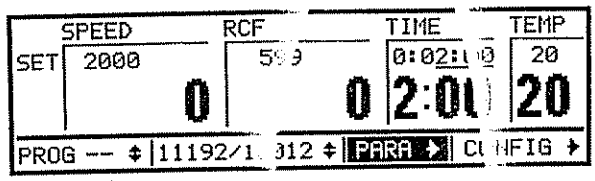



Rotor selection list

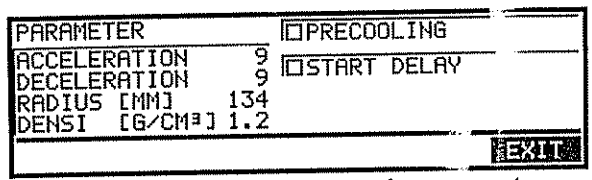



The area marked with arrows for the rotor selection list offers all available rotors which can be selected via the knob.

## 4.2.8 Parameters (PARA)

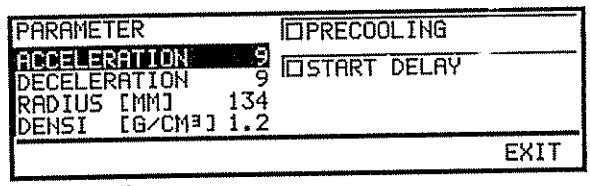



Parameters




If this area has been selected, parameters can be changed and the precooling and the start delay can be activated or deactivated.

### 4.2.8.1 Acceleration



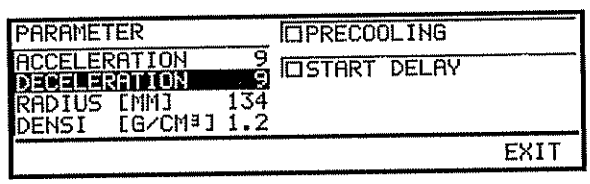

Acceleration

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

| | |
|---|---|
| 0 - 9 | linear |
| 10 - 19 | quadratic up to 1000 rpm, then linear |

Their shape is further explained in chapter 9.1 "Slope of the specified curves, linear curves" and 9.2 "Quadratic curves".

### 4.2.8.2 Deceleration

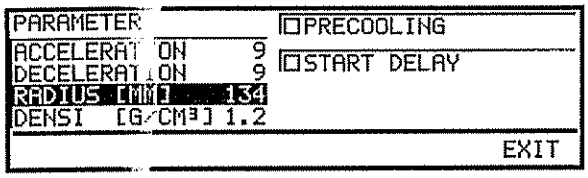



Deceleration

The deceleration number selects a deceleration curve that decelerates the centrifuge down to standstill. The deceleration curves are inverted images of the

acceleration and are labelled with identical numbers. Curve no. 0 represents brakeless deceleration.

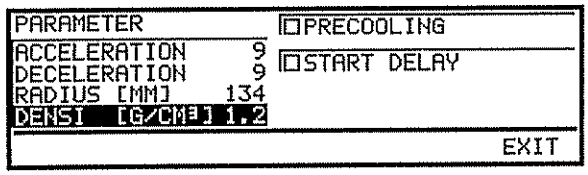
### 4.2.8.3 Radius




Radius

The set radius will determine the displayed RCF-value. If the radius is not changed, the max. RCF-value will be displayed.

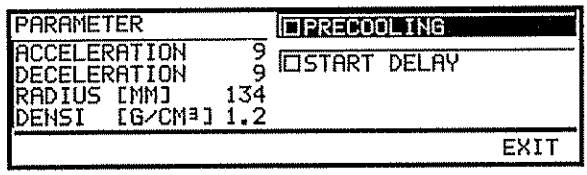
### 4.2.8.4 Density




Density

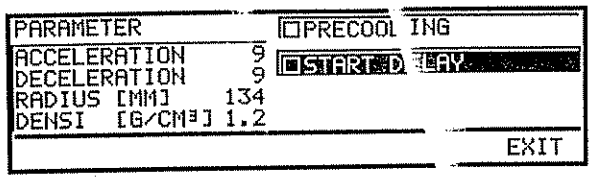
If the density of a sample exceeds 1.2 g/cm$^3$, the maximum final speed will reduce (refer to chapter 9.4.2 "Density"). A value between 1.2 and 9.9 g/cm$^3$ is possible.

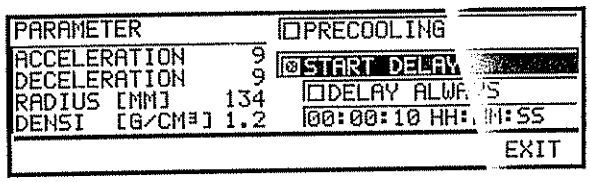
### 4.2.8.5 Precooling




This function offers a precooling to the set value after switching on of the centrifuge. The lid has to be closed.

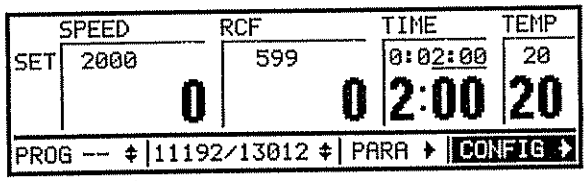
### 4.2.8.6 Start Delay



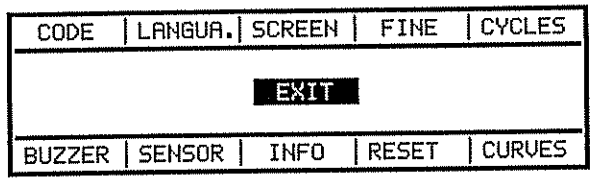

With this function a single or a permanent start delay can be set.

### 4.2.9 Configuration




Configuration

Selection of configuration (CONFIG) opens a menu where Code, Language, Screen, Fine, Buzzer, Sensor, Info, Reset and the creation of freely programmable curves can be chosen. Furthermore, the cycles and run times of the individual rotors can be read.

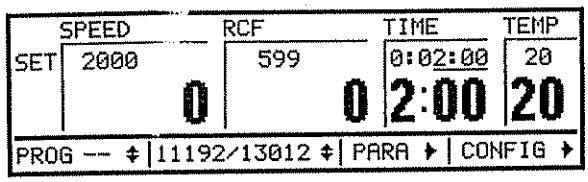


# 5. Operation:

## 5.1 Selection, Display and Alteration of Program Parameters

The value of each area can be changed as follows:

- This display shows the default values. No area is inverted.




Default values

- One area can be activated by pressing the knob once. It is then inverted. Being in the selection mode now, you can select other areas by turning the knob.
- Activate a selected area by pressing the knob. You are now in the alteration mode, "SET" and the selected area are inverted.
- Select the new value of the selected area by turning the knob.
- Confirm the entry by pressing the knob. You then leave the alteration mode. "SET" and the selected area are deactivated. The alteration mode is left automatically after 20 seconds. The areas are no longer inverted, the actual values are taken over.
- Now, you can select other areas by turning the knob or you can operate the start key. Then, the centrifuge starts with the selected values.

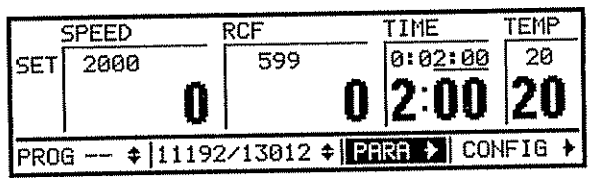
Notice:

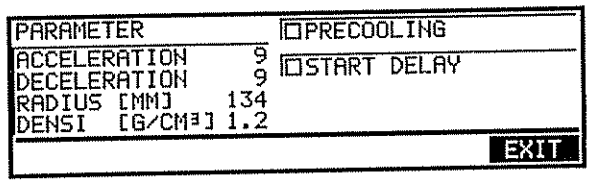
All entry limits are automatically checked. When reaching a limit, the counting operation is stopped (refer to chapter 9.3 "Entry limitations").

## 5.1.1 Selection and Alteration of the Parameters and Activation of the Precooling and the Start Delay

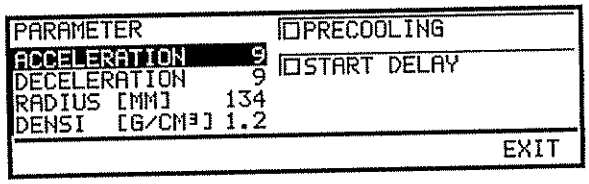
Selection and alteration of the parameters

- Select the area "Parameters" (PARA) by turning the knob (selection mode) and confirm by pressing the knob.

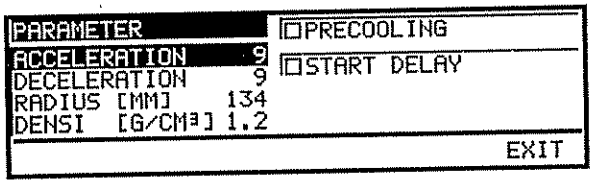


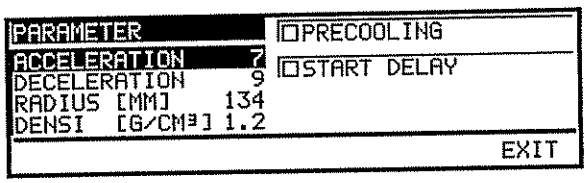




- The parameters to be changed, e.g. acceleration, deceleration, radius, density and the precooling and start delay can be selected (here: acceleration).




- Confirm the selected parameter by pressing the knob (here: acceleration). The parameter is activated. Select the desired acceleration curve by turning the knob.

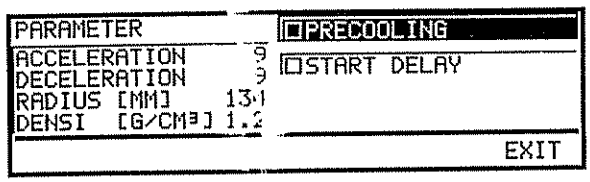


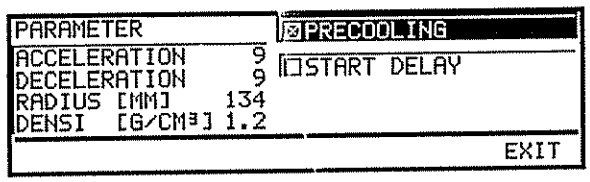

Deceleration, radius and density are changed in the same way.

Activation of the precooling and/or the start delay

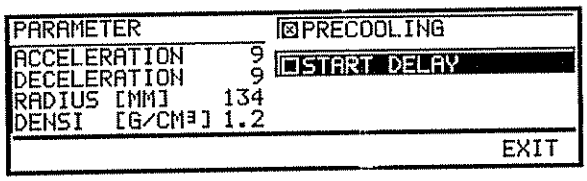
- Select "PRECOOLING" by turning the knob.



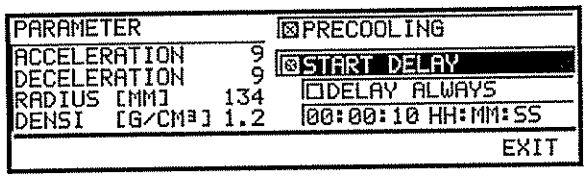

- Activate the "PRECOOLING" by pressing the knob.

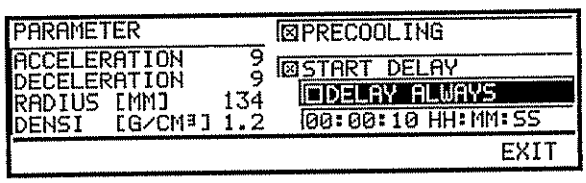



- Select "START DELAY" by turning the knob.

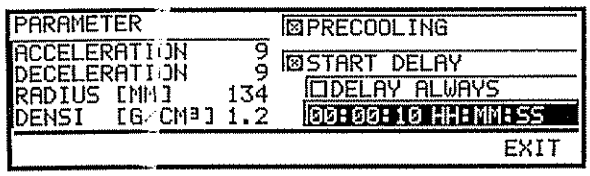



- Activate the "Start Delay" by pressing the knob. When activated, an additional selection is available. "DELAY ALWAYS" can be activated by turning and pressing the knob. The start delay would then not be deactivated automatically after a run.

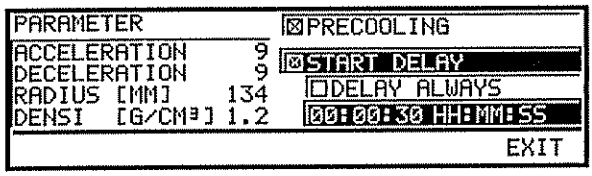


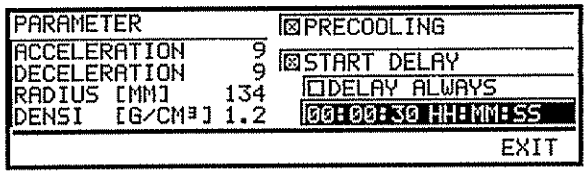



- Select time delay (here: 10 seconds) by turning and confirm by pressing the knob.



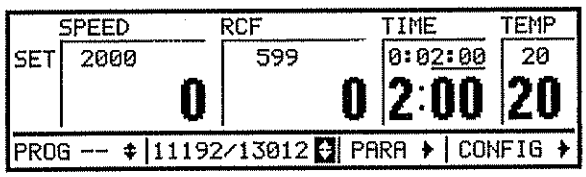

- Change the set time by turning the knob and deactivate the start delay by pressing the knob.




## 5.1.2 Selection and Alteration of the Rotor Part Number

- Select the area of the rotor selection list (⇕) by turning the knob.




- After pressing the knob, you get a view over all available rotor types.

| NO | ROTOR | BUCKET | SPEED | RCF | RMAX | RMIN |
|---|---|---|---|---|---|---|
| 1 | 11124 | | 12000 | 11913 | 74 | 35 |
| 2 | 11189 | | 11000 | 10958 | 81 | 47 |
| 3 | 11192 | 13009 | 5000 | 3158 | 113 | 56 |
| 4 | 11192 | 13012 | 5000 | 3745 | 134 | 51 |
| 5 | 11192 | 13022 | 5000 | 3801 | 136 | 50 |
| 6 | 11192 | 13040 | 5000 | 3885 | 139 | 47 |

Rotor selection list

- Select the number of the actual rotor/bucket combination by turning the knob and confirm the entry by pressing the knob.

**Attention: Please take care that the correct rotor/bucket combination is entered as otherwise the max. allowable speed could be exceeded. This is not allowed.**

### 5.1.3 Alteration of Program Parameters during the Centrifuge Run

During the run, the following values can be altered.

- Speed
- RCF
- Run time
- Switching into the continuous run mode/time mode
- Temperature
- Acceleration curve
- Deceleration curve
- Start delay

Alter the Set values as usual by activating the Alteration mode (refer to chapter 5.1 "Selection, Display and Alteration of Program Parameters").

You cannot change:

- Rotor
- Program
- Radius
- Density

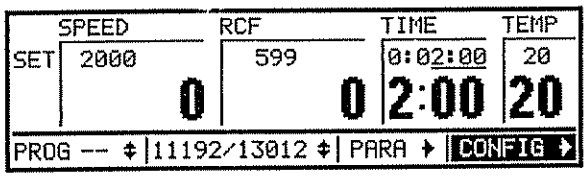
The following functions can be activated/deactivated:

- Precooling
- Start delay

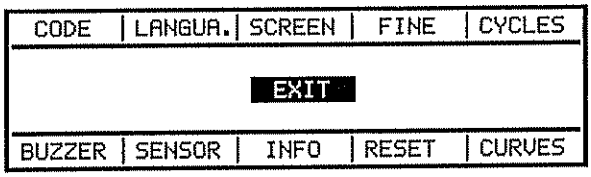
## 5.1.4 Alteration of the Configuration

In the configuration mode, several background functions can be changed and data can be read.

- Select the configuration mode by turning the knob.




- After pressing the knob, the configuration menu appears.




- Select by turning the knob the desired area and activate the function by pressing the knob.

- **CODE:** Protection of specific functions by a code, deactivation of the protection and changing of the code

- **LANGUAGE:** Selection of the language of the operation

- **SCREEN:** Magnification of the speed or the RCF display

- **FINE:** In this function it is possible to preselect the set speed in steps of 1 or 10 $min^{-1}$. The set time can be preselected in steps of 1 min or 1 sec. Exeption: Curve input in 1/10 sek.

- **CYCLES:** For each rotor/bucket combination cycles and run time are stored. The data of the used rotors are displayed.

- **BUZZER:** An acoustic signal can be activated for a preselected time after termination of a run or in the event of an imbalance or an error message. In the event of "IMBALANCE" or "ERROR" the acoustic signal is already activated.

- **SENSOR:** The sensor menu displays different signals. In case of a failure of the instrument this makes the diagnosis of errors and their fast repair through the service easier. Values can neither be entered nor altered.

- **INFO:** The Info menu displays information like the type of centrifuge and the EPROM version, the number of cycles, the total run time and the software version and date. In case of a failure of the instrument this helps to find reasons for the fault. Values can neither be entered nor altered.

- **RESET:** The "Reset"-function offers the possibility to delete all programs, parameters and configurations to get the original settings again.

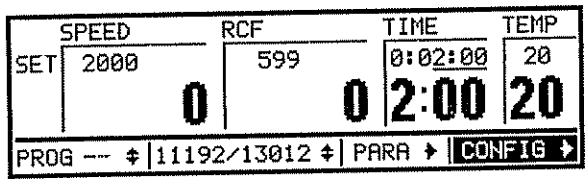
- **CURVES:** Creation of user defined accelerations and decelerations.

The procedure of alteration of the basic functions shall be explained by an example (Alteration of the screen).

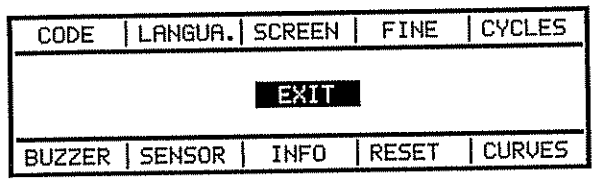
- You can choose between three display versions:

  - RCF and speed at normal size
  - Speed magnified -Zoom- (no RCF display)
  - RCF magnified -Zoom- (no speed display)

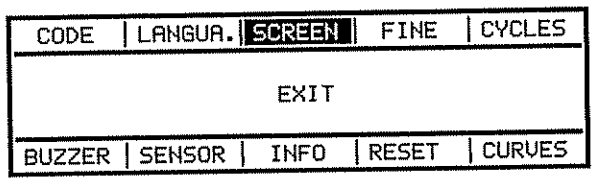
  - Select the configuration mode by turning the knob.



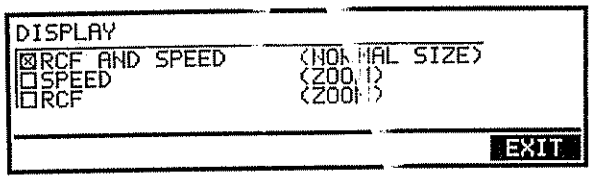

  - After pressing the knob the configuration menu appears.



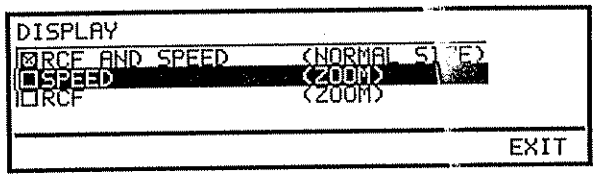

  - Select "SCREEN" by turning the knob.



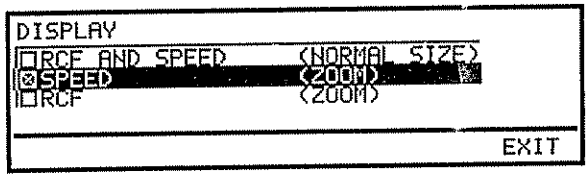
- By pressing the knob you get into the screen menu. The screen marked with a cross is activated. If you want to select the screen "SPEED - (ZOOM)" you proceed as follows.



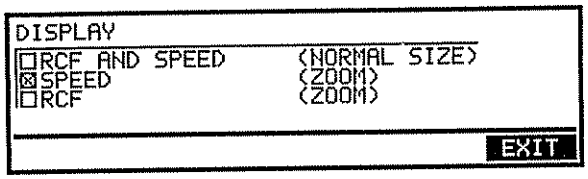

- Select "SPEED - (ZOOM)" by turning the knob.

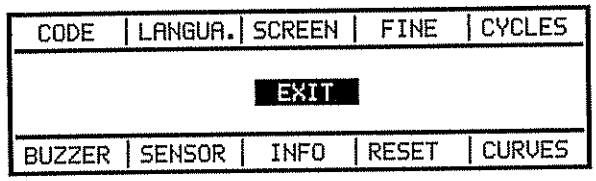



- Activate the Speed-Zoom-screen by pressing the knob

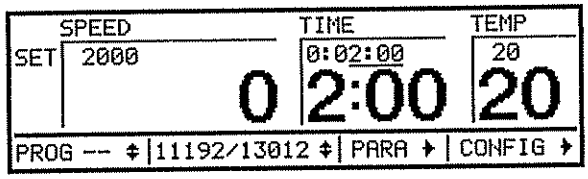



- Select "EXIT" by turning the knob. Confirm it by pressing the knob. You get into the configuration menu again.

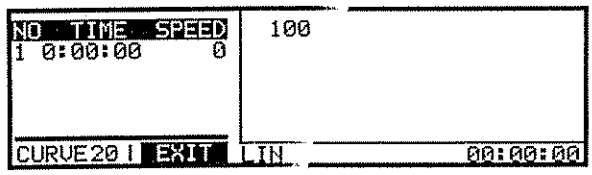


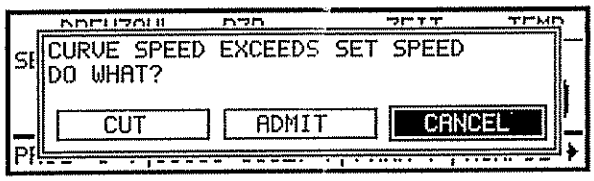

- By pressing the knob you return to the main display. The areas "SPEED" and "TIME" are displayed magnified. The area "RCF" disappears.



### 5.1.4.1 Curves




With the "curve function" user defined accelerations and decelerations can be created. Curve numbers 20 – 29 are available. The intervals no. 1 – 10 of each curve consist of fix points which are defined by time and speed. In the event that the speed of one interval is higher than the set speed for the run, the curve speed can be limited or allowed or starting can be prohibited.




| | |
|---|---|
| CUT ⇒ | Speed in one interval is automatically limited to the set speed for the run. |
| ADMIT ⇒ | Chosen speed in one interval is allowed. |
| CANCEL ⇒ | A stop occurs. Starting is not possible without to a change of the curve speed in one interval. |

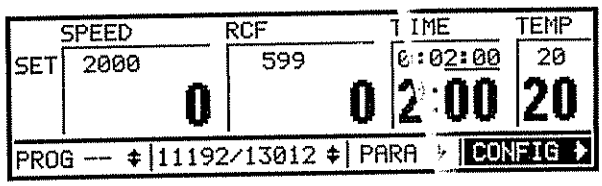
For interval no. 1 a linear (LIN) or quadratic (QUAD) acceleration can be chosen. All further accelerations are linear.

Furthermore, run profiles can be created. The following conditions must be fulfilled:

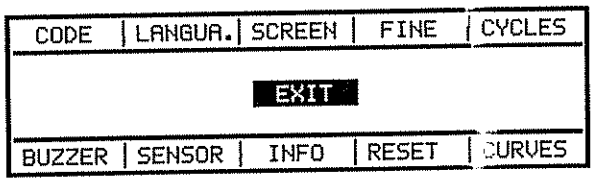
- The max. preset final speed of one interval corresponds to the set speed of the run.
- The total time corresponds to the set time of the run.
- The final speed of the last interval is 0.

### 5.1.4.2 Creation of Curves for Variable Accelerations and Decelerations

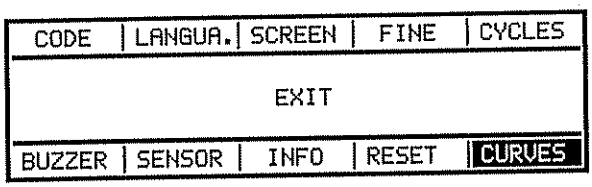
- Select the configuration mode by turning the knob.



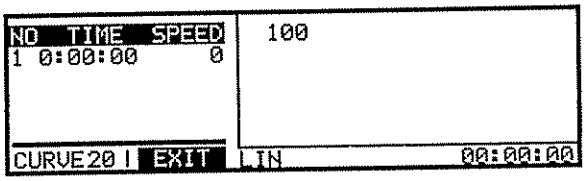

- After pressing the knob the configuration menu appears.



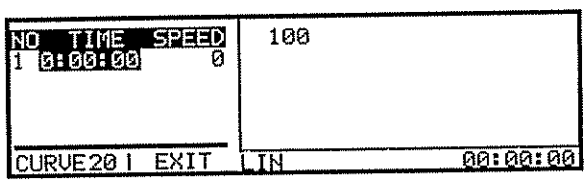

- Select "CURVES" by turning the knob.

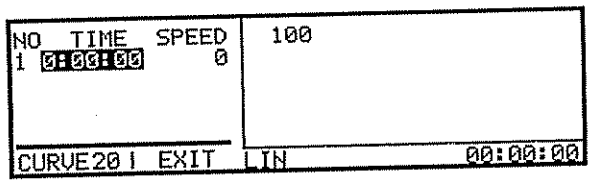



- After pressing the knob the curve menue appears

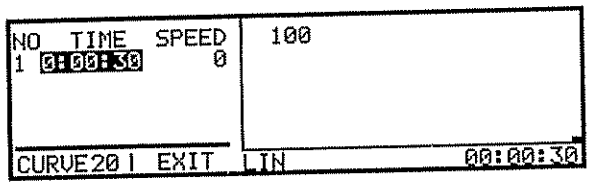



- Select "0:00:00" by turning the knob. You are now creating interval no. 1. Activate "0:00:00" by pressing the knob.

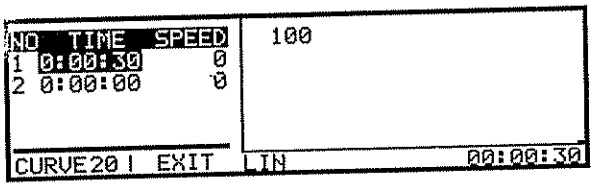




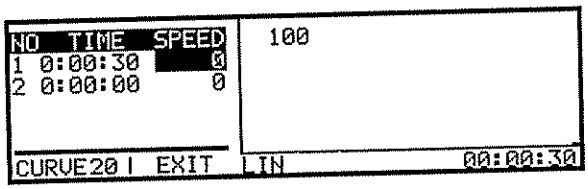

- Set the time by turning the knob.



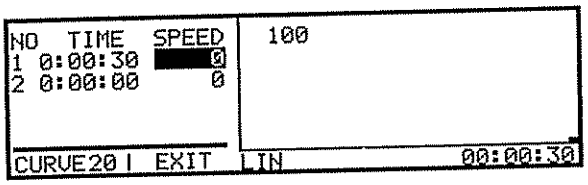

- Save the time value in interval no. 1 by pressing the knob.



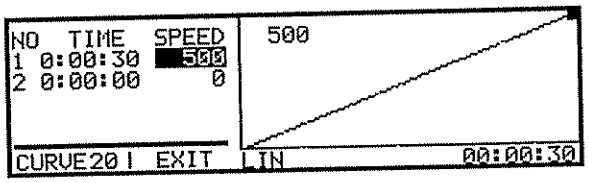

- Select "SPEED" by turning the knob.



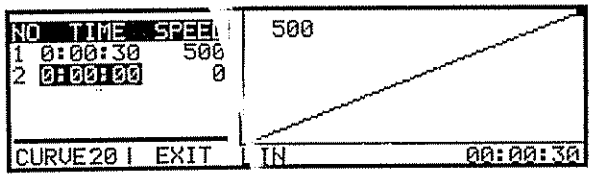

- Activate speed value "0" of interval no. 1 by pressing the knob.



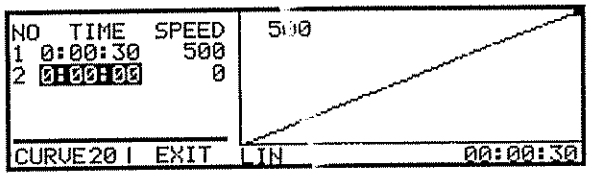

- Change the speed value by turning the knob. The created curve with the max. curve speed appears.



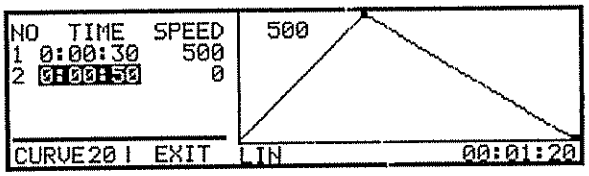
- After pressing and turning the knob the time value of interval no. 2 appears.



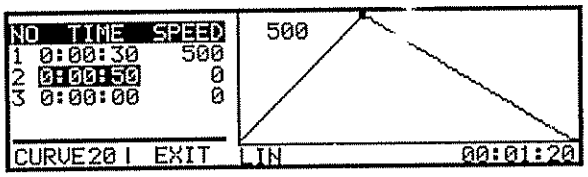

- Activate "0:00:00" of the second interval by pressing the knob.



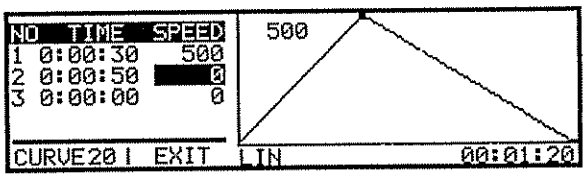

- Set the time by turning the knob. The extended curve appears.



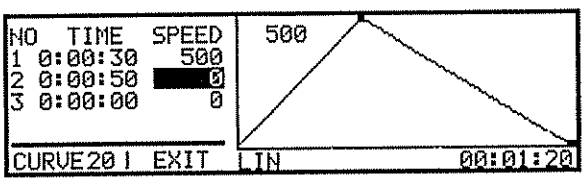

- Save the time value no. 2 by pressing the knob.



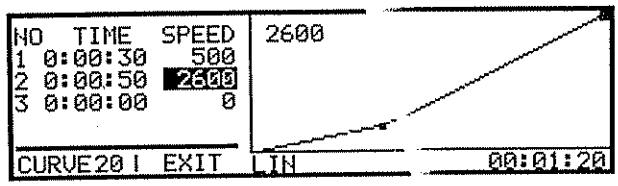

- Select "SPEED" by turning the knob.



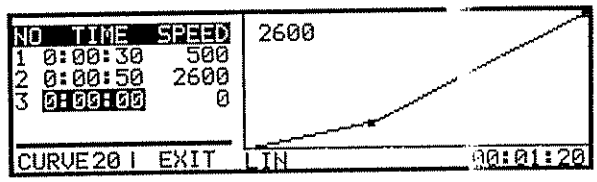

- Activate the speed value "0" by pressing the knob.



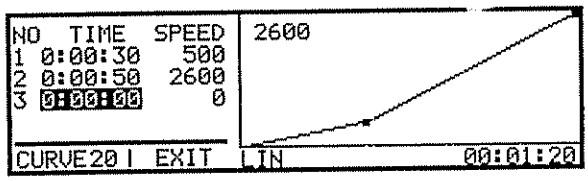
- Change the speed value by turning the knob.



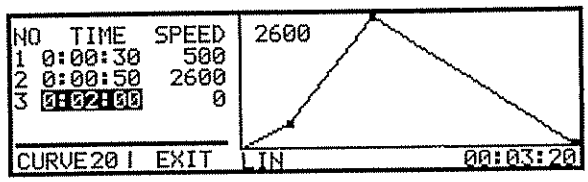

- After pressing and turning the knob the time value of interval no. 3 appears.



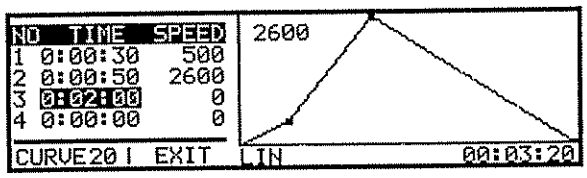

- Activate "0:00:00" of the third interval by pressing the knob.



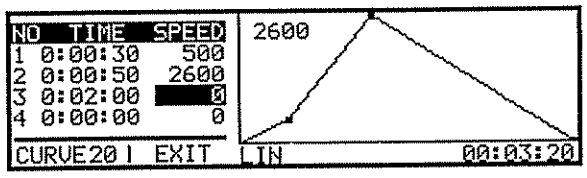

- Set the time by turning the knob. The extended curve appears.



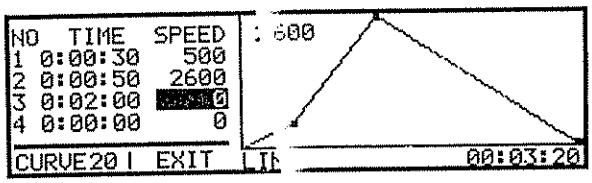

- Save the time value no. 3 by pressing the knob.



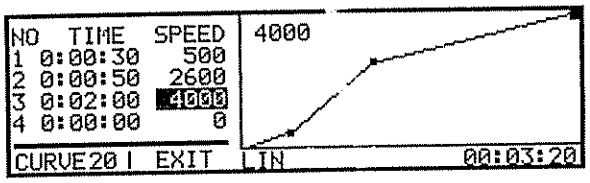

- Select "SPEED" by turning the knob.



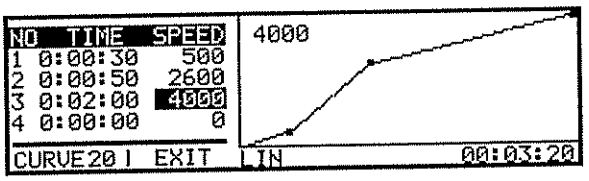
- Activate "0" by pressing the knob.

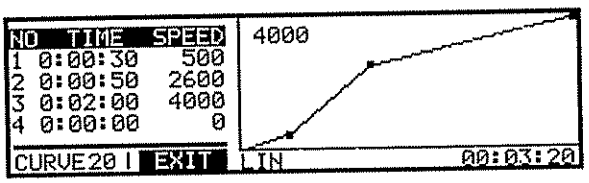



- Change the speed value by turning the knob. The curve appears and can be programmed as acceleration or deceleration curve under no. 20.




- Select "EXIT" by pressing and turning the knob and leave the curve mode by pressing the knob again.



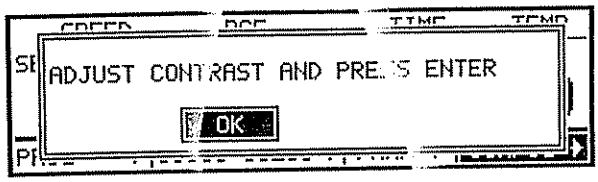

- The created curve no. 20 is saved and can be recalled when programming the parameters.

### 5.1.4.3 Alteration of Existing Curves

After activation of the area "CURVES" in the configuration menu you can analogous to the procedure discribed in 5.1.4.2 select already existing curves and alter them.

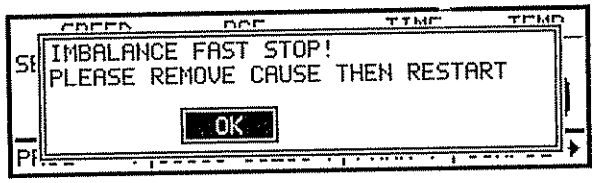
### 5.1.5 Alteration of the Contrast

If you press the knob for longer than a second, a dialogue window appears. Now you can select the contrast by turning the knob. By pressing the knob again, you confirm the entry, the new contrast remains.




### 5.1.6 Imbalance Monitoring

An imbalance dialogue window indicates an excessive imbalance during operation.




Run cannot be continued (imbalance > cut-off limit). Run is terminated with max. deceleration.

Reason:
Improper loading or malfunction during operation (e.g. glass breakage) resulting in an uneven run.

Note!
Additional information and a detailed description of errors and their correction is given in chapter 9.5 "Error correction".

### 5.1.7 Shortrun and Faststop

- Shortrun

  By pressing the Start-key continuously the shortrun function is activated. The instrument accelerates to the maximum speed with the maximum acceleration curve and after release decelerates with the maximum deceleration curve until standstill.

- Faststop

  Pressing the Stop-key during operation for longer than a second leads to maximum deceleration until standstill.

- Faststop

Pressing the Stop-key during operation for longer than a second leads to maximum deceleration until standstill.

# 6. Programming:

## What is considered a program?

A program contains all data that are required for a centrifuge run.

The advantage is that special sedimentation results can be repeated under equal conditions without a change of data caused by entry errors.

Programs can be loaded, operated, altered, and deleted any time.

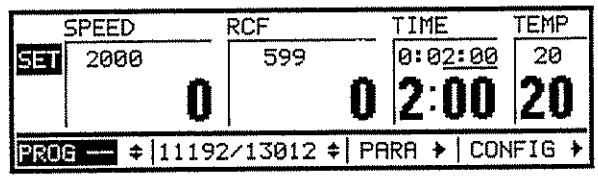
All programs can be protected against unauthorized use by a personal Code.

## 6.1 Load, Save and Delete Programs

### 6.1.1 Load a Program

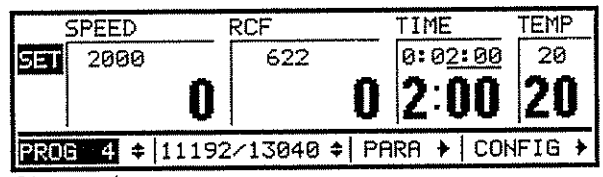
There are two possibilities of loading a program:

1. Loading by program number
- Select the program area ("PROG --") by turning the knob, and activate it by pressing the knob.




Activated program area

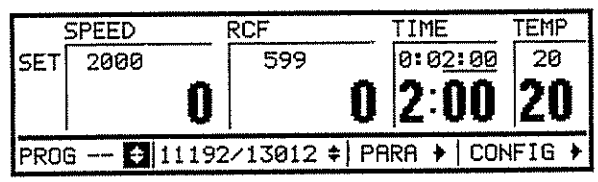
- By turning the knob, all programs saved and the actual program ("--") appear one after the other.

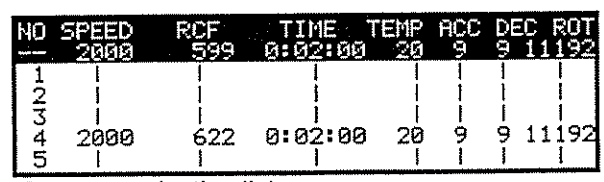



Changed program

- Load desired program by pressing the knob.

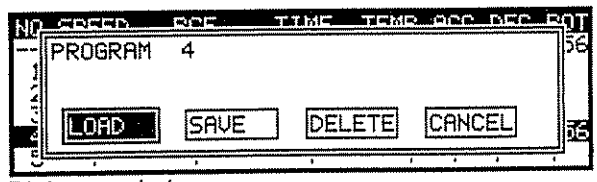
2. Loading from the list of programs
- Select the program selection list (⇕) by turning the knob and activate this area by pressing the knob. You are able to see all programs in the memory, "--" indicates the actual program.




Program selection list

- Select the program you want to load by turning the knob. After pressing the knob a dialogue window appears. Select the instruction "LOAD" and confirm it by pressing the knob.

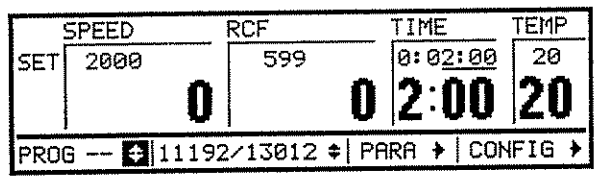


Dialogue window

## 6.1.2 Save a Program

If you want to save an actual program:

- Select the program selection (⇕) list by turning the knob and activate it by pressing the knob to get a view over all programs in the memory and the free positions in the list.



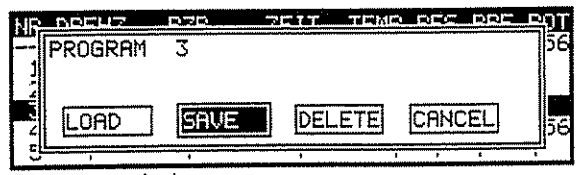

| NO | SPEED | RCF | TIME | TEMP | ACC | DEC | ROT |
|---|---|---|---|---|---|---|---|
| -- | 2000 | 599 | 0:02:00 | 20 | 9 | 9 | 11192 |
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | 2000 | 622 | 0:02:00 | 20 | 9 | 9 | 11192 |
| 5 | | | | | | | |

Program selection list

- Select the desired program position in the list by turning the knob.

| NO | SPEED | RCF | TIME | TEMP | ACC | DEC | ROT |
|---|---|---|---|---|---|---|---|
| -- | 2000 | 599 | 0:02:00 | 20 | 9 | 9 | 11192 |
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | 2000 | 622 | 0:02:00 | 20 | 9 | 9 | 11192 |
| 5 | | | | | | | |

- After pressing the knob a dialogue window appears. Select "SAVE" and confirm it by pressing the knob.

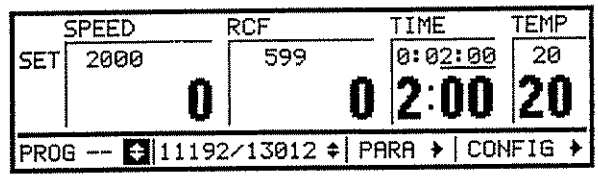


Dialogue window

## 6.1.3 Delete a Program

If you want to delete a program from the list:

- Select the program selection list (⇕) by turning the knob and activate this area by pressing the knob to see the list of programs:

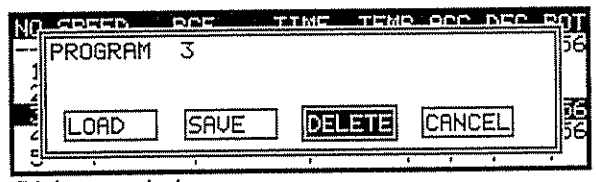



| NO | SPEED | RCF | TIME | TEMP | ACC | DEC | ROT |
|---|---|---|---|---|---|---|---|
| -- | 2000 | 599 | 0:02:00 | 20 | 9 | 9 | 11192 |
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | 2000 | 608 | 0:02:00 | 20 | 9 | 9 | 11192 |
| 4 | 2000 | 622 | 0:02:00 | 20 | 9 | 9 | 11192 |
| 5 | | | | | | | |

Program selection list

- Select the program you want to delete by turning the knob.

- A dialogue window appears after pressing the knob. Select "DELETE" and confirm it by pressing the knob.



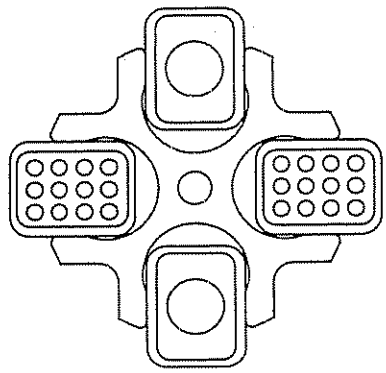
Dialogue window

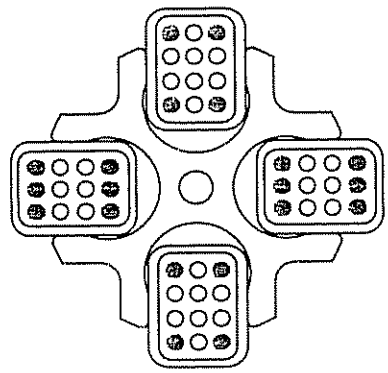
# 7. Notes for Centrifugation:

## 7.1 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: The vessels should be placed symmetrically so that the buckets and their suspensions are loaded evenly. Loading an inner or outer position of the bucket only is not allowed (see illustration). Even angle rotors should be loaded symmetrically to same weight.

   Centrifugation with different tubes: Working with different tube sizes is possible. Opposite places must be loaded with the same vessels (see illustration).





9. Load all positions of swing-out rotors.
10. Load vessels outside the centrifuge.
11. Please pay attention to the max. speed of glass tubes. 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.

# 7. Notes for Centrifugation:

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 imflammable materials.

18. Record all program data, refer to forms of appendix chapter 9.8.

19. When centrifuging substances with a density > 1,2 g/cm$^3$ the allowable max. speed must be reduced (refer to chapter 9.4.2 "Density").

## 7.2 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/cm$^3$ if centrifuged at max. speed. If liquids of higher density are used, the speed must be reduced accordingly (refer to chapter 9.4 "Mathematical relations").
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 affect the mechanical strength of rotors, buckets and carriers.
9. Operation of rotors and accessories not allowed by the manufacturer. 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.

# 7. 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. Such materials are prohibited which chemically interact vigorously.

18. Do not spin explosive or inflammable materials.

19. Substances which could damage the material of the centrifuge, the rotors or the buckets must not be centrifuged. Infectious, toxic, pathogene or radioactive substances must be centrifuged in suitable rotors and vessels only and all necessary safety precautions are taken

# 8. Care and Maintenance:

## 8.1 Care and Cleaning of the Centrifuge

Please use water-soluble, mild detergents for cleaning. Avoid corroding and aggressive substances. Do not use alkaline solutions or solvents or agents with abrasive particles. Before using detergents or decontamination agents which had not been recommended by us, the user has to contact us to make sure that such procedure would not damage the centrifuge.

Remove product particles from the rotor chamber using a cloth or paper towl. It is recommended to open the cover when the centrifuge is not in use so that moisture can evaporate. Increased wear of the motor bearings will thus be avoided. **If there is the risk of toxic, radioactive or pathogene contamination, special safety measures must be kept.**

## 8.2 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 oscillating pressure and chemical reaction) can affect 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 (SIGMA part no.: 70104 for 20 ml slushing oil). Before using detergents or decontamination agents which had not been recommended by us, the user has to contact us to make sure that such procedure would not damage the centrifuge. The rotor tie-down screw must be greased using the supplied grease (SIGMA part no.: 70284).

Cleaning of accessories should be done outside of 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, alternatively, 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 detergent 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.

## 8.3 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).

## 8.4 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 occured, 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.

## 8.5 Care and Cleaning of the Condenser

A lamellar condenser is used to cool the compressed refrigerant. It is installed in the back part of the centrifuge and 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).

## 8.6 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. Before using detergents or decontamination agents which had not been recommended by us, the user has to contact us to make sure that such procedure would not damage the centrifuge. For sterilization by steam resistance to temperature of the individual material must be checked refer to point 8.6.1 "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.

## 8.6.1 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. temp. °C | max. time min | min. time min | max. cycles |
|---|---|---|---|---|
| Glass tubes | 134-138 | 5 | 3 | - |
| Polycarbonate tubes | 115-118 | 40 | 30 | 20 |
| Polypropylene tubes | 115-118 | 40 | 30 | 30 |
| Teflon tubes | 126-129 | 15 | 10 | - |
| Aluminium rotors | 126-129 | 15 | 10 | - |
| Polypropylene rotor 12034 | 115-118 | 40 | 30 | 20 |
| Polypropylene rotor 12124 | 115-118 | 40 | 30 | 20 |
| Polycarbonate/Polyallomer lids for angle rotors | 115-118 | 40 | 30 | 20 |
| Aluminium buckets | 126-129 | 15 | 10 | - |
| Polycarbonate caps for buckets | 115-118 | 40 | 30 | 50 |
| Polypropylene caps for buckets | 115-118 | 40 | 30 | 50 |
| Rubber adapters | 115-118 | 40 | 30 | - |
| Rubber cushions | 115-118 | 40 | 30 | - |
| Round carriers for 13104/ 13117, Polypropylene | 115-118 | 40 | 30 | - |
| ditto, Polyallomer and Polycarbonate | 115-118 | 40 | 30 | - |
| Round carriers for 13350/ 13550, Polypropylene | 115-118 | 40 | 30 | - |
| Rectangular carriers, Polypropylene | 115-118 | 40 | 30 | - |
| ditto, Polyallomer and Polycarbonate | 115-118 | 40 | 30 | - |

## 8.7 Checks by Operator

The operator has to ensure that no important part of the centrifuge is damaged.

This especially refers to:

1. Motor suspension
2. Concentricity of the motor shaft
3. Fastening of the trunnions in the rotor
4. Rotors and accessories have to be free from corrosion, cracks, material abrasion etc.
5. Screw connections have to be tight.

Furthermore, the earth wire must be checked regularly.

## 9.1 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)**

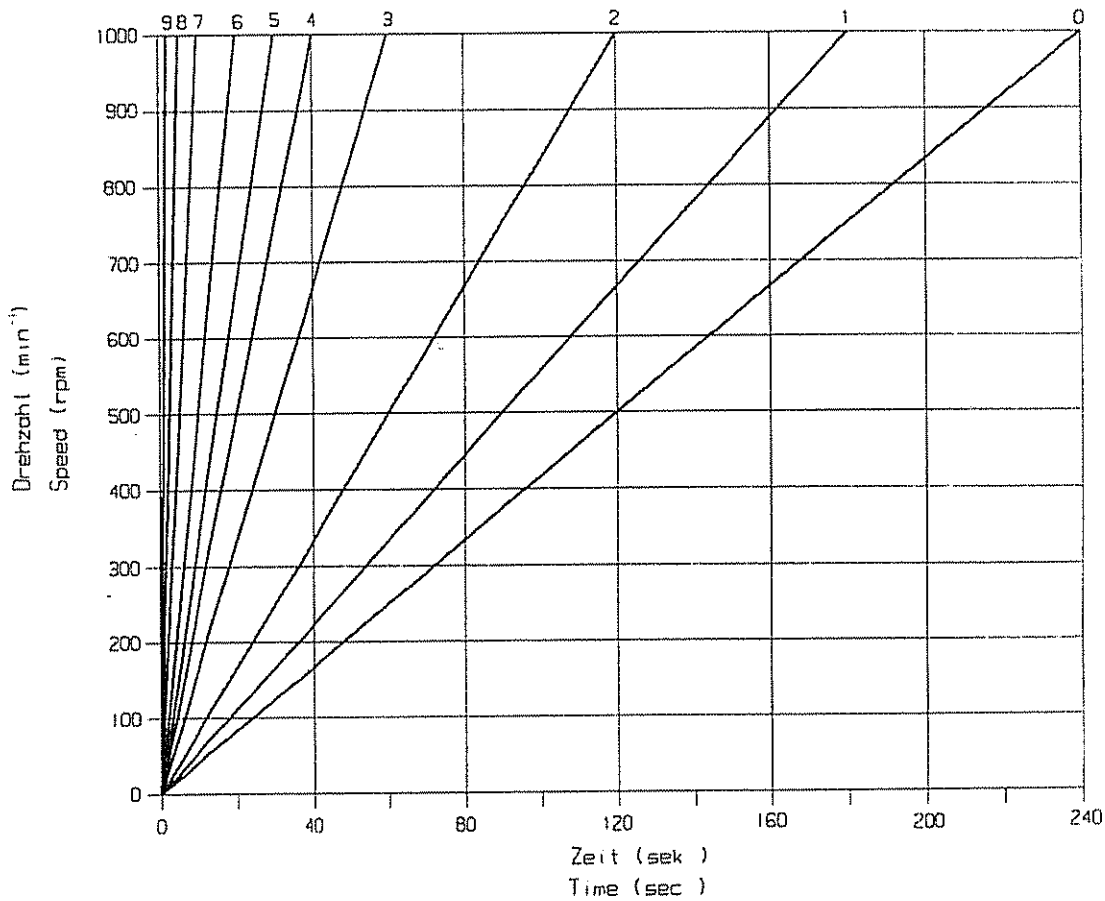



**Figure 2**

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. |

## 9.2 Quadratic Curves

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

**Quadratic Curves (10 - 19)**

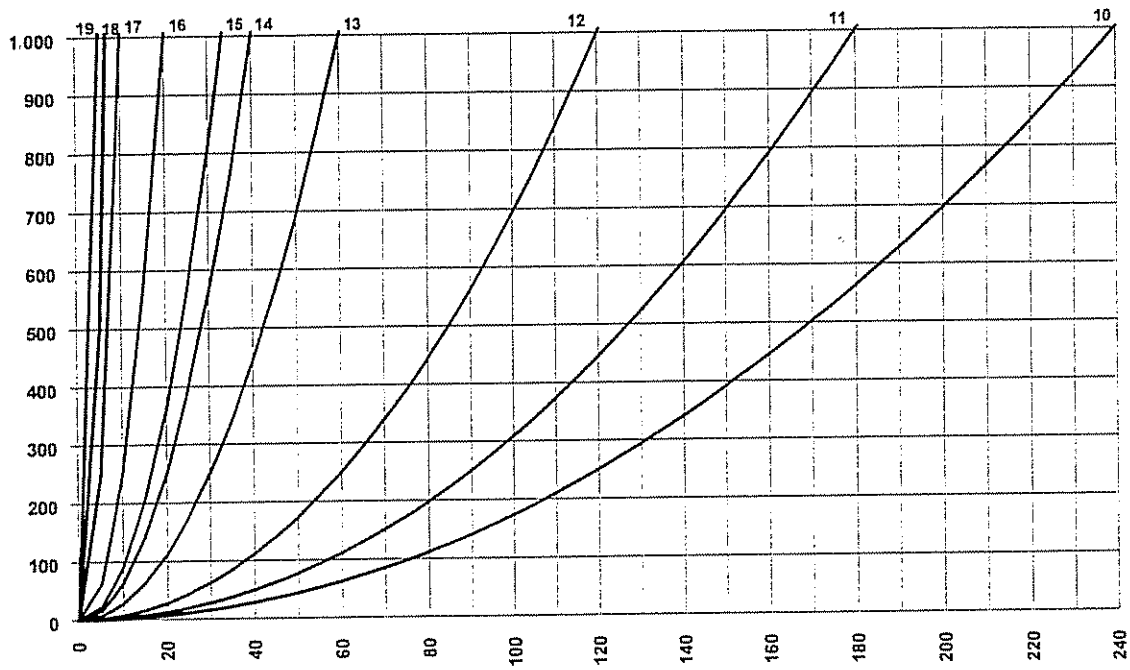



**Figure 3**

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.

# 9. 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. |

## 9.3 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 operation is stopped.

Interdependent parameters are limited further with a change of the corresponding parameter. With the alteration of a parameter, the corresponding parameter is recalculated. If the changed parameter is selected, the recalculated value is displayed.

## 9.4 Mathematical Relations

### 9.4.1 Relative Centrifugal Force (RCF)

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

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

If two values are given, the third value is determined by the equation. If the speed or the rotation radius is 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

### 9.4.2 Density

If the density of the liquid is higher than 1.2 g/cm$^3$, the allowed maximum speed of the centrifuge is calculated according to the following formula:

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

Gamma = density in g/cm$^3$

## 9.5 Error Correction

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

| **No indication on the command panel:** | **Actions:** |
|---|---|
| – No power in the socket? | • Check fuse in mains supply. |
| – Power cord plugged in and line voltage present? | • Plug in power cord correctly. |
| – Input fuse ok? | • Switch on thermal fuse. |
| – Power switch on? | • Switch on power. |
| – Contrast? | • Change contrast. |

### 9.5.1 Centrifuge cannot be Started

| | |
|---|---|
| a) Start-key LED not illuminated: | • Close lid. Motorized lid locks must close. |
| b) Start-key LED illuminated: | • Power off/on. If error occurs again, call service. |

### 9.5.2 Centrifuge Decelerates during Operation

Imbalance dialogue window is active:

| | |
|---|---|
| – 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 77 after power on. | • These error numbers indicate an error in the internal program storage. This error is e.g. generated when a power failure occurs during a storage procedure. |

## 9.5.3 Lid cannot be Opened/Closed

When first trying to open the lid the locks are not released. Press the Lid-key to activate the motorized lid locks again (refer to chapter 9.6 "Error codes", ERROR 79). Call Service.

## 9.5.4 Emergency Lid Release

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

Remove stopper at the upper right side front panel using e.g. a screw driver.

Unlock the motorized lid lock using the supplied square wrench. Put in wrench and turn to the right. The lid is unlocked and can be opened.

**Attention!**

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

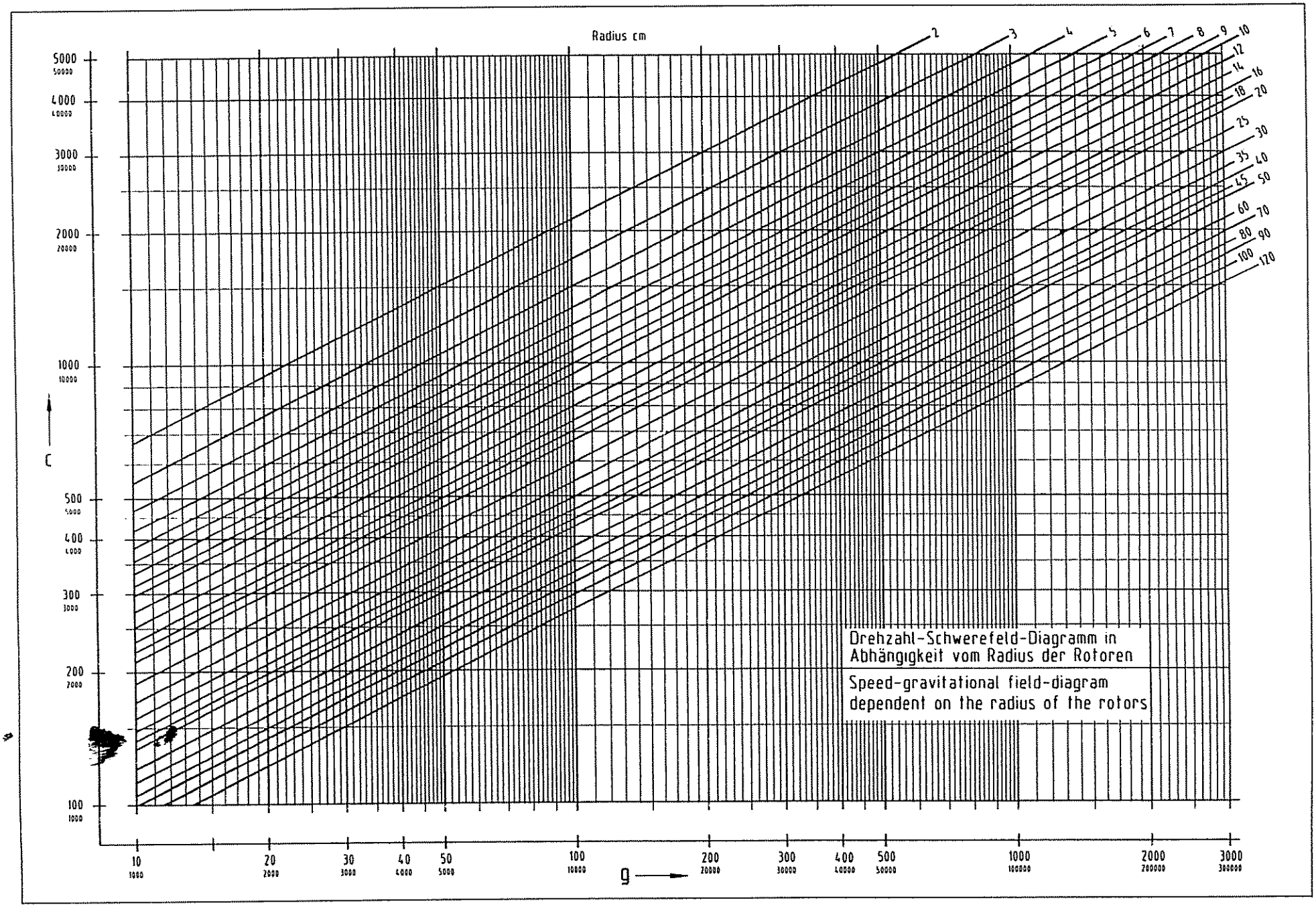
## 9.6 Error Codes

| Error no. | Kind of error | Measures | Comment |
|---|---|---|---|
| 1-62 | Internal error | • let slow down<br>• power off/on | |
| 69-77 | EEPROM error | • let slow down<br>• power off/on | ATTENTION: Saved curves and programs could have been deleted. |
| 78 | Lid does not close | • power off/on<br>• remove impurities | |
| 79 | Faulty log identification | • press lid key<br>• close lid rapidly<br>• check log opening for impurities | |
| 80 | Lid electronics defective | • contact Service | |
| 81 | Rotor spins with open cover | • let slow down<br>• close lid<br>• power off/on | |
| 82-83 | Lid does not open | • power off<br>• emergency lid release | |
| 84 | Excess temperature heat sink | • let cool down<br>• provide for better ventilation<br>• power off/on | |
| 85 | Excess temperature centrifuge chamber (> 50 °C) | • let cool down<br>• provide for better ventilation<br>• power off/on | |
| 87 | Actual temperature > 45 °C resp. < -20 °C | • provide for better ventilation | |
| 90-96 | Sensor defective | • power off/on | |
| 98 | Faulty rotor identification | • check rotor | |
| 99 | Incorrect rotor | • check rotor and set rotor resp. bucket identification | |

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

## 9.7 Speed-RCF-Diagram

An additional help is the enclosed Speed-RCF-Diagram.


Radius cm
2
3
4
5
6
7
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9
10
12
14
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35
40
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60
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Drehzahl-Schwerefeld-Diagramm in
Abhängigkeit vom Radius der Rotoren
Speed-gravitational field-diagram
dependent on the radius of the rotors

## 9.8 Declaration of Decontamination / Return Declaration

The following declarations serve for keeping safety and health of our employees. Fill in the forms and attach them when returning centrifuges, accessories and spare parts. Please understand that we cannot carry out any work before we have the declarations. (We recommend to make **several copies of this page.**)

!!! Attention – This form must be glued on outside of the box !!!

# Return declaration

| | YES | NO |
|---|---|---|
| Decontamination declaration inside : | | |
| | | |
| Unit / component contaminated : | | |
| | | |
| Unit / component unused (new) : | | |

!!! Attention – This form must be glued on outside of the box !!!

Please make some copies before removing this page.

## Declaration of Decontamination of Centrifuges, Accessories and Spare Parts

This declaration may only be filled in and signed by authorised staff.

Repair Order dtd. : _____

Order No. : _____

Type of unit : _____ Serial No. : _____

Type of unit : _____ Serial No. : _____

Type of unit : _____ Serial No. : _____

Type of unit : _____ Serial No. : _____

Accessories : _____

_____

Is the equipment free from harmful substances ? YES O NO O

If not, which substances have come into contact with the equipment?

Name of the substances : _____

_____

Remarks (e.g to be touched with gloves only) ; _____

_____

General characteristics of the substances :

| | | | |
|---|---|---|---|
| Corrosive | O | Explosive | O |
| Biologically hazardous | O | Radioactive | O |
| Toxic | O | | |

In combination with which substances may hazardous mixtures develop?

Name of the substances : _____

_____

Has the equipment been cleaned before shipment? YES O NO O

Is the equipment decontaminated and not harmful to health? YES O NO O

Prior to repair, radioactively contaminated components must be decontaminated according to the valid regulations for radiation protection.

**Legally Binding Declaration**

I / we hereby declare that the information on this declaration are correct and complete.

Company / Institute : _____

Street : _____

Postcode, City : _____

Tel. : _____ FAX : _____

Name : _____

Date : _____ Stamp :

Signature : _____ _____

Please make some copies before removing this page.

9.9 Program No.:

Used for

Alteration:

by:

Date:

Speed

Gravitational field

Rotor

Bucket

Made on:

by: