Operation Manual

IEC® Micromax Centrifuges

VENTILATED
Cat. No.3590: 120 VAC, 60Hz
Cat. No.3591: 220-240 VAC, 50/60Hz
Cat. No.3595: 100 VAC, 50/60Hz

REFRIGERATED
Cat. No.3592: 120 VAC, 60Hz
Cat. No.3593: 220-240 VAC, 50Hz
Cat. No.3594: 220, 230 VAC, 60Hz
Cat. No.3596: 100 VAC, 50/60Hz

OM3590 Rev. 10 11 January 2004

Analyze • Detect • Measure • Control™

Thermo ELECTRON CORPORATION

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DECLARATION OF CONFORMITY

According to ISO/IEC guide 22 and EN45014

Manufacturer's Name **Thermo Electron Corporation**

And Address: **450 Fortune Blvd**
Milford, MA 01757
USA

Declares under our sole responsibility that the product:

Micromax Ventilated Microcentrifuge Models 3591
and Micromax RF Refrigerated Microcentrifuge 3593

to which this declaration relates, is in conformity with the following standards and normative documents

EMC:

EN 55011, Class A, Group 1, Limits and Measurement Methods for Radio Disturbance of Industrial, Scientific, and Medical Equipment
Type Testing to EN61326, Electrical equipment for measurement, control and laboratory use - EMC requirements
EN61000-4-2: Electrostatic Discharge
EN61000-4-3: Radiated Susceptibility
EN61000-4-4: Electrical Fast Transient
EN61000-4-5: Surge Immunity Requirements
EN61000-4-6: Conducted Disturbances Induced by Radio-Frequency Fields
EN61000-4-11: Voltage Dips, Interruptions and Voltage Variations.
EN61000-3-2 Electromagnetic compatibility (EMC) Part 3-2: Limits - Limits for harmonic current emissions (equipment input current up to and including 16 A per phase), Class A

SAFETY

EN61010-1, + A 1; + A 2 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use-
EN 61010-2-20, Part 2, Particular Requirements for Laboratory Centrifuges

Following the provisions of Directives 73/23/EEC (Low Voltage) and 89/336/EEC (EMC) as amended by 93/68/EEC (CE Marking).

Dated January 12, 2004 by Robert A Cutright

Robert A. Cutright
VP Engineering
Thermo Electron Corporation

Contents

1. Introduction

1.1 Product Description

The IEC Micromax microcentrifuge is a quiet, high-speed bench-top centrifuge for medical, industrial, and scientific laboratories. The unit can achieve centrifugal force of up to 21,000 xg, making it ideal for sedimentation of protein precipitates and separation of blood serum.

The unit reaches full speed within 15 seconds, even when fully loaded, and brakes to a stop in approximately 15 seconds. It features a maintenance-free, brushless motor and an easy-to-use front panel which provides three versatile modes of operation:

- Automatic timed run,
- Momentary spin (pulse) and
- Continuous operation (hold mode)

Acceleration and deceleration rates may be controlled to optimize runs - rapid for fast separations or slow for delicate samples. Repeat runs with precisely the same speed and time settings may be achieved at the touch of a button.

Micromax is a variable-speed unit with a range of 1000 to 15,000 RPM. The unit accommodates lightweight, dynamically-balanced polypropylene rotors. The rotors cannot corrode, offer excellent acceleration and deceleration characteristics and totally contain tubes, allowing complete sample recovery even if a tube breaks.

- The 891 rotor holds up to 24 sample tubes and provides aerosol containment for biological samples.
- The 851 rotor holds up to 24 x 1.5-2 mL and 24 x 0.5 mL sample tubes.The 851 rotor has room to accommodate screw-cap microtubes, microtube filters, and micro spin-columns.
- The 852 rotor holds up to 48 x 0.5 mL or 24 x Microtainer tubes
- The 853 rotor holds up to 40 x 0.25 mL/0.4 mL or 6 x 50 mm glass tubes.

A fail-safe cover interlock ensures that the cover is closed before a run can begin and keeps the cover closed until the rotor has reached a safe low speed (below 150 rpm), even in the event of a power failure.

2. Installation

2.1 Receive the Unit

All units are shipped in protective packaging.

1. Follow the unpacking instructions on the carton.
2. Inspect the unit upon receipt and immediately file any damage claims with the shipper/carrier.
3. Complete and return the postage-paid warranty card.

2.2 Prepare the Installation Site

The unit normally resides on a bench top.

1. OPTIONAL:
   Ventilated models can be placed in a cold room (no colder than 4°C), for processing temperature-sensitive samples.

   ⚠CAUTION
   When you remove the centrifuge from a cold environment, do not operate for a minimum of two hours to allow condensation to evaporate prior to use.

   NOTE: When used in a cold room environment, some bearing noise may become evident. The bearing lubricant thickens at low temperatures. As the centrifuge speeds up, it is thinned and distributed more evenly. Once this occurs, any noise should subside.
2. Place the centrifuge on a clean, dry surface, to make certain that the suction feet at the bottom grip the surface firmly. Keep the area beneath the unit free of debris and loose materials.

   ⚠CAUTION
   The resting surface must be level, to ensure quiet, vibration-free operation. A rigid and stable location is important. An improperly loaded centrifuge may vibrate or move
3. Locate the centrifuge to allow a clearance of 8 cm (3 inches) on each side and 4 in. (10.2 cm) in the rear of the unit for ventilation. Provide clearance of 28 cm (11 inches) above the unit to open the cover.

⚠WARNING
International Electrotechnical Commission standard 1010 part 2-20 limits the permitted movement of a laboratory centrifuge to 12" (300 mm) in the unlikely event of a disruption. Laboratory management procedures should require that no person or any hazardous materials enter within this boundary while the centrifuge operates.

2.3 Verify Power Configuration

Verify that the correct power cord and connector is provided for your installation.

1. The unit requires a grounded power supply (3-outlet). If your facility does not have grounded power outlets, arrange for proper grounding.

   For high voltage models 3591, 3593 (RF), 3594 (RF), IEC provides a 3 Conductor (line, Neutral and Ground/ Earth) plastic unshielded equipment power cord with 3" strip. Ensure to terminate Line (Brown), Neutral (Blue) and Ground/Earth (Yellow stripe with Green) respectively to the correct polarity before engaging into the power outlet.

⚠WARNING

ELECTRICAL HAZARD!
Do not remove the grounding pin from the centrifuge power cord. Do not use the bare wired power cord to attach a power plug that does not have a grounding pin.
The power cord provided with the unit is correctly rated for the highest current demand. This power cord should not be interchanged with cords from equipment with lower current demand. Exchange of power cords between equipment may create a fire hazard.

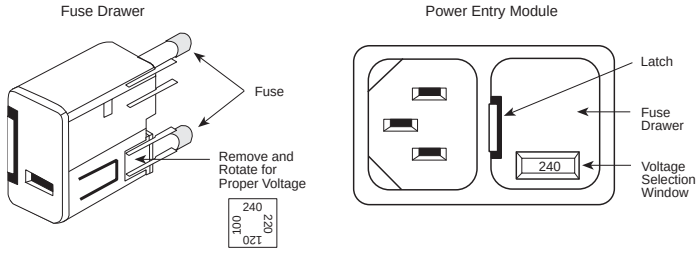
Verify the voltage and frequency of the power source. Requirements are listed below:

MODEL	VOLTAGE	FREQUENCY
3590	120	60 Hz
3591	220 - 240	50/60 Hz
3592 (RF)	120	60 Hz
3593 (RF)	220 - 240	50 Hz
3594 (RF)	220,230	60 Hz
3595	100	50/60 Hz
3596 (RF)	100	50/60 Hz*

* Locate the 50/60 Hz selector switch to the left of the power receptacle at the rear of the centrifuge. Adjust the switch to match the line frequency at the site.

2. Ensure that your site is configured to match the centrifuge's power requirements. **Plugging the Micromax into incorrect voltage or frequency will void your warranty.**

2.4 Install fuses



1. Locate the power entry module on the back side of the unit. The removable fuse drawer is located in the module. A small latch holds the drawer in place. Press this latch, then slide the drawer out.

Model. No.	Fuse Description	Rating (Amps)	Part. No.
3590	The fuse drawer will have one spare and one active fuse installed at the factory.	6.25	50606B
3591	The fuse drawer will have two active fuses installed at the factory.	4.0	43689
3592	The fuse drawer will have one spare and one active fuse installed at the factory.	8.0	50606A
3593, 3594	The fuse drawer will have two active fuses installed at the factory.	6.3	50607A
3595	The fuse drawer will have one spare and one active fuse installed at the factory.	8.0	50021
3596	The fuse drawer will have one spare and one active fuse installed at the factory. Note that the frequency selector adjacent to the power entry module must be set for the correct frequency.	10.0	49998

2. Ensure that the fuses are securely in place and reinstall the entire drawer into the power entry module

2.5 Moving the Unit

To move the unit to a new location:

⚠WARNING

Use caution when moving to avoid any injury.

1. Check that the new site meets the criteria in Section 2.2 before moving the unit.
2. Before moving, unplug the centrifuge and remove all accessories and the rotor.
3. Position a flat object, such as a tongue depressor, near a suction cup at the bottom of the unit.
4. Lift up an edge of the cup, and insert the flat object far enough to break the vacuum suction seal.
5. When all four suction cups are disengaged, lift the unit from the work surface.
6. When the unit is in its new location, ensure that the suction cups adhere correctly to the work surface

3. Operation

3.1 Warnings and Cautions

⚠WARNING

To Avoid Electric Shock:
Plug the power cord into a grounded outlet.

⚠WARNING

Never remove the grounding prong from the power plug, or use any adapter which does not complete the grounding circuit.

⚠WARNING

Always unplug the power cord before attempting to clean or service the centrifuge.

⚠CAUTION
DO NOT exceed maximum rated speed for each rotor/ accessory combination. Maximum speeds can be found in Section 4.1 Speed and Force Tables. All rotors and accessories are stamped with their cat. no.for easy identification.

⚠CAUTION
Samples of specific gravity higher than 1.2 require the maximum speed to be derated.

⚠CAUTION
Ensure that loads are properly balanced around the rotor to minimize vibration. All IEC accessories are stamped with their weight for easy balancing.

⚠CAUTION
Do not block the vents, otherwise, airflow will be restricted.

⚠CAUTION
Be sure the rotor and accessories are properly installed before attempting to start a run.

⚠CAUTION

3.2 Rotor and Accessories

A balanced load is essential for all centrifuges. An unbalanced load produces vibration, and can damage the unit. ALWAYS balance containers on opposite sides of the rotor.

> **NOTE**: A 2-gram load imbalance, at a speed of 4600 RPM, imparts force equivalent to 20 pounds (9.1 kg) at rest. Always ensure that the rotor is loaded symmetrically, with a full complement of accessories, and a full (or paired) set of tubes. Tube adapters should also be installed symmetrically.

Balance load within 1 gram

The rotors are dynamically balanced at the factory. The manufacturer matches removable parts (trunnion rings, shields, buckets, and carriers) to within 1 gram, and stamps the weight on each piece. Check these markings, whenever you interchange parts, to ensure that opposite parts are matched. Ensure that the total weight of samples and removable parts, loaded in opposing positions, are equal in weight, to within 1 gram. The position numbers,

present on many rotors and adapters, identify opposing tube positions.

Opposing containers must be alike in shape, thickness, and distribution of glass or plastic. This is especially important for large containers.

Rotor Installation

1. To install the rotor, lower it straight onto the shaft.
2. Align the holes in the rotor with the positioning pins on the shaft. To do this, hold the rotor in one hand and hold the shaft as it protrudes through the rotor with the other hand. Rotate them in opposite directions until the pins line up with the holes and the rotor drops down into position. Do not apply excessive force.
3. Screw the metal locking nut (clockwise) on the shaft to hold the rotor down. Make sure the orange rubber ring is facing downward.
4. Hold the rotor and tighten the nut moderately with your fingers; do not overtighten it.

The 891 rotor cover must be installed prior to the rotor being placed in the centrifuge. Verify that the O-ring seals (2) are in place around the outer and inner perimeters of the rotor. To install the cover, place the rotor on a flat surface and then place the rotor cover on top of the rotor. Using the palm of your hand(s), press down evenly around the cover to fully engage the seals.

The 851, 852 and 853 rotor covers prevent generation of aerodynamic noise during the spin. They also prevents gross aerosol effects in the event of tube failure. Covers fits snugly over the rotor and pull off easily. Rotate the cover until it drops easily onto the adapter spline. Press down until the rim of the cover contacts the rotor.The spline at the top of the shaft adapter drives the lid during rotation.

⚠CAUTION
Improper placement of the cover may allow it to come off during a spin.

Rotor Removal

To remove the rotor, first remove the cover (851, 852 or 853 only). Then unscrew (counterclockwise) and remove the metal locking nut. The rotor can now be lifted straight out of the rotor chamber. You can refrigerate the rotor without removing the tubes but do not operate the rotor when the rotor temperature is below 0°C.

To remove the 891 rotor cover, place the rotor on a flat surface. Place your thumbs on the inner perimeter of the cover, and your fingers on the outer edge. Pry it up from the outer edges.

3.3 Operating Modes

The Micromax Models offer three operating modes: Timed, Continuous (Hold), and Momentary.

Mode	Description
Timed Run	To start a timed run or spin: Select the Set parameters using the control panel buttons then press START. To view the set parameters at any time, press any arrow key. The spin duration may be changed at any time, even during the spin, by pressing the arrow keys until the new desired setting(s) is displayed. If a time less than the elapsed time is programmed (for example, one second), the spin ends immediately. If a time greater than the elapsed time is programmed, the elapsed time continues until the newly selected time is reached (the time does not reset). The speed and temperature (RF only) may similarly be changed during a run. Three seconds after the parameter's arrow key is released, the centrifuge will adjust to the newly set parameter.
Hold Mode	To set Hold (continuous) mode: Select the Set parameters using the control panel buttons. Scroll down through zero time on the Time display until the word Hold appears in the display. This mode is used for runs greater than 99 minutes.
Momentary	To operate in the momentary mode: Select the Set parameters using the control panel buttons. Press and hold the PULSE button. The run begins when you press the button and ends when you release the button. NOTE: In this mode the unit displays Set parameters for three seconds, the time display counts upward and displays the elapsed time since you pressed the PULSE button. In this mode very quick separations can be performed, or you may closely monitor the progress of a run. (This is useful for easily separated samples, for simultaneous mixing of samples, and to deposit condensate droplets at the bottom of the tube.)

3.4 Control Panel

Speed/Force display: The number in the display above this symbol represents the rotor speed in RPM or force in RCF. When RPM is selected the display indicates revolutions per minute. When RCF is selected the display indicates relative centrifugal force. Press this button to toggle between RPM and RCF. Use the arrow buttons to change the set speed or force. The display shows speed within 100 RPM and never requires calibration. Select speed in increments of 100 RPM from 1000 through 15,000 RPM. Select RCF in increments from 1 - 1000 xg by 50 xg, from 1,000 - 10,000 xg by 100 xg, and from 10,000 - 21,000 by 200 xg.

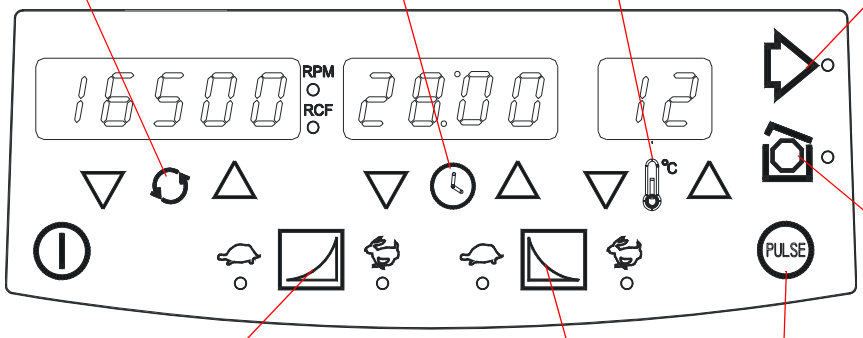
Time display: The number in the display above this symbol indicates time. Time is displayed as minutes:seconds. You can set time from 1 second to 99 minutes using the arrow buttons.

In normal timed mode, the system counts down from set point.

In continuous or momentary spin modes, the system counts up.

Temperature display: The number in the display (above this symbol) represents temperature in degrees Celsius, from – 9 °C through + 40 °C (Refrigerated only).

This key starts a run. A run is governed by the Set parameters (manual or programmed). The associated green light blinks, until the rotor reaches 95% of the set run speed. The light stays on until the end of the run.



This key controls rotor acceleration.

If the yellow light over the rabbit is lit, full acceleration is selected.

If the yellow light over the turtle is lit, slow acceleration is selected. Slow acceleration takes from 5 to 10 seconds to achieve 1500 RPM, depending on the rotor and its contents.

This key controls rotor braking. If the yellow light over the rabbit is lit, full braking is selected. If the yellow light over the turtle is lit, slow braking is selected. If both lights are out, all braking is disabled and the rotor will coast from operating speed to a stop. When using the 851, 852 , 853 or 891 rotors the difference in time between full and slow braking is approximately a half second.

The centrifuge will run up to set speed while this button is pressed, and stop when it is released.

This button stops the run, and unlocks the cover when the rotor has slowed to below 150 rpm. (A run will also stop automatically when the set time has elapsed or the momentary run button is released.) The red light will flash as an indication that the rotor is still slowing down (braking). When the run ends, the red light stays on, indicating that the rotor has stopped and the cover can be opened.

Use the arrow keys to view or change the Set parameters for Speed/Force, Time, Temperature (Refrigerated only) Rotor/ Radius, or Program. The first time the key is pressed the numeric display switches from Actual readings to Set parameters, without changing them. If you press the key a second time the selected parameter increases or decreases once for each depression. If you hold the key down, the setting will keep changing until you release the key.

The longer you hold the key the more rapidly the setting changes. Hold a key down to approach a desired setting. Then press the up or down key repeatedly to select the exact setting. When you release the arrow keys for 3 seconds the display returns to the Actual readings.

On/Off Button

The On/Off button applies power to the control panel and refrigeration system (RF only). The red STOP light indicates that the centrifuge is plugged in. In RF models, temperature is displayed whenever the unit is plugged in.) The On/Off button is inoperative during the actual run. Shut off refrigeration with the On/Off button, but stop a run with the STOP button.

The control panel contains numeric displays for RPM/RCF (SPEED/FORCE), TIME and TEMPERATURE (RF only). These displays have two states or modes: Actual and Set. In the Actual mode, they indicate current run conditions such as:

- rotor speed or force
- elapsed time of, or time remaining in, the run
- actual temperature (RF only).

The display in the Set mode indicates the desired settings for the run and is operative:

- whenever you use the up and down arrows
- briefly at the start of a run
- briefly after the unit is switched ON

When the display shows Actual parameters, the numbers are bright; when the display shows Set parameters, the numbers are dim. The numeric displays can also display warning or error messages.

3.5 Refrigeration (RF only)

Models 3592, 3593, 3594 and 3596 are refrigerated models. Whenever the cover of one of these units is closed and the unit is switched ON, the refrigeration system begins to cool the rotor chamber to the set temperature.

NOTE: The unit is not designed for use as a refrigerator. The natural fanning action of the rotor serves to maintain a uniform temperature distribution inside the chamber. Therefore, at zero RPM, there is no correlation between set and actual chamber temperatures.

If a run begins and the rotor chamber is not at the specified temperature, the run will not be aborted. If desired, press STOP to discontinue the run and pre-cool the chamber by spinning the rotor (empty) until you are satisfied with the temperature.

If a temperature higher than ambient is specified, the units will not heat the rotor chamber except through the normal heating effect of the equipment (friction and motor heat).

Remove frost or condensation from the rotor chamber by first allowing it to melt and then removing it with a sponge or cloth. When a centrifuge is not in use, turn it off or leave the cover open (disables refrigeration).

4. Applications

4.1 Introduction

This section describes the use of specific rotors and accessories. More detailed information is shipped with the rotor or accessory itself. This section contains:

- Speed and Force Tables
- Derating Table for Dense Samples
- Chemical Resistance Table
- Decontamination Table
- Nomograph

⚠WARNING

Misapplication of any tube can cause tube rupture. To avoid this, never spin tubes faster than their recommended G-force, and never centrifuge disposable tubes more than once. If the tubes are not rated for the needed force, use more suitable tubes. If breakage does occur, residue will be captive in the tube cavity in the rotor. You may be able to recover it by pipetting.

Corrosive solvents

Your IEC centrifuge is made of materials designed to resist attack from common laboratory chemicals. The rotor and lid are made of polypropylene and the interior of the rotor chamber is stainless steel. Use covered sample tubes if the samples contain acids or solvents known to attack these materials. Promptly cleaning spills from the rotor and from the sample chamber minimizes the effects of corrosive chemicals. Replace any component that exhibits crazing, frosting, peeling, or similar faults. Do so before any resulting vibration requires more expensive repair. Replace the shaft adapter, rotor, lid, or metal locking nut if they become cracked, scratched, or gouged.

Sample Heating

The rotor chambers of Models 3590 and 3591 centrifuges are ventilated during operation. However, during very long runs, some heat inevitably travels to the samples. You can minimize sample heating by placing the unit in a refrigerator or cold room.

4.2 Speed and Force Table

Rotor Cat. No.	No. of Tubes and Tube Size	Adapter Cat. No	Max Speed (RPM)	Max RCF (xg)	Radius (cm)
891[1] (Aerosol Contained)	24 x 1.5ml	-	15000	21004	8.35
	24 x 0.6ml B/D Microtainers™	5763**		21256	8.45
	24 x 0.5ml PCR microtubes	5763**		18740	7.45
	24 x 0.4ml microtubes	5764**		21004	8.35
	24 x 0.25ml microtubes	5764**		18237	7.25
851[2]	24 x 1.5ml	-	15000	21004	8.35
	24 x 0.6ml B/D Microtainers™	5763**		21256	8.45
	24 x 0.5ml microtubes	-		17432	6.93
	24 x 0.5ml PCR microtubes	5763**		18740	7.45
	24 x 0.4ml microtubes	5764**		21004	8.35
	24 x 0.25ml microtubes	5764**		18237	7.25
852[2]	48 x 0.5ml PCR microtubes	-	15000	20124	8.00†
				18866	7.50‡
	24 x B/D Microtainers™	-		21633	8.60†
853[2]	40 x 0.4ml microtubes	-	15000	21130	8.40
	40 x 0.25ml microtubes	-		18866	7.50
	40 x 0.8ml (6x50mm) glass	-		21382	8.50

Microtainers™ is a trademark of Becton Dickinson

* RCF displayed on control panel is based upon radius of rotation for 891 and 851 rotors for 1.5/2.0ml tubes (8.35cm).

** Order 2 pks of adapters separately. IEC 5763 and 5764 are packaged 12/pk.

† Outer row holds 24 tubes

‡ Inner row holds 24 tubes

1 IEC 891 Rotor
Provides Aerosol Containment and has been tested for microbiological containment by PHYLSCAMR, Porton Down. Meets requirements of US OSHA Bloodborn Pathogen Final Rule: (Regulation 29 CFR Part 1910.1030. Complete with IEC 50417 Aerosol Containment Cover, IEC 505851 and IEC 36597 Outer rubber O-ring seals
2 IEC 851, 852, 853 rotors

4.3 Chemical Resistance Table

The centrifuge, rotors and accessories are comprised of made of materials that are designed to resist attack from most laboratory chemicals. For your convenience, the chemical resistance table below shows the suitability of various materials with different classes of reagents.

NOTE: Refer to the cleaning section for information on cleaning and removing corrosion from various parts. Clean spills promptly to minimize the effect of corrosive chemicals and avoid expensive repairs.

	Plastic										Metal					Other			
	POLYALLOMER	POLYCARBONATE	POLYETHYLENE	POLYPROPYLENE	POLYURETHANE	PHENYLENE OXIDE (NORYL®) MODIFIED	ACETAL HOMOPOLYMER (DELRIN®)	ACETAL COPOLYMER (CELCON®)	NYLON	POLYSTYRENE	TITANIUM	STAINLESS STEEL	ALUMINUM	MAGANESE BRONZE	MAGNESIUM	RUBBER	BUNA-N	VITON®	PHENOLIC FIBER
Acids, dilute or weak	E	E	E	E	G	E	F	N	F	E	G	G	F	F	N	F	E	E	E
Acids*, strong or conc.	E	N	E	E	F	N	N	N	N	F	N	N	N	N	N	N	F	G	N
Alcohols, aliphatic	E	G	E	E	F	E	E	E	N	E	E	E	E	E	F	E	E	G	E
Aldehydes	G	F	G	G	G	G	G	G	F	N	E	E	E	E	E	E	N	E	E
Bases	E	N	E	E	N	G	N	G	F	E	E	E	E	E	E	G	G	N	N
Esters	G	N	G	G	N	E	G	G	E	N	E	E	E	E	E	N	N	N	E
Hydrocarbons, aliphatic	G	F	G	G	E	N	E	E	E	N	E	E	E	E	E	N	E	E	E
Hydrocarbons, aromatic	F	N	G	F	N	N	E	E	E	N	E	E	E	E	E	N	N	E	E
Hydrocarbons, halogenated	F	N	F	F	N	N	G	E	G	N	E	E	E	E	N	N	N	F	E
Ketones	G	N	G	G	N	N	E	E	E	N	E	G	G	G	E	N	N	N	E
Oxidizing Agents, strong	F	N	F	F	N	N	N	N	N	N	E	F	N	N	N	N	F	E	E
Salts	E	E	E	E	E	E	E	E	E	E	E	F	F	F	N	E	E	E	E

*For Oxidizing Acids, see "Oxidizing Agents, strong".

Classification of Resistance

E = EXCELLENT F = FAIR

G = GOOD N = NOT RECOMMENDED

4.4 Decontamination Table

Compatible Processes For Decontamination

Sterilization Methods	Plastic										Metal					Other				
	POLYALLOMER	POLYCARBONATE	POLYETHYLENE	POLYPROPYLENE	POLYURETHANE	MODIFIED PHENYLENE OXIDE (NORYL)	ACETAL HOMOPOLYMER (DELRIN)	ACETAL COPOLYMER (CELCON)	NYLON	POLYSTYRENE	TITANIUM	STAINLESS STEEL	ALUMINUM	MAGANESE BRONZE	MAGNESIUM	RUBBER	BUNA-N	VITON	PHENOLIC FIBER	PT - PAINTED SURFACE
Mechanical																				
Autoclave*	S	M	U	S	M	U	S	S	S	U	S	S	S	S	S	S	S	M	S	M
Ethylene Oxide Gas	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	U	U	S	S	S
Dry Heat (2Hrs. @ 160°C)	U	U	U	U	U	U	U	U	U	U	S	S	U	S	S	U	U	U	U	U
Chemical																				
Ethanol	S	S	S	S	U	S	S	S	U	M	S	S	S	S	S	S	S	S	S	S
40% Formalin	S	S	S	S	U	S	S	S	S	U	S	S	S	S	S	S	U	S	S	S
Methanol	S	M	S	S	M	S	S	S	U	M	S	S	S	S	S	S	S	U	S	S
2-Propanol	S	S	S	S	M	S	S	S	U	S	S	S	S	S	M	S	S	S	S	S
.5% Sodium Hypochlorite**	S	S	S	S	U	S	U	U	U	S	S	M	U	U	U	S	U	S	S	M
3% Hydrogen Peroxide	S	S	S	S	S	S	M	S	U	S	S	S	S	S	U	S	S	S	S	M
100% Hydrogen Peroxide	S	S	S	S	S	U	U	U	U	S	S	S	S	S	S	U	U	S	S	U
5% Phenol Solution	M	U	U	S	U	U	M	M	U	M	M	M	M	M	M	M	U	S	S	U

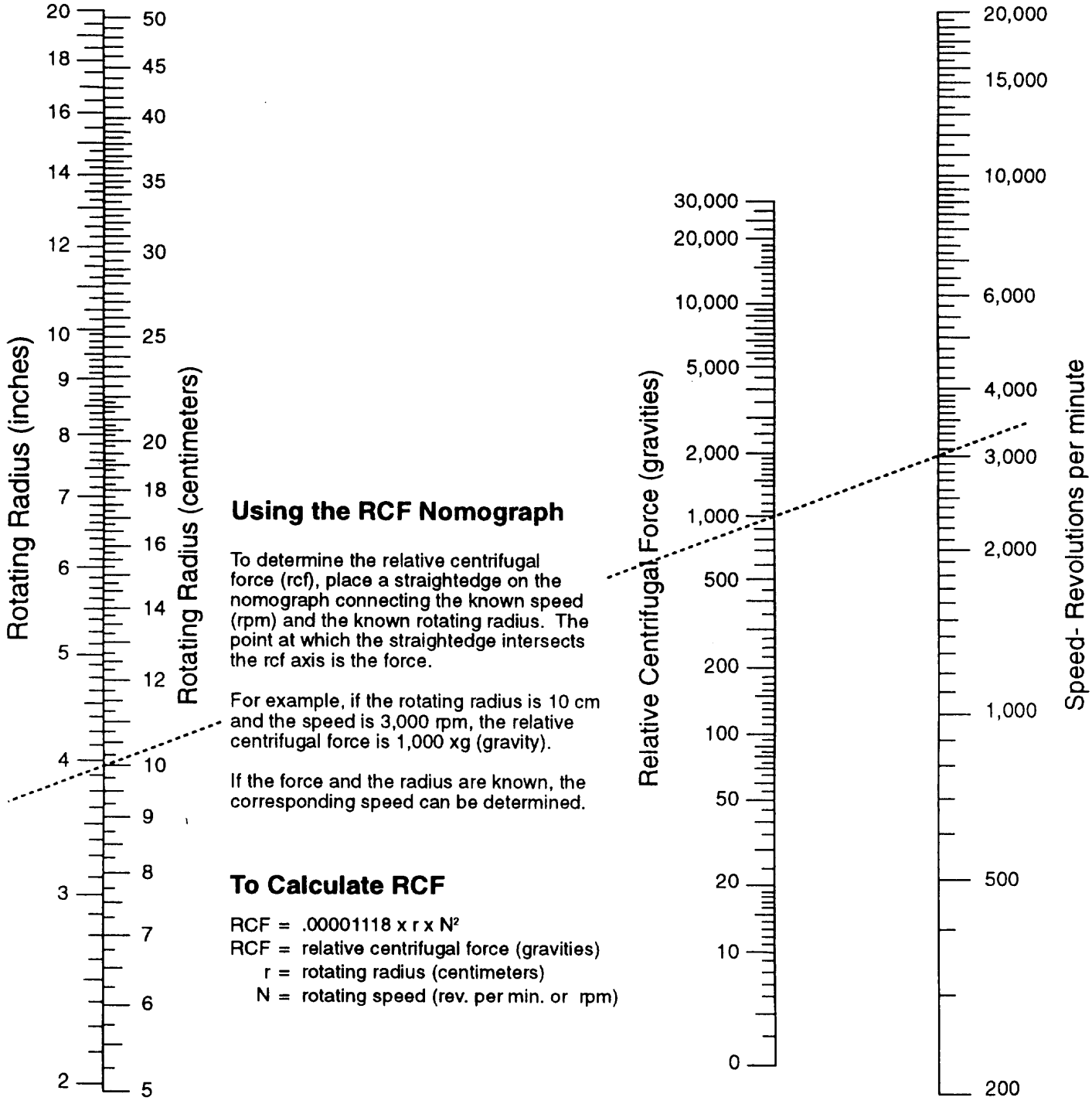
*For Oxidizing Acids, see "Oxidizing Agents, strong"

Autoclaving 121° C for 20 min. @ 2 ATM (15 PSIG)
** 1 to 10 Dilution of Household Bleach
S = SATISFACTORY
M - MARGINAL
U - UNSATISFACTORY

⚠WARNING

This chart describes the material compatibility of various sterilization methods. It does not specify the adequacy of sterilization. Refer to the Chemical Resistance Table on the previous page for material compatibility during centrifugation.

4.5 RCF Nomograph



Using the RCF Nomograph

To determine the relative centrifugal force (rcf), place a straightedge on the nomograph connecting the known speed (rpm) and the known rotating radius. The point at which the straightedge intersects the rcf axis is the force.

For example, if the rotating radius is 10 cm and the speed is 3,000 rpm, the relative centrifugal force is 1,000 xg (gravity).

If the force and the radius are known, the corresponding speed can be determined.

To Calculate RCF

$RCF = .00001118 \times r \times N^2$

RCF = relative centrifugal force (gravities)
r = rotating radius (centimeters)
N = rotating speed (rev. per min. or rpm)

5. Maintenance

5.1 Care and Cleaning

- Keep the centrifuge clean to ensure good operation and to extend its life.
- Clean the sample chamber, rotor, and lid, at the end of each work day, and immediately after any spill. Use a damp sponge, warm water, and a mild liquid detergent suitable for washing dishes by hand, such as Ivory® liquid. Do not use caustic detergents or detergents that contain chlorine ions. These attack metals.
- Remove stubborn stains with a plastic scrub pad. Do not use steel wool, wire brushes, abrasives, or sandpaper as they create corrosion sites. Never pour water directly into the rotor chamber.
- Scrub the rotor's tube cavities with a stiff test tube brush that has end bristles and a non-metallic tip. After cleaning, dry each part with a clean absorbent towel.

⚠CAUTION
In the case of glass breakage, be careful to remove ALL particles of glass from the unit! In particular, be sure thoroughly scrub adapters and cushions with a wire brush or replace these items as glass shards embedded in the adapters can cause further breakage.

5.2 Corrosion Cleaning Procedure

The rotors and structural accessories are finished to give maximum resistance to corrosion. To maximize the life of the unit, continually inspect the rotor cavities for corrosion especially if you use chloride ion solutions such as sodium chloride (saline), and sodium hypochlorite (household bleach), because these solutions attack most metals.

Clean the rotor, rotor chamber, and accessories (particularly the sample compartments and bucket cups) thoroughly after each exposure. Inspect all surfaces under bright light for corrosion. Be aware that small crevices grow deeper, eventually resulting in system failure.

If you see any corrosion, remove it immediately, using the following procedure:

1. Follow the cleaning procedure at the start of this section.
2. Soak the product in mild hand dish-washing detergent and scrub the product thoroughly with a stiff test tube brush. The brush should have end bristles and a non-metallic tip.
3. Soak the product in clear warm water for a minimum of an hour.
4. Rinse the product in warm water then in distilled water.
5. Dry the product thoroughly with a clean absorbent cloth.

⚠CAUTION
If this procedure does not remove the corrosion, discontinue use of the product and inform technical service.

5.3 Storage: Keep the Unit Dry

Store parts on a soft surface to avoid damage.

Rotors and other parts should be clean and dry. Store them open to the air, not in a plastic bag, so any residual moisture evaporates. Face the parts upward to avoid moisture retention in the cavities.

5.4 Decontamination Procedures

⚠WARNING
If tube breakage occurs releasing toxic, infectious, pathogenic, or radioactive material into the unit, decontaminate the chamber.

Decontamination is called for if tube breakage occurs and infectious, pathogenic, or radioactive material is released into the unit. If spillage is confined to the polypropylene rotor, it may be sufficient to decontaminate the rotor, which is totally compatible with household bleach at a 1-to-10 dilution and radioactivity decontamination washes such as Count-Off.

Polypropylene sealed carriers can be autoclaved. Remove any sample tubes before autoclaving unless they are completely full of sample. Remove caps, stoppers, and other tube closures before autoclaving to keep the tubes from collapsing under pressure. Autoclave the rotor and accessories at 121° C @ 15 psig for 20 minutes. Do not stack polypropylene rotors during this process. After cooling, perform a normal cleaning operation as described above.

Repeated autoclaving seriously degrades the performance of polycarbonate sealing covers.

5.5 Cover Interlock Bypass

The cover will remain locked if power fails. If you need to remove samples from the unit before power is restored, use the cover interlock bypass after the rotor has come to a stop.To bypass the cover interlock:

1. Unplug the centrifuge.
2. Locate the hidden plastic plug underneath the front ledge of the cabinet.
3. Use a screwdriver to pry out and remove the plug.
4. Pull the attached cord to release the cover interlock.
5. Replace the plug in the hole.

⚠WARNING
Do not perform this operation routinely. The centrifuge's cover interlock provides operator safety. It allows the cover to be opened promptly, whenever rotation has stopped.

5.6 Condition of Returned Equipment

Obtain a return goods authorization (RGA) before returning equipment to the manufacturer. The RGA paperwork includes a Certificate of Decontamination for you to sign. It indicates that you have performed the proper steps for decontaminating the unit.

⚠WARNING

All returned units must be decontaminated, free of radioactivity, and free of hazardous, infectious, pathogenic, or toxic materials.

All return equipment shipments will be refused until the signed certificate is received.

You must prepay transportation to the service depot.

6. Specifications

Maximum Speed	15,000 RPM	
Maximum Force	21,000 xg	
Maximum Number of Tubes	24 x 24 (1.5 x 0.5 mL) (851 rotor), and 48 x 0.5 mL (852) rotor	
Maximum Sample Volume	60 mL (851 rotor 24 x 2.0 mL and 24 x 0.5 mL)	
Operator Controls: Rotation	1,000 -1,5000 by 100 RPM	
Operator Controls: Spin Duration	0:01 through 0:59, by 1 sec. 1:00 through 4:45, by 15 sec. 5:00 through 99, by 1 min. Momentary Spin mode Continuous (Hold) mode	
Repeatability		
Rotation	Within 10 RPM	
Spin Timing	0.1 sec.	
Temperature	-	+/- 1 ×C in the range +4 ×C to ambient
Mechnical		
Motor	Brushless DC motor (maintenance free)	
Refrigeration system	-	Hermetic compressor 1/4 hp
Refrigerant	-	R-404A (HP-62)
Dimensions		
Height	COVER CLOSED: 24.9 cm (9.8 in) COVER OPEN: 50.3 cm (19.8 in)	COVER CLOSED: 24.9 cm (9.8 in) COVER OPEN: 50.3 cm (19.8 in)
Width	30.5 cm (12 in)	30.5 cm (12 in)
Depth	33.8 cm (13.3 in)	58.9 cm (23.2 in)
Unit Weight	16.4 kg (36 lbs.)	32 kg (70.5 lbs.)
Shipping Weight	19.3 kg (42.5 lbs.)	35 kg (77 lbs.)

Specifications subject to change without notice.

7. Service

7.1 Beeper/Warning Messages

The beeper sounds in three situations:

- twice on power up
- three times at the end of a spin
- three times when a warning occurs

A Warning Message indicates improper operation and may be cleared by opening the lid and correcting the problem.

Display	Meaning
LId	The cover was not properly closed when the start button was pressed, or the cover was opened during a run.
PFL	Power to the centrifuge was lost during a run.

7.2 Error Codes

Error Codes indicate a malfunction of the centrifuge. They are cleared by disconnecting and reconnecting power to the centrifuge. If an Error Code or Warning Message persist, service may be required.

Display	Meaning
Err 1	No Tachometer Tachometer signals were not present during run. The rotor coasts to a stop. Cover opening is inhibited after this error.
OSPd	Overspeed Speed is 15,200 RPM. The rotor will brake to a stop.
run A	Runaway During stopping, rotor has not been decelerating for 8 seconds, or when at standby, rotor speed exceeds 600 RPM. The rotor coasts to a stop.
rEFr	Refrigeration Failure (RF only) The unit displays this code if the measured temperature exceeds 45° C at any time during the run.
FSAFE	Fail-safe Time-out Independent circuitry on the circuit board has sensed a lack of activity from the control microprocessor. All power outputs are disabled (including motor, latch solenoid, etc.).
COPF	COP Watchdog/OpCode Trap Error The microprocessor itself has sensed a lack of activity from the program that controls the centrifuge. The rotor coasts to a stop.
COP	COP Watchdog Not Enabled The microprocessor COP is not enabled. The rotor coasts to a stop.
UndFl	Undefined Interrupt The microprocessor was interrupted by an undefined source. The rotor coasts to a stop.
ILLOP	Op-Code Trap Error The rotor coasts to a stop.

Warnings during a spin. The "LId", "PFAIL" and "Error" messages can occur during a spin. In this case, the rotor brakes or coasts to a stop and the run ends.

7.3 Troubleshooting

If the unit fails, follow this procedure:

No motor operation, and no Display lights are lit:

Verify that the unit is plugged into a live electric outlet. Check the circuit at the fuse or circuit breaker, or plug a lamp or other appliance into the outlet to verify it.

If there is power, examine the centrifuge's fuse. Unplug the unit and locate the fuse drawer at the rear of the unit. Remove the fuse drawer according to section 2.3. Examine the fuse. If it is blown, or if you are in doubt, replace it with one of the spare fuses from the plastic bag shipped with the unit. Plug the centrifuge back in and see if it works. If replacing the fuse did not solve the problem, call Technical Service.

No motor operation, but the displays are lit.

Check that the cover is properly closed. Press the START button. If you do not hear rotation, call Technical Service.

7.4 Spare Parts

Cat. No.	Description
49856	Rotor Cover (851, 852, 853)
50417	Rotor Cover (891)
65690	Rotor Nut (851, 852, 853)
50469	Rotor Nut (891)
65231	Rotor nut washer
43689*	4 Amp fuse
50606B*	6.25 Amp fuse
50607A*	6.3 Amp fuse
50606A*	8 Amp fuse
50021*	8 Amp fuse
49998*	10 Amp fuse
50524	O-ring (891 rotor - Inner)
36597	O-ring (891 rotor - Outer)
2084	Grease Tube (for O-rings)

* see section 2.3 for fuse selection

Fuses Not Replaceable By Operator

F1: 6.3A, Fast, 250V

F2 and F3: 0.75A, Fast, 125V

Warranty

Thermo warrants that the Products will operate substantially in conformance with Thermo's Specifications applicable to such Products, when subjected to normal, proper and intended usage by properly trained personnel, for a period of twenty-four (24) months from the date of installation, not to exceed thirty (30) months from date of shipment from Thermo (the "Warranty Period"). Thermo agrees during the applicable Warranty Period, provided it is promptly notified in writing upon the discovery of any defect and further provided that all costs of returning the defective Products to Thermo are pre-paid by Purchaser, to repair or replace, at Thermo's option, non-conforming Products so as to cause the same to operate in substantial conformance with said Specifications. Such repair shall include parts only during the final twelve (12) months of the Warranty Period. Replacement parts may be new or refurbished, at the election of Thermo. All replaced parts shall become the property of Thermo. Lamps, fuses, bulbs and other expendable items are expressly excluded from the warranty. Thermo's sole liability with respect to equipment, materials, parts or software furnished to Thermo by third party suppliers shall be limited to the assignment by Thermo to Purchaser of any such third party supplier's warranty, to the extent the same is assignable. In no event shall Thermo have any obligation to make repairs, replacements or corrections required, in whole or in part, as the result of (i) normal wear and tear, (ii) accident, disaster or event of force majeure, (iii) misuse, fault or negligence of or by Purchaser, (iv) use of the Products in a manner for which they were not designed, (v) causes external to the Products such as, but not limited to, power failure or electrical power surges, (vi) improper storage of the Products or (vii) use of the Products in combination with equipment or software not supplied by Thermo. If Thermo determines that Products for which Purchaser has requested warranty services are not covered by the warranty hereunder, Purchaser shall pay or reimburse Thermo for all costs of investigating and responding to such request at Thermo's then prevailing time and materials rates. If Thermo provides repair services or replacement parts that are not covered by the warranty, Purchaser shall pay Thermo therefore at Thermo's then prevailing time and materials rates. ANY INSTALLATION, MAINTENANCE, REPAIR, SERVICE, RELOCATION OR ALTERATION TO OR OF, OR OTHER TAMPERING WITH, THE PRODUCTS PERFORMED BY ANY PERSON OR ENTITY OTHER THAN THERMO WITHOUT THERMO'S PRIOR WRITTEN APPROVAL, OR ANY USE OF REPLACEMENT PARTS NOT SUPPLIED BY THERMO, SHALL IMMEDIATELY VOID AND CANCEL ALL WARRANTIES WITH RESPECT TO THE AFFECTED PRODUCTS.

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