LORDERAN LABORATORY CENTRIFUGE SERIES

USER MANUAL

High-Speed Refrigerated Centrifuge

Installation · Operation · Programs · Maintenance



25,000 rpm
MAX. SPEED (BH2500R)

64,983 × g
MAX. RCF (BH2500R)

−20 → +40 °C
TEMPERATURE RANGE

4 × 1000 ml
MAXIMUM CAPACITY

Floor-standing | Touch screen | Continuous flow | BH2500R | BH2300R

Applies to the LORDERAN BH2500R / BH2300R High-Speed Refrigerated Centrifuges and their rotors, buckets and adapters.

www.lorderan.com

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BEFORE YOU BEGIN

About this manual

BEFORE YOU BEGIN

- Read this manual carefully and make sure you understand all of it before you install, operate or maintain the centrifuge.
- Keep the manual close to the instrument, where every operator can reach it.
- The content of this manual may be revised for functional upgrades without prior notice.
- If you have any questions, contact LORDERAN at **support@lorderan.com**.

Introduction

This manual is written for the people who install, operate and look after the LORDERAN BH2500R / BH2300R High-Speed Refrigerated Centrifuges. It explains how to set the instrument up, how to fit and load a rotor, how to run single-step and multi-step programs from the touch screen, and how to keep the centrifuge and its rotors in safe working order. Where the models differ, the text and tables say so.

First-time users should read Chapters 1 to 5 in full before the first run. Experienced users will find the essentials on one page in the **Quick Start**, and the key numbers in Appendix A.

What this centrifuge does

A centrifuge separates the components of a liquid sample by spinning it. The spin creates a **relative centrifugal force (RCF)**, expressed as a multiple of the earth's gravity (× g). Particles that are denser than the surrounding liquid move outwards and form a pellet; lighter components stay in the supernatant. The BH2500R reaches up to 25,000 rpm and 64,983 × g, the BH2300R up to 23,000 rpm and 60,900 × g. Both take fixed-angle rotors from micro tubes up to 4 × 1000 ml, swing-out rotors and continuous-flow rotors, and hold the chamber between -20 °C and +40 °C. Typical tasks are nucleic-acid and protein preparation, subcellular fractionation, large-volume harvesting of cells and bacteria, and continuous-flow separation.

Labels on the instrument

Label	Name	Meaning
	Danger “Electrical hazard”	Live parts inside. Covers may only be removed by qualified service personnel after the power has been disconnected. Connect the instrument only to an earthed (grounded) supply.
	Warning “Read the safety instructions”	Read the related text in this manual before you operate the instrument, and follow it.
	Mandatory “Read the manual”	Read the user manual before the first use.
	Protective earth	Marks the protective earth connection. Never use a supply without an earth conductor.

Safety symbols used in this manual

Symbol	Type	Meaning
	Danger	An imminently hazardous situation that will cause death or serious injury if it is not avoided.

Symbol	Type	Meaning
	Prohibited	An action that must never be carried out.
	Notice	A situation that may cause minor injury or damage to the instrument, the rotor or the samples.
	Must do	An action that must be carried out.
	Note	Additional information that helps you operate the instrument correctly.
	Tip	A practical recommendation from LORDERAN application experience.

Scope and documentation set

Document	Contents
User Manual (this manual)	Safety, installation, operation, programs, settings, troubleshooting and maintenance of the BH2500R / BH2300R.
Packing list	The rotor(s), buckets, racks and adapters actually supplied with your order. Check it against the delivery (Section 2.2).
Datasheet	Specifications and rotor data, available from www.lorderan.com.

How this manual is organised

Part	What it covers	Read it
Chapter 1 · Safety	Hazards of a spinning rotor, prohibited samples, biosafety	Before anything else
Chapter 2 · Installation	Unpacking, site, power supply, first power-on	Before the first run
Chapter 3 · Instrument Overview	Specifications, rotors, parts, the touch screen	Before the first run
Chapter 4 · Centrifugation Essentials	RCF and rpm, balancing, fill levels, ramps, temperature	Before the first run
Chapter 5 · Operation	Fitting the rotor, setting and starting a run	Every day
Chapter 6 · Programs	Presets, multi-step programs, batch numbers	When needed
Chapter 7 · System Settings and Records	Settings, pre-cooling, clock, run history, USB export	When needed
Chapter 8 · Troubleshooting	Alarm messages, faults and remedies, emergency lid release	When a problem occurs
Chapter 9 · Care and Maintenance	Cleaning, rotor care, transport, storage, disposal	Weekly / as scheduled
Appendices A – F	Quick reference, alarm index, logs, checklists, glossary, warranty	Any time

QUICK START

Your first run in eight steps

This page is a summary for trained operators. It does not replace Chapters 1 to 5. The section number on each card tells you where to find the details.

1

Switch on

Push the power breaker on the right-hand side up to ON. The display shows the last settings. **5.1**

2

Open the lid

Tap **Open** and lift the lid with both hands; the gas struts hold it. **5.1**

3

Fit the rotor

Lower it straight onto the drive and fix it as described for your rotor type. **5.2**

4

Balance the load

Equal mass (±1 g) in opposite positions. Max. fill 80 % (angle) / 90 % (swing). **4.2**

5

Close the lid

Press down until the lock clicks; lift gently to check. **5.3**

6

Set the run

Rotor No., speed or RCF, time, temperature, ACC / DEC. **5.4**

7

Start

Tap **Start**. Stay until full speed is reached and the run is quiet. **5.5**

8

Unload

After the beep and a full stop, open the lid and remove the samples. **5.6**

NEVER

- Run an unbalanced or asymmetrically loaded rotor.
- Exceed the maximum speed of the rotor, bucket, adapter or tube — the lowest of them applies.
- Select a rotor number that does not match the installed rotor.
- Spin flammable, explosive or strongly reactive samples.
- Open the lid with the emergency release while the rotor is turning.

GOOD HABITS

- Pre-cool the chamber and rotor before cold runs (Section 4.5).
- Use RCF (× g) instead of rpm in your protocols — it transfers between rotors.
- Remove the rotor and wipe the chamber dry at the end of the day.
- Log every run of a rotor; rotors have a service life (Section 9.3).

The main screen at a glance



- **Left:** rotor number and its maximum speed — tap to change the rotor.
- **Centre:** speed, time and temperature — small figures are set values, large figures are actual values.
- **Right:** Jog, Pre-cool, Speed / RCF and Step mode.
- **Bottom:** Preset, Batch, ACC / DEC, Start and Open.
- **Gear icon:** System Settings.

Full description: Section 3.5.

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CHAPTER 1

Safety Precautions

A loaded rotor at 25,000 rpm stores a large amount of kinetic energy. Almost every centrifuge accident has the same few causes: an unbalanced load, an overloaded, damaged or over-age rotor, a wrong rotor number, a wrong sample, or a lid opened too early. This chapter explains how to avoid them. Read it before you use the instrument, and make sure every operator has read it.

1.1 General Safety Guidelines

- Only trained and authorised persons may operate the centrifuge. Keep a record of who uses it; LORDERAN recommends that one person is responsible for the instrument.
- Do not operate or service the instrument before you have read and understood this manual.
- Use the instrument indoors only. Connect it only to a supply with a protective earth conductor that matches the rating plate (AC 220 V ±10 %, 50 Hz, single phase, three-wire). Never use the neutral conductor as the earth, and never share the earth.
- Use only rotors, rotor lids, buckets, adapters and accessories approved by LORDERAN for the BH2500R / BH2300R. If you want to use a third-party accessory, ask LORDERAN to confirm that it is suitable before you use it.
- Check the rotor, lid, buckets and tubes before every run. Never use a part that is corroded, scratched, cracked or deformed.
- Do not lean on the instrument, place objects on the lid, or move the instrument while the rotor is turning.
- Keep a **safety zone of at least 50 cm** around the centrifuge. No persons or objects may stay in this zone during a run (Section 2.3).
- Do not place containers with liquid on or next to the instrument. Spilled liquid can enter the housing and damage electrical and mechanical parts.
- Maintenance and repairs other than those described in Chapter 9 may only be carried out by LORDERAN or a service partner authorised by LORDERAN.
- If you meet a situation that this manual does not cover, stop and contact LORDERAN before you continue.

1.2 Samples and Materials That Must Not Be Centrifuged

PROHIBITED · DANGER

The BH2500R / BH2300R are not explosion-proof centrifuges. Do not centrifuge, handle or store the following materials in or near the instrument.

Flammable and explosive materials

- Flammable solvents and liquids, and samples that can release flammable vapours or gases.
- Explosive substances and peroxide-forming compounds.

Strongly reactive materials

- Mixtures that can react violently, heat up or build up pressure during the run.
- Highly corrosive samples that can attack the rotor, buckets or chamber.

Toxic and radioactive materials

- Only with the containment, approvals and procedures required by your safety officer.

Pathogenic material

- Infectious or potentially infectious samples (including clinical blood samples) only in sealed tubes and sealed buckets or rotor lids — see Section 1.4.

1.3 Rotor and Load Safety

- **Balance every load.** Opposite positions must carry the same mass to within **1 g**, and the tubes or bottles must be placed symmetrically about the drive shaft (Section 4.2).
- **Select the correct rotor number.** The speed limit, the RCF conversion and the overspeed protection depend on it. Never run a rotor under the number of a faster rotor.
- **Respect the lowest speed limit.** The permitted speed is the lowest of the limits of the rotor, the bucket, the adapter and the tube. For commercial tubes, use the speed or RCF stated by the tube manufacturer.
- **Do not overfill.** Fixed-angle rotors: at most 80 % of the nominal volume. Swing-out rotors: at most 90 %. Dense samples need less (Section 4.3).
- **Load all buckets.** On a swing-out rotor, all buckets and racks must be in place for every run, even the empty ones, and they must be identical in opposite positions.
- **Close the rotor lid.** On fixed-angle rotors, fit the rotor lid and tighten its knob or nut before every run.
- **Fix the rotor.** Check before every run that the rotor is seated on the drive and that its nut or knob is tight.
- **Respect the service life.** Rotors have a service life of 5 years. After that, return the rotor to LORDERAN for inspection or replace it (Section 9.3).

⚠ **DANGER**

- If you hear an unusual noise or feel strong vibration, stop the run immediately. If the rotor does not slow down, switch the instrument off at the power switch, keep away from it and do not open the lid until the rotor has stopped completely.
- Never open the lid with the emergency release while the rotor is turning. A turning rotor can cause serious injury.

1.4 Biological Safety

Spinning tubes can leak, and a broken tube can release fine droplets (aerosols) into the chamber. With infectious material, these aerosols are the main risk to the operator.

- Use tubes and bottles with screw caps and, where available, sealed buckets or aerosol-tight rotor lids.
- Load and unload sealed buckets and rotors in a biological safety cabinet.
- After the run, wait a few minutes before you open the lid, so that any aerosol can settle.
- If a tube has broken, leave the lid closed for at least 30 minutes, then decontaminate the chamber, rotor and accessories according to your laboratory's procedure (Section 9.2).
- You are responsible for the risks of the samples you use. Take every necessary precaution before you centrifuge toxic, radioactive or pathogenic samples.

⚠ **NOTICE**

Do not disinfect the instrument or the rotor with strong chlorine-based disinfectants (for example sodium hypochlorite solution). They corrode aluminium and paint. See Section 9.2 for suitable agents.

1.5 Electrical Safety and Servicing

- Switch the instrument off and disconnect it from the supply before cleaning or maintenance. If a cover must be removed, wait at least **4 minutes** after disconnecting the power before you open it; this work is for qualified service personnel only.
- The miniature circuit breaker (power breaker) protects the circuits against overcurrent. Replace it only with a breaker of the same type and rating.
- Replacement parts must be approved by LORDERAN. Unapproved parts can cause fire, electric shock or other hazards.
- Never change the settings of the motor frequency inverter. They are set at the factory for the drive and the rotors.
- Switch the instrument off at the power breaker when you finish work for the day.

1.6 Intended Use and Limitation of Liability

The BH2500R / BH2300R are intended for the separation of liquid samples in tubes, bottles in a laboratory, by trained personnel, within the limits given in this manual. Any other use is not intended. LORDERAN accepts no responsibility for damage caused by:

- use not in accordance with this manual;
- unbalanced, overloaded or overfilled rotors;
- a rotor run under a wrong rotor number;
- rotors, accessories or spare parts not approved by LORDERAN;
- use of a rotor beyond its service life;
- repairs or modifications by persons not authorised by LORDERAN;
- an unsuitable power supply or site;
- accidents, fire, flooding or other force majeure.

CHAPTER 2

Installation

This chapter takes you from the delivered crate to the first test run. A correct site and a correct power supply prevent most vibration, cooling and electrical problems later on.

1. **Inspect** — crate on arrival
2. **Unpack** — by the service engineer
3. **Check** — parts vs. packing list
4. **Place** — level floor, safety zone
5. **Connect** — earthed supply
6. **Test run** — empty rotor

2.1 Receiving and Unpacking

When the delivery arrives, check the crate before you sign for it. If it is damaged, wet or has been tipped over, note this on the delivery receipt, take photographs and contact LORDERAN and the carrier immediately.

MUST DO

The BH2500R / BH2300R are installed, commissioned and handed over by a LORDERAN service engineer or an authorised service partner, who also trains the operators. Do not open the crate yourself unless LORDERAN has agreed to this. The steps below describe what the engineer does, so that you can prepare the site.

Main unit

1. Cut the two steel straps around the crate and remove them. **Wear gloves and eye protection** — the strap ends spring back.
2. Remove the wood screws that join the left and right panels to the base, then lift the four side panels and the top panel off as one unit.
3. Remove the plastic cover. Unscrew the two nuts at the bottom of the lower front panel and take the panel off.
4. Remove the two bolts that fix the instrument base to the pallet (at the front), and the screws that hold the rear cover to the wooden block. Take the block away.
5. Roll the instrument off the pallet and push it to the installation site. The instrument weighs about **350 kg**; use enough people and a ramp.

NOTICE

The casters are only for short moves on a flat floor inside the building. Moving the instrument over thresholds, ramps or long distances on its casters can damage them.

Rotor crate

Remove the screws of the crate lid, take out the foam packing and lift out the rotor body, the rotor lid and the accessories.

NOTICE

- Handle rotors and buckets gently. Their surface is protected by an anodised (oxide) layer; scratches and dents in this layer start corrosion.
- Do not push or lift the instrument by the front panel or the lid. Force on these parts can damage them.
- Keep the crate and packing material. You will need them if the instrument has to be returned or moved over a long distance (Section 9.6).

2.2 Checking the Delivery

Check the instrument for transport damage and compare the parts with your packing list. Report any difference to LORDERAN or to the service engineer.

Table 2-1 Standard scope of delivery

#	Item	Qty	Remark
1	BH2500R or BH2300R centrifuge	1	Service life 8 years
2	Rotor with lid as ordered	1 set	Service life 5 years (Section 9.3)
3	Centrifuge bottles	1 set	Service life 100 cycles
4	Rotor tightening tool / T-bolt	1	Section 5.8
5	Emergency lid-release key	1	Section 8.4
6	User manual	1	This document

2.3 Choosing the Site

Install the centrifuge on a site that meets every condition below.

- A solid, level floor that can carry at least **350 kg** plus rotor and load without flexing or resonating. Lower the levelling feet until they stand firmly on the floor, so that the instrument does not rest on its casters.
- Indoors. No strong vibration sources (pumps, compressors, shakers) and no strong magnetic fields nearby.
- No corrosive gases, metal dust, dripping water, steam or oily dust.
- Ambient temperature **5 – 40 °C**, relative humidity **≤ 80 %** without condensation, air pressure 86 – 106 kPa.
- No direct sunlight and no heat sources next to the air vents.
- A **safety zone of at least 500 mm** on every side, in which no persons or objects stay during a run, and at least **300 mm** free space behind the instrument for the cooling air (**Figure 2-1**).

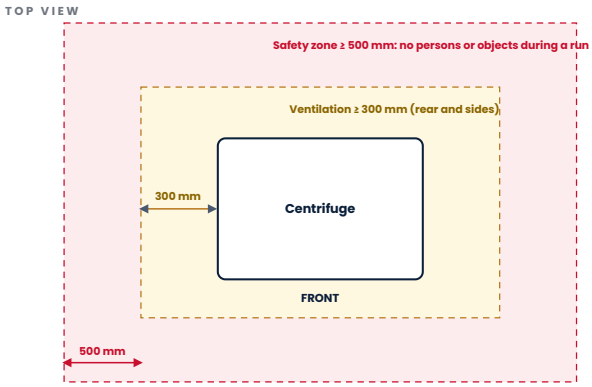


Figure 2-1 Safety zone and ventilation space

TIP · WHY CLEARANCE MATTERS

The refrigeration system releases the heat it removes from the chamber through the vents. If the warm air cannot escape, the condenser runs hotter, cooling slows down and the lowest chamber temperature rises. In a warm room leave even more space and avoid placing several instruments side by side.

2.4 Power Supply Requirements

Table 2-2 Electrical connection

Item	Requirement
Supply	AC 220 V ±10 %, 50 Hz, single phase, three-wire
Rated power	5 kW
Connection	Dedicated circuit with a protective earth conductor (three-wire, single-phase). Do not use the neutral as the earth, do not share the earth, and avoid extension cables and multi-way strips. For a 5 kW instrument, have a qualified electrician provide a dedicated circuit with suitable protection.
Unstable mains	Where the voltage fluctuates outside the permitted range, use a suitable voltage stabiliser rated for the instrument's power.

DANGER

Operating the instrument without a protective earth can cause a fatal electric shock. If you are not sure that the supply is earthed, have it checked by an electrician before you connect the centrifuge.

2.5 First Power-On and Test Run

The service engineer carries out the first power-on and the test run, and shows the operators how to use the instrument. For later re-installation (for example after a move), use the same procedure:

1. Let the instrument stand at room temperature for at least **2 hours** if it was transported or stored in the cold. Condensed moisture must dry before power is applied.
2. Check that the condensate drip tray is in place (Section 9.4).
3. Connect the instrument to the supply and push the power breaker on the right-hand side up to **ON**. The display starts.
4. Open the lid and check that the chamber is clean and empty.
5. Install a rotor with all buckets but **without samples** (Section 5.2), fit the rotor lid, close the lid (Section 5.3).
6. Select the installed rotor number, set 1000 rpm and 2 minutes at 20 °C, and start. Watch and listen: acceleration should be smooth, the run quiet, and the rotor should stop without knocking.
7. Repeat at the rotor's maximum speed for 5 minutes. If you notice vibration or unusual noise, stop and see Section 8.3.

NOTE

Set the language, date and time before your first real run (Chapter 7). The run history uses this clock.

CHAPTER 3

Instrument Overview

This chapter introduces the BH2500R / BH2300R: what they can do, the rotors they accept, the parts you will handle, and the touch screen you use to control them.

3.1 Technical Specifications

Table 3-1 Technical specifications

Parameter	BH2500R	BH2300R
PERFORMANCE		
Maximum speed	25,000 rpm	23,000 rpm
Maximum RCF	64,983 × g	60,900 × g
Maximum capacity	4 × 1000 ml	
Speed setting range	300 rpm to the maximum of the selected rotor; or set as RCF	
Speed accuracy	±10 rpm	
Timer	1 s – 99 h 59 min 59 s	
Acceleration / deceleration	ACC levels 1 – 10, DEC levels 0 – 10 (0 = free coast), or ramp time in seconds	
TEMPERATURE		
Temperature setting range	-20 °C to +40 °C	
Temperature accuracy	±1 °C	
Refrigeration	Imported hermetic compressor unit, CFC-free refrigerant R404A	
CONTROL AND SAFETY		
Display / control	Large colour TFT touch screen	
Programs	100 user programs with description; multi-step programs with up to 10 steps; presets	
Data	Run history (over 1000 records), speed / temperature / ramp curves; USB export, program import / export	
Safety devices	Electronic lid lock, lid interlock, imbalance, over-temperature, overspeed and motor-temperature protection, automatic rotor recognition	
Seal	One-piece food-grade silicone chamber seal	
INSTALLATION		
Power supply	AC 220 V ±10 %, 50 Hz, single phase, three-wire	
Rated power	5 kW	
Noise	≤ 65 dB(A)	
Ambient conditions	5 – 40 °C, ≤ 80 % RH (non-condensing), 86 – 106 kPa	

Parameter	BH2500R	BH2300R
External dimensions (L × W × H)	760 × 900 × 1005 mm	
Packing dimensions (L × W × H)	880 × 1020 × 1105 mm	
Net weight	350 kg	
Service life	Instrument 8 years; rotors 5 years; bottles 100 cycles	

3.2 Rotors and Accessories

The controller limits the speed to the maximum of the **selected** rotor number. It also checks at low speed that the installed rotor matches the selected number and stops with an alarm if it does not. You must therefore always select the rotor number of the rotor that is actually installed (Section 5.4).

Table 3-2 Rotors recognised by the controller

No.	Type	Capacity	BH2500R rpm / × g	BH2300R rpm / × g	r (mm)*
No.1	Fixed-angle	24 × 1.5/2.2 ml	25,000 / 64,983	23,000 / 47,313	93
No.2	Fixed-angle	16 × 10 ml	23,000 / 60,900	23,000 / 60,900	103
No.3	Fixed-angle	8 × 50 ml	18,000 / 40,930	18,000 / 40,930	113
No.4	Fixed-angle	6 × 250 ml	14,000 / 30,200	14,000 / 30,200	138
No.5	Fixed-angle	6 × 400/500 ml	10,000 / 17,800	10,000 / 17,800	159
No.6	Fixed-angle	4 × 1000 ml	8000 / 12,879	8000 / 12,879	180
No.7	Continuous-flow	1000 ml	16,000 / 28,100	16,000 / 28,100	98
No.8	Continuous-flow	3000 ml	10,000 / 14,800	10,000 / 14,800	132
No.9	Swing-out	4 × 50/85 ml	10,000 / 15,316	10,000 / 15,316	137
No.10	Swing-out	8 × 50 ml	10,000 / 17,329	10,000 / 17,329	155
No.11	Fixed-angle	6 × 50 ml	21,000 / 45,816	21,000 / 45,816	93
No.12	Fixed-angle	10 × 5 ml	16,500 / 22,564	16,500 / 22,564	74

* Effective radius calculated from the rated speed and RCF (Section 4.1); a reference value, not a measured dimension. "—": rotor not available for this model. Your packing list shows which rotors and adapters were supplied; further rotors are available on request.

3.3 Parts of the Instrument

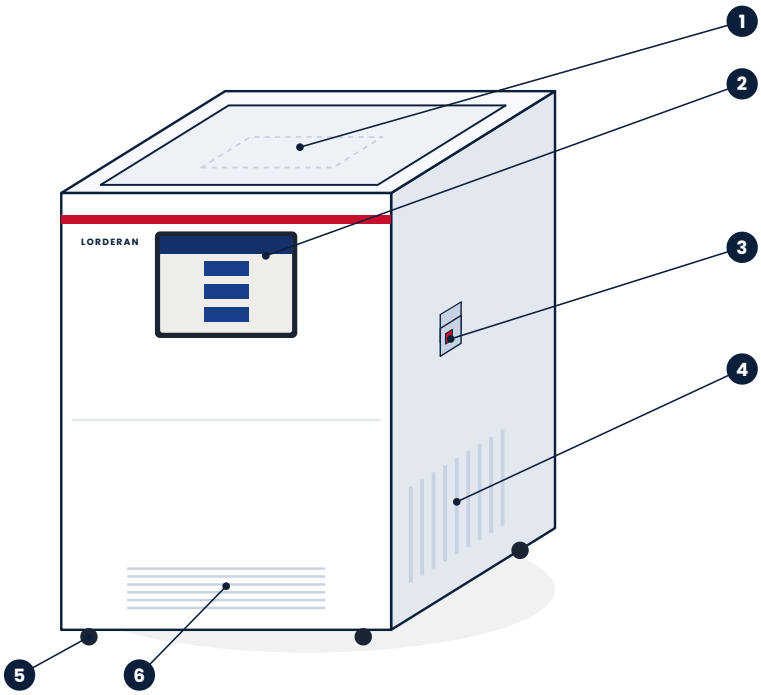


Figure 3-1 Main parts (illustration)

#	Part
1	Lid with gas-spring struts and electronic lock
2	Colour TFT touch screen (front)
3	Power breaker and USB port (right-hand side)

#	Part
4	Air vents — keep the ventilation space free
5	Casters and levelling feet
6	Lower front panel



Figure 3-2 Power breaker (ON = handle up) and USB port

The power breaker on the right-hand side switches the supply to the instrument and protects it against overcurrent. Push the handle **up** to switch on (ON) and **down** to switch off (OFF). The USB port next to it is used to export the run history and to import and export multi-step programs.

3.4 How the Instrument Works

The centrifuge consists of the main unit, the rotor and its accessories. The main unit contains the cabinet, lid, control panel, drive system, refrigeration system, electrical control system and safety devices.

Drive system

A high-torque, variable-frequency AC motor directly drives the rotor. A special damping mount reduces vibration and noise. The rotor sits on a tapered drive head that centres it.

Refrigeration

A hermetic compressor with refrigerant R404A cools an evaporator around the chamber. A solenoid valve sends hot gas to the evaporator when the chamber has to be warmed, so the set temperature is held in both directions.

Control system

A microprocessor compares the measured speed, time, temperature and fault inputs with the set values, controls the drive and the cooling, monitors the safety devices and shows the RCF. Speed and time can be changed during a run.

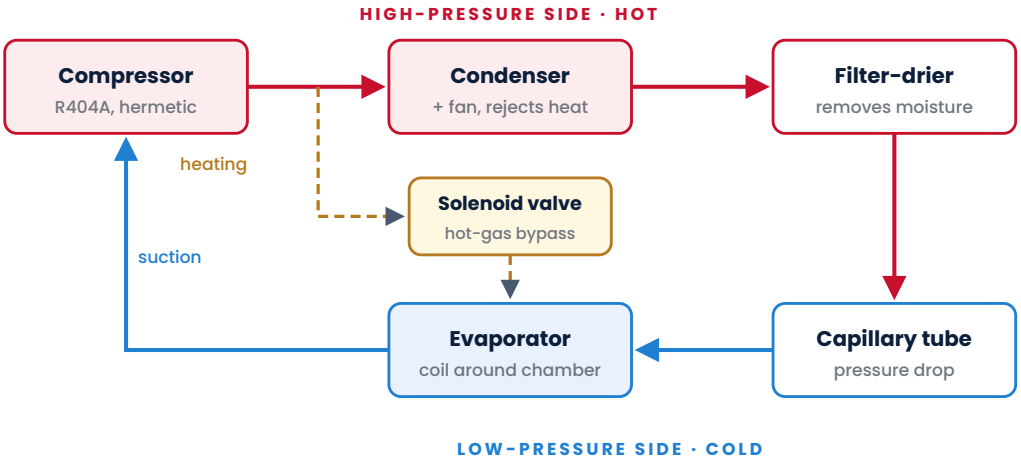


Figure 3-3 Refrigeration principle

3.5 The Touch Screen

All functions are operated from the touch screen. Tap a field with your fingertip to change it; an on-screen keypad opens (Section 3.6). The main screen shows the set values and the actual values side by side.



Figure 3-4 Main screen (screens in this manual are illustrations; the layout on your instrument may differ slightly with the software version)

Table 3-3 Elements of the main screen

#	Element	Function
1	Rotor	Shows the selected rotor number and its maximum speed. Tap to select another rotor (Section 5.4).
2	Speed / RCF	Toggles between setting the run by speed (rpm) or by relative centrifugal force (× g).
3	Preset	Shows the active preset number, or **DEF** when the values have been changed by hand. Tap to save or recall presets (Section 6.1).
4	Pre-cool	Starts the pre-cooling run with the values set under Pre-cool Settings (Section 7.2).
5	Speed field	Small figures: set value. Large figures: actual value. Tap the large field to enter a new speed or RCF.
6	Time field	Set run time (H:M:S) and remaining time. Tap the hours, minutes or seconds to change them.
7	Temperature field	Set temperature and actual chamber temperature in °C. Tap to change the set value.
8	ACC / DEC	Acceleration and deceleration level (or ramp time in seconds). Higher numbers ramp faster; DEC 0 lets the rotor coast down freely.
9	Step	Opens Program Mode for multi-step runs (Section 6.2).
10	Start / Stop	Starts the run. During a run the key becomes **Stop**.
11	Open	Releases the lid lock. Works only when the rotor has stopped.
12	Jog	Short spin: the rotor runs as long as the jog screen is open (Section 5.7).

#	Element	Function
13	Settings (gear)	Opens the System Settings screen (Chapter 7). Date, time and the model name are shown in the status bar on the left.
14	Batch	Enters a batch number for the current run (Section 6.3).
15	Curve	Shows the speed and temperature curve of the current or last run.

3.6 The On-Screen Keypad

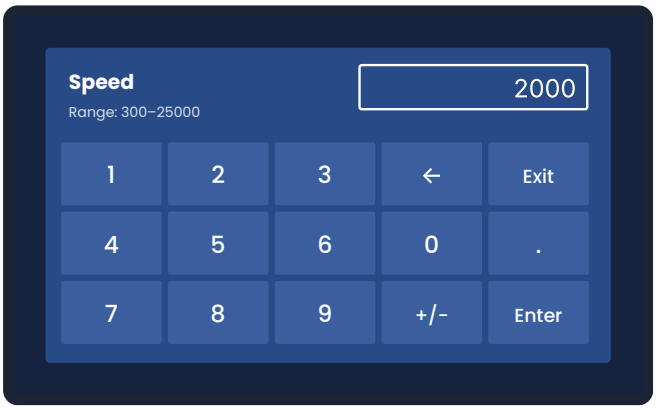


Figure 3-5 On-screen keypad, here for the speed

Whenever you tap a value, the keypad opens. Its title shows the parameter, and the line below it shows the **permitted range** for the selected rotor.

Key	Function
0 – 9, .	Enter the value
+/-	Enter a minus sign (temperatures below zero)
←	Delete the last digit
Enter	Save the value and close the keypad
Exit	Close the keypad without saving

NOTE

A value outside the permitted range is not accepted. If you saved a wrong value by mistake, tap the field again and enter the correct value.

3.7 Safety Devices

Protective ring

A steel ring surrounds the rotor chamber. It contains fragments in the unlikely event of a rotor failure and protects the operator.

Lid interlock

A run can start only when the lid is fully closed and the electronic lock has engaged. The lid cannot be opened while the rotor turns; if the lid is forced open during a run, the drive stops at once.

Overspeed protection and rotor recognition

The controller blocks any speed above the limit of the selected rotor. If the actual speed exceeds the set speed by a defined margin, the run is stopped. A rotor that does not match the selected number is detected at low speed.

Imbalance and speed monitoring

An imbalance sensor detects strong vibration caused by uneven loading and stops the run. If the speed signal is lost, the drive is stopped as well (Chapter 8).

Temperature monitoring

If the chamber temperature leaves the safe range, or a temperature sensor fails, the run is stopped with an alarm.

Motor protection

A sensor monitors the motor temperature; above 80 °C the run is stopped to protect the drive.

CHAPTER 4

Centrifugation Essentials

Four things decide whether a run is safe and reproducible: the force applied to the sample, the balance of the rotor, the fill level of the tubes and bottles, and how the rotor speeds up and slows down and holds its temperature. This chapter explains each of them in practical terms.

4.1 Speed (rpm) and Relative Centrifugal Force (× g)

The **speed** tells you how fast the rotor turns. What acts on the sample, however, is the **relative centrifugal force (RCF)**. It grows with the square of the speed and in proportion to the radius — the distance from the axis of rotation to the sample. The same rpm therefore gives a different force in a different rotor. Write your protocols in × g and let the instrument convert.

$RCF = 1.118 \times 10^{-6} \times r \times n^2$

RCF in × g · r = radius in mm (axis to the bottom of the tube for the maximum RCF) · n = speed in rpm

Solved for speed: $n = \sqrt{(RCF \div (1.118 \times 10^{-6} \times r))}$

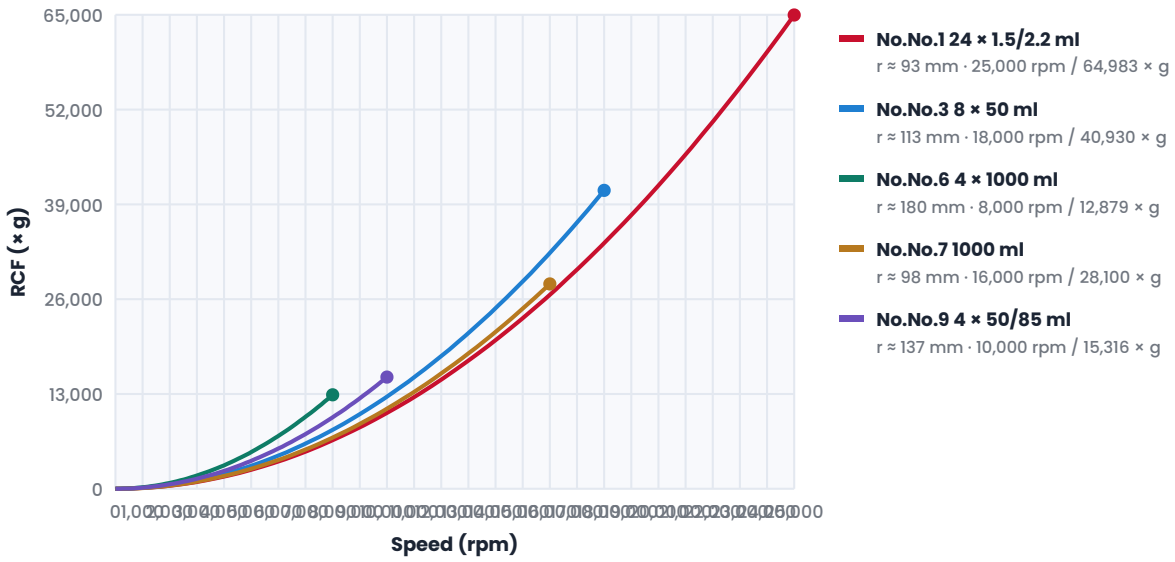


Figure 4-1 RCF versus speed for selected rotors (BH2500R limits)

WORKED EXAMPLE

A protocol asks for **10,000 × g**. In rotor No.1 (r ≈ 93 mm) the speed is $n = \sqrt{(10000 \div (1.118 \times 10^{-6} \times 93))} \approx$ **9810 rpm**. Simply select RCF on the main screen and enter 10000 — the instrument calculates the speed for the selected rotor.

Table 4-1 Speed needed for common RCF values (rpm, rounded)

RCF (× g)	No.1 · r 93 mm	No.3 · r 113 mm	No.6 · r 180 mm	No.7 · r 98 mm	No.9 · r 137 mm
1000	3100	2810	2230	3020	2560
2000	4390	3980	3150	4270	3610
3000	5370	4870	3860	5230	4430

RCF (× g)	No.1 · r 93 mm	No.3 · r 113 mm	No.6 · r 180 mm	No.7 · r 98 mm	No.9 · r 137 mm
5000	6930	6290	4980	6760	5710
10,000	9810	8900	7050	9550	8080
20,000	13,870	12,580	—	13,510	—
30,000	16,990	15,410	—	—	—
40,000	19,610	17,790	—	—	—
50,000	21,930	—	—	—	—
60,000	24,020	—	—	—	—

"—" means the RCF is above the rotor's limit. Values are calculated with the formula above.

4.2 Balancing the Rotor

An unbalanced rotor makes the drive shaft whip. This causes vibration and noise, wears the drive, stops the run with an imbalance alarm and, in the worst case, damages the instrument. Balance therefore is not optional.

- Opposite positions must carry the **same mass to within 1 g**. Weigh the filled tubes, bottles or buckets on a balance; do not judge by eye.
- Load the tubes **symmetrically about the axis**. With only a few samples, place them in opposite positions, or add a blank tube filled with water to the same mass.
- Use the **same type** of tube, adapter and bucket in opposite positions.
- Equal mass is not always enough: samples of different **composition or density** may form pellets at different heights, and tubes of different diameter, material or shape have a different centre of gravity. Both can unbalance the rotor during the run. Fill opposite tubes with the same sample type and the same tube type.

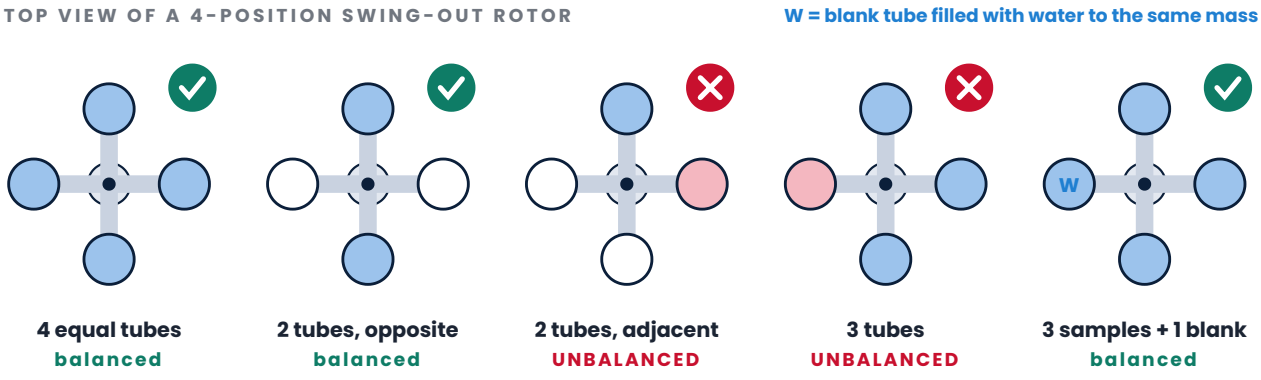
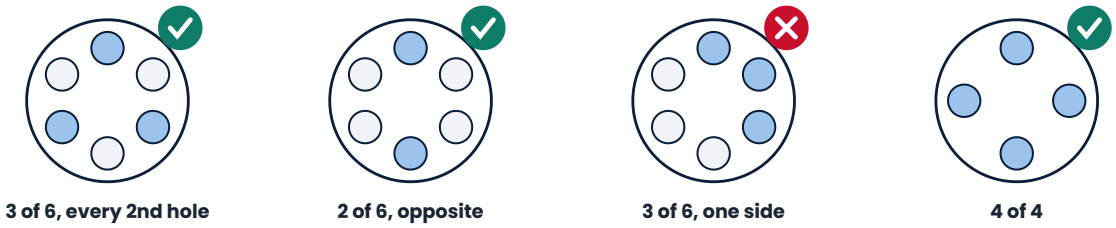


Figure 4-2 Correct and incorrect loading of a 4-position swing-out rotor



Inside each bucket, load the adapter symmetrically, and load opposite buckets identically.

Figure 4-3 Symmetric loading of a multi-place rotor or adapter

4.3 Fill Levels, Sample Density and Tubes

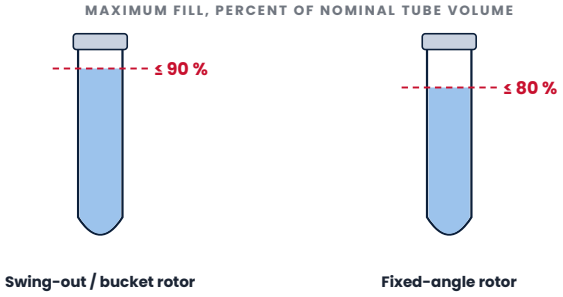


Figure 4-4 Maximum fill levels

- **Fixed-angle rotors:** fill each tube or bottle to no more than **80 %** of its nominal volume, because the liquid surface tilts towards the cap.
- **Swing-out rotors:** no more than **90 %**.
- Use tubes and bottles rated for at least the RCF of your run. Replace those that are deformed or cracked.
- Close tubes and bottles tightly, and dry the outside before loading.

Dense samples in large bottles

The nominal capacity of every bottle is based on water (density 1 g/ml). For bottles of **250 ml and larger**, limit the volume according to the density of the sample, to protect the rotor and extend its life:

> **Maximum volume = nominal capacity ÷ sample density**
>
> Example: 500 ml bottle, sample density 1.25 g/ml → max. 400 ml; density 2 g/ml → max. 250 ml. The 80 % / 90 % fill limits apply in addition.

4.4 Acceleration, Deceleration and Timing

The ACC and DEC settings decide how quickly the rotor reaches the set speed and how quickly it stops. Fast ramps save time; gentle ramps protect loose pellets, density gradients and layered samples from being stirred up.

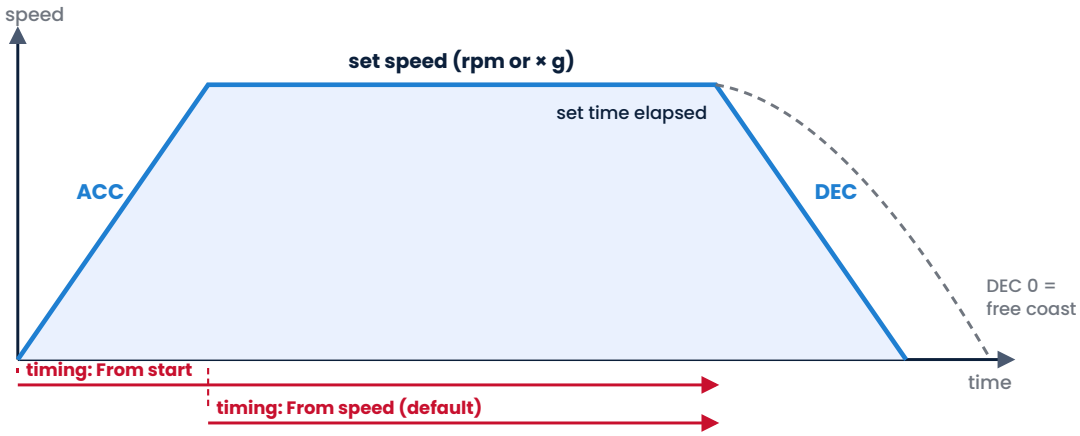


Figure 4-5 Run profile: acceleration, run time and deceleration

Choosing ACC / DEC

- ACC 1 – 10, DEC 0 – 10. **Higher numbers ramp faster**; DEC 0 = free coast.
- Large or heavily loaded rotors: use gentler (slower) levels.
- Density gradients and fragile pellets: use the gentlest deceleration.

When does the timer start?

- **From speed** (default): the timer starts when the set speed is reached, so every run gets the same time at full force.
- **From start**: the timer starts as soon as you start the run. Select the mode in System Settings (Section 7.1).

NOTE

Depending on rotor and load, the actual ramp can differ slightly from the set ramp. For multi-step programs, the ramp time between two steps cannot be shorter than the fastest ramp the rotor can achieve.

4.5 Temperature and Pre-Cooling

- The chamber temperature is controlled; the sample follows with a delay that depends on its volume. A 500 ml bottle needs much longer than a 1.5 ml tube to reach the set temperature.
- For cold runs, **pre-cool the chamber and the rotor** with the Pre-cool function (Section 7.2) and, if possible, pre-cool the samples. Load the samples only when the chamber has reached the set temperature.
- Air friction warms the rotor, especially at high speed. Check the sample temperature with a thermometer in a dummy tube if it is critical, and set the chamber slightly lower if needed.
- Below 0 °C, moisture from the air freezes in the chamber. Wipe the chamber dry after cold runs and leave the lid open for a while (Section 9.1).

CHAPTER 5

Operation

This chapter describes a complete run, from switching on to unloading the samples. Multi-step programs and presets are described in Chapter 6.

1. **Switch on** 5.1
2. **Fit rotor** 5.2
3. **Load & close** 5.3
4. **Set values** 5.4
5. **Start** 5.5
6. **Unload** 5.6

DANGER

- The centrifuge is not explosion-proof. Never centrifuge flammable, explosive or violently reacting materials, and do not handle or store them near the instrument.
- Take all necessary precautions before you use toxic, radioactive or pathogenic samples (Section 1.4).

NOTICE

- Do not place containers with liquid in the chamber, on the instrument or next to it.
- Do not tilt or move the instrument, and do not lean on it, while the rotor turns.
- Do not press the touch screen with sharp objects such as ballpoint pens.

5.1 Switching On and Opening the Lid

1. Push the power breaker on the right-hand side of the instrument up to **ON**.
2. The touch screen starts and shows the main screen with the parameters of the last run.
3. Tap **Open**. The lid lock releases (after power-on the lock may open automatically). Lift the lid with both hands; the gas-spring struts hold it open.

5.2 Fitting the Rotor and Loading the Samples

DANGER

- Use only rotors, rotor lids, buckets and adapters specified for the BH2500R / BH2300R.
- Before fitting, check the rotor for cracks and corrosion pits — especially at the bottom of the bores of fixed-angle rotors. Never use a cracked or corroded rotor.
- Large rotors are heavy. Lift and fit them with two people.

Before you fit any rotor, wipe the drive head (taper) and the bore of the rotor with a soft cloth and apply a very thin film of the lubricant supplied or medical petroleum jelly. Hold the rotor level and lower it **vertically and slowly** onto the drive; the bore must seat fully on the taper. Never drop or force it.

Fixed-angle rotors (seated on the drive head)

1. Hold the rotor body by its base with both hands, align its centre bore with the drive head and lower it gently until it seats on the taper.
2. Turn the rotor slowly by hand. If it does not move up and down and turns without noise, it is seated correctly.
3. Load the balanced bottles symmetrically (max. 80 %), fit the rotor lid and tighten the knurled lid nut by hand.

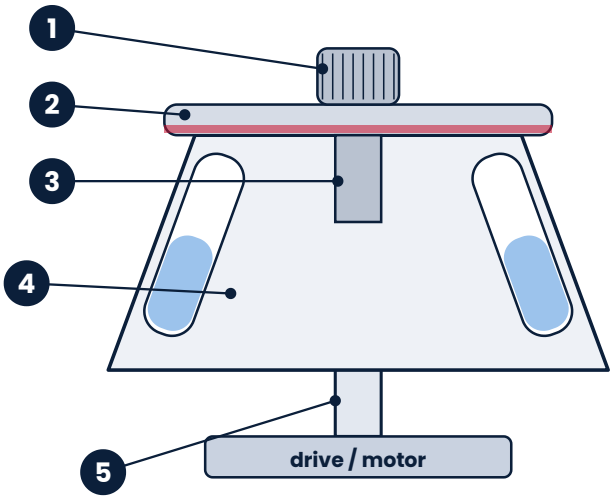


Figure 5-1 Fixed-angle rotor: 1 knurled lid nut · 2 rotor lid with seal ring · 3 centre press head · 4 rotor body with bottles · 5 drive head

Swing-out rotors (seated on the drive head)

Fit the swing-out rotor body in the same way as a fixed-angle rotor (two people), check that it is seated, and hang the buckets symmetrically on the pins.

Loading the samples

1. Fill the tubes or bottles (fixed-angle max. 80 %, swing-out max. 90 % of nominal volume) and balance opposite pairs to within **1 g** (Section 4.2).
2. Place them symmetrically about the axis. Never run an asymmetric load — add balance tubes instead.
3. On swing-out rotors, all buckets or carriers must be in place, including empty ones, and each must swing freely.

> **NOTICE**
> Do not exceed the maximum speed of the rotor, bucket, adapter or tube. If their limits differ, the lowest limit applies (Table 3-2). With commercial tubes, use the speed or RCF stated by the tube manufacturer; otherwise the tubes can break during the run.

5.3 Closing the Lid

Lower the lid and press it down gently with both hands on the side with the latch until the latch engages with an audible click. Then try to lift the lid lightly with both hands to confirm that it is locked. A run cannot start while the lid is not fully closed (Section 8.1).

5.4 Setting a Run

Tap the value you want to change on the main screen; the keypad opens with the permitted range. Enter the value and tap Enter. Set the parameters in the order below — the speed range depends on the rotor, so select the rotor first.

NOTE

As soon as you change a value by hand, the Preset field shows **DEF**: the current settings are a user-defined run that has not been saved as a preset. See Section 6.1 to save it.

1 · Select the rotor



Figure 5-2 Rotor Selection screen

Tap the **Rotor** field. The Rotor Selection screen lists the rotors with their capacity, maximum speed and maximum RCF. Use the arrow keys to page up and down.

Tap the row of the installed rotor — it is highlighted — and tap the back arrow. The Rotor field on the main screen now shows the new rotor number and its maximum speed.

2 · Set the speed or RCF

Tap **Speed / RCF** to choose how you want to set the run. Then tap the large speed field. The keypad shows the range for the selected rotor (for example 300 – 25,000 rpm for rotor No.1). Enter the value and tap **Enter**.

3 · Set the time

The time is set in hours, minutes and seconds. Tap the minutes in the time field, enter for example **20** and tap **Enter**; then tap the seconds and enter **30**. The range for minutes is 0 – 59, for seconds 0 – 59.

4 · Set acceleration and deceleration

Tap **ACC** and enter a level from 1 to 10; tap **DEC** and enter 0 to 10 (0 = free coast). Higher numbers ramp faster. If the ramp mode is set to **Time mode**, enter the ramp time in seconds instead (Section 7.1).

TIP

For large rotors and heavy loads, choose lower ACC / DEC levels or longer ramp times. They reduce the load on the drive and keep pellets and layers undisturbed.

5 · Set the temperature

Tap the temperature field. The range is -20.0 to 40.0 °C. For a negative value, tap **+/-** first. Example: enter **4** and tap **Enter**.

Check all values on the main screen before you start.

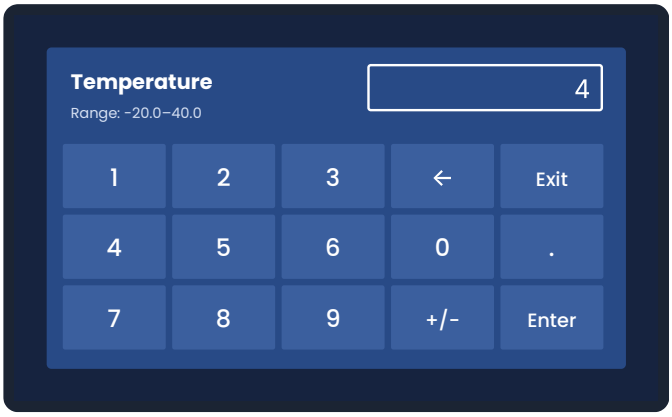


Figure 5-3 Entering the temperature



Figure 5-4 Main screen after setting the run

5.5 Starting, Monitoring and Stopping a Run

Tap **Start**. The rotor accelerates to the set speed; the timer starts when the set speed is reached (or immediately, if the timing mode is **From start**). At low speed the instrument checks that the installed rotor matches the selected rotor number. Stay near the instrument until the rotor has reached full speed and runs quietly.

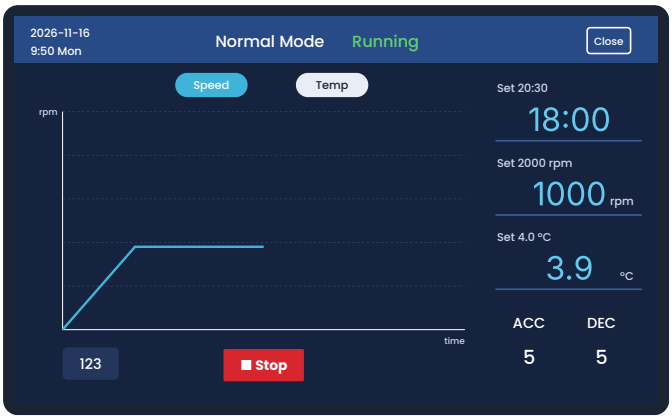


Figure 5-5 Run screen with speed curve

- Tap the curve icon on the main screen to see the speed or temperature curve of the run. The right-hand column shows set and actual time, speed and temperature, and the ACC / DEC levels.
- You can change the speed and the time during the run.
- To end the run early, tap **Stop**. The rotor decelerates with the set DEC level.

> **DANGER**
> If you hear unusual noise or feel vibration, stop the run at once and contact LORDERAN or your service partner. Do not restart until the cause is found (Section 8.3).

5.6 End of Run and Unloading

1. When the time has elapsed, the rotor decelerates and stops. A beep signals the end of the run.
2. Wait until the rotor has **stopped completely**. With Auto-open lid switched on (factory setting), the lock opens by itself; otherwise tap **Open**. Lift the lid with both hands.
3. On a fixed-angle rotor, unscrew the lid nut and take off the rotor lid. Take out the tubes or bottles, or lift out the buckets, holding them upright so that the pellet is not disturbed.
4. Check the chamber and the rotor for spilled liquid or broken glass; clean if necessary (Section 9.2).
5. At the end of the working day, remove the rotor, wipe the chamber dry and switch off at the power breaker.

5.7 Jog (Short Spin)

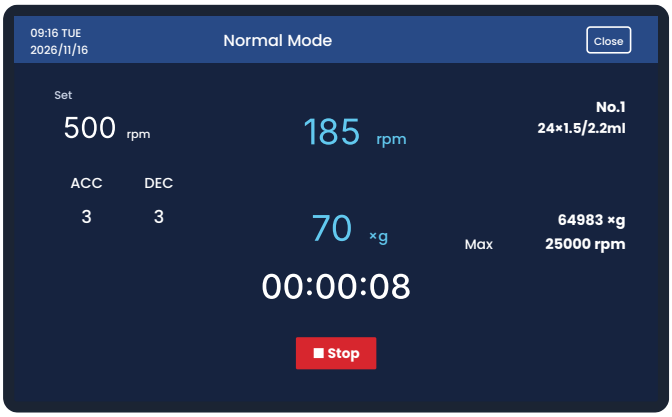


Figure 5-6 Jog screen

Use Jog to collect drops from the walls and caps of tubes, or for a quick spin-down. Tap **Jog** on the main screen. The drive starts at once and the screen shows the actual speed, RCF and elapsed time. The run continues until you tap **Stop**.

> **NOTICE**
> A jog run uses the same rotor limits as a normal run. Balance the load exactly as for a normal run.

5.8 Removing the Rotor

> **NOTICE**
> Switch the instrument off before you change or remove the rotor. Lift the rotor **vertically**; tilting it can damage the drive shaft. Heavy rotors must be lifted by two people.

1. Hold the rotor body with one hand so that it cannot turn.
2. Screw the T-bolt supplied into the centre bore of the rotor and turn it **clockwise**. It pushes against the drive head and frees the rotor from the taper.
3. Lift the rotor slowly and vertically out of the chamber (two people).
4. Clean and dry the rotor and store it in a dry, ventilated place (Section 9.3).



Figure 5-7 T-bolt for rotor removal

5.9 Before-Every-Run Checklist

CHECKLIST

- ☐ Rotor, lid, buckets and adapters are approved for the instrument and undamaged.
- ☐ The rotor is seated on the drive and fixed.
- ☐ The chamber is clean, dry and free of objects.
- ☐ Tubes and bottles are intact, closed and filled to the permitted level.
- ☐ Opposite positions are balanced to within 1 g and loaded symmetrically.
- ☐ All buckets / carriers are in place and swing freely.
- ☐ The rotor lid of a fixed-angle rotor is fitted and tight.
- ☐ The selected rotor number matches the installed rotor.
- ☐ Speed / RCF is within the limits of rotor, adapter and tube.
- ☐ The lid is closed and locked; nothing lies on the lid.
- ☐ Nobody stays in the safety zone during the run.

CHAPTER 6

Programs

Store the runs you use every day as presets, and combine several speeds and temperatures in one multi-step program. Programs save time, and they make sure that every operator runs a method exactly the same way.

6.1 Presets — Saving and Recalling a Run

A preset stores one complete single-step run: rotor, speed or RCF, time, ACC / DEC and temperature.

Saving the current settings as a preset

1. Set all run parameters on the main screen (Section 5.4). The Preset field shows **DEF**.
2. Tap the **Preset** field. The Preset Selection screen opens.
3. Tap the row of the preset number you want to use (for example 3). The row is highlighted.
4. Tap **Replace**. The stored values of that preset are overwritten with the current settings, and the Preset field on the main screen shows **3**.

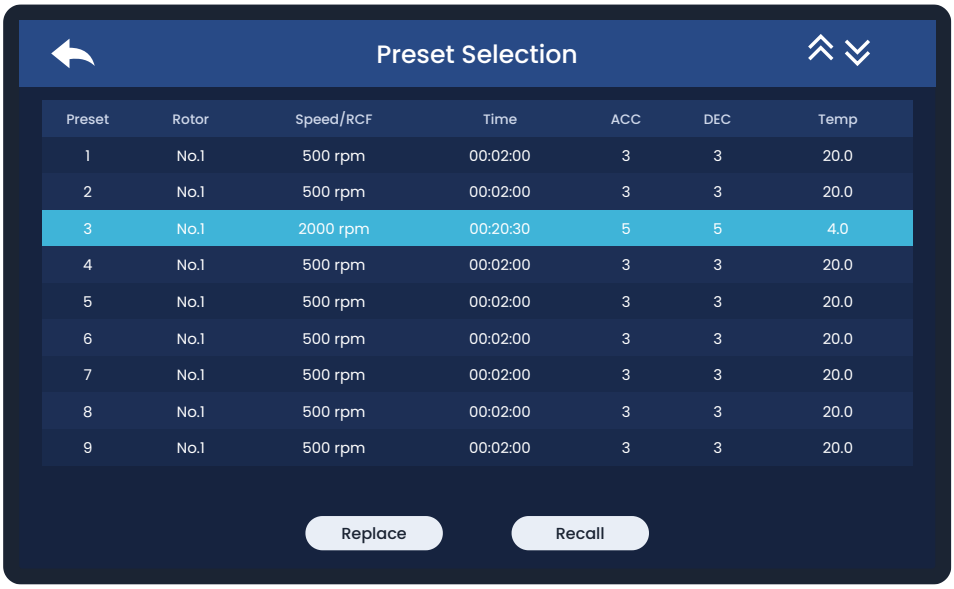


Figure 6-1 Preset Selection screen: preset 3 has been replaced with the current settings

Recalling a preset

1. Tap the **Preset** field on the main screen.
2. Tap the row of the preset you want (for example 1) and tap **Recall**.
3. The main screen shows the values of the preset. Check that the selected rotor matches the installed rotor, then start the run.

> **TIP · KEEP A PRESET REGISTER**
> Write down what each preset number is used for, for example on a label on the instrument or in the operation log (Appendix C). Replace a preset only after you have checked that nobody else depends on it.

6.2 Multi-Step Programs

A multi-step (step) program runs up to **10 steps** one after the other. Each step has its own speed or RCF, temperature, ramp time and run time. Use it, for example, for a gentle pre-spin followed by the main separation, or for gradient protocols with a slow start and a slow stop. Programs are stored under a name.

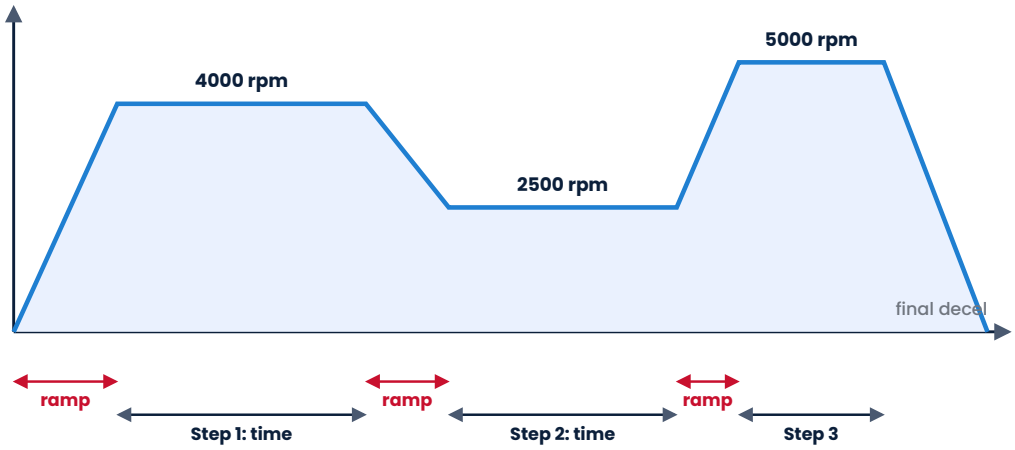


Figure 6-2 How a three-step program runs

Table 6-1 Parameters of a program step

Parameter	Meaning
Speed / RCF	Target speed (rpm) or force (× g) of the step, depending on the Speed / RCF selection of the program
Temp	Chamber temperature during the step (°C)
Ramp	Time from the end of the previous step until this step reaches its speed (min:s). It cannot be shorter than the fastest ramp the rotor can achieve.
Time	Run time of the step at its speed (min:s)

Opening Program Mode

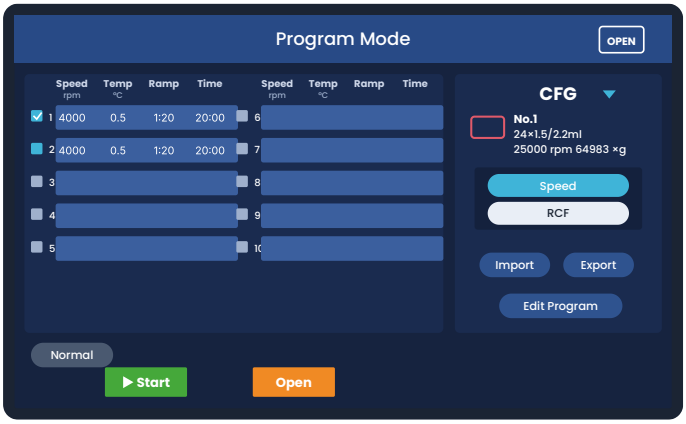


Figure 6-3 Program Mode, viewing program "CFG"

Tap **Step** on the main screen. Program Mode shows the 10 steps of the current program in two columns on the left, and the program name, rotor and limits on the right.

- A tick in the box in front of a step means the step is **active**. Tap the box to activate or deactivate it.
- **Speed** / **RCF** selects the main parameter of the program.
- Tap ▼ next to the program name to choose another program.
- **Normal** returns to the normal (single-step) mode.

> **NOTE**
> **Import** copies programs from a USB stick into the instrument, **Export** copies them to the stick. Use a FAT32-formatted USB stick in the USB port next to the power breaker.

Editing a program

1. In Program Mode, tap **Edit Program**. In view mode the steps cannot be changed.
2. Tap the field you want to change (speed, temperature, ramp or time) and enter the value with the keypad, exactly as on the main screen.
3. On the right, you can change the program name and the rotor. To edit the program by force instead of speed, tap **RCF**.
4. Tap **Save**, then **Exit**.



Figure 6-4 Editing a program by speed

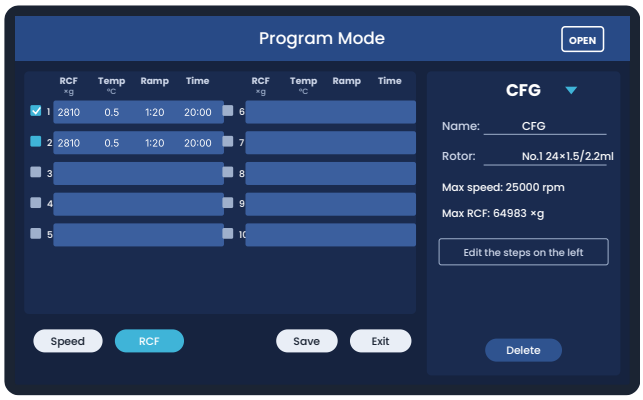


Figure 6-5 Editing the same program by RCF

Creating a new program

1. In Program Mode, tap ▼ next to the program name. The list of programs opens; tap an empty position.
2. Tap the name field. A keyboard opens. Enter a name with letters and numbers (for example **LAB001**) and tap **OK**.
3. Select the rotor, then enter the steps on the left as described above.
4. Tap **Save**.

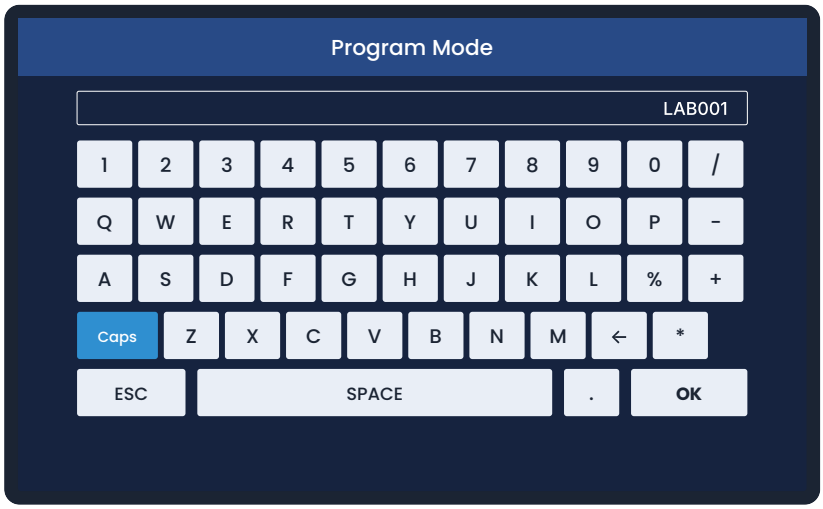


Figure 6-6 Entering a program name

Deleting a program

A program can only be deleted in edit mode. Open the program, tap **Edit Program**, then **Delete**. Confirm the question with **Confirm**, or tap **Exit** to keep the program.

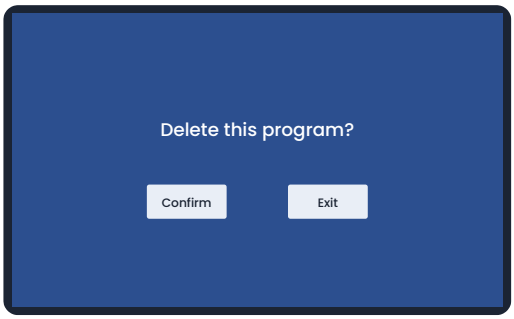


Figure 6-7 Confirming deletion

Running a program

Select the program, check the active steps and tap **Start**. The instrument runs to the speed of the first step and counts down its time. It then ramps to the speed of the next active step, and so on. After the last step, it decelerates to a stop.

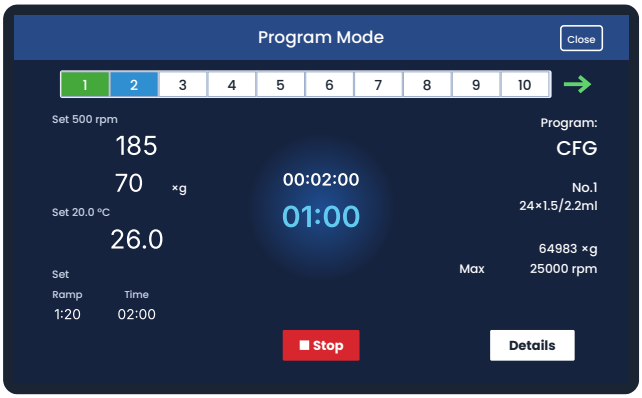


Figure 6-8 Program running: step 1 is complete (green), step 2 is running (blue)



Figure 6-9 Step details (tap **Details**)

WORKED EXAMPLE · GENTLE CELL HARVEST

Step 1: 500 × g, 2 min, ramp 1:00 — loosely collects the cells. Step 2: 1500 × g, 8 min, ramp 1:20 — forms a firm pellet. Set DEC to a low level so the pellet is not disturbed. Save the program as **CELLS15** so every operator uses exactly the same method.

6.3 Batch Number

Tap **Batch** on the main screen, tap the text field and enter a batch or lot number for the samples of the current run. Tap the back arrow to return to the main screen.

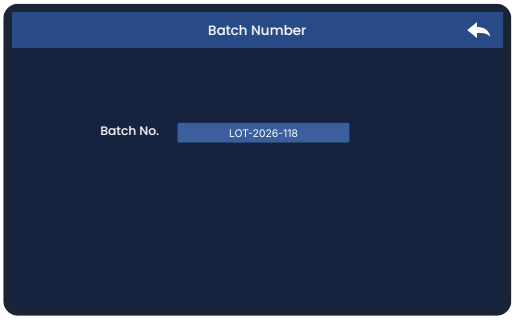


Figure 6-10 Batch Number screen

CHAPTER 7

System Settings and Records

Tap the gear icon in the top-right corner of the main screen to open System Settings. Here you adapt the instrument to your laboratory, set up pre-cooling, and look up the run history.

7.1 System Settings

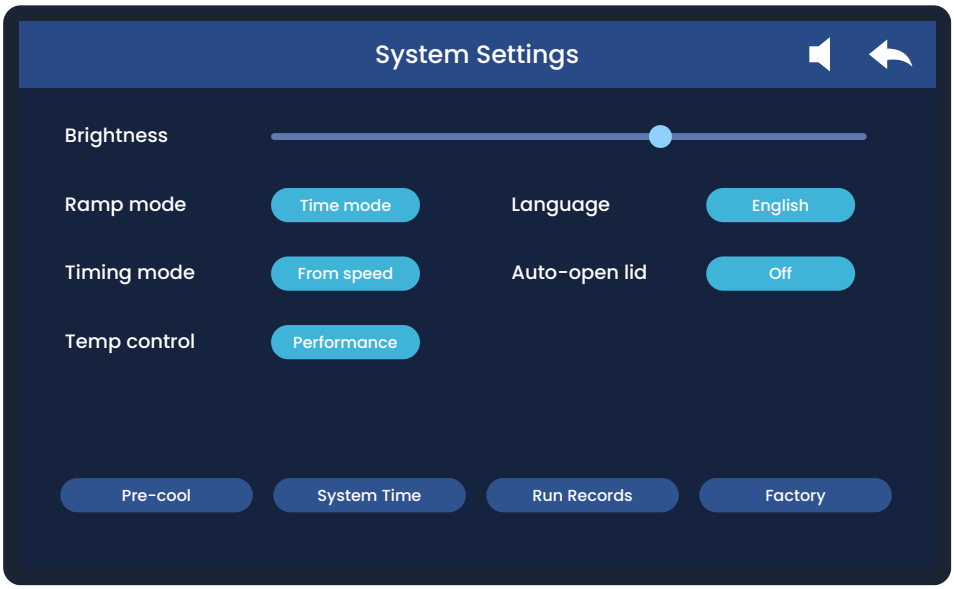


Figure 7-1 System Settings screen

Table 7-1 Settings

Setting	Options	Effect
Brightness	Slider	Drag the dot left or right to adjust the screen brightness.
Ramp mode	Level mode · Time mode	Level mode: ACC / DEC are set as levels (ACC 1 – 10, DEC 0 – 10). Time mode: ACC / DEC are set as ramp times in seconds, within the limits the rotor allows.
Language	Chinese · English	Language of the screen texts.
Timing mode	From start · **From speed**	From start: the timer starts when you tap Start. From speed: the timer starts when the set speed is reached (default). See Section 4.4.
Auto-open lid	**On** · Off	On: the lid opens automatically after the rotor has stopped. Off: the lid stays locked until you tap Open.
Temp control	Energy-saving · Economy · Performance	Energy-saving: refrigeration off, the compressor does not start. Economy: the compressor switches on and off as needed to hold the set temperature. Performance: the compressor runs continuously after power-on for the fastest cooling.

Bold: factory default where known.

NOTE

Tapping Temp control switches through the three modes in the order shown. After each change, the compressor needs about **30 seconds** to respond to the new mode.

7.2 Pre-Cooling

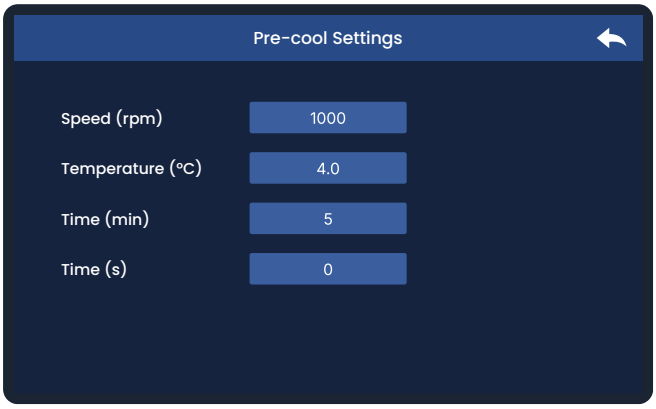


Figure 7-2 Pre-cool Settings screen

Pre-cooling brings the empty chamber and the rotor to the working temperature before you load cold samples. A slow spin circulates the air and cools the rotor evenly.

1. In System Settings, tap **Pre-cool**.
2. Set the speed, temperature and time (minutes and seconds) of the pre-cooling run.
3. Tap the back arrow to save and return.
4. Install the empty rotor with all buckets, close the lid and tap **Pre-cool** on the main screen.

TIP

Pre-cool at a moderate speed, for example 1000 rpm, to the same temperature as your run. For large volumes, pre-cool the samples separately in a refrigerator or on ice as well — the chamber alone cannot cool a full 100 ml bottle quickly.

7.3 Date and Time

In System Settings, tap **System Time**. Set year, month, day, hour and minute, tap **OK** to save and the back arrow to return. The date and time are stored with every run record, so set them correctly before the first run.

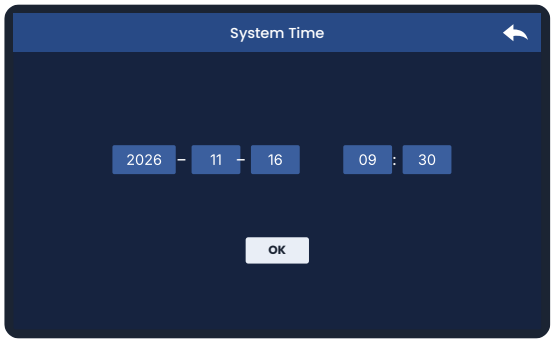


Figure 7-3 System Time screen

7.4 Run Records and Curves

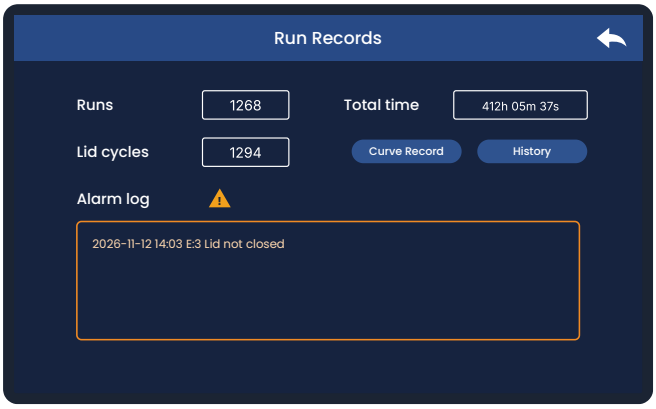


Figure 7-4 Run Records screen

In System Settings, tap **Run Records**. The screen shows the number of runs, the total run time, the number of lid-lock cycles and the alarm log. Two keys open the detailed records:

- **Curve Record**: speed, temperature, acceleration and deceleration curves of the most recent run. Tap Speed, Temp, Accel or Decel on the right to switch.
- **History**: the list of previous runs (Section 7.5).

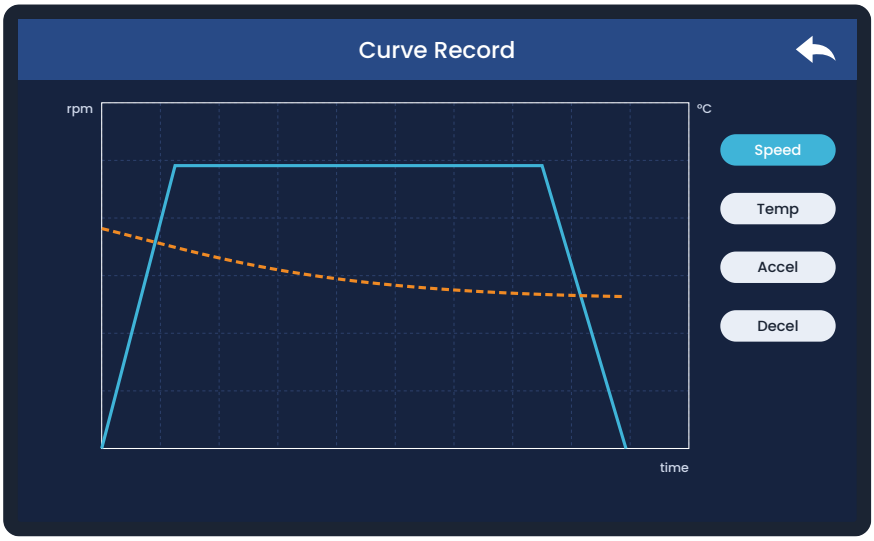


Figure 7-5 Curve Record of the last run

7.5 History and USB Export

The History screen lists the previous runs with date, program, rotor, speed, temperature, ramp, run time and status. Tap **Prev** and **Next** to page through the list.

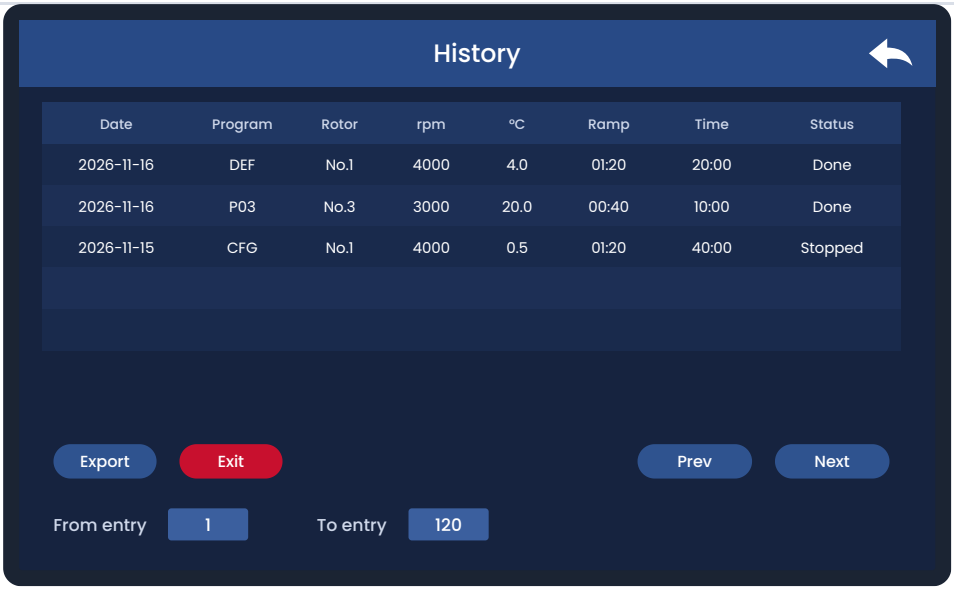


Figure 7-6 History screen

Exporting the history to a USB stick

1. Insert a USB stick (FAT32) into the USB port next to the power breaker on the right-hand side.
2. In **From entry**, enter the number of the oldest record you want to export; in **To entry**, the number of the newest.
3. Tap **Export**. The records are copied to the USB stick.
4. Tap **Exit** to return to Run Records.

> **TIP**
> Export the history regularly — for example monthly — and file it with your quality records. Use an empty USB stick that is reserved for the instrument.

7.6 Factory Settings

The **Factory** menu is used to adjust the instrument before delivery and by service personnel. It is protected and not intended for users. No user adjustment is necessary.

CHAPTER 8

Troubleshooting

The instrument monitors itself continuously. When it detects a fault, it stops the drive and shows an alarm. This chapter explains each alarm, lists other faults you may notice, and describes how to open the lid when the power has failed.

8.1 Alarm Messages



Figure 8-1 Alarm display (example: lid not closed)

When an alarm occurs, the upper part of the screen turns red and shows the alarm message. The buzzer sounds and the drive stops.

1. Read the message and note it, together with the time.
2. Tap the red area to acknowledge the alarm.
3. Find the alarm in the table below and remove the cause before you start again.

Alarms are also stored in the alarm log under Run Records (Section 7.4).

Table 8-1 Alarm messages and remedies

Alarm	Cause	What to do
Rotor identification error	The selected rotor number does not match the installed rotor (detected at low speed after the start).	Acknowledge the alarm, select the number of the installed rotor, check all parameters and start again.
Imbalance	Vibration caused by imbalance exceeded the limit; the system stopped automatically.	1. Check that the instrument is level. 2. Refit the rotor correctly. 3. Re-balance and redistribute the samples (Section 4.2).
Over-temperature	Temperature sensing element damaged or temperature control fault; the system stopped automatically.	1. Check that the room is not too warm and the vents are free. 2. Check the set temperature. 3. If the compressor does not run or the alarm returns, contact service.
Temperature sensor error	Temperature sensor not connected or damaged, or a fault in the refrigeration system.	Do not restart — contact service.
Motor over-temperature	The motor temperature exceeded 80 °C during the run.	Let the instrument cool down with the lid closed. If the alarm returns, the motor temperature sensor or the motor may be faulty — contact service.
Lid not closed	The lid is not fully closed at start, or it was forced open during the run; the system stopped automatically.	1. Close the lid firmly until it clicks (Section 5.3). 2. If the alarm persists, the lid switch or lock may be faulty — contact service.
Overspeed	The set speed is higher than the maximum of the selected rotor, or the actual speed exceeded the set speed during the run.	1. Check that the selected rotor number matches the installed rotor. 2. Enter a speed within the rotor's range. 3. If the alarm occurs during the run, contact service.

Alarm	Cause	What to do
Speed sensor fault	No speed signal is detected while the drive is running.	The speed sensor connection is loose or the sensor is defective. Do not restart — contact service.
Communication error	The control panel cannot communicate with the control board before the start.	Switch off and on again. If the alarm returns, a connector may be loose — contact service.
Inverter fault	The motor frequency inverter reports a fault: the motor does not run after START, or the run stops.	Switch off, wait 5 minutes and switch on again. If the alarm returns, contact service. Never change the inverter settings.

NOTE

The wording of the alarm messages on your instrument may differ slightly from this table. If an alarm is not listed here, note the code and message and contact LORDERAN (Section 8.5).

8.2 Faults Without an Alarm

Table 8-2 Common faults and remedies

Symptom	Possible cause	Remedy
Display stays dark, nothing happens	No power; supply not connected; breaker off or tripped	Check the supply and the power breaker. If a breaker trips again, contact service.
Rotor does not start	Lid not locked; an alarm is active; set speed out of range	Close the lid; acknowledge and remove the alarm (Section 8.1); check rotor number and speed.
Lid does not open	Rotor still turning; power failure	Wait until the rotor has stopped. After a power failure, use the emergency lid release (Section 8.4).
Poor cooling; set temperature not reached	Temperature control set to Energy-saving; room too warm; instrument too close to a wall; condenser fins dusty or condenser fan not running; refrigerant leak	Select Economy or Performance (Section 7.1); keep the required clearance; reduce the room temperature; pre-cool before loading. Fan, condenser and refrigerant: contact service.
Ice or water in the chamber	Moisture from the air condensed or froze during cold runs	Switch off, open the lid, let the ice melt and wipe the chamber dry. Empty the drip tray (Section 9.4).
Unstable operation, frequent stops	Unsuitable or fluctuating mains voltage	Use a suitable voltage stabiliser or connect to a stable supply (Section 2.4).
Increased vibration or unusual noise	See Section 8.3	Stop the run and check the causes in Section 8.3.

8.3 Vibration and Unusual Noise

A well-balanced run is smooth and quiet. If vibration or noise increases, stop the run and check the following causes, in this order:

Load

- Opposite positions not balanced to 1 g, or not symmetrical.
- Different tube types or fill levels in opposite positions.
- A bucket missing, or not swinging freely.

Rotor

- Rotor not seated on the taper, or not fixed.
- Rotor damaged or its balance impaired (dropped, corroded).

Site

- Floor or bench not solid; strong vibration nearby.
- Instrument not level; the feet carry unequal load.

Drive (service)

- Motor shaft bent or running out of true.
- If the noise remains with a correctly balanced, correctly fitted rotor, contact service.

8.4 Emergency Lid Release

The lid lock is electrically operated. If the lid cannot be opened because of a power failure or another fault, you can release the lock by hand.

> ⚠ **DANGER**
> Use the emergency release **only when the rotor has stopped completely**. Listen and wait: if you are not sure, wait longer. Never use the release to open the lid while the rotor is turning.

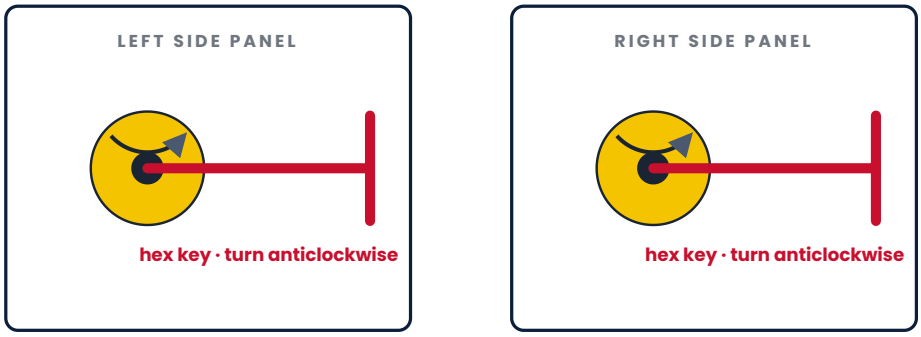


Figure 8-2 Emergency lid release

1. Switch off the instrument and disconnect it from the supply.
2. Wait until the rotor has stopped completely.
3. There is an emergency hole on each side of the instrument. Insert the hex key into the **left** hole and turn it **anticlockwise** to release the left lock.
4. Insert the hex key into the **right** hole and turn it **anticlockwise** to release the right lock. Lift the lid.

8.5 Contacting LORDERAN Service

If you cannot remove a fault yourself, contact LORDERAN at **support@lorderan.com** or through www.lorderan.com. To help us solve the problem quickly, please have this information ready:

- Model and serial number from the rating plate
- Date of delivery
- Alarm code and message, and when it occurs
- Rotor number, speed, temperature and load of the run
- Photographs or a short video of the problem
- The exported run history (Section 7.5)

CHAPTER 9

Care and Maintenance

The instrument is designed to need little maintenance. Regular cleaning and careful rotor handling are what keep it safe and accurate for its 8-year service life. Before any cleaning or maintenance, switch off the instrument and unplug it.

9.1 Daily Care

- After use, remove the rotor, then wipe the chamber clean and dry with a soft cotton cloth.
- After cold runs, leave the lid open for a while so that condensation can evaporate.
- Clean the touch screen only with a dry, soft cloth. Never let water reach it — water can enter and destroy the control board.
- Do not place rotors, bottles or tools on the lid or the top of the instrument. They can scratch or damage it.

9.2 Cleaning and Disinfection

Table 9-1 Cleaning agents

Part	Use	Do not use
Cabinet and lid	Soft cloth, water with a mild neutral detergent	Solvents, abrasive cleaners — they damage the paint
Chamber	Soft cotton cloth, mild neutral detergent; dry thoroughly	Large amounts of liquid, sharp tools
Rotor, buckets, adapters	Mild neutral detergent, rinse, dry with a soft cloth	Alkaline or non-neutral cleaners, metal brushes
Disinfection	A disinfectant compatible with aluminium and painted surfaces, for example 70 % ethanol	Chlorine-based disinfectants (sodium hypochlorite solution), strong acids or alkalis
Touch screen	Dry soft cloth only	Water, sprays

NOTICE · AFTER A TUBE BREAKAGE

1. With infectious material, leave the lid closed for at least 30 minutes so that aerosols can settle.
2. Wear gloves and eye protection. Remove the buckets and rotor; collect glass splinters with forceps, never with your fingers.
3. Clean and disinfect the chamber, rotor, buckets and adapters as described above. Check the rubber parts for splinters.
4. Check the rotor and buckets for damage before the next use.

9.3 Rotor Care and Service Life

The rotor is the part that carries the highest mechanical stress. Its anodised surface protects the aluminium from corrosion; once the surface is damaged, corrosion can weaken the rotor from the inside without being visible.

- After each use, take the rotor out of the chamber, clean it with a neutral detergent, dry it with a soft cloth and store it in a dry, ventilated place.

- Before each use, check that the centre nut or cap nut is not loose; tighten it if necessary.
- Protect the taper of the drive head and the bore of the rotor from knocks. Before installing the rotor, wipe both clean and apply a thin film of lubricant or medical petroleum jelly.
- Never use a rotor that has been dropped, shows corrosion pits (check the bottom of the bores of fixed-angle rotors), cracks, deformation or damage to the hanger slots or pins, until LORDERAN has inspected it.
- Check the seal ring of the rotor lid; replace it if it is cracked or hardened.
- Centrifuge bottles have a limited life (100 cycles); replace them in time and whenever they are deformed or cracked.
- The service life of a rotor is **5 years**. After this, the rotor must be returned to LORDERAN for inspection, or replaced with a new rotor.

TIP · ROTOR LOG
Record every rotor in the rotor log (Appendix C) with its first-use date. Write the date on the rotor case as well — this makes the end of the service life easy to see.

9.4 Drip Tray

Condensate that forms during operation runs into a drip tray at the bottom of the right-hand side (pull it out to empty it), so that it does not wet the floor. Empty it regularly, depending on how often you run cold.

9.5 Continuous-Flow Rotors

Continuous-flow rotors (rotor numbers No.7, No.8) separate large volumes while the suspension flows through the spinning rotor. They are used with a feed and outlet system and have their own assembly, sealing and cleaning procedure. Follow the instructions supplied with the continuous-flow rotor, and ask LORDERAN for training before the first use. Never exceed the speed limit of the rotor and the flow rate specified for it.

9.6 Longer Shutdown, Transport and Storage

Before a longer period without use

- Clean the chamber and leave a desiccant bag in it to absorb moisture and prevent the drive shaft from rusting. Apply a little grease to the motor shaft.
- Store the instrument with the lid open, in a ventilated, dry and clean room, away from direct sunlight, corrosive substances and flammable or explosive materials.
- Storage conditions: **−10 °C to +50 °C**, relative humidity **≤ 75 %**.

Transport

- For long-distance transport, use a wooden crate. Put a dust cover over the instrument and fill the space above, below and around it with foam cushioning.
- Remove the rotor and pack it separately.
- During transport, avoid knocks, never turn the instrument upside down or on its side, and protect it from rain and snow.
- Short moves inside the building are possible without packing, but avoid strong vibration, impact and tilting.

9.7 Repairs and Spare Parts

- Do not dismantle or repair the instrument yourself. Contact LORDERAN or a service partner authorised by LORDERAN.

- Spare parts must have the same specification as the original parts and be approved by LORDERAN.
- Replace the power breaker only with a breaker of the same type and rating.

9.8 Disposal

At the end of its life, do not dispose of the instrument with household or general waste. It contains electrical and electronic components and a refrigeration circuit with refrigerant R404A and compressor oil, which must be recovered by a qualified refrigeration technician. Hand the instrument over to a licensed recycling company in accordance with your local regulations. Decontaminate the chamber, rotor and accessories before disposal if they have been in contact with hazardous samples.

APPENDIX A

Quick Reference

The key data on one page. Full specifications: Table 3-1; rotors: Table 3-2.

25,000 rpm	64,983 × g	−20 → +40 °C	4 × 1000 ml
MAX. SPEED (BH2500R)	MAX. RCF (BH2500R)	TEMPERATURE RANGE	MAXIMUM CAPACITY

A.1 Key Values and Limits

Item	Value	Section
Speed setting	up to the maximum of the selected rotor	5.4
Timer	1 s – 99 h 59 min 59 s	5.4
ACC / DEC	ACC 1 – 10 · DEC 0 – 10 (higher = faster; DEC 0 = free coast)	4.4
Temperature setting	-20 to +40 °C	5.4
Imbalance between opposite positions	≤ 1 g	4.2
Max. fill, fixed-angle / swing-out	80 % / 90 % of nominal volume; bottles ≥ 250 ml: ÷ sample density	4.3
Space around the instrument	safety zone ≥ 500 mm; ventilation ≥ 300 mm behind	2.3
Power supply	AC 220 V ±10 %, 50 Hz, single phase, three-wire; 5 kW	2.4
Ambient conditions (operation)	5 – 40 °C, ≤ 80 % RH, 86 – 106 kPa	2.3
Storage conditions	-10 to +50 °C, ≤ 75 % RH	9.6
Wait after power-off before opening covers	≥ 4 minutes (service personnel only)	1.5
Service life	Instrument 8 years · rotor 5 years	9.3

$RCF = 1.118 \times 10^{-6} \times r \times n^2$

r in mm, n in rpm — see Section 4.1 and the conversion table there.

APPENDIX B

Alarm and Fault Index

Find the symptom, the likely cause and the section that explains the remedy.

Symptom / message	Likely cause	Section
ALARMS		
Rotor identification error	Wrong rotor number selected	8.1
Imbalance	Unequal or asymmetric load, rotor not seated, instrument not level	8.1
Over-temperature	Room too warm, cooling fault	8.1
Temperature sensor error	Sensor or refrigeration fault	8.1
Motor over-temperature	Motor overheated	8.1
Lid not closed	Lid not latched, or opened during the run	8.1
Overspeed	Wrong rotor number, speed above the rotor limit	8.1
Speed sensor fault	No speed signal	8.1
Communication error	Loose internal connection	8.1
Inverter fault	Frequency inverter fault	8.1
SYMPTOMS WITHOUT AN ALARM		
Display dark	No power, breaker	8.2
Rotor does not start	Lid, alarm, speed out of range	8.2
Lid does not open	Rotor turning, power failure	8.2, 8.4
Vibration / noise	Imbalance, loose rotor, site	8.3, 4.2
Temperature not reached	Room, clearance, condenser, no pre-cooling	8.2, 4.5
Tube or bottle broken in the chamber	Unsuitable, overfilled or damaged tube	9.2, 4.3

APPENDIX C

Maintenance Schedule and Logs

Copy these pages, or keep the logs electronically. Intervals marked “Required” are stated by the manufacturer; the others are LORDERAN recommendations.

C.1 Maintenance Schedule

Task	Interval	Basis	Section
Inspect rotor, lid, buckets, adapters and tubes; check that the rotor is fixed	Before every run	Required	5.9
Remove the rotor, clean and dry rotor and chamber	After use / daily	Required	9.1
Empty the drip tray	Weekly, or daily with frequent cold runs	Recommended	9.4
Clean the taper and rotor bore, apply a thin film of lubricant	When the rotor is fitted	Required	9.3
Check the rotor for corrosion, cracks and damage under good light	Monthly	Recommended	9.3
Check the lid seal and the space around the vents	Monthly	Recommended	2.3
Export the run history to USB	Monthly	Recommended	7.5
Clean the condenser fins (service)	Yearly, or when cooling weakens	Recommended	8.2
Rotor inspection by LORDERAN or replacement	After 5 years	Required	9.3

C.2 Operation Log

Date	Operator	Rotor	Program / rpm or × g / time / °C	Batch	Remarks

Date	Operator	Rotor	Program / rpm or × g / time / °C	Batch	Remarks

C.3 Rotor Log

Rotor No.	Serial no.	First use	Inspection due	Findings / action	Sign

C.4 Maintenance Log

Date	Done by	Work carried out / parts replaced	Sign

APPENDIX D

Checklists

Checklists distilled from the chapters of this manual. Tick them off until the routine is second nature.

D.1 Before First Use

CHECKLIST

- [ ] Delivery checked against the packing list; no transport damage (Section 2.2).
- [ ] Solid, level site; required space around the instrument; no vibration sources nearby (Section 2.3).
- [ ] Dedicated, earthed supply as specified (Section 2.4).
- [ ] Instrument acclimatised for 2 hours after cold transport.
- [ ] Language, date and time set (Chapter 7).
- [ ] Test run with the empty rotor completed without vibration (Section 2.5).
- [ ] All operators have read Chapters 1 to 5.

D.2 Before Every Run

See the checklist in Section 5.9.

D.3 End of the Day

CHECKLIST

- [ ] Samples removed; chamber checked for spills and broken tubes.
- [ ] Rotor removed, cleaned, dried and stored together with its lid and tools.
- [ ] Chamber wiped dry; lid left open for a while after cold runs.
- [ ] Drip tray checked.
- [ ] Run entered in the operation log; instrument switched off at the power breaker.

APPENDIX E

Glossary

Terms and abbreviations used in this manual.

Term	Meaning
ACC / DEC	Acceleration and deceleration setting of the rotor.
Adapter	Insert that holds smaller tubes in a rotor bore, bucket or rack.
Aerosol	Fine droplets suspended in air; released, for example, when a tube breaks.
Anodised layer	Protective oxide layer on aluminium rotors and buckets.
Balance (blank) tube	Tube filled with water to the same mass as the sample tube opposite it.
Bucket	Container that hangs on a swing-out rotor and swings out to the horizontal during the run.
Continuous-flow rotor	Rotor through which the suspension flows during the run, for large volumes.
DEF	Shown in the Preset field when the current settings were entered by hand and not saved.
Fixed-angle rotor	Rotor whose tubes are held at a fixed angle to the axis; fast pelleting at high RCF.
Imbalance	Mass difference between opposite positions of the rotor; max. 1 g.
Jog	Short spin that runs as long as the jog screen is open.
Pellet	Solid material collected at the bottom or outer wall of the tube.
Pre-cooling	Cooling the chamber and rotor before a cold run.
Preset	Stored single-step run that can be recalled.
r (radius)	Distance from the axis of rotation to the sample, in mm.
RCF (× g)	Relative centrifugal force, as a multiple of the earth's gravity.
rpm	Revolutions per minute.
Step program	Named program with up to 10 steps of different speed, temperature, ramp and time.
Supernatant	Liquid above the pellet after centrifugation.
Swing-out rotor	Rotor whose buckets swing to the horizontal, so the pellet forms at the bottom of the tube.
Taper	Conical drive head of the motor shaft that centres the rotor.

APPENDIX F

Warranty and Service

LORDERAN stands behind every instrument it delivers. This appendix summarises the warranty and how to obtain service.

F.1 Warranty

- The BH2500R / BH2300R are covered by a **1-year warranty** from the date of delivery against defects in materials and workmanship, under normal use in accordance with this manual.
- Within the warranty period, LORDERAN repairs or replaces defective parts free of charge. Major defects are covered by replacement or a full refund, as stated in the LORDERAN warranty policy on www.lorderan.com.
- The warranty does not cover damage caused by: repairs or modifications by persons not authorised by LORDERAN; incorrect installation; an incorrect supply voltage; use not in accordance with this manual; accidents, fire, flooding or other force majeure; wear parts and consumables.
- Outside the warranty, or for excluded damage, LORDERAN offers repair against a charge for service and parts.
- Please keep your proof of purchase. The serial number on the rating plate identifies your instrument.

F.2 Product Record

Fill in this record when the instrument is installed and keep it with this manual.

Product	High-Speed Refrigerated Centrifuge	**Model**
Serial number		**Delivery date**
Organisation / department		
Address		
Contact person		**Telephone**
E-mail		
Rotors supplied		

F.3 Contact

Technical support and service

support@lorderan.com
www.lorderan.com

Spare parts and rotors

Order through www.lorderan.com or support@lorderan.com. Please state the model and serial number.

LORDERAN

High-Speed Refrigerated Centrifuge — User Manual

BH2500R · BH2300R

The content of this manual may be revised due to functional upgrades without prior notice.

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