LORDERAN LABORATORY CENTRIFUGE SERIES

USER MANUAL

Low-Speed Refrigerated Centrifuge

Installation · Operation · Programs · Maintenance



5000 rpm
MAXIMUM SPEED

4390 × g
MAXIMUM RCF

−20 → **+40** °C
TEMPERATURE RANGE

4 × 2 × 100 ml
MAXIMUM CAPACITY

Benchtop | 7-inch touch screen | 4 rotors | TDL-5A

Applies to the LORDERAN TDL-5A Benchtop Low-Speed Refrigerated Centrifuge and its 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 TDL-5A Benchtop Low-Speed Refrigerated Centrifuge. It explains how to set the instrument up, how to load and balance 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.

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 TDL-5A reaches up to 5000 rpm and 4390 × g and keeps the rotor chamber between -20 °C and +40 °C, so temperature-sensitive samples such as blood, cells and proteins can be processed cold. Typical tasks are separating serum and plasma, pelleting cells in 15 ml and 50 ml conical tubes, clarifying extracts and spinning 96-well microplates.

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) socket.
	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 socket or extension cable 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.
	Prohibited	An action that must never be carried out.

Symbol	Type	Meaning
	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 TDL-5A.
Packing list	The rotor, 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	Installing 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

Plug in, then switch on at the right-hand side. The main screen 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 shaft and tighten the centre nut with the wrench. **5.2**

4

Balance the load

Equal mass (±0.1 g) in opposite positions. Swing buckets: max. 90 % fill. **4.2**

5

Close the lid

Press down on both sides 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, tap **Open** 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.
- Spin flammable, explosive or strongly reactive samples.
- Open the lid with the emergency release while the rotor is turning.

GOOD HABITS

- Pre-cool the empty chamber and rotor before cold runs (Section 7.2).
- 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 5000 rpm stores a large amount of kinetic energy. Almost every centrifuge accident has the same few causes: an unbalanced load, an overloaded or damaged rotor, 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.
- Connect the instrument only to a socket with a protective earth conductor that matches the rating plate (AC 220 V ±10 %, 50 Hz). Never use the neutral conductor as the earth, and never share the earth.
- Use only rotors, buckets, adapters and accessories approved by LORDERAN for the TDL-5A. If you want to use a third-party accessory, ask LORDERAN to confirm that it is suitable before you use it.
- Check the rotor, 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 clearance of at least 30 cm around the instrument at all times. This is a ventilation space and a safety zone: no person should stay in it longer than necessary during a run.
- 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 TDL-5A is **not** an explosion-proof centrifuge. 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 — see Section 1.4.

1.3 Rotor and Load Safety

- **Balance every load.** Opposite positions must carry the same mass to within **0.1 g**, and the tubes must be placed symmetrically about the drive shaft (Section 4.2).
- **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.** Swing-out buckets: at most 90 % of the tube's nominal volume. Fixed-angle rotors: at most 80 % (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.
- **Tighten the rotor.** Check before every run that the centre nut or cap nut 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, tap **Stop** 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 with screw caps and, where available, sealed buckets or aerosol-tight lids.
- Load and unload sealed buckets 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 buckets 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 unplug it 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.
- Replace a fuse only with a fuse of the same type and rating.
- Replacement parts must be approved by LORDERAN. Unapproved parts can cause fire, electric shock or other hazards.
- Switch the instrument off at the power switch when you finish work for the day.

1.6 Intended Use and Limitation of Liability

The TDL-5A is intended for the separation of liquid samples in tubes, bottles and microplates 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;
- 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** — straps, panels, foam
3. **Check** — parts vs. packing list
4. **Place** — level bench, 30 cm free
5. **Connect** — earthed 220 V socket
6. **Test run** — empty rotor, low speed

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.

1. Cut the two steel straps around the crate with suitable cutters and remove them. **Wear gloves and eye protection** — the strap ends spring back.
2. Lift the four side panels and the top panel off as one unit.
3. Remove the plastic cover. Lift the centrifuge off the base pallet and carry it to the installation site. The instrument weighs **80 kg**: lift it with at least two people (four are recommended), hold it by the base, never by the lid or the front panel.
4. Remove the foam packing and take out the rotor, buckets, racks and adapters.

> ⚠ **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 9.5).

2.2 Checking the Delivery

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

Table 2-1 Standard scope of delivery

#	Item	Qty	Remark
1	TDL-5A centrifuge	1	Service life 8 years
2	Rotor with buckets / racks and adapters	1 set	As ordered; service life 5 years (Section 9.3)
3	Emergency lid-release wrench (T-hex)	1	Keep it near the instrument (Section 8.4)
4	Rotor tightening wrench	1	For the rotor centre nut / cap nut
5	Silicone rubber seal set	1 set	Spare seals
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 bench or floor that can carry at least **80 kg** plus rotor and load without flexing. All rubber feet must touch the surface firmly.
- 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.
- At least **300 mm** free space on every side for cooling air and as a safety zone (**Figure 2-1**).

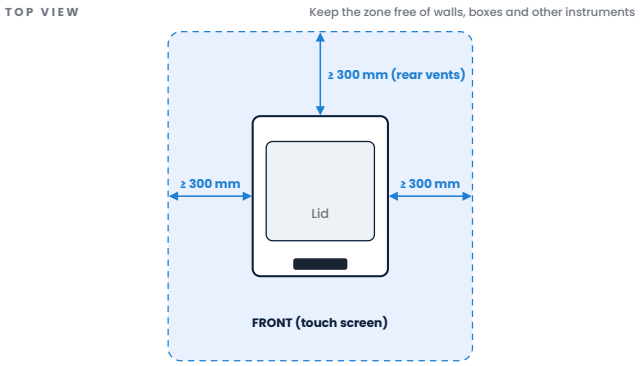


Figure 2-1 Minimum clearance around the instrument

TIP · WHY CLEARANCE MATTERS

The refrigeration system releases the heat it removes from the chamber through the side and rear vents. If the warm air cannot escape, the condenser runs hotter, cooling slows down and the lowest chamber temperature rises. In a warm room (above about 30 °C) 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	Single-phase AC 220 V ±10 % (198 – 242 V), 50 Hz
Rated power	1.2 kW
Socket	Dedicated socket with a protective earth conductor. Do not use the neutral as the earth, do not share the earth, and avoid extension cables and multi-way strips.
Unstable mains	Where the voltage fluctuates outside the range above, use a suitable voltage stabiliser rated for at least 1.5 kW.

DANGER

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

2.5 First Power-On and Test Run

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 drip tray is in place under the instrument (Section 9.4).

3. Connect the power cord and switch on with the power switch on the right-hand side. The touch screen starts and shows the main screen.
4. Tap **Open**, lift the lid and check that the chamber is clean and empty.
5. Install the rotor with all buckets but **without samples** (Section 5.2), close the lid (Section 5.3).
6. Select the installed rotor number, set 1000 rpm, 2 minutes, 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 TDL-5A: what it can do, the rotors it accepts, the parts you will handle, and the touch screen you use to control it.

3.1 Technical Specifications

Table 3-1 Technical specifications of the TDL-5A

Parameter	Specification
PERFORMANCE	
Maximum speed	5000 rpm
Maximum RCF	4390 × g
Maximum capacity	4 × 2 × 100 ml (800 ml) with the standard rotors
Speed setting range	300 rpm to the maximum speed of the selected rotor; or set as RCF (× g)
Speed accuracy	±10 rpm
Timer	1 s – 99 h 59 min 59 s (H:M:S); continuous operation via the Jog function
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, in steps of 0.1 °C
Temperature accuracy	±1 °C
Refrigeration	Imported hermetic compressor, CFC-free refrigerant R134a; solenoid-valve hot-gas heating
CONTROL AND SAFETY	
Display / control	7-inch colour LCD touch screen
Programs	User presets and named multi-step programs with up to 10 steps each
Data	Run history, alarm log and speed / temperature curves; USB export
Safety devices	Self-locking lid with interlock, overspeed protection, speed-sensor monitoring, imbalance protection, automatic rotor recognition, steel protective ring around the chamber
INSTALLATION	
Power supply	AC 220 V ±10 %, 50 Hz, single phase
Rated power	1.2 kW
Noise	< 65 dB(A)
Ambient conditions	5 – 40 °C, ≤ 80 % RH (non-condensing), 86 – 106 kPa
External dimensions (L × W × H)	750 × 480 × 420 mm

Parameter	Specification
Packing dimensions (L × W × H)	800 × 580 × 490 mm
Net weight	80 kg
Service life	Instrument 8 years; rotors 5 years

3.2 Rotors and Accessories

The controller recognises the installed rotor automatically and refuses a speed above the rotor's limit. You must still select the correct rotor number on the screen (Section 5.4), because the speed range, the RCF conversion and the program limits depend on it.

Table 3-2 Rotors for the TDL-5A

No.	Type	Capacity	Max. speed (rpm)	Max. RCF (× g)	Radius r (mm)*
STANDARD ROTORS					
No.1	Swing-out	4 × 100 ml (tube rack)	5000	4390	157
No.2	Swing-out	4 tube buckets with adapters for 50 ml and 15 ml tubes	4000	2810	157
No.3	Swing-out	4 × 18 × 7 ml blood collection tubes (also 4 × 12 × 7 ml rack)	4000	3200	179
No.4	Microplate	2 × 2 × 96-well plates (carrier included)	4000	2200	123
FURTHER ROTORS RECOGNISED BY THE CONTROLLER (ON REQUEST)					
No.5	Swing-out	4 × 2 × 100 ml	4000	3093	173
No.6	Swing-out	4 × 20 × 7 ml	4000	3090	173
No.7	Swing-out	4 × 250 ml	4000	3062	171
No.8	Swing-out	4 × 500 ml	4000	3040	170

* Effective radius calculated from the rated speed and RCF (Section 4.1). It is a reference value, not a measured dimension. Your packing list shows which rotors and adapters were supplied.

3.3 Parts of the Instrument

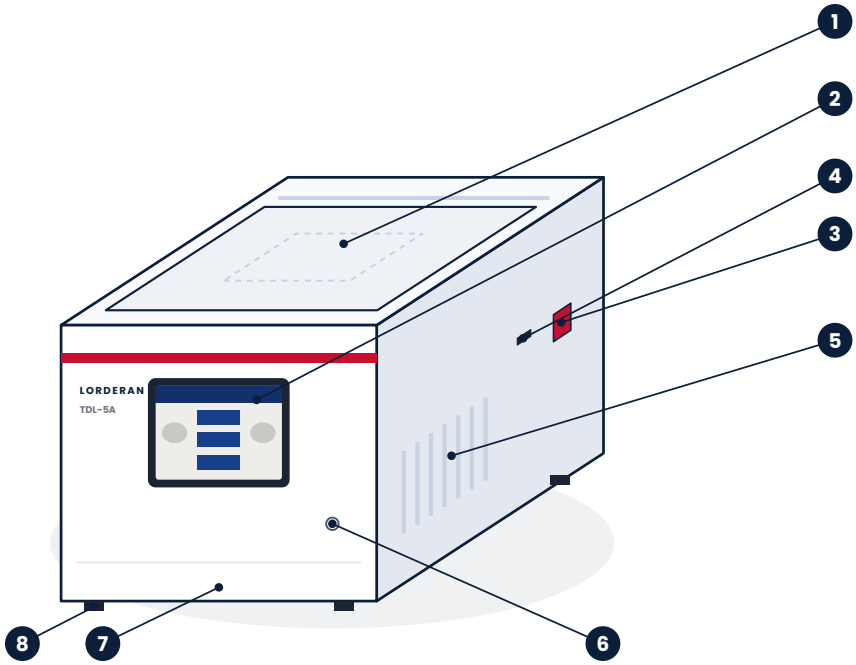


Figure 3-1 Main parts of the TDL-5A (illustration)

#	Part
1	Lid with gas-spring struts and self-locking latch
2	7-inch touch screen (control panel)
3	Power switch (right-hand side)
4	USB port (right-hand side)

#	Part
5	Air vents of the refrigeration system — keep free
6	Emergency lid-release hole with plug (Section 8.4)
7	Condensate drip tray, under the instrument (Section 9.4)
8	Rubber feet

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 and electrical control system.

Drive system

A high-torque, variable-frequency AC motor drives the rotor directly. A special damping mount reduces vibration and noise. The motor shaft ends in a taper that centres the rotor.

Refrigeration

A hermetic compressor cools an evaporator coil 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 and temperature with the set values, controls the drive and the cooling, and monitors the safety devices. Speed and time can be changed during a run.

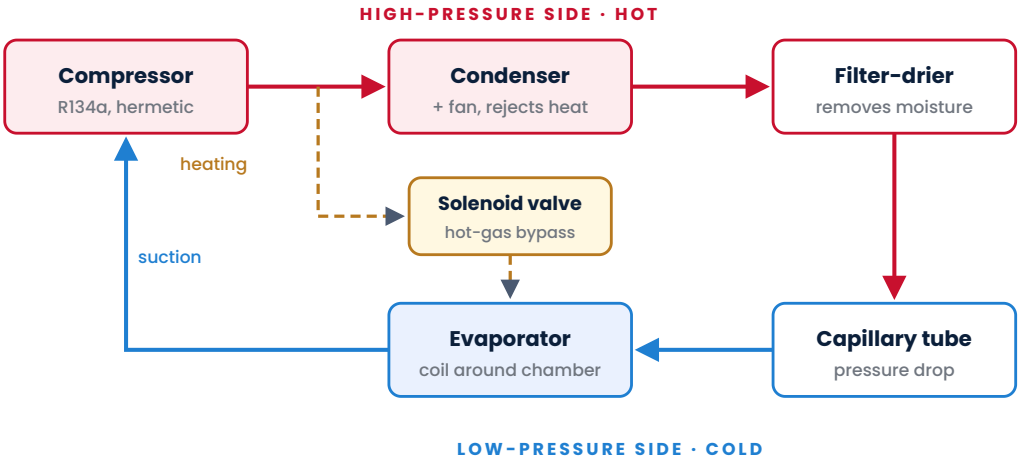


Figure 3-2 Refrigeration principle

3.5 The Touch Screen

All functions are operated from the 7-inch 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.

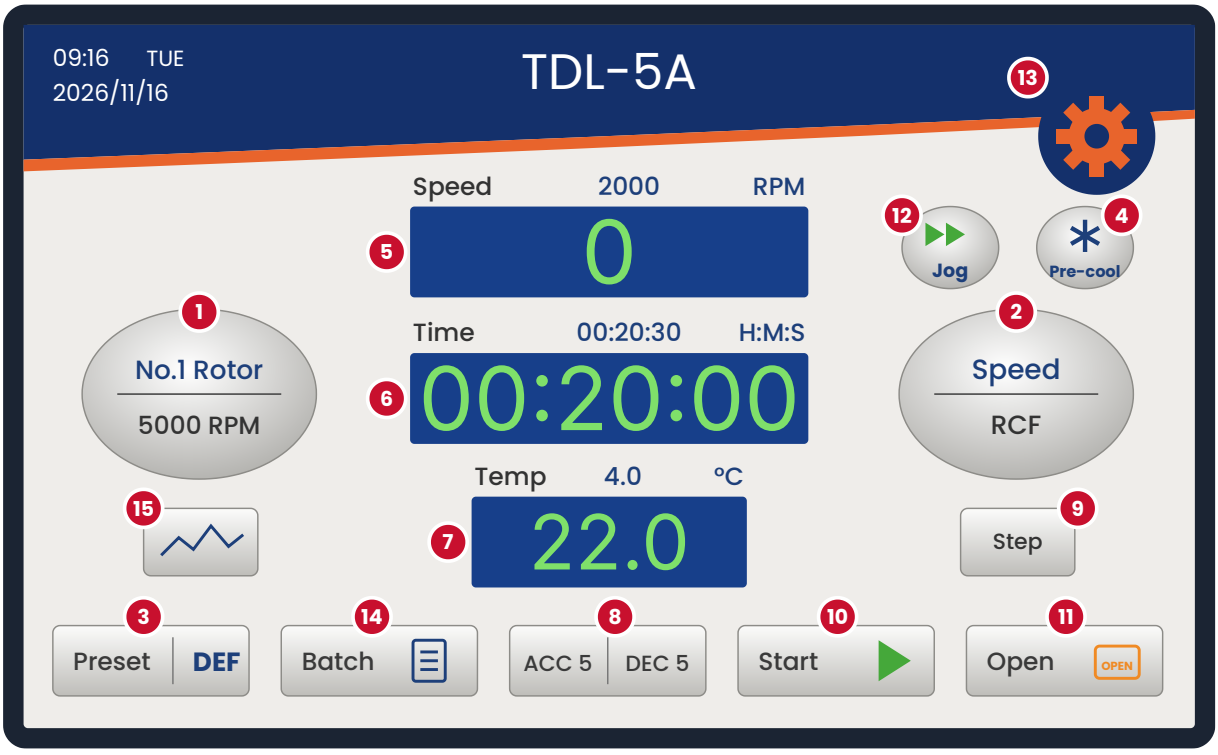


Figure 3-3 Main screen (screens in this manual are illustrations; the layout on your instrument may differ slightly with the software version)

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).

#	Element	Function
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 speed, temperature and time 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).
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 that is stored with the run record (Section 6.3).
15	Curve	Shows the speed and temperature curve of the current or last run.

3.6 The On-Screen Keypad

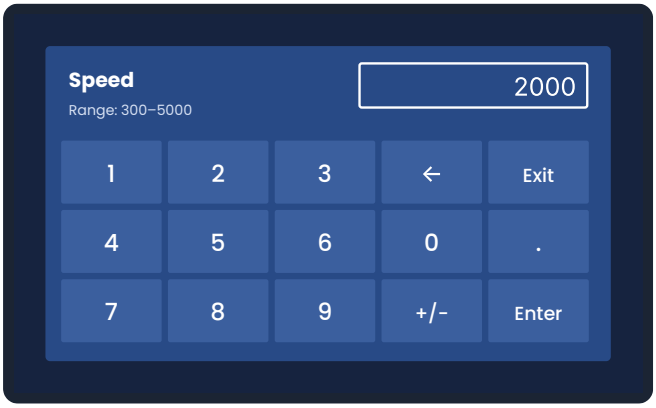


Figure 3-4 On-screen keypad, here for the speed

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 lock has engaged. The lid cannot be opened by the Open key while the rotor turns; if the lid opens during a run, the drive stops at once.

Overspeed and rotor recognition

The controller identifies the rotor and blocks any speed above its limit. If the actual speed exceeds the set speed by a defined margin, the run is stopped.

Speed sensor and imbalance monitoring

If the speed signal is lost, or if the run becomes severely unbalanced, the drive is stopped and an alarm is shown (Chapter 8).

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 how the rotor speeds up, 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: $n = \sqrt{(RCF \div (1.118 \times 10^{-6} \times r))}$

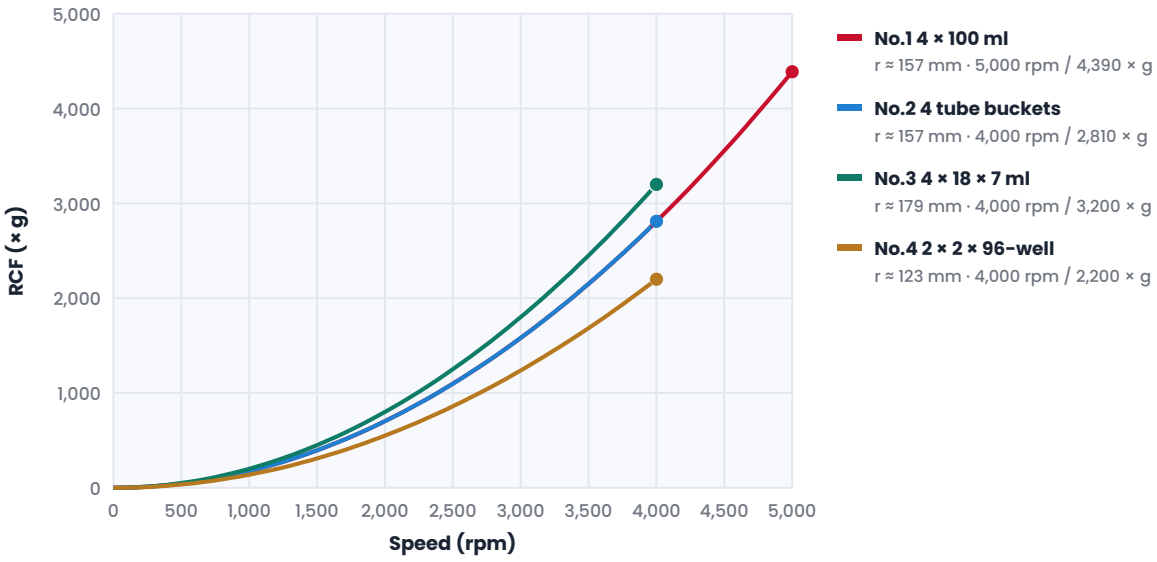


Figure 4-1 RCF versus speed for the standard rotors of the TDL-5A

WORKED EXAMPLE

A protocol asks for **1500 × g for 10 minutes** to pellet cells in 15 ml tubes. In rotor No.2 (r ≈ 157 mm) the speed is $n = \sqrt{(1500 \div (1.118 \times 10^{-6} \times 157))} \approx$ **2920 rpm**. Simply tap **Speed / RCF** so that RCF is active and enter 1500 — 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 157 mm	No.2 · r 157 mm	No.3 · r 179 mm	No.4 · r 123 mm
100	750	750	710	850
300	1,310	1,310	1,220	1,480

RCF (× g)	No.1 · r 157 mm	No.2 · r 157 mm	No.3 · r 179 mm	No.4 · r 123 mm
500	1,690	1,690	1,580	1,910
1,000	2,390	2,390	2,240	2,700
1,500	2,920	2,920	2,740	3,300
2,000	3,380	3,380	3,160	3,810
2,500	3,770	3,770	3,530	—
3,000	4,130	—	3,870	—
4,000	4,770	—	—	—

"—" 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 motor bearings, can stop the run with an alarm and, in the worst case, damages the instrument. Balance therefore is not optional.

- Opposite positions must carry the **same mass to within 0.1 g**. Weigh the filled tubes 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.

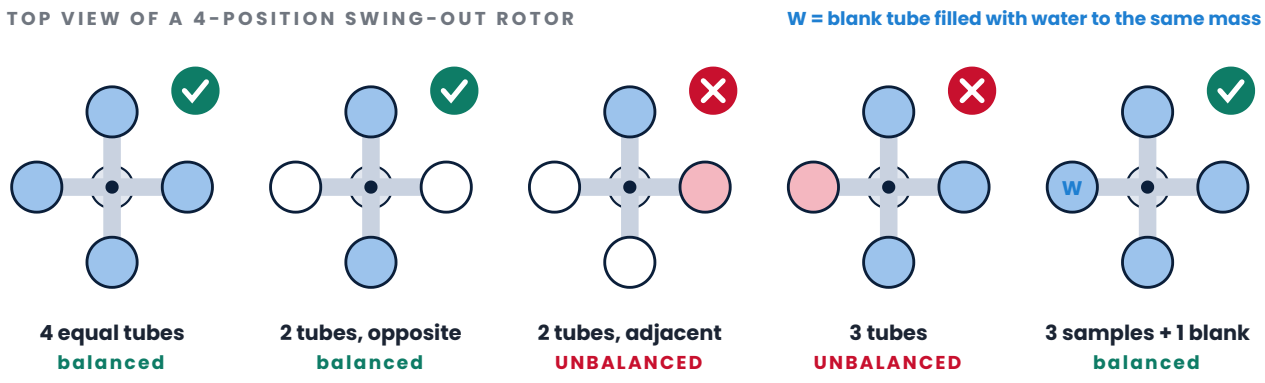
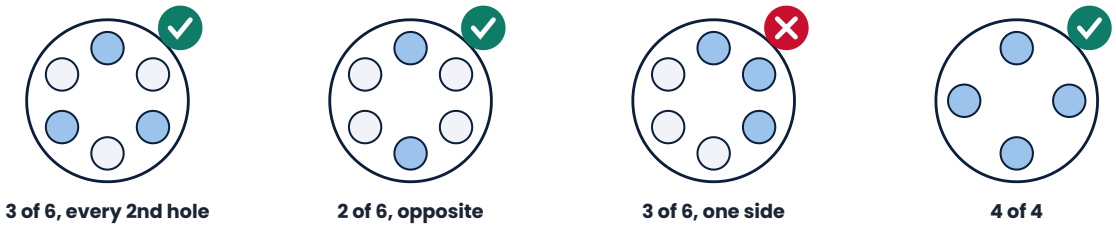


Figure 4-2 Correct and incorrect loading of a 4-position swing-out rotor



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

Figure 4-3 Symmetric loading inside multi-tube adapters

4.3 Fill Levels and Tubes

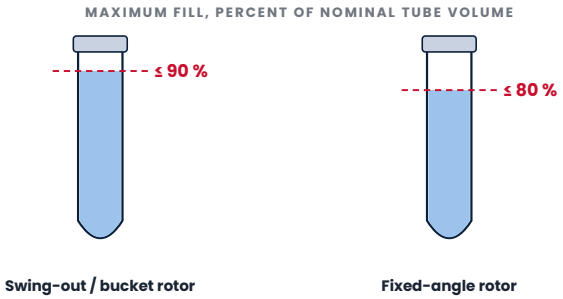


Figure 4-4 Maximum fill levels

- **Swing-out rotors:** fill each tube to no more than **90 %** of its nominal volume.
- **Fixed-angle rotors:** no more than **80 %**, because the liquid surface tilts towards the cap.
- Use tubes that are rated for at least the RCF of your run. Replace tubes that are deformed or cracked.
- Close tubes and bottles tightly, and dry the outside before loading.
- If the density of your samples is higher than usual (for example concentrated salt or sucrose solutions), ask LORDERAN for the rated sample density of the rotor and reduce the speed accordingly.

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 (for example blood separated on a density medium) from being stirred up.

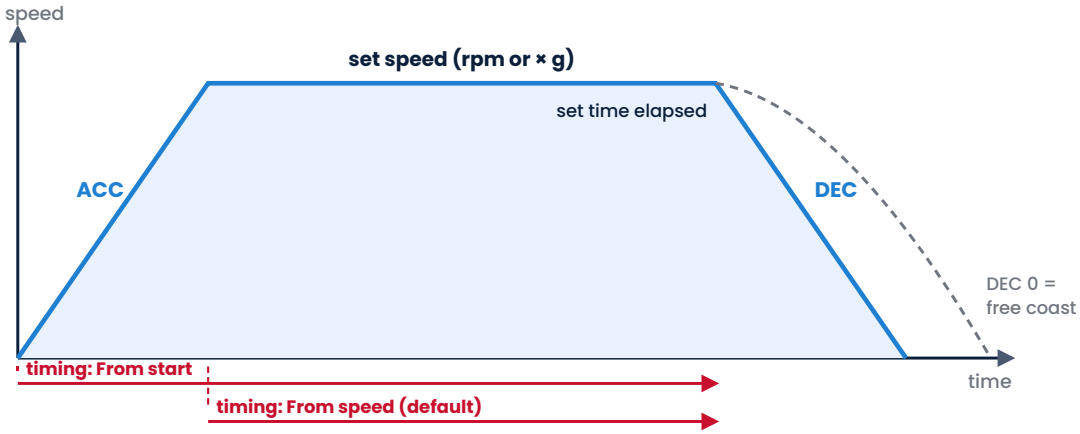


Figure 4-5 Run profile: acceleration, run time and deceleration

Choosing ACC / DEC

- Level 1 is the gentlest, level 10 the fastest.
- Large or heavily loaded rotors: use lower levels.
- Density gradients and fragile pellets: low DEC, or DEC 0 (free coast) for the last part of the run.

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 tap Start. 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 time. 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 the tube volume. A 100 ml bottle needs much longer than a 1.5 ml tube to reach the set temperature.
- For cold runs, **pre-cool the empty 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 as speed increases. At high speed the chamber may need a set value slightly below the sample temperature you want; check with a thermometer in a dummy tube if the temperature is critical.
- 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).

TIP · TEMPERATURE CONTROL MODE

Between runs the compressor can stay in standby to save energy. Choose the temperature control mode in System Settings (Section 7.1): **Performance** keeps the compressor running for the fastest cooling, **Economy** cycles it as needed, **Energy-saving** switches refrigeration off for runs at room temperature.

CHAPTER 5

Operation

This chapter describes a complete single-step 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** 5.2 – 5.3
4. **Set values** 5.4
5. **Start** 5.5
6. **Unload** 5.6

DANGER

- The TDL-5A 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. Plug the power cord into the socket and switch on with the power switch on the right-hand side of the instrument.
2. The touch screen starts and shows the main screen with the parameters of the last run.
3. Tap **Open**. The lid lock releases. Lift the lid with both hands; the gas-spring struts hold it open.

5.2 Installing the Rotor and Loading the Samples

DANGER

- Use only rotors, buckets and adapters specified for the TDL-5A.
- Never use rotors, buckets or adapters that are corroded, scratched or cracked. Inspect them before every run.

Installing a swing-out rotor

The TDL-5A uses two types of swing-out rotor. Disc-type rotors (No.1, No.2, No.5) are held by a **cap nut**, which you tighten with the open-end wrench. Cross-arm rotors (No.3, No.4, No.6 – No.8) are held by a **centre nut**, which you tighten with the T-hex wrench.

1. Wipe the motor shaft taper and the bore of the rotor with a soft cloth. Apply a very thin film of the lubricant supplied (or medical petroleum jelly) to the taper.
2. Turn the rotor so that the correct side faces up: on a cross-arm rotor, the side with the centre nut; on a disc rotor, the side with the bucket hanger slots.
3. Hold the rotor level and lower it **vertically and slowly** onto the motor shaft. The bore must seat fully on the taper; do not drop or force it.
4. Tighten the centre nut clockwise with the T-hex wrench, or the cap nut with the open-end wrench, while you hold the rotor still with the other hand.

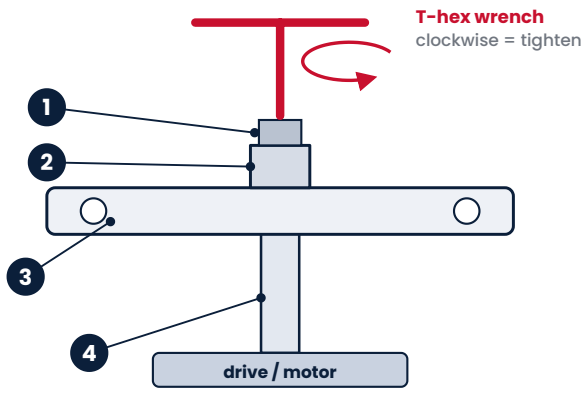


Figure 5-1 Cross-arm rotor: 1 centre nut · 2 nut retainer · 3 rotor body · 4 motor shaft with taper

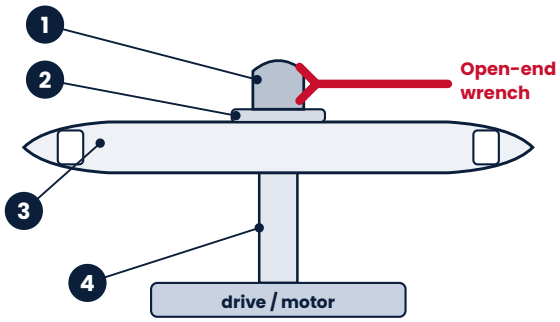


Figure 5-2 Disc-type rotor: 1 cap nut · 2 flat washer · 3 rotor disc with hanger slots · 4 motor shaft

Loading buckets, racks and tubes

1. Fill the tubes or bottles (max. 90 % of the nominal volume) and balance opposite pairs to within **0.1 g** (Section 4.2).
2. Hang all buckets or racks on the rotor, including the ones you do not use. Each must swing freely.
3. Place the adapters in the buckets and the tubes in the adapters, symmetrically about the axis. Never run an asymmetric load, even when you have only a few samples — add balance tubes instead.
4. For microplates (rotor No.4), load the plate carriers in opposite positions with plates of the same type and mass.

> **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 left and right, 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 (alarm E:3, 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 5-3 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 rotor No.1: 300 – 5000 rpm). Example: enter **2000** 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 and seconds is 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.

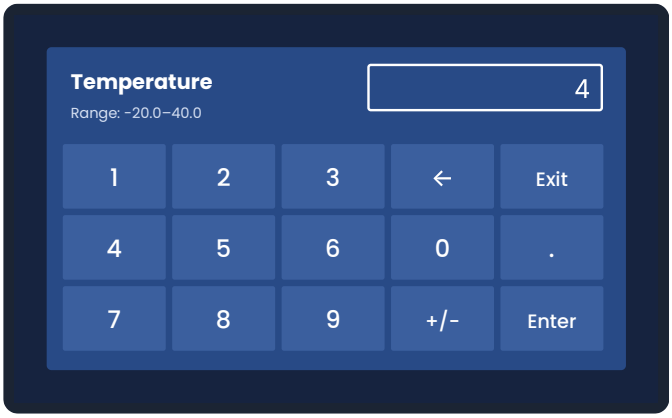


Figure 5-4 Entering the temperature



Figure 5-5 Main screen after setting: rotor No.1, 2000 rpm, 20 min 30 s, 4.0 °C, ACC 5 / DEC 5

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**). Stay near the instrument until the rotor has reached full speed and runs quietly.

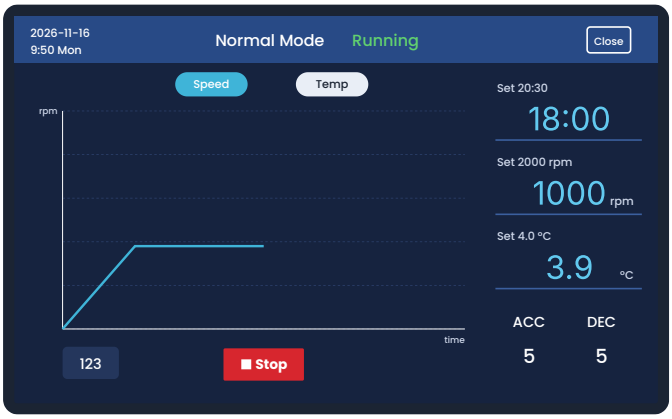


Figure 5-6 Run screen with speed curve

- 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, tap **Stop** 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**. Tap **Open** and lift the lid with both hands.
3. Take the tubes or bottles out of the buckets, or lift out the buckets. Hold them upright so that the pellet is not disturbed.
4. Check the chamber and buckets 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 switch.

5.7 Jog (Short Spin)

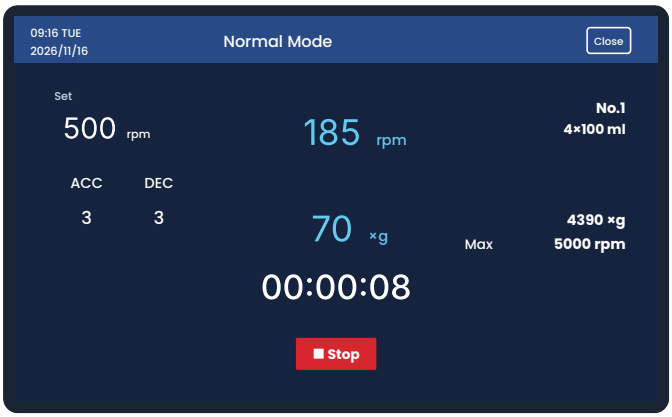


Figure 5-7 Jog screen

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 bend the motor shaft.

1. Hold the rotor body with one hand so that it cannot turn.
2. Loosen the centre nut anticlockwise with the T-hex wrench, or the cap nut with the open-end wrench.
3. Hold the rotor with both hands and lift it slowly and vertically out of the chamber.
4. Clean and dry the rotor and store it in a dry, ventilated place (Section 9.3).

5.9 Before-Every-Run Checklist

CHECKLIST

- ☐ Rotor, buckets and adapters are approved for the TDL-5A and undamaged.
- ☐ The rotor is seated on the shaft and the nut is tight.
- ☐ The chamber is clean, dry and free of objects.
- ☐ Tubes are intact, closed and filled to the permitted level.
- ☐ Opposite positions are balanced to within 0.1 g and loaded symmetrically.
- ☐ All buckets / racks are in place and swing freely.
- ☐ 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 30 cm 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**.

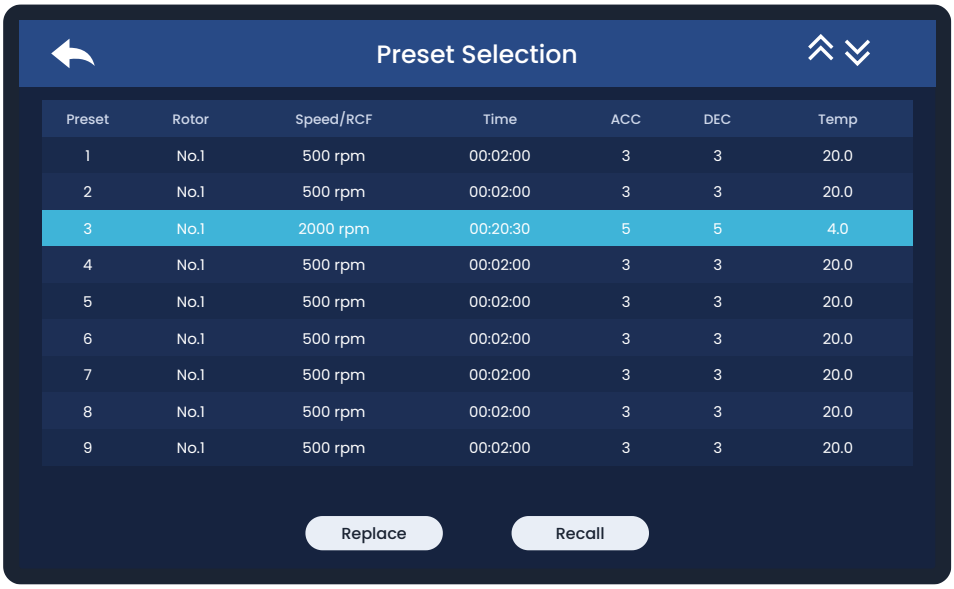


Figure 6-1 Preset Selection screen: preset 3 has been replaced with the current settings

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.

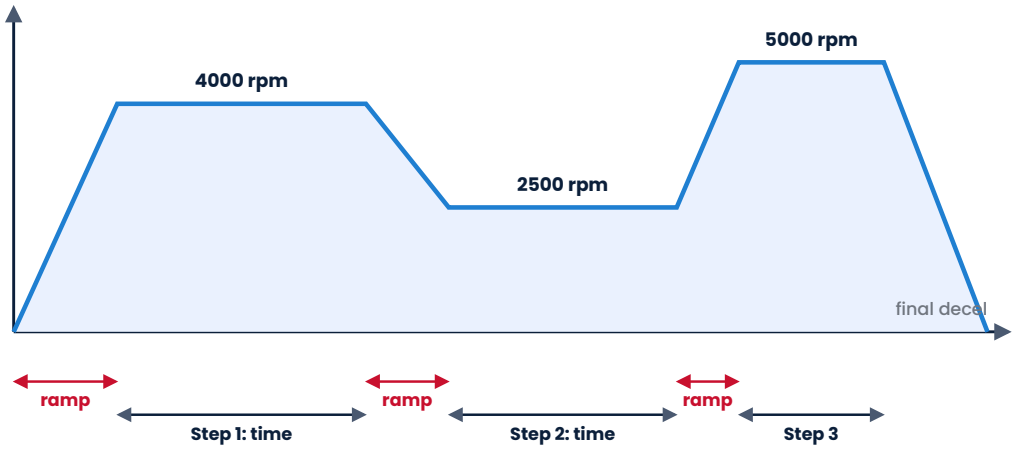


Figure 6-2 How a three-step program runs

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

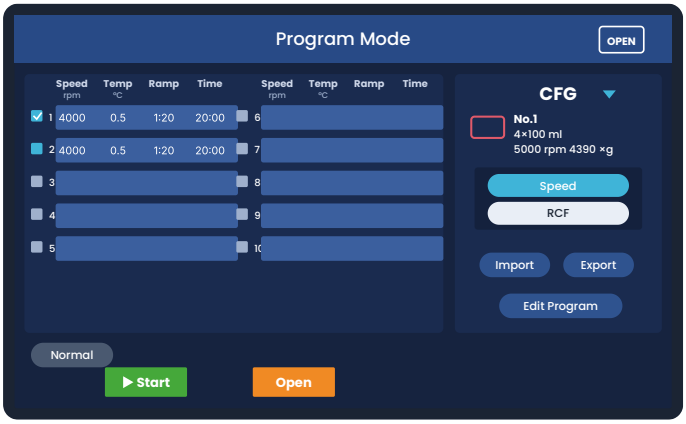


Figure 6-3 Program Mode, viewing program "CFG"

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. These functions are available on instruments with the extended software configuration only.

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

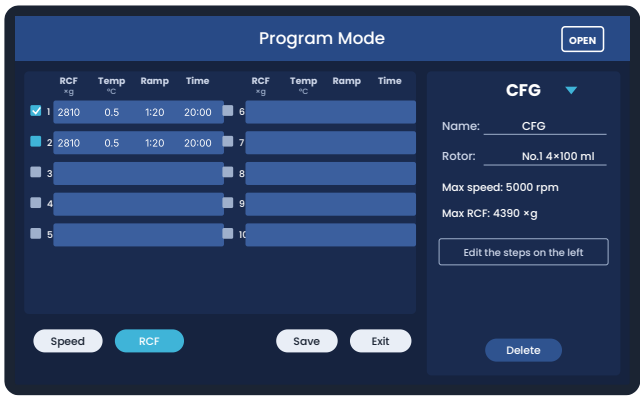


Figure 6-5 Editing the same program by RCF

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**.

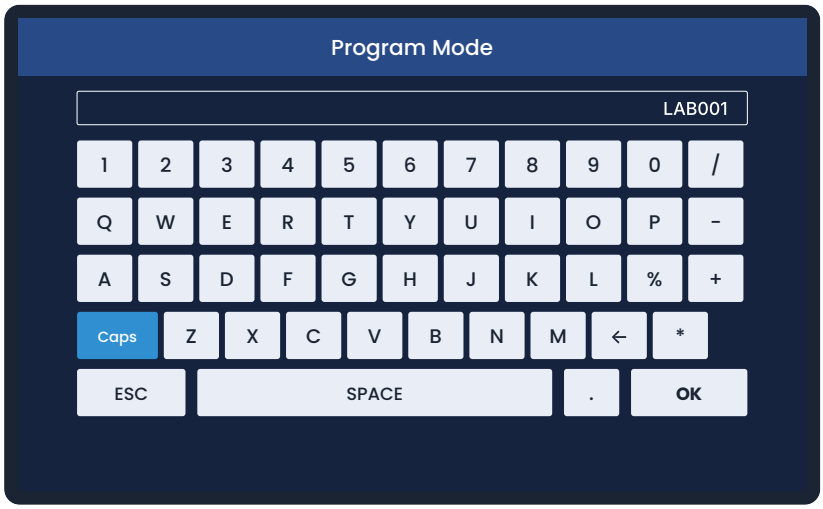


Figure 6-6 Entering a program name

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.

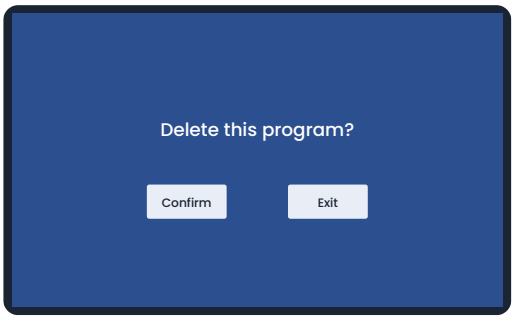


Figure 6-7 Confirming deletion

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.

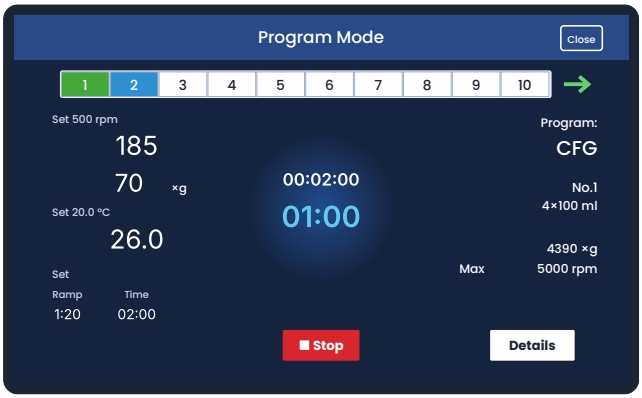


Figure 6-8 Program running: step 1 is complete (green), step 2 is running (blue)



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.

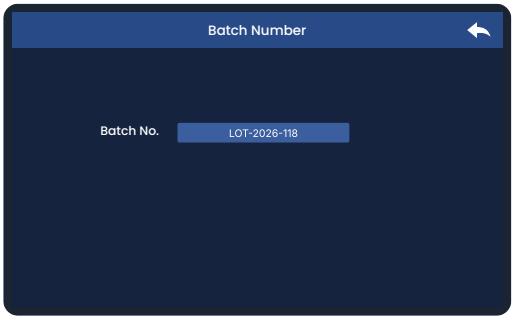


Figure 6-10 Batch Number screen

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

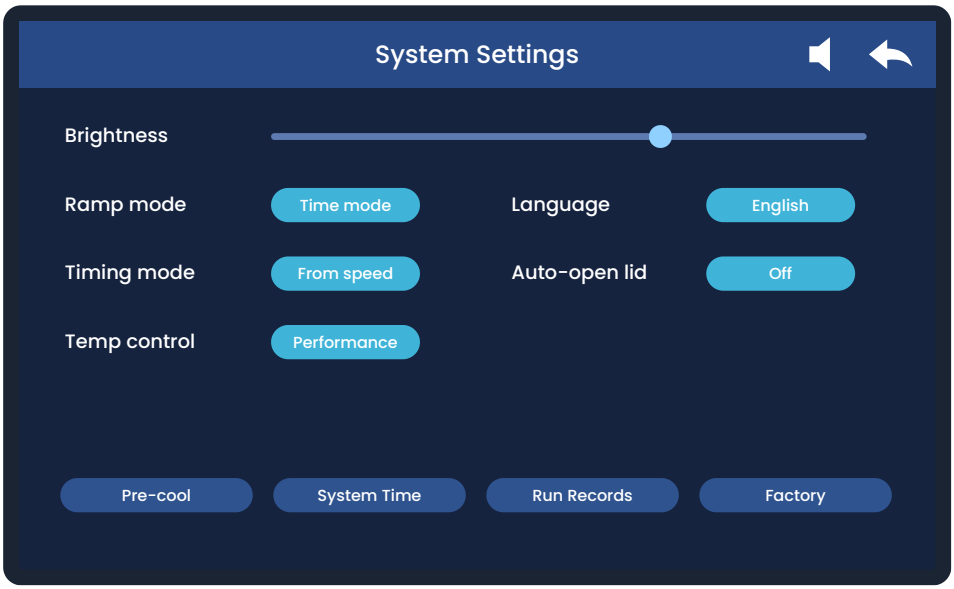


Figure 7-1 System Settings screen

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 (default): 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

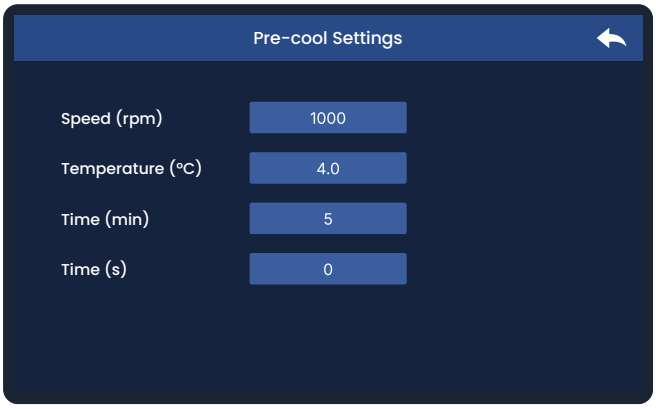


Figure 7-2 Pre-cool Settings screen

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.

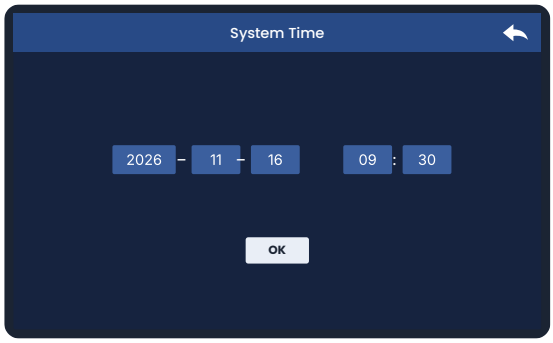


Figure 7-3 System Time screen

7.4 Run Records and Curves

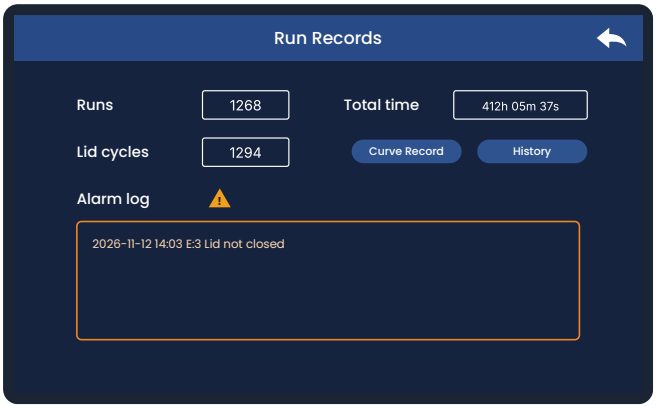


Figure 7-4 Run Records screen

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).

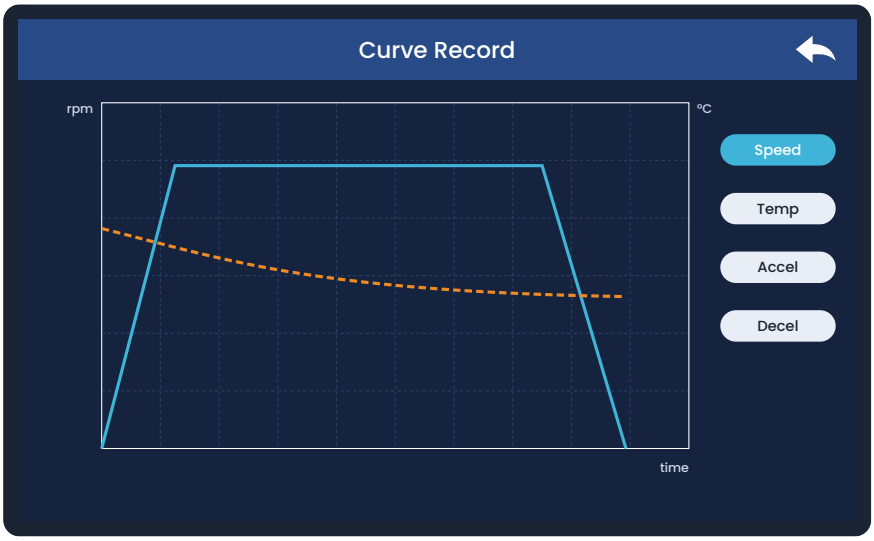


Figure 7-5 Curve Record of the last run

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.

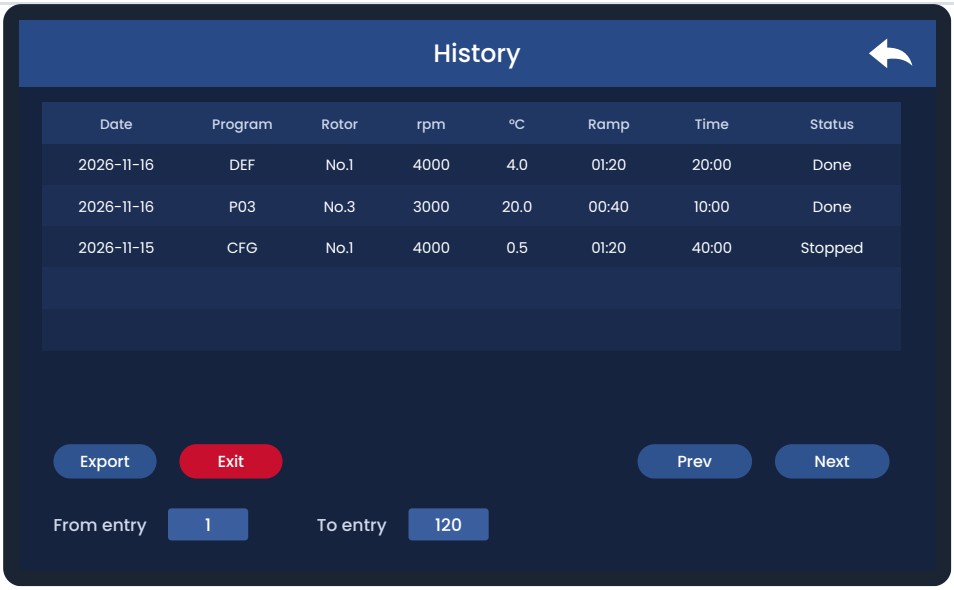


Figure 7-6 History screen

Exporting the history to a USB stick

1. Insert a USB stick into the USB port on the right-hand side of the instrument.
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 TDL-5A 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 code and 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
Lid not closed (E:3)	The lid is not fully closed at start, or it was opened during the run. The system stops automatically.	1. Close the lid firmly until it clicks (Section 5.3). 2. If the alarm persists, the lid switch or latch 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, the speed measuring system must be checked — contact service.
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 drive / control board before the start.	Switch off and on again. If the alarm returns, a cable may be loose or disconnected — contact service.

NOTE

The wording of the alarm messages on your screen 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
Screen stays dark, nothing happens	No power; plug or socket not connected; blown fuse	Check the plug, the socket and the power switch. If the fuse has blown, have it replaced with an identical fuse by qualified personnel.
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).
Chamber does not reach the set temperature	Temperature control set to Energy-saving; vents blocked; room too warm; lid opened frequently	Select Economy or Performance (Section 7.1); keep 30 cm clearance; reduce the room temperature; pre-cool before loading (Section 7.2).
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, tap **Stop** and check the following causes, in this order:

Load

- Opposite tubes not balanced to 0.1 g, or not placed symmetrically.
- Different tube types or fill levels in opposite positions.
- A bucket or rack missing, or not swinging freely.

Rotor

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

Site

- Bench or floor 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

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**. Look through the gap or listen: if you are not sure, wait. Never use the release to open the lid while the rotor is turning.

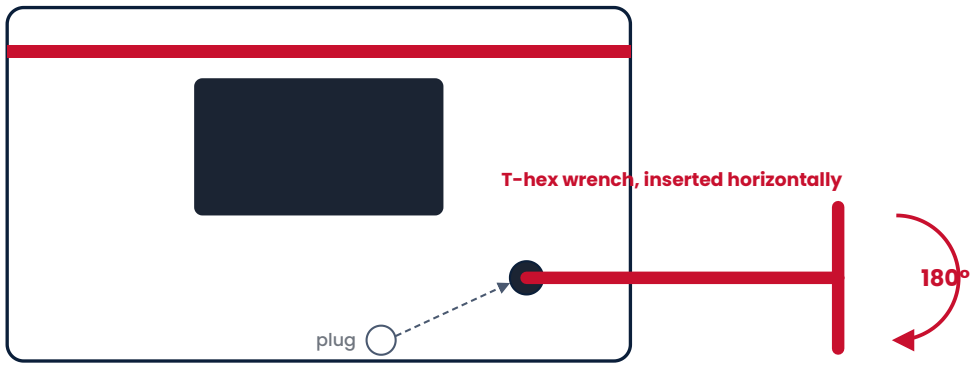


Figure 8-2 Emergency lid release with the T-hex wrench

1. Switch off the instrument and unplug it.
2. Wait until the rotor has stopped completely.
3. Remove the white plug from the emergency release hole in the front panel.
4. Insert the T-hex wrench horizontally into the hole and turn it by **180°**. The lock releases; lift the lid.
5. Refit the plug after use.

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 (TDL-5A) 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, if available (Section 7.5)

CHAPTER 9

Care and Maintenance

The TDL-5A 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 shaft 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, cracks, deformation or damage to the hanger slots, until LORDERAN has inspected it.
- 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.3) 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 under the instrument, so that it does not wet the bench. Empty it regularly, depending on how often you run cold.

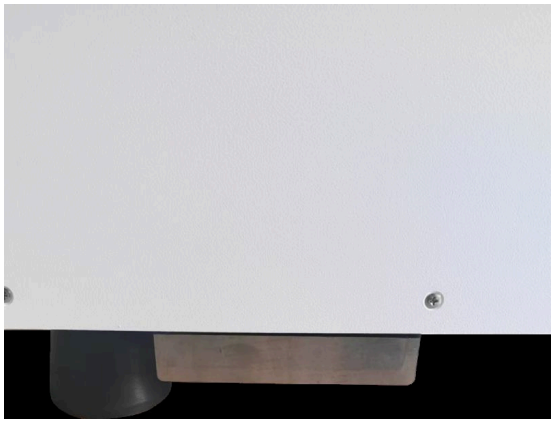


Figure 9-1 Drip tray in operating position



Figure 9-2 Drip tray pulled out for emptying

9.5 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.

9.6 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 fuses only with fuses of the same type and rating.

9.7 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 R134a 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 of the TDL-5A on one page. Full specifications: Table 3-1.

5000 rpm	4390 × g	−20 / +40 °C	0.1 g
MAX. SPEED	MAX. RCF	TEMPERATURE	MAX. IMBALANCE

A.1 Rotor Summary

No.	Capacity	Max. rpm	Max. × g	r (mm)	Fixing
No.1	4 × 100 ml	5000	4390	157	Cap nut · open-end wrench
No.2	4 tube buckets (50 / 15 ml adapters)	4000	2810	157	Cap nut · open-end wrench
No.3	4 × 18 × 7 ml	4000	3200	179	Centre nut · T-hex wrench
No.4	2 × 2 × 96-well	4000	2200	123	Centre nut · T-hex wrench

A.2 Key Values and Limits

Item	Value	Section
Speed setting range	300 rpm – max. of the selected rotor	5.4
Timer	up to 99 h 59 min 59 s	5.4
ACC / DEC	ACC 1 – 10 · DEC 0 – 10 (0 = free coast)	4.4
Temperature setting	-20.0 to +40.0 °C	5.4
Imbalance between opposite positions	≤ 0.1 g	4.2
Max. fill, swing-out / fixed-angle	90 % / 80 % of nominal tube volume	4.3
Clearance around the instrument	≥ 300 mm on all sides	2.3
Power supply	AC 220 V ±10 %, 50 Hz, 1.2 kW, earthed socket	2.4
Ambient conditions (operation)	5 – 40 °C, ≤ 80 % RH, 86 – 106 kPa	2.3
Storage conditions	-10 to +50 °C, ≤ 75 % RH	9.5
Wait after power-off before opening covers	≥ 4 minutes (service personnel only)	1.5
Compressor response after a mode change	about 30 s	7.1
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 ON THE SCREEN		
Lid not closed (E:3)	Lid not latched, or opened during the run	8.1, 5.3
Overspeed	Wrong rotor selected, speed above the rotor limit	8.1, 5.4
Speed sensor fault	No speed signal	8.1
Communication error	Loose internal connection	8.1
SYMPTOMS WITHOUT AN ALARM		
Screen dark	No power, fuse	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	Mode, vents, room, no pre-cooling	8.2, 7.1, 7.2
Ice or water in the chamber	Condensation after cold runs	8.2, 9.4
Tube broken in the chamber	Tube unsuitable, overfilled, damaged	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, buckets, adapters and tubes; check that the nut is tight	Before every run	Required	5.9
Remove the rotor, clean and dry rotor and chamber	After use / daily	Required	9.1, 9.3
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 installed	Required	9.3
Check the rotor for corrosion, cracks and damage under good light	Monthly	Recommended	9.3
Check the lid seal and the clearance around the vents	Monthly	Recommended	2.3
Export the run history to USB	Monthly	Recommended	7.5
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 Chapters 2 to 9. 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; 300 mm clearance on all sides; no vibration sources nearby (Section 2.3).
- [ ] Dedicated, earthed AC 220 V / 50 Hz socket (Section 2.4).
- [ ] Instrument acclimatised for 2 hours after cold transport; drip tray in place.
- [ ] 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; nut and wrench stored with it.
- [ ] 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 switch.

APPENDIX E

Glossary

Terms and abbreviations used in this manual.

Term	Meaning
ACC / DEC	Acceleration and deceleration setting: a level (ACC 1 – 10, DEC 0 – 10) or a ramp time in seconds.
Adapter	Insert that holds smaller tubes in a 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.
DEF	Shown in the Preset field when the current settings were entered by hand and not saved.
Free coast	DEC 0: the rotor slows down without braking.
Imbalance	Mass difference between opposite positions of the rotor; max. 0.1 g.
Jog	Short spin that runs as long as the jog screen is open.
Pellet	Solid material collected at the bottom of the tube.
Pre-cooling	Cooling the empty 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 end 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 TDL-5A is 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	Low-Speed Refrigerated Centrifuge	**Model**	TDL-5A
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

Low-Speed Refrigerated Centrifuge — User Manual

T D L - 5 A

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

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