

SORVALL®

Biofuge *primo*



**OPERATING
INSTRUCTIONS**

How to use this manual

Use this manual to get acquainted with your centrifuge and its accessories.

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

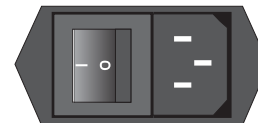
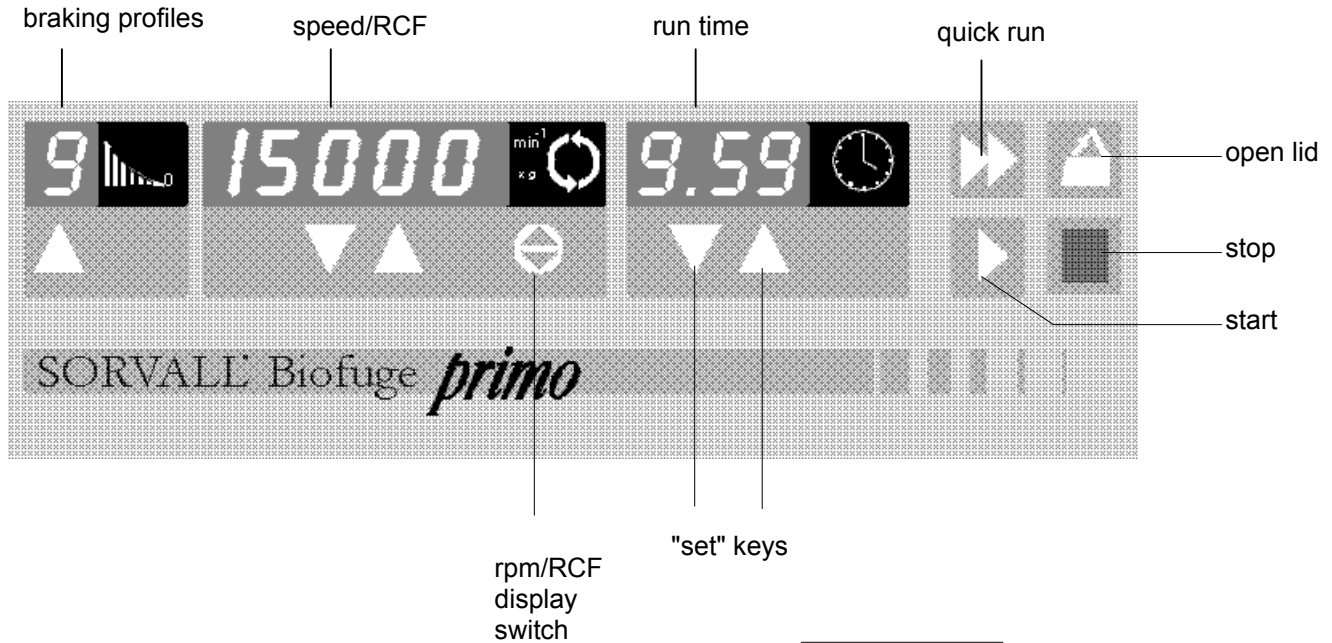
A manual that is not kept handy cannot provide protection against improper handling and thus against damage to persons and objects.

The manual comprises chapters on

- Safety regulations
- Instrument description
- Rotor program and accessories
- Transportation and hook-up
- Use of the centrifuge
- Maintenance and care
- Troubleshooting
- Technical data
- Index

Overleaf you will find a graphic representation of the control panel with a survey of the most important functions

Please fold out



back panel:
socket for mains cable
mains switch

Control panel of the Biofuge primo

Display

Braking profiles

Continuous

display: braking profile last used, 1 - 9.
2 - 9 = max. acceleration and various
braking profiles
(2 [weak] to 9 [strong])
1 = slow acceleration and
braking curve 2

Speed/RCF

During run: current rpm or RCF (after actuation of
display switch)

End of run: "End"

Lid open: "OPEN"

Error message: alternating display (if relevant)

Run time

During run: - remaining run time to 0

Continuous: - current run time
operation (hLd) (in hours and minutes)

"Quick run" : - run time passed
(in minutes and seconds)

Keys

Start : normal start

Stop: manual stop

Open lid: open lid (possible only with the instru-
ment switched on)

Quick run: short-term operation of the centrifuge as
long as key remains pressed

rpm/RCF
switch: Switching between rpm and RCF dis-
play.

"Set" keys: stepwise increase/decrease of preset
values, accelerated change when
pressed permanently

Short pressing of any of the "set" keys: switch from
current to preset value, signalled by flashing display.

*Error codes (troubleshooting see chapter
"Troubleshooting"):*

E-00: motor blockage

E-03 speed measurement

E-08: overvoltage

E-14: no rotor or rotor identification impossible

E-17: lid does not open

rotor: set speed higher than permissible speed
of the rotor

bAL: imbalance

Lid: lid turned loose or opened during run;
drive overheated

OPEN: with lid closed: safety circuit triggered (drive
overheated)

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For your safety

The SORVALL® 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.



When damages at the power cord or at casing were noticed the centrifuge has to be set out of operation!

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 its 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. 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 in 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 exceptions 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 an opened lid.
- Never use the centrifuge if the front panel has been partially or totally removed.
- Changes in mechanical or electrical components of the centrifuge may only be carried out by individuals authorized by Kendro Laboratory Products.

Conformity to current standards

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

- for all voltages

- **IEC 61010**

- for 120 V only



- for 230 V only



Details of the test standards take you please from the technical data.

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

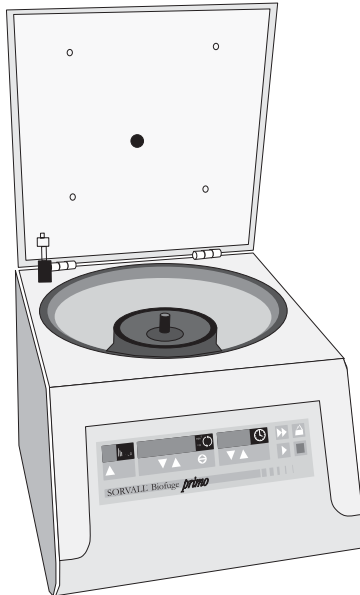
- Regulations for prevention of accidents BGV A2
- Regulations for prevention of accidents VBG 5
- Regulations for prevention of accidents VBG 7z

For your safety

Notes

The *Biofuge primo*

The figure below shows a general view of the *Biofuge primo* with open lid and the rotor put into place.



Safety systems

The *Biofuge primo* is equipped with a number of safety systems:

- Housing and rotor chamber manufactured from impact-resistant plastic; inner armouring made of steel
- Lid with window and lid lock
You can open the centrifuge lid only when the power is turned on and the rotor has come to a halt. You can start the centrifuge only if the lid is properly locked.
- Rotor identification for power adjustment
- Electronic unbalance detection
- Warning if instrument is manually opened during a run

If the lid is manually opened during a run, or if the temperature of the drive exceeds a critical value, a corresponding message appears in the display ("Lid" and "OPEN", respectively).

- Emergency lid release: only in case of emergency, e.g. during power failure (see chapter "Troubleshooting")



Do not tamper with the safety systems!

for your notes

Properties

The *Biofuge primo* is a laboratory centrifuge for use with a variety of rotors and a large number of commercially available centrifuge tubes.

The preset speed is reached in seconds. The maintenance-free induction motor provides quiet and vibration-free operation even at high speeds and warrants an extremely long lifetime.

The user-friendly "Easycontrol" control panel permits easy preselection of speed, RCF value, run time and run profile (acceleration and braking behavior). You can switch from speed to RCF display or entry and vice versa.

You can change the set values even during a run.

With the "quick run" key (▶) you can centrifuge a sample for only a few seconds if that is required for your particular task.

Items delivered

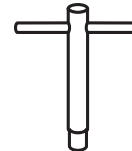
Items delivered with the centrifuge comprise:

- a special cap nut for fixing the rotor



cap nut
order no. 70056208

- 10-mm tubular socket wrench for fastening the cap nut



tubular socket wrench
order no. 2036 0072





- power cord

The printed documents consist of the delivery notes and this Manual.

Functions and features

Part / function	Description / feature
design / housing	galvanized sheet chassis with armored shell and plastic housing placed on top
tank	plastic
drive	induction drive without carbon brushes
key and display board	key and display elements covered by an easy-care protective foil
control	microprocessor-driven by Easycontrol II
program memory	the data last entered remain in memory
functions	RCF preselection, quick run
acceleration profiles	2 acceleration and 8 braking curves
rotor identification	automatic
unbalance detection	electronic, optimally adjusted for each rotor as a function of speed
lid lock	automatic locking upon pressing the lid shut

The "Easycontrol" user interface

Function	Feature
lid opening	electromagnetic release via "open lid" key  when mains supply OK (unlocking in case of power failure: see chapter "Troubleshooting")
start	start key ()
stop	stop key ()
short-term acceleration	"quick run" key (): short-term run when permanently pressed; stop upon key release
acceleration/braking profiles	1 = slow acceleration and slowest braking curve (2) 2 - 9 = fast acceleration and 8 different braking profiles
speed selection	adjustable in steps of 10 min^{-1} within the range of 300 min^{-1} to 15000 min^{-1}
RCF display	upon actuating the switchover key, the current RCF value is displayed
run time selection	adjustable in minutes from 1 min to 9 h 59 min; "hLd" mode: permanent operation
run time display in "quick run" mode	between 1 s and 60 s in seconds steps, above in minutes
end of run	speed display reads "End"

Function	Feature
diagnostic messages	<ul style="list-style-type: none">• incorrectly closed lid: display "OPEN"• general malfunction (error messages ERROR codes, see chapter "Troubleshooting")

Before use

Transport and installation

The centrifuge is delivered in a special box. Cut it open and remove the protective material.



Damage to the centrifuge by jolting!
Transport the centrifuge only in the upright position using the special box provided with the instrument and secure it properly. Place the centrifuge carefully.

Proper location

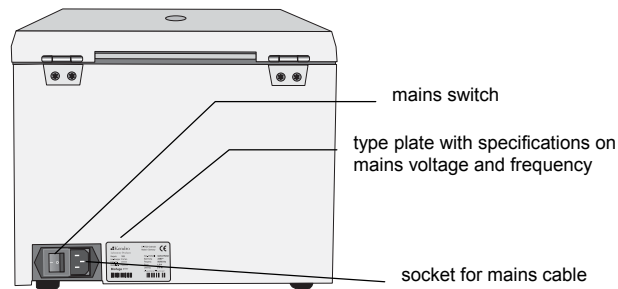
The location for the centrifuge must meet the following criteria:

- A safety zone of at least 30 cm around the centrifuge must be maintained where neither persons nor hazardous materials may be stationed during centrifugation.
- The substructure must be stable and resonance-free. A good support is provided by a plane laboratory bench or a large laboratory carriage with lockable casters.
- To ensure sufficient air circulation, a minimum distance from the wall of 10 cm at the back and of 15 cm on each side must be kept.
- The centrifuge must be protected from heat and direct sunshine.
- The location must be well ventilated at all times.

Mains connection

Make sure that voltage and frequency correspond to the specifications on the instrument label.

Turn the mains switch on the back panel off (press "0"); only then connect the centrifuge with the mains supply via the power cord.



Accessories

The *Biofuge primo* is delivered without rotor!

You may choose from among a large variety of rotors available as accessories (see Rotor program, Table 1).

In addition, there are sets of adapters and reduction sleeves for diverse commercially available vessels (see Adapters, Table 2).

Please consult our sales documentation for a complete collection of accessories including technical data and order numbers.

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



Rotor program

<i>Table 1: Rotor program (1)</i>			
Rotor designation	Highconic® rotor 6 x 50 ml	swinging bucket rotor 4 x 100 ml	drum rotor
order no.	75007588	75007591	75007595
	buckets and caps see Table 2		
maximum permissible load [g]	6 x 130	4 x 200	8 x 80
maximum speed n_{\max} [min^{-1}]	8500	4000	12 000
maximum RCF value at n_{\max}	10 016	2522	14 005
maximum radius [cm]	12.4	14.1	8.7
minimum radius [cm]	6.0	5.0	3.8
angle [°]	45	90	90 / 60
acceleration time [s]	55	25	40
braking time [s]	35	20	30
aerosol-tight ¹⁾	yes (reduced filling)	yes	no
permissible temperature range autoclavable (number of cycles)	– 121 °C; (unlimited)	– 121 °C; (unlimited)	– no

1) Checked by CAMR, Porton-Down, UK

<i>Table 1: Rotor program (2)</i>			
Rotor designation	microliter rotor 24 x 2 ml aluminium	microliter rotor 24 x 2 ml Polypropylene	PCR-rotor 4 x PCR-Strip
order no.	75007593	75007587	75007569
maximum permissible load [g]	24 x 4	24 x 4	4 x 4 (32 x 0,5)
maximum speed n_{\max} [min^{-1}]	15 000	13 000	13 000
maximum RCF-value at n_{\max}	21 882	16 060	12 846 (11 524) ²⁾
maximum radius [cm]	8.7	8.5	6,8 (6.1) ²⁾
minimum radius [cm]	5.9	5.9	6,1 (4.7) ²⁾
angle [°]	45	40	45
acceleration time [s]	40	15	15
braking time [s]	30	25	25
aerosol-tight ¹⁾	yes (reduced filling)	yes (reduced filling)	yes (reduced filling)
permissible temperature range autoclavable (number of cycles)	– 121°C; (unlimited)	–4 °C to +40 °C 121°C, (10 cycles)	–4 °C to +40 °C 121°C, (10 cycles)

1) Checked by CAMR, Porton-Down, UK

2) The values relate to vessel places 4 and 5 in the PCR-Rotor

Adapters

Table 2: Adapters (1)

Adapters for Highconic® rotor 75007588	max. vessel size ∅ x length [mm]	number per adapter	number per rotor	color	order no.
1.5 ml microvessels	11 x 57	4	24		7600 2905
3.5 ml	11 x 100	4	24		7500 3091
6.5 ml	13 x 113	2	12		7500 3092
12 ml	16 x 95	2	12		7500 3093
16 ml	18 x 122	1	6		7600 2906
38 ml	25 x 112	1	6		7500 3094
50 ml	29 x 122	1	6		7500 3014
15 ml Falcon	16.5 x 120	1	6		7500 3095
50 ml Falcon	30 x 117	1	6		7500 3096

Adapters for microliter rotor 75007587	max. vessel size ∅ x length [mm]	vessel capacity [ml]	number per set	color	order no.
reduction sleeve PCR	6.2 x 20	0,2	24	gray	7600 3750
reduction sleeve	8 x 43.5	0.5 / 0.6	24	turquoise	7600 3758
reduction sleeve	6 x 46	0.25 / 0.4	24	red	7600 3759

Table 2: Adapters (2)

Buckets and adapters for swinging bucket rotor 75007591	incl. rubber buffer	max. vessel size Ø x length [mm]	number per adapter	number per rotor	color	order no.
Roundbucket 100 ml/50 ml conical	1807	44 x 100	–	–	–	7500 7555
1.5 / 2 ml micro vessels		11 x 42	10	40	white	7500 7547
7 ml DIN	1818	12 x 102	5	20	white	7500 7545
7 ml DIN blood sampling	1818	13 x 105	3	12	white	7500 7546
15 ml DIN blood sampling	1803	17 x 102	3	12	white	7500 7544
25 ml DIN	1804	25 x 110	1	4	white	7500 7543
50 ml DIN	1805	35 x 105	1	4	white	7500 7542
adapters 50 ml - Falcon		30 x 117	–	–	–	7500 7556
adapters 15 ml - Falcon		16.5 x 120	1	4	white	7500 7557
Aerosol-tight caps						7500 7598



The rubber pads 76001807 are only to be used for centrifuging 100 ml glass containers.

Remove the rubber pads when using adapters.

Table 2: Adapters (3)

Racks for drum rotor 75007595			number per adapter	number per rotor	color	order no.
1.5 ml microvessels			10	80	yellow	7600 1499
1.5 / 2 ml microvessels			10	80	red	7600 1244
1.5 / 2 ml microvessels (60°)			6	48	white	7500 1498
0.3 ml microcapillary vessels			8	64	blue	7600 1246
0.5 / 0.6 ml microvessels			15	120	green	7600 1247
0.25 / 0.4 ml microvessels			20	160	yellow	7600 1248

Handling rotors

Swinging Bucket Rotors



All positions must always be loaded with identical carrier buckets!

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.

Lifetime of the rotor

There is no limitation on the service life of the high performance rotors. However please observe the following due to safety reasons:



Rotors and accessories made of plastic should not be exposed to direct sunlight and UV rays!

If the rotor shows signs of discoloration, deformation or wear, or is out of balance it must be exchanged straight away!

Permissible rotor temperature



The rotors made of plastic are only to be used within the temperature range from -4°C to +40°C.

Pre-cooling in the freezer is not permitted

Highconic® - rotor



You must always equip all sample locations with adapters!



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!

Drum rotor



You must always equip all sample locations with adapters or sample racks!



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 bio-containment.



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!

Replacements parts are delivered with the rotor or can be ordered separately as spare part package.

- **75003058** for the Highconic® rotor 75007588
- **75003404** for the Mikroliter rotor 75007593
- **75003268** for Mikroliter rotor 75007587 and PCR-rotor 75007569



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

Attention :

Please check that your sample containers are suitable for the centrifugal application desired.

(16060 x g ; temperature in uncooled devices approx. 10 K above room temperature)

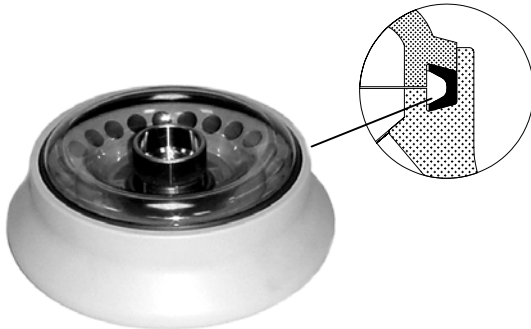
Mikroliter rotor 75007587 and PCR-rotor 75007569



Aerosol density applications are permissible only with closed container caps!

The following steps have to be carried out:

- Lubricate the seals before inserting them (lubricant order no. 75003500)
- Insert the seal (C profile) in the groove at the side of the body of the rotor.
- Insert the O-ring into the inner groove on the screw-on top.



Loading for aerosol-tight operation



For the centrifugation of hazardous samples you must always respect the highest permissible sample amounts.

Aerosol-tight operation presupposes that sample vessels are properly filled and the rotor lid is correctly closed.

The vessels may generally be filled only to a point where the sample cannot reach the vessel rim during centrifugation. For the most commonly used vessels, the maximum allowed volumes are listed in the table.

Rotor	vessel type / maximum filling volume			
microliter rotor 24 x 1,5 ml 75007593	Reakt 1,5 ml 1,0 ml	Reakt 2,0 ml 1,5 ml		
microliter rotor 24 x 2,0 ml 75007587	Reakt 1,5 ml 1,0 ml	Reakt 2,0 ml 1,5 ml		
Highconic® rotor 6 x 50 ml 75007588	Falcon 50 ml 49 ml	Falcon 15 ml 14 ml		
swinging bucket rotor 75007591	Glas 100 ml 80 ml	Glas 50 ml 45 ml		
	others: - 2/3 nominal volume			

- Reakt – reaction vessel
- Falcon – bucket type Falcon
- Glas – glass vessel

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.

Operation

Switching on the centrifuge

Turn on the mains switch at the back of the instrument.
For a couple of seconds the following reading appears in the control panel:



This tells you that the instrument carries out an internal check of its software. (see table on page 54).

After this check the display switches to the actual values. The values for the remaining run time and speed both read 0 (default value is speed). The display of the acceleration/braking curve depends on the value last set.

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



Opening the

Press the "open lid" key .

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

Closing the lid

The centrifuge is closed by slightly pressing down the front part of the lid.



Do not slam the lid shut!

Inserting the rotor



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

The rotors approved for the *Biofuge primo* are detailed in the chapter "Accessories". Use only rotors with this instrument that are contained in this list.

To insert the rotor, you need the rotor, the cap nut and the tubular socket wrench supplied (see chapter "Accessories – items delivered").



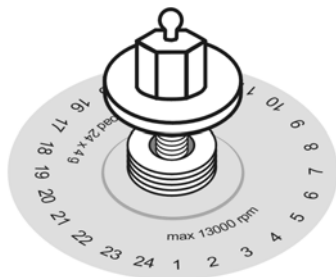
Possible damage to drive and rotor!

You may insert the rotor only if the temperature of the drive, the rotor and the cap nut is between 10 °C and 30 °C.

Proceed as follows:

1. Open the lid and make sure that the rotor chamber and the rotor are clean. Remove eventual dust, foreign material or sample residues. The thread and the O-Ring on the motor shaft must be in perfect condition.
2. Turn the rotor so that the notch for engaging the drive shaft points downward.
3. Place the rotor on top of the drive shaft so that the notch of the rotor is located precisely above the retaining pin.

4. Push the rotor gently down until the thread is completely laid bare (see figure).



5. If you have placed the rotor correctly, you can screw on the cap nut easily and secure it with the tubular socket wrench delivered with the instrument.



Do not push the rotor down using force. If you cannot screw on the cap nut, you must carefully lift off the rotor and insert it again.

6. Place the rotor cap onto the rotor.



Regularly check the proper positioning of the rotor and re-tighten the cap nut as needed.

Loading the rotor

Maximum loading



Overloading may cause the rotor to explode! Exploding parts may severely damage the centrifuge!

The *Biofuge primo* can reach high rotational speeds implying enormous centrifugal force. The rotors are designed in a way warranting 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.

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:

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

Filling the centrifuge tubes



Please note that plastic sample vessels only have a limited service life - particularly when used at maximum rpm or temperature - and must be replaced as necessary!



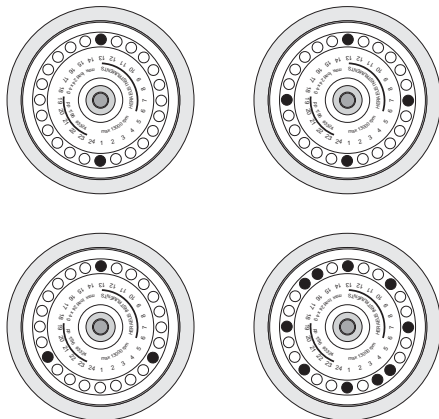
Check carefully whether your sample vessels are permissible for the respective *g* value and reduce the speed if necessary.

The smaller the unbalance of the centrifuge, the better the separation since separated zones are no longer perturbed by vibration. It is therefore important to balance the centrifuge tubes as well as possible.

To minimize unbalance you should fill the tubes as evenly as possible. You can achieve this by eye. However, you must nonetheless ensure that opposite tubes are filled to the same level.

Placing the tubes in the rotor

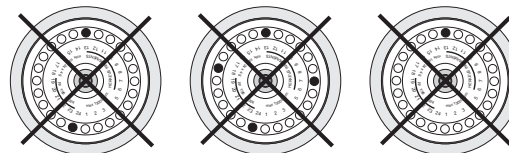
The rotor must be loaded symmetrically. When loading the rotor only partially, you must ensure that opposite bores always receive tubes of equal weight (when centrifuging a single sample, place a centrifuge tube e.g. filled with water opposite). The following figure gives examples for proper loading.



properly loaded rotors



Uneven loading can in the extreme case lead to actuation of the unbalance detection. Unbalance not only causes a noisy run, but also rapidly damages the motor suspension.



improperly loaded rotors

These examples are to be applied to the other rotors in an analogous manner!

After placing the tubes, close the rotor lid.


Close the centrifuge lid by firmly pressing it down. The lid must snap audibly into place so that it cannot be opened manually any more.

Entering parameters

Braking curves

The *Biofuge primo* offers a total of 9 centrifugation profiles for gently centrifuging sensitive samples and gradients. Please consult the Appendix for a graphic representation of the acceleration and braking curves.

After switching the centrifuge on, the centrifugation profile last entered is preselected.

By pressing the "set" key  you can switch through the subsequent braking profiles 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 and vice versa



Upon turning on the centrifuge, the speed display is the default setting.

Use the speed/RCF display switch to choose between speed and RCF entry or display.



Selecting the speed

The centrifuge can be set to a minimum of 300 and a maximum of 15 000 min^{-1} (depending on the rotor).

You can adjust the speed in steps of 10 min^{-1} . Proceed as follows:

1. By pressing once one of the "set" keys  (for an increase) or  (for a decrease) in the "speed" section of the control panel, you switch from actual to setpoint values. The value last stored is displayed, with the digit to be entered flashing (if there is no value stored in memory, this is indicated by dashes -----).
2. By **briefly** pressing the input key you can now raise or lower the speed by one step (10 min^{-1}).
3. If you keep the key pressed, the display changes at first slowly and after a few seconds at an accelerated pace.
4. Release the key as soon as you have reached the desired value, and fine tune if necessary by repeatedly pressing the key. The decimal place flashes for a number of seconds, then changes to permanent display. The speed is now stored.



5. For faster operation, you may shift the flashing cursor in the speed/RCF and in the run time panels: just press both  and  simultaneously. The cursor moves by one digit to the left for each key depression.

Entering the RCF value

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

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

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

NOTE:

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

Concerning the RCF value

The relative centrifugal force (RCF) is given in multiples of the earth gravity g . It is a dimensionless number that allows one to compare 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 is based on the maximum radius of the vessel bore.



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



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

Selecting the run time

You can select a run time between 1 min and 9 h 59 min or continuous operation (hLd).

Preselected 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 "time" section of the control panel once to switch from the actual to the set-point mode.
2. By **briefly** pressing the input key you can now raise or lower the run time in 1-minute steps.




3. If you keep the selected key pressed, the display changes at first slowly and after a few seconds at an accelerated pace.

4. Release the key as soon as you have reached the desired value, and fine tune if necessary by repeatedly pressing the key.

The minute display flashes for a number of seconds, then changes to permanent display. The run time is now stored.

You may shift the flashing cursor to set the value as described under "Selecting the speed".


Continuous operation

To switch the *Biofuge primo* to the continuous mode, you must press the key  until the display reads "hLd".

With this setting, the centrifuge keeps running until stopped manually.

Starting the centrifuge

Once the rotor is properly placed, the mains switch is turned on and the lid is closed, you can start the centrifuge.

Press the "start" key  in the control panel. The centrifuge accelerates to the preselected value. Simultaneously, the run time display starts going backward from the preset time, at first giving the remaining run time in minutes and upon reaching the last minute in seconds (in 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 pressing the "start" key; the centrifugation is then continued. Otherwise the centrifuge stops, and you must enter a permissible value.

You cannot open the lid during the run.

Unbalance detection

In case there is an unbalance in the rotor, this is indicated at a speed slightly exceeding approximately 300 rpm by the message "bAL".

The run is terminated, and you may restart the centrifuge after correcting the error (check loading).

Changing the settings during the run


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


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

Stopping the centrifuge

Stopping with preset time



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

As soon as the speed is down to zero, the display reads "End". You can now open the centrifuge by pressing the "open lid" key  and remove your samples.

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


At this point the remaining run time is displayed.

Stopping with continuous operation

If you have chosen continuous operation, you must stop the centrifuge manually. Press the "stop" key  in the control panel. The centrifuge starts braking with the preset braking profile. The display reads "End", and you can open the lid by pressing the "open lid" key  and remove your samples.

Short-time centrifugation

For short-term operation, the *Biofuge primo* 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 with full power up to the maximum speed. The preset speed or RCF is ignored in this case.



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

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

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

Removing the rotor

To remove the rotor, you must follow the steps described for insertion in reverse order.



Grab rotor with both hands and pull upwards perpendicularly.

1. Open the centrifuge lid.
2. Remove the rotor lid.
3. Unscrew the cap nut by turning it counterclockwise using the socket wrench supplied, and remove the cap nut.
4. Grab the rotor with both hands and lift it carefully off the drive shaft. Make sure not to tilt it.

When using an aerosol-tight lid, you may in case of contamination separate the pertinent rotors from the drive shaft without opening the lid!

for your notes

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 Services!

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.

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.



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!

To protect the rotor 75007587 and 75007569 as far as possible you must take the following precautions:

1. Avoid high temperatures!
The bleaching solution and the rotor should not be warmer than ca. 25 °C.
2. Do not let the bleaching solution act longer than absolutely necessary!
3. After disinfection, rinse the rotor thoroughly with distilled water and allow to dry.

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!

You may autoclave the rotor and the adapters at 121 °C.

Maximum permissible autoclaving cycle: 20 min at 121 °C.



For reasons of safety you may autoclave the rotor 75007587 and 75007569 maximally 10 times!

The rotor must be cleaned and rinsed with distilled water before being autoclaved. Remove the rotor lid, the centrifuge tubes and the adapters. Place plastic rotors on an even surface to avoid deformation.



Chemical additives to the steam are not permitted.



Never exceed the maximum permissible values for autoclaving temperature and autoclaving time.

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

The KENDRO service offer

Kendro Laboratory Products recommends annual servicing of the centrifuge and the accessories by authorized customer service or trained professionals. The customer 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 you cannot open the lid normally using the normal electrical lid unlocking mechanism. To permit unloading even in this case, the centrifuge is equipped with a manual lid unlocking system. However, you may use this system **only** in case of emergency.



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

Always wait for several minutes until the rotor has come to a complete stop. Without power the brake does not function, and braking takes much longer than normal!

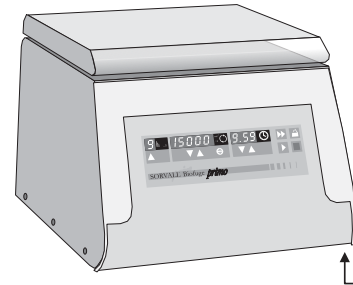
Proceed as follows:

1. Make sure the rotor stands still (consult window in the lid).



Never brake the rotor using your hands or tools!

2. Unplug the mains plug.
3. Behind the right-hand front base there is a plastic plug that you can pry out of the bottom plate using a screw driver or a knife. By pulling the attached rip cord you can activate the mechanical lid unlocking mechanism.



Troubleshooting

4. If the rotor still turns, close lid immediately and wait until it has come to a complete stop
5. As soon as the rotor stands still, remove your samples and close the lid.

Finally, push the rip cord back into the instrument and close the opening with the plastic plug.


Problems you can handle yourself




If problems other than those described in the following tables arise, you must consult the authorized service.

Error	Behavior of the centrifuge	Possible cause(s) and measures to be taken
Displays remain dark	The motor stops. The rotor stops without braking. The lid cannot be opened.	<p>Mains failure or not connected</p> <ol style="list-style-type: none"> 1. Is the mains plug connected to the mains socket? 2. Check the mains connection. 3. If the mains connection is OK, call the nearest Service.
Displays fail briefly.	The motor stops suddenly. The rotor stops without braking. The display reads E-14.	<p>Brief interruption of mains supply</p> <ol style="list-style-type: none"> 1. Turn off mains switch. 2. Check whether the plug is plugged in properly. 3. Restart the centrifuge.

Troubleshooting

Error	Behavior of the centrifuge	Possible cause(s) and measures to be taken
Lid cannot be opened.	Pressing the "open lid" key has no effect.	<p>A) Lid not correctly engaged or lid warped.</p> <ol style="list-style-type: none"> 1. Check whether mains connection is OK and the instrument switched on (displays lit). 2. Press lid down in the middle of the front section once, and actuate the "open lid" key anew. 3. If this is unsuccessful, you may open the lid using the emergency lid release (see page 45). <p>B) Heat monitoring relays of the lid unlocking mechanism have been actuated</p> <p>Press key again after a short pause (approx. 1 min).</p>
-	Centrifuge is exceptionally noisy.	<ol style="list-style-type: none"> 1. Stop the centrifuge by pressing the "stop" key , in case of emergency pull mains plug. 2. Wait until the centrifuge stands still. 3. Check whether the rotor is properly loaded. 4. Check whether a broken vessel, damage to the rotor or motor malfunction was responsible for the noise. <p>If you cannot locate and solve the problem, call Service.</p>

Error	Behavior of the centrifuge	Possible cause(s) and measures to be taken
<p>Message "bAl" appears in display.</p>	<p>Rotor stops without braking.</p>	<p>Unbalance switch actuated</p> <ol style="list-style-type: none"> 1. Open the instrument by pressing "open lid" key . 2. Check whether the rotor is properly loaded. 3. Check whether a broken vessel or damage to the rotor was responsible for unbalance switch actuation.
<p>Message "rotor" appears in display.</p>	<p>Rotor decelerates with brake on.</p>	<p>Set speed exceeds permissible maximum speed for the rotor in question. (The same holds for RCF setting)</p> <ol style="list-style-type: none"> A) For about 15 sec. the display shows alternately "rotor" and the maximum permissible speed for the inserted rotor. Within this period, it is possible to adopt this value by again pressing the "start" key. The centrifugation is then continued. B) Following onset of braking 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 anew.


Troubleshooting

Error	Behavior of the centrifuge	Possible cause(s) and measures to be taken
<p>Display "OPEN" appears although lid is closed .</p>	<p>Start impossible.</p>	<p>A) Lid not properly closed Press the front of the lid firmly down.</p> <p>B) Overtemperature protection of the motor has been triggered.</p> <ol style="list-style-type: none"> 1. Pull mains plug. 2. Check and clean if necessary the ventilation slots underneath the instrument. 3. You may restart the instrument after 20 min. <p>If the safety circuit is triggered again, you must call our Service.</p>
<p>Message "Lid" appears in the display.</p>	<p>Drive stops. Rotor coasts to rest.</p>	<p>A) Lid was opened manually during the run.</p> <ol style="list-style-type: none"> 1. Press the lid shut again. The instrument stops without braking. 2. If you want to continue the run, you must switch the instrument off and on again.. <p>B) Overtemperature protection of the motor has been triggered.</p> <ol style="list-style-type: none"> 1. Pull mains plug. 2. Check and clean if necessary the ventilation slots underneath the instrument. 3. You may restart the instrument after 20 min. <p>If the safety circuit is triggered again, you must call our Service.</p>

Error	Behavior of the centrifuge	Possible cause(s) and measures to be taken
E-00	Motor does not start.	<p>Motor or rotor blocked.</p> <ol style="list-style-type: none"> 1. Switch instrument off and on again using the mains switch. 2. Open the lid. 3. Check whether the rotor can turn freely. <p>If you cannot thus relieve the malfunction, call our Service.</p>
E-02	Rotor stops without braking to standstill. Instrument cannot be operated.	<p>Internal program error in memory</p> <p>Switch the instrument off and on again. If the error persists, call our Service.</p>
E-03	Rotor stops without braking to standstill. Instrument cannot be operated.	<p>Error in speed measurement</p> <p>Switch the instrument off and on again. If the error persists, call our Service.</p>
E-06	Rotor stops without braking to standstill. Instrument cannot be operated.	<p>Communication error between keyboard and main processor.</p> <p>Switch the instrument off and on again. If the error persists, call our Service.</p>
E-08	Rotor stops without braking to standstill. Instrument cannot be operated.	<p>Overvoltage at the U/F converter</p> <p>Mains voltage outside tolerance. Brake resistance defective. Call Service if trouble persists.</p>

Troubleshooting

Error	Behavior of the centrifuge	Possible cause(s) and measures to be taken
E-10		NV-RAM; error in program memory Switch the instrument off and on again. If the problem persists, call Service.
E-14	Instrument does not start or brakes to standstill.	No rotor present or rotor identification impossible A) Check whether a rotor is inserted. B) Following a brief power failure, the rotor could not be identified. Switch the instrument off and on again using the mains switch. C) Phases at the motor mixed up.
E-15	Rotor stops without braking to standstill. Instrument cannot be operated.	Check sum in NV-RAM wrong.
E-17	Lid does not open.	Lid blocked or jammed. Press the front part of the lid centrally down once, and press the "open lid" key anew. Otherwise see "Emergency lid release"
E-19		Wrong NV-RAM or keyboard
E-22		NV-RAM parameter incompatible with processor

Error	Behavior of the centrifuge	Possible cause(s) and measures to be taken
E-24		NV-RAM 2 absent
E-25	Rotor stops without braking to standstill.	<p>Start without rotor.</p> <ol style="list-style-type: none"> 1. Turn instrument off and on again. 2. Open the instrument by pressing the "Open lid" key . 3. Check whether the rotor is loaded and placed correctly. 4. Check whether a broken vessel or a damaged rotor was responsible for actuating the unbalance switch. <p>If the error persists, call Service.</p>

In case you must call the Service

Should you require our Service, please tell us the order no. and serial number of your instrument. You find the pertinent information at the back of the instrument near the socket for the mains plug.

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

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

All displays read 8.88888... for about one second.

Subsequently, the display may read e.g. the following readings for 2 seconds each:

Software version keyboard	__597	__2
Software version	__590	__6
NV-RAM version 1	__2577	__7
NV-RAM version 2	__2572	__2

The values in the time panel give the development stage.

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

Function/parameter	Value
environmental conditions	<ul style="list-style-type: none"> - indoor use - max. elevation 2000 m above sea level - max. relative humidity 80 % up to 31 °C; linearly decreasing down to 50 % relative humidity at 40 °C.
permissible temperature of the environment	+2 °C to +40 °C
run time	1 min - 9 h 59 min, hold = permanent operation
maximum speed n_{\max}	15 000 min^{-1} (rotor-dependent, adjustable in steps of 10)
minimum speed n_{\min}	300 min^{-1}
maximum RCF value at n_{\max}	21 885
maximum kinetic energy	<10 kNm
noise at maximum speed	< 62 dB (A)
maximum sample temperature after 30 min permanent operation	room temperature + 15 K
dimensions (H x W x D)	315 mm x 380 mm x 475 mm
weight without rotor	40 kg

Technical data

Function/parameter	Value
Testing standards - all devices manufactured and examined in agreement also: - for 120 V only - for 230 V only	IEC 61010-1:1990 + amendment 1:1992 + amendment 2:1995 IEC 61010-2-020:1993 + amendment 1:1996 - Pollution degree 2, - Overvoltage category II CAN/CSA-C22.2 No. 1010-1.92 CAN/CSA-C22.2 No. 1010-1.B97 amendment 2 UL 3101-1 (pending) EN 292 EN 61 010-1, EN 61 010-2-020 EN 61326, EN 55011 B

Electrical connections/fuses

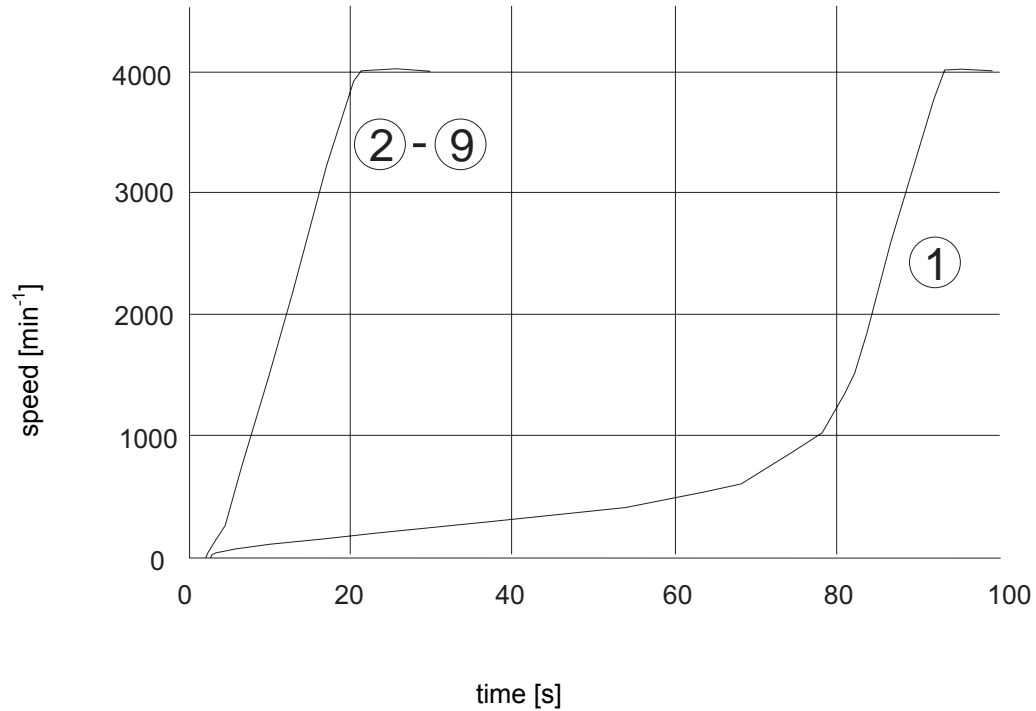
Order no.	Voltage	Frequency	Nominal current	Power consumption	Fuses inside instrument *
7500 5185	230 V	50/60 Hz	2.4 A	310 W	2 x 4 AT (5 x 20 mm)
7500 5184	120 V	60 Hz	4.5 A	310 W	2 x 8 AT (6.3 x 32 mm)
7500 5186	100 V	50/60 Hz	4.9 A	310 W	2 x 8 AT (6.3 x 32 mm)

* The fuse may be replaced only by authorized servicing personnel!

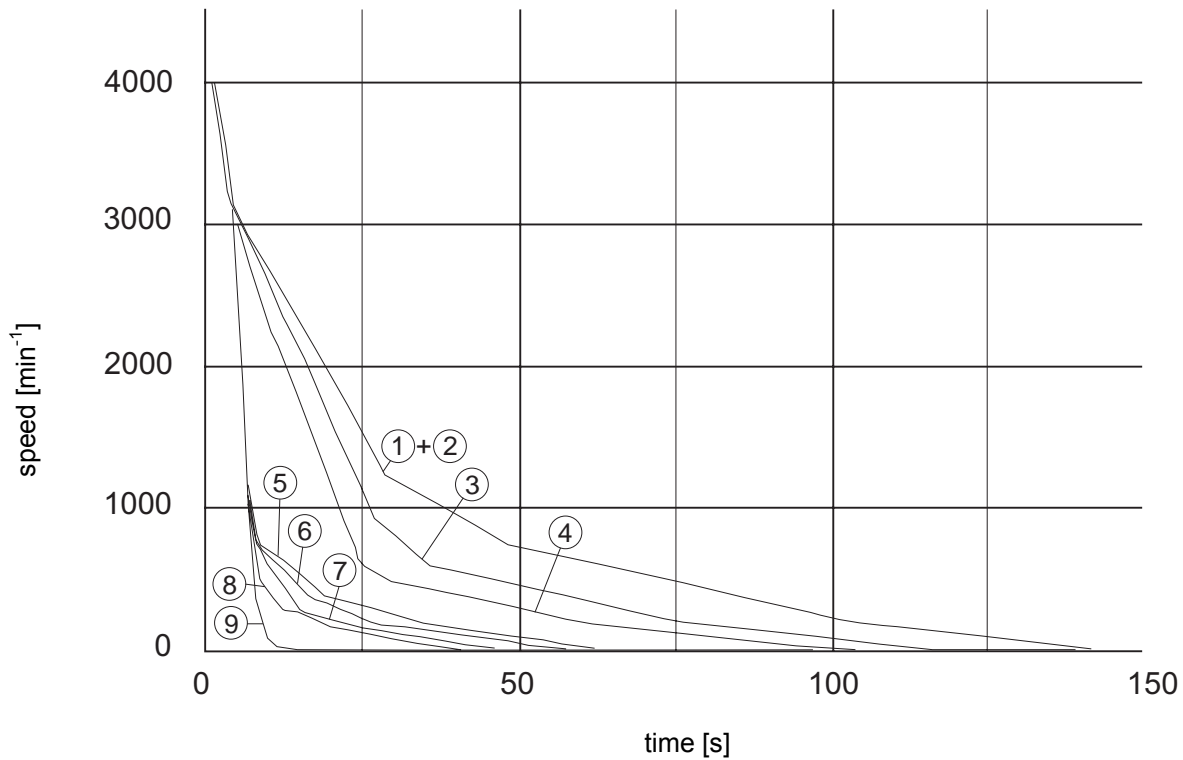
Appendix

Braking and acceleration curves

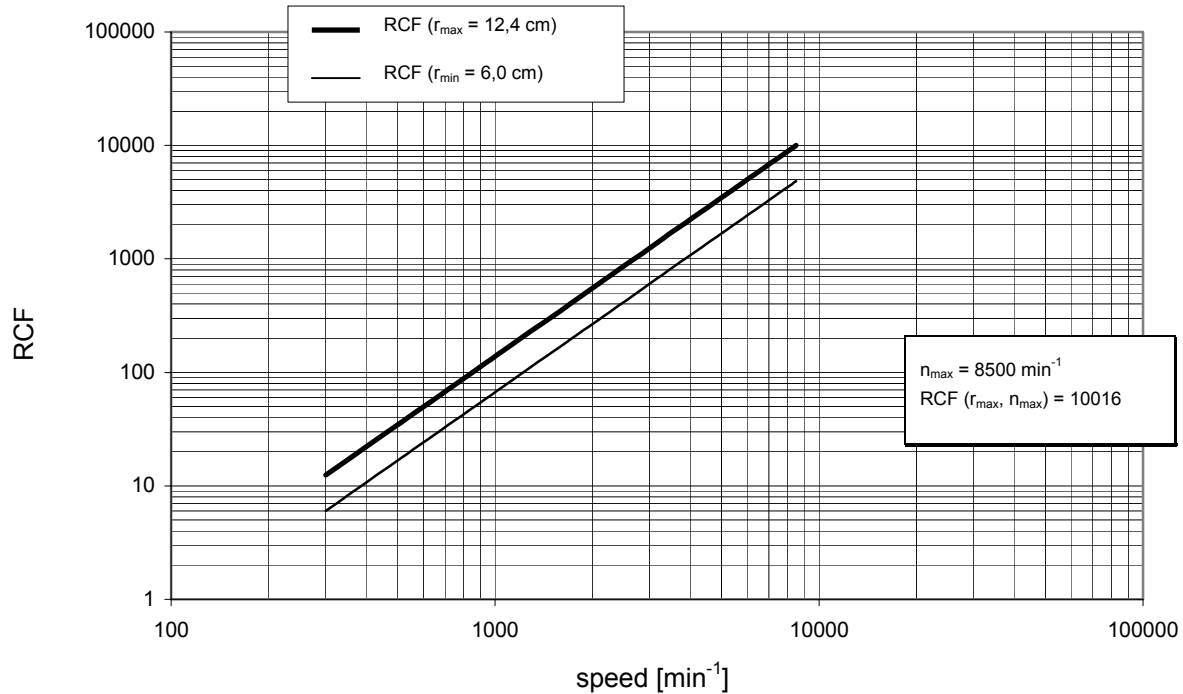
Acceleration curves



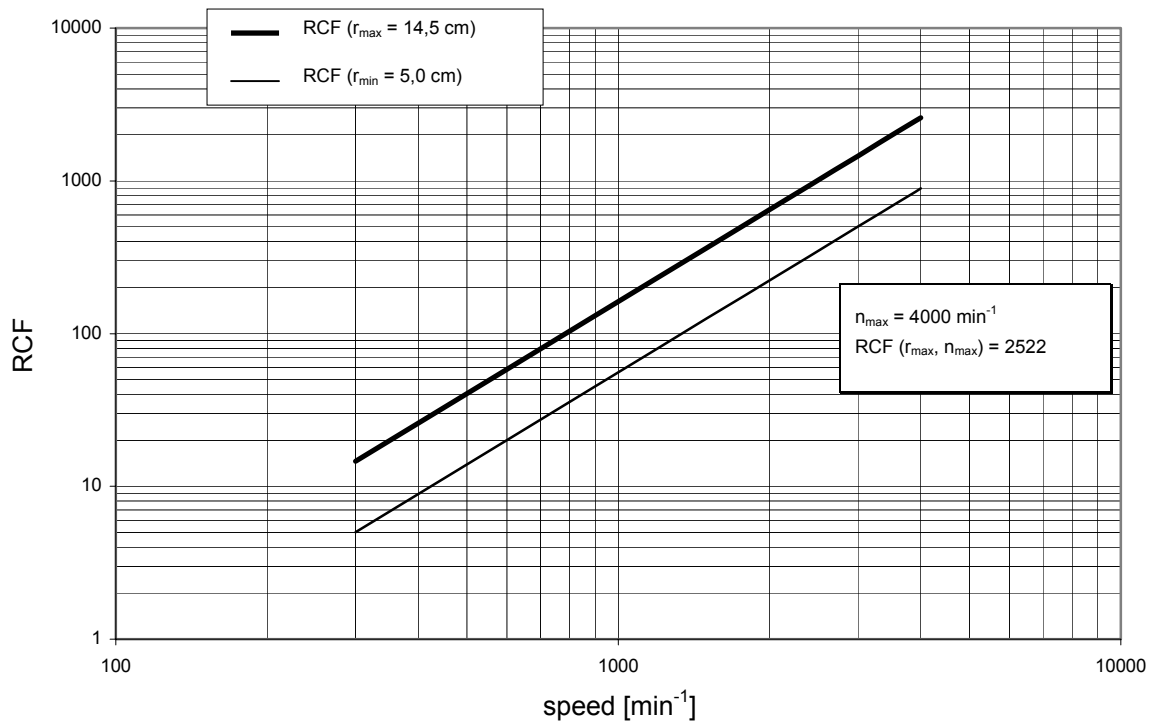
Braking curves



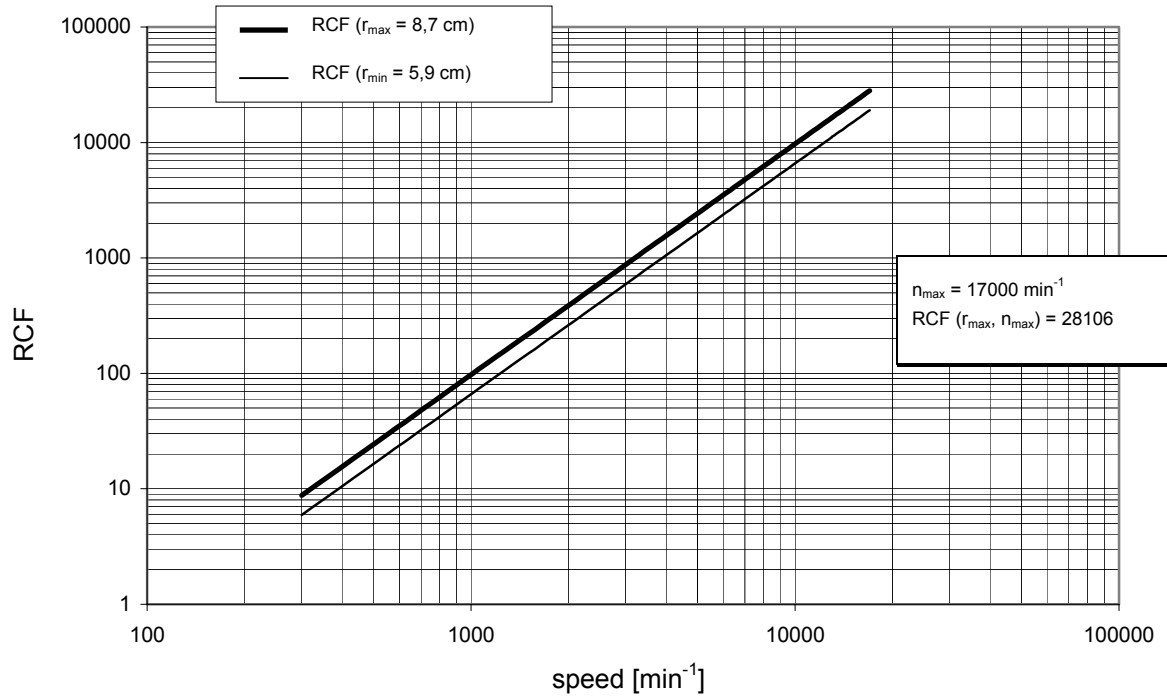
Speed / RCF diagrams

75007588 Highconic[®] rotor 6 x 50 ml

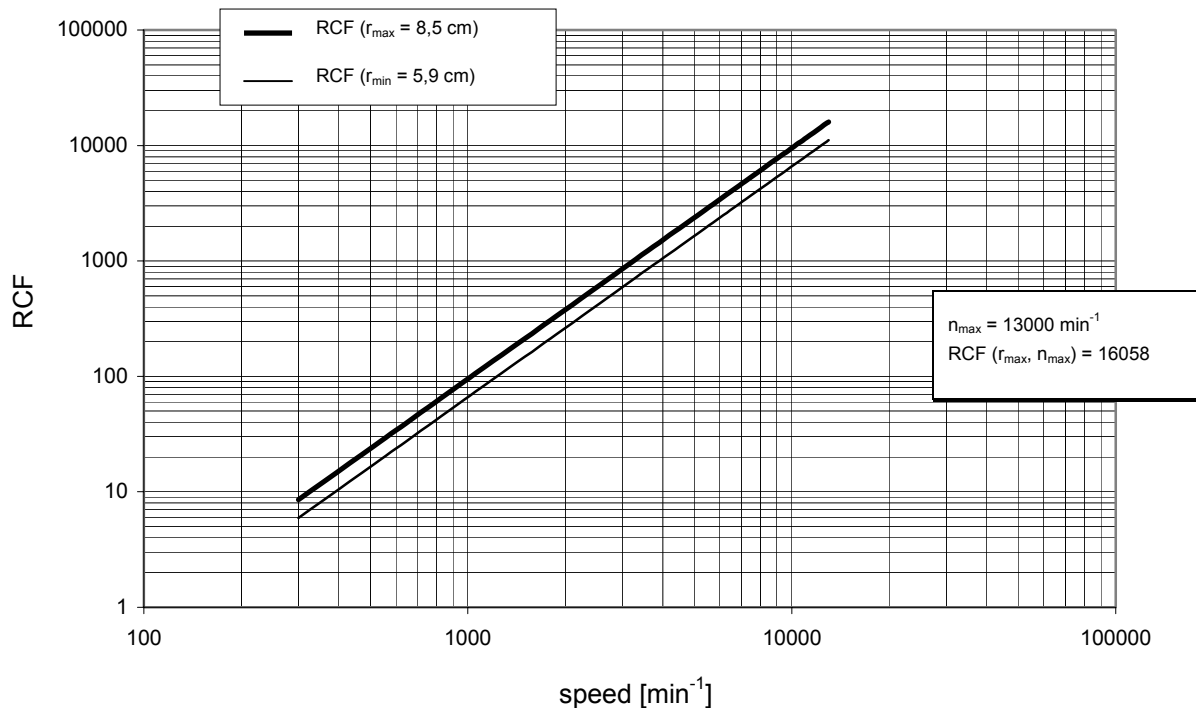
75007591 swinging bucket rotor 4 x 100 ml



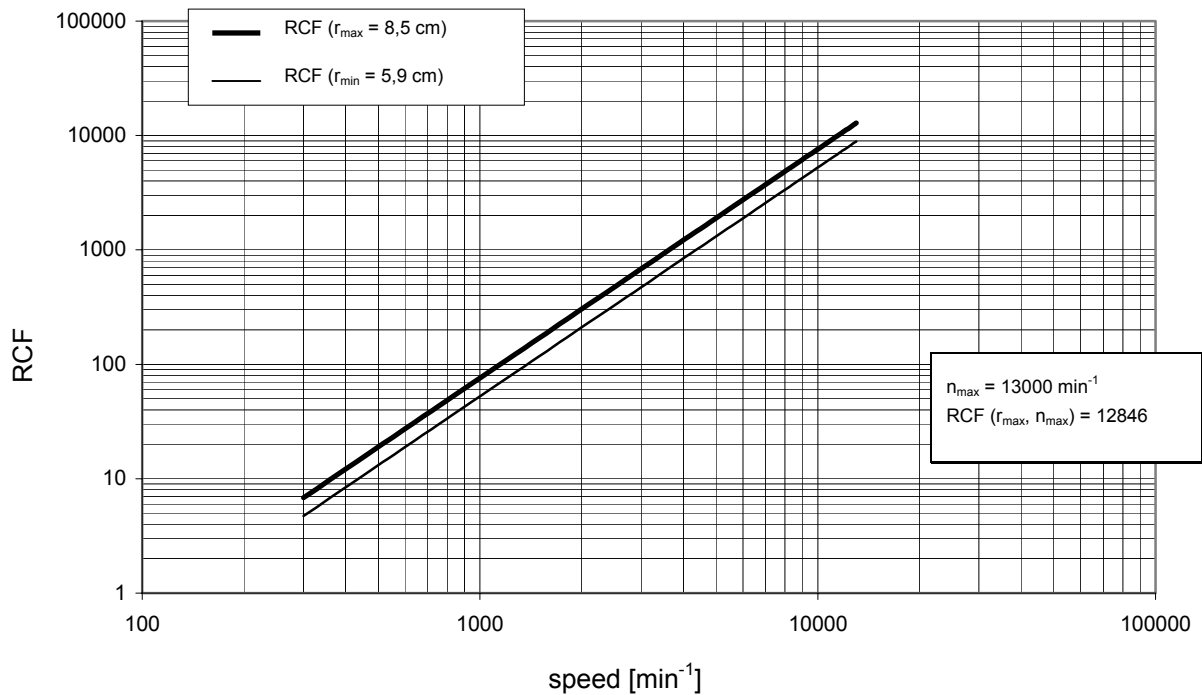
75007593 fixed-angle rotor 24 x 1.5 / 2 ml



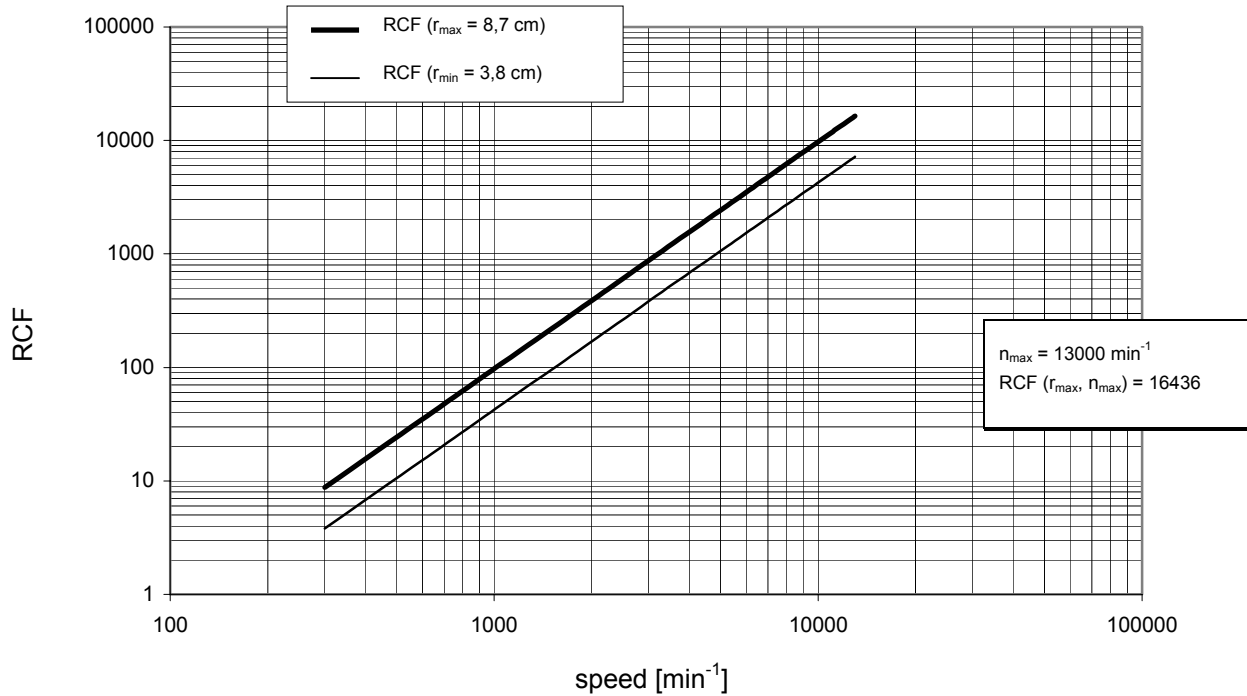
75007587 microliter rotor 24 x 1.5 / 2 ml



75007569 PCR-rotor



75007595 drum rotor 80 x 2 ml



Autoclaving protocol				
	Date	Remark	Operator	Signature
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

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