Heraeus

Multifuge® 4 KR

Instruction Manual

Kendro

How to use this manual

Please, use this manual to get acquainted with your centrifuge and its accessories.

The manual helps you to avoid inappropriate handling. Make sure to always keep it close to the centrifuge.

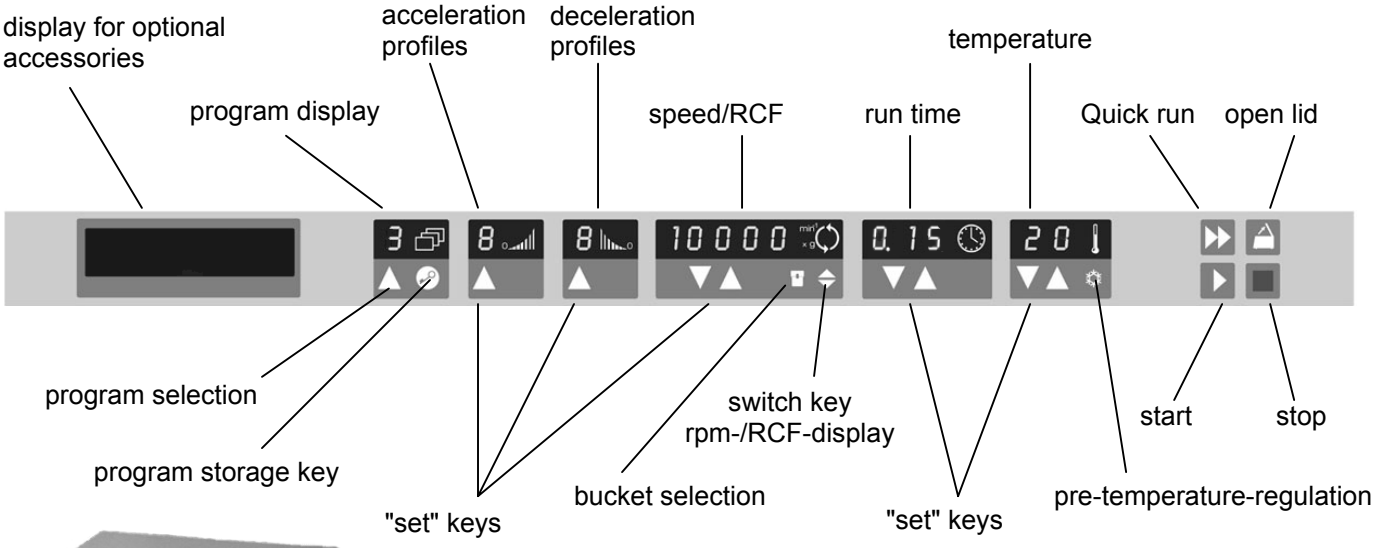
A manual that is not kept handy cannot provide aid against improper handling and thus against damage to individuals and surrounding.

The manual contains chapters on

- Safety regulations
- Instrument description
- Transport and installation of the centrifuge
- Rotors and accessories
- Use of the centrifuge
- Maintenance and care
- Troubleshooting
- Technical data
- Index

Overleaf you will find a graphical illustration of the control panel and a survey of the most important functions

Unfold, please



The **mains switch** is located on the right-hand side panel.

Pressed up = ON I

Pressed down = OFF 0

Before switching on the centrifuge please read this manual!

Control panel of the Multifuge® 4 KR

Displays

Program selection
Program selection key: stepwise recall of programs
Switch key: open/shut program storage
Acceleration profiles (1= slow ..... 9= fast)
display: acceleration profile last set 1- 9
Deceleration profiles (1= slow ..... 9= fast)
display: deceleration profile last set 1- 9

Speed / RCF
run: actual value of speed or RCF after actuating switch key
end: "End"
lid open: "OPEN"
"Lift Lid" (if lid is not automatically lifted off)
(before start)
lid closed: "0" with flashing point
(rotor not yet identified)
error code: will flash in display

Run time
time selection: - remaining run time up to 0
continuous operation (hold) - run time passed (in minutes and seconds)
"quick run": - run time passed (in minutes and seconds)

Temperature
run: actual sample temperature in °C
(in temperature equilibrium)

Keys

start : normal start of the centrifuge
stop : manual stop of a run
open lid: open lid (possible only with the instrument switched on)
Quick run: short-term operation of the centrifuge as long as key remains pressed
switching rpm/RCF: switching between rpm and RCF display
Bucket set: setting of the bucket number
Pretemp : pre-temp-function
"set" keys: stepwise increase/decrease of set values

Short pressing of any of these keys: switching from actual to set value, signaled by flashing display

Troubleshooting see chapter "Troubleshooting"):

E-00: motor blocked
E-03: speed measurement
E-08: over voltage; over temperature in the electronics
E-14: no rotor or rotor identification not possible
E-17: lid cannot be opened
E-23: under voltage; over temperature in the motor or excessive pressure in the refrigerator
rotor: set speed higher than highest permissible speed of the rotor
bAL : imbalance
Lid: lid burst open during run or open

Contents

For your safety

Heraeus centrifuges are manufactured according to current technical standards and regulations. Nonetheless, centrifuges may pose danger to individuals and surrounding if

- they are not used as designed
- they are operated by untrained personnel
- their design is improperly changed
- the safety instructions are not followed

Therefore, personnel involved with operation and maintenance of the centrifuge must read and follow the safety instructions.

In addition, the pertinent regulations for prevention of accidents must be strictly followed

This manual is an integral part of the centrifuge assembly and must be kept close at hand at all times.

Proper use

The centrifuge is designed to separate liquid-suspended materials having different densities and particle size, respectively (maximum sample density is 1.2 g/cm³ {ml} at maximum speed).

Improper use

During a run, a safety zone of 30 cm around the centrifuge must be maintained where neither persons nor hazardous materials may be present.

The centrifuge may cause harm to user or other persons or may damage goods if safety measures are not followed:

Centrifuging hazardous materials

- The centrifuge is neither made inert, nor is it explosion-proof. Therefore never use the centrifuge in an explosion-prone environment.
- Do not centrifuge explosive or flammable substances must not be centrifuged. The same holds for substances prone to react violently with each other.

- Do not centrifuge toxic or radioactive substances or pathogenic microorganisms without suitable safety systems.
  If microbiological samples of risk group II (according to "Laboratory Bio-safety Manual" of WHO) are being centrifuged, aerosol-tight bio-seals have to be used.
  For materials with a higher risk group, more than one precaution is required.
- Should toxins or pathogenic substances enter the centrifuge or its parts, you must perform appropriate procedures for disinfection (see "Maintenance and care – Disinfection").
- Strongly corrosive substances that may cause damage to materials and reduce the mechanical strength of the rotor, may be centrifuged only inside protective tubes.

Handling the centrifuge

- Use only original accessories for the centrifuge. The only exception are common glass or plastic centrifuge tubes, if they are approved for the rotor speed and RCF values.
- Never use the centrifuge unless the rotor is properly installed.
- You may use the centrifuge only with a properly loaded rotor. You must not overload the rotor.
- Strictly follow the rules and regulations for cleaning and disinfection
- If the rotor or the rotor lid shows signs of corrosion or wear, you must stop using it.
- Never open the lid manually if the rotor still turns.
- You may use the emergency lid release only in case of emergency, e.g. during an interruption of power supply
  (see chapter "Troubleshooting").
- Never use the centrifuge with the lid open.
- Never use the centrifuge if the front panel has been partially or totally removed.
- Changes in mechanical or electrical components of the centrifuge may be carried out only by individuals authorized by Kendro Laboratory Products.

Conformity to current standards

Heraeus centrifuges are manufactured and tested according to the following standards and regulations:

CE

- EC-Regulation "Machines" (98/37/EU)
- EC-Regulation "Electromagnetic Compatibility" (89/336/EEC)
- EC-Regulation "Low Voltage" (73/23/EEC)
- EN 292
- EN 61010-1
  - Pollution degree 2
  - Over voltage category II
- EN 61010-2-020
- EN 61326 (+ EN 61000-3-2/A14:2000-06)
- EN 55011 B (Radio noise suppression)
- EN 61000-6-2

Safety instructions in this manual

This symbol denotes potential hazards to persons.

This symbol denotes potential damage to the centrifuge or parts in its immediate surroundings.

General hints are marked with this symbol.

In addition, you are asked to adhere to the pertinent regulations, in Germany

- Regulations for prevention of accidents VBG 4
- Regulations for prevention of accidents VBG 5
- Regulations for prevention of accidents VBG 7z
- Regulations for prevention of accidents VBG 20

Notes

The *Multifuge*® *4 KR*

The figure below shows a *Multifuge* ® *4 KR* with the lid open and a LH-4000 rotor installed.

Description

The *Multifuge*® *4 KR* is a large volume, refrigerated universal centrifuge for clinics. The *Multifuge*® *4 KR* is designed for large volume high throughput laboratory needs. The micro test plates and tubes can be centrifuged with the unique double rectangular bucket.

This high performance centrifuge is optimized for automatic laboratory processes in clinical central labs. With the help of the Diagnostik™ rotor commercial sample racks could directly be centrifuged. Moreover, the *Multifuge*® *4 KR* is a compact centrifuge for the separation of blood components.

Safety systems

The *Multifuge*® 4 KR is equipped with a number of safety systems:

- Casing and lid made of 8 mm armored steel sheet.
- Lid with sight glass
- Lid lock with safety check

  You can open the centrifuge lid only when the centrifuge is switched on and the rotor has come to a stop. Start the centrifuge with properly locked lid only.
- Automatic rotor identification
- Electronic imbalance detection as a function of rotor (SMARTspin™)

Do not tamper with the safety system!

Schedule of parts supplied

Accessories supplied with the centrifuge are:

- connection cable
- a wrench for fixing the rotor
- corrosion protective oil
- installation set with instrument feet. mounting tools and box level

The printed documents include the delivery documents and this Manual.

The rotors are not included in the schedule of parts supplied of the *Multifuge*®.

Function and features

Basic unit/ function	Description / feature
Assembly / casing	galvanized steel sheet base with armored steel chamber
Chamber	stainless steel
Drive	brush less induction drive
Keys and display	key pad and display elements covered by an easy-care protective cover
Control	microprocessor controlled by "Easycontrol II"
Operating memory	last set parameters remain
Program memory	values are stored until new data will be entered after starting.
Functions	RCF-selection, quick run, pretemp , temperature regulation during standby
Acceleration and deceleration profiles	9 acceleration and 9 deceleration profiles
Rotor identification	automatic
SMARTspin™ imbalance detection system	electronic, effective as a function of rotor and speed
Lid lock	motor assisted lid locking

The Easycontrol user interface

Function	Feature
Program display	free program selection • [-] operating memory • [1...9] memory capacity for set values • [≡] "quick run"-mode
Acceleration / deceleration profile	1 = slow, ... 9 = fast acceleration / deceleration curve
Speed selection	adjustable from 300 rpm to 10 000 rpm, in 10 rpm increments
RCF selection	after actuating RCF switch key, the RCF value can be entered
Time selection	adjustable in seconds up to 9 min 59 sec, in the range of 10 min up to 99 min in minutes, "hold"-mode: continuous operation
Run time display in "quick run" mode	in second increments
Temperature selection	adjustable from -9°C to +40°C, in one degree increments
End of centrifugation	the speed display will read "End"

Function	Feature
Lid opening	automatic unlocking via ”open lid" key (⏏) (unlocking in case of power failure: see chapter ”Troubleshooting")
Start	start key (▷)
Stop	stop key (■)
"quick run" mode	pressing the "quick run" key (⏩) activates maximum acceleration up to the maximum permissible speed of rotor; upon key release centrifuge stops with maximum deceleration power.
Diagnostic messages	• alternating display ”rotor"/maximum speed or RCF (speed selected exceeds max. speed of the rotor) • lid has not been lifted off the lock during opening: display ”lift lid" (manual lifting of lid required) • general instrument malfunction (error messages with ERROR codes, see "Troubleshooting")

Notes

Before use

Centrifuge transport and installation

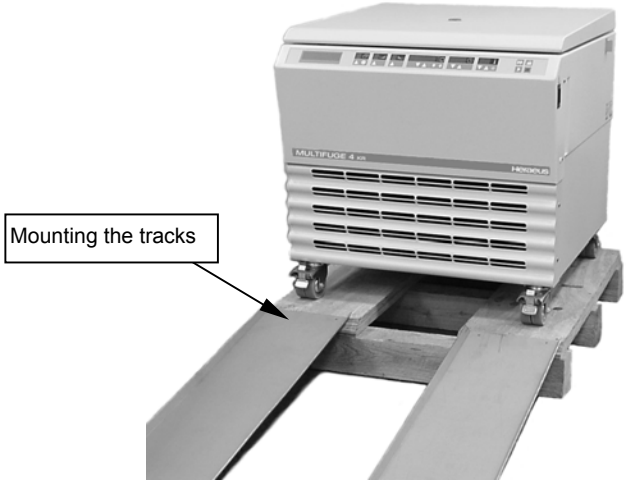
The centrifuge might be damaged by jolting during transport!

Transport the centrifuge in an upright position, without rotor and only in the corresponding special packaging

Secure it properly!

After opening the box please remove stretch tapes and the front mount from the transport pallet.

The centrifuge can be moved off the transport pallet on the delivered tracks. Please mount the tracks at the front of transport pallet with screws or nails.



At least two adult persons are necessary for removing the centrifuge from the transport pallet.

Mind the weight!

Proper location

The centrifuge may only be used indoors. Its location must meet the following criteria:

- A safety zone of at least 30 cm (12 inches) around the centrifuge must be maintained. Hazardous materials must not be stored there during centrifugation.
- The bottom has to be stable and free of resonances.
- To ensure sufficient air circulation, a minimum distance from the wall of 10 cm (4 inches) at the back and of 15 cm (6 inches) on each side must be kept.
- The centrifuge has to be protected against heat and intensive solar radiation.
- The location has to be kept well ventilated at all times.

UV radiation reduces the durability of plastics.

Protect the centrifuge, rotors and plastic accessories from direct solar radiation!

Multifuge® *4 KR*

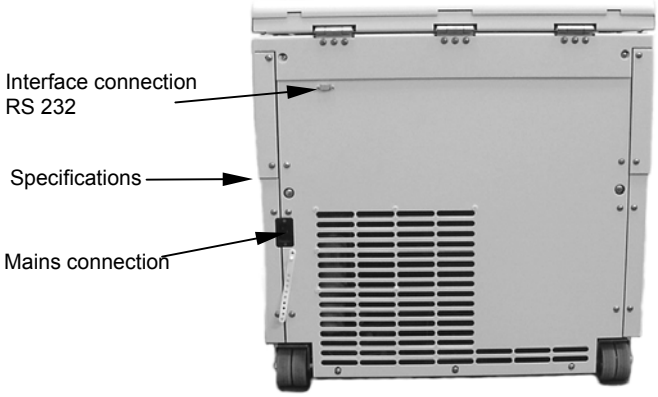
The mobile under table centrifuge is to be operated only with locked casters!

Please lock or release the casters by stepping on the pedals of both of the front casters.

Mains connection

Connect the centrifuge only to a grounded mains plug. Check if the cable is compatible with the safety regulations valid in your country. Make sure your mains voltage and frequency correspond to the specifications at the instrument label.

Please switch off the mains switch on the right-hand side of the front panel (press down switch) before connecting the connection cable to the mains connection.



Notes

Rotors and accessories

A large variety of rotors are available as accessories.

In addition, there are adapters and reduction sleeves for a variety of commercially available tubes and bottles.

For a complete list of accessories together with technical data and order numbers refer to our current sales documentation.

For more information you can visit our web site at http://www.Kendro.com

Rotors and rotor buckets for *Multifuge® 4 KR*

Table 1: Rotors

Rotor designation	**LH-4000 4 x 1000 ml 7500 6475**	
With bucket Order no.	**Round bucket** **7500 6477**	**Double rectangle bucket 2 x 250 ml** **7500 6478**
Maximum permissible load [g]	4 x 1400	4 x 1500
Maximum speed n_{max} [rpm]	4400	4400
Maximum RCF value at n_{max}	5346	4654
Radius (max.) / (min) [cm]	24.7 / 8.8	21.5 / 11.5
Acceleration / deceleration time [s]	75 / 80	80 / 80
Min. temperature at n_{max} relative to room temperature 23°C	9	6
Speed at 4 °C [min^{-1}]	4100	4100
k-factor [S×h]	13 487	8244
Aerosol-tight *	(with cap 75006421)	(with cap 75006479)
Autoclavable	121°C	121°C

* Checked by TÜV (Technical Supervision Association) Product Service GmbH – Hamburg

Table 1: Rotors

Rotor designation	**LH-4000 W 4 x 1000 ml 7500 6476**	
With bucket Order no.	**Round bucket 1000 ml** **7500 6477**	**Double rectangle bucket 2 x 250 ml** **7500 6478**
Maximum permissible load [g]	4 x 1400	4 x 1500
Maximum speed n_{max} [rpm]	4400	4400
Maximum RCF value at n_{max}	5346	4654
Radius (max.) / (min) [cm]	24.7 / 8.8	21.5 / 11.5
Acceleration / deceleration time [s]	90 / 85	95 / 85
Min. temperature at n_{max} relative to room temperature 23°C	1	1
Speed at 4 °C [min^{-1}]	4400	4400
k-faktor [S×h]	13 487	8244
Aerosol-tight *	(with cap 75006421)	(with cap 75006479)
Autoclavable	121°C	121°C

* Checked by TÜV (Technical Supervision Association) Product Service GmbH – Hamburg

Table 1: Rotors

Rotor designation Order no.	**BIOshield® Rotor 4 x 250 ml 7500 6435**	**Highplate® Rotor 2 x 5 plates 7500 6444**	**Diagnostik™ Rotor 7500 6480**
Maximum permissible load [g]	4 x 600	2 x 500	2 x 2000
Maximum speed n_{max} [rpm]	5850	5650	3500
Maximum RCF value at n_{max}	6963	5889	2547
Radius (max.) / (min) [cm]	18.2 / 13.8	16.5 / 10.5	18.6 / 14.1
Acceleration / deceleration time [s]	85 / 100	80 / 100	60 / 65
Min. temperature at n_{max} relative to room temperature 23°C	1	0	< 0
Speed at 4 °C [min^{-1}]	5850	5650	3500
k-factor [S×h]	—	—	—
Aerosol-tight *	Yes	Yes	No
Autoclavable	121°C	No	No

* Checked by TÜV (Technical Supervision Association) Product Service GmbH – Hamburg

Table 1: Rotors

Rotor designation Order no.	**High*conic*® Rotor 6 x 50 ml 7500 3046**	**LAC-250 6 x 250 ml 7500 6483**	
Maximum permissible load [g]	6 x 130	6 x 400	
Maximum speed n_{max} [rpm]	8500	10 000	
Maximum RCF value at n_{max}	10 016	15 317	
Radius (max.) / (min) [cm]	12.4 / 6.0	13.7 / 9.5	
Angle of incidence [°]	45	23	
Acceleration / deceleration time [s]	70 / 70	95 / 110	
Min. temperature at n_{max} relative to room temperature 23°C	< 0	1	
Speed at 4 °C [min^{-1}]	8500	10 000	
k-factor [S×h]	2545	926	
Aerosol-tight * (loading see page 39)	Yes	No	
Autoclavable	121°C	No	

* Checked by CAMR, Porton-Down, UK

Adapter and accessories

Table 2: Adapter (1.1) * max. tube length with aerosol-tight cap

Adapter and accessories for round bucket 7500 6477 **Centri-Lab® Adapter type C**	max. tube dimensions d x length / * [mm]	cap diameter [mm]	tubes per rotor	color	order no.
48 x 1.5 / 2 ml micro liter tubes	11.0 x 50	13.0	192	black	7500 8132
35 x 7 ml DIN	12.8 x 177	14.0	140	yellow	7500 8133
19 x 7 ml blood sampling	13.5 x 177	18.5	76	light-grey	7500 8134
19 x 15 ml DIN	17.0 x 177	18.5	76	red	7500 8135
17 x 15 ml blood sampling	17.0 x 177	20.0	68	white	7500 8136
12 x 15 ml conical	16.5 x 177	23.5	48	olive-brown	7500 8137
12 x 14 / 15 ml with flange	18.3 x 177	21.5	48	brown	7500 6494
7 x 25 ml DIN	25.0 x 177	31.0	28	orange	7500 8138
7 x 45 / 50 ml flat and round bottom	29.5 x 177	31.0	28	blue	7500 6493
4 x 50 ml DIN	34.5 x 177	39.0	16	green	7500 8140
5 x 50 ml conical	29.5 x 177	35.5	20	light- green	7500 6533
2 x 100 ml DIN	45.0 x 177	47.5	8	light- blue	7500 8142
1 x 150 ml DIN / 180 ml bottle	56.5 x 132 / 128		4	white	7500 6498
1 x 175 -225 ml conical[1)] / 250 ml bottle	62.0 x 177	75.0	4	nature	7500 8144
1 x 250 ml	59.0 x 190		4	nature	7500 6649
1 x 250 ml Corning®-tubes, conical	61.5 x 190		4	nature	7500 8147
1 x 500 ml Nalge®- tubes	70.0 x 190		4	nature	7500 8145
1 x 500 ml Corning®- tubes, conical	96.0 x 190		4	nature	7500 6438
Liquid pressure balance	for 500 ml DIN-bottle				7500 7722
Liquid pressure balance	for 500 ml Baxter®-bottle				7500 7723
Aerosol-tight caps	2 pieces, incl. seals and lubricants				**7500 6421**

1) An additional pad is necessary obtainable from tube manufacturer

Table 2: Adapter (1.2)

Accessories for centrifugation of blood bags in the round bucket 7500 6477		order no.
Plastic plug "XL"	for 400 - 450 ml and blood bag system (set of 2 pieces)	7500 6496
Plastic plug "M"	for small volume special blood bank applications (set of 2 pieces)	7500 6485
Tare plates	caoutchouc, 2 x 35 and 65 g each	7500 5759
Tara weights for plastic plug 7500 6485	1 set of 4 weights, 6 g each and 15 g each	7500 7645

Table 2: Adapter (2.1) * max. tube length with aerosol-tight cap

Adapter and accessories for double rectangular bucket DoubleSpin™ 7500 6478 Centri-Lab® Adapter type D (2 adapter per bucket)	max. tube dimensions d x length / * [mm]	cap diameter [mm]	tubes per rotor	color	order no.
56 x 1.5 / 2 ml micro liter tubes	11.0 x 50	13.0	448	black	7500 6452
28 x 7 ml DIN	12.8 x 120 – 151[1)]	14.0	224	yellow	7500 6453
20 x 7 ml blood sampling	14.0 x 118 – 150	17.5	160	light-grey	7500 6454
16 x 15 ml DIN / blood sampling	17.0 x 120 – 149	19.0	128	red	7500 6455
9 x 15 ml conical / US-urine	16.5 x 122 – 153	24.0	72	olive-brown	7500 6456
9 x 14 / 15 ml with flange	18.3 x 122 – 147	25.0	72	brown	7500 6492
6 x 25 ml DIN	25.0 x 127 – 149	28.0	48	orange	7500 6457
4 x 25 / 50 ml universal container	25.5 x 132 – 145	32.0	32	blue-green	7500 6459
4 x 45 / 50 ml flat and round bottom	29.5 x 125 – 145	35.0	32	blue	7500 6491
3 x 50 ml DIN	34.5 x 127 – 148	38.0	24	green	7500 6460
4 x 50 ml conical	29.5 x 129 – 149	35.5	32	light- green	7500 6461
1 x 100 ml DIN	45.0 x 138	66.0	8	light- blue	7500 6462
1 x 150 ml DIN / 180 ml bottle	56.6 x 147	66.0	8	grey-blue	7500 6463
1 x 175 ml conical [2)] / 250 ml bottle	62.0 x 140 / 145	63.0	8	black	7600 6465

1) The maximum tube length depends on the position in the adapter!
In the corners only the shorter tubes can be used.

2) An additional pad is necessary obtainable from tube manufacturer

Table 2: Adapter (2.2) * max. tube length with aerosol-tight cap

Adapter and accessories for double rectangle bucket DoubleSpin™ 7500 6478 (1 adapter per bucket)	max. tube dimensions d x length / * [mm]	cap diameter [mm]	tubes per rotor	color	order no.
24 x 15 ml conical / US-urine	16.5 x 120 – 147 [3)]	23.0	96	nature	7500 6468
for cyto- system			8	black	7600 6466
for Centri-Lab® Adapter type A			8	black	7600 6467
for 1 x Centri-Lab® Adapter type D			4		7500 6499
Plate holder for micro test plates	Basic area 127 x 85 ; max. hight of charge 110 mm				**7500 6486**
Aerosol-tight caps	2 pieces, incl. seals and lubricants				**7500 6479**

3) The maximum tube length depends on the position in the adapter!
In the corners only the shorter tubes can be used.

Table 2: Adapter (3) * max. tube length with aerosol-tight cap

Adapter and accessories for BIOshield® Rotor 7500 6435 **Centri-Lab® Adapter type D**	max. tube dimensions d x length / * [mm]	cap diameter [mm]	tubes per rotor	color	order no.
56 x 1.5 / 2 ml micro liter tubes	11.0 x 50	13.0	224	black	7500 6452
28 x 7 ml DIN	12.8 x 117	14.0	112	yellow	7500 6453
20 x 7 ml blood sampling	14.0 x 117	17.5	80	light-grey	7500 6454
16 x 15 ml DIN / blood sampling	17.0 x 117	19.0	64	red	7500 6455
9 x 15 ml conical / US-urine	16.5 x 120	24.0	36	olive-brown	7500 6456
9 x 14 / 15 ml with flange	18.3 x 117	25.0	36	brown	7500 6492
6 x 25 ml DIN	25.0 x 117	28.0	24	orange	7500 6457
4 x 25 / 50 ml universal container	25.5 x 117	32.0	16	blue-green	7500 6459
4 x 45 / 50 ml flat and round bottom	29.5 x 117	35.0	16	blue	7500 6491
3 x 50 ml DIN	34.5 x 117	38.0	12	green	7500 6460
4 x 50 ml conical	29.5 x 118	35.5	16	light-green	7500 6461
1 x 100 ml DIN	45.0 x 125	66.0	4	light-blue	7500 6462
1 x 150 ml DIN / 180 ml bottle [1)]	56.6 x 125	66.0	4	grey-blue	7500 6463
1 x 250 ml bottle	62.0 x 125	63.0	4	black	7600 6465
for cyto-system				black	7600 6466
for Centri-Lab® Adapter type A				black	7600 6467

1) Pay attention to the maximum load of 600 g!

Table 2: Adapter (4)

Set adapter for Diagnostik™ Rotor 7500 6480	Rack length / width [mm]	max. height incl. tubes and rack [mm]	tubes per rack	racks per rotor	order no.
Hitachi	118 x 20	120	5	2 x 10	7500 6416
Olympus	177 x 20	120	10	2 x 6	7500 6417
Sysmex	200 x 25	120	10	2 x 6	7500 6418
Dade-Behring	—	120	10	2 x 2	7500 6419
LKB	164 x 19	120	11	2 x 6	7500 6422
Beckmann	—	120	7	2 x 2	7500 6423

Table 2: Adapter (5)

Adapter for High*conic*® Rotor 7500 3046	max. tube dimensions d[1)] x length [mm]	number per adapter	number per rotor	color	order no.
1.5 ml micro tubes	11 x 58	4	24	nature	7600 2905
3.5 ml	11 x 103	4	24	nature	7500 3091
6.5 ml	13 x 115	2	12	nature	7500 3092
12 ml	16 x 96	2	12	nature	7500 3093
16 ml	18 x 124	1	6	nature	7600 2906
38 ml	25 x 112	1	6	nature	7500 3094
50 ml	29 x 118	1	6	nature	7500 3014
15 ml conical	16.5 x 120	1	6	nature	7500 3095
50 ml conical	30 x 117	1	6	nature	7500 3096
Spare seal	2 sets, incl. lubricants				**7500 3423**

Table 2: Adapter (6)

Adapter and accessories for LAC-250 7500 6483	max. tube dimensions d[1] x length [mm]	tubes per rotor		color	order no.
250 ml Dry-Spin and Oak Ridge bottle (without adapter)	61 x 153	6			––
1 x 250 ml PA Oak Ridge bottle	60 x 120	6			12002
1 x 150 / 125 ml Corex® bottle	53 x 132	6		yellow	00372
1 x 150 ml thick-walled tubes	45 x 132	6		white	00458
1 x 100 ml Pyrex bottle	44 x 137	6		yellow	00371
12 x 5 / 4 ml	12 x 75	72		red	00388
7 x 12 ml	16 x 100	42		purple	00389
3 x 30 ml Corex® bottle	24 x 105	18		white	00449
5 x 14 ml Pyrex® bottle	18 x 120	30		grey	00456
1 x 50 / 35 ml conical	30 x 115	6		white	03072
5 x 3 ml Pyrex® tube	10 x 75	30		green	00370 and 00456 [1]

1) These adapters have to be inserted together.

Handling rotors

Swinging Bucket Rotors

All positions must always be loaded with identical carrier buckets!

The various swinging buckets are split up into weight categories. These can be identified from the letters suffixing the order number on the bucket. Buckets of identical weight categories should always be installed in opposing rotor positions to avoid imbalance.

On swinging bucket rotors, at regular intervals, apply a light coating of lubricant to the rotor body trunnion pins and to the corresponding mating surfaces of the buckets!

Lubricant 7000 6692 is supplied with the centrifuge.

LH-4000
LH-4000 W
Diagnostik™ Rotor

These rotors have a slide coating, which guarantees perfect operation without additional lubrication of body trunnion pins for many years.

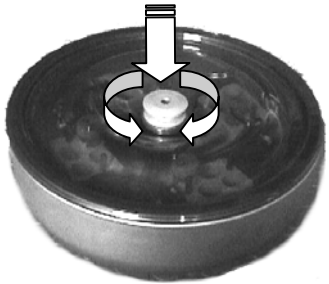
Should an imbalanced run occur although the charge is tared this could be due to wear of the slide coating.

In this case the rotor function remains intact through normal lubrication!

BIOshield® - Rotor

The bucket set is a permanent part of the rotor and must not be interchanged with other rotors.

Do not run the rotor without the rotor lid closed. The rotor lid is opened respectively closed by pushing down and turning the lid locking knob at the same time.



Store the BIOshield® Rotor with the lid removed after cleaning. This will enable the rotor to dry completely.

The rotor has to be replaced upon reaching the end of its service life depending on the mechanical load and on the speed respectively.

max. speed	max. cycles
5850 rpm	22 000
5350 rpm	31 000

Exceeding the maximum number of cycles can result in rotor fracture leading to a destruction of the centrifuge!

The following examples are intended to illustrate the limited service life in praxis:

Profile of use	Max. service life at	
	5850 rpm	5350 rpm
- frequent use 20 runs / day, 220 days / year	5 years	7 years
- average use 7 runs / day, 220 days / year	14 years	20 years

Always maintain the rotor in the recommended manner!
The rotor and accessories must be cleaned and inspected regularly: do not use when showing signs of corrosion or cracking.

Highplate®- Rotor

Do not run the rotor with the rotor lid open.

Store the Highplate®-Rotor with the lid removed after cleaning. This will enable the rotor to dry thoroughly.

Handling micro plates

For the loading and unloading of micro test plates remove the plate holder from the bucket.

Before loading, ensure that the rubber bottom is placed in the cut-outs of the plate holder. Deepwell plates can also be inserted directly in the swing without plate holder.

Not all commercial micro test plates withstand the high centrifugal forces!

In case of problems, please ask the manufacturer for higher rated plates (e.g. plates from PP).

Make sure the rotor charge is balanced!

The plate carriers are inserted as shown in the illustration below.

Highplate®-Rotor

Plate holders for micro test plates 7500 6486 in the double rectangle bucket 7500 6478

Diagnostik™- Rotor

The swings or carriers should always be completely loaded with racks.

In case of partial loadings the racks could tip over, and tubes could be damaged.

Highconic®- Rotor

In case longer tubes shall be centrifuged precluding the complete locking of the rotor lid, it is allowed to operate the rotor without lid, up to a maximum speed of 4000 rpm.

Above 4000 rpm the rotor may not be operated without lid in any case. Otherwise the rotor could be destroyed!

LAC-250

The rotor consists of carbon fiber-epoxide resin compound with metal components.
Compared to traditional metal rotors these composite rotors show changed characteristics with regard to chemical resistance. Organic solutions, strong acids or bases can initiate premature material weakness.

Never expose the rotor to ethylene oxide!

Doing so will damage the composite material.

Before use carefully and regularly inspect rotors made of carbon fiber composite material for surface wear.

The rotor may not be operated if, due to damage, fibers escape the rotor surface!

Be careful with damaged carbon fiber rotors!

Never stop a running rotor manually! Sharp carbon fiber splinters can cause injuries.

Wear suitable protective gloves (e.g. of leather) when handling damaged carbon fiber rotors!

Temperature behavior:

Rotors of carbon fiber composite material require significantly more time to change temperature than a metal rotor does, since this carbon fiber composite material works like a thermal insulator.

Therefore it is recommended to store the rotor, the adapter and the samples already at the desired running temperature.

Maintenance and care:

Do not immerse the rotor in liquid. Liquid can get trapped inside the cavity of the bottom plate.

In case liquid has been trapped inside, a 5 minute run at 300 rpm will remove it

The speed must not exceed 300 rpm, otherwise rotor damages can occur!

Procedure in case of damage:

In case of rotor failure wrong handling can cause dangers by the carbon fibers of the rotor.

In case of damage allow 30 minutes for particles to settle before accessing the rotor chamber.

Wear protective clothes!

Always handle centrifuges with a destroyed carbon fiber rotor with protective glasses, respirator and suitable protective gloves of leather.

Particles have to be removed from the surface with humid cloth or sponges.

Do not sweep or vacuum dry!

Dispose rotor pieces and particles in such a way, that an accidental exposure to fibers is not possible.

Aerosol-tight operation

When centrifuging dangerous samples aerosol-tight rotors and tubes may only be opened in an approved safety work bench!

Mind the maximum permissible filling quantities!

Correct operation when filling the sample tubes and closing the rotor lid are prerequisites for aerosol biocontainment.

Before each use, the seals in the rotors and rotor lids, as well as the aerosol-tight caps, have to be checked for abrasion or damage and slightly greased if necessary.

Replace damaged O-rings and seals!

For greasing the seals only use the special lubricant 7600 3500!

Spare parts are delivered with the rotor or may be ordered separately.

Replace damaged or clouded caps and lids of rotors and tubes immediately.

BIOshield®-Rotor 7500 6435
Highplate®-Rotor 7500 6444

The aerosol-tight bio-containment of windshield-rotors is only secured in a horizontal position!

If the air vessel rotors are filled with samples outside the centrifuge (e.g. in a safety work bench), one has to care, that during the insertion into the centrifuge the rotor should be kept in a vertical position.

Closing round buckets aerosol-tight

After greasing the seal, turn the lid until it fits slightly to the bucket.

To achieve an uniform pre-stressing, turn the lid clockwise by 1 ½ grip areas (approx. 15°). Use the setting marks on the bucket as an orientation.

Closing rectangular bucket 7500 6478 aerosol-tight

Before closing grease the lid seal, if necessary.

Please flap both lock levers upwards. Now you can easily put the cap on the bucket.

By flapping down the lever the bucket is being locked.

Both of the levers must click, in order to achieve aerosol-tight bio-containment!

Levers not being flapped down cause damages of the caps during the centrifugation!

Closing Highconic®- Rotor aerosol-tightly

The hexagon screwdriver of the pliers should be used as a support tool to fasten and loosen the lid of the fixed angle rotor in order to achieve secure closing (insert the hexagon through the hole in the screw cap).

Please mind the maximum permissible filling volume during centrifugation of dangerous samples!

conical cell culture tube in High*conic*® Rotor 7500 3046

Nominal volume:	permissible filling volume :
15 ml	- **14 ml**
50 ml	- **49 ml**

Checking of aerosol-tight bio-containment

The checking of the rotor type and bucket was done according to the dynamic microbiological test procedure with regard to EN 61010-2-020 appendix AA.

The aerosol-tight bio-containment of the rotor mainly depends on proper handling!

Check the aerosol-tight bio-containment of your rotor whenever necessary!

It is very important, that all the seals and seal-surfaces are being tested for wear and damages like cracks, scratches and embrittlement carefully!

As a quick test there is the possibility to check the aerosol-tight buckets and fixed angle rotors according to the following procedure:

- grease slightly all seals.
- Fill the bucket or rotor with approx. 50 ml carbon dioxide mineral water.
- Close the bucket or rotor according to the respective handling instructions.
- Shaking the bucket releases the carbon dioxide of the water, and an excessive pressure is built up.
- Leaks are recognized by humidity release and audible disinflation of gas mix.
- Finally buckets respectively rotor, lid and lid seal have to be dried.

The construction of BIOshield®- and Highplate®- rotors does not allow a quick test according to this procedure by the user; therefore a very careful control of seals, seal surfaces and lids is necessary!

Operation

Switching on the centrifuge

Locate the mains switch on the right-hand side of the front panel.

For a short time the following reading appears in the control panel:

The display shows that the instrument is going through an internal check of its software (see table on page 75).

After this check, the display changes into the actual value mode. The remaining run time and speed should both read "0”. The display of the acceleration/deceleration curve depends on the last set value.

The following figure gives an example of possible readings. A detailed description of possible settings is given below in this chapter.

Actuating the lid

Opening the lid

Press the "open lid" key ⏏.

If the message "Lift lid” appears, you must lift the lid slightly.

(Emergency release in case of malfunction or power failure: see chapter "Troubleshooting")

Closing the lid

The centrifuge lid is locked by slightly pressing down the front part of the lid. Locking is motor-driven.

Do not slam the lid!

Installing the rotor

Improper or improperly combined accessories may cause severe damage to the centrifuge!

The rotors approved for the *Multifuge® 4 KR* are detailed in the chapter "Rotors and Accessories" on page 17. Use only rotors listed.

To install the rotor, you need the socket wrench supplied (see chapter "Schedule of parts supplied" on page 8).

Proceed as follows:

1. Open the lid and make sure that rotor chamber and rotor are clean. Remove any dust, foreign material or sample residues out of chamber before use.
2. Check whether the collet chuck is loose (collet chuck moves freely on the spindle). If not, loosen the rotor seat using the socket wrench supplied.
3. Place the rotor on the drive shaft so that the rotor chuck is located precisely above the center.
4. The rotor must glide freely down the collet chuck until it hits the lower stop.
5. If you have installed the rotor correctly, you can tighten the collet chuck easily using the socket wrench supplied.
6. Place the rotor lid on the rotor and screw it tightly.

Regularly check the correct positioning of the rotor and re-tighten the collet chuck as needed.

Loading the rotor

Maximum loading

Overloading can result in destruction and severe damage to the centrifuge!

The *Multifuge® 4 KR* can reach high speeds implying enormous centrifugal forces. The rotors are designed in a way having sufficient residual strength even at the highest permissible speed.

However, this safety system presupposes that the maximum permissible load of the rotor is not exceeded.

Please note the data on the maximum permissible load and maximum speed in chapter "Rotors and accessories" on page 17.

If you wish to centrifuge samples that together with the adapters exceed the maximum permissible load, you must either reduce the sample volume or calculate the permissible speed n_{perm} according to the following formula:

$$n_{perm} = n_{\max} * \sqrt{\frac{maximum\ permissible\ load}{actual\ \ load}}$$

n_{perm} = permissible speed
n_{max} = maximum speed

Filling the centrifuge tubes

Check carefully whether your tubes are approved for the respective RCF value. If not, reduce speed.

For common borosilicate glass tubes the maximum permissible RCF is limited to 4000 xg!

The tube manufacturers normally limit the respective maximum permissible RCF value to the fixed angle rotor.

Please note that for the same RCF value the stress for the tubes in a swinging-bucket rotor is higher!

Because of the higher difference of the radii (r_{max} - r_{min}) the pressure of the liquid column to the tube bottom is considerably higher and strongly depended on filling.

Plastic tubes – especially for the highest load (speed, temperature) – have a limited service life only and must be replaced. For detailed questions please contact the manufacturer of the plastic tubes.

Maximum permissible load difference

The smaller the imbalance of the centrifuge, the better the separation effect, because there are no turbulences in the separated zones caused by vibrations.

Therefore it is important, that the tubes are balanced properly.

The permissible load difference depends on many factors (e.g. rotor, loading). For the swinging bucket rotors LH-4000 and LH-4000W this difference amounts to at least 30 g in opposite carriers.

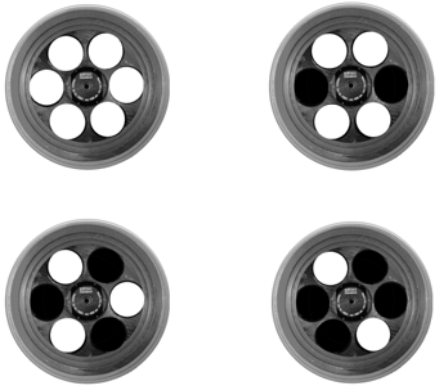
Inserting the centrifuge tubes

In extreme cases an unsymmetrical loading of the rotor could release the imbalance identification. Imbalance does not only result in noisy operation but also in a premature wear of the drive.

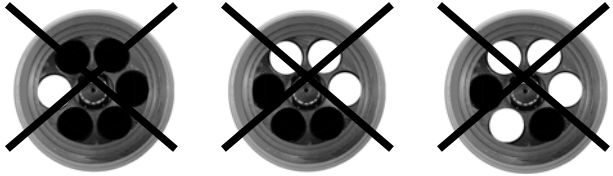
The rotor has to be loaded symmetrically. When loading the rotor only partially, you have to ensure that opposite bore holes always receive tubes of equal weight (when centrifuging a single sample, place a centrifuge tube e.g. filled with water).

After placing the tubes, close the rotor lid.

Fixed-angle rotors:

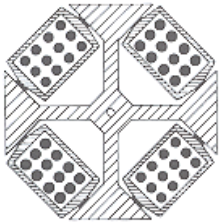


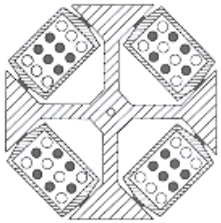
Proper loading



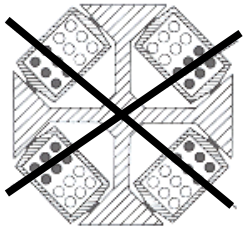
Improper loading

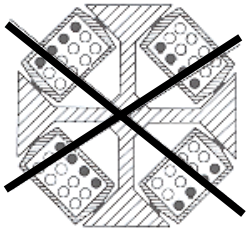
Swinging bucket rotors:





Proper loading





Improper loading

For swinging bucket rotors please note the symmetrical loading of the buckets. These examples are to be applied to the other rotors in an analogous manner!

Mixed loading with different bucket types is not allowed!

Entering parameters

Acceleration / Deceleration curves

The *Multifuge® 4 KR* offers 9 acceleration and deceleration profiles for optimum centrifuging samples and gradients. Please consult the diagram examples in the Appendix for more details of the acceleration and deceleration curves (for rotors not mentioned here you may extrapolate the respective values).

After switching the centrifuge on, the centrifugation profiles last entered are preset.

By pressing the "set" key you can scroll through the profile settings until the desired profile is reached.

Once the display stops flashing, the value is stored in memory and remains unchanged until changed by a new entry.

Switching from speed to RCF display

Upon turning the centrifuge on, the speed display is set.

Use the speed mode selection key to switch speed entry and display between rpm and RCF.

Bucket selection for swinging bucket rotors

The automatic rotor identification feature will recognize the rotor cross of the swinging bucket rotors.

If various buckets or carriers are installed in the rotor cross, the corresponding type of bucket must be selected.

The bucket selection affects the correct RCF values display and the correct selection of the corresponding parameters of the temperature regulation.
You will find the permitted bucket for the corresponding rotor in the table "Rotors and rotor buckets for *Multifuge® 4 KR*" on page 18.

The current part number of the buckets is displayed by pressing the bucket selection key (corresponds to the last four digits of the order number).

To change the bucket selection, press the bucket selection key again until the correct set of buckets appears.

The value is accepted when the change back to the speed / RCF display has occurred.

Selecting speed

The centrifuge speed can be set to a minimum of 300 rpm and to a maximum of 10 000 rpm (depending on the rotor).

You can adjust the speed in 10 rpm increments. Proceed as follows:

1. By pressing the "set" keys ▲ once (for an increase) or ▼ (for a decrease) in the "speed" section of the control panel, you switch from actual to set value mode. The value last stored is displayed, with the digit entered flashing (if there is no value stored in memory, this is indicated by dashes -----).
2. By briefly pressing the "set" key you can raise or lower the speed by one step (10 rpm) at a time.

3. If you hold down the key the display changes continuously and slowly at first and after a few seconds at an accelerated pace up respectively down.
4. Release the key as soon as you have reached the desired value, and adjust if necessary by repeatedly pressing the key. The decimal place flashes for a few seconds, then changes to actual value display. The speed is now stored.

When pressing any key for setting of set value on the control panel, the altered value will be set immediately and the function of the respective key is realized.

For faster operation, you may shift the flashing cursor in the speed/RCF and the run time display: just press both ▲ and ▼ simultaneously. With each pressing the cursor moves to the left by one digit.

Entering the RCF value

You can adjust the RCF set value in steps of 1. The set value is entered analogously to the speed.

As long as the rotor has not been identified, it is not possible to display RCF values. This is signaled by dashes ----- in the display.

Shortly after starting the centrifuge run, the rotor is identified and the actual value is displayed.

NOTE:

If you select an extremely low RCF value, this may be automatically corrected if the resulting speed is lower than 300 rpm.

RCF value explanation

The **r**elative **c**entrifugal **f**orce (RCF) is given in multiples of the earth gravity *g*. It is a unit-free number that allows the comparison of the efficiency of separation or sedimentation of diverse instruments, since it is independent of the instrument used. The only values entered in the equation are radius and speed of centrifugation:

$$RCF = 11.18 * \left(\frac{n}{1000}\right)^2 * r$$

r = radius of centrifugation in cm

n = speed in rpm

The maximum RCF value refers to the maximum radius of the tube bore.

Please note that this value decreases depending on the tubes and adapters used.

You may take this into account when calculating the RCF value for your application.

Selecting run time

The run time setting consists of two setting ranges:

Up to a value of 9 min 59 sec setting is done in steps of seconds. Above 10 min up to 99 min run time is set in steps of minutes.

Additionally there is the possibility of operating the centrifuge continuously (hold).

Fixed run time

To set a fixed run time, proceed as follows:

1. Press one of the "set" keys △ (for an increase) or ▽ (for a decrease) in the "run time" section of the control panel once to switch from the actual to the set value mode.
2. By **briefly** pressing the "set" key you can now raise or lower the run time step by step.

3. If you keep the selected key pressed, the display changes continuously and slowly and after a few seconds at an accelerated pace up respectively down.
4. Release the key as soon as you have reached the desired value, and adjust if necessary by repeatedly pressing the key. The time display flashes for a few seconds, then changes to permanent display. The run time is stored now.

You may shift the flashing cursor to set the value as described for speed selection (see above).

Continuous operation

In order to set the *Multifuge® 4* KR to continuous operation please press one of the time set keys until "hold" occurs on the display.

With this setting, the centrifuge keeps running until stopped manually, with the "stop" key ■.

Limited time mode

There is the possibility to limit the run time setting to the range up to 9 min 59 sec. The centrifuge may be run continuously here, too (hold) .

Switching on or off this option is done by pressing the key in the actual value mode. After approx. 1 sec you get to the selection mode. The speed display shows "beep", and the time display "on" or "off". As far as you press this key the selection mode is active.

Pressing the upward key within the speed display, you can switch back and forth between the signal menu "beep" and the time menu "t-set".

After selecting the time menu "t-set", you can switch between the standards time mode "00.0" and the limited time mode "0.00" by pressing the upward key .

k-factor

The k-factor is an information about the sedimentation capacity of a rotor (see "Table 1" on page 18).
You may calculate the necessary time of sedimentation for the relevant rotor according to the formula:

$$t = \frac{K}{S_{20,\,W}}$$

t = time of sedimentation in hours
k = clearing factor of the rotor (k-factor)
$s_{20,\,W}$ = sedimentation coefficient for sample particles in water at 20° C as expressed in svedbergs

The k-factors mentioned in this manual refer to

r_{max} = bucket bottom,
(bore bottom at the fixed angle rotors)

r_{min} = upper edge of bucket,
(bore upper edge at the fixed angle rotors)

For tubes, deviating from max. / min. radii (e.g. for micro test plates) the k-factor may be recalculated according to the formula:

$$K = (253000)\left[\ln\left(\frac{r_{max}}{r_{min}}\right)\right] \div \left(\frac{Speed}{1000}\right)^2$$

Selecting the temperature

You can select the temperature in the range of -9 °C to +40 °C.

(Please consult the standard diagram in the appendix to obtain the attainable values.)

To adjust the temperature, proceed as follows:

1. Press one of the "set" keys ▲ (for an increase) or ▼ (for a decrease) in the "temperature" section of the control panel once to switch from the actual to the set value mode.
2. By **briefly** pressing the input key you can now raise or lower the run time in 1° steps.

3. If you keep the selected key pressed, the display changes continuously and slowly at first and then in accelerated paces up or down.
4. Release the key as soon as you have reached the desired value, and adjust if necessary by repeatedly pressing the key.

The temperature display flashes for a few seconds, then changes to the actual value mode. The temperature set value is stored now.

Pretemp function

The Pretemp function permits easy and quick pretemperature-regulation of the unloaded rotor.

Upon calling this function by actuating the key ❄, all you have to do is to enter the desired temperature.

After actuating the start key ▷, the rotor temperature is equalized within 30 respectively 60 minutes at the speed defined in the pretemp function.

Starting the centrifuge

Once the rotor has been properly installed, the main switch turned on and the lid closed, you can start the centrifuge.

Press the "start" key ▷ in the control panel. The centrifuge accelerates to the selected value. Simultaneously time display starts counting down in sec. increments (during continuous operation the time display goes forward).

If a value exceeding the maximum permissible speed or RCF of the respective rotor was entered, this is indicated after the start of the centrifuge by the alternately flashing messages "rotor" and the maximum permissible value for the inserted rotor.

Within 15 seconds you may adopt this value by again actuating the "start" key repeatedly; the centrifugation is then continued. Otherwise the centrifuge stops, and you must enter a permissible value.

You cannot open the lid during the run.

Imbalance display

If an imbalanced load exists, this will be displayed above a speed of approximately 300 rpm through the hint "bAL" in the speed display.

The run is terminated, and you may restart the centrifuge after having corrected the imbalance (check loading).

Changing the settings during the run

You can change all settings during a run. By pressing once any of the "set" keys in the control panel you can switch from the actual to the set value mode.

The setting to be adjusted flashes and can then be altered. Once the data input has been completed and the display has changed to the actual value mode, the new settings become operative.

Stopping the centrifuge

At limited run time

Normally the run time has been set manually and all you have to do is wait until the centrifuge terminates the run automatically at the end of the set time.

As soon as the speed reaches zero, the display reads "end". You can now open the centrifuge by pressing the "open lid" key and remove the centrifuged material.

If the lid has not been fully lifted out of the lid lock, the message "lift lid" appears (manual lift of the lid is necessary).

You can manually stop the centrifuge at any time by actuating the "stop" key.

At this point the remaining run time is displayed.

At continuous operation

If you have chosen continuous operation, you must stop the centrifuge manually. Press the "stop" key in the control panel. The centrifuge will be decelerated with the preset deceleration profile.

The display reads "end", and you can open the lid by pressing the "open lid" key and remove the centrifuged material.

Temperature control during standby

The exact regulation will be active after identification of the rotor. This is the case after a centrifugation run exceeding 300 rpm. At standby the speed display reads "end".

If the rotor has not been identified (lid has been closed and the "start" key has not yet been actuated, speed display shows "0" with flashing point), the temperature regulation inhibits the freezing of the sample only. An exact regulation cannot be guaranteed.

Working with programs

The program memory offers the opportunity of storing and recalling a maximum of 9 individual centrifugation runs.

Program display

Depending on the kind of operation the 3 following symbols can appear:

- [–] normal run with set values of the operating memory
- [1] (respectively 2 ... 9) run with program 1 ... 9
- [≡] quick run

The symbols stay after completion of the run, so that the kind of operation recalled last can be seen.

If the rotor starts with a program, the speed or rcf set value of which is impermissibly high or the rcf set value of which lies below the rotor specific minimum value, the display in the program panel will change to [–] after identification of the rotor.

Entering/changing a program

From the manufacturer all the program places 1 to 9 have been preset with the same values.

For a change please follow this procedure:

- Select memory place number with the program selection key:
  → memory place number flashes.
- Open the program memory by actuating the program memory key (possible only, if the memory place number flashes):
  → all the pre-selection displays flash.
- Desired parameters may be put in:
  → only the altered pre-selection display flashes.
- After setting all set values, please wait a short time, until all preset values are flashing commonly again.
- By actuating the program memory key the programming has been completed:
  → memory place number flashes; thereafter the program has been set.

For the setting of further memory places the procedure has to be repeated accordingly.

Centrifuging with a program

After closing the centrifuge lid, recall the desired program memory number using the program selection key and actuate the start key ▷ .

If the rotor is started with a program the speed or RCF set value of which exceeds the permissible one for the inserted rotor or the RCF/set value of which is below the rotor-specific minimum, the display in the program display section is changed to [–] after the identification of the rotor.

”Quick Run”

For short-term operation, the *Multifuge® 4 KR* is equipped with a "Quick Run" function.

Short-term centrifugation is started by pressing the "quick run" key ▷▷ continuously; it stops as soon as the key is released.

In this mode the centrifuge accelerates and decelerates with full power. The set speed or RCF is ignored in this case.

Depending on the rotor installed, the centrifuge accelerates to the maximum speed!

Check carefully whether you have to maintain a specific speed limit for your application.

During acceleration the time is counted forward in seconds. The display stays until the centrifuge lid is opened.

Removing the rotor

1. Open the centrifuge lid.
2. Remove the rotor lid if necessary.
3. Unscrew the clamping sleeve counterclockwise using the socket wrench supplied with the instrument until no resistance exists.
1. Grab the rotor with both hands and pull it perpendicularly off the drive shaft carefully. Make sure not to tilt it.

Grab rotor with both hands and pull upwards perpendicularly.

When using an aerosol-tight bio-containment lid, in case of contamination, you may remove the respective rotor from the drive shaft without opening the lid!

You may then open the rotor e.g. in a safety work bench and decontaminate it.

Audible alarm

Accompanying all error messages, a warning signal is given out which only is silenced upon actuating any key.

As an option, you can also have the end of a run signaled acoustically. For activating or deactivating this option please press the  key in the actual value mode. After about 1 sec you get into the selection mode. The speed display shows "beep" and the time display shows "on" or "off". As long as the key is pressed, the selection mode is active.

By actuating the upward-key  in the time display the signal function can be switched on or off.

When the message "rotor" flashes, pressing the start key once is sufficient to turn off the warning signal and to accelerate the rotor to the maximum speed displayed by the instrument.

Putting the centrifuge out of operation

By switching the mains switch into "0" position the centrifuge is turned off.

Please mind, that the rotor has to come to a complete standstill, before the centrifuge is disconnected from the mains!

Without motor deceleration, it takes much more time until the rotor comes to a standstill.

The centrifuge lid can only be opened automatically if the centrifuge is switched on!

Maintenance and care

Maintenance to be performed by the customer

For the protection of persons, environment and material you are obliged to clean the centrifuge regularly and to disinfect it if necessary.

Unsuitable cleaning agents or disinfection procedures may damage the centrifuge and its accessories!

If you intend to use cleaning agents or disinfection procedures not recommended by the manufacturer, you have to make sure by consulting the manufacturer, that the procedure foreseen does not cause any damages to the instrument!

Cleaning

Pull mains plug before cleaning the instrument!

Clean the casing, the rotor chamber, the rotor and the accessories regularly and in case of need. This is indicated both for reasons of hygiene and to prevent corrosion due to contamination sticking to the instrument and its accessories.

Clean them with mild agents of pH values ranging from 6 to 8.

For other cleaning agents please consult KENDRO!

Immediately after cleaning, dry the aluminum parts or put them into a warm-air dryer at a temperature not exceeding 50°C.

During cleaning liquids and especially organic solvents should not come into contact with the drive shaft and the ball bearing.

Organic solvents may decompose the lubricant of the motor bearing. The drive shaft may block.

Instruments with refrigeration unit:

If a strong ice sheet is present in the internal chamber, be sure to remove all condensate after defrosting!

Please control and clean the venting slots regularly!

Before cleaning the venting slots please disconnect the centrifuge from the mains supply.

Please pull mains plug!

For cleaning the venting slots the following steps are necessary:

1. Disconnect the centrifuge from the mains supply!
2. After removing the lateral fastening screws the venting grid may be demounted.

3. The cooling lamellas may be cleaned carefully with a brush.

Do not bend the lamellas!

4. Finally the venting grid has to be re-screwed again.

Disinfection

If a centrifuge tube containing infectious material leaks during a run, you have to disinfect the centrifuge immediately.

Infectious material could enter the centrifuge if spills or tube breakage occur.

Danger of infection may occur upon contact! Take appropriate protective measures for personnel!

Mind the permissible filling volumes and loading limits for the tubes!

In case of contamination the operator has to make sure, that no further persons are jeopardized!

Contaminated parts have to be decontaminated immediately.

If required further protective measures have to be initiated.

Rotor and rotor chamber must be treated with a neutral, universal disinfectant. Best suited for this purpose are disinfectant sprays, ensuring that all rotor and accessory surfaces are covered evenly.

- Please use 70% ethanol for disinfection, or a 2% gluteraldehyde solution for sterilization.

Please note the safety measures and handling hints when applying these substances!

For other disinfectants please consult KENDRO Services!

- You may disinfect the rotor and the accessories as described in the following section. Be sure to follow the pertinent safety procedures for handling infectious material.

1. Pull mains plug.
2. Unscrew the rotor chuck.
3. Grab the rotor with both hands and pull it perpendicularly off the drive shaft.
4. Remove the centrifuge tubes and adapters, and disinfect them or dispose of them as necessary.
5. Treat the rotor and the rotor lid according to the instructions given for the disinfectant (soaking in liquid or spraying). You must strictly observe the specified action times!
6. Turn the rotor head down and drain off the disinfectant. Thereafter thoroughly rinse rotor and lid with water.
7. Dispose of the disinfectant according to valid regulations.
8. Aluminum rotors have to be treated with anticorrosive protective oil subsequently.

Disinfection with bleaching lye

These agents contain highly aggressive hypochlorites and must not be used with aluminum rotors!

Decontamination

For general radioactive decontamination, use a solution of equal parts of 70% ethanol, 10% SDS and water. Follow this with ethanol rinses, then de-ionized water rinses, and dry with a soft absorbent cloth. Dispose of all washing solutions in appropriate radioactive waste containers!

Autoclaving

Check whether autoclaving is permitted!

(see label on the rotor body and the rotor lid)

For the autoclavable parts the permissible autoclaving cycle is 20 min at 121 °C.
Remove the rotor lid together with the centrifuge tubes and the adapter. The rotor has to be cleaned and rinsed with distilled water before being autoclaved. Buckets and tubes must not be closed during autoclaving.

Place plastic rotors on an even surface to avoid deformation.

Chemical additives to the steam are not permitted.

Never exceed the maximum permissible autoclaving time and temperature.

Aluminum rotors have to be treated with corrosion protective oil each time they have been autoclaved.

Should the rotor show signs of wear or corrosion, you must stop using it!

Corrosion protective oil 7000 9824 is delivered with the centrifuge.

The KENDRO service offer

Kendro Laboratory Products recommends annual servicing of the centrifuge and the accessories by authorized customer service or trained professionals. The custormer service personnel is inspecting:

- the electrical installations
- the suitability of the location
- the lid lock mechanism and the safety circuit
- the rotor
- the rotor fastening and the drive shaft

Defective material is exchanged.

KENDRO offers inspection and service contracts covering it. Inspection costs are charged as flat-rate contracts.

Necessary repairs are carried out free of cost within the warranty conditions, and against payment after expiration of the warranty period.

Warranty conditions

The warranty period starts with the day of delivery. Within the warranty period the centrifuge is repaired or replaced free of cost if there are provable faults in materials or workmanship.

Conditions for a warranty are:

- the centrifuge is used according to the instructions of use
- mounting, extensions, settings, alterations or repairs are carried out exclusively by personnel authorized by KENDRO
- the required maintenance and care procedures are carried out regularly.

Troubleshooting

Emergency lid release

In case of a power failure the lid cannot be opened using the electrical lid release. To permit unloading in this case, the centrifuge is equipped with an emergency lid release. However, you may use this system in case of emergency only.

Rotor can run at high speed! Touching it may cause severe injuries!

Always wait several minutes until the rotor has come to a complete standstill without deceleration.
Without power supply the brake is out of operation, and deceleration takes much longer than normal!

Proceed as follows:

1. Make sure that the rotor is at a standstill (sight glass in the lid).

During a power failure it is impossible to lock the lid once the emergency lid release has been actuated!
Never decelerate the rotor using your hands or tools!

2. Pull mains plug.
3. On the right- and left hand side of the front screen there is a plastic plug, which you can remove with a screwdriver or a knife.

Emergency release

By joltingly pulling the attached cord the mechanical lid unlocking mechanism is activated. The lid will open and you can remove your samples.

4. Afterwards push the cord back into the instrument and close the opening by the plug again.

Once the power failure has been eliminated, you can connect the instrument to the mains and switch it on.

Following the self test of the centrifuge, the lid may be closed and locked with the motor.

Troubleshooting you can handle yourself

If problems other than those described in the following table arise, you should contact the authorized customer service.

Error message	Symptoms	Possible causes and corrective measures
Displays remain dark	The drive stops. The rotor stops without deceleration. The lid cannot be opened.	**Mains voltage interrupted** 1. Is the mains switch switched on? 2. Check the mains supply. 3. If the mains voltage is OK, contact customer service.
Displays fail briefly.	The drive stops suddenly. The rotor stops with deceleration. The display shows E-14.	**Brief interruption of mains voltage** 1. Turn off mains switch. 2. Check whether the mains plug is connected properly. 3. Restart the centrifuge.
Lid cannot be opened.	Pressing the "open lid" key has no effect.	**Lid not correctly engaged or lid warped.** 1. Check whether mains voltage is on and the instrument is switched on (display is lit). 2. Press lid down in the center of the front section once, and actuate the "open lid" key subsequently. 3. If this is unsuccessful, you may open the lid using the mechanical emergency lid release (see page 65)

Error message	Symptoms	Possible causes and corrective measures
-	Exceptional noise.	1. Stop the centrifuge by pressing the "stop" key, in case of emergency, pull mains plug. 2. Wait until the centrifuge comes to a complete standstill. 3. Check whether the rotor is properly mounted and loaded. 4. Check whether a broken tube, damage to the rotor or motor is responsible for the noise. If you cannot locate and solve the problem yourself, contact customer service.
Message "bAL" appears in display.	Rotor stops with deceleration.	**Imbalance switch actuated** 1. Open the instrument by pressing "open lid" key .. 2. Check whether the rotor is properly loaded. 3. Check whether a broken tube or damage to the rotor was responsible for imbalance switch actuation.

Error message	Symptoms	Possible causes and corrective measures
Message "rotor" appears in display.	Rotor decelerates with delayed deceleration.	**Set speed exceeds permissible maximum speed for the rotor.** (The same holds for RCF setting) A) For approx. 15 sec. the maximum permissible rotor speed or rcf for the inserted rotor will be shown alternately by ”rotor” in the display Within this period, it is possible to accept this value by again pressing the "start" key. The centrifugation is then continued. B) Following onset of deceleration you must wait until the rotor has stopped. By opening and closing the lid you reset the message "rotor". After entering a permissible speed you can start again.
Display "OPEN" appears although lid is closed.	Will not start.	**Lid not properly closed** Open the lid and repeat locking procedure.
Message "Lid" appears in the display.	Drive stops. Rotor stops without deceleration to standstill.	**Lid was opened manually during the run.** 1. Press the lid again shut. The instrument stops without deceleration. 2. If you want to continue the run, you must switch the instrument off and on again.

Error message	Symptoms	Possible causes and corrective measures
Message "Lift Lid" appears in the display	Lid does not open automatically.	**The lid has not been lifted from the lock after release.** 1. Avoid laying objects onto the centrifuge lid. 2. Lift the lid slightly.
E-00	Motor does not start.	**Motor or rotor blocked.** 1. Switch instrument off and on again using the mains switch. 2. Open the lid. 3. Check whether the rotor can turn freely. If you cannot clear the malfunction, contact customer service.
E-02	Rotor stops without deceleration to standstill. Instrument cannot be operated.	**Internal program error in the memory** Switch the instrument off and on again. If the error persists, contact customer service.
E-03	Rotor stops without deceleration to standstill. Instrument cannot be operated.	**Error in speed measurement** Switch the instrument off and on again. If the error persists, contact customer service.
E-04	Rotor stops without deceleration to standstill. Instrument cannot be operated.	**Temperature measurement malfunction** (sensor fracture). Switch the instrument off and on again. If the error persists, contact customer service.

Error message	Symptoms	Possible causes and corrective measures
E-06	Rotor stops without deceleration to standstill. Instrument cannot be operated.	**Communication error between key panel and CPU** Switch the instrument off and on again. If the error persists, contact customer service.
E-07	The rotor is decelerated to a standstill. The lid can be opened.	**Over temperature in the centrifuge chamber** Display > 51°C or measured temperature > 70°C. (Cooling machine possibly defective.)
E-08	Rotor stops without deceleration to standstill. Instrument cannot be operated.	**Over voltage at frequency converter**. Mains voltage outside the tolerance. Deceleration resistance defective. If necessary, request customer service.
E-10	Self-test after switching on the centrifuge.	**NV-RAM; error in program memory** Switch the instrument off and on again. If the error persists, contact customers service.
E-12	Rotor stops without deceleration to standstill. Instrument cannot be operated.	**Temperature measurement error.** Switch the instrument off and on again. If the error persists, contact customer service.

Error message	Symptoms	Possible causes and corrective measures
E-14	Instrument does not start or decelerates to stand-still.	**No rotor present or rotor identification impossible.** A) Check whether a certified rotor is inserted. B) Please take care of the readability of the inscription of the swinging bucket rotor cross installed. (rotor identification must show to the chamber bottom) C) For the swinging bucket rotor the set bucket type must be permitted for the operation in the respective rotor. Please note the hints of chapter "Bucket selection of swinging bucket rotors" (page 47) and compare the permitted rotors and rotor buckets for *Multifuge® 4 KR* in "table 1" on page 18. D) Following a brief power failure, the rotor could not be identified. Switch the instrument off and on again using the mains switch.
E-15	Rotor stops without deceleration to standstill. Instrument cannot be operated.	**Incorrect checksum in NV-RAM**
E-17	Lid does not open.	**Lid is blocked or jammed.** Press the lid down once at the front in the center and then actuate the "lid open" key again. Otherwise, see "Emergency lid release" (page 65)

Error message	Symptoms	Possible causes and corrective measures
E-19	Self-test after switching on the centrifuge.	**Incorrect NV-RAM or key panel**
E-22	Self-test after switching on the centrifuge.	**NV-RAM parameter does not fit the processor**
E-23	Rotor stops without deceleration to standstill or does not start. .	• **Mains voltage too low.** • **Excessive pressure in the refrigeration unit, or motor overheated.** 1. Turn instrument off and pull mains plug. 2. Check and clean ventilation slots if necessary. 3. After about 60 min you can restart the instrument. If the error persists, contact customer service.
E-24	Self-test after switching on the centrifuge.	**NV-RAM 2 missing**

Error message	Symptoms	Possible causes and corrective measures
E-25	Rotor stops without deceleration to standstill.	**Start without rotor, or improper rotor fastening .** 1. Switch the instrument off and on again. 2. Open the centrifuge by pressing the ”lid open"-key ⏏., 3. Check, whether the rotor has been inserted and fastened correctly. If the error persists, contact customer service.
E-27	Rotor stops without deceleration to standstill. Instrument cannot be operated.	• **Mains voltage too low.** • **Electronics overheated.** 1. Turn instrument off and pull mains plug. 2. Check and clean ventilation slots if necessary. 3. After about 60 min you can restart the instrument. If the error persists, contact customer service.

If customer service is required

Should you require our Service, please advise us of the catalog and serial number of your instrument. You will find the pertinent information at the specifications, near the socket for the mains cable.

Moreover it is helpful for our service representative to know the software version. You can determine the software version as follows:

1. Switch the instrument off
2. Switch the instrument on

   For about 1 sec all displays read

Subsequently, the following readings will be displayed for 2 seconds each:

Software version key panel	__591	__2
Software version	__590	__6
NV-RAM version 1	_7270	__3
NV-RAM-version 2	_7211	__2

The values in the time display show the actual version.

The last information displayed is the current cycle status.

Cycle counter	__235	_CY

The values given are only examples!

During the subsequent program test, the message _ TEST PRO 9 ... 0 is displayed

Technical Data

Features *Multifuge® 4 KR*	Specification
Ambient conditions	- indoor use - maximum elevation 2000 m (6562 ft) above sea level - maximum relative humidity 80 % up to 31°C (88°F), linearly decreasing down to 50 % relative humidity at 40°C (104°F).
Ambient temperature permitted	+2 °C to +40 °C
run time	1sec – 99 min, hold = continuous operation
maximum speed (n_{max})	10 000 rpm (rotor-dependent, adjustable in steps of 10)
minimum speed (n_{min})	300 rpm
maximum RCF at n_{max}	15 317 (fixed angle rotor 7500 6483)
maximum kinetic energy	83.3 kNm
noise at maximum speed	< 61 dB (A) (sound pressure level of emission according to DIN EN ISO 11 201)
Temperature set range	-9 °C to +40 °C
Dimension (H x W x D)	700 mm x 680 mm x 720 mm
Weight without rotor	236 kg

Features *Multifuge® 4 KR*	Specification
Testing standards 230V instruments Manufactured and tested in accordance with	EN 61 010-1, EN 61 010-2-020 EN 61326 (+ EN 61000-3-2/A14:2000-6) EN 55011 B, EN 61000-6-2.

Electrical connections / fuses

Order no.	Voltage	Frequency	Nominal current	Power consumption	Fuse protection of instrument * thermal excess current release	Fuse protection of building
Multifuge® 4 KR 7500 4461	230 V	50 Hz	12.9 A	2760 W	16 A	16 AT

Appendix

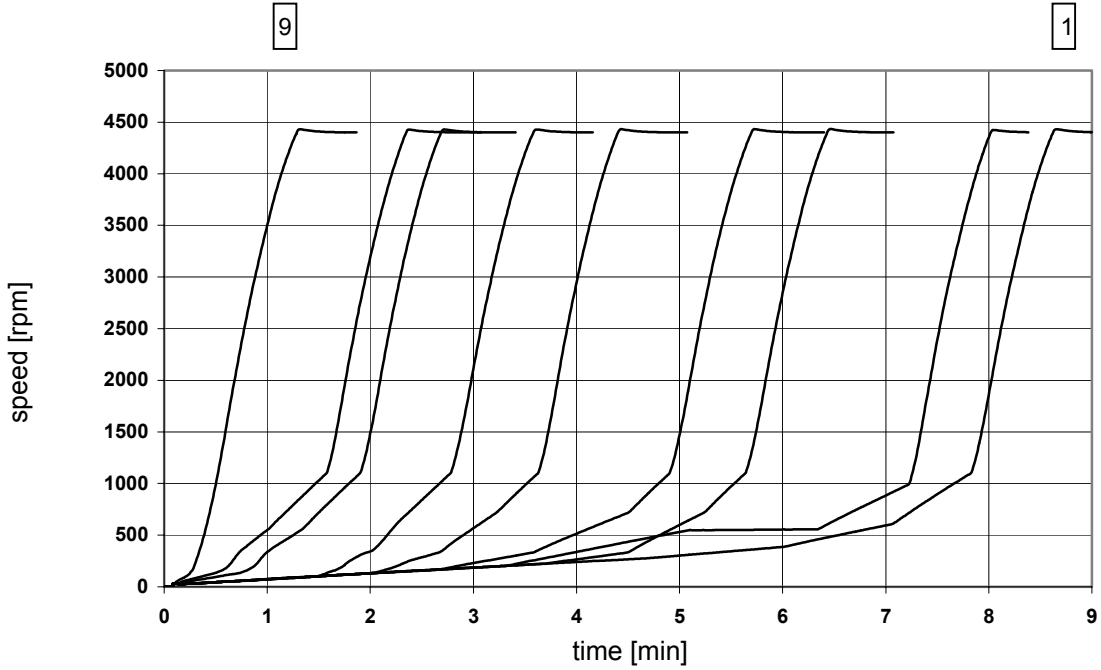
Acceleration and deceleration profiles

On the following pages you will find acceleration and deceleration profiles for each rotor type respectively.

Acceleration profiles

LH-4000 7500 6475

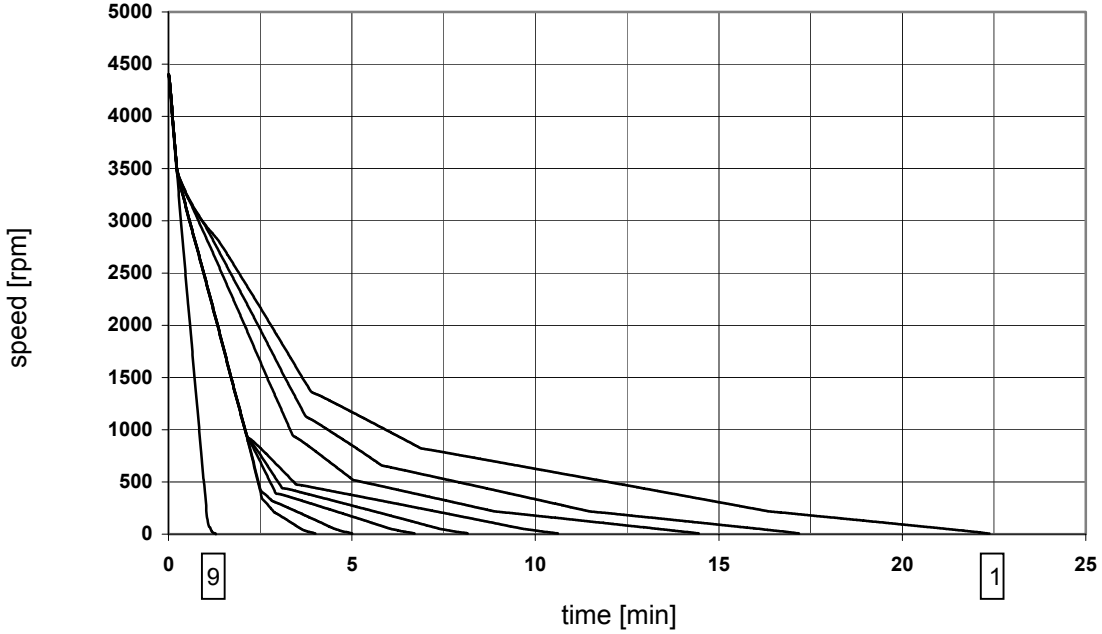
(with round bucket 7500 6477 and double rectangular bucket 7500 6478)



Deceleration profiles

LH-4000 7500 6475

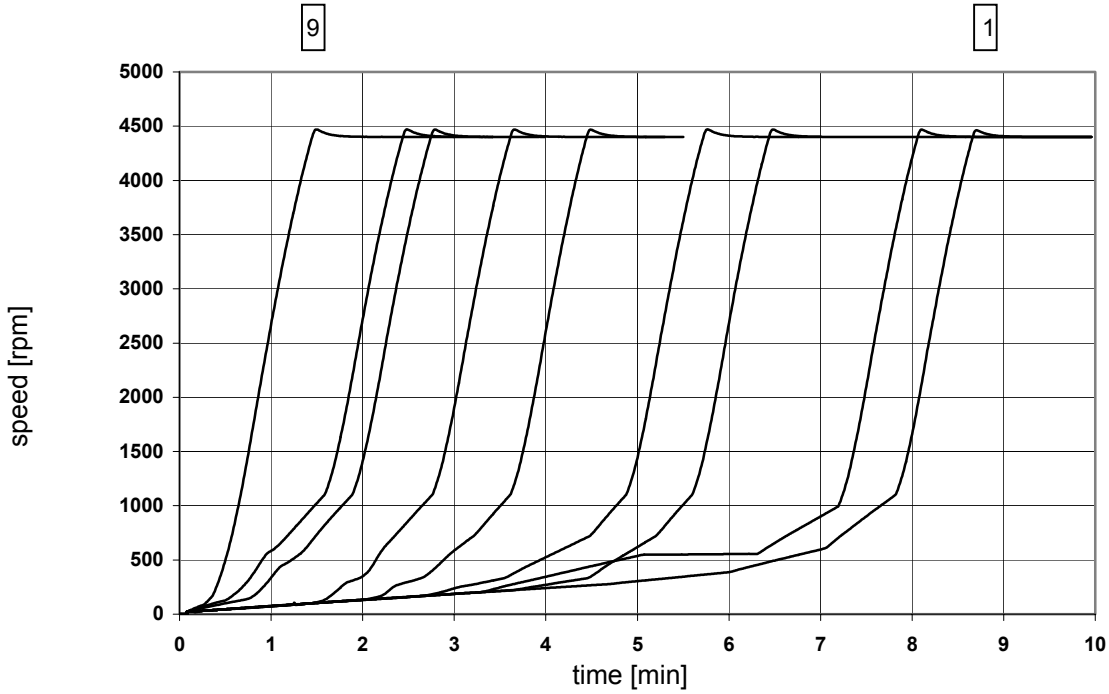
(with round bucket 7500 6477 and double rectangular bucket 7500 6478)



Acceleration profiles

LH-4000W 7500 6476

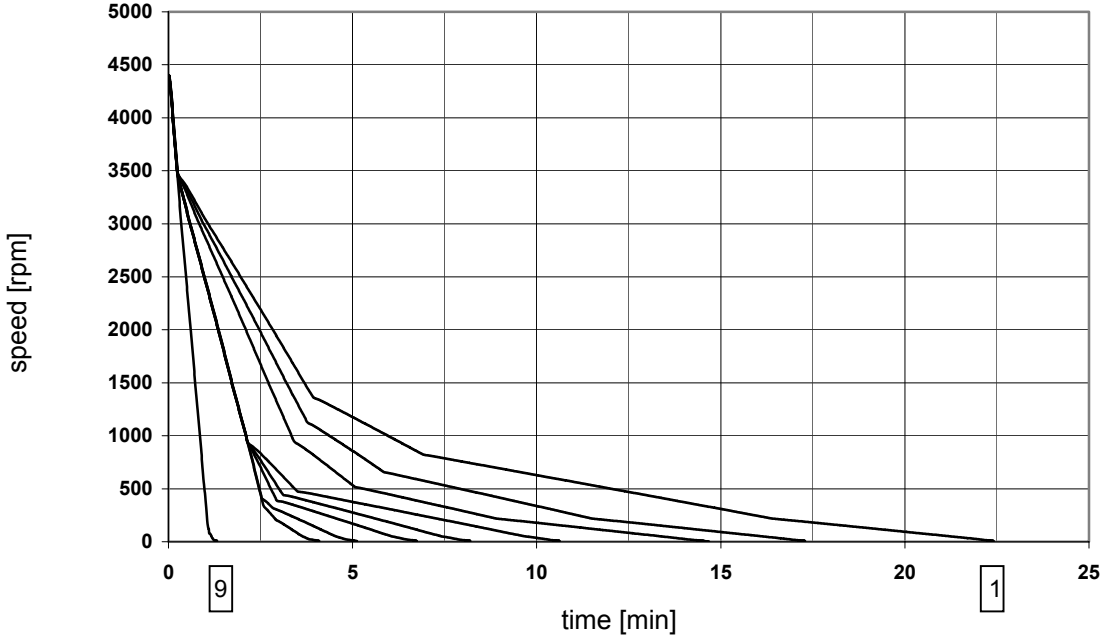
(with round bucket 7500 6477 and double rectangular bucket 7500 6478)



Deceleration profiles

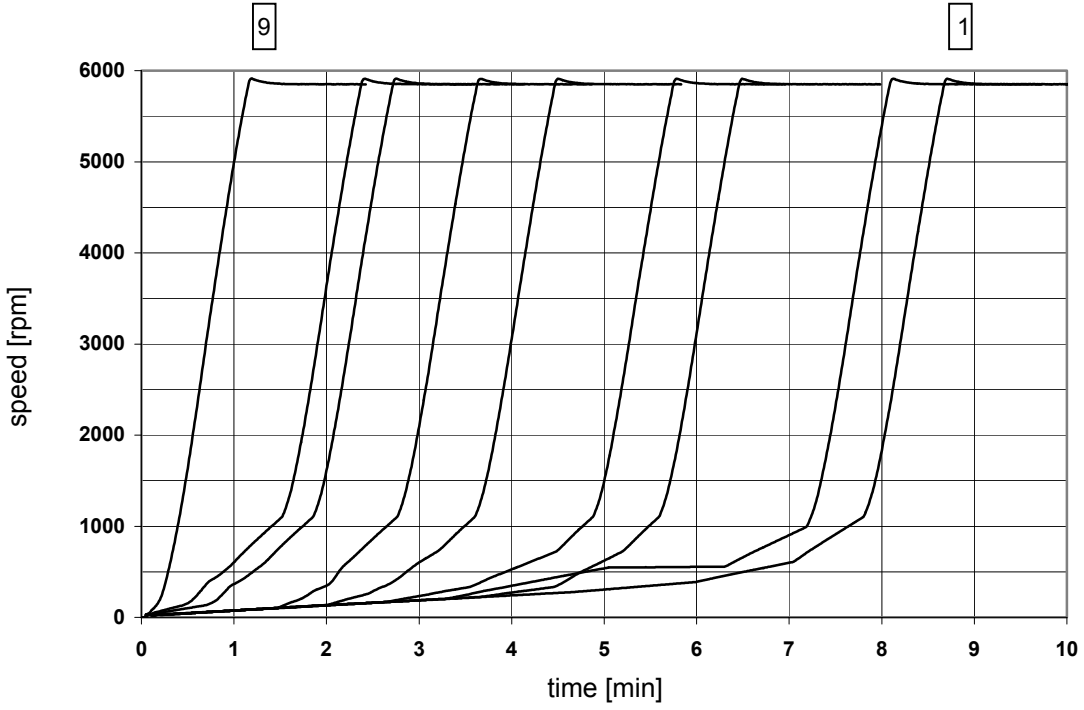
LH-4000W 7500 6476

(with round bucket 7500 6477 and double rectangular bucket 7500 6478)



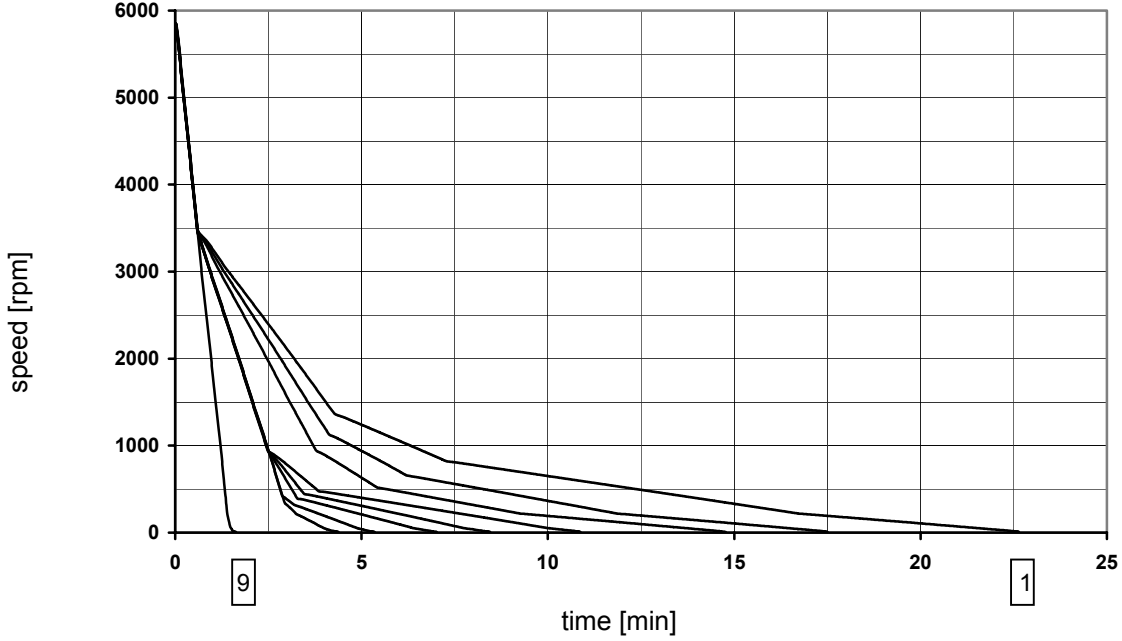
Acceleration profiles

BIOshield® Rotor 7500 6435
Highplate® Rotor 7500 6444



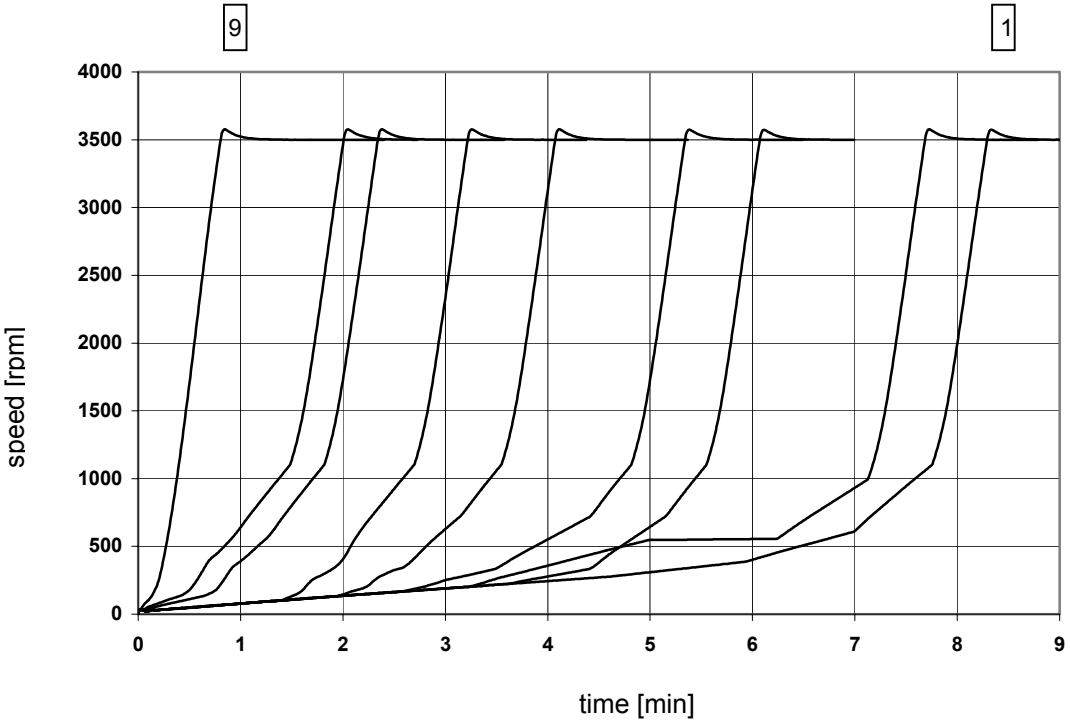
Deceleration profiles

BIOshield® Rotor 7500 6435
Highplate® Rotor 7500 6444

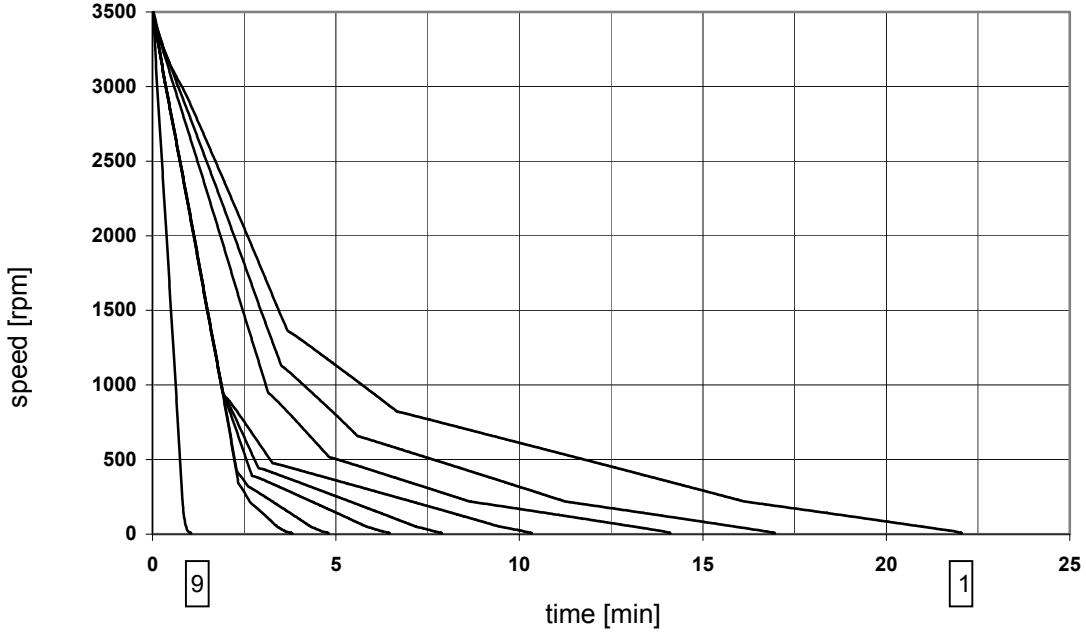


Acceleration profiles

Diagnostik™ Rotor
7500 6480



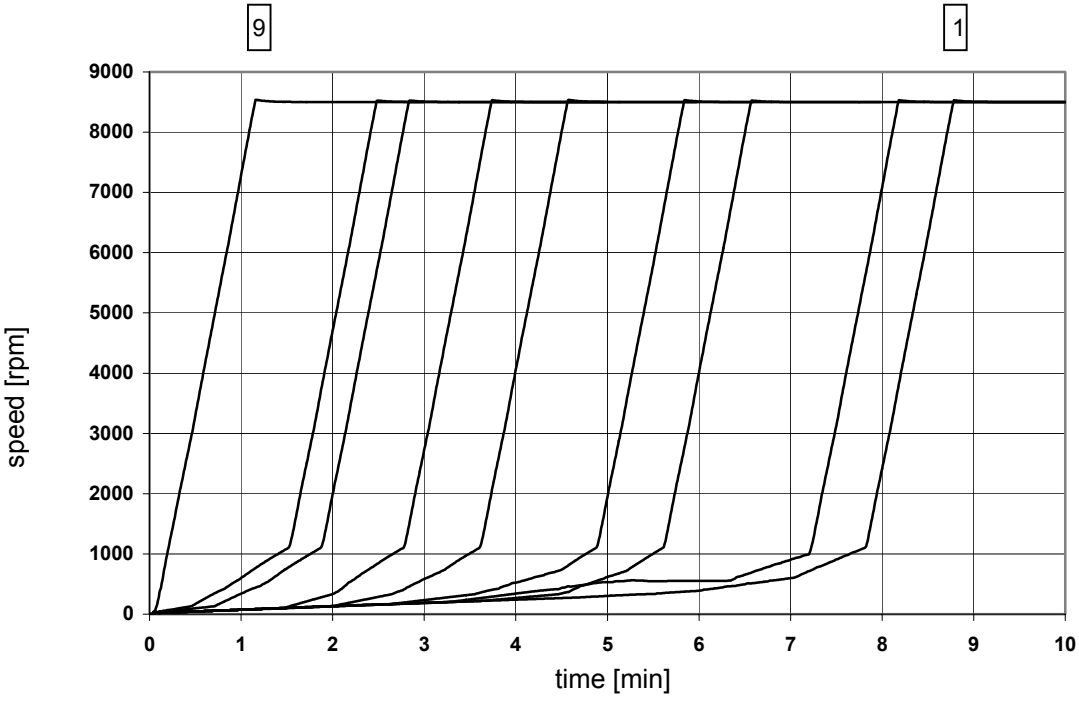
Deceleration profiles
Diagnostik™ Rotor
7500 6480



Acceleration profiles

High*conic*® Rotor

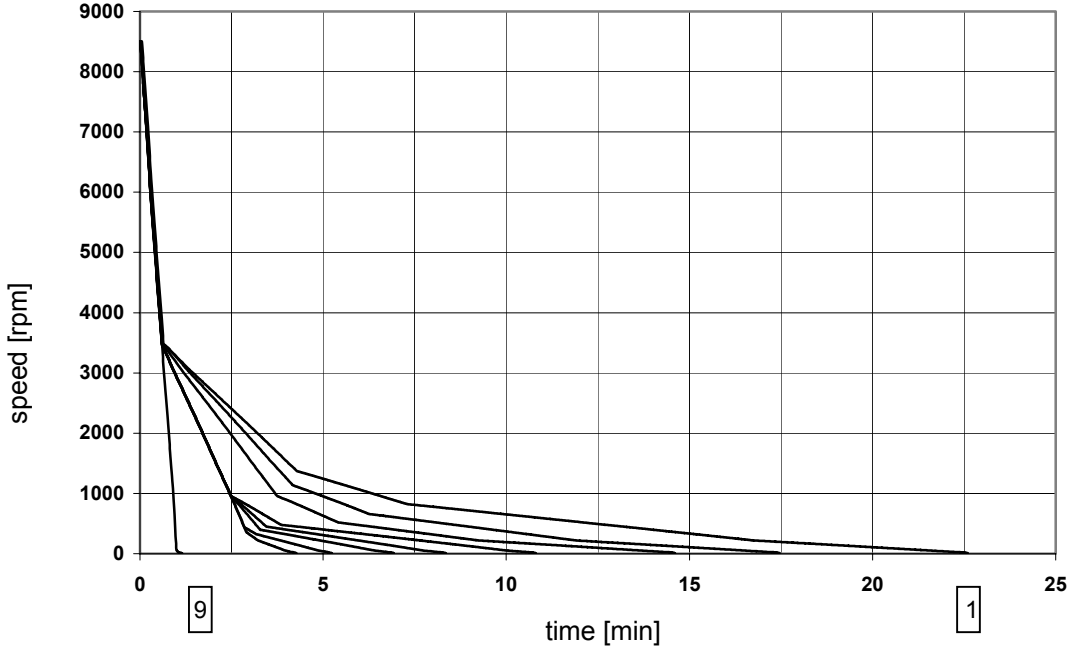
7500 3046



Deceleration profiles

High*conic*® Rotor

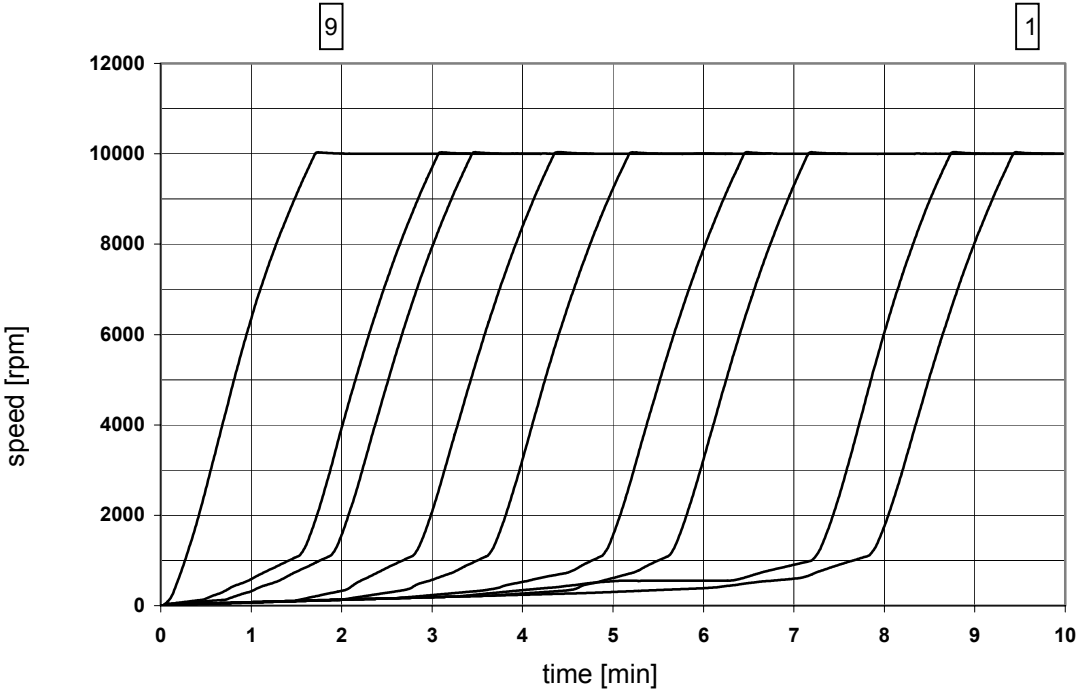
7500 3046



Acceleration profiles

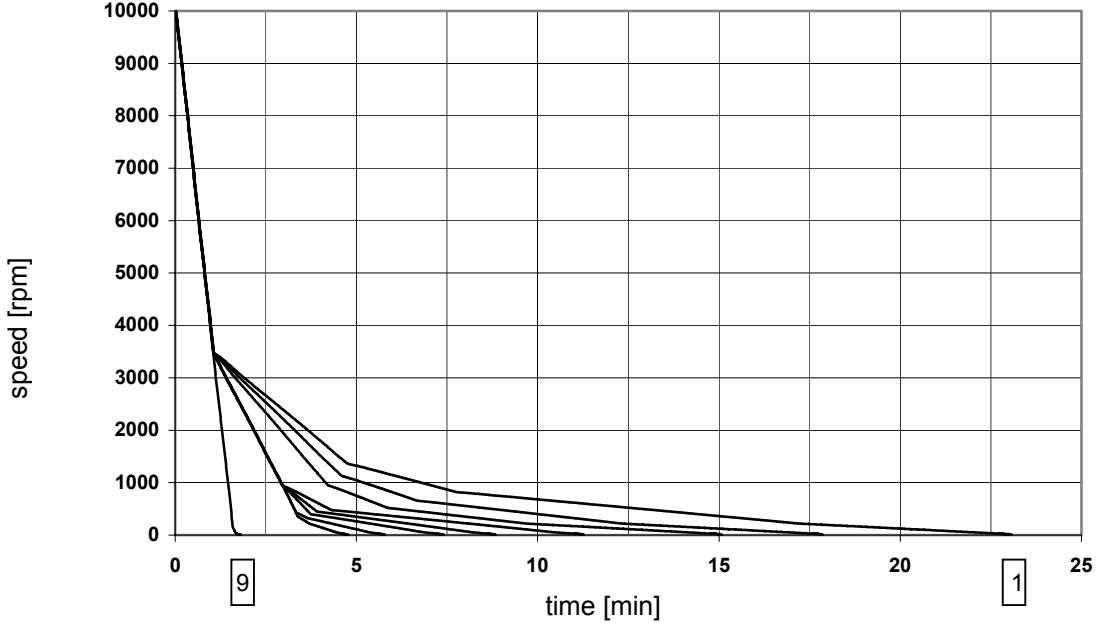
LAC-250

7500 6483

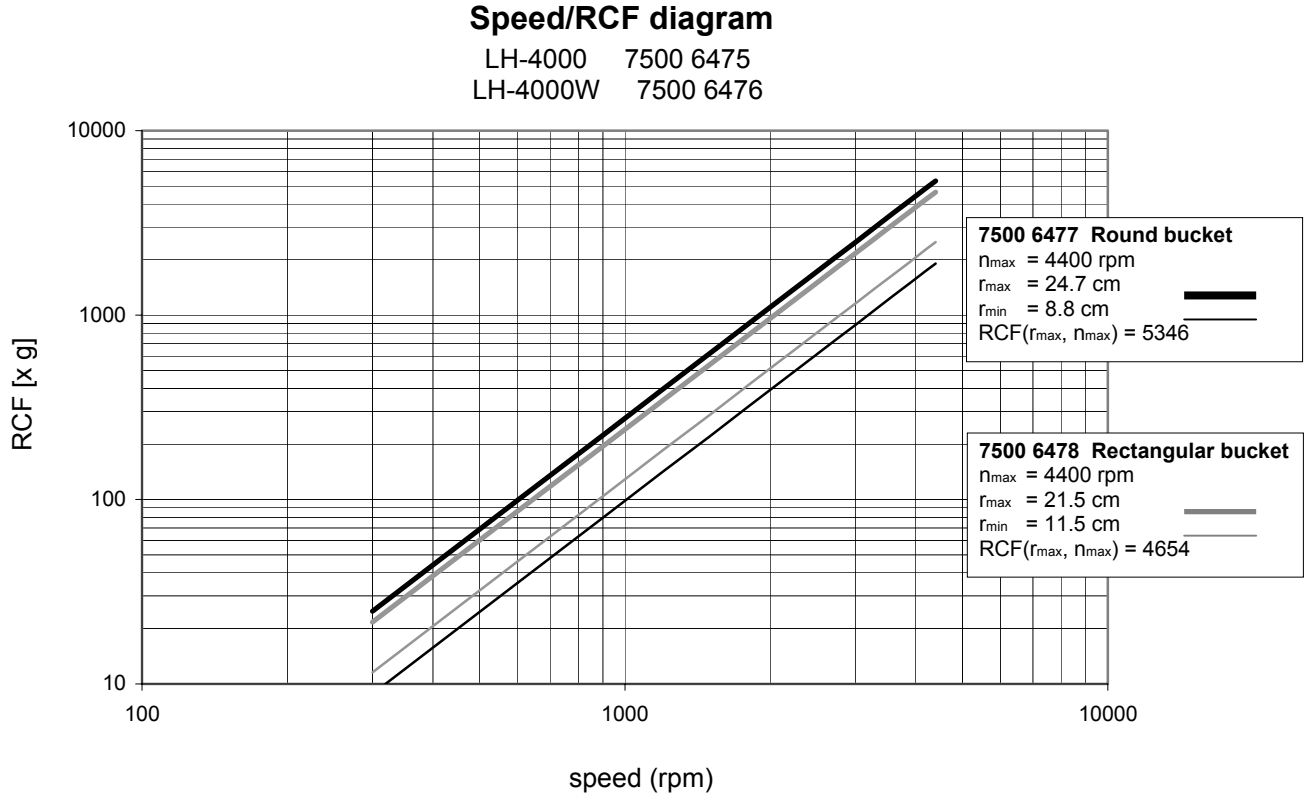


Deceleration profiles

LAC-250
7500 6483

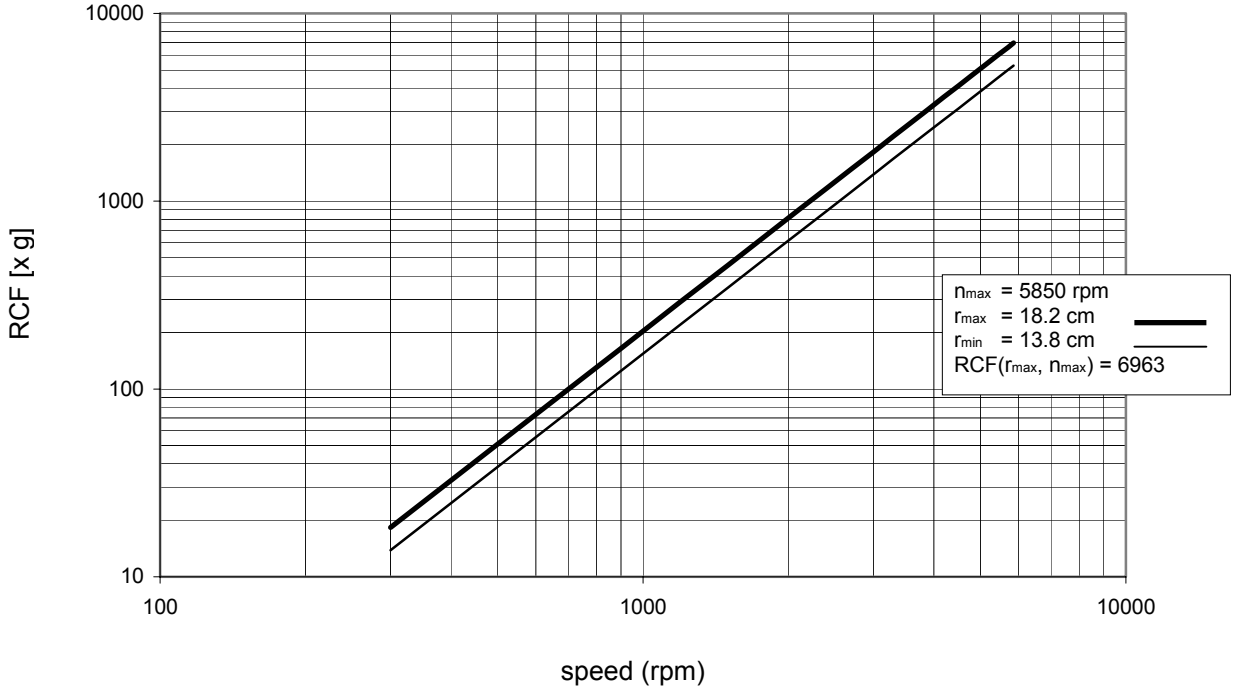


Speed/RCF diagrams



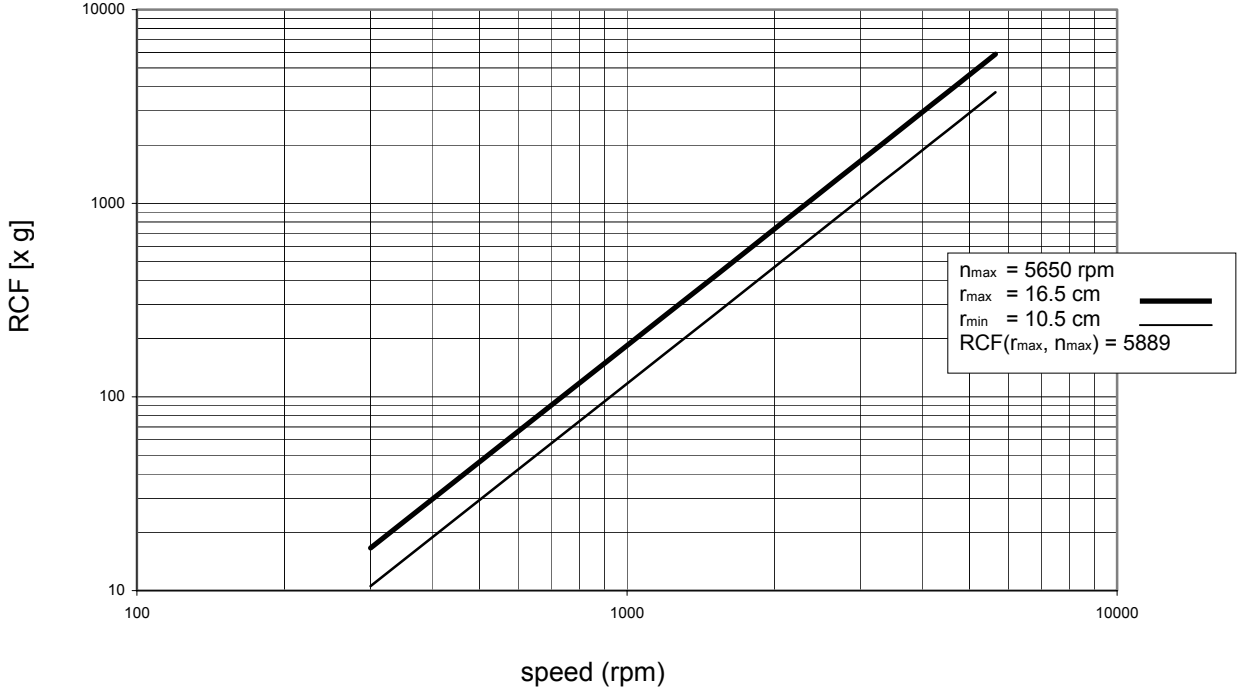
Speed/RCF diagram

BIOshield® Rotor 7500 6435



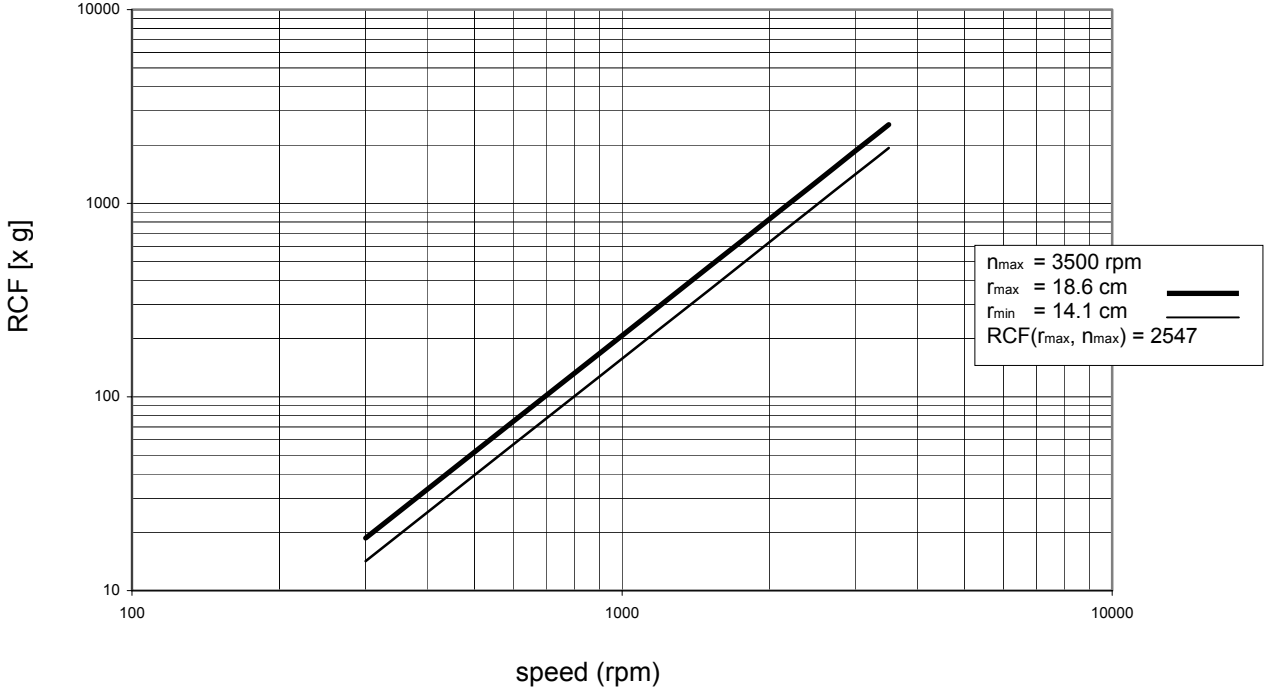
Speed/RCF diagram

Highplate® Rotor 7500 6444



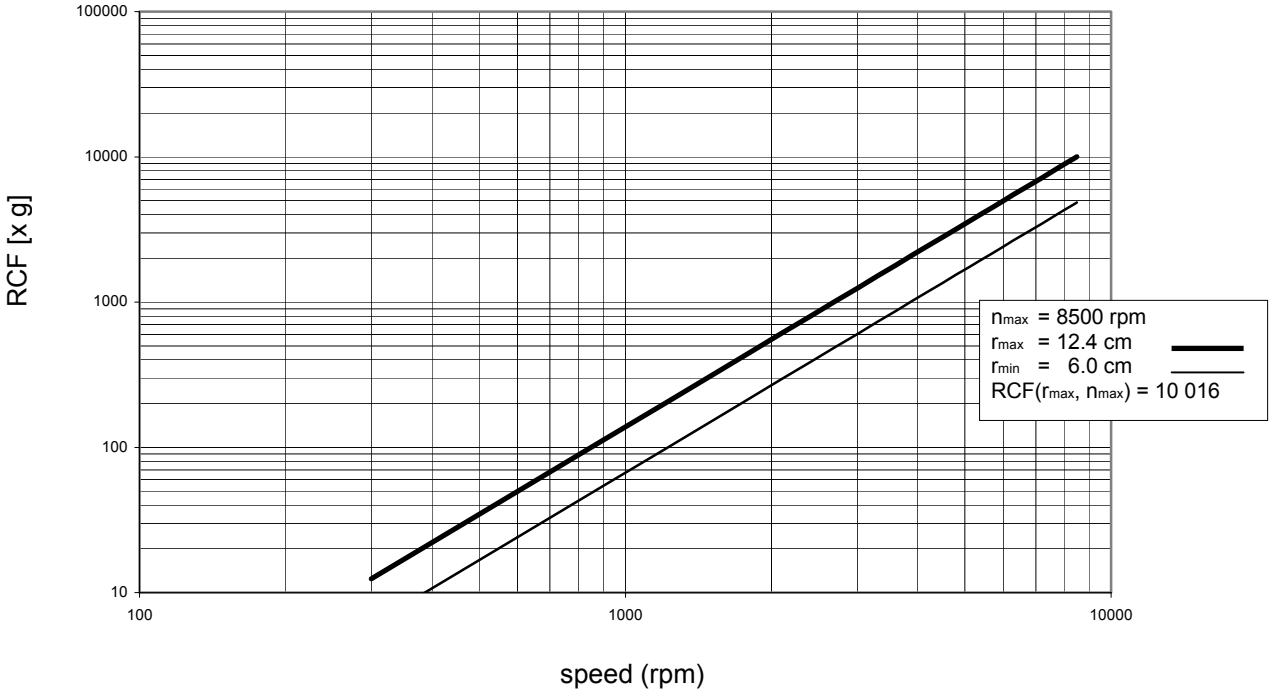
Speed/RCF diagram

Diagnostik™ Rotor 7500 6480



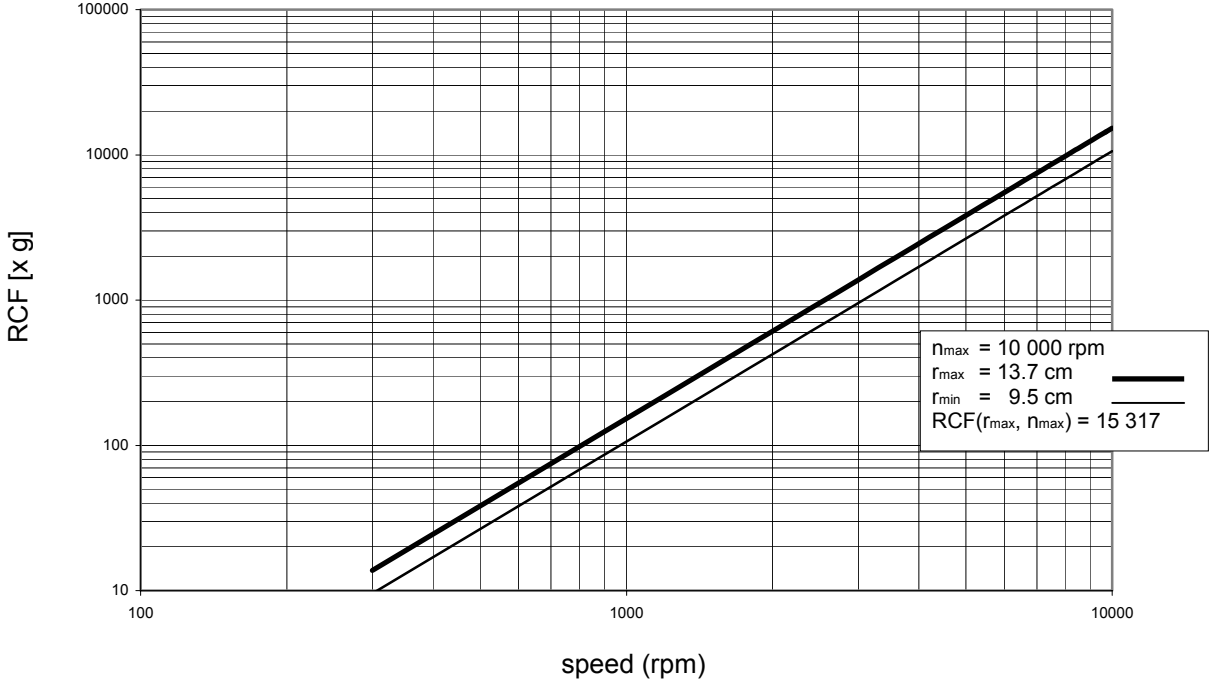
Speed/RCF diagram

High*conic*® Rotor 7500 3046



Speed/RCF diagram

LAC-250 7500 6483



Index

A

B

C

D

E

G

H

I

K

L

M

N

O

P

Q

R

S

T

W

For Ordering or Technical Information

Asia Pacific Kendro Laboratory Products (H.K.) Limited · Hong Kong · Tel. +852 2711 3910 · Fax +852 2711 3858 · info.cn@kendro.spx.com

Europe, Middle East, Africa
Kendro Laboratory Products International Sales · Langenselbold · Germany · Tel. +49 (0) 6184-90 6940 · Fax +49 (0) 6184-90 7474 · info.de@kendro.spx.com

Latin America Kendro Laboratory Products International Sales · Asheville, NC · USA · Tel. +1 828-658 2711 · Fax +1 828-645 9466 · info@kendro.spx..com
North America Kendro Laboratory Products · Asheville, NC · USA · Tel. +1 800 -879 7767 · Fax +1 828-658 0363 · info@kendro.spx.com

Internet http://www.kendro.com

Kendro Laboratory Products GmbH
Robert-Bosch-Straße 1
D-63505 Langenselbold
Telephone: +49 (0) 6184 90 6940

20057761 Multi 4 KR_uk 11/03
Printed in Germany