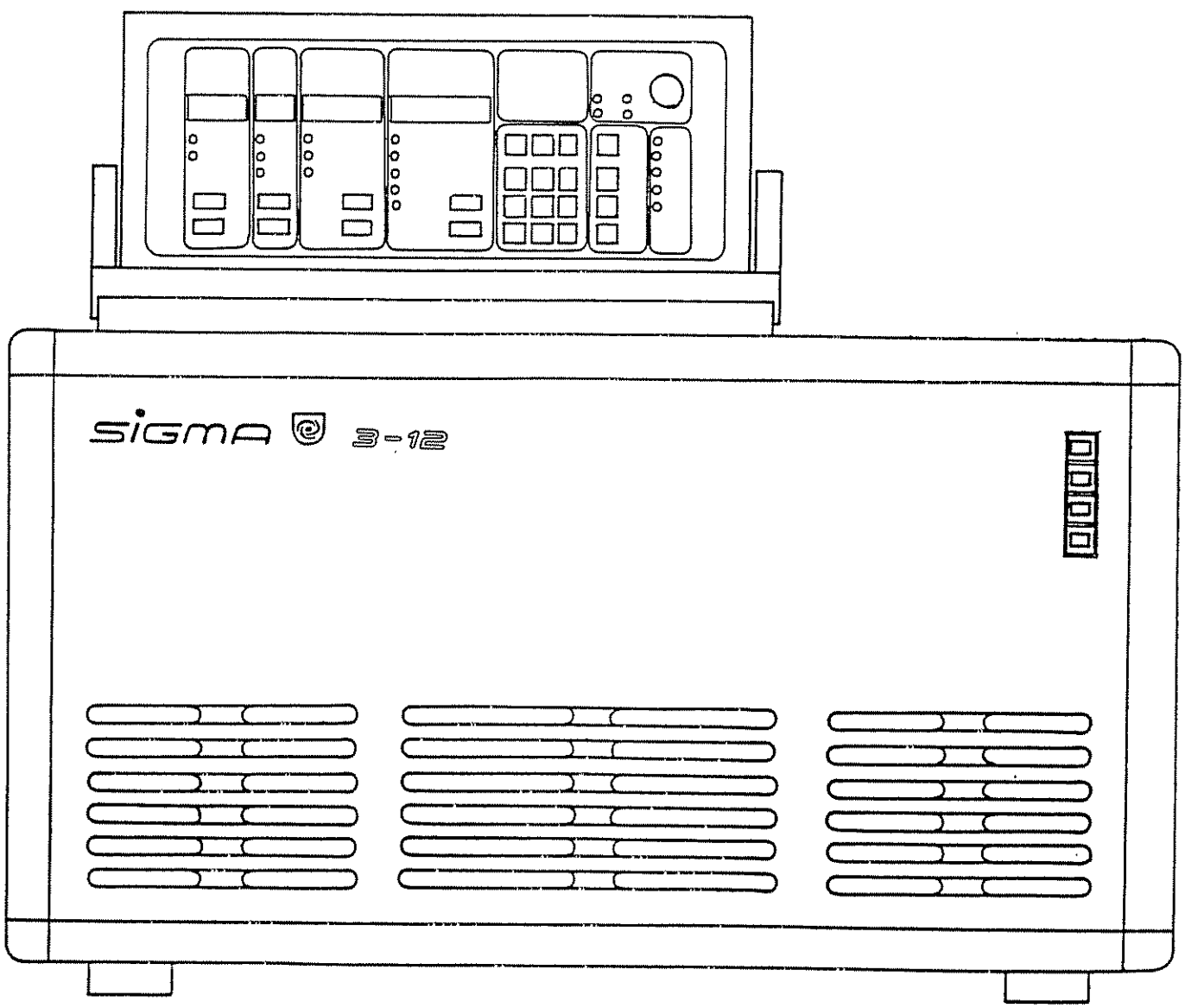
SIGMA

Operating Instructions

3-12

free programming of the centrifuge parameter with +/– counting keys



Dear customer,

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

A wide sprectrum of programming options and an electronic run-time monitoring allow a problem-free operation 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-friedly options which make the operation and standard settings easier for you. Built-in error-detecting functions keep the user from entering incorrect instructions and check the complete operation.

A special advantage is the storage capacity the centrifuge offers. Besides a large program memory which can store up to 100 different data sets, the device 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 intermediately.

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

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

SIGMA Laborzentrifugen GmbH
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Tel. 05522/5007-0 - Telefax 05522/500712
Telex 9 65 101

1. 1. Technische Daten	
Hersteller:	S I G M A Laborzentrifugen GmbH 3360 Osterode
Typenbezeichnung:	3-12
elektr. Anschluss:	230 V, 50/60 Hz
Anschlußleistung: [KVA] Leistungsaufnahme: [KW] max. Stromaufnahme: [A]	0,65..... 0,43..... 2,9.....
Leistungsdaten:	
max. Drehzahl: [min-1] max. Kapazität: [ltr] max. Schwerefeld: [x g] max. kin. Energie: [Nm]	14 500..... 0,72..... 20 450..... 9 500.....
sonst. Einstellparameter	
Zeitbereich: Programme: Beschleunigungskurven: " " " " Bremskurven: " " Zeitintegral: Schleuderradius: Rotor- und Becherbestellnummer:	9 h, 59 min /Dauerlauf 100 10 linear 10 quadratisch 10 frei programmierbar 10 linear 10 quadratisch 10 frei programmierbar 9999 Exp. 11 Swedberg max./min. s. 1.2 s. 1.2
phys. Daten:	
Tiefe: [mm] Breite: [mm] Höhe: [mm] Gewicht: [kp] Funkentstört: gem. VDE 0871 Geräuschpegel: [dBA]	560..... 580..... 530..... 50..... Klasse B..... 61.....
Prüfpflicht gem. UVV VBG 7 z	ja
Anwendernotiz: Seriennummer: Lieferdatum: Inventarnummer: Aufstellungsort: Verantwortungsbereich:	 ....

Die angebenen Daten gelten für eine Umgebungstemperatur von 22° und 220 Volt +/- 1% sowie eine Rotortemperatur von 20° C

1.2 Suitable Accessories

Part No.	Description	Max. speed (rpm.)	Max. gravitational field (x g)
11133	Swing-out rotor for 4 round buckets for the following accessories	5 000	4 165
13130	Round bucket, aluminium, for 3 Falcon tubes 15 ml, closeable with sealing cap 17111		
13104	Round bucket, aluminium, with thread for the system of round carriers		
17111	Round sealing cap made of polycarbonate, clear, autoclavable, for hermetic sealing of bucket 13104/13130		
13117	Round bucket, aluminium, for the system of round carriers		
17000	Round carrier, two-piece, undrilled, autoclavable, polyallomer		
17006	Round carrier for 12 RIA-vials, 12 x 55 to 75 mm, autoclavable, polyallomer		
17007	Round carrier for 12 glass tubes 7 ml, autoclavable, polyallomer		
17008	Round carrier for 12 reaction-vials (Eppendorf) 1,5 ml, autoclavable, polypropylene		
17012	Round carrier for 6 tubes 10 ml no. 15000/15010/15019, autoclavable, polyallomer		
17013	Round carrier for 9 hemolysis tubes max. 12,9 x 85 mm, autoclavable, polypropylene		
17014	Round carrier for 12 hemolysis tubes max. 12,5 x 75 mm, autoclavable, polyallomer		
17015	Round carrier for 7 glass tubes 15 ml, autoclavable, polyallomer		

17018	Round carrier for 4 tubes with sealing cap (e.g. Monovette), autoclavable, polyallomer		
17019	Round carrier for 3 Falcon tubes 15 ml, autoclavable (in 13014 without sealing cap, polypropylene		
17025	Round carrier for 2 glass tubes 25 ml, autoclavable, polyallomer		
17027	Round carrier for 7 Vacutainer-tubes, ø 12/16 x 75/80 mm, autoclavable, polypropylene		
17030	Round carrier for 2 tubes 30 ml no. 15029/15030/15032/15034, autoclavable, polypropylene		
17049	Round carrier for 1 Falcon tube 50 ml, autoclavable, polypropylene		
17050	Round carrier for 1 glass tube 50 ml, autoclavable, polyallomer		
17052	Round carrier for 1 tube 50 ml no. 15051/15052/15054, autoclavable, polyallomer		
17085	Round carrier for 1 tube 85 ml no. 15074/15075/15076, autoclavable, polyallomer		
17100	Round carrier for 1 glass tube 100 ml, autoclavable, polyallomer		
17125	Reducer for 1 tube with screw cap 125 ml no. 15125, autoclavable, polypropylene		
11132	Swing-out rotor 28 x 15 ml complete, consisting of rotor 11133, 4 round buckets 13117, 4 carriers 17015 and 28 PS-tubes 15020, max. radius 14,9 cm, min. radius 5,2 cm	5 000	4 165
11130	Swing-out rotor for 4 buckets, for the following accessories	6 000	6 118
13100	Bucket 150 ml, V4A, 1 glass tube 15100 with rubber cushion 16100 can be set in (attention, when using glass tubes there is danger of glass breakage with speeds exceeding 5 000 rpm.)		

11131	Swing-out rotor 4 x 150 ml complete, consisting of rotor 11130, 4 V4A-buckets 13100, 4 rubber cushions 16100 and 4 glass tubes 15100, max. radius 15,2 cm, min. radius 5,2 (attention, when using glass tubes there is danger of glass breakage with speeds exceeding 5 000 rpm.)	6 000	6 118
11136	Rotor for reaction-vials (max. 60/120 pcs) with cover for the following cassets 14000/14002 max. radius 7 cm, min. radius 3 cm Please pay attention to the fact that speeds exceeding 13000 rpm there is an increased danger of breaking tubes	13 000	13 226
14000	Casset, PA6, for 20 reaction-vials 0,25/0,4/0,55/0,75 ml		
14002	ditto for 10 reaction-vials 2,0 or 1,5 ml		
11222	Swing-out rotor with 2 carriers for 2 - 6 microtitre plates 85 x 130 mm, max. radius 11 cm, min. radius 7 cm	3 000	1 107
11223	Swing-out rotor with 2 carriers for 2 - 6 microtitre plates 85 x 130 mm, max. radius 11 cm, min. radius 7 cm	4 000	1 968
12110	Angle rotor 12 x 1,5/2,0 ml, max. radius 6,4 cm, min. radius 3,1 cm, angle 45°	14 500	15 044
12111	Angle rotor 10 x 10 ml, max. radius 7,6 cm, min. radius 2 cm, angle 35°	14 500	17 865
12150	Angle rotor 6 x 50 ml, max. radius 8,4 cm, min. radius 2,1 cm, angle 25 °	10 000	9 391
12153	Angle rotor 36 x 2,0 or 1,5 ml, e.g. Eppendorf reaction-vials, 2 lines, max. radius 8,7/7,7 cm, min. radius 5,6/4,6 cm, angle 45°	14 500	20 450/18100

12154	Angle rotor 24 x 2,0/1,5 ml, max. radius 8 cm, min. radius 5 cm, angle 45°	14 500	18 805
12155	Angle rotor 4 x 85 ml, max. radius 9,0 cm, min. radius 2,1 cm, angle 30°	10 000	10 062
12156	Angle rotor 8 x 50 ml, max. radius 9,4 cm, min. radius 3,3 cm, angle 25°	9 000	8 512
12157	Angle rotor 20 x 10 ml, max. radius 9,8 cm, min. radius 5,9 cm, angle 25°	9 000	8 875
12158	Angle rotor 6 x 30 ml, max. radius 7,8 cm, min. radius 2,3 cm, angle 30°	14 500	18 335
12159	Angle rotor 6 x 85 ml, max. radius 9,7 cm, min. radius 2,5 cm, angle 25°	8 000	6 941
19776	Angle rotor for 6 falcon tubes 50 ml, max. radius 8,8 cm, min. radius 3,2 cm, angle 25°	9 000	8 331
19777	Angle rotor for 10 falcon tubes 15 ml, max. radius 9,2 cm, min. radius 3,8 cm, angle 25°	9 000	8 422

Adapters and synthetic tubes

13000	Adapter, POM, for reaction-vials 0,25/0,4/0,55/0,75 ml for 12110/12153/12154/14002/17008
13002	Adapter, POM, for Eppendorf reaction-vials 0,75 ml, ø 7,9/10 x 28/31 mm for 12110/12153/12154/14002/17008
15008	Reaction-vials 1,5 ml (Eppendorf-system), pack with 100 pieces, suitable for 12110/12153/12154/14002/17008
15014	Reaction-vials 0,4 ml, polypropylen pack with 100 pieces, suitable for 13000/14000

15000	Teflon tube 10 ml, incl. screw cap, ø 16,1 x 81,1 mm, suitable for 12111/12157/17012
15010	ditto polycarbonate
15019	ditto polyallomeric
15020	Polystyrene tube 15 ml, 17 x 100 mm, suitable for 17015/14015
15021	Stopper PP for 15020
15023	Polypropylene tube 15 ml, 17 x 100 mm, suitable for 17015
15029	Teflon tube 30 ml, incl. screw cap, ø 25,3 x 92 mm, suitable for 12158/17030
15030	ditto polycarbonate
15032	ditto polypropylene
15034	ditto polyallomer
13055	Tube made of stainless chromium steel 50 ml, closable with sealing cap 17054, suitable for 12150/12156/17052
17054	Sealing cap for 13055
15049	Polycarbonate tube 50 ml, grad., ø 34 x 100 mm, suitable for 17050
15051	Teflon tube 50 ml, incl. screw cap, ø 28,5 x 107 mm, suitable for 12150/12156/17052
15052	Polypropylene tube 50 ml, incl. screw cap, ø 28,5 x 107 mm, suitable for 12150/12156/17052
15054	Polycarbonate tube 50 ml, incl. screw cap, ø 28,5 x 107 mm, suitable for 12150/12156/17052
13085	Tube made of stainless steel 85 ml, closable with sealing cap 17185, suitable for 12155/12159/17085

17185	Sealing cap for 13085
15074	Polycarbonate tube 85 ml, incl. special screw cap made of aluminium for high speeds, ø 38 x 104 mm, suitable for 12155/12159/17085
15075	ditto, with normal screw cap
15075	ditto, polypropylene, with special screw cap
15102	Polypropylene tube 100 ml, ø 45 x 100 mm, suitable for 17100/13100
15103	ditto polycarbonate
15202	Polypropylene tube 200 ml, incl. screw cap, ø 56,5 x 104 mm, can be directly put into buckets 13104 and 13117
15203	Polycarbonate tube 200 ml, incl. screw cap, ø 56,5 x 104 mm, can be directly put into buckets 13104 and 13117

Centrifuge glass tubes

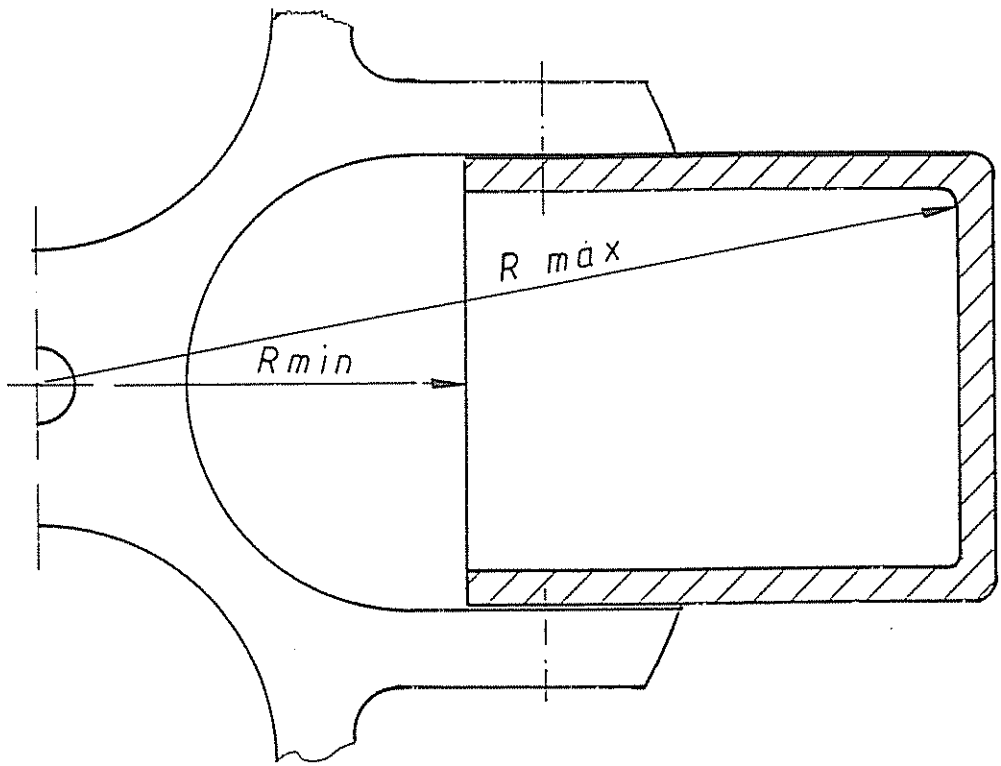
15007	Centrifuge glass tubes 7 ml, ø 12 x 100 mm, suitable for 17007
15015	Centrifuge glass tube 15 ml, ø 16 x 100 mm, suitable for 17015
15022	Corex glass tube 15 ml, ø 17,5 x 104 mm, suitable for 12150/12156 with 16018 and 12155/12159 with 16019, (max.allowed speeds 7000 rpm)
15024	Centrifuge glass tube 15 ml, ø 16 x 100 mm, graduated, suitable for 17015
15025	Centrifuge glass tube 25 ml, ø 24 x 100 mm, suitable for 17025
15026	Centrifuge glass tube 25 ml, ø 24 x 100 mm, graduated, suitable for 17025
15027	Centrifuge glass tube 7 ml, ø 12 x 100 mm, graduated

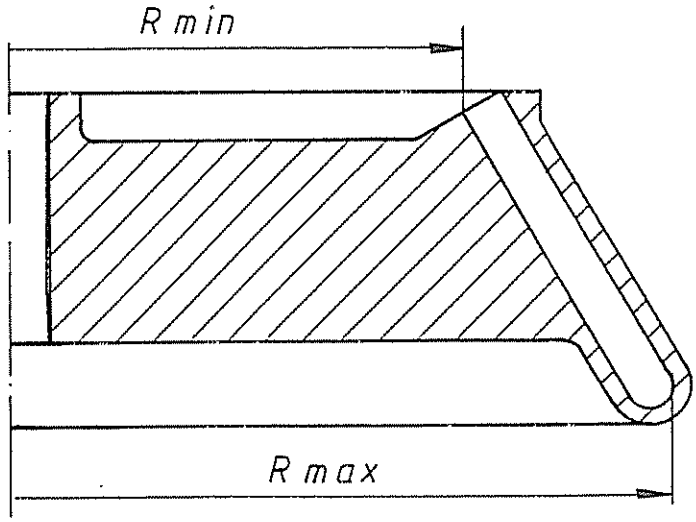
15033	Corex glass tube 30 ml, ø 24 x 105 mm, suitable for 12150/12156 with 16030 and 12155/12159 with 16031, (max. allowed speeds 7000 rpm)
15050	Centrifuge glass tube 50 ml, ø 34 x 100 mm, suitable for 17050
15056	Centrifuge glass tube 50 ml, ø 34 x 100 mm, graduated, suitable for 17050
15100	Centrifuge glass tube 100 ml, ø 44 x 100 mm, suitable for 17100/13100
15106	Centrifuge glass tube 100 ml, ø 44 x 100 mm, graduated, suitable for 17100/13100

Further accessories

16018	Rubber case for Corex glass tube 15 ml no. 15022, suitable for 12150/12156
16019	Rubber case for Corex glass tube 15 ml no. 15022, suitable for 12155/12159
16030	Rubber case for Corex glass tube 30 ml no. 15033, suitable for 12150/12156
16031	Rubber case for Corex glass tube 30 ml no. 15033, suitable for 12155/12159
16100	Rubber cushion for V4A-bucket 13100
16910	Rubber plate for round carriers 17006/17007/17012/17015/17025
16911	Rubber plate for round carriers 17050 and 17100
17111	Round sealing cap made of polycarbonate, clear, for tube 13104
16251	Sealing ring 57,2 x 3 mm for bucket 13104
17903	Table for centrifuges made of chipboards with 2 doors and 1 regale for accessories, movable (suitable for centrifuges 3-12/3K12/ 3K30/4-10/4K10)
17904	Fastener for table 17903

Further accessories available on request.


R max
Rmin


R min
R max

1.3 Delivery Inclusions

The following belongs to the centrifuge:

1 Rotor spanner SW 10	Part No. 930 100
20 ml slushing oil	Part No. 70 104
1 Tube grease for rotor load-bearings	Part No. 70 284
1 Short operating instructions	
1 Operating instructions	
1 Operating and use rotor and accessories	

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

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

1.4 Norms and regulations

These centrifuges belong to group 3 according to § 2 of the MEDIZINGERÄTEVERORDNUNG (MedGV). They meet the general requirements of § 3 of the MedGV.

For construction the following norms and regulations have been considered:

1. German accident prevention regulation for electric equipment and operating material UVV, VBG 4
2. German accident prevention regulation for centrifuges UVV, VBG 7z
3. German accident prevention regulation for refrigerating plants UVV, VBG 20
4. VDE 0871 interference suppression class A
5. DIN 58970, part 1, 2, 3 and 4, centrifuges, centrifuge tubes
6. The centrifuge meets the requirements of the equipment safety law according to the general requirements ISO/IEC Guide 38 and 40.

1.5 Important comment

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

According to the German accident prevention regulation UVV, VBG 7z the operator is obliged to take care of the following points:

1. The max. speed marked on the used rotor must not be exceeded.

2. According to § 19 of the UVV, VBG 7z the operator has to make operating instructions considering those of the manufacturer and to inform the employees accordingly.

3. By reasons of safety these operating instruction must clearly state that the stamped max. speed of the used rotor and the max. allowable filling quantity must not be exceeded.

4. If the density of the material exceeds 1,2 g/cm^3, the max. speed of the centrifuge must be reduced.

5. Operation of the centrifuge in hazardous locations is not allowed.

6. The centrifuge should be fastened onto the table. Consideration has been given to this fact (see point 3.2.4).

7. During operation the centrifuge must not be touched or moved.

2. Description of Centrifuge:

2.1 General outlay

The new generation of SIGMA laboratory centrifuges is microprocessor controlled and equipped with brushless, silent and long-life asynchronous motors.

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

2.2 Construction and constructive safety measures

The centrifuges are built into a solid aluminium frame and cased with foamed synthetic parts. The opening to the rotor chamber in the tabletop is much smaller than the rotor chamber which offers additional safety in case of a crash. The centrifuge lid is also made of solid sheet steel and cased with synthetic parts which include the necessary thermal protection. From the back the lid is secured by a solid shaft and at the front by two separate cover locks.

The bottom of the armoured chamber is a screwed in, one-piece steel plate so that there is a solid safety case around the rotor chamber. The centrifuges stand on noise absorbing, elastic feet. Moreover they are equipped with devices which allow fastening at the installation point.

2.3 Drive

The drive motors are well dimensioned asynchronous motors where the centrifuge rotors are directly connected to.

By reason of no commutation device no carbon brush change is necessary, there is no carbon dust pollution and the noise level is low.

2.4 Data input and output

The input and output unit is a hermetically sealed foil keyboard with clearly distincted action point. Easily readable displays and LED's signal operating states and lead the operator through the wide range of application possibilities.

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

2.5 Electonics

The microprocessor controlled electronics allows extensive matching possibilities of the centrifuge to the different tasks. The following parameter can be programmed and called among others:

- Speed preselection in steps of 1 rpm.
- RCF in steps of 1 x g
- Input of centrifugal radii
- Input and measurement of time integral
- Endurance and time operation (9 h, 59 min.)
- Short-term operation
- Operation with preparatory time
- Fixed deceleration and acceleration curves
- Free arrangement of deceleration and acceleration curves
- Saving, loading and altering of programs
- Warning of breaking glass danger
- Fault messages recongnized by the system and storage for service
- Compensation of sensors is carried out by software so that compensation elements cannot misadjust.
- The centrifuges are prepared for zonal operation.

2.6 Safety devices

Apart from the above passive safety devices in armouring there are the following active precautions for your safety:

2.6.1 Lid lock, cover closing device

The centrifuge can only be started when the lid is correctly closed. Both electric locks must be locked. The lid can only be opened when the rotor has stoped. If the lid is opened by the emergency release during operation, the centrifuge will immediately switch off and brake with maximum rate until rotor has stoped. If the lid is opened, the drive is completely separated from the mains supply, that means starting of the centrifuge is impossible (refer to point 8.7.4 "Lid emergency release").

2.6.2 Imbalance monitoring system

In case of uneven loading of opposite buckets the drive is switched off during acceleration or during run.

2.6.3 Inapplicable

2.6.4. Rotor monitoring

During programming the rotor part no. must be entered. The computer checks, if the entered speed or the gravitational field is allowed for the rotor. Errors are indicated by flashing LED's in the corresponding parameter, starting the centrifuge is impossible. After starting, during the start-up phase, the computer additionally checks identity of the rotor. If the rotor doesn't correspond to the programmed rotor no., STOP is carried out and an error message is issued. Restarting the centrifuge is only possible, when the rotor part no. has been corrected.

2.6.5. Standstill monitoring

Opening of the centrifuge lid may only be possible, if the rotor is at standstill. This standstill is checked by the computer and also by a second additional hardware circuit. Both monitoring devices must independently of each other have recognized that the rotor is at standstill, before the lid can be opened.

2.6.6 System check

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

3.1 Unpacking centrifuge

Open carton or case. Take out carton containing accessories. Remove upper foamed material. Take of centrifuge upwards with two persons.

Please store packing for possible dispatch of centrifuge lateron.

3.1.1 Transport safety device

SIGMA 3-12 is equiped with a transport safety device which must be removed before initiation. The transport safety device blocks the drive and imbalance recognition system.

The transport safety device screws are accessible at the bottom of the centrifuge.

Lift left side of centrifuge to place a suitable object - e.g. a wood block or something similar - between table and centrifuge.
Attention: Risk of injuring!

The black transport safety device screws will be visible and can be manually loosened and removed. At the screw in front there is a string which is carefully removed along with the screw. Thus the imbalance system is activated.

Align centrifuge and continue initiation.

The transport safety device screws should be kept for possible return of centrifuge (service, repair).

3.2 Installation

3.2.1 Siting

Nearly the whole supplied energy of the centrifuge is converted into heat and emitted into the ambient air. By this reason sufficient ventilation is important. The ventiducts in the unit must totally remain in effect. Moreover, the centrifuge shouldn't be positioned near radiators and direct insolation should be avoided.

The table should be steady with a solid, even top. A safe distance of at least 30 cm around the centrifuge should generally be kept.

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

3.2.2 Connection

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

SIGMA laboratory centrifuges are units of safety class I and include a three-core connection cable 2,5 m long with shock-proof right angle plug.

At the back beside the mains supply there is an additional ground wire connection where a separate ground wire can firmly be connected to. By this measure the allowable leakage current cannot flow over a person in case of a defect in the ground wire system. The leakage current is harmless but by reason of e.g. fright there can arise secondary dangers.

3.2.3 Fuses on site

The centrifuges must be protected typically with at least each 16 A time lag.

3.2.4 Tabletop fastening

By safety reasons the centrifuge should be fastened onto a table. After loosening the panel, four junction plates are visible in the corners of the bottom plate. There are square holes 8 x 8 mm. Screws can be put into these holes which can establish a connection with the tabletop.

3.3 Insertion of rotors and accessories

1. Open centrifuge lid with lid button (K4).

2. Unscrew rotor fixing screw from motor shaft (counter-clockwise).

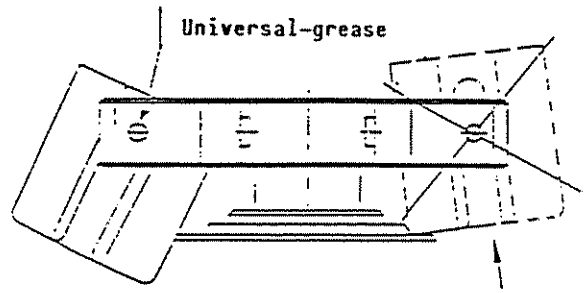
3. Put central boring of rotor vertically onto the motor shaft.

4. Screw in rotor fixing screw (clockwise) and tighten it firmly with the aid of the supplied rotor spanner so that the disc spring, if existing, is pressed together.

Fastening torque	110/112/113/203/204/2-15/2K 15:	ca. 5 Nm
	3-10/3K 10/3-12/3K 12/3K 30:	ca. 7,5 Nm
	4-10/4K 10/6-10/6K 10:	ca. 10 Nm

In the event of frequent use the rotor fixing screw must be loosened by some circles and fastened again. This should be done once a week or after approx. 20 cycles. This ensures a proper connection between rotor and shaft (please refer to "Care and cleaning of accessories" as well).

5. Swing-out rotors have to be fitted out with buckets in all positions. Pay attention that each bucket swings out free.



6. Use only appropriate vessels for the rotor set in, refer also to point 1.2 "Suitable accessories".

7. Fill vessels external to the centrifuge.

8. Put or screw on covers of vessels.

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

10. In high speed centrifuges the synthetic buckets must always be totally filled in angle rotors to avoid distortion of buckets and leakages or loosening of the caps in case of partial filling.

11. **Attention:** The centrifuge will absorb smaller differences im weight when loading the rotors. But it is advisable to balance the vessels as exactly as possible in order to ensure a run with minimal vibrations. Should the centrifuge be operated with very uneven load, the imbalance device will switch off the drive and an error diagnostics is issued.The LED Unwucht/Imbalance Ü3 of the monitoring panel is illuminated (see folding picture 4.1).

12. Rotors with cover should principally be operated with such covers. The rotor cover is fastened with the rotor spanner. Correct fastening must be ensured. **Attention!** The cover screw serves for fastening the cover onto the rotor only, not for fastening of the rotor onto the collet chuck. Before installation of cover correct fastening of the rotor fixing screw must always be checked using a spanner.

13. Don't fix the rotor screw without a rotor. Otherwise you'll destroy the collet chuck.

3.4 Initial Start-up

Attention!

Before initial start-up please pay attention to the fact that your centrifuge is orderly installed (refer to point 3.2 "Installation").

3.4.1 Switching on the centrifuge

Connect the centrifuge to the electrical supply (mains switch at the back of the centrifuge).

- The LED 's labelled TD, PD, ZD, and DD light up:
- the speed display (DD) indicates "2000",
- the time display (ZD) indicates "2",
- the programming panel (PD) indicates "0"
  (the above mentioned indications are default parameters when program no. 0 is loaded),

- i.e.: the centrifuge is to accelerate to 2000 rpm,
- the centrifuge operation is terminated after 2 minutes,
- deceleration of centrifuge is carried out according to curve 8.

3.4.2 Opening lid

Press the lid button (K4)

- The lid opens.
- The display continues to show the nominal values of the selected program.

3.4.3 Insertion of rotor

Put a rotor onto the shaft and fasten it by screwing the rotor fixing screw onto the shaft. Please use the supplied rotor spanner and hold on to outer part of the rotor. Please pay attention to the fact that during fixing the disc spring of the rotor fixing screw, if existing, is pressed together and the screw is screwed in as far as possible (see 3.3 "Insertion of rotor and accessories").

3.4.4 Selection of rotor part no.

Press the parameter key (DP) in the speed panel three times,

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

Press countin key (DZ), (+) or (-),

- another rotor part no. will appear in the speed panel
- press this key until the rotor part no. belonging to the used rotor will appear on the speed display
- with the new rotor part no. new nominal values possibly are displayed

Press parameter key (DP) in the speed panel again.

- LED "Bucket" (D4) is illuminated. The rotor capacity e.g. 8-50 is illuminated.

3.4.5 Starting and stopping the centrifuge

Close the lid until you can hear the clicking of both lid locks,

- the LED inside the start button (K1) lights up, indicating that the operation can be initiated.

Press the start button (K1),

- the LED's of the start button (K1) and the lid button (K4) turn off,
- the stop and faststop LED's in the corresponding buttons (K2, K3) light up,
- the motor accelerates to the set speed,
- the speed display (DD) indicates the current rotor speed.

Aborting an operation

Press the stop button (K2),

- the start button LED lights up again, indicating that the operation can be continued by pressing the start button,
- the motor decelerates according to the set deceleration curve until it comes to a standstill,
- the display continues to indicate the current operational data.

Or:

Activating the faststop button (K3),

- the start button LED is turned off,
- the operation can not be re-initiated by pressing the start button,
- the motor decelerates with maximum deceleration to a standstill,
- the display continues to indicate the current operational data.

The operational period is terminated,

- the time display (ZD) changes to "0",
- the start LED is on and indicates that the operation can be restarted by pressing the start button,
- the motor decelerates according to the set deceleration curve,
- the display continues to indicate the current operational data.

Press the lid button (K4),

- the lid opens,
- the centrifuge operation is terminated,
- the nominal values of the selected program are displayed, as indicated before the centrifuge operation was started.

Note!

If problems occur, refer to point 8.7 "Error correction".

4.1 Operating panel (folding illustration at the end ot the operating instruction)

4.2 Displays and keys

All settings of the centrifuge are executed via the control panel. The panel is subdivided into control panels and display panels.

4.2.1 Control panels

The control panels are located at the right-hand side of the panel:

- Command panel (K)
- Keyboard (E)
- Lockswitch (S)

These panels only contain operator controls which initiate or terminate the centrifuge operation. The lockswitch as an addition control has a special significance.

4.2.2 Display panels

- Speed display and control (D)
- Time display and control (Z)
- Programming display and control (P)
- Monitoring panel (Ü)

The display panels indicate the current state of the centrifuge program. In addition, data concerning the centrifuge operation are displayed. The individual panels contain the following operator controls and displays:

4.2.3 Displays

(Displays are labelled by two letters, the latter one being a D: PD, ZD, DD). The displays are located at the upper part of the panel. Because of a high intensity contrast, they are easy to read and allow for a simultaneous presentation of important data concerning the centrifuge operation (e.g. speed, run-time, no. of program etc.).

4.2.4 Light Emitting Diodes (LED)

(The LED's are labelled by the letter of the correponding panel and numbered in sequential order: e.g. D1, D2, ...). The LED's are arranged vertically below the displays. One of the LED's is constantly on. It identifies the value given on the corresponding display.

4.2.5 Parameter keys

(The keys are labelled by two letters, the latter being a P: TP, PP, ZP, DP). The parameter key is located at the bottom right corner of each panel. The parameters keys are used for activating the corresponding panel for an entry, selecting a display parameter and terminating the entry process.

The monitoring panel does not contain any keys but only LED's.

4.2.6 Counting keys

In these operating instructions also labelled by two letter, PZ, ZZ and DZ. The counting keys are on the panels above the parameter keys and labelled (+) or (–).

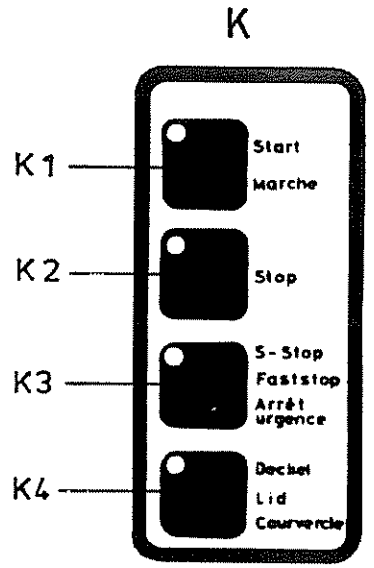
With the aid of these keys the values in the displays can be increased or decreased by depressing the (+) or the (–) key. Short depressing results in one single counting step, holding in continuous steps with increasing speed. Counting is stopped when the possible value range is exceeded or fallen below but can be continued by depressing the counting key again, rsulting in an overflow.

4.2.7 Cursor key

During standstill of the centrifuge and with open lid the lid button K4 can be used as a cursor control key, that means for program alterations the last flashing digit on the active display panel can be shifted and directly changed by depressing the lid button. This is advantageous if extensive value alterations are necessary. Moreover the speed can also be changed in the tens or units digit by this.

The monitoring panel only contains the warning LED for imbalance.

4.3 Control panels



4.3.1 Command panels (K)

The centrifuge operation is initiated directly via the command panels. The operational readiness of the buttons is indicated by illuminated LED's.

* Start button (K1)

This key can be used for the following:

- starting centrifuge operation,
- aborting a previously initiated deceleration process and restarting it,
- terminating keypad entries,
- terminating entries during operation and transfer (refer to point 5.6 "Altering programs during centrifuge operation").

The centrifuge can be started if

- the lid is closed,
- no incorrect entries were made,
- no LED's are blinking,
- the start-LED is on,
- the faststop button was not previously pressed

* Stop button (K2)

This button can used to terminate the operation prematurely. The centrifuge decelerates according to the preset curve to a standstill. Deceleration can be terminated by pressing the start button again.

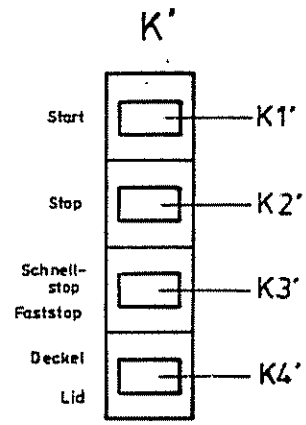
* Faststop button (K3)

Pressing this button decelerates the centrifuge as quickly as possible. The deceleration process can not be terminated but the centrifuge comes to a standstill in any case. Restarting is only possible after opening and closing the lid.

* Lid button (K4)

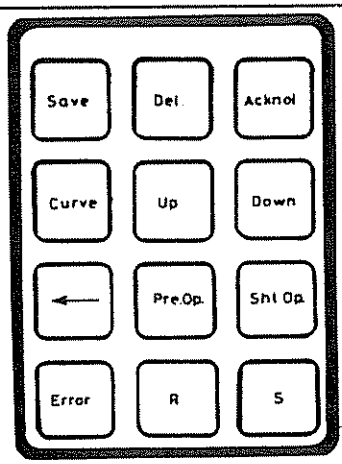
This button is used to open the lid. This can only be executed if

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



(at the right in the front panel)

4.3.2 Keypad (F)



- The keypad can be utilized to enter or delete program above function keys.
- If the user is in alteration mode (the display is flashing, as additional option, specific individual digits can be selected by pressing the arrow key and then be altered by the user. Each keystroke of the arrow key makes a display digit available for alteration in sequential order from left to right.

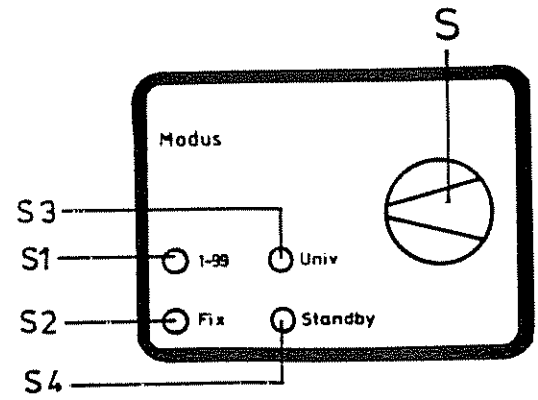
	–	selectes specific individual digits	(refer to point 4.2.7)
Pre. Op.	–	preparation time	(refer to point 5.9.3)
Sht. Op.	–	short term operation	(refer to point 5.9.2)
Curve	–	prepares for a curve entry	(refer to point 5.8)
Up	–	next curve interval	(refer to point 5.8)
Down	–	previous curve interval	(refer to point 5.8)
Save	–	saves a programm	(refer to point 5.5)
Del.	–	deletes a program	(refer to point 5.4)
Acknol.	–	acknowledges an entry	(refer to point 5.4)
Error	–	error mode	(refer to point 5.10)
R	–	inapplicable operation	(refer to point 5.6)
S	–	function servicekey	

Attention: The operating of the function servicekey should only be used by the serviceengineer. Otherwise an operating error could de-adjust the temperature value. A calibrated temperature indication would thus be impossible.

4.3.3 Lockswitch (S)

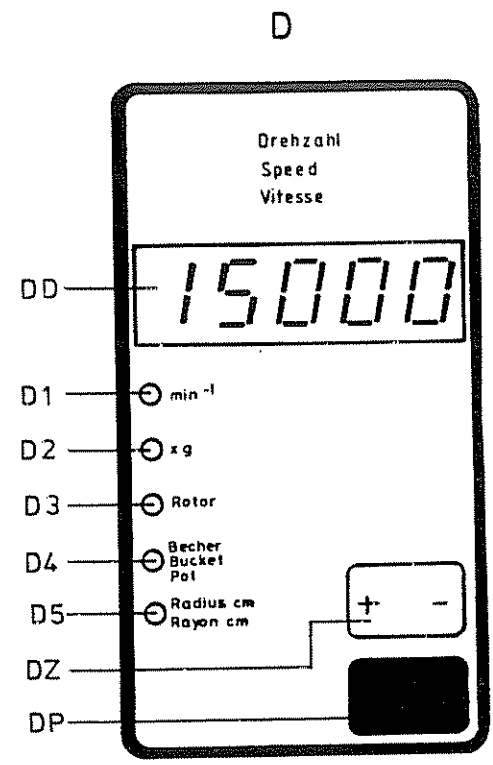
The lockswitch enables the user to restrict the access to the centrifuge operation. Four switch positions, indicated by LED's, are available:

Standby (S4)	–	Only the operation of the running centrifuge can be stopped. After terminating the operation, the LED is turned off.
Fix (S2)	–	Only starting and stopping of the preset program is possible.
1 – 99 (S1)	–	Loading and starting/stopping of different programs is possible.
Universal (S3)	–	Program can be altered, saved, deleted, and run.



4.4 Display panels

4.4.1 Speed panel (D)



Speed (D1)

When entering a speed parameter, the nominal value of the centrifuge speed is set. After starting the centrifuge, the current actual speed of the rotor is displayed.

RCF (D2)

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

If the RCF parameter is selected during an operation, the actual parameter value is displayed.

After entering a new RCF parameter, the speed and acceleration LED's might light up. This indication is given if the limit is exceeded. Please refer to point 8.3 "Entry limitations".

Rotors (D3) and buckets (D4)

Different rotors and buckets can be selected via the counting key. By pressing this key, all available rotor and bucket types are offered for selection in the display in sequential order. The selection is terminated if the the selected bucket and/or rotor is displayed. The corresponding maximum radius for the rotor/bucket combination is automatically set. The radius is necessary for calculation of the RCF value.

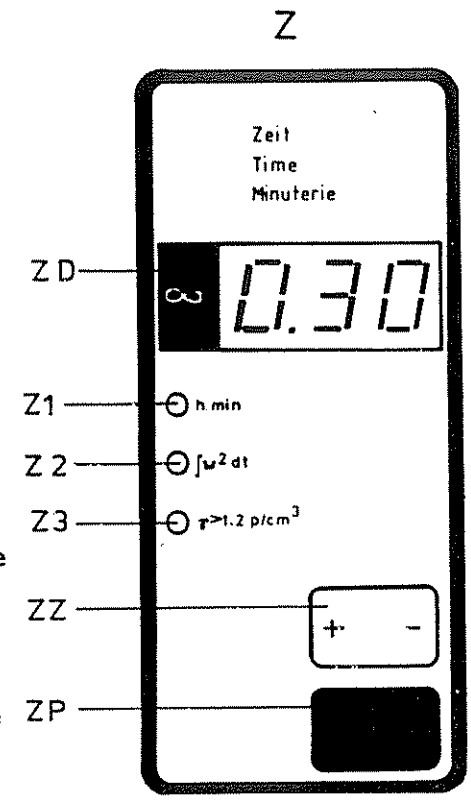
After selecting a different rotor, the corresponding bucket LED might blink. This indicates that several buckets are available for this rotor (refer to point 8.5 "Rotor-bucket-verfication"). To complete a new entry, the bucket to be utilized from the bucket list is selected via the counting key.

Radius (D5)

The radius is the distance between the center of the rotor axis and the interior bottom of the centrifuge tube. If there is no definite radius given, the maximum value is automatically loaded.

In general, each radius between and minimum limits can be set (refer to point 1.2 "Suitable accessories") for calculation of the gravitational field. The data is entered as a three-digit number in centimeters. The decimal point is automatically positioned. If parameters are entered here, the calculation of the relative centrifugal acceleratiion (RCF) is changed. For further information and description refer to point 5.7.1 "Specifying the relative centrifugal acceleration.

4.4.2 Time Panel (Z)



Time (Z1)

In its basic state, this display shows the programmed operational period. During the operation of the centrifuge, the remaining run-time is displayed in hours and minutes.

Entering new run-time data is executed in hours and minutes. If the minutes parameter exceeds a value of 59, it is automatically converted into hours. The maximum programmable run-time is 9 hours 59 minutes. Run-time is defined as the period from starting-up the centrifuge to the beginning of deceleration.

The key combination Shift/"continuous operation" (∞) activates the centrifuge for continuous operation. The time and integral displays are omitted, only two dashes (--) are displayed and the LED for continuous operation left of the display lights up. By entering a specific run-time, the continuous mode is deactivated.

After starting-up a continuous operation, the run-time period of the so far executed operation is displayed, and a display of the actual integral value can be obtained. The centrifuge operation can only be terminated by pressing the stop or faststop button.

Integral (Z2)

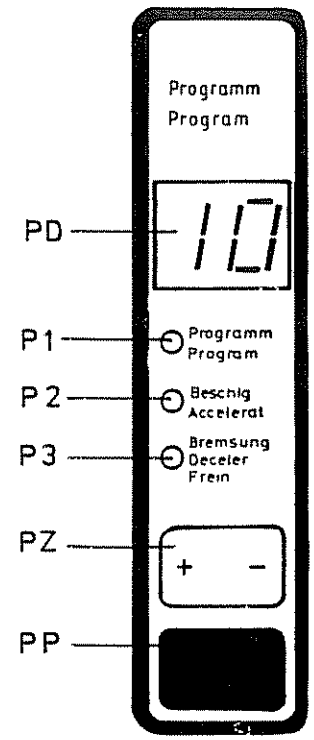
The integral parameter describes the dynamic stress the sample is exposed to. In order to be able to display the high integral values that are possible, the exponential denotation is used. It is given on two displays: the speed indication is a four-digit mantissa, the time indication is a two-digit exponent. Further information and descriptions are given in point 5.7.3 "Specifiying an integral".

Density (Gamma >1.2) (Z3)

If the density of a liquid to be centrifuged exceeds a value of 1.2 g/ cm^3, the corresponding gamma value must be entered here for safety reasons. The maximum possible speed is decreased appropriately. The entry can be any two-digit value in the range of 1.2 to 9.9. The decimal point is automatically set, e.g. 22 is 2.2 (refer to point 8.6.2 "Density").

4.4.3 Inapplicable

P



4.4.4 Program panel (P)

Program (P1)

A new program is loaded by entering a program code number. After turning the centrifuge on, the last active program is loaded. The user can alter programs, save them again or delete them. The values of a different program that was loaded are only displayed if a further button is pressed. For further information please refer to point 5 "Programming".

Acceleration (P2)

The acceleration number selects an acceleration curve that the centrifuge follows until it reaches its final speed. Three different rise variants can be selected:

0... 9	linear rise
10...19	quadratic rise in the speed range up to 1000 rpm
20...29	freely programmable curvature

Curves 0 to 19 are preset by the manufacturer and cannot be altered by the user. Their curvature can be looked up in point 8.1 "Shape of fixed curves" and 8.2 "Quadratic curves". Curves 0 to 9 are linear, curves 10 to 19 are quadratic up to a speed of 1000 rpm. When exceeding a speed of 1000 rpm, the acceleration parameter is constant.

The acceleration response is expressed by the curve slope. For example: curve no. 8 is steeper than curve no. 7, i.e. the centrifuge reaches its final speed in a shorter period.

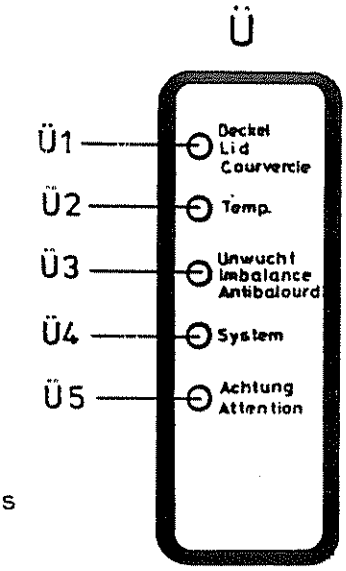
Curves 9 and 19 apply a maximum acceleration to the centrifuge. These curves represent an exception. The centrifuge accelerates to its maximum torque. The time necessary to reach this maximum is only dependent on the inertia of the rotor.

Acceleration curves 20 to 29 are freely definable by the user and can be applied over the entire speed range. Additional information is supplied in point 5.8 "Programming variable acceleration and deceleration runs".

Deceleration (P3)

The deceleration no. selects a deceleration curve that decelerates the centrifuge down to standstill. The deceleration curves are mirror-inverted images of the acceleration curves and are labelled with identical numbers.

4.4.5 Monitoring panel (Ü)



The task of this field is to indicate possible troubles during centrifuge operation. The corresponding five control and monitor LED's start to blink if a malfunction of an associated panel occurs:

"Lid" (Ü1) – The lid was not closed correctly, the centrifuge doesn't start.

"Temperature" (Ü2) Function only by refrigerated centrifuges

"Imbalance" (Ü3) – The centrifuge loading is not balanced or an interference has occured (e.g. broken glass container) so a balanced rotation cannot be executed.

System" (Ü4) – A blinking system monitoring LED is an indication of an internal error in the data calculation of the centrifuge. More precise information in respect to the present problem is given by the error message displayed on the speed panel (see point 8.8 "Error table").

"Warning" (Ü5) – This LED warns of the danger of glass breaking which can occur with the selected speed.

Note!

Additional information and a detailed description of errors and their correction is given in point 8.7 "Error correction".

5. Programming:

What is considered a program?

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

In other words, a program contains a sequence of key operations in a memory. This sequence of key operations can be loaded with one single operation and also be executed. A program is useful if a defined centrifuge operation should more than one time be proceeded under same conditions as the parameters have to be selected only once.

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

Programs can be loaded, run, saved, altered and deleted.

For a better differentiation, programs are labelled with numbers which are displayed on the program panel (PD). A maximum of 100 programs (with the identification numbers 0-99) can be stored. Note: please use the forms of appendix 8.10 and 8.11.

When the equipment is delivered, the manufacturer has already stored standard programs with acritical parameters, i.e. if a desired program no. is loaded for the first time these standard values will principally appear. Thus operation of the centrifuge is always possible (refer to point 3.4 "Initial start-up").

But the original task of these standard programs is to get programs useful for operation by changing the parameters and storing.

5.1 Selections, displays and alterations of program parameters

Nominal values

When in standstill, the centrifuge displays the last entered nominal parameters (PD, ZD,DD) in the program, time, and speed panel displays that the centrifuge is to execute during operation.

Actual values

During the operation, the displays indicate the actual parameteres. These values are continuously determined and represent the speed, the integral, the relative centrifugal acceleration (RCF), the time, the temperature etc..

The LED's (P1-3, Z1-3, D1-5) below the displays indicate the parameters which the displays are currently showing. In its basic state, the upper LED's are on. The speed is displayed on the speed panel, the run time is displayed on the time panel and the program on the program panel.

The value of each of the parameters equipped with a LED can be altered prior to a centrifuge operation by executing the following:

Press the corresponding parameter button (PP, ZP, DP) on the appropriate display field.

- You are now in the alteration mode: the last digit of the display is blinking.

Select your parameter.

- This is executed by pressing the parameter button again. When pressing this button, the parameters from top to bottom of the corresponding field are given on the display.
- The LED of the selected parameter lights up.
- The last digit of the display is blinking, indicating that the user is still in the alteration mode.
- If after 10 sec. no alteration is made, the display turns to basic status.

Entry of new data via the counting keys (PZ, ZP, DZ)

- If only part of the parameters is to be altered, the arrow keys ( ) in the keypad (F)can be used to select individual digits for alterating. Each pressing of the key sequentially sets a digit from left to right to alteration mode. The blinking digit can be corrected to show a different value by pressing the corresponding numeric keys
- If an alteration has been made, the new value is read. The programm number in the program panel is replaced by "--" and shows that an unstored or altered program is used.

5.2 Loading a program

A program stored with a specific program number is to be loaded, i.e. it is to be called up for starting the centrifuge:

- Activate the program panel (P) by pressing the program parameter button (PP).
- Enter the desired program number via the program counting keys (PP) (0–99 is possible).
- Terminate the entry by pressing any parameter button (PP, ZP or DP) or by initiating the starting-up by pressing the start button (K1).
  - The selected program is loaded.
  - The new final speed, run-time, the selected program number and temperature are displayed. (If the entry was merely executed via one of the parameter keys, the display of the corresponding display panel will be in active mode for a approx. 15 sec., i.e. the last digit is blinking.)
  - If a program carrying the selected number is non-existing, the standard program is automatically loaded.

At this point, the user can start the centrifuge with the selected program by pressing the start button (K1) provided that this has not already been executed.

Note!

The centrifuge remembers the last correct program that was executed and automatically re-loads it for the next centrifuge operation. But if it is an altered program (display indicates "--"), the program with the original values is loaded and proposed for the next operation after the centrifuge was turned off and back on again, e.g. the next day.

Should an altered or new program be used again after the centrifuge was turned off and back on again, it must be correctly be stored under a program number (see point 5.5 "Saving a program").

5.3 Altering a program

The individual parameters of a program can be called up by pressing the parameter buttons and changed with the aid of the counting keys.

Examples:
++ **Speed parameters are to be altered.**

Move to the speed panel after pressing the parameter button (DP).

- Now the user is in alteration mode: the last digit of the display is flashing.
- **The speed nominal value can now be altered as desired in steps of 100 rpm within the allowable speed range by depressing the (+) or (–) key.**

If a step of 100 rpm is too much, at standstill it is possible to alter the single and ten values by using the arrow key in the command panel from right to left.

Thus it is possible to program the speed with an accuracy of one rotation or to change a desired digit in the display (see 4.2.6).

++ The centrifugation period is to be altered.

Move to the time panel after pressing the parameter button (ZP).

- Now the user is in alteration mode: the last digit of the display is flashing.
- The time nominal value can now be altered as desired within the allowable time range by depressing the (+) or (–) key.

Also the flashing digit of the display can be shifted to every position and changed by repeatedly pressing the arrow key. This is advantageous, if bigger alterations of the time range are necessary.

Note!

Invalid entries or such exceeding the allowed limits are not accepted which is indicated by the corresponding LED which starts to flash (refer to point 8.3 "Entry Limitations")

5.4 Deleting a program

Activate the program panel (P) by pressing the parameter button (PP) and enter the program number to be deleted via the program counting key (PZ).

Press the key "DEL" in the keypad (F)

- If a program exists under the entered number, "Quit" will be displayed.
- If a program of that number is not stored, the display remains.

Acknowledge the deletion by pressing "Acknol"

- The program is deleted.
- The program number is freely assignable now. When selecting it the standard program is loaded.

5.5 Saving a program

The user has altered individual parameters, or generated a new program as described in the point 5.3 "Altering a program". The program panel displays two dashes ("--").

Activate the program panel (P) via the parameter button (PP).

Enter the new program number via the program counting key (PZ).

Press the key "Save".

Note!

1. Do not press parameter or operator keys at this point, a new programm is otherwise loaded.

2. A program can only be saved as long as the display on the program panel is blinking. After a period of 10 sec. the previous program is automatically loaded and the newly entered data are lost.

The speed display now reads "Safe", i.e.:

- The program is stored.

The speed panel displays "Quit.", i.e.:

- There is a program of that number already stored.
- The newly entered program parameters are not saved.

The user has two alternatives at this point:

The old program is to be overwritten:

Press "Quit." as long as the speed panel still displays it.

- The speed panel displays "Safe".
- The old program is overwritten and the new program is stored instead.

The old program is to be saved under a different program number:

Enter the new program number via the program counting key (PZ).

- "Quit." is deleted on the speed panel display.
- Save the program as described above.
- Use the arrow key to make the microprocessor offer the next freely assignable program number.
- After pressing the arrow key (<--) the next freely assignable program number is indicated on the program panel.
- Save the program as described above.

5.6 Altering a program during centrifuge operation

If the centrifuge is running, the following parameters can be altered:

- Speed
- Run-time
- Switching to continuous operation mode/time mode
- Deceleration curve when the centrifuge is not decelerating

Select the parameter to by altered via the parameter keys (PP, ZZ, DP).

- The actual values are displayed.

Alter the parameters as described before with the counting key (refer ot point 5.3 "Altering a programm").

- The actual values are displayed.

Press the start button.

- The parameters are transferred to the actual operation.
- The display now show actual values.
- After disconnection of the centrifuge the altered values are stored.

If during the correction mode no entry is made every 10 sec., the program returns to its original state without any alteration of the data record. The start button must be pressed 10 sec. at the latest after a change in data was executed to make the alteration effective.

Note!

If the entry exceeds the parameter range, the speed panel displays the word "Error". After a period of 10 sec., alteration mode is automatically resumed. The original parameter is shown on the display and the entry can be repeated as described above. The (delay) period can be omitted by reactivating the entry parameter by the user (refer to the point 8.3 "Entry limitations").

5.7 Programming the relative centrifugal acceleration, density and integral

An alteration of these parameters automatically leads to recalculating and altering of other parameters because a direct mathematical interrelation exists between them (refer to point 8.4 "Verification of actual values" and point 8.6 "Mathematical formulae interrelation").

These parameters should only be altered if practical experience has already been gained in respect to the intended parameters and the lower and upper limits are known. When exceeding these limits, the LED's of the corresponding parameters a correction of which seems to be sensable start to blink until secure operation is ensured by corresponding corrections.

5.7.1 Specifying a relative centrifugal acceleration value (RCF)

The relative centrifugal acceleration, abbreviated RCF, is a measure for the dynamic load the sample is undergoing. Its magnitude depends on the radius and the speed (refer to point 8.6.1 "RCF").

During the operation, the RCF value (actual value) is continuously calculated and can be displayed by calling up the parameter. Therefore control over the actual load the probe is exposed to can be obtained.

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

Example:

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

  The final speed has been recalculated.
- Switch to the time panel and enter a smaller radius.

  The RCF value has been decreased.
- Increase the final speed controlling the RCF at the same time until the originally set RCF value is obtained again.

Result!

By decreasing the radius, a (proportionally) higher final speed is required in order to obtain an identical RCF value.

Note!

If the selected final speed exceeds the maximum possible speed, the RCF (D2), radius (D5) and speed (D1) LED's start to blink. Switch back to the speed panel, activate RCF and reduce the RCF value accordingly until no error message is displayed anymore.

5.7.2 Specifying a density value

If the density of a liquid to be centrifuged exceeds 1.2 p/cm³, the max. speed must be reduced for the used accessories or the centrifuge.

The centrifuge is able to calculate the reduced max. speed, if the parameter "Gamma" in the time panel is activated (LED Z3 on) and the higher density is entered via the time counting keys (ZZ). The entry range of the gamma value is between 1.0 and 9.9. The decimal point is automatically set.

A value exceeding 1.2 g/cm³ decreases the maximum possible final speed (refer to point 8.6.2
"Density").

Example:

- Enter a final speed which is just below the maximum possible rotor speed (refer to table 2 in point 8.3 "Entry limitations").

- Enter a density exceeding 1.2 g/cm³.

  The possible maximum final speed is recalculated. If the final speed exceeds the new upper limit, the gamma, rotor, and speed LED's start to blink. The centrifuge does not start.

Attention!

Operation with densities exceeding 1,2 g/cm³ with unreduced speed can cause dangerous situations and is therefore not allowed.

Note!

When working with sedimentation constants the necessary time constant can be calculated with the aid of the time integral when the original operating speed must be reduced by reason of too high density (refer to point 5.7.3 "Specifying an integral"). Calculation is made as follows:

- Enter originally desired program data.

- Call up corresponding integral value and remember it.

- Enter actual gamma value (the originally intended operating speed is reduced and also the original integral value.)

- Enter original integral value (the corresponding run-time is calculated).

Operation can now be started. The original sedimentation constants are effective.

5.7.3 Specifying an integral

An integral is a measure of the temporal and dynamic load the sample is exposed to. This value is given in its exponential form. The four-digit mantisse is displayed with a preceding "n" on the speed display and a two-digit exponent with a preceding "E" on the time display.

During operation, the integral is constantly determined. Its value depends on the speed and the passed centrifuge run-time. Its value increases constantly (refer to point 8.6.3 "Integral").

The actual values of the integral can be displayed during run or thereafter.

It is possible to specify a nominal integral. Entries are executed from right to left, i.e. are shifted through the mantisse display (speed panel) to the exponent display (time panel).

The following factors are considered when calculating an integral:

- run-time
- final speed
- acceleration curve
- deceleration curve.

If a new final speed was entered directly before the entry of a nominal integral, the centrifuge independently determines the total run-time. In all other cases the final speed is determined (refer to point 8.4 "Checking entries").

Independent conversion of the run-time is also useful, if the max. speed must be reduced by reason of high specific density of the material and thus the run-time must be increased (refer to point 5.7.2 "Specifying a density value").

Example:

- Specify new final speed data, run-time values and acceleration curves in sequential order.

  The resulting integral changes.

- Now specify a smaller integral.

  The resulting final speed decreases.

- Specify an integral after having altered the final speed.

  The resulting run-time also changes.

Note!

If during calculations the limits are exceeded e.g. resulting in an excessive final speed, the LED's for acceleration, deceleration, time, RCF, radius, rotor and speed start to blink. Move back to the panel on which you have altered a parameter and enter a new (smaller) value until no further error messages are displayed.

5.8 Programming variable acceleration and deceleration runs

Besides being able to select between 20 preset acceleration and deceleration curves, acceleration and deceleration processes are freely programmable. Up to 10 different curve shapes can be stored. Curve nos. 20 - 29 are available for this task (refer to point 4.4.4 "Program panel").

Up to 10 intervals can be specified per acceleration or deceleration curve respectively the entry of which is executed individually. An interval is defined by its run-time in seconds and the speed to be obtained at the end of the interval. The final speed of the last interval must correspond to the operating speed for the intended run. If the final speed of the last interval does not correspond to the operating speed the centrifuge calculates the acceleration time from the set curve slope (change of speed/clock unit). For the first interval, a quadratic acceleration can be preselected, otherwise the acceleration is linear. A "0" on the display (PD) indicates a linear acceleration, a "1" a quadratic acceleration.

Only acceleration curves are programmed. The deceleration curves automatically result from a mirroring of the acceleration curves. Each acceleration curve is therefore also applicable as a deceleration curve.

When programming a variable curve, first the absolute final speed for the acceleration curve to be programmed must be entered via the speed panel. Then the parameter button on the program panel (P) is used to select an acceleration value and a characteristic curve number (between 20 and 29).

After specifying an absolute final speed, the individual intervals are entered. Then the key "Curve" (preparing for characteristic curve entry) is used to switch to characteristic curve mode. The function of the individual display panels is changed as follows:

Speed display (DD)	-	the speed to be obtained per interval
Time display (ZD)	-	run-time during the interval in seconds whereafter the centrifuge should reach its preset interval speed (0 - 9 99)
Temperature display (TD)	-	automatic numbering (1 - 10) of intervals
Program display (PD)	-	type of interval: "0" for linear acceleration "1" for quadratic acceleration (only during the first interval) "99" for identifiying the last interval (automatically set during saving)

After switching to characteristic curve mode, the first interval is displayed. The program display (PD) starts to blink and is activated for entering the acceleration type ("0" for linear, "1" for quadratic"). Then the user must enter a speed and interval time which is within the permitted limits after the corresponding display was activated. The speed can be increasing or decreasing in such a case.

The key "Up" pages one interval forward which is then available to the user for entering data. From now on only linear acceleration (= "0") is possible. When all intervals are entered, the user exits the characteristic curve mode by pressing the key "Save". The complete data record of the charateristic curve is permanently stored under the entered acceleration number (20 - 29).

Save the entered curve during the final interval, i.e. have the final interval displayed with "Up" or "Down" before pressing key "Save", because the displayed interval is saved as the last entered interval and labelled "99". All following data records are not considered.

Before exitting the characteristic curve mode, the entered data record is checked according to the following criteria:

- **The speed must never be equal to zero.**
- **The time must never be equal to zero.**
- **The acceleration during the last interval must never be equal to zero.**
- **The acceleration can only be quadratic in the first panel.**
- **The last interval must be identified by a "99" on the program display** (the "99" is automatically set during saving).
- **The resulting acceleration values from time and speed must be realistic.**

If errors are detected, the speed display shows an error message and the characteristic curve mode can not be exitted. The error code number informs the user about the type of errors that occurred and during which interval the error was detected for the first time. Please refer to point 5.8.4 "Error code for self-generated characteristic curves".

The saved curves can be used as deceleration or acceleration curves in programs as desired.

5.8.1 Deleting characteristic curves

Curves can only be deleted, if they are not used in programs.

Switch to the acceleration panel via the parameter button and enter the number of of the characteristic curve to be deleted (20 - 29). Then press key "Del.". All programmed intervals are deleted; when calling up this characteristic curve no. again, the standard curve parameters are loaded.

5.8.2 Altering an existing characteristic curve

Call up the characteristic curve to be altered. The first interval is displayed. Switch to the desired interval by pressing "Up" and enter the new value. A repeated pressing of "Up" or "Down" causes a run through all remaining intervals which can then be altered if intended. If further intervals should be set, the "99" of the actual last interval must be replaced by "0".

If all characteristic curve numbers have been assigned, new acceleration data can only be entered after deleting an existing curve or by altering an existing curve.

5.8.3 Example:

An acceleration run under a number between 20 and 29 is to be programmed. Its final speed is to be 3100 rpm. This speed is achieved in three intervals:

Interval	Type	Time	Speed	Comment
1	1	10	1000	quadratic acceleration in 10 sec. to 1000 rpm.
2	0	6	2000	linear acceleration in 6 sec.to 2000 rpm.
3	99	5	3100	continuous acceleration with given inclination up to the final speed

- Enter characteristic curve mode as described above. If no curve has been saved under this number, the standard curve set is loaded into the working storage. Enter the desired interval values sequentially. Pressing the key "Up" displays the next interval. Proceed accordingly up to the last interval. By pressing "Save" the curve entry mode is terminated. The entered data record is saved. Now the nominal values are displayed again as before. Check the absolute final speed and correct it if necessary to 3100 rpm..

  Prepare a program with an operating speed of 3100 rpm. as usual and work in the prepared curves.

- Start the prepared program with the entered program no.. The intervals are executed according to the program.

In general there will be a delay of 2 - 5 seconds when starting the curves. This is necessary as after starting the computer must first regulate the motor voltage according to the set curve until it can recognize start of the motor. Only after start of the motor the speed can be regulated and timing of the curve can start.

In general, the last interval is processed differently, if its final speed does not correspond to the operating speed of the centrifuging operation: its curve characteristics are only executed until the centrifuge reaches its final speed. Therefore the significance of the last interval is not determined by the period of the curve but by its inclination which specifies the acceleration.

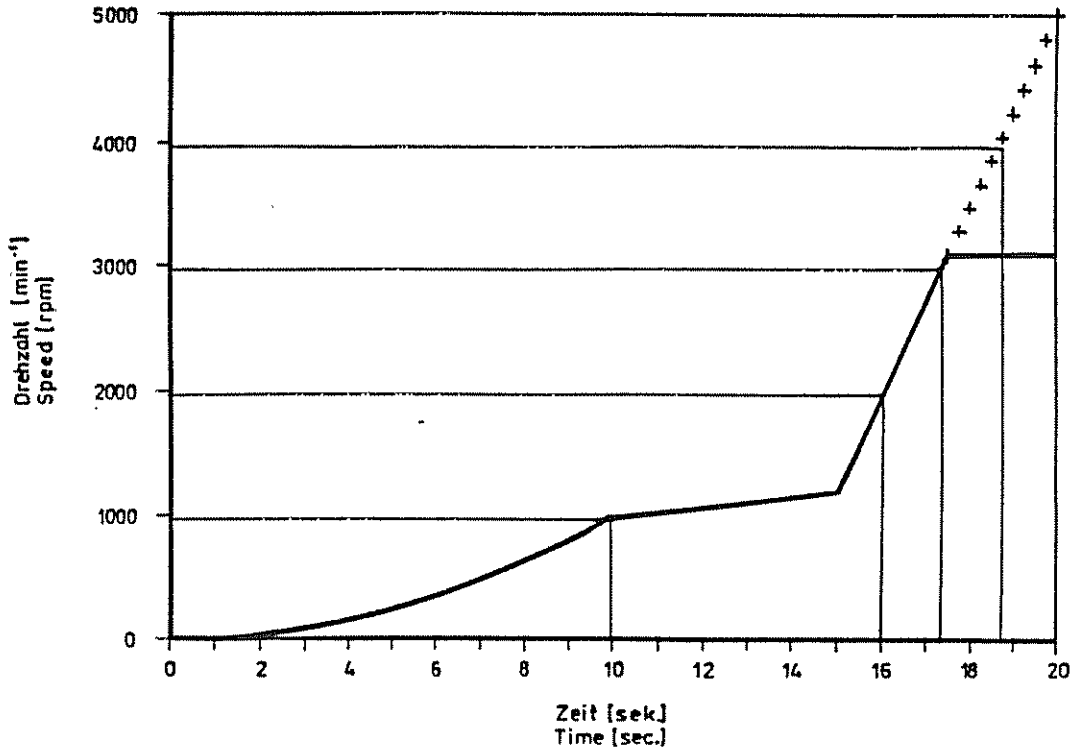


Figure 1 Speed–time curve

5.8.4 Error codes for self-generated curve characteristics

When an invalid entry is made, the speed panel displays an error message. The two-digit number informs about error location and type. The tens-digit identifies the interval in which the error was located. A zero is an indication of the interval number 10, a 1 of interval number 1. The ones-digit displays the error number.

Error number	recognized error
.. 1	Entered speed exceeds the valid value range
.. 2	Speed equals zero
.. 3	Time equals zero
.. 4	Incorrect entry on program panel
.. 5	Acceleration too high (-> increase time value or reduce speed)
.. 6	Acceleration too low (-> reduce time value or increase speed)
.. 7	Acceleration in last interval equals zero

Additional blinking of the acceleration and speed LED's indicates that the absolute speed can not be obtained during the last interval due to the following:

a) the starting speed of the last interval is already higher than the final speed and the desired speed requires an additional increase in acceleration or

b) the desired speed of the last interval is below the starting speed, the starting speed being below the absolute final speed.

5.9 Special time preselection

5.9.1 Continuous operation mode

With an activated continuous operation, the centrifuge run-time is unlimited an must be manually stopped. The nominal values on the time and integral panels are omitted and two dashes appear ("--") on the displays.

The continuously calculated (actual) integral and the time passed since program start (run-time) can be optionally displayed. The time display increases in contrast to the run-time display.

Continuous operation mode can be activated when the centrifuge is running (refer to point 5.6 "Altering a program during centrifuge operation") or in standstill mode.

Reversion to continous operation with the aid of the counting keys is carried out with the aid of the counting keys after 9 hours and 59 minutes have been exceeded or after zero has been fallen.

Deativating
By entering a concrete run-time, continuous operation mode is exitted; the run-time depends on the entered nominal value.

An immediate abortion of the operation is executed by pressing the stop or faststop buttons.

5.9.2 Short-term operation

Short-term operation is activated by pressing key "Sht Op.". The centrifuge accelerates according to the programmed curve.

In the time panel the seconds(!) up to termination of short-term operation are counted. This time display remains valid as long as no other control button (start, stop, faststop, lid) is operated.

5.9.3 Preparatory time

The preparatory time in hours and minutes is entered by pressing key "Pre. Op.".
All displays except the time panel are dark. The proposed value of preparatory time is 0 minutes, max. 9 hours 59 minutes. Input and verification of 0 minutes immediately terminates input mode for preparatory time.

Pressing the start button verifies input, changes to preparatory mode and starts preparatory time. Desired keys terminate preparatory mode prematurely.

After termination of preparatory time (time panel displays 0) the run mode is activated and the centrifuge is started.

5.10 Error mode

System errors that might occur (no user errors!) are stored in the same order as they occured and can be called up in the error mode. This function is used if operational malfunctions occur.

Error mode is entered by pressing the key "Error". The speed display shows the number of the first occuring error. Further and subsequent (different) errors can be displayed sequentially by pressing the arrow key. The error table in point 8.8 lists types and possible corrections for the present errors.

The error table of the error mode can accomodate max. 15 status messages. If further errors occur, the first errors are overwritten by the last ones. The key "Del." deletes the error numbers. But this should be done by our technician to receive the necessary informations of the errors.

By repeatedly pressing the key "Error" the error mode is terminated.

6. Notes for Centrifugation:

6.1 Practical notes for centrifugation

1. Put centrifuge horizontally onto a solid location.
2. Ensure secure location.
3. Keep free space around the centrifuge.
4. Provide for sufficient ventilation.
5. Tigthen rotor firmly onto motor shaft.
6. Avoid imbalance.
7. Load opposite buckets with same accessories.
8. Centrifugation with different tube sizes.

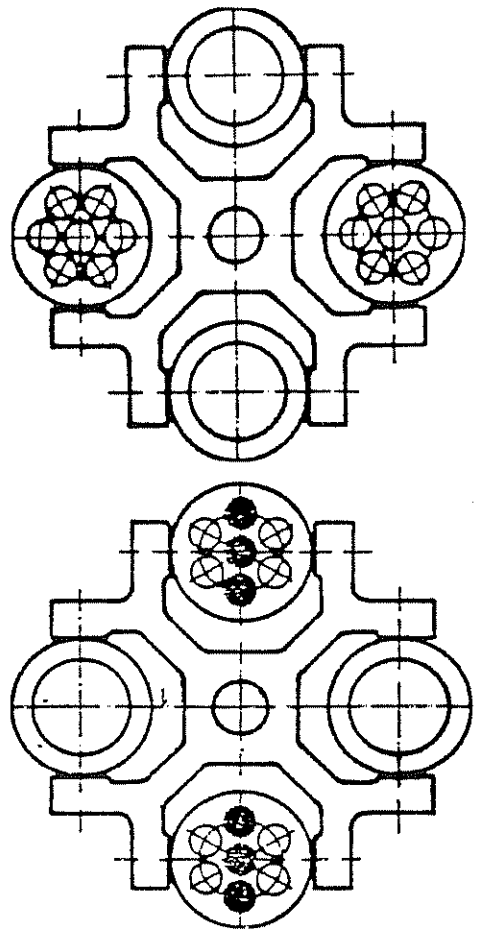
   In principle operation with different sizes is possible. But it is absolutely necessary that opposite carriers are the same.

   The example shows a swing-out rotor with buckets, 2 x carrier 100 ml and 2 x carrier 7 x 15 ml with corresponding glass tubes respectively synthetic tubes.

   Centrifugation with low capacity.

   An example is the swing-out rotor 28 x 15 ml.

   The tubes should not only be inserted symmetrically but buckets and their suspensions should be loaded evenly. Loading e.g. an outer or inner position of the buckets is not allowed.



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

    a) swing-out rotors approx. 5000 rpm., approx. 5000 x g

    b) angle rotors approx. 4000 rpm., approx. 4000 x g
       (refer also to warning LED Ü5)

12. Fill vessels carfully to same weight.
13. Grease joints of buckets and rotor bolts.

6. Notes for Centrifugation:

14. Use only perfect accessories.

15. Avoid corrosion to accessories by careful maintenance.

16. Centrifuge infectious materials in closed buckets only.

17. Do not centrifuge explosive or highly inflammable materials.

18. Record all generated program data, refer to forms of appendix point 8.10 and 8.11.

6.1.1 Inapplicable

6.2 Inadmissible centrifuging operations

1. Operation of inexpert installed centrifuge.
2. Operation without panelling.
3. Operation after repair by non authorized persons.
4. Operation with rotor not installed orderly (refer to point 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 rotor limited by the manufacturer and the max. speed (see stamp at the rotor) must not be exceeded. The rotors are intended for liquids of an average homogeneous density of 1,2 g/cm³ or less if centrifuged at max. speed. If liquids of higher density should be used, the speed must be reduced for such rotation (refer to point 8.6 "Mathematic formulae interrelation").
7. Operation with rotors, buckets and carriers showing corrosion or other damages.
8. Operation of very corrosive substances which can cause damages to material and impair mechanical consistency of rotors, buckets and carriers.
9. Operation of rotors and accessories not allowed by the manufacturer, except commercial vessels of glass or synthetic materials. The use of poor commodity goods is expressly warned of. At high speeds breaking glass or bursting vessels can cause dangerous imbalances.
10. Operation in hazardous locations.
11. Operation with too long vessels.
12. Centrifugation of foreign bodies.
13. Operation with partially filled synthetic buckets in high speed angle rotors.
14. Operation by non authorized personnel.
15. During operation the centrifuge must not be touched or moved.
16. Do not put down potential dangerous materials – eg. glass vessels containing liquids – near the centrifuge.
17. Attention: Do not open cover and/or reach into rotor chamber unless the rotor is at standstill.

7.1 Care and cleaning of centrifuge

Please use soap water or other water-soluble, mild agents for cleaning. Avoid corroding and aggressive substances. Do not use alkaline solutions or burning solvents or agents with abrasive particles like VIM, ATA or others. Remove condensation water or product residues from the rotor chamber using a cloth. It is recommended to open the cover when the centrifuge is not in use so that moisture can escape.

7.2 Care and cleaning of accessories

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

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

Chemical reactions as well as corrosion (combination of changing pressure and chemical reaction) can corrode 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 another change, also corrosion, the part (rotor, bucket etc.) must be replaced immediately.

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

Cleaning of accessories should be carried out external to the centrifuge once a week or better after every use. The rubber cushions should be removed from buckets and carriers. After this the parts should be dried with a soft cloth or also in a drying chamber at approx. 50 °C.

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

Careful maintenance increases life time and avoids premature failure of the rotor. Corrosion or resultant damages which are caused by insufficient care cannot be claimed with the manufacturer.

7.3 Receivers for swing-buckets

The trunnions 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 for load-bearing bolts).

7.4 Glass breakage

In case of glass breakage all glass particles must be carefully removed. Rubber insets have to be cleaned carefully and possibly be replaced. If this is not kept to the following points have to be considered:

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

Particles in the receivers 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 e.g. Vaseline. Then the rotor should rotate for some minutes at a moderate speed. The glass and metal particles will now collect at the greased part and can easily be removed with a cloth together with the grease. If necessary repeat this procedure.

7.5 Inappliable

7.6 Sterilization and disinfection of rotor chamber and accessories

All usual disinfectants like e.g. Buraton and Terralin can be used. The centrifuges and the accessories consist of different materials. A possible incompatibility must be considered. For sterilization by steam continuous resistance to temperature of the individual materials must be considered. Please contact us from case to case.

Principally we want to point out that for centrifuging of e.g. infectious material hermetically sealed buckets should be used in order to avoid that this will reach the centrifuge.

7.7 Check of operating safety according to UVV VBG 7z

Centrifuges of a kinetic energy exceeding 10000 Nm and a power consumption of 500 watt must be checked in working order at least once a year and additionally in disassembled condition when required but at least every three years by an expert regarding their operating safety. A reason for a shorter period than three years could be e.g. frequent imbalances or corrosive surroundings.

The results of the checks must be registered in a test book which must be stored at the location of the centrifuge (UVV VBG 7z, § 15 and 16).

7.8 Checks by operator

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

This especially refers to:

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

8.1 Shape of fixed curves, linear curves

- The inclination of fixed acceleration curves is defined as the time required to accelerate to 1000 rpm.
- With linear and quadratic inclinations, curves are numbered in the direction of increasing acceleration (from right to left).

Linear inclination (curves 0 – 9)

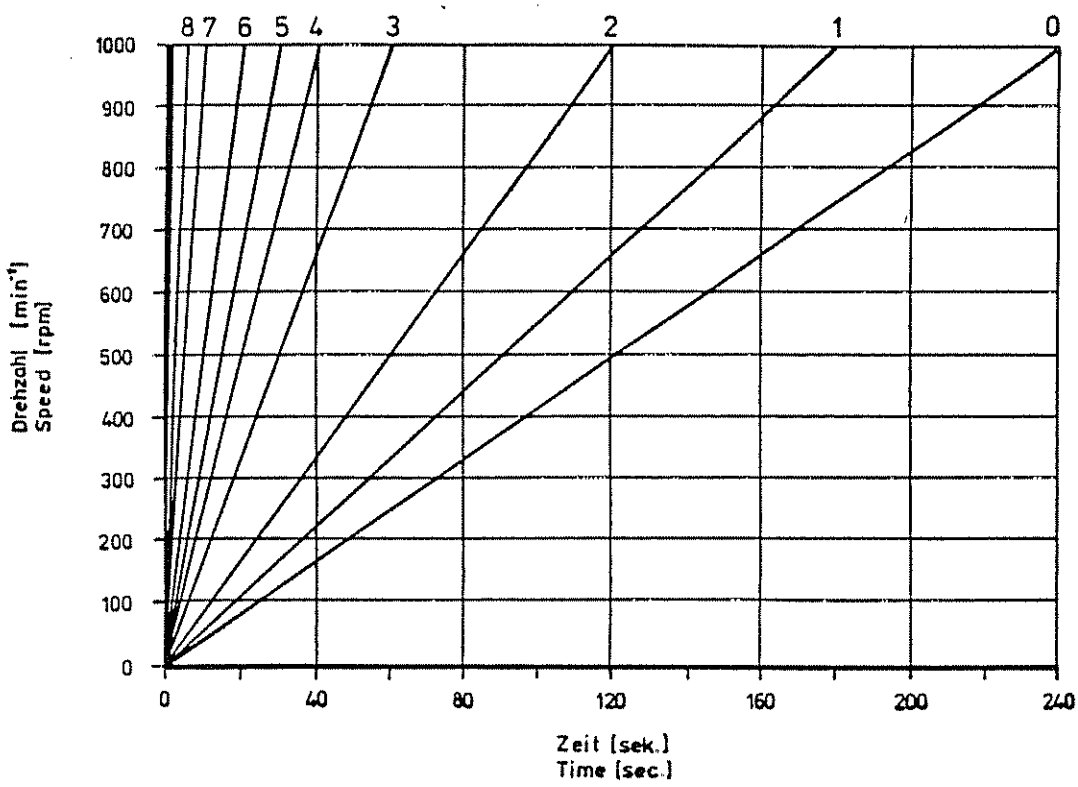


Figure 2

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

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

8.2 Quadratic curves

Quadratic inclination (curves 10 - 19)

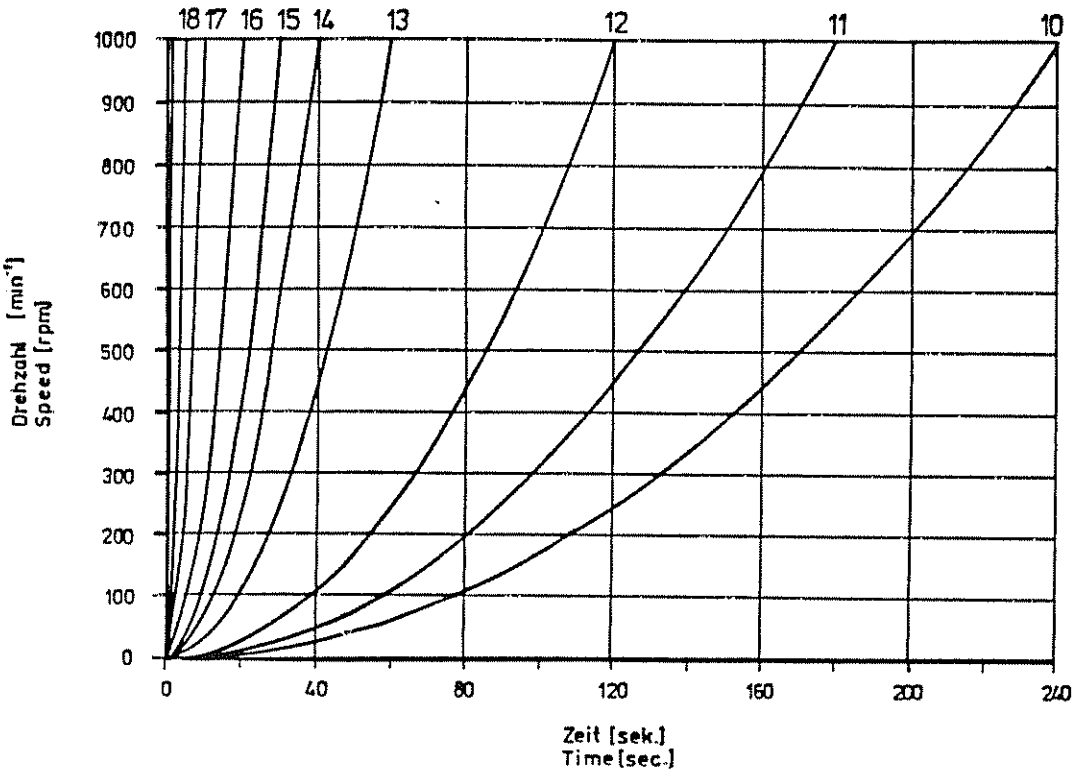


Figure 3

The curve 19 is a special case compared with the other curves. The centrifuge accelerates with max. power. The run-up time only depends on moment of inertia of the rotor.

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

8.3 Entry limitations

The entry of data for the 14 parameters (index no. 0 to 13) is executed under the same unit which is displayed on the operator panel. The entered parameters must be within the valid value ranges.

Some parameters are calculateed from others. The interrelation of such parameters is given in the last column of table 1. The numbers given under the "generates new calculations of" column represent the index of the parameters which are part of the calculations of the corresponding value.

Example: The speed depends on the RCF, rotor and bucket. If one of these three parameters changes, the speed also changes.

Parameter	Index	Unit	Valid Value Range	Generates New Calculation of
Speed	0	rpm	0 ... 28200 *	2,12,13
RCF	1	-	1 ... 65535 *	0,12,13
Density	2	-	1.0 ... 9.9	-
Time (standard)	3	h, min	0 . 9h59min	-
Time (curve)	4	s	0 999	-
Integral	5	Swedberg	0 ..9999E11	0,3,9,10,11
Radius	6	cm	2.4 .. 40.0	12,13
Acceleration no.	9	-	0 29	-
Deceleration no.	10	-	0 29	-
Program	11	-	0 29	-
Rotor	12	-	-	-
Bucket	13	-	-	

Table 1: Value ranges, dimensions and dependences

* These values are type dependent.
* Selection of rotors and their speed depends on the type of centrifuge.

8.4 Checking entries

Entered nominal values can be checked before they are transferred. The checking is executed in the following order:

A – If the value for individual parameters is falling below or exceeding a valid value range, the corresponding LED starts to blink (refer to point 8.3. "Entry limitations, table 1").

B – If a value is within a valid value range, the interrelated values of this value are calculated (refer to table 3). Certain parameters might exceed the value limitations. In such a case only such LED's of parameters start to blink the alteration of which (e.g. decrease) is recommendable.

Exception:

If the rise time (selectable via the acceleration number) is more than the programmed run-time, the acceleration and time LED's start to blink.

Note!

It is often sufficient to decrease the entered value.

Entered Value	Parameter Considered	Calulated Value
Speed after that	Radius RCF, Time, Acc./Decel. Curve	RCF Integral
Radius	Speed	RCF
RCF after that	Radius Time, Speed, Acc./Dec. Curve	Speed Integral
Program Acc./Decel.Curve	Time, Speed, Acc./Decel.Curve Time, Speed	Integral Integral
Integral [1] Integral [2]	Time, Acc./Decel. Curve Speed, Acc./Decel. Curve	Speed Time
Rotor/Bucket then	Radius	Radius Maximum Speed
Gamma > 1.2		Maximum Speed
Contin. Operation		Integral = 0

[1] enter time before
[2] enter speed before

Table 2: Calculating the nominal value – additional limitations of value range

8.5 Rotor–bucket verification

The bucket LED starts to blink if the rotor identification number was altered and the bucket identification number was not altered accordingly. This is only the case if there are several buckets for one specific rotor.

8.6 Mathematic formulae interrelation

8.6.1 RCF

The parameters speed, RCF and the group consisting of rotor, bucket, and radius cannot be entered independently of each other. They are interrelated via the following formula:

$$RCF = 11.18 * 10^{-6} * r * n^2$$

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

8.6.2 Density

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

$$n = m_{max} * \sqrt{(1/gamma)}$$

8.6.3 Integral

The integral describes the periodic and speed-dependent stressing of the sample during centrifuge operation.

During the operation, the actual integral is constantly calculated and displayed.

To assist the user when entering new speed-time curves, the nominal integral is determined. With freely programmable curves, the speed-time characteristics are defined per interval.

$$I = \int_0^\tau \Omega^2 \, dt = \int_0^\tau (\pi/30)^2 n^2 \, dt = (\pi/30)^2 \int_0^\tau n^2 \, dt$$

Due to small deviations between the nominal and actual speed during the acceleration phase, differences beween the nominal and actual value of the integral might occur. With extremely long run-times, especially with small speed values, the calaculation of the actual integral can be incorrect.

Units:			
	n	in	rpm.
	r	in	cm
	RCF	in	$1/s^2$
	I	in	1/s

8.7 Error correction

Most of the errors can be corrected by switching the equipment off and on again. With short-term power supply failures during operation the run is continued after the power was restored.

No indication on the display

* Is the power cord plugged in and the line voltage present?
* Replace fuse.
* No voltage in the socket?
* Switch lock in standby position?
* Call service.

8.7.1 Centrifuge cannot be started

a) Start button LED is off.

- One or more LED's on the display panels are blinking.
* Repeat entry with altered values until no exceeding of the limits occurs.

- Lid LED (Ü1) is on.
* Close lid. Both lid locks must lock with appropriate sound. If the lid LED does not go off, call service.

- System monitoring LED (Ü4) is on.
* Switch power off/on. If error reoccurs, call service.

b) Start button LED is on.
* Switch power off/on. If error reoccurs, call service.

8.7.2 Centrifuge decelerates during operation.

- One monitoring LED is blinking or constantly on.

a) Imbalance monitoring LED (Ü3)

- Rotor is loaded out of balance	* balance rotor loading
- Centrifuge is misaligned (tilted)	* align centrifuge
- Drive error (mechanical damage)	* call service
- Centrifuge was moved during operation	* restart after lid opening in standstill

b) Lid monitoring LED (Ü1)

- Lid was not closed correctly	* close lid

c) System monitoring LED (Ü4)

- System error occured
  * refer to error table for service
  * switch power on/off
- A different rotor other than preset on the centrifuge is inserted.
- The centrifuge displays an error from group 73 to 75 after it is turned on.

* These error numbers indicate an error in the internal program storage. This error is generated when a power failure occurs during a storage procedure. In most cases the centrifuge can be operated anyway if key "Quit." is pressed. The stored program or characteristic curve containing the error is then deleted.

8.7.3 Lid cannot be opened

When trying to open the lid only one lock was released. Press lid down on the left and on the right until green LED of lid button (K4) in the control panel is on.

8.7.4 Emergency release of lid

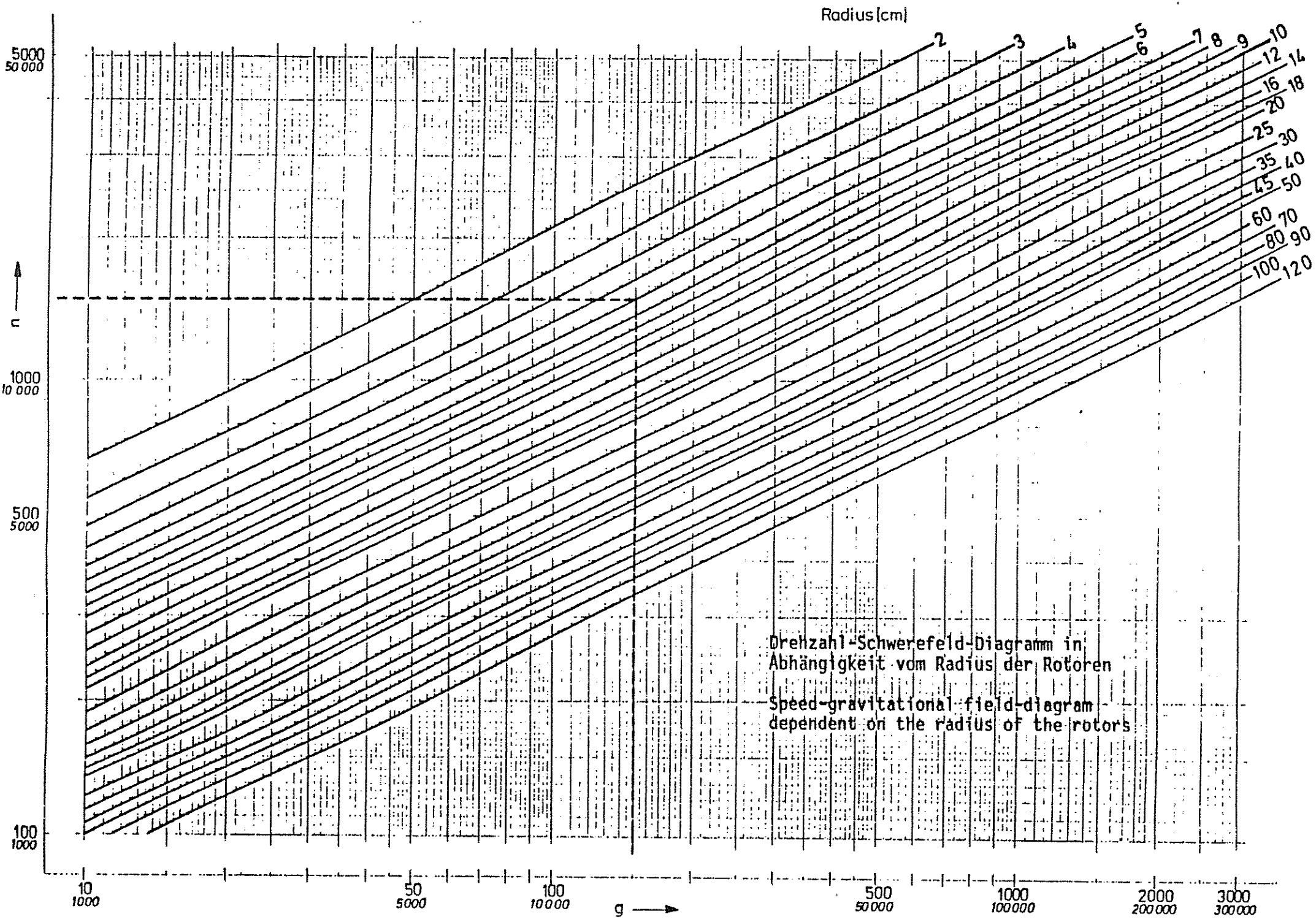
In case of a power supply failure it is possible to manually open the lid. At the front of the bottom plate there are two stoppers which can be removed with the aid of a screw driver. The lid can be released be pulling the visible strings.

Note!

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

8.8 Error table

Error No.	What happened?	Consequences	User	Service
10	error rotation-interrupt	reset	power off/on	clear EEPROM replace EPROM
11	error PBM-interrupt	error is indicated during		check hardware
12	error MPX-interrupt	standstill		
13	polling error	run is continued		
14	overfrequency			
15	stack-overflow	operation is blocked		
16	hardware watchdog			
40	PBM-overrun			
21	overvoltage	centrifuge comes to a standstill operation is blocked	let centrifuge come to a standstill power off/on	check frequency converter and brake
22	speed generator defective		call service	check speed generator
24	excessive speed			check rotor
28	rotor blocked or sluggish			
21..35	several of these faults at same time			
41	rotation-overrun	error is indicated until next operation	press key	
42	MPX-overrun			
50 59	wrong values of EEPROM are used for calculation	operation is blocked faststop	power off/on call service	clear EEPROM
60	insufficient power back-up voltage after reset	faststop is carried out	let centrifuge come to a standstill press lid button	check hardware
69	unsuited software has been used	operation is blocked	call service	replace EPROM or clear centrifuge type in EEPROM
71	EEPROM not present	operation is blocked	call service	mount EEPROM
72	EEPROM mistake	interruption during programming	incorrect data in EEPROM are cleared by depressing a key	clear EEPROM data records
73	error in program data record error in characteristic curve data record	number of incorrect program is displayed number of incorrect characteristic curve is displayed		replace EEPROM in case of repetition
75	error in backup data record	error display until next operation		
76	EEPROM storage cell defective	operation is blocked faststop	call service	replace EEPROM
81	"lid open" detected while centrifuge is running	faststop	let centrifuge come to a standstill close lid	check cover switch
82	programm run error	faststop	let centrifuge come to a standstill press lid button	
83	keyboard defective	operation is blocked	call service	check keyboard
84	overtemperature heat sink	centrifuge comes to a standstill	let centrifuge cool down	check sensor heat sink
85	overtemperature centrifuge chamber	faststop	let centrifuge cool down	check switch centrifuge chamber
86	refrigerator does not reach pre-selected temperature	faststop	increase set temperature	check temperature sensor check refrigerator
90..97	temperature sensor defective (short or fracture	faststop	power off/on call service	check temperature sensor
98	rotor not recognized	faststop	call service press lid button	check rotor recognition
99	rotor recognized but incorrect	faststop	mount chosen rotor press lid button	check rotor recognition


Radius [cm]
2
3
4
5
6
7
8
9
10
12
14
16
18
20
25
30
35
40
45
50
60
70
80
90
100
120
n
5000
50 000
1000
10 000
500
5000
100
1000
10
1000
50
5000
100
10000
500
50000
1000
100000
2000
200000
3000
300000
g
Drehzahl-Schwerefeld-Diagramm in Abhängigkeit vom Radius der Rotoren
Speed-gravitational field-diagram dependent on the radius of the rotors

8.10 Program No.:

Used for .....

.....

.....

.....

Alteration notes: .....

.....

by: .....

Alteration date: ....

Speed ....

Gravit. field ....

Rotor ....

Bucket ....

Radius ....

Density ....

Run-time ....

Time integral ....

Acceler. curve ....

Deceler. curve ....

Generated on: .....

Generated by: .....

8.11 Curve Nr.:

Interval No.:	Type	Acceleration time	Speed
1	quad/lin	..... sec	.....rpm.
2	lin/99	..... sec	.....rpm.
3	lin/99	..... sec	.....rpm.
4	lin/99	..... sec	.....rpm.
5	lin/99	..... sec	.....rpm.
6	lin/99	..... sec	.....rpm.
7	lin/99	..... sec	.....rpm.
8	lin/99	..... sec	.....rpm.
9	lin/99	..... sec	.....rpm.
10	99	..... sec	.....rpm.

Used in Prog No.: ..... for acceleration [ ] / for deceleration [ ]

Used in Prog No.: ..... for acceleration [ ] / for deceleration [ ]

Used in Prog No.: ..... for acceleration [ ] / for deceleration [ ]

Used in Prog No.: ..... for acceleration [ ] / for deceleration [ ]

Used in Prog No.: ..... for acceleration [ ] / for deceleration [ ]

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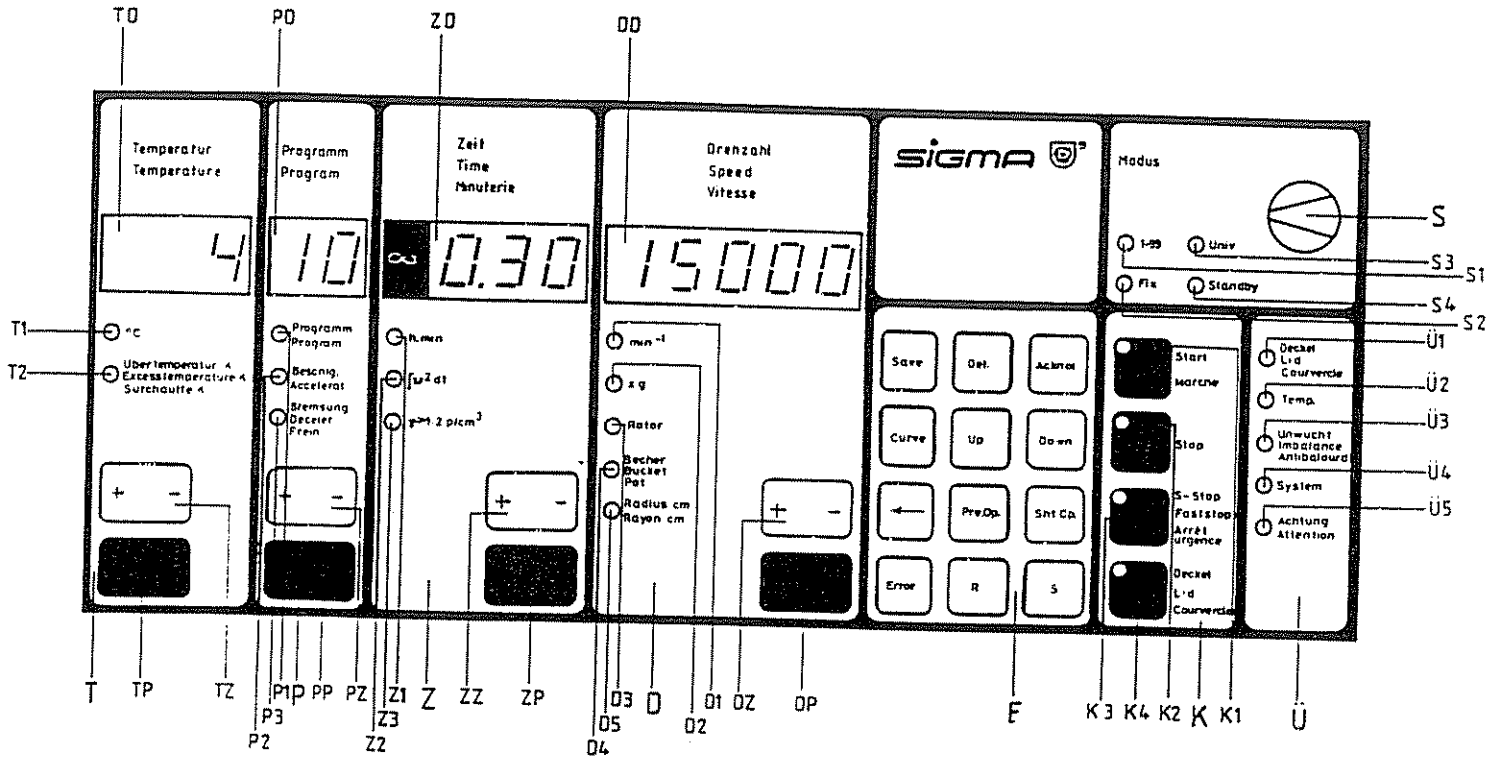
Used in Prog No.: ..... for acceleration [ ] / for deceleration [ ]

Used in Prog No.: ..... for acceleration [ ] / for deceleration [ ]

Used in Prog No.: ..... for acceleration [ ] / for deceleration [ ]

4.1 Operating panel



T Temperature panel*
TD Temperature display
T1 Temperature LED
T2 Overtemperature LED
TP Temperature parameter key
TZ Temperature counting key

P Program panel
PD Program display
P1 Program LED
P2 Acceleration LED
P3 Deceleration LED
PP Program parameter key
PZ Program counting key

Z Time panel
ZD Time display
Z1 Time LED
Z2 Integral LED
Z3 Density LED
ZP Time parameter key
ZZ Time counting key

D Speed panel
DD Speed display
D1 Speed LED
D2 RCF LED
D3 Rotor LED
D4 Bucket LED
D5 Radius LED
DP Speed Parameter key
DZ Speed Counting key

K Command panel
K1 Start button
K2 Stop button
K3 Faststop button
K4 Lid button

B Control panel
B1 Start button
B2 Stop button
B3 Faststop button
B4 Lid button

Ü Monitoring panel

Ü1 Lid monitoring LED
Ü2 Temperature monitoring LED
Ü3 Imbalance monitoring LED
Ü4 System monitoring LED
Ü5 Warning LED

S Lockswitch
S1–
S4 Switch LED's

F Key pad
FS Function service key

Attention: The operating of the function service key should only be used by the service engineer. Otherwise operating errors could de-adjust the temperature value. A calibrated temperature indication would thus be impossible.

* By centrifuges without refrigeration the temperature panel has no function.