

Discovery M120/150SE User's Manual



Analyze • Detect • Measure • Control™

OPERATING INSTRUCTIONS

SORVALL[®] *Discovery*[™] M150 SE
***Discovery*[™] M120 SE**
Micro-Ultracentrifuge

Thermo Scientific
Asheville, North Carolina
U.S.A.

SORVALL[®]



Intended Use and Safety Definitions

This manual is a guide to the use of the

SORVALL® Discovery™ M150/M120 SE Micro-Ultracentrifuges

Information herein has been verified and is believed adequate for the intended use of the centrifuge. Because failure to follow the recommendations set forth in this manual could produce personal injury or property damage, always follow the recommendations set forth herein. Thermo does not guarantee results and assumes no obligation for the performance of centrifuges or other products that are not used in accordance with the instructions provided. This publication is not a license to operate under, nor a recommendation to infringe upon, any process patents.



Safety Definitions

DANGER, WARNING, CAUTION, and NOTE within the text of this manual are used to emphasize important and critical instructions.



DANGER: Informs the operator of an extreme hazard or an unsafe practice that will result in death or serious injury.




WARNING: Informs the operator of a hazard or an unsafe practice that could result in serious injury or death, affect the operator's health, or contaminate the environment.



CAUTION: Informs the operator of a hazard or an unsafe practice that could cause minor injury, or result in damage of equipment or property.

NOTE: Highlights essential information that is not hazard-related.

DANGER, WARNING and CAUTION information is accompanied by a hazard symbol  and appears throughout the manual, both on the Important Safety Reminder pages and near the information it corresponds to.

Before you operate the centrifuge, we recommend that you read this instruction manual thoroughly, particularly all DANGERS, WARNINGS and CAUTIONS. Never operate the centrifuge without first considering all items on the Important Safety Reminder pages, and never operate the centrifuge in any manner not described in this instruction manual.



Important Safety Reminder

Certain potentially dangerous conditions are inherent to the use of all centrifuges. To ensure safe operation of this centrifuge, anyone using it should be aware of all safe practices and take all precautions described below and throughout these operating instructions.



- DANGER:**
- Before removing any cabinet panel (such as for maintenance or repair), always turn the main Power Switch OFF and unplug the centrifuge, then wait at least three minutes to eliminate the potential for severe electric shock.
 - The S52ST Swinging Bucket Rotor is specifically designed for the Discovery™ M150 SE and Discovery™ M120 SE Ultracentrifuge. This rotor CAN NOT be used in any other centrifuge.



- WARNING:**
- Never exceed the maximum rated speed of the installed rotor; to do so can cause rotor failure.
 - Always reduce (derate) rotor speed whenever:
 1. The rotor speed/temperature combination exceeds the solubility of the gradient material and causes it to precipitate.
 2. The compartment load exceeds the maximum allowable compartment load (or design mass) specified for your rotor.Failure to reduce speed under these conditions can cause rotor failure.
 - Always inspect the rotor as specified in your rotor manual. Do not use a rotor that shows signs of damage or corrosion.
 - Centrifuges routinely deal with high energy levels and could move suddenly in the unlikely event of rotor failure. During centrifuge operation, never lean on or move the centrifuge, keep the surrounding area clear of objects (including all hazardous and flammable materials), and do not work on top of or next to the centrifuge (as a rule, keep people and objects at least 300 mm [12 inch] away).
 - Never unlock the chamber door, attempt to open the door, or otherwise attempt to touch the rotor while it is rotating. In the event of a power outage, it can take more than three hours for the rotor to stop – be sure to wait at least three hours before opening the door.
 - Never attempt to override or otherwise disable any safety features.
 - When using radioactive, toxic, or pathogenic materials, be aware of all characteristics of the materials and the hazards associated with them in the event leakage occurs during centrifugation. If leakage does occur, neither the centrifuge nor the rotor can protect you from particles dispersed in the air. To protect yourself, we recommend additional precautions be taken to prevent exposure to these materials, for example, use of controlled ventilation or isolation areas.



Important Safety Reminder (*continued*)

- Always be aware of the possibility of contamination when using radioactive, toxic, or pathogenic materials. Take all necessary precautions and use appropriate decontamination procedures if exposure occurs.
- The use of sealed rotors, buckets and/or sample containers will provide increased protection from contamination during routine operation. However, these items will not guarantee contamination protection from accidents resulting in damage to the rotor or buckets. Do not run hazardous materials in the centrifuge unless placed in a biohazard enclosure and operated using all appropriate safety precautions.
- Never use any materials capable of producing flammable or explosive vapors, or extreme exothermic reactions.
- The centrifuge is equipped with a three-wire power cord that has one wire for connection to ground. The centrifuge must be correctly grounded to guard against shock hazards.



CAUTION:

- Do not operate the control keys using a ball-point pen or a sharp object.
- Do not run or precool the rotor at the critical speed as this will have a detrimental effect on centrifuge component life (see rotor manual).
- Do not operate the centrifuge with a rotor that is not balanced within specification. To do so can cause damage to the centrifuge drive assembly.
- Always make sure the rotor is correctly assembled and properly seated on the centrifuge drive spindle before operation. If using a swinging-bucket rotor, always make sure that a bucket is installed at each position and that each is properly seated and can swing freely after installing the rotor on the centrifuge drive spindle (see rotor manual).
- Do not exceed the maximum speed of the tubes, bottles, or adapters being used. Check manufacturer's published specifications or see Sorvall Rotor and Tube Guide on our internet web site at ***http://www.thermo.com or http://www.thermo.de***; if unsure, to avoid loss of valuable sample, we recommend performing a test run.
- Do not continue to operate the centrifuge if abnormal sounds occur during operation. Immediately discontinue use of the centrifuge and contact Thermo Service.
- Supply power must be checked before the centrifuge is connected to power because the centrifuge can be damaged if connected to the wrong voltage. Thermo is not responsible for incorrect installation and warranty is void if an initial installation or electrical modification of the centrifuge is not performed by Thermo or a Thermo representative.



Important Safety Reminder (*continued*)

- Before moving the centrifuge, always remove the rotor from the rotor chamber to avoid damage to the drive assembly.
- Do not place fluids inside, on top of, or close to the centrifuge – spillage can result in electrical or mechanical failure.
- Always operate and maintain the centrifuge and all rotors as instructed in this manual and in the rotor manual(s).

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1. Description

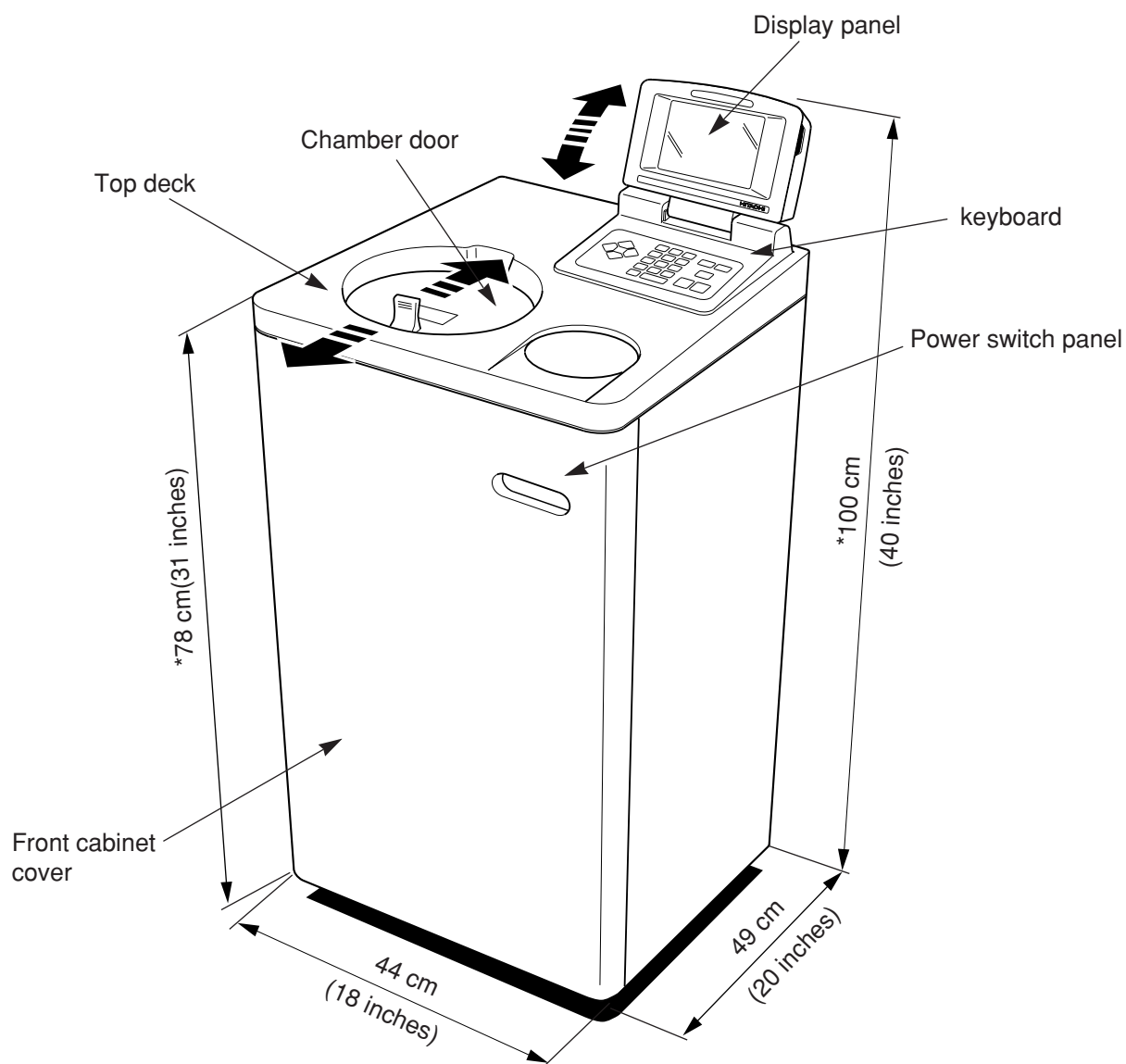
1-1 General description

The Discovery™ M150 SE and Discovery™ M120 SE Micro-Ultracentrifuges are designed to be user friendly and reliable based on our many years of experience in developing centrifuges. They offer many new features that are listed below.

1. A maximum speed of 150,000 rpm and a maximum centrifugal force of 1,048,684x g (for Discovery™ M150 SE only).
2. Space-saving, compact floor standing design with small footprint.
3. A Flip Back Control Panel with easy-to-read liquid crystal display that can be closed when not in use .
4. The displayed language can be switched between English and Japanese.
5. Various alarm indicators help identify the cause of a performance error.
6. Rotors are automatically secured to the drive shaft in the rotor chamber eliminating the need for push buttons and tools.
7. Samples can be balanced visually.
8. Extremely quiet operation well suited for personal use within the laboratory environment.
9. A CFC-free thermoelectric cooling system with greater cooling capacity.
10. The real-time control (RTC) feature enables setting a start time or a finish time, allowing running machine at a desired date and time.
11. Centrifugal force (RCFmax and RCFavg) can be displayed and set.
12. Ten programs each with up to nine steps that can be programmed for a wide range of applications such as step runs.
13. Two independent microprocessors are incorporated for overspeed detection.

1-1-1 External view of ultracentrifuge

The Discovery™ M150 SE and Discovery™ M120 SE Micro Ultracentrifuges are floor-standing and require a small amount of floor space.



*Note: The dimensions marked * are from floor level.*

Fig. 1-1-1 External view and Dimensions of Discovery™ M150 SE and Discovery™ M120 SE Ultracentrifuges

1-2 Structure

1-2-1 Operation panel

The operation panel for the Discovery™ M150 SE and Discovery™ M120 SE micro-ultracentrifuges consists of a display panel and a keyboard.

The display panel incorporates an easy-to-read liquid crystal display that tilts to facilitate operation. The display panel (field display) displays running conditions and running status (this screen is called the Run Screen), along with Programmed Run, Rotors List, and User Customizations Screens.

Fig. 1-2-1 shows the display panel, and Fig.1-2-2 represents the keyboard.

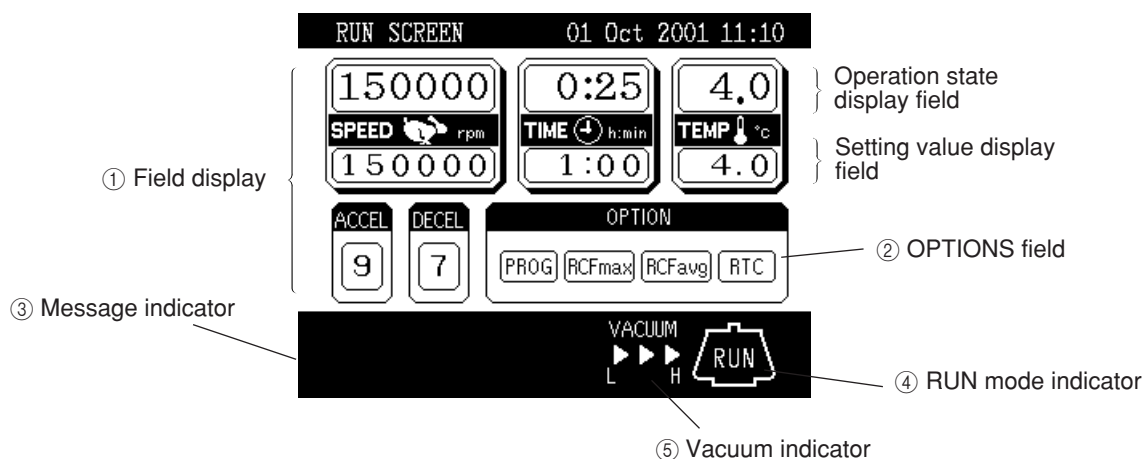


Fig. 1-2-1 Display panel

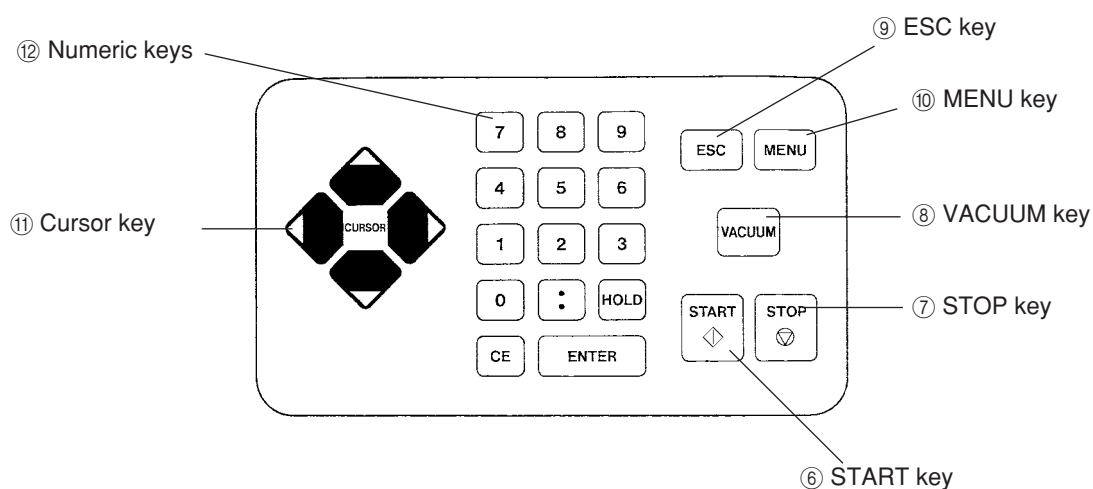









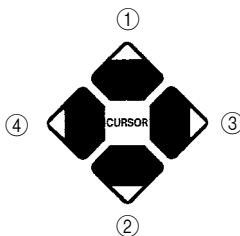
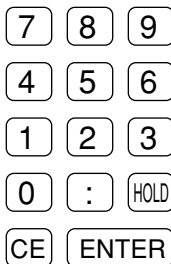






Fig. 1-2-2 Keyboard

[Functions of the display panel]

No.	Name and symbol	Functions and actions
①	Field display SPEED  TIME  TEMP 	<p>Displays various fields. The SPEED, TIME, and TEMP fields give the current status indicator in the top row and the setting indicator in the bottom row. (For setting, see Section 2-2-1.)</p> <ul style="list-style-type: none"> ● SPEED (RPM indicator) (Top row) Displays speeds in increments of 10 rpm at lower than 5,000 rpm, and in steps of 100 rpm at 5,000 rpm or more. (Bottom row) Sets speeds from 5,000 to maximum speed in increments of 1,000 rpm. The lower three digits (one, ten, and one-hundred positions) display zeros. Maximum speed Discovery™ M150 SE: 150,000 rpm Discovery™ M120 SE: 120,000 rpm ● TIME (running time indicator) (Top row) Displays the remaining operation time of the unit. If the running time is set to HOLD, this field displays time elapsed. (Bottom row) Specifies a setting in the range from 1 minute to 99 hours 59 minutes in steps of minutes and hours. ● TEMP (temperature indicator) (Top row) Displays in steps of 0.1°C. (Bottom row) Sets a setting in the range from 0°C to 40°C in increments of 1°C. ● ACCEL (acceleration mode indicator) Displays acceleration modes 1 through 9. ● DECEL (deceleration mode indicator) Displays deceleration modes 1 through 9, along with free coast (F).
②	Options field	<ul style="list-style-type: none"> ● PROG Activates step-mode operation and other programmed runs. ● RCFmax: Displays and specifies maximum centrifugal force. ● RCFavg: Displays and specifies average centrifugal force. ● RTC: Sets a start time or an end time. (For details, see Section 2-3.)
③	Message indicator	Displays an alarm message and various suggestions for operation.
④	Run mode indicator	<p>Displays run mode in the rotor graphic. The following terms are displayed: STOP, ACCEL, RUN (running at the set speed) DECEL, WAIT (waiting for vacuum during acceleration) DELAY (until the start time in an RTC run)</p>
⑤	Vacuum indicator	<p>Displays the following four stages according to the vacuum of the rotor chamber.</p> <p>(1)  Atmospheric state. The vacuum pump is not activated.</p> <p>(2)  In a low vacuum. The rotor is set to 5,000 rpm and waits until the vacuum reaches an intermediate level.</p> <p>(3)  In an intermediate vacuum.</p> <p>(4)  In a high vacuum.</p> <p><i>Note: If the sample is sensitive to a temperature rise, do not press the START key until the chamber is at high vacuum level.</i></p>

[Functions of keys]

No.	Name and symbol	Functions and actions
⑥	START key 	Starts rotor rotation. If VACUUM is off, this key activates the vacuum pump and starts temperature control.
⑦	STOP key 	Stops rotor rotation.
⑧	VACUUM key	Used to turn vacuum pump on and off before a run is started. Temperature control begins when the pump turns on. When the pump is off temperature it is maintained at 25°C. It must be pressed after a run to release the vacuum and allow access to the chamber.
⑨	ESC key	Moves the display back to the screen at the preceding level (for example, to switch back from the Menu Screen to the Run Screen).
⑩	MENU key	Displays the Menu Screen. The Menu Screen offers the choice of Rotor List, Alarm Information, and User Customizations.
⑪	Cursor key 	(A) Displays the cursor on the Run Screen, putting the display into input wait status. (B) Move the cursor on the screen. ① Moves the cursor up (↑). ② Moves the cursor down (↓). ③ Moves the cursor to the right (→). ④ Moves the cursor to the left (←).
⑫	Numeric keys 	Used to type numbers for setting run conditions.  During time entry: toggles between hours and minutes.  (1) During operation time entry: sets continuous run. (2) When entering deceleration conditions: sets a free coast.  Use this when you have typed the wrong value while entering an operating condition or entering a number or when the alarm device is activated. Functions of this key (1) This key clears the cursor-carrying input field and returns you to the pre-input state. (2) Use this key to clear an alarm signal. If more than one alarm signal is on, this key will clear them one by one.  Registers the entered value.

1-2-2 POWER switch panel

The POWER switch panel is located on the front cabinet cover of the centrifuge and consists of the power switch, running lamp, and the stop lamp.

If the display panel is folded down to the top deck, the operating state will still be displayed on the power switch panel.

- POWER switch

Controls power supply to the centrifuge.

"|": ON

"○": OFF

- RUNNING lamp

The lamp blinks when the rotor is accelerating, and it stays lit when the rotor reaches the set rotation speed.

- STOP lamp

The lamp blinks when the rotor is decelerating, and it stays lit when the rotor stops.

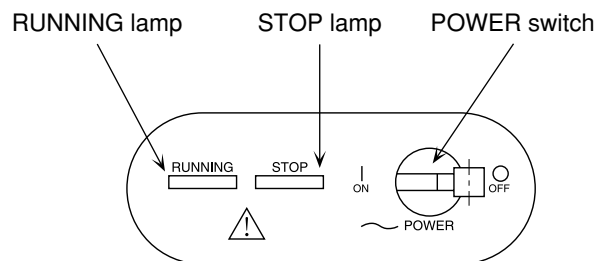


Fig. 1-2-3 POWER switch panel

1-2-3 Rotor chamber

Fig. 1-2-4 shows the structure of the rotor chamber (vacuum chamber).

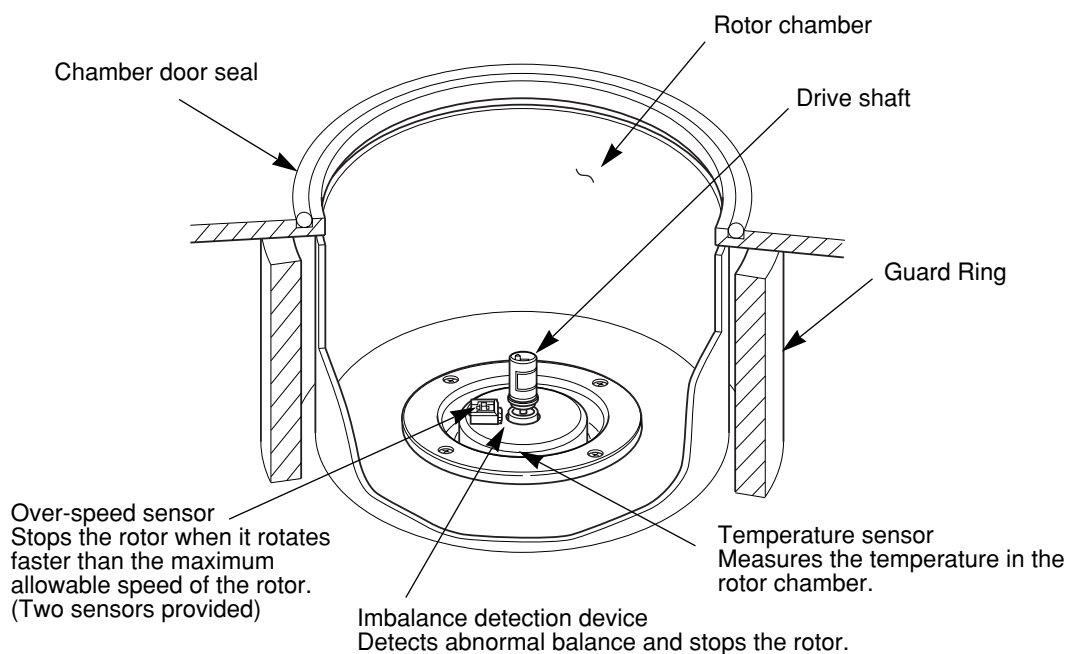


Fig. 1-2-4 Rotor chamber

1-2-4 Safety devices

(1) Protecting the operator.

Should a rotor failure occur, the guard ring will contain the contents of the rotor inside the centrifuge (Fig. 1-2-4).

(2) Imbalance detection

This micro-ultracentrifuge has a sensor designed to detect an increase in rotor vibration due to improper bucket placement or other gross imbalance conditions. However, the micro-ultracentrifuge is designed to tolerate imbalances associated with visual balancing.

(3) Door lock

The door locks automatically before the rotor starts spinning, and remains locked while the power is off.

The door can be opened only if the rotor has stopped and the vacuum key has been pressed.

To open the door during a power outage, see Section 4-3 "Emergency recovery from power outage".

(4) Overspeed detector

This micro-ultracentrifuge has a detector designed to prevent the rotor from spinning at a speed exceeding the maximum allowable speed.

Two independent microprocessors (CPUs) check the rotor for overspeed.

The first CPU detects overspeed and performs operation, display, and run control. Should the rotor be set to a speed exceeding the permissible speed, this CPU detects it from the low speed range (about 2,000rpm), displays an alarm message, and stops the rotor.

The second CPU, newly adopted, detects overspeed similarly to but independent of the first CPU and stops the rotor.

(But this second CPU does not display an alarm message, because it is not connected to the display-performing CPU. Should the alarm device be activated, pressing START key will not run the instrument. Turn off the POWER switch, wait for several minutes, turn the POWER switch on again, then press START key.)



IMPORTANT

Before operating the centrifuge, read and observe all safety information on the Important Safety Reminder pages in the front of this manual.

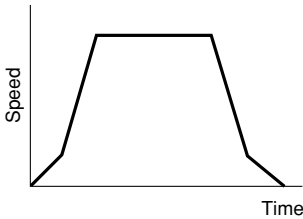
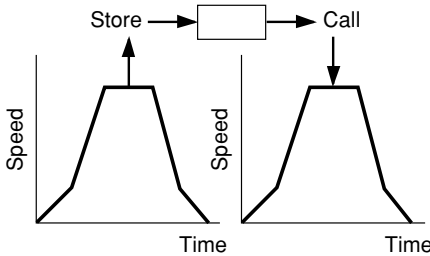
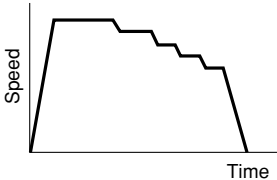
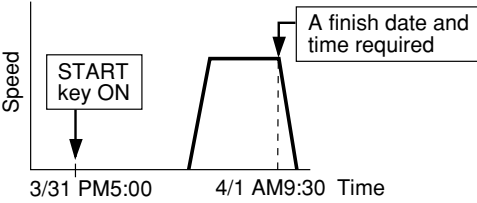
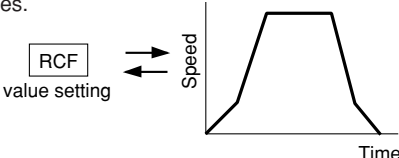
***IMPORTANT***

Before operating the centrifuge, read and observe all safety information on the Important Safety Reminder pages in the front of this manual.

2. Operation

This chapter provides the information that you need to operate your Discovery™ M150 SE and Discovery™ M120 SE Micro Ultracentrifuge.

The micro ultracentrifuge can be applied to a wide range of uses. A brief description of each mode of operation is given below.

Mode	Brief description	Reference
Normal operation		Section 2-2 "Basic operation"
Optional features	<p>Programmed operation</p> <p>You can store set run conditions in memory for later use in repeated operation.</p> 	Section 2-3 "How to use the OPTIONS field" Section 2-3-1 "Programmed operation"
	<p>Step-mode operation</p> <p>More than set of run conditions can be combined into a sequence for successive centrifugations.</p> 	Section 2-3-2 "Step-mode operation"
	<p>RTC (real-time control) operation</p> <p>Can be initiated or terminated at specified dates and times.</p> 	Section 2-3-3 "RTC feature"
	<p>RCF (centrifugal force) value display setting</p> <p>This feature calculates centrifugal force (RCF) values from set speed. It can also calculate reversely, i.e., finding speed from such values. Runs can also be set using RCF values.</p> 	Section 2-3-4 "Displaying and setting RCF"

2-1 Run preparation

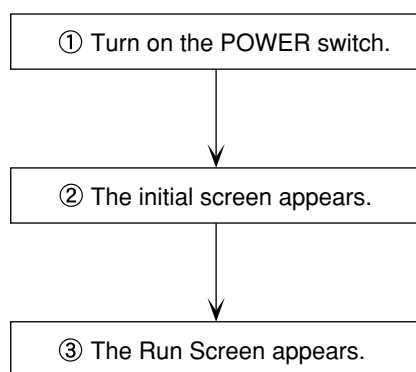
⚠ WARNING: ① Never use any material capable of producing flammable or explosive vapors, or extreme exothermic reactions.

② Be sure to take necessary safety measures before using materials which are toxic, radioactive, or contaminated with pathogenic micro-organisms.

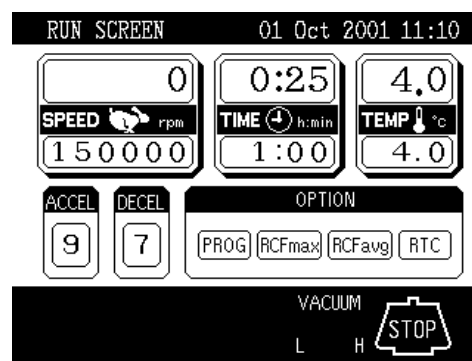
⚠ CAUTION: Do not place any fluids in the rotor chamber, on the top deck, or close to this ultracentrifuge. Any spillage can result in an electrical or mechanical failure.

2-1-1 Starting up this machine

(1) Turn centrifuge on.



Initial screen

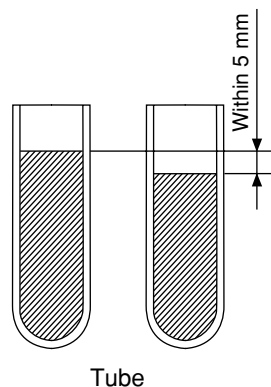


Run Screen

Fig. 2-1-1 Initial screen and the Run Screen

2-1-2 Cautions in preparing and handling a rotor and tubes

Sample balancing can be done visually. The difference between the meniscus level of the samples loaded in the same rotor must be within 5 mm.



For an S100AT5 rotor, the allowable meniscus level is decreased to 3 mm, and for an S80AT3 rotor, the allowable meniscus level is decreased to within 4 mm.

Fig. 2-1-2 Sample balancing

⚠ CAUTION: Do not run the ultracentrifuge in an extremely imbalanced condition. This might cause a mechanical failure.

Depending on the type of tube or rotor combined with this machine, an excessively low liquid level may limit the speed or crush the tube.

- When sealed tubes are used, fill the tubes with liquid to the full level.

⚠ CAUTIONS:

- ① Before using a rotor, read the rotor instruction manual carefully.
- ② Do not use any corroded, or cracked rotor or bucket.
Before operation, always check if there is any corrosion or damage on the rotor surface.
- ③ Before running a swinging bucket rotor, make sure that each bucket is properly seated on its support pins.
For proper balance, always operate the rotor with a full compliment of buckets.
- ④ Some tubes and adapters will not operate at the maximum speed of the rotor.
Refer to the rotor instruction manual.

2-1-3 Applicable rotors

For the Discovery™ M150 SE and the Discovery™ M120 SE Micro-Ultracentrifuges you can only use automatic securing rotors shown below. These rotors can be installed by merely placing it on the drive shaft in the rotor chamber. Screw-type rotors, also shown below, can only be used in RC-M100, RC-M120, and RC-M120 EX.

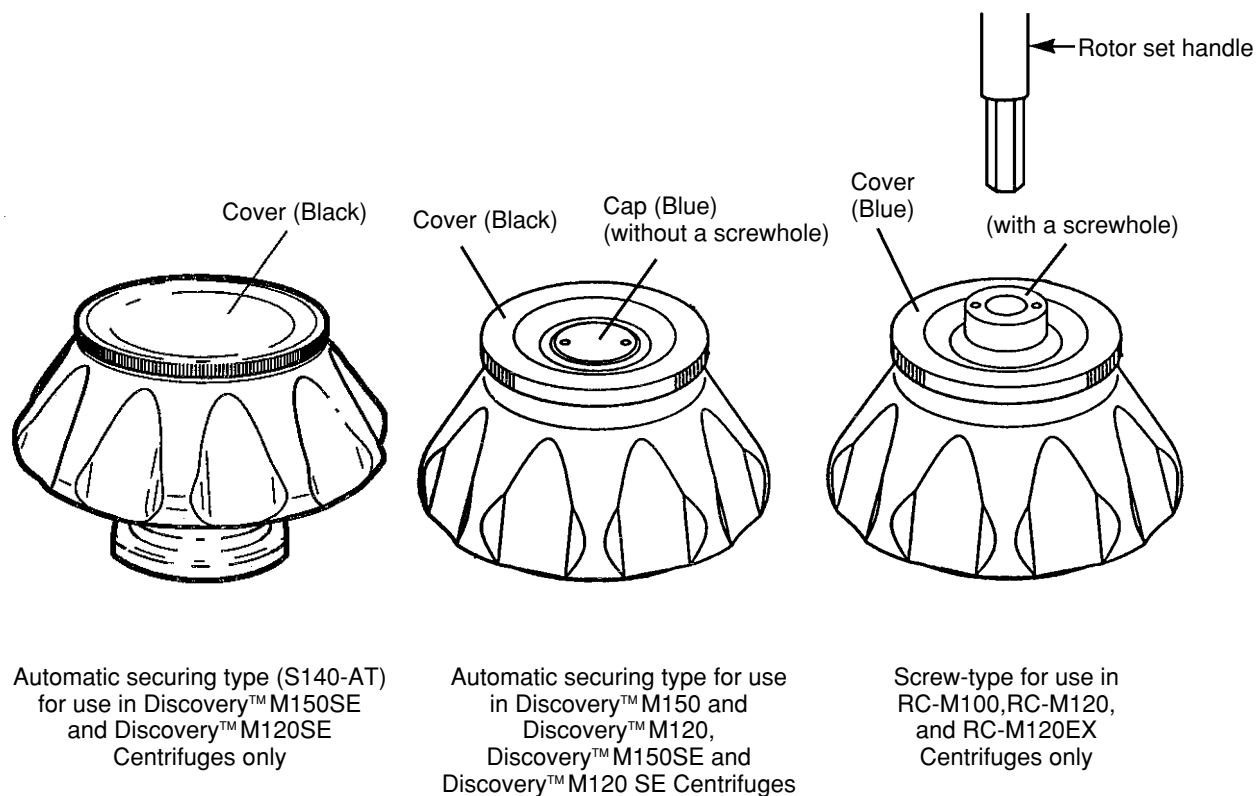


Fig. 2-1-3 Applicable rotors

- ⚠ CAUTIONS:**
- ① Always use a quick setting rotor for this micro ultracentrifuge. The screw-type rotors are incompatible .
Automatic securing rotors are not applicable in older models (RC-M100, RC-M120, and RC-M120 EX).
 - ② The rotor must be gently placed on the drive spindle to avoid damaging the drive shaft.
 - ③ Use only Thermo rotors.

⚠ DANGER: The S52-ST Rotor is specifically designed for the Discovery™ M150 SE and Discovery™ M120 SE Ultracentrifuge. This rotor **CAN NOT** be used in any other centrifuge.

2-2 Basic operation

⚠ WARNING: Do not tilt, lean or place anything on the centrifuge while in operation.

⚠ CAUTIONS:

- ① Open and close the display panel gently.
- ② Do not operate the keyboard with a ball-point pen or any sharp object.
- ③ If an abnormal sound occurs during operation, stop the instrument and contact your authorized Thermo Field Service Engineer.

2-2-1 Setting run conditions

This section will first describe the screen for basic operation (the Run Screen) and the cursor keys.

[Run Screen]

The screen for displaying run conditions and operational status is called the Run Screen.

Speed, time, and temperature are displayed in two rows: the top row displays the current actual run conditions, and the bottom row displays the set run conditions.

The acceleration (ACCEL) and the deceleration (DECEL) fields display set conditions.

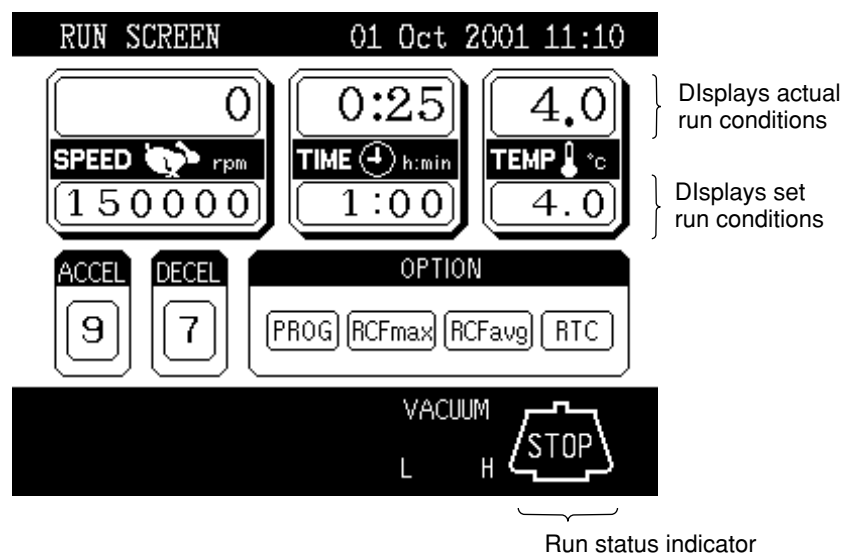


Fig. 2-2-1 Run Screen

[Cursor key]

Pressing the cursor key will highlight the field where changes can be made. (This blinking object is referred to as the cursor in this manual.)

The screen setting field is in either of the following states depending on whether the cursor is there.

- (1) Default input state: This is a normal state and the cursor does not appear.
- (2) Input wait state: Press a cursor key (either the top, bottom, right, or left) while in the default input state, and the numerical part of the setting field will blink and display the cursor.

In this state, the system accepts a numerical input.

Press cursor keys to move the cursor.

To set a run condition, enter the cursor into an input wait state, move the cursor to the item you want to set, then enter a value. If you have made no keystroke (such as a numerical input) for more than 30 seconds, the system will automatically enter a default input state.

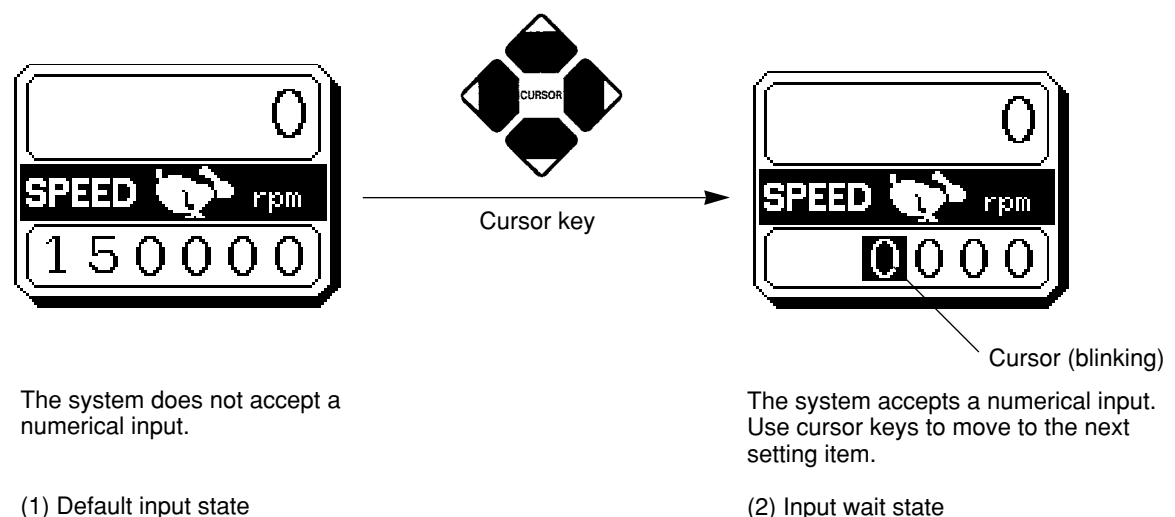


Fig. 2-2-2 Setting indicator

The next page describes how to set run conditions by citing some examples.

Notes

- (1) If you enter the wrong value, press CE key to return to the input wait state.

If you have pressed ENTER key, press a cursor key, enter the device into an input wait state, then enter the correct value.

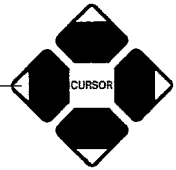
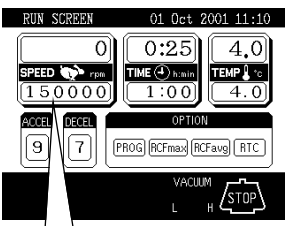
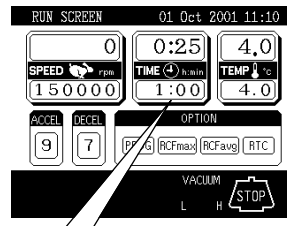


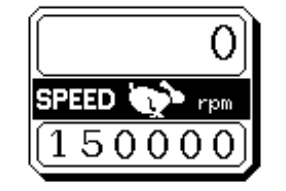

- (2) When setting two or more run conditions, you do not have to press ENTER key after each setting. Pressing the cursor key will enter the setting, thus making the system wait for a new input.
- (3) If you first set the system to continuous run (HOLD) and then enter a new time setting while in operation, enter the sum of the time elapsed plus the time remaining.

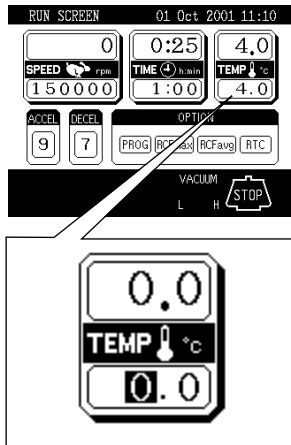
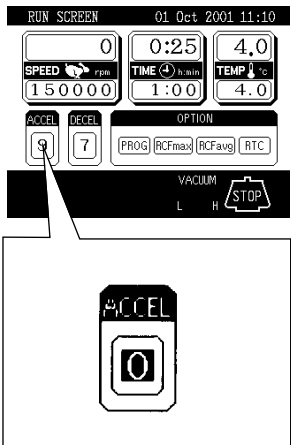
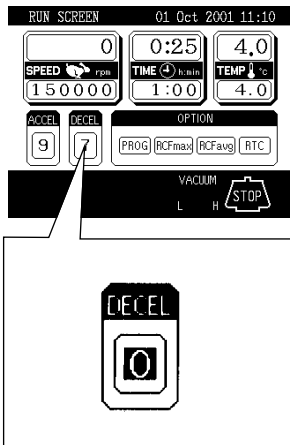



If, for example, this machine has run continuously for five hours and you want to stop it one and a half hours later, use cursor keys to enter TIME into an input wait state, then enter

6 : 3 0 ENTER

How to set speed, running time, temperature, and other parameters

Here are some examples and their explanations.




Setting item			RPM (SPEED)	Running time (TIME)
Typical setting			150,000 rpm	2 hours 30 minutes
Operation procedure	1	Press cursor keys to enter the system into an input wait state.	The system enters an input wait state.	The system enters an input wait state.
	2	Use cursor keys to move the cursor to the status indicator. (The arrows indicate the directions the cursor can be moved.) <div style="text-align: center;">  </div>	The system enters an input wait state. 	The system enters an input wait state. 
	3	The cursor in the setting item field blinks for about 30 seconds.		
	4	Use numeric keys to enter a setting. <div style="display: flex; flex-direction: column; align-items: center;"> <div>7 8 9</div> <div>4 5 6</div> <div>1 2 3</div> <div>0 : HOLD</div> <div>CE ENTER</div> </div> <p>Entered numbers are moved to the left every time a new number is entered.</p>	<div style="display: flex; justify-content: space-around; width: 100px;"> 150 </div> <p>The last three digits are fixed.</p>	<div style="display: flex; justify-content: space-around; width: 100px;"> 2:30 </div> <p>Press the : key to move the cursor to the “minutes” position. For a continuous run, press HOLD.</p>
	5	Check your entry , then press ENTER. The cursor key alternately acts as the enter key and moves to the next field.	Set it to 150,000 rpm. 	Set it to 2:30 (2 hours 30 minutes). 
Setting range and units			Can be set to any value in the range from 5,000 rpm to maximum speed in increments of 1,000 rpm.	Can be set to any value up to 99 hours 59 minutes in increments of 1 minute.

Temperature (TEMP)	Acceleration (ACCEL)	Deceleration (DECEL)
4 °C	9	7
Enters an input wait state.	Enters an input wait state.	Enters an input wait state.
<p>The cursor in the setting blinks.</p> 	<p>The cursor in the setting blinks.</p> 	<p>The cursor in the setting blinks.</p> 
4	9	7
		<p>For free coast, press HOLD.</p> <p>Display: F</p>
<p>Set it to 4°C.</p> 	<p>Set it to 9.</p> 	<p>Set it to 7.</p> 
Can be set to any value in the range from 0 to 40°C in increments of 1°C.	1 to 9	1 to 9 + free coast (F)



2-2-2 Operational procedure

Below is a description of the operational procedure for a normal run.

Note: Before starting up this machine, carefully read the operation manual for your rotor and make sure that you have selected the correct type of tubes and entered the correct amount of sample. If sample temperature control is of importance, you should equilibrate the sample temperature before a run.

Step	Operation and keystrokes	Unit operation and considerations
1	Turn POWER on.	<ul style="list-style-type: none"> The panel display lights up. The door is unlocked.
2	Install the rotor. (Always use the automatic securing rotors. See 2-1-3, "Applicable rotors".)	<ul style="list-style-type: none"> Install the rotor securely on the drive spindle.
3	Set run conditions.	<ul style="list-style-type: none"> See 2-2-1 "Setting run conditions" and set run conditions.
4	Press VACUUM key. (You can omit this step.) 	<ul style="list-style-type: none"> The machine starts evacuating the rotor chamber. Temperature control starts. The degree of vacuum in the rotor chamber is displayed on the vacuum indicator on the display panel. <div style="display: flex; align-items: center;">  <div style="margin-left: 10px;"> <p>(1) In a low vacuum ▶ (1 indicator)</p> <p>(2) In an intermediate vacuum ▶▶ (2 indicators)</p> <p>(3) In a high vacuum ▶▶▶ (3 indicators)</p> </div> </div> <ul style="list-style-type: none"> If the rotor compartment has moisture or frost on it, it takes a long time to reach an intermediate high vacuum. In that case, wipe it off with a cloth. If the sample is sensitive to a temperature rise, do not press the START key until the chamber is at high vacuum level.
5	Press START key. 	<ul style="list-style-type: none"> The RUNNING lamp on the POWER switch blinks and the rotor starts turning. The timer begins operating. When the speed reaches the setting, the RUNNING lamp comes on. This ultracentrifuge waits at 5,000 rpm until an intermediate vacuum is reached.

Note: If there is a leak in the rotor chamber or ambient temperature is low, the vacuum waiting time at 5,000 rpm may be longer.

Step	Operation and keystrokes	Unit operation and considerations
6	The specified centrifugation time elapses (time-out). Or press STOP key. 	<ul style="list-style-type: none"> The RUNNING lamp on the POWER switch goes off. The STOP lamp on the POWER switch blinks and the rotor starts decelerating.
7	The rotor stops.	<ul style="list-style-type: none"> The STOP lamp comes on. The buzzer sounds to indicate that the rotor has stopped.
8	Press VACUUM key. 	<ul style="list-style-type: none"> The vacuum pump stops, the air vacuum release activates, and the rotor chamber reaches atmospheric pressure. The door unlocks, and can be opened and closed.
9	Take out the rotor.	<ul style="list-style-type: none"> Be sure the rotor has come to a complete stop before removing.

The run mode indicator on the display panel displays the following:

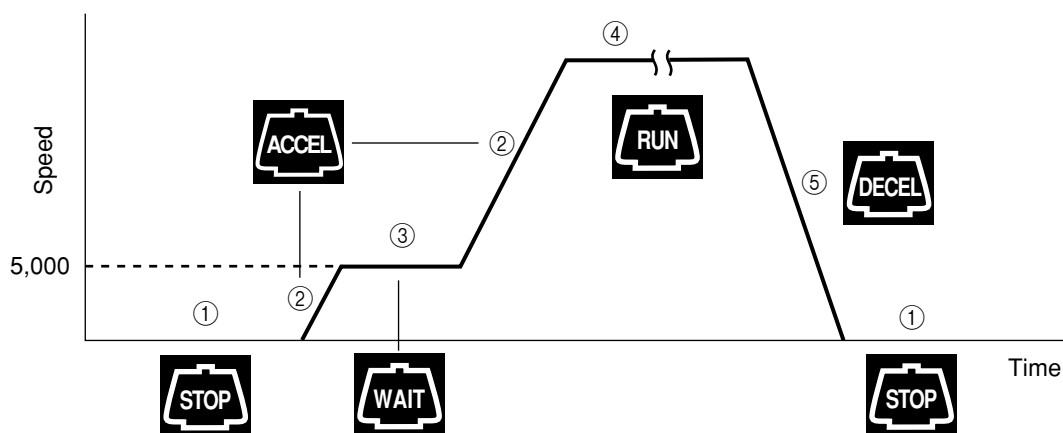
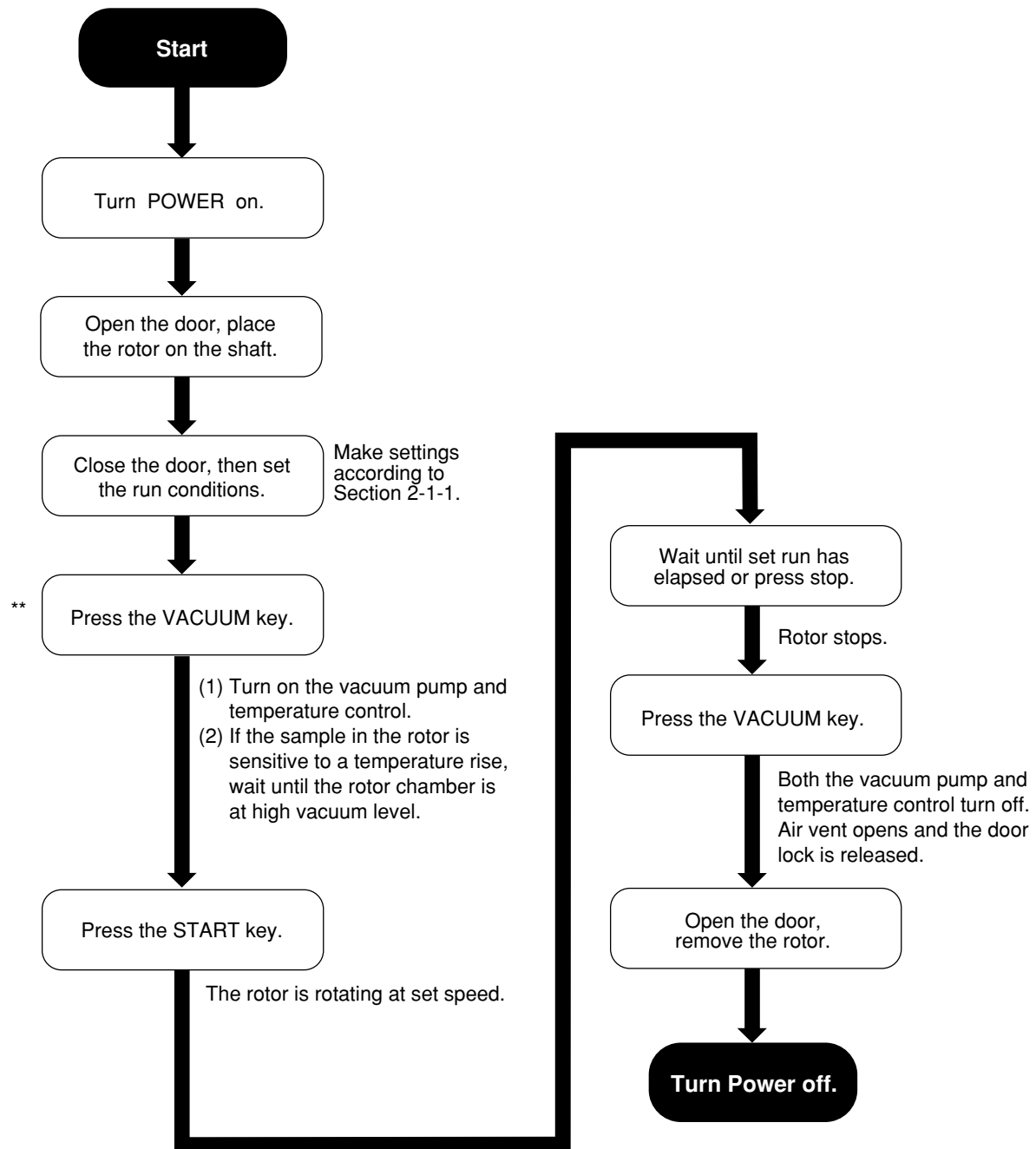


Fig. 2-2-3 Displays of run modes

Fig. 2-2-3 Normal operation flow chart.

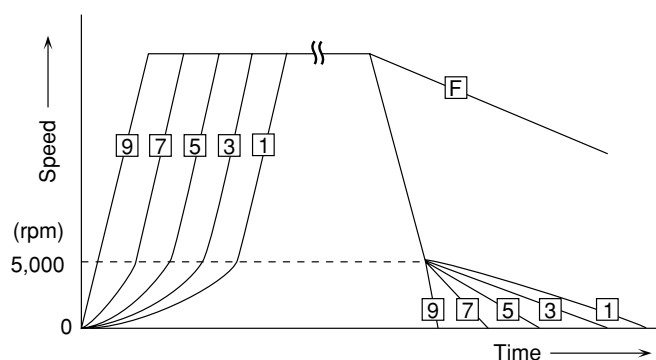


** This step may be omitted, in which case pressing the START key later in the procedure turns on the vacuum pump and the rotor stays at 5000 rpm to wait for chamber vacuum to reach its intermediate level.

Fig. 2-2-4 Operational procedure

2-2-3 Acceleration rate and deceleration rate

The acceleration rate adjusts the time a rotor takes to accelerate from 0 to 5000 rpm. At 5000 rpm, the rotor will accelerate at its maximum rate to set speed. The deceleration rate adjusts the time it takes a rotor to decelerate from 5000 to 0 rpm. The rotor decelerates from set speed to 5000 rpm at maximum rate. If free coast (HOLD) is selected, the rotor rotating at set speed will free-coast to a stop. The figure below shows how a rotor accelerates and decelerates in compliance with a number selected from 1 through 9 and F. The numbers on the curves are keyed to the numbers in the table to the right of the figure below.



Code no.	Time (minutes) for acceleration from 0 to 5,000 rpm (±15 sec)	Time (minutes) for deceleration from 5,000 to 0 rpm (±30 sec)
9	Minimum*	Minimum*
8	0.5	1
7	1	2
6	1.5	3
5	2	4
4	2.5	5
3	3	6
2	3.5	7
1	4	8
F	—	Coasting deceleration from set speed

*: The minimum time is the one that occurs when the rotor is being accelerated or decelerated with the maximum torque of the driving motor. This time varies with the type of rotor in use.

The table below shows typical examples of acceleration and deceleration rates.

Type of centrifugation	Code no.		Characteristics of centrifugation done
	ACCEL	DECEL	
Density gradient centrifugation using a vertical rotor	5	7	The sample and density gradient in tubes reorient during acceleration and deceleration. Therefore, the sample and gradient can become mixed if you use rapid acceleration or deceleration.
DNA separation by CsCl isopycnic centrifugation (self-forming gradients)	9	7	You can operate at maximum acceleration because the density gradient is formed during the run. As for the deceleration, it is better to decelerate slowly to obtain sharp bands.
Pelleting using a fixed angle rotor	9	9	Rapid pelleting of samples is possible (the run time decreases).
Density gradient centrifugation using a swinging bucket rotor	5 to 8	5 to 8	The sample and density gradient do not reorient. Therefore, mixing of the layers is less than that in the case of using a vertical rotor. But it is safe not to accelerate or decelerate the rotor by selecting minimum time.

2-3 How to use the OPTIONS field

The micro-ultracentrifuge has a number of features, for example, step-mode, programmability, RCF run, control, and RTC (real-time control) . These features are displayed in the OPTIONS field.

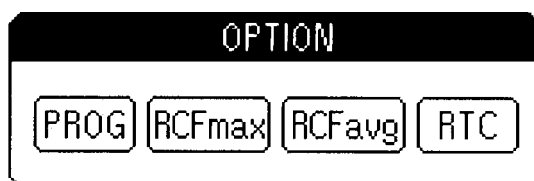


Fig. 2-3-1 OPTIONS screen

- PROG** : Programs, stores, and recalls run conditions.
This feature also offers a step-mode operation: a continuous run of multiple run conditions.
- RCFmax** : Maximum centrifugal force for the maximum radius (**r_{max}**) of the rotor identified (i.e. with the correct rotor ID input for the rotor in use).
System automatically calculates and displays RCFmax.
It also sets an RCFmax value and calculates the speed.
- RCFavg** : Average centrifugal force system automatically calculates and displays RCF avg for the average radius (**r_{avg}**) of the rotor identified.
It also sets an RCFavg value and calculates the speed.
- RTC** : (Real Time Control) sets a desired setting or finishing time and runs the micro ultracentrifuge at a desired date and time.

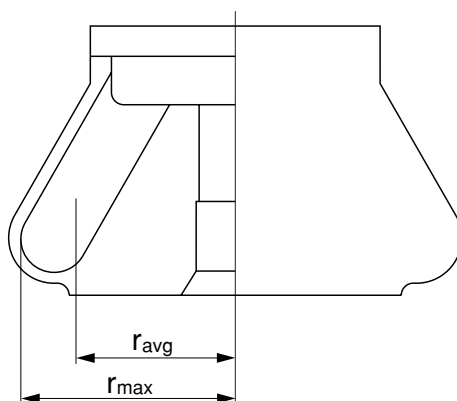


Fig. 2-3-2 Rotor radius

The above features can be used in combination.

When all settings are entered, press ESC to move back to the Run Screen. Then enter a setting for another feature to form a combination.

Note: To perform a combination of **PROG** and **RTC** , first set **PROG** and then set **RTC** .
Once **RTC** is activated, you cannot change the run time, or activate **PROG** .

2-3-1 Programmed operation

Frequently used run conditions may be stored as programs.

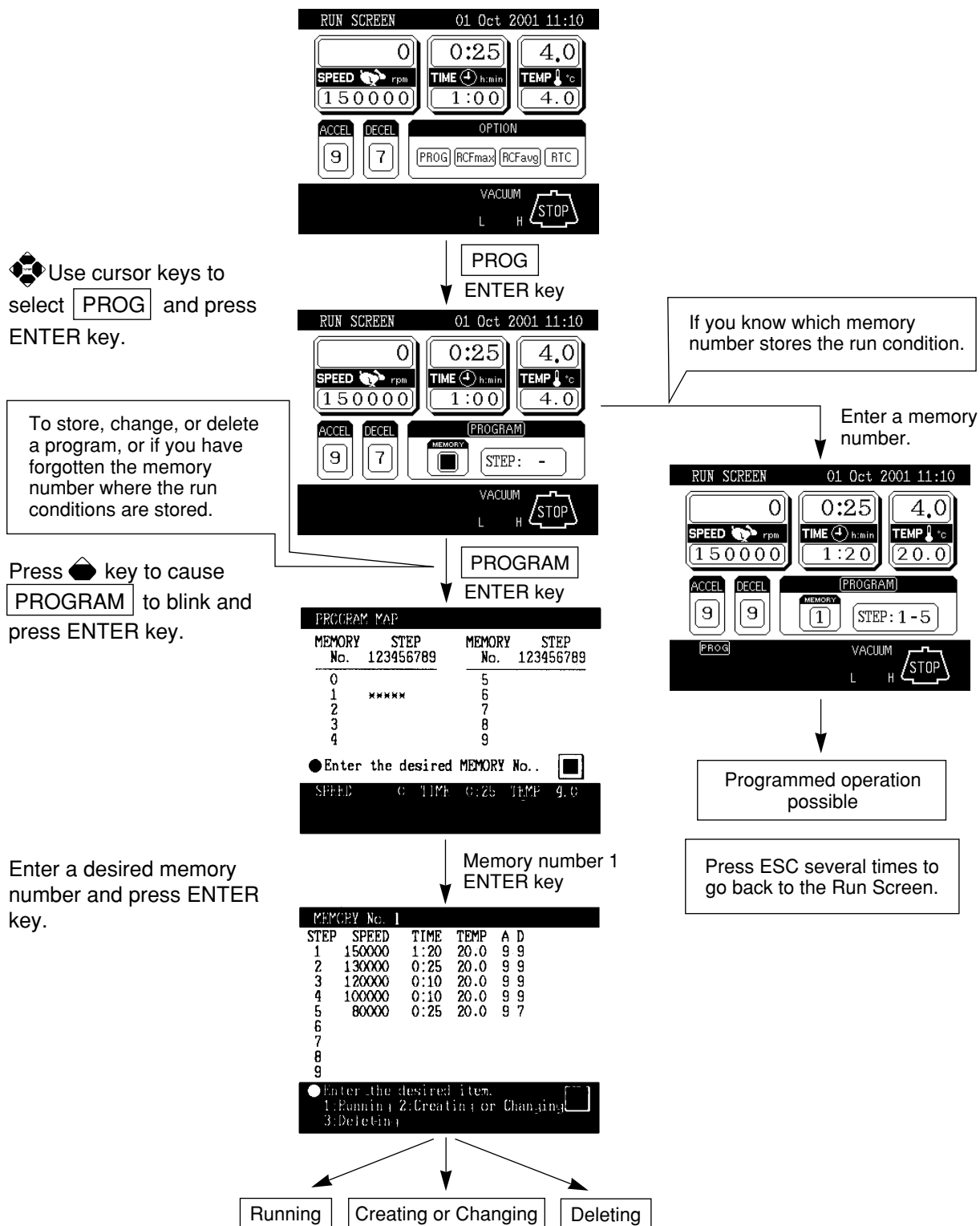
This centrifuge incorporates the program areas indicated below. It has ten memory areas and nine steps in each memory number. This means that the centrifuge can store up to ten patterns of run conditions and each memory number can store nine steps.

Running this machine with each memory number retaining multiple steps will allow you to change speed, run time, temperature, and other parameters while in operation (step-mode operation).

Memory 0	Step 1	Step 2	-----	Step 9
Memory 1	Step 1	Step 2	-----	Step 9
Memory 2	Step 1	Step 2	-----	Step 9
⋮	⋮	⋮	----- ----- ----- -----	⋮
Memory 9	Step 1	Step 2	-----	Step 9

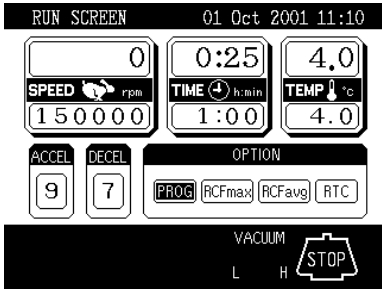
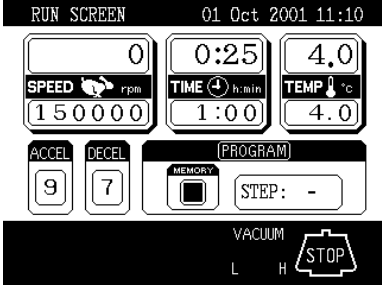

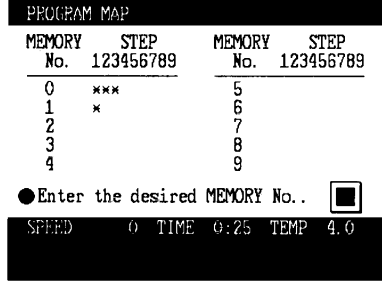

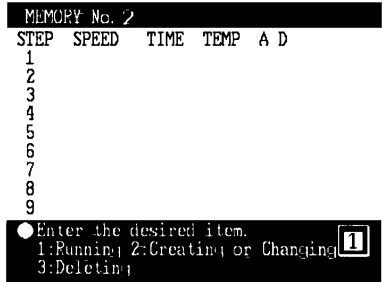
Fig. 2-3-3 Program areas


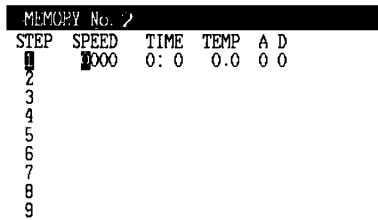
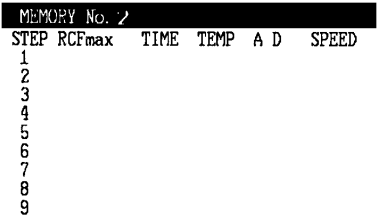

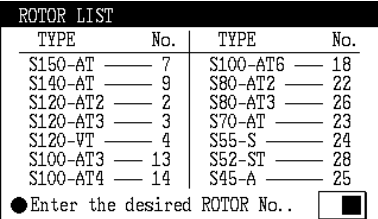
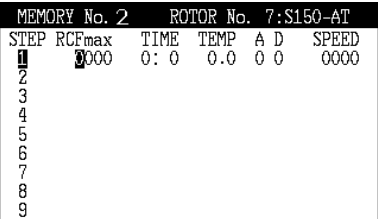
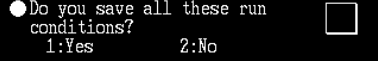
(Basic operation of the programmed operation feature)



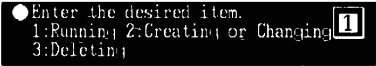
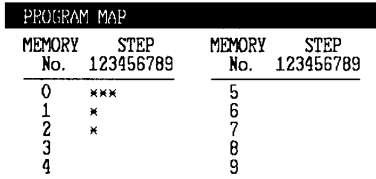
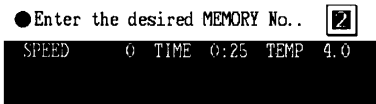
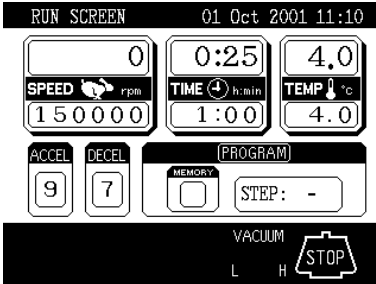
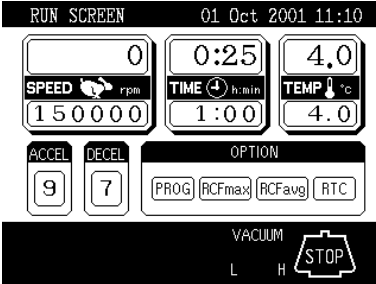
Note: You cannot create, change, or delete a program while the instrument is running. However, you can search the memory screen at any time.

(1) Programming procedure for run conditions (creating, changing or storing)

Step	Key operation	Screen display and considerations
1	While in the Run Screen, use the cursor keys to move the cursor to PROG and press ENTER key.	 <p style="text-align: center;">↓</p>  <ul style="list-style-type: none"> • The OPTIONS field switches to the PROGRAM field. • The MEMORY No. setting field blinks.
2	Press the upward cursor key  to cause PROGRAM to blink, then press ENTER key.	 <ul style="list-style-type: none"> • The display switches to the Program Map screen and the MEMORY No. selection field blinks. • Enter the desired MEMORY No.  • The mark * indicates that an operational condition is already written there. (MEMORY 0 shown above stores a three-step run condition.) • If you wish to store a new condition, enter it into an empty memory number.
3	Use numeric keys to enter a memory number you wish to store or change. Example: To store a condition in memory number 2, press 2 ENTER	 <ul style="list-style-type: none"> • The memory screen you have just specified appears. • Enter the desired item. 1:Running; 2:Creating; or Changing; 3:Deleting

Step	Key operation	Screen display and considerations
4	Select "Creating or Changing." 2 ENTER	 <ul style="list-style-type: none"> The message field in the bottom row switches to what is shown in the figure to the left.
5	Enter a desired condition. [To enter the condition in RPM] ① Select SPEED. 1 ENTER	 <ul style="list-style-type: none"> The display switches to the SPEED priority setting screen and the SPEED field blinks.
	[Entering a condition in RCF] ① Select RCFmax (or RCFavg). 2 (3) ENTER	 <ul style="list-style-type: none"> The display switches to the RCF priority setting screen.
	② If you do not know which rotor number you are using, press  to cause LIST to blink, then press ENTER key. [If you know which rotor number you are using, omit this step.]	 <ul style="list-style-type: none"> The display switches to the Rotors List screen. You can search for the rotor number you need.
	③ Enter the rotor number you are using, and then press ENTER key. (If you are using an S150AT, enter a 7.) 7 ENTER	 <ul style="list-style-type: none"> The rotor type you have just entered appears in the top row in the screen. The RCF field in the RCF priority screen blinks.
		 <ul style="list-style-type: none"> Setting an RCFmax (or RCFavg) will cause the system to calculate and display the speed at the right end. You can enter a value directly into the SPEED field. You cannot enter an RCF value exceeding the maximum allowable speed of your rotor.

Step	Key operation	Screen display and considerations
6	<p>Enter values into SPEED (RCFmax or RCFavg), TIME, TEMP, A (ACCEL), and D (DECEL).</p> <p>Example</p> <p>1 5 0 </p> <p>1 : 2 0 </p> <p>2 5 </p> <p>9 </p> <p>7 Downward cursor key</p>	<div> </div> <ul style="list-style-type: none"> When you finish entering run conditions for step 1, step 2 enters into an input wait state. <div> </div> <ul style="list-style-type: none"> To enter run conditions in multiple steps in a step-mode operation, continue the operation from the above. (See 2-3-2 "Step-mode operation.") You cannot skip a step. (You cannot enter anything in step 2 with nothing entered into step 1.)
	<p>To change a run condition, use cursor keys to move to the item you want to change and then enter a value.</p>	<div> </div> <ul style="list-style-type: none"> This diagram shows what you will get if you move the cursor and enter the TIME field into an input wait. <div> </div>
7	<p>Press the downward cursor key to blink the value part of the message field in the bottom row. Then select Yes.</p> <p>Yes 1 ENTER</p> <p>No 2 ENTER</p>	<ul style="list-style-type: none"> If you select Yes: <div> </div> If you select No, the message field in the bottom row switches to what you see in process 4. Select a new setting. <div> </div> The message field in the bottom row switches to what is shown in the diagram to the left, and the storing of the run conditions in memory number 2 is completed.

Step	Key operation	Screen display and considerations
8	When all run conditions have been entered and saved, press ESC key several times.	<ul style="list-style-type: none"> The first push on ESC key switches the message display in the bottom row to what you see in step 3 as shown below. To run this program, select Run.  <ul style="list-style-type: none"> Pushing ESC key a second time displays the Program Map screen shown in process 3.  <ul style="list-style-type: none"> Make sure that the condition is stored in memory number 2. (i.e. the number of steps should be displayed correctly.) <ul style="list-style-type: none"> Enter the desired MEMORY No..  <ul style="list-style-type: none"> The third push on ESC key switches you back to the Run Screen (program screen).  <ul style="list-style-type: none"> The fourth push on ESC key switches you back to the Run Screen (OPTIONS field). 

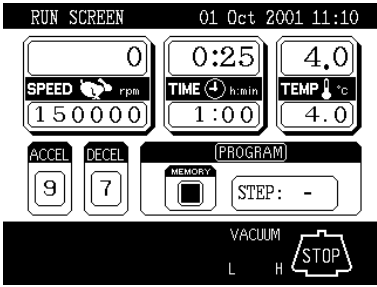
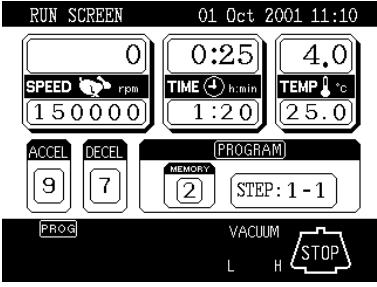
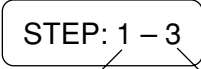
Notes

- (1) If you make and store changes in a memory area that already had stored run conditions, the previous conditions are replaced by the new conditions.
- (2) You cannot store a run condition while instrument is running (rotor is rotating).

(2) How to perform a programmed operation

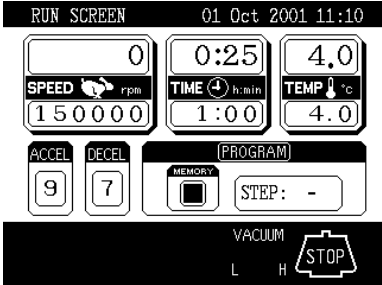

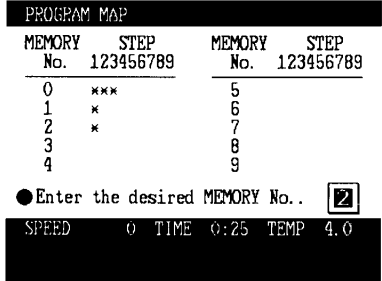
Shown below is how to recall a stored set of run conditions.

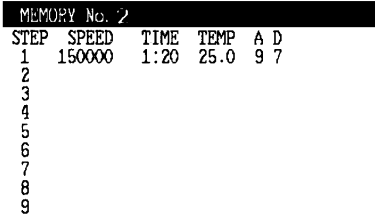
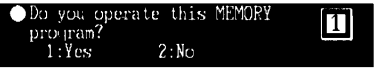
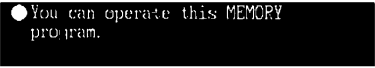
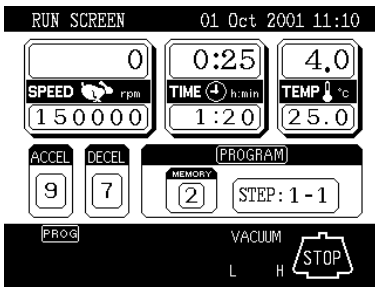
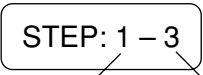
- ① If you know which memory number you need

Step	Key operation	Screen display and considerations
1	Turn POWER on.	<ul style="list-style-type: none"> The panel display appears. The door unlocks.
2	Install a rotor.	<ul style="list-style-type: none"> Place the rotor on the drive spindle. Always use the automatic securing rotors only. (See 2-1-3 "Applicable rotors.")
3	While in the Run Screen, use cursor keys to move the cursor to PROG and then press ENTER key.	 <ul style="list-style-type: none"> The OPTIONS field switches to the PROGRAM field. The MEMORY No. setting field blinks.
4	Enter the memory number you wish to operate. Example: To call memory 2, press 2	 <ul style="list-style-type: none"> The run conditions in memory appear in the respective fields. <div style="text-align: center;">  <p>In the Run Screen, the run conditions of this step are displayed.</p> <p>Total number of steps.</p> </div> <ul style="list-style-type: none"> The message field in the bottom row displays PROG. If the STEP field displays what is shown below, this means that the memory number you have just called stores multiple run conditions (step-mode feature). For details, see 2-3-2 "Step-mode operation." The system does not accept has an unused memory number for recall.

Step	Key operation	Screen display and considerations
5	Run the centrifuge under normal operation without making changes to the run conditions.	<ul style="list-style-type: none"> Run this machine according to 2-2-2 "Operation procedure." If you make changes to the run conditions (such as SPEED and TIME) after calling a program, the program you have just called is canceled. You must call it again to use it.

② If you do not know which memory number you need

Step	Key operation	Screen display and considerations
1	Turn on the POWER switch of this machine.	<ul style="list-style-type: none"> The panel display appears. The door unlocks.
2	Install a rotor.	<ul style="list-style-type: none"> Install the rotor on the drive spindle. Always use the automatic securing rotors only. (See 2-1-3 "Applicable rotors.")
3	While in the Run Screen, use cursor keys to move the cursor to PROG and then press ENTER key.	 <ul style="list-style-type: none"> The OPTIONS field switches to the PROGRAM field. The MEMORY No. setting field blinks.
4	Press the upward cursor key  to blink PROGRAM . Then press ENTER key.	 <ul style="list-style-type: none"> The display switches to the Program Map screen and the MEMORY No. selection field blinks. <p>● Enter the desired MEMORY No.. 2</p> <p>SPEED 0 TIME 0:25 TEMP 4.0</p> <ul style="list-style-type: none"> The mark * indicates that a run condition is already stored there. (The memory unit 0 above stores three sets of run conditions.)

Step	Key operation	Screen display and considerations
5	<p>Use numeric keys to enter the memory number where you have stored data.</p> <p>To call memory number 2, press</p> <p>2 ENTER</p>	 <ul style="list-style-type: none"> The image of the specified memory number appears. <p>● Enter the desired item. 1:Running 2:Creating or Changing 3:Deleting 1</p> <ul style="list-style-type: none"> If the contents of the memory number you have just called is not what you want, press ESC to switch back to the Program Map screen and then call another memory number.
6	<p>If you get the memory number you want, select Running.</p> <p>1 ENTER</p>	<ul style="list-style-type: none"> The message field in the bottom row switches to what you see below. 
7	<p>To run the centrifuge, select Yes.</p> <p>Yes 1 ENTER</p> <p>No 2 ENTER</p>	<ul style="list-style-type: none"> If you select Yes  <ul style="list-style-type: none"> If you select No, the message field in the bottom row displays what you see in process 5. Select a new condition.
8	<p>Press ESC key.</p> <p>ESC</p>	 <ul style="list-style-type: none"> The display switches back to the Run Screen. The run conditions in memory appear in the respective fields. <ul style="list-style-type: none"> The message field in the bottom row displays PROG. If the STEP field displays what is shown in the figure below, that means that the memory number you have just called stores multiple run conditions (step-mode feature). For details, see 2-3-2 "Step-mode run." <div style="text-align: center;">  <p>In the Run Screen, step whose run conditions are shown. (In this case, the first step.)</p> <p>Total number of steps.</p> </div>

Step	Key operation	Screen display and considerations
9	Start running the centrifuge under normal operation with no changes made to the run conditions.	<ul style="list-style-type: none">● Run this machine according to 2-2-2 "Operation procedure.")● If you make changes to the run conditions (such as SPEED and TIME) after calling a program, the program you have just called will be canceled. You must call the program again to use it.

Notes: (1) To check the contents (run conditions) of the memory number for the program while in running, follow steps 3 through 5 in ② "If you do not know which memory number you need." After the check, press ESC to get back to the Run Screen.

(2) To perform a combination of a programmed run with RTC (real-time control) (see 2-3-3 "RTC feature"), call a programmed memory number, then set RTC.

The system will then calculate the total of the running times of all steps of the programmed run and calculate the start time for RTC. Therefore, cannot call the program memory after setting RTC.

2-3-2 Step-mode operation

The micro-ultracentrifuge has a step-mode operation feature which stores multiple run conditions in one program memory area and switches between different values of speed, running time, temperature, and other parameters while in operation. This centrifuge can store up to nine steps.

(1) How to activate a step-mode operation

– Typical settings

Shown below is the example of a three-step run and how to activate a step-mode operation.

	Step 1	Step 2	Step 3
Speed	150,000rpm	120,000rpm	100,000rpm
Run time	1h30min	1h	30min
Temperature	20°C	20°C	20°C
Acceleration mode	9	9	9
Deceleration mode	9	9	7

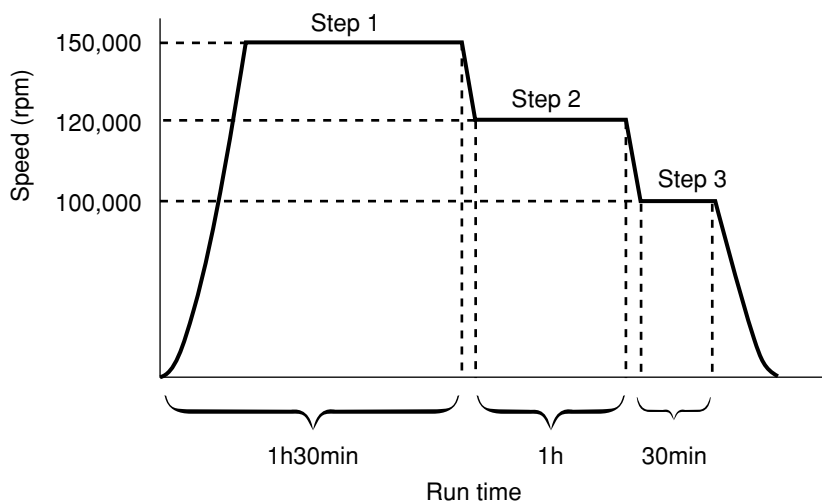
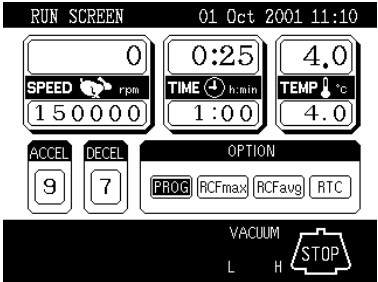
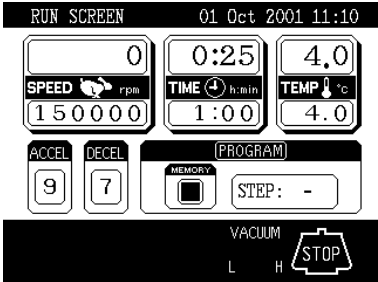

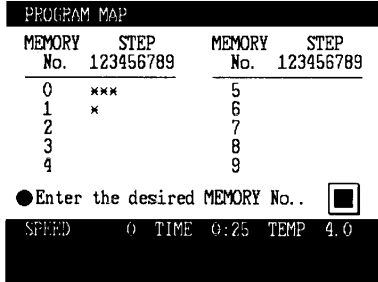



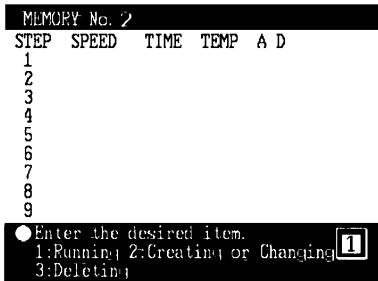
























































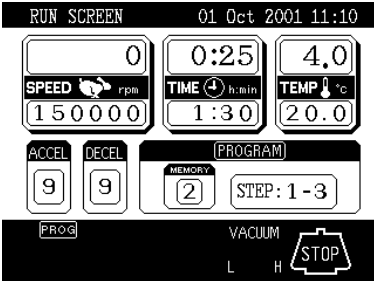


Fig. 2-3-4 A typical step-mode run

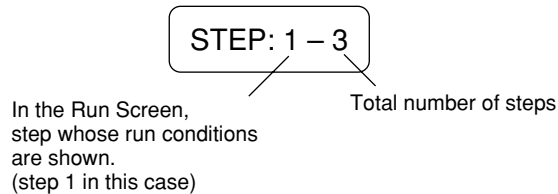
Step	Key operation	Screen display and considerations
1	While in the Run Screen, use the cursor keys to move the cursor to PROG and press ENTER key.	 <p style="text-align: center;">↓</p>  <ul style="list-style-type: none"> • The OPTIONS field switches to the PROGRAM field. • The MEMORY No. setting field blinks.
2	Press the upward cursor key  to cause PROGRAM to blink, then press ENTER key.	 <ul style="list-style-type: none"> • The display switches to the Program Map screen and the MEMORY No. selection field blinks. <p>● Enter the desired MEMORY No.. </p>
3	Use numeric keys to enter the memory number you want to store. To store data in memory 2, press  	 <ul style="list-style-type: none"> • The image of the specified memory number appears. <p>● Enter the desired item. 1:Running; 2:Creating or Changing  3:Deleting</p>

Step	Key operation	Screen display and considerations
4	Select "Creating or Changing."  	 <ul style="list-style-type: none"> ● Select the desired setting parameter. 1: SPEED 2: RCFmax 3: RCFavg ● The message field in the bottom row switches to what you see on the left.
5	Enter a desired condition. To select SPEED, press  	 <ul style="list-style-type: none"> ● The display switches to the SPEED priority setting field and the SPEED area blinks. ● To select and enter RCFmax or RCFavg, see 2-3-1 (1) "Programming procedure for run conditions (Creating or Changing)."
6	Specify run conditions for step 1.                 Downward cursor key	 <ul style="list-style-type: none"> ● The entry of run conditions for step 1 is complete. ● If you press the cursor key  (downward) after setting numeric value for DECEL (D) in step 1, setting the run conditions in step 1 finishes and step 2 enters into an input wait state.
7	Then specify run conditions for step 2.              Downward cursor key	 <ul style="list-style-type: none"> ● The entry of run conditions for step 2 is complete.
8	Lastly, specify run conditions for step 3.                Downward cursor key	 <ul style="list-style-type: none"> ● The entry of run conditions for step 3 is complete and step 4 is ready for into.

Step	Key operation	Screen display and considerations
9	<p>Press the downward cursor key  to blink the value part of the message field in the bottom row. Then select Yes.</p> <p>Yes <input type="text" value="1"/> <input type="text" value="ENTER"/></p> <p>No <input type="text" value="2"/> <input type="text" value="ENTER"/></p>	<ul style="list-style-type: none"> If you select Yes: <ul style="list-style-type: none"> ● These run conditions have been saved. The message field in the bottom row switches to what is shown in the diagram on the left, and the storing of the run conditions in the appropriate memory is completed. If you select No, the message field in the bottom row switches to what you see in process 4. Input a new setting. <ul style="list-style-type: none"> ● Select the desired setting parameter. 1: SPEED 2: RCFmax 3: RCFavg
10	<p>When the storing is over, press ESC key.</p> <p><input type="text" value="ESC"/></p>	<ul style="list-style-type: none"> ● Enter the desired item. 1: Running 2: Creating or Changing 3: Deleting
11	<p>Select "Running".</p> <p><input type="text" value="1"/> <input type="text" value="ENTER"/></p>	<ul style="list-style-type: none"> ● Do you operate this MEMORY program? 1: Yes 2: No
12	<p>To run the centrifuge, select Yes.</p> <p>Yes <input type="text" value="1"/> <input type="text" value="ENTER"/></p> <p>No <input type="text" value="2"/> <input type="text" value="ENTER"/></p>	<ul style="list-style-type: none"> If you select Yes: <ul style="list-style-type: none"> ● You can operate this MEMORY program. If you select No, the message field in the bottom row displays what you see in process 10. Make the selection again.
13	<p>Press ESC key.</p> <p><input type="text" value="ESC"/></p>	 <ul style="list-style-type: none"> The display switches back to the Run Screen. The run conditions of step 1 in memory appear in the respective fields. The message field in the bottom row displays PROG.
14	<p>Start running the centrifuge under normal operation with no changes made to the operational conditions.</p>	<ul style="list-style-type: none"> Run the centrifuge according to 2-2-2 "Operation procedure." If you make changes to the run conditions (such as SPEED and TIME) after calling a program, the program you have just called gets canceled. You must call the program again. Pressing START makes the rotor rotate under the run condition of step 1. When step 1 ends, the system moves to steps 2 and 3 automatically.

Notes:**(1) Step display**

The PROGRAM field displays steps as follows:



When the system finishes separating step 1 and moves to step 2,

A rounded rectangular box containing the text "STEP: 2 - 3".

When the system moves from step 2 to the final step 3,

A rounded rectangular box containing the text "STEP: 3 - 3".

Thus, you can see at a glance how many steps are stored in the specified memory and which step the centrifuge is following.

- (2) While instrument is running (rotor is rotating), you cannot store a step-mode run condition.*
- (3) To check the contents (run conditions) of a step-mode program memory, follow steps 1 through 3. To get back to the Run Screen after the check, press ESC key.*
- (4) To perform a combination of a step mode run with an RTC (real-time control) run (see Section 2-3-3 "RTC feature"), call a program memory number, then set RTC.*

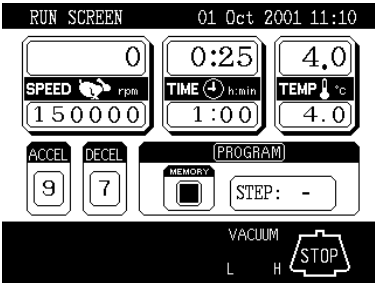

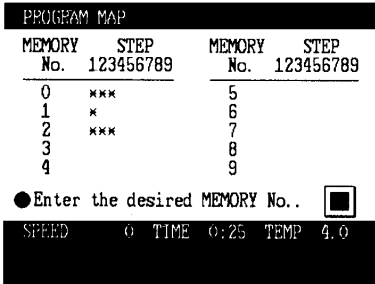

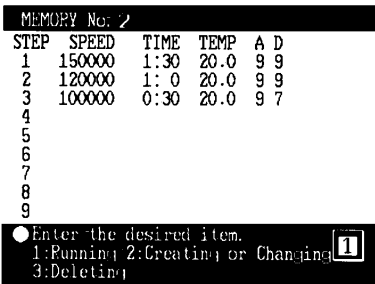

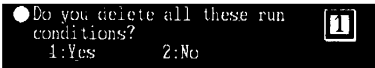
The system then calculates the total of running times of all steps of the programmed run and calculates the startup time for RTC. You therefore cannot call a program memory after setting RTC.

(2) Deleting a program

This section explains how to delete a set of run conditions stored in program memory.

To delete a memory number, delete all steps in that memory number.

(Note) While running, you cannot delete a program memory unit.

Step	Key operation	Screen display and considerations
1	While in the Run Screen, use cursor keys to move the cursor to PROG and then press ENTER key.	 <ul style="list-style-type: none"> The OPTIONS field switches to the PROGRAM field. The MEMORY No. setting field blinks.
2	Press the upward cursor key  to cause PROGRAM to blink, then press ENTER key.	 <ul style="list-style-type: none"> The display switches to the Program Map screen and the MEMORY No. field blinks. Enter the desired MEMORY No.  The mark * indicates that a run condition is already stored there.
3	Use numeric keys to enter the memory unit number you want to delete. To delete memory number 2, press 2 ENTER	 <ul style="list-style-type: none"> The image of the memory you have just specified appears. Enter the desired item. 1:Running 2:Creating or Changing  3:Deleting
4	Select "Deleting." 3 ENTER	 <ul style="list-style-type: none"> The message field in the bottom row switches to delete choices.

Step	Key operation	Screen display and considerations																																																												
5	<p>To delete this memory , select Yes.</p> <p>Yes <input type="text" value="1"/> <input type="text" value="ENTER"/></p> <p>No <input type="text" value="2"/> <input type="text" value="ENTER"/></p>	<ul style="list-style-type: none">● If you select Yes <div><p>MEMORY No. 2</p><table><thead><tr><th>STEP</th><th>SPEED</th><th>TIME</th><th>TEMP</th><th>A</th><th>D</th></tr></thead><tbody><tr><td>1</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>2</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>3</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>4</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>5</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>6</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>7</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>8</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>9</td><td></td><td></td><td></td><td></td><td></td></tr></tbody></table><p>● The run conditions have been deleted.</p></div> <ul style="list-style-type: none">● The system deletes all run conditions in memory number 2. (While in step mode, all steps get deleted.) <ul style="list-style-type: none">● If you select No, the screen switches to what you see in step 3. Make the selection again.	STEP	SPEED	TIME	TEMP	A	D	1						2						3						4						5						6						7						8						9					
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6	<p>Press ESC several times to move back to the Run Screen.</p>	<ul style="list-style-type: none">● Once a memory is deleted you cannot call the conditions that were previously there.																																																												

(3) Other procedures

1) Making changes to the run conditions

Call the memory number you want to make changes to, make the changes or delete the memory number, then store a new set of run conditions.

To make a change that will result in fewer steps, delete the memory and then enter a new set of run conditions and store them.

While in a programmed run, modification of a run condition is limited to the step which is currently running.

2) Running the centrifuge starting from an intermediate step

You cannot run the centrifuge starting from an intermediate step in a memory that contains multiple steps.

Store (register) run conditions for the intermediate step and later steps in another memory. Then call the memory and run it.

3) What if a "SPEED" alarm goes on?

If a step stores a speed exceeding the maximum allowable speed of your rotor, the system will delete it in the step 1 run and display the "SPEED" alarm.

Double-check the speed of all steps and correct if necessary.

4) Stopping the centrifuge in operation

Press STOP. The rotor stops and the system does not move to the next step.

2-3-3 RTC (real-time control) feature

The Discovery™ M150 SE and Discovery™ M120 SE micro-ultracentrifuges contain an internal clock, allowing you to run the machine at a specified start or finish time for centrifugation. This feature is called the RTC (real-time control) feature. The feature is beneficial in that it calculates the delay time for “delayed-start operation”.

Explained below is how to perform an RTC run.

Example: If you wish to install your rotor on the centrifuge under the run conditions listed below in the afternoon of April 1 and to take out the samples centrifuged around 9:30 a.m. the next morning;

- ① Rotor: S150-AT
- ② RPM: 150,000 rpm
- ③ Separation time: 2 hours
- ④ Control temperature: 4 °C
- ⑤ Acceleration mode: 9
- ⑥ Deceleration mode: 7

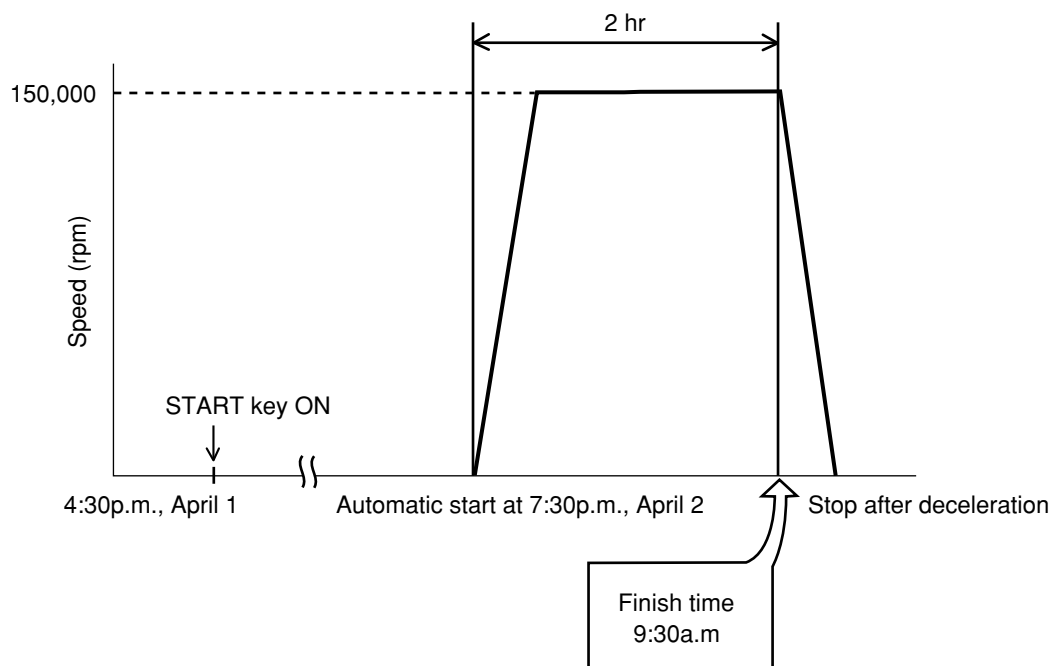
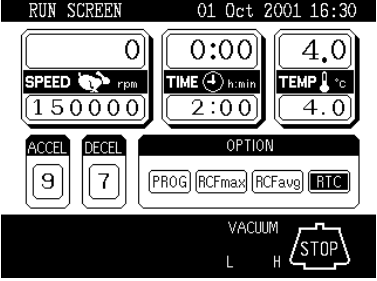
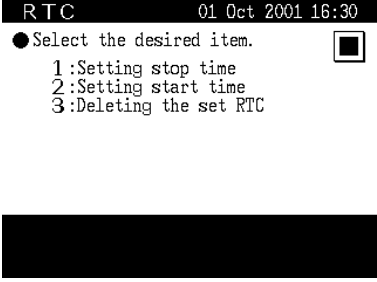
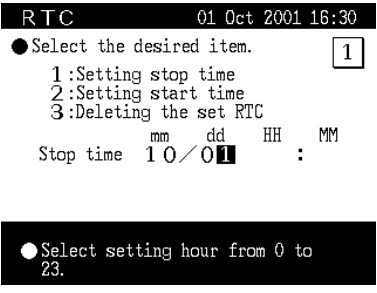
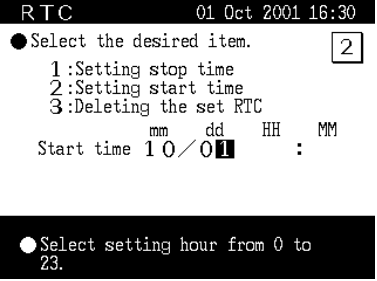


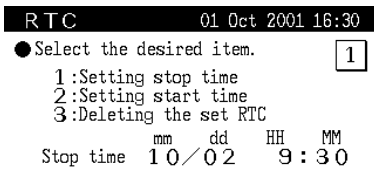
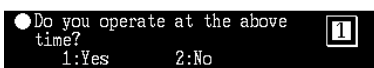
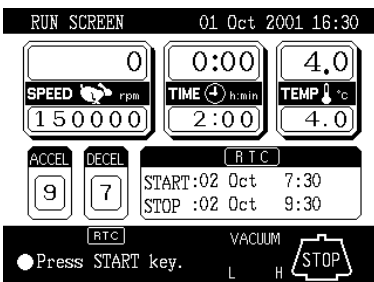

Fig. 2-3-5 A typical RTC run

In this example, you set the above run conditions ② through ⑥, set the finish time for RTC run to 9:30 a.m. , April 2 and start the centrifuge.

(You can make an identical setting by setting the start time to 7:30 a.m. instead of setting the start time to 9:30 a.m. - you can only select one setting method.)

(1) How to perform an RTC run

Step	Key operation	Screen display and considerations
1	<p>Set operational conditions while in the Run Screen.</p> <p>1 5 0 </p> <p>2 </p> <p>4 </p> <p>9 </p> <p>7 </p> <p>Move to RTC.</p>	 <ul style="list-style-type: none"> Blink the RTC in the OPTIONS field. Must set run time, cannot use hold.
2	<p>While RTC is blinking, press ENTER key.</p> <p>ENTER</p>	 <ul style="list-style-type: none"> The display switches to the RTC Setup screen.
3	<p>Select the item you wish to set. TO select the "Setting stop time," press</p> <p>1 ENTER</p>	<ul style="list-style-type: none"> Setting the "Setting stop time"  <ul style="list-style-type: none"> The "dd" item blinks. "mm" and "dd" indicate the current date as a default. Setting the "Setting start time"  <ul style="list-style-type: none"> If you do not make any input for 30 seconds, the cursor disappears, and you cannot make an input. At that time, press a cursor key.

Step	Key operation	Screen display and considerations
4	Use cursor keys and numeric keys to enter month, day, hours, and minutes. Lastly, press ENTER key.	 <p>● Select the desired item. 1</p> <p>1:Setting stop time 2:Setting start time 3:Deleting the set RTC</p> <p>Stop time mm/dd HH:MM 10/02 9:30</p>  <p>● Do you operate at the above time? 1</p> <p>1:Yes 2:No</p> <ul style="list-style-type: none"> ● To set the hours, use a number between 0 and 23 (in the 24-hour system). ● Enter a time later than the current time. When setting the “Setting stop time,” allow for centrifugation time and set the centrifugation start time to a time later than the current time. ● You cannot set the centrifugation start time to a date more than 20 days in the future.
5	<p>If you are sure that you have made the correct settings, select Yes.</p> <p>Yes 1 ENTER</p> <p>No 2 ENTER</p>	<ul style="list-style-type: none"> ● If you select Yes  <ul style="list-style-type: none"> ● The display switches to the Run Screen and the specified RTC time appears. ● The message field displays RTC. ● If you select No, you will get the display you see in process 2. Make the selection again.
6	<p>Check the RTC setting in the Run Screen, then press START key.</p> <div style="border: 1px solid black; padding: 10px; margin: 10px auto; width: 100px; text-align: center;">START</div> <div style="border: 1px solid black; padding: 10px; margin: 10px auto; width: 200px;"> <p>The RTC run does not get activated unless you press START key.</p> </div>	<ul style="list-style-type: none"> ● Run the centrifuge according to Section 2-2-2 “Operation procedure.” ● Once the RTC setting is made, you cannot change the run time (centrifugation time). If you wish to make a change to the run time, cancel RTC first. ● Pressing START enters the system into a “DELAY,” condition causing the centrifuge to wait until the set time comes. This centrifuge will turn on automatically at the specified time and run for the specified period.  <ul style="list-style-type: none"> ● The run mode in the message display field switches to “DELAY.”

Notes:

- (1) For an RTC run, the run mode indicator on the display panel displays the following:

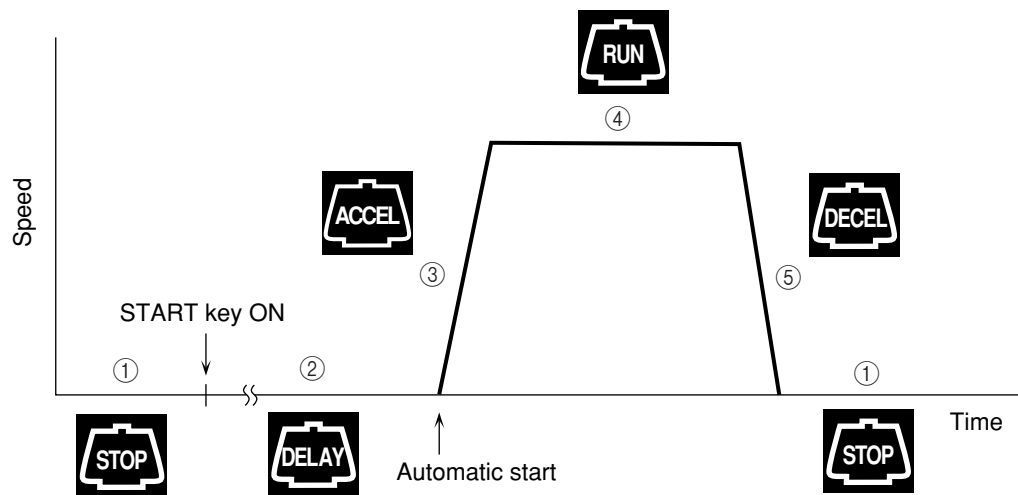





Fig. 2-3-6 Run mode display (RTC)

- (2) You cannot make an RTC setting in any of the following cases:

- ① When the Run Screen is set to HOLD (continuous run)
 Set the run time (centrifugation time) to a numerical value.
- ② When it is past the start time
 Set the start time to a time later than the current time.
- ③ When the start time is more than 20 days after the current time
 Set the time to a time no more than 20 days afterwards.

- (3) To change the run time (centrifugation time) after making an RTC setting, cancel RTC and then set a new run time.

- (4) To perform a combination of a programmed operation (including a step-mode operation) with an RTC run,

call a program memory number, then set RTC.

The system calculates the total run times of all steps of the programmed operation and calculates the start time for RTC.

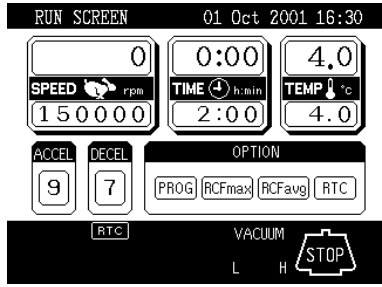
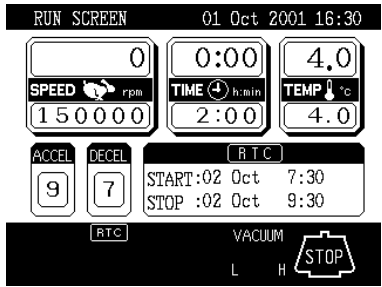
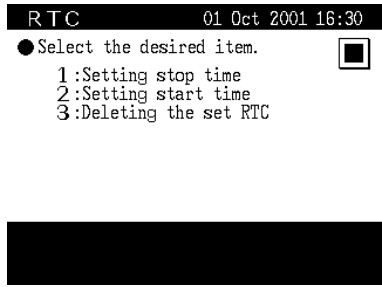
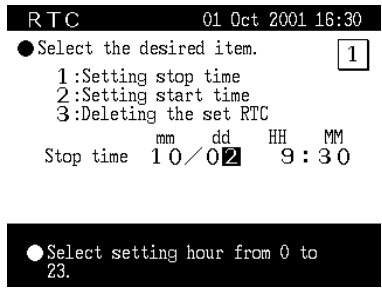
Therefore, you cannot call the program memory number after setting RTC.


- (5) To stop this ultracentrifuge in RTC operation, press STOP key. The system then stops RTC and stops the rotor.

(2) Making changes to and canceling the RTC settings

This section shows how to cancel or make changes to the RTC settings you have made.

If you have already started an RTC run, press STOP to abort the RTC first. Press STOP to cancel the RTC run.

Step	Key operation	Screen display and considerations
1	While in the Run Screen, use cursor keys to move the cursor to RTC and then press ENTER key.	 <p>↓</p>  <ul style="list-style-type: none"> • The OPTIONS field switches to the RTC field. • The message indicator displays RTC.
2	Press cursor keys to blink RTC and then press ENTER key.	
3	Making a change to the date and time settings ① Select "Setting stop time" or "Setting start time." To change the "Setting stop time," press <div style="display: inline-block; border: 1px solid black; padding: 2px 10px; margin: 5px;">1</div> <div style="display: inline-block; border: 1px solid black; padding: 2px 10px; margin: 5px;">ENTER</div>	 <ul style="list-style-type: none"> • The screen switches to a screen where you can enter a stop time (or start time).

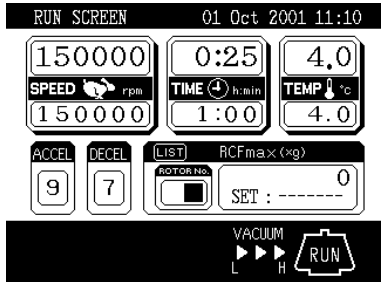

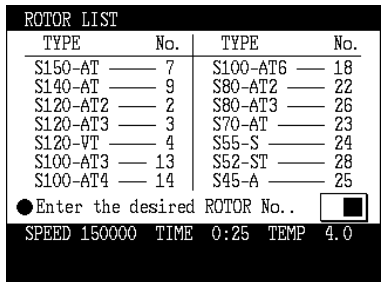


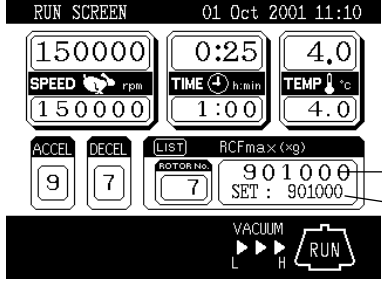
Step	Key operation	Screen display and considerations
	② Perform steps 4 through 6 as before.	<ul style="list-style-type: none"> See (1) "How to perform an RTC run."
	<p>[Canceling date and time settings]</p> <p>① Select "Deleting the set RTC."</p> <p>3 ENTER</p> <p>② Select "Yes".</p> <p>1 ENTER</p>	<p>● Do you delete the above setting time? 1:Yes 2:No </p> <ul style="list-style-type: none"> The message indicator in the bottom row changes.
		<p>● If you select "Yes"</p> <p>RTC 01 Oct 2001 16:30</p> <p>● Select the desired item. <input type="checkbox"/></p> <p>1:Setting stop time 2:Setting start time 3:Deleting the set RTC</p> <p>● The RTC setting has been canceled.</p> <p>● RTC has been deleted.</p> <p>● If you select "No", you will get the display you see in step 2. Make the selection again.</p>
	<p>③ Press ESC.</p> <p>ESC</p>	<p>RUN SCREEN 01 Oct 2001 16:30</p> <p>SPEED 0 TIME 0:00 TEMP 4.0 150000 2:00 4.0</p> <p>ACCEL DECEL OPTION 9 7 PROG RCFmax RCFavg RTC</p> <p>VACUUM L H STOP</p> <ul style="list-style-type: none"> The display switches back to the Run Screen. The RTC in the message indicator in the bottom row disappears.

2-3-4 Displaying and setting RCF

The micro-ultracentrifuge stores the maximum and average radii of each rotor in internal memory. Setting a speed causes this centrifuge to automatically calculate and display the RCF (relative centrifugal force) value, while setting an RCF value causes the centrifuge to automatically calculate and display the speed.

Below is a description of how to display and set RCF.

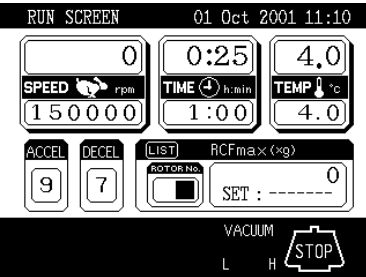

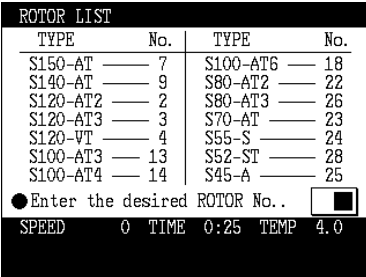
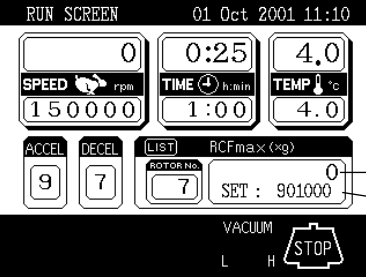
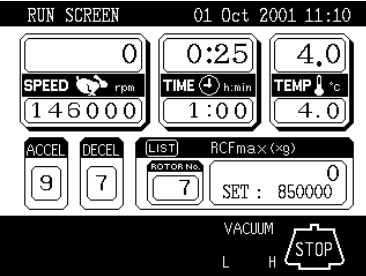
(1) How to display an RCF value

Step	Key operation	Screen display and considerations
1	While in the Run Screen, set a speed.	<ul style="list-style-type: none"> See 2-2-1 "Setting run conditions."
2	Use cursor keys to move the cursor to RCFmax (or RCFavg) and press ENTER key.	 <ul style="list-style-type: none"> The OPTIONS field switches to the RCF field. The ROTOR No. field blinks.
3	<p>If you do not know which rotor number you need, press the upward cursor key  to blink LIST and then press ENTER key.</p> <p>(If you do know which rotor number you need, skip this process.)</p>	 <ul style="list-style-type: none"> The display switches to the Rotors List screen. You can search for a rotor number.
4	<p>Enter the rotor number you wish to use and press ENTER key. (Enter a 7 if you are using an S150-AT rotor.)</p> <p> </p>	 <ul style="list-style-type: none"> The RCF display field displays the RCF value of the rotor in use. The RCF value associated with the set speed you have just entered in process 1 appears in the RCF setting field.

Note: Press ESC key to cancel the RCF field

(2) How to set an RCF value

Enter a rotor number and an RCF value, and the machine will calculate, set, and display the speed. Shown below is the procedure.

Step	Key operation	Screen display and considerations
1	While in the Run Screen, use cursor keys to move the cursor to RCFmax (or RCFavg) and press ENTER key.	 <ul style="list-style-type: none"> The OPTIONS field switches to the RCF field. The ROTOR No. field blinks.
2	<p>If you do not know which rotor number you need, press the upward cursor key  to cause LIST to blink and press ENTER key.</p> <p>(If you do know which rotor number you need, skip this process.)</p>	 <ul style="list-style-type: none"> The display switches to the Rotors List screen. You can search for a rotor number.
3	<p>Enter the rotor number you wish to use, and press ENTER key. (Enter a 7 if you are using an S150-AT.)</p> <p>7 ENTER</p>	 <ul style="list-style-type: none"> The RCF setting field displays the RCF value associated with the current set speed. <p>RCF display field RCF setting field</p>
4	<p>Use cursor keys to move the cursor to the RCF setting field, and enter a desired centrifugal force.</p> <p>Example: RCFmax=850x1000g</p> <p>8 5 0 ENTER</p>	 <ul style="list-style-type: none"> The value you have just entered appears in the RCF setting field. Based on the rotor number and RCF value, the system automatically calculates the speed and displays it in the SPEED display field. <ul style="list-style-type: none"> Specify the RCF value to thousands. If you make no input for 30 seconds, the cursor will disappear, and you will be unable to make an input. At that time, press a cursor key.

Notes

- (1) Press ESC key to cancel the RCF field.*
- (2) It is important to input the correct rotor code, because if a wrong rotor number is entered or selected that will result in inaccurate information being displayed.*
- (3) When you run this centrifuge at a speed determined based on an RCF value, a slight discrepancy may occur (up to 2%) between the set RCF value and the actual value, because the speed setting and RCF settings are in increments of 1,000 rpm.*

2-4 Features of the Menu Screen

Press MENU key on the keyboard, and the Menu Screen will appear.

This feature is designed to allow you to use the Discovery™ M150 SE and Discovery™ M120 SE micro-ultracentrifuge with additional options including:

- (1) Rotor list (Rotor No.)
- (2) Alarm information
- (3) User customization routines

Key in the number of the item you wish to use and press ENTER key, and the corresponding screen will appear.

The message field at the bottom of the Menu Screen displays the revolution count (TOTAL REV.) of the drive unit. Note the information for drive unit maintenance, particularly when you wish to call a service representative.

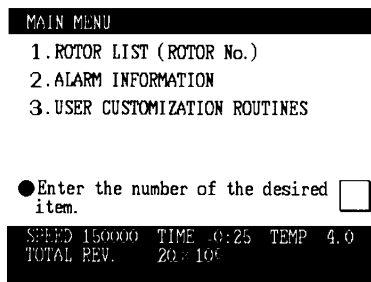


Fig. 2-4-1 Menu Screen

2-4-1 Rotor list

You can refer to the applicable rotor types and numbers.

ROTOR LIST			
TYPE	No.	TYPE	No.
S150-AT	7	S100-AT6	18
S140-AT	9	S80-AT2	22
S120-AT2	2	S80-AT3	26
S120-AT3	3	S70-AT	23
S120-VT	4	S55-S	24
S100-AT3	13	S52-ST	28
S100-AT4	14	S45-A	25

SPEED 150000 TIME 0:25 TEMP 4.0

Fig. 2-4-2 Rotor List Screen

2-4-2 Alarm information

The Alarm Information screen displays the contents of the alarm signals and what to do when such signals occur.

For details, see Section 4. "Troubleshooting."

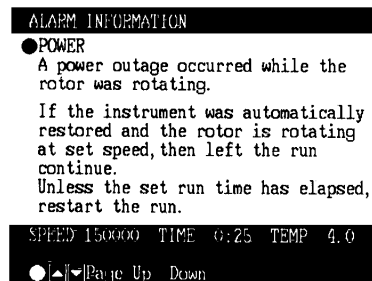


Fig. 2-4-3 Alarm Information screen

2-4-3 User Customizations

The user customization screen allows you to set the most current time and adjust screen contrast.

(1) Toggling between English and Japanese

Select whether to give displays in English or Japanese.

Key in the number of the desired language and press ENTER key.

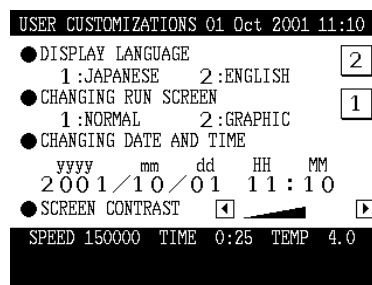


Fig. 2-4-4 User Customizations screen

(2) Switching from the Run Screen

- ① Normal: Displays the Run Screen.
- ② Graphics: Twenty seconds after the actual speed reaches the set speed while in the Run Screen, the display will automatically switch to the screen shown in Fig. 2-4-5. The display will then return to the Run Screen if you press any key on the keyboard or while a deceleration shift is in progress.



Fig. 2-4-5 Graphics screen

(3) Changing the current time setting

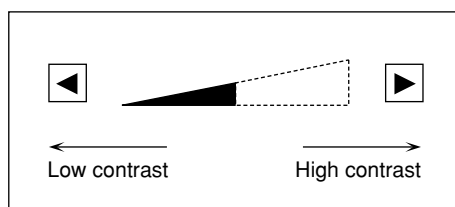
Use this option to set the current time of the internal clock.

Set the date and time for RTC operation.

Use cursor keys and numeric keys and then press ENTER.

(4) Screen contrast

Use cursor keys  and  to adjust the contrast.





Notes: (1) To get back to the Run Screen, press ESC several times.

(2) If you make no entry for 30 seconds, the cursor will disappear, and you will be unable to make a further input. If this happens, press a cursor key.


3. Maintenance

Before conducting any maintenance, always read the following:

 **DANGER:** Before removing the cover, top deck, or other component for maintenance, always turn off the POWER switch of the instrument, unplug the power cord from the wall outlet, and wait at least three minutes to avoid the risk of electrical shock.

 **WARNINGS:**

- ① Be sure to take necessary safety measures before using materials which are toxic, radioactive, or contaminated with pathogenic micro-organisms.
- ② If the instrument, the rotor, and/or accessories that has been used with toxic, radioactive, or pathogenic materials, clean it by following the Service Decontamination Policy in Section 5.
- ③ If the instrument, rotor and/or accessories require servicing by Thermo either at the customer's site or at Thermo facilities, disinfect and decontaminate it following the Service Decontamination Policy in Section 5.

 **CAUTION:** Do not operate the instrument in any way other than specified in this manual. If there is any problem with the instrument, call an authorized Thermo Field Service Engineer.

To maintain the rotor, tubes, and other equipment, refer to the instruction manual furnished with the rotor.

3-1 Rotor chamber

The rotor chamber should be kept clean and wiped dry routinely to maintain efficient vacuum and coolong. Wash the chamber with a mild dishwashing liquid, then rinse the chamber and dry it with a soft absorbent cloth. Wipe the rotor chamber with a cloth dampened with 70% ethanal to disinfect it or a 2% glutaraldehyde solution to strilize it, then rinse the chamber well with deionized water. For general radioactive decontamination, use a solution of equal parts of ethanol, 10% SDS, and water. Follow this with ethanol rinses then deionized water rinses. Dry with a soft absorbent cloth. Dispose of all wash solutions in proper radioactive waste containers.

3-2 Drive shaft

Wipe the drive spindle with a dry soft cloth before every run to reduce the chance of the rotor sticking to the spindle.

3-3 Cabinet

Use a mild non-alkaline detergent and water or a household wax cleaner to clean the cabinet panels.

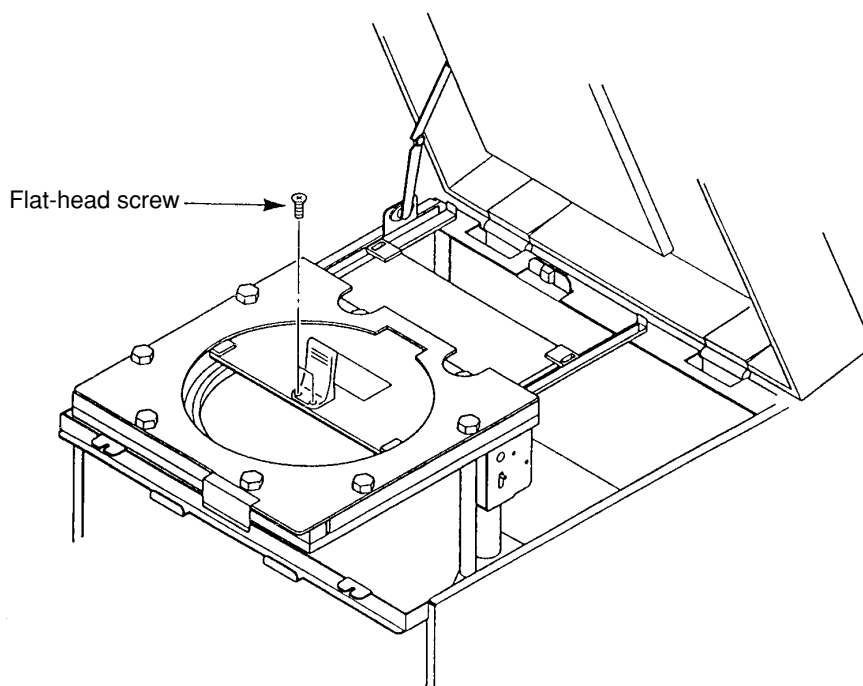
3-4 Chamber door seal

To ensure that a high vacuum level is obtainable, the chamber door O-ring must be kept clean and properly lubricated; if damaged, it must be replaced.

If the door is used frequently, take out the O-ring every three to four months, wipe it with a soft cloth and apply a thin coat of vacuum grease. Clean the door seal O-ring groove with a clean, soft cloth dampened with alcohol.

3-4-1 Removing the door O-ring

- ① While the door is open, turn off the POWER switch and unplug the power cord from the wall outlet.
- ② Remove the front cabinet cover and lift the top deck. (Refer to Section 4-3 "Emergency recovery from power outage.")
- ③ Remove the two flat-head screws that fasten the handle, and remove the handle.



- ④ Open the door wider to allow all the packing to be seen.
- ⑤ Use a thin-tipped tool to take the door packing out of the groove. At that time, be careful not to damage the door O-ring or groove.
- ⑥ Clean the door O-ring and groove. If the door O-ring is damaged, replace it. {Part code of replacement door O-ring (not furnished with the accessories): 84520135}
- ⑦ Apply a thin coat of vacuum grease to the door packing, insert it into the groove, and close the door as it was. If the door lock interferes, push down the door lock.
- ⑧ Install the handle, top deck, and front cabinet cover in their original positions.

3-5 Vacuum pump

If displaying the VACUUM alarm, poor evacuation, or other trouble occurs frequently, the vacuum pump may have a problem.

Then call a service representative.


Oil for the vacuum pump is furnished with this centrifuge. Store it in a safe place and give it to the service representative if requested.


3-6 Ordering replacement parts

To order replacement parts, contact your local authorized Thermo Field Service Engineer. Be sure to provide the part number, the part name, and the quantity of parts you need, as well as the model and serial number of the micro-ultracentrifuge you are using.


4. Troubleshooting

Before troubleshooting, always read the following:

 **DANGER:** Before removing the cover, top deck, or other component for troubleshooting, always turn off the POWER switch of the instrument, unplug the power cord from the wall outlet, and wait at least three minutes to avoid the risk of electrical shock.

 **WARNINGS:**

- ① Be sure to take necessary safety measures before using materials which are toxic, radioactive, or contaminated with pathogenic micro-organisms.
- ② If the instrument, the rotor, and/or accessories that has been used with toxic, radioactive, or pathogenic materials, clean it by following the Service Decontamination Policy in Section 5.
- ③ If the instrument, rotor and/or accessories require servicing by Thermo either at the customer's site or at Thermo facilities, disinfect and decontaminate it following the Service Decontamination Policy in Section 5.

 **CAUTION:** Do not operate or run the instrument in any way other than specified in this manual. If there is any problem with the instrument, call an authorized Field Service Engineer.

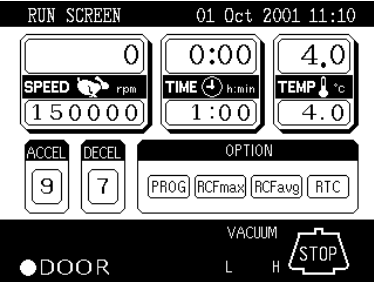
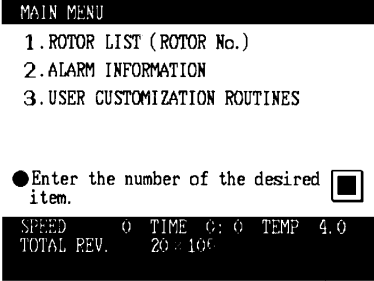
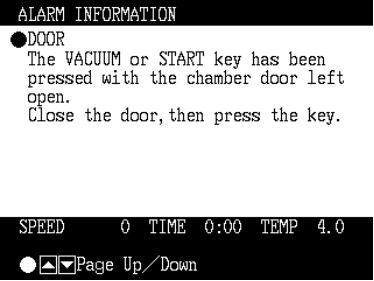
The micro-ultracentrifuge incorporates a “self-diagnosis feature” that diagnoses the cause of any trouble which may occur when you start the centrifuge or while in operation.

4-1 Alarm indicators

If any trouble occurs, the micro-ultracentrifuge gives a buzzer sound and displays an alarm message in the message field of the Run Screen.

The Alarm Information screen is designed to allow you to take immediate action when such an alarm signal is given. You can open the Alarm Information screen as indicated below :

(1) Searching for Alarm Information

Step	Key operation	Screen display and considerations
1	A “DOOR” alarm signal occurs.	 <ul style="list-style-type: none"> An alarm message appears in the message field of the Run Screen.
2	Press MENU key.	 <ul style="list-style-type: none"> The display switches to the Menu Screen.
3	Select “ALARM INFORMATION”.	 <ul style="list-style-type: none"> The “ALARM INFORMATION” screen appears. The screen related to the current alarm signal is displayed before any other screen. To get back to the Run Screen, press ESC key twice.

(2) Responding to an alarm signal

If an alarm message appears, check the chart below and press CE key . You will then be able to resume your centrifugation.

If the alarm message still remains after the recommended action, contact an authorized Thermo Field Service Engineer.

Alarm	Cause	Action
DOOR	1. The VACUUM or START key has been pressed with the chamber door left open.	<ul style="list-style-type: none"> Shut the door completely and press VACUUM or START key.
VACUUM	1. Required level of vacuum cannot be reached. 2. After a satisfactorily high level of vacuum was reached, it lowered.	<ul style="list-style-type: none"> Wipe off the moisture from inside the rotor chamber. Clean the door packing, then apply a thin coat of vacuum grease. (Refer to Section 3-4 "Chamber door seal.") Check if the sample is leaking from the rotor and/or tubes. If so, the tubes may be overfilled or may be cracked or broken. In these cases, reduce the amount of sample in the tubes or change the tubes.
ROTOR	1. The rotor is not installed.	<ul style="list-style-type: none"> Install the rotor.
IMBALANCE	1. Rotor is not properly balanced, and abnormal vibration has occurred in the rotor. 2. Rotor cover or cap is not properly tightened.	<ul style="list-style-type: none"> Check if the sample tubes exceed allowable imbalance level. Check if any one of the tubes is deformed, and if there is any sign of sample leakage. Tighten rotor cover or cap securely.
SPEED	1. Rotor speed is set higher than the maximum allowable speed.	<ul style="list-style-type: none"> Set the speed within the permitted limits.
POWER	1. A power outage occurred while the rotor was rotating.	<ul style="list-style-type: none"> Unless the set run time has elapsed, restart the run. If the instrument was automatically restored and the rotor is rotating at set speed, then let the run continue.
	Refer also to Section 4-3 "Emergency recovery from power outage."	
E11 to E64	Refer to Note.	<ul style="list-style-type: none"> Call your authorized Thermo Field Service Engineer.

*Note: If a "ROTOR" alarm message appears, the micro-ultracentrifuge does not accept the CE or VACUUM key for seven minutes to ensure safety.
Wait at least seven minutes, then press CE key.*

If any alarm message between E11 and E64 appears, the micro-ultracentrifuge requires maintenance by an authorized Thermo Field Service Engineer.

Note: E13 is an alarm code that indicates a failure of the speed detector.

If this alarm code appears, this machine does not accept the CE or VACUUM key for 25 minutes to ensure safety.

These 25 minutes are required for the rotor to stop.


Wait at least 25 minutes before pressing CE key.


4-2 User-identified problems


Some problems are not identified by the micro-ultracentrifuge. To correct these problems, take the action(s) described in the table below.

Symptom	Possible cause	Action
Ultracentrifuge will not start up when its power is on.	<ol style="list-style-type: none"> 1. Building power circuit breaker is open. 2. The power cord is unplugged from the outlet. 	<ul style="list-style-type: none"> ● Close the circuit breaker. ● Plug the cord into the outlet.
Rotor does not cool, or rotor temperature is rising.	1. Rotor was accelerated at low or intermediate vacuum level.	<ul style="list-style-type: none"> ● Start accelerating the rotor when rotor chamber is at high vacuum level (after the display panel indicator displays ►►►).
	2. High vacuum level cannot be reached.	<ul style="list-style-type: none"> ● Inspect the door seal O-ring (see Section 3-4).
You press START, but the rotor will not turn.	1. If the "ROTOR" alarm message appears, the overspeed detector may issue a signal that prevents the rotor from rotating. (This is not a fault.)	<ul style="list-style-type: none"> ● Turn off the POWER switch, wait several minutes, turn on the POWER switch again, and press START key. ● If this procedure still does not activate this ultracentrifuge, call an authorized Thermo Field Service Engineer.
The display panel screen is in too high or low contrast.	1. The screen contrast is not adjusted.	<ul style="list-style-type: none"> ● Make the adjustment while referring to the clause "Screen contrast" in Section 2-4-3 "User customizations."

4-3 Emergency recovery from power outage

 **DANGER:** Before removing the cover, top deck, or other component for troubleshooting, always turn off the POWER switch of the instrument, unplug the power cord from the wall outlet, and wait at least three minutes to avoid the risk of electrical shock.

 **WARNING:** ① Do not open the door while the rotor is rotating.
② Do not touch the rotor while rotating.

 **CAUTION:** Do not operate or run the instrument in any way other than what is described in this manual. If there is any problem with the instrument, call an authorized Thermo Field Service Engineer.

(1) Rotor rotating


If the power fails, a partial vacuum will remain in the chamber, temperature control will be maintained, and the rotor will safely coast to a stop. If power is restored while rotor speed is above 300 rpm, the rotor will accelerate to set speed and the run will continue. If rotor speed is below 300 rpm, when power is restored, the rotor will continue to decelerate to a stop and the run will not resume until start is pressed.

(2) Control panel display

When power is restored, all set parameters are restored by means of a battery backup. Then instrument then displays an alarm message indicating that there was power outage.

(3) Removing the rotor during a power outage

① Make sure that the rotor has stopped.

 **WARNING:** Listen carefully for sound from within the rotor chamber and make sure that the rotor is not turning.
Never unlock the chamber door, while the rotor is rotating.

The rotor chamber is in a vacuum with low air resistance. The rotor may rotate for more than 30 minutes before stopping. Allow enough time before opening the door.

- ② Unplug the power cord.
- ③ Remove the two screws that fasten the bottom side of the front cabinet cover, pull down the bottom of the cover while pulling it towards you, and remove the cover. The top side of the front cabinet cover is attached on hooks.
- ④ Remove the two top deck-fastening screws from the front bottom of the top deck and lift it.

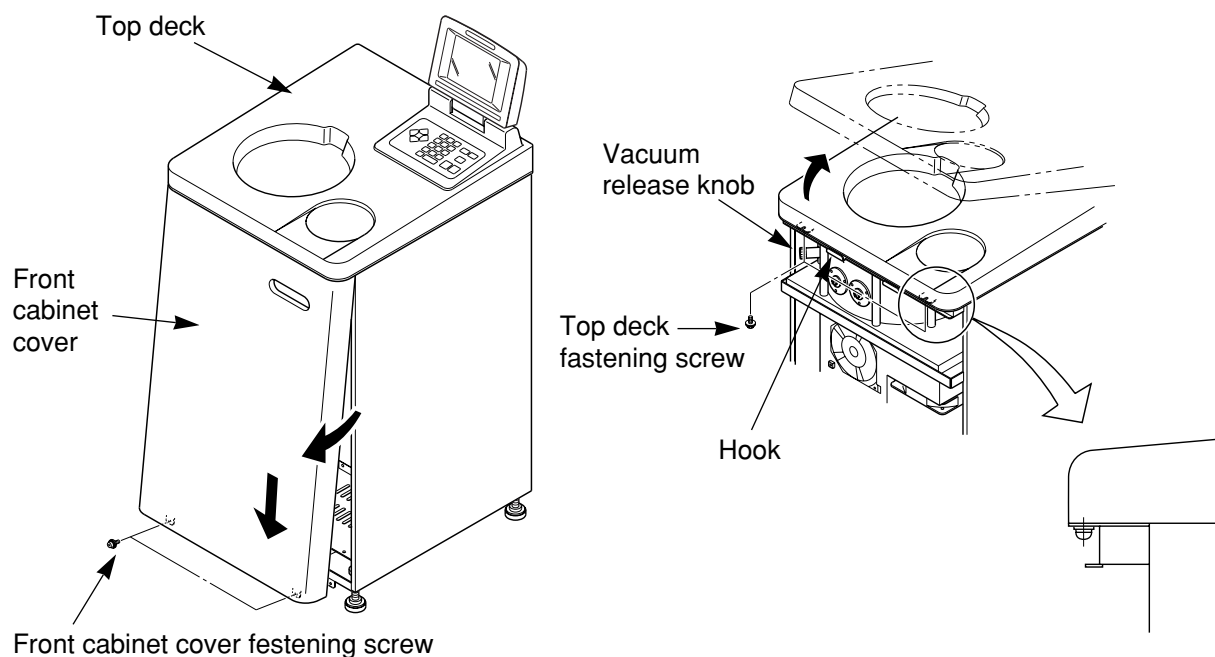


Fig. 4-3-1 Removing the top deck

- ⑤ Remove the vacuum release knob at the left of the vacuum chamber (by turning its tip counterclockwise) to allow air to enter the rotor chamber. When the rotor chamber reaches atmospheric pressure, return the vacuum release knob to its previous position.
- ⑥ Push down the release pin of the door lock in the right corner of the vacuum chamber, and open the door. Make sure that the rotor is not rotating.

⚠ WARNING: Do not touch the rotor while rotating.

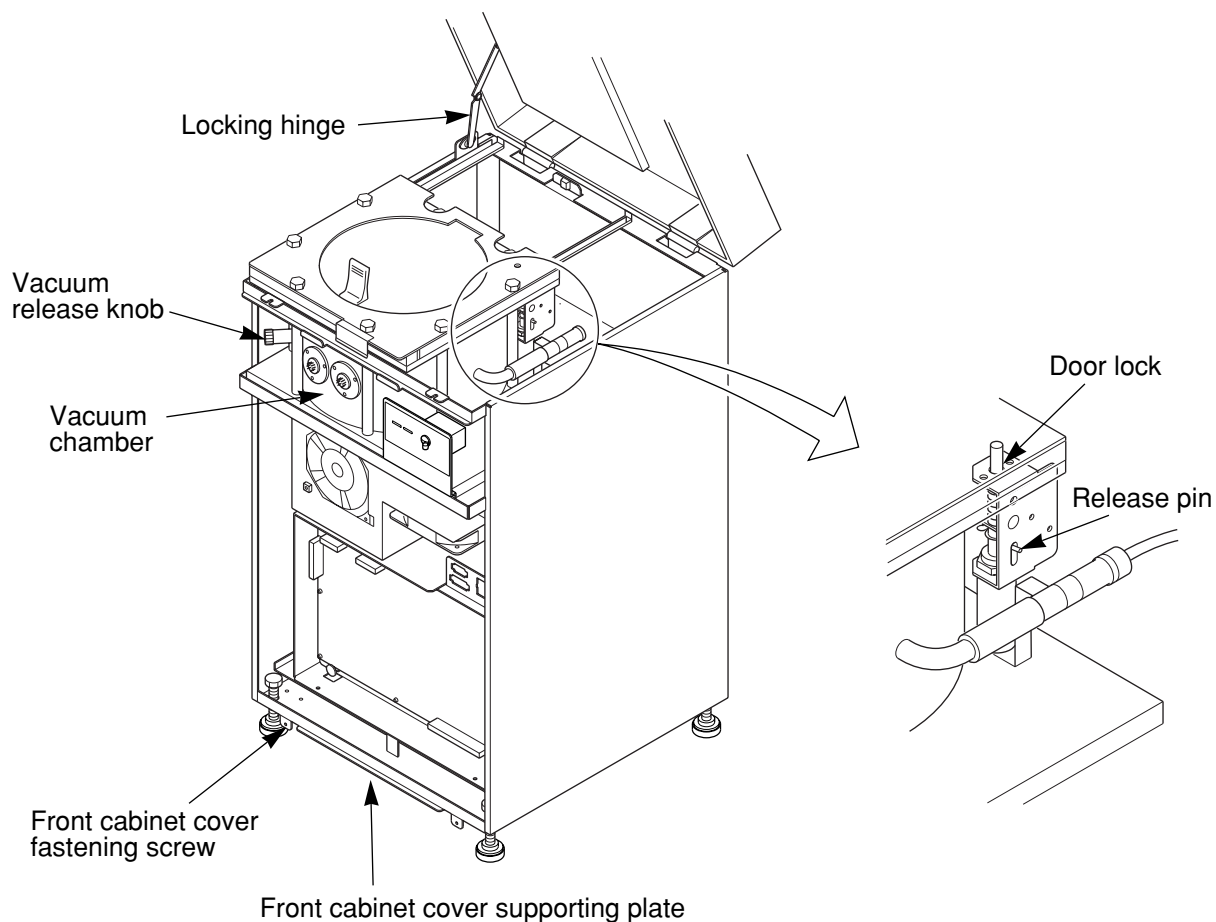


Fig. 4-3-2 Door lock and vacuum release knob

- ⑦ After taking out the rotor, fold the top deck locking hinge, close the top deck, and fasten its components together with their screws.
Having inserted the hook into the square hole in the top surface of the front cabinet cover, place the bottom side of the front cover on the plate that supports the front cover in reverse order of removal, and fasten them with the fastening screws.
- ⑧ Plug the power cord.

⚠ CAUTION: If the micro-ultracentrifuge will not be used for a long time, keep it unplugged.

5. Installation

This chapter describes the location, temperature, and electrical requirements that you must make provisions for prior to installation of your micro-ultracentrifuge by an authorized Thermo Field Service Engineer.

⚠ DANGER: Before removing the covers from the ultracentrifuge, always turn off the POWER switch of the ultracentrifuge, unplug the power cord from the wall outlet, and wait at least three minutes.

Note: The installation and leveling of your ultracentrifuge must be done by an authorized Thermo Field Service Engineer. If the micro-ultracentrifuge is installed by anyone else, the micro-ultracentrifuge warranty will be void.

(1) Location

- ① Locate the ultracentrifuge on a level, vibration-free floor capable of withstanding 350 kg/sq•m. (71.7lb/sq•ft).
- ② Ambient temperature for the ultracentrifuge must be from 5°C to 35°C. If ambient temperature exceeds 35°C, actual rotor temperature will become higher than the set temperature. Do not locate the ultracentrifuge in direct sunlight, near heat sources or in a dusty environment.
- ③ Keep the back of the instrument at least 20 cm (8 inches) away from the wall. We recommend you install the sides of the instrument about 15 cm (6 inches) away from the walls. However, the centrifuge's performance will not be affected if its sides are about 5 cm (2 inches) away from the walls, provided that the walls are at heights similar to those of this ultracentrifuge. Make sure that the air can circulate adequately around this ultracentrifuge. Avoid installing this ultracentrifuge close to a heat-generating device, which might reduce this centrifuge's cooling capacity.

⚠ WARNING: For safety, do not allow anyone to come closer than 30 cm (12 inches) from the centrifuge while it is in operation. Do not leave any hazardous (flammable or explosive) material within 30 cm (12 inches) from the centrifuge.

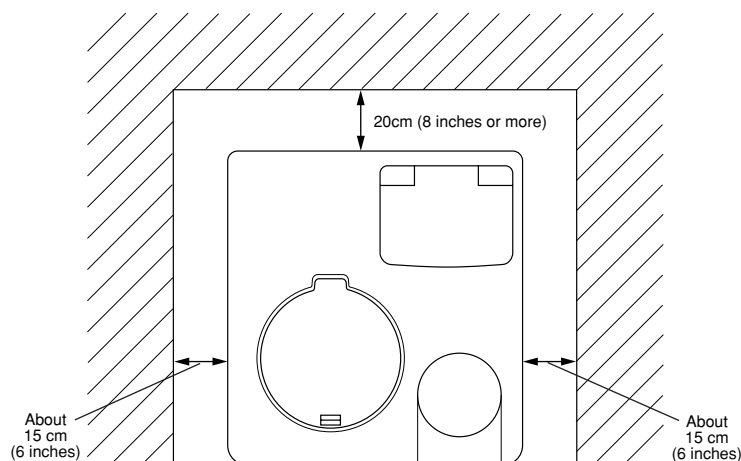


Fig. 5-1 Clearances for ultracentrifuge

(2) Electrical power requirements

- ⚠ CAUTIONS: ① Your ultracentrifuge can be damaged if connected to a wrong voltage. Check the voltage before plugging the ultracentrifuge into a power source.
- ② Your ultracentrifuge must be grounded properly.

An emergency switch (circuit breaker) should be installed that turns off the main power supply in the event of malfunctioning.

Your ultracentrifuge can operate on one of the following five power voltages: 208, 220, 230, or 240Vac (50/60Hz, 6A), or 115Vac (50/60Hz, 12A).

The voltage requirement for your ultracentrifuge is on the rating plate which is visible in the rear panel of the ultracentrifuge near the power cord connector. Be sure to read the marking plate before plugging in the micro-ultracentrifuge.

(3) Leveling

- ① Use the four leveling pads furnished with this ultracentrifuge.
- ② While referring to Fig. 5-2, apply the leveling pads to the four leveling screws, turn the leveling screws with a wrench until the casters are to 5 to 10 mm (1/8 to 3/8 inch) off the floor.

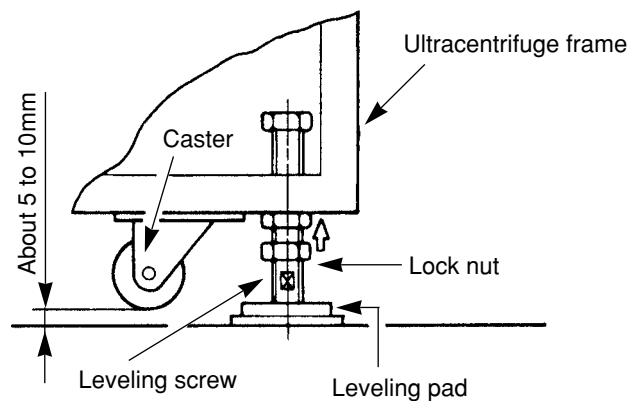


Fig. 5-2 Leveling adjustment

- ③ Turn on the power to ultracentrifuge, open the chamber door, and then turn off the power.
- ④ Place the level (supplied with instrument) on the drive shaft in the rotor chamber and turn the four leveling screws to adjust the ultracentrifuge (Fig. 5-3).

- ⑤ When micro-ultracentrifuge is level, make sure that the four leveling screws are fastened securely to the leveling pads and tighten the lock nut in the direction of the arrow in Fig. 5-2.

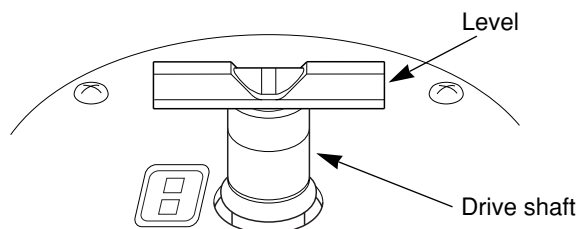


Fig. 5-3 Level placement

(4) Moving this ultracentrifuge


Disconnect the power cord, turn the leveling screws with a wrench, lower the casters onto the floor, and remove the leveling pads.

After moving this ultracentrifuge, always install and level it again.

⚠ CAUTION: Before moving the centrifuge, take the rotor out of the rotor chamber.

Service Decontamination Policy

If a centrifuge or rotor that has been used with radioactive or pathogenic material requires servicing by Thermo personnel, either at the customer's laboratory or at a Thermo facility, comply with the following procedure to ensure the safety of all personnel:

 **WARNING:** Because of the characteristics of the samples likely to be processed, biological or radioactive contamination may occur. Always be aware of this possibility and take normal precautions. Use appropriate decontamination procedures should exposure occur.

1. Clean the centrifuge to be serviced of all encrusted material and decontaminate (see Maintenance Section of centrifuge) it prior to servicing by the Thermo representative or returning it to the Thermo facility. There must be no radioactivity detectable by survey equipment.

The SORVALL® Product Guide contains descriptions of commonly used decontamination methods and a chart showing method compatibility with various materials. The Maintenance Section of this instruction manual contains specific guidance about cleaning and decontamination methods appropriate for the product it describes.

Clean and decontaminate your centrifuge as follows:

- a. Remove rotor from the rotor chamber.
 - b. Decontaminate door and rotor chamber using an appropriate method.
2. Complete and attach Decontamination information Certificate (in the back of your rotor or instrument manual) to the centrifuge before servicing or return to Thermo facility. If Certificate is not available, attach a written statement verifying decontamination (what was the contaminant and what decontamination method was used.)

If the centrifuge must be returned to a Thermo facility:

1. Contact your Thermo representative to obtain a Return Service Order Number (RSO No.); be prepared with the name and serial number of the centrifuge or rotor and the repairs required.
2. Send item(s) with the RSO No. clearly marked on the outside of packaging to the address obtained from your Thermo representative.

Note: United States federal regulations require that parts and instruments must be decontaminated before being transported. Outside the United states, check local regulations.

If the centrifuge to be serviced does not have a Decontamination information Certificate attached and, in Thermo's opinion presents a potential radioactive or biological hazard, the Thermo representative will not service the equipment until proper decontamination and certification is complete. If Thermo receives a centrifuge at its Service facilities which, in its opinion, is radioactive or biological hazard, the sender will be contacted for instructions as to disposition of equipment. Disposition costs will be borne by the sender.

Decontamination information Certificates are included with these instructions. Additional certificates are available from the local Account Representative or Field Service Engineer. In the event these certificates are not available, a written statement certifying that the unit has been properly decontaminated and outlining the procedures used will be acceptable.

Note: The Field Service Engineer will note on the Customer Service Repair Report if decontamination was required and, if so, what the contaminant was and what procedure was used. If no decontamination was required, it will be so stated.

6. Warranty

THERMO SCIENTIFIC MAKES NO WARRANTY OF ANY KIND, EXPRESSED OR IMPLIED, INCLUDING THAT OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE EXCEPT AS STATED IN THIS WARRANTY POLICY STATEMENT.

Subject to the exceptions and upon the conditions specified in this Warranty Policy Statement, Thermo warrants each SORVALL *Discovery*TM M150 SE and *Discovery*TM M120 SE Micro-Ultracentrifuge (instrument) to be free from defects in material or workmanship for a period of one (1) year from the date of installation of any such instrument. Thermo agrees to correct, either by repair or, at Thermo's election, by replacement, any defects of material or workmanship which develop within one (1) year after installation of any such instrument, provided that investigation and/or factory inspection by Thermo discloses that such defect developed under normal and proper usage. The exceptions and conditions mentioned above are the following;

- (a) Some components and accessories by their nature are not intended to and will not function for the warranty period. If any such component or accessory manufactured by Thermo and part of the instrument sold fails to give reasonable service for a reasonable period of time, Thermo will, at its election, replace or repair such component or accessory. What constitutes reasonable service and what constitutes a reasonable period of time shall be determined solely by Thermo after Thermo is in possession of all the facts concerning operating conditions and other pertinent factors and after such component or accessory has been investigated and/or factory inspected by Thermo.
- (b) All items claimed defective must be returned to Thermo, transportation charges prepaid, and will be returned to Buyer with transportation charges prepaid. Thermo will be released from all obligations under this warranty in the event that any such instruments have been installed by, or repairs or modifications are made by, persons other than its own or service personnel authorized by it unless such installation, modification and/or repairs by others are made with the prior written consent of Thermo.
- (c) Thermo is not obligated to incorporate into any instrument any design, engineering, or performance change developed after delivery of the instrument to the original purchaser.

In addition to the foregoing one (1) year warrants and subject to the foregoing exceptions and conditions, Thermo warrants the drive assembly of the SORVALL^R *Discovery*TM M150SE and *Discovery*TM M120 SE Micro-Ultracentrifuge to be free from defects in material or workmanship for five (5) years from the date of micro-ultracentrifuge installation, subject to all the conditions, limitations, and other aspects of warranty expressed above and to the following further conditions;

- (a) The instrument shall be operated only within its rated maximum speed and temperature in accordance with the instructions in this manual.

- (b) The drive unit shall not be overloaded nor loaded with an unbalanced rotor or an improper rotor and it shall be free from any corrosion or rust caused by spilled sample or solution on the drive spindle or in the chamber.
- (c) The drive unit shall not be modified, disassembled, or repaired by any party but Kendro or by a service representative authorized, in writing, by Kendro.

KENDRO LABORATORY PRODUCTS, L.P. EXPRESSLY DISCLAIMS ANY LIABILITY TO ITS CUSTOMERS, DEALERS, AND REPRESENTATIVES, AND TO USERS OF ITS PRODUCTS, AND TO ANY OTHER PERSON OR PERSONS FOR SPECIAL OR CONSEQUENTIAL DAMAGES OF ANY KIND AND FROM ANY CAUSE WHATSOEVER ARISING OUT OF OR IN ANY WAY CONNECTED WITH THE SALE, HANDLING, REPAIR, MAINTENANCE OR REPLACEMENT ARISING OUT OF OR IN ANY WAY CONNECTED WITH THE USE OF SAID PRODUCTS.

Representations and warranties made by any person, including dealers and representatives of Kendro, which are inconsistent or in conflict with the terms of this warranty (including but not limited to the limitations of the liability of Kendro as set forth above), shall not be binding upon Kendro unless reduced to writing and approved by Kendro.


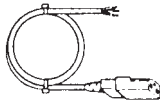
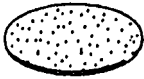
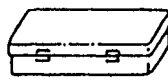

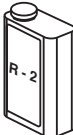



NO CLAIM OF ANY KIND, WHETHER IT IS TO GOODS DELIVERED OR FOR NONDELIVERY OF GOODS, SHALL BE GREATER IN AMOUNT THAN THE PURCHASE PRICE OF THE GOODS IN RESPECT OF WHICH SUCH DAMAGES ARE CLAIMED, AND FAILURE TO GIVE NOTICE OF CLAIM WITHIN NINETY (90) DAYS FROM DATE OF DELIVERY OR THE DATE FIXED FOR DELIVERY, OR AS OTHERWISE PROVIDED IN THIS WARRANTY POLICY STATEMENT SHALL CONSTITUTE A WAIVER BY BUYER OF ALL CLAIMS IN RESPECT OF SUCH GOODS.

No charges or expenses incident to any claim will be allowed unless approved by authorized representative of Kendro in writing. Goods shall not be returned to Kendro without Kendro's permission.

7. Specifications

Type	Discovery™ M150SE	Discovery™ M120SE
Maximum speed	150,000rpm	120,000rpm
Maximum RCF	1,048,684xg (S140-AT)	770,462xg (S140-AT)
Set speed	5,000 rpm to maximum speed in increments of 1,000 rpm	
Speed control	±50 rpm	
Set time	1 minute to 99 hours 59 minutes, HOLD for continuous operation RTC operation	
Temperature control	±2°C (setting range: 0°C to 40°C)	
Vacuum system	Oil rotary vacuum pump and oil diffusion vacuum pump combined. Ultimate vacuum reached: 0.13Pa (1 x 10 ⁻³ Torr)	
Noise level	48dB (measured, on A-scale, 1m [3.28ft] in front of the instrument)	
Maximum heat dissipation into the room	0.6kW (2k BTU/hr)	
Cooling method	Thermo-electric cooling (refrigerant-free)	
Screen display and operation	Movable liquid crystal display and keyboard	
Dimensions	Width: 44 cm (17.3 in); depth: 49 cm (19.3 in); height: 85 cm (33.5 in) (with the panel folded)/100 cm (39.4 in) (with the panel unfolded); height to top deck: 78 cm (30.7 in)	
Weight	110 kg (243 lbs.)	
Power requirements ***	Single phase: 208, 220, 230 or 240 Vac ±10%; 50/60 Hz; 6A 115 Vac ±10%; 50/60 Hz; 12A	
Ambient temperature	5 to 35°C	

8. Supplied items list

Item name	Part No.	Units supplied	Item drawing	Note
Leveling pad	45208	4		
Power cord assembly 115V 208V 220V thru 240V	67328 67823 91605	1		
Top deck rubber mat	45743	1		
Tool box		1		
Phillips head screwdriver	45210	1		
Vacuum pump oil	45509	1		Supplied in 1qt. containers
Vacuum grease	65937	1		
Level	45216	1		
Instruction manual	45980	1		

DECONTAMINATION INFORMATION CERTIFICATE

Complete and attach to equipment **BEFORE** servicing (instructions on reverse)

PLEASE PRINT

DECONTAMINATION
CERTIFIED BY _____ TITLE/POSITION _____
PHONE _____ FAX _____ DEPARTMENT _____
INSTITUTION _____ ADDRESS _____
CITY _____ STATE _____ ZIP _____
INSTRUMENT _____ SERIAL NUMBER _____
ROTOR _____ SERIAL NUMBER _____
PART _____ PART NUMBER _____
HAZARDOUS CONTAMINANT(S) _____ DECONTAMINATION DATE _____
DECONTAMINATION METHOD(S) _____
DECONTAMINATION
CERTIFIER'S SIGNATURE _____ DATE _____

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INSTRUCTIONS

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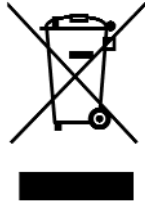
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