Thermo Fisher Scientific

WX Ultra Series
WX 100, WX 90, WX 80

Instruction Manual

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Thermo Fisher Scientific
Robert-Bosch-Straße 1
D - 63505 Langenselbold

Germany

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Preface - Intended use and safety definitions

This manual is a guide to the use of the Sorvall WX Ultra series ultracentrifuge.

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.

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.
- 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.

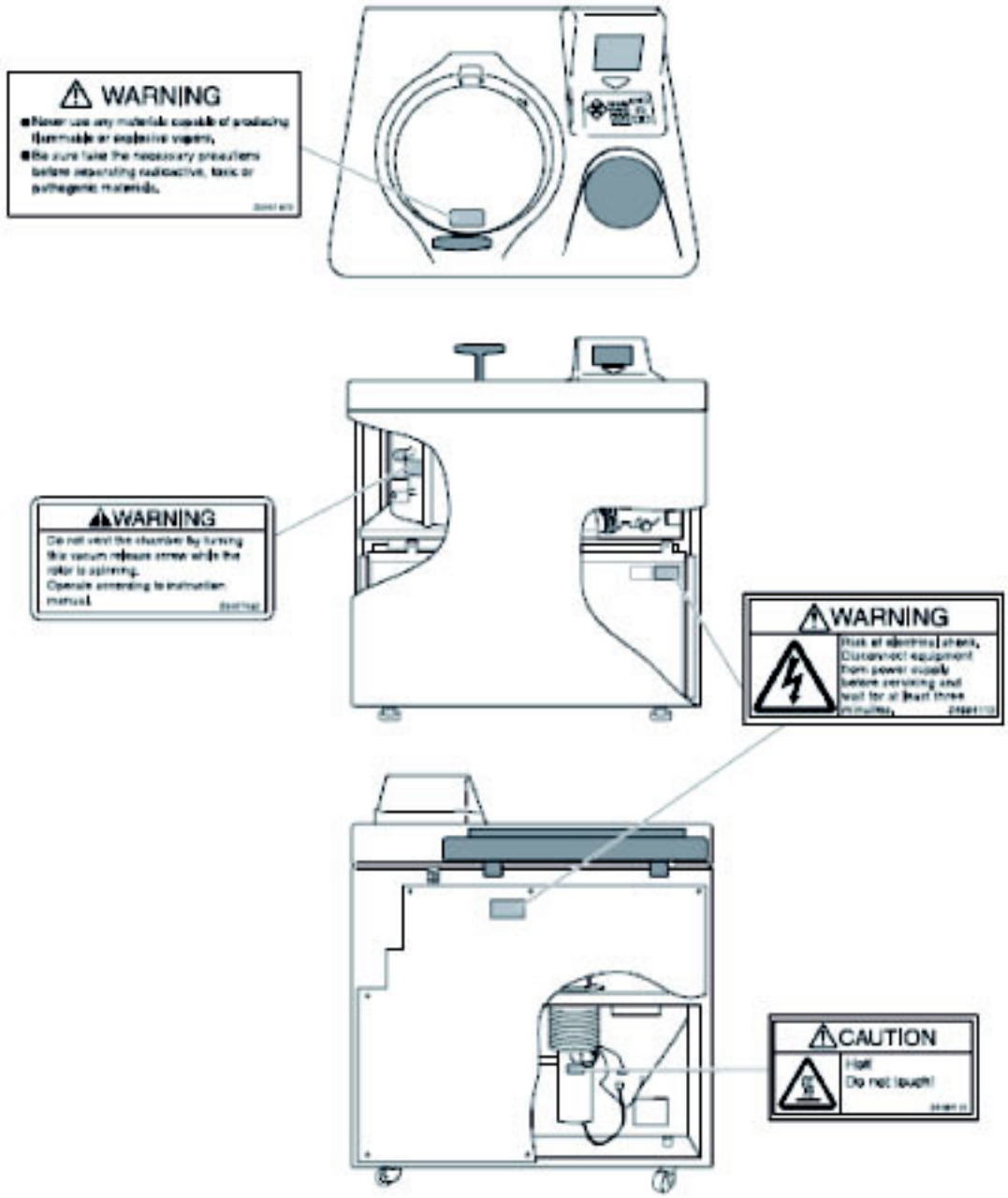
WARNING

- 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 Product Guide; 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.
- 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).


WARNING
WARNING
WARNING
CAUTION

Description

General description

The Sorvall WX Ultra series ultracentrifuges are designed and manufactured based on our long experience in the development of centrifuges; they are easy to use and highly reliable. Features include the following:

1. Maximum speed of 100,000 rpm (802,006 x g)
2. Control panel is simple with easy key operation and easy-to-see liquid crystal screen.
3. The displayed language can be switched over between English and Japanese.
4. The real-time control (RTC) feature enables setting a start time or a finish time, thus letting you run your machine at a desired date and time.
5. Centrifugal force (RCFmax and RCFavg) can be displayed and set.
6. Twenty varieties of nine stepped modes can be programmed for a wide range of applications.
7. Various alarms notify users of causes and necessary actions when fault conditions are detected allowing easier and quicker troubleshooting.
8. Space saving design. The installation area required is 0.81 m_2 (90 x 90 cm) pr 9.0 ft_2 (3.0 x 3.0 ft). Lower top deck makes it easy to install and remove the rotor.
9. Low noise level makes the ultracentrifuge suitable for use in any laboratory.
10. Samples can be easily balanced visually.
11. CFC-free thermoelectric cooling system with greater cooling capacity.

Advanced features (options)

The options of the Sorvall WX Ultra series ultracentrifuges are: Compass Software, Lockout Kit, and a Printer.

The Compass Software is a calculation/simulation system for centrifuge support that is compatible with Windows ® 2000 / XP Professional. Compass Centrifugation software helps determine appropriate run conditions prior to starting centrifugal separation, and calculates optimum centrifuge and rotor run conditions for materials in which proper run conditions are unknown. For more information on this please consult the Compass Operator's Manual.

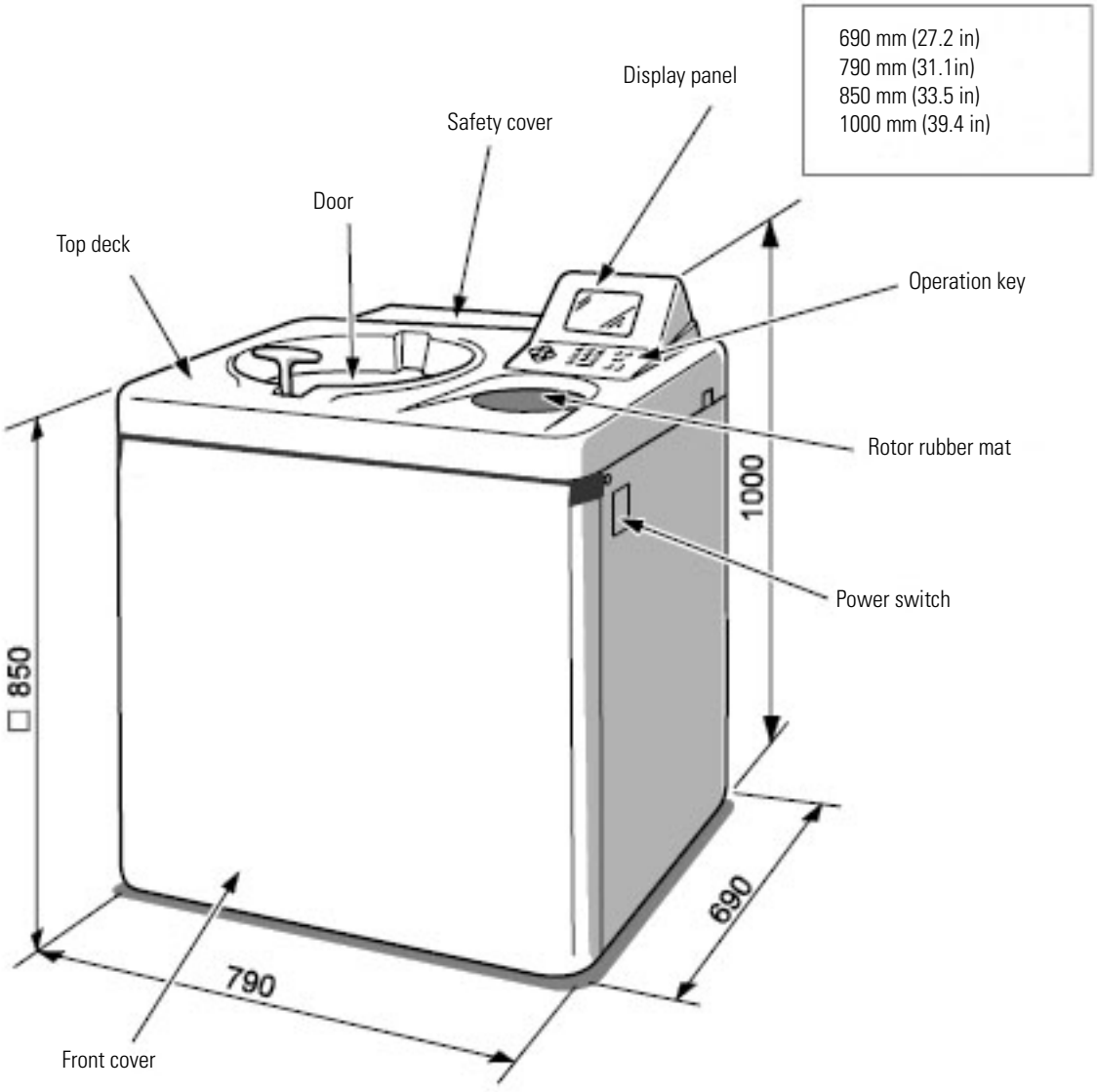
The Lockout Kit limits centrifuge access to a group of registered users (up to 40) which is controlled by lab managers/supervisors (up to 3). For more information on this see page 2-95, Lockout.

The printer provides hard copy reports of information maintained in the centrifuge including: Set and actual run conditions, rotor use, programmed memory contents, and others. For more information on this see page 2 - 89, Print Utilities.

External view of ultracentrifuge

The WX Series ultracentrifuge have the same external view, except for the model name printed on front cover. The following is the external view of the WX ultracentrifuge.

External view of ultracentrifuge



Note * This height is measured from level floor surface.

Figure 1-1 External view of the Sorvall WX Ultra series

Design

Control panel

The control panel for the Sorvall WX Ultra series consists of a color screen, a touch sensitive display panel and a keyboard.

The display panel incorporates an easy-to-read liquid crystal display. The display panel (field display) displays running conditions and running status (this screen is called the Run Screen), along with features such as Programmed Run, Rotors List, and User Customization Screens. Fig. 1-2 shows the display panel, and Fig.1-3 represents the keyboard.

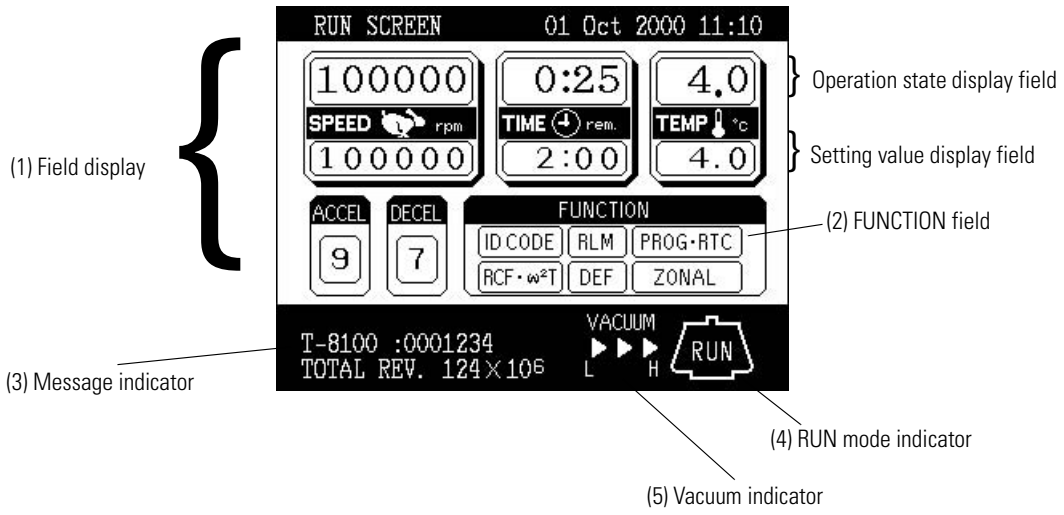


Figure 1-2 Display panel

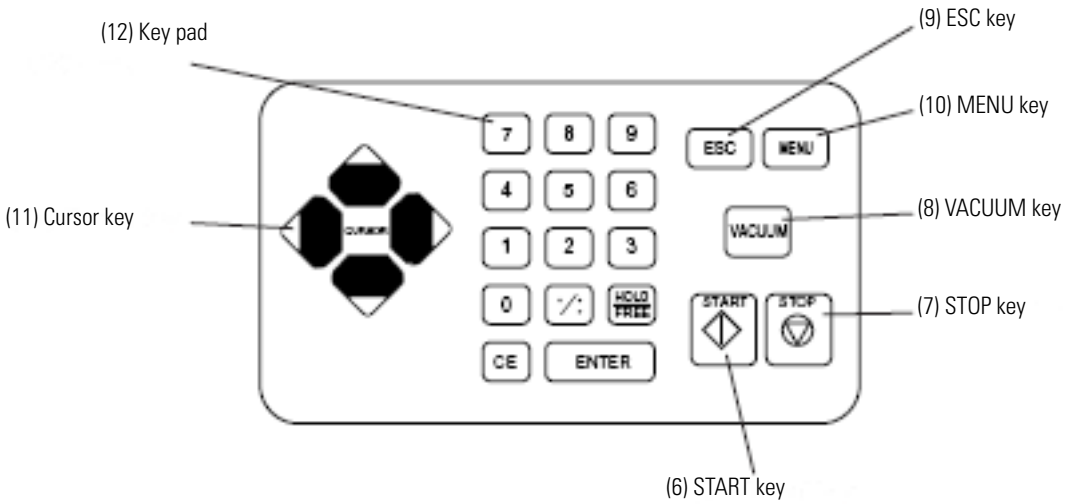


Figure 1-3 Keyboard

Table 1-1 [Functions of the display panel-keyed by item no. to fig. 1-2]

No.	Name and Symbol	Functions and actions
(1)	Field display SPEED TIME TEMP	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 "Setting run conditions".) • SPEED (Speed 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 1,000 to maximum speed in increments of 100 rpm. The lower two digits (one, ten positions) display zeros. • TIME (running time indicator) (Top row) Displays the remaining operation time or the time elapsed during operation if settings are performed on the User Customization screen. 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 0.1 °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)	Function field	• ID CODE Sets an ID code. • RLM Switches to the Rotor Management screen. • PROG • RTC Sets, recalls programmed runs or sets the time and the end time for a programmed run. • RCF • ω^2T Sets and displays the centrifugal force or sets an ω^2T • DEF Sets and resets the defrost function. • ZONAL Sets the zonal operation mode.
(3)	Message indicator	Displays an alarm message and various suggestions for operation.
(4)	Run mode indicator	The following terms are displayed: STOP, ACCEL, RUN (running at the set speed) DECEL, WAIT (waiting for vacuum during acceleration) ZONAL (for zonal operation) DELAY (until the start time in an RTC run)
(5)	VACUUM indicator	Displays the following four stages according to the vacuum of the rotor chamber. (1) Atmospheric state. The vacuum pump is not activated. (2) Low vacuum. The rotor waits at 4,000 rpm until the vacuum reaches an intermediate level (3) Intermediate vacuum. (4) High vacuum. **Note** If the sample is sensitive to a temperature rise, do not press the START key until the chamber is at high vacuum level.

Table 1-2 [Functions of keyboard-keyed by item no. to fig. 1-3]

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	Starts up the vacuum pump and activates air vent (As soon as vacuum pump is on, temperature control starts.) Air vent for vacuum chamber after a run cannot be opened as long as the rotor is spinning.
(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 Centrifuge Scheduler, User List, Alarm Information, Rotor Catalog, and User Customization Routines.
(11)	Cursor key 1. 4. CURSOR 3. 2.	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 key 7 8 9 4 5 6 1 2 3 0 •/: HOLD FREE CE ENTER	Used to type numbers for setting run conditions. •/: During time and temperature entry: Moves cursor from hours to minutes. Acts as decimal point for data entry. HOLD FREE a. During operation time entry: sets continuous run. b. When entering deceleration conditions: sets a free coast. CE Use this when you have entered the wrong value while entering an operating condition or entering a number or when the alarm device is activated. Functions of this key a. This key clears the cursor-carrying input field and returns you to the preinput state. b. Use this key to clear an alarm signal. If more than one alarm signal is on, this key will clear them one by one. ENTER Registers the entered value.

Rotor chamber

The structure of the rotor chamber (vacuum chamber) is shown in Fig. 1-4.

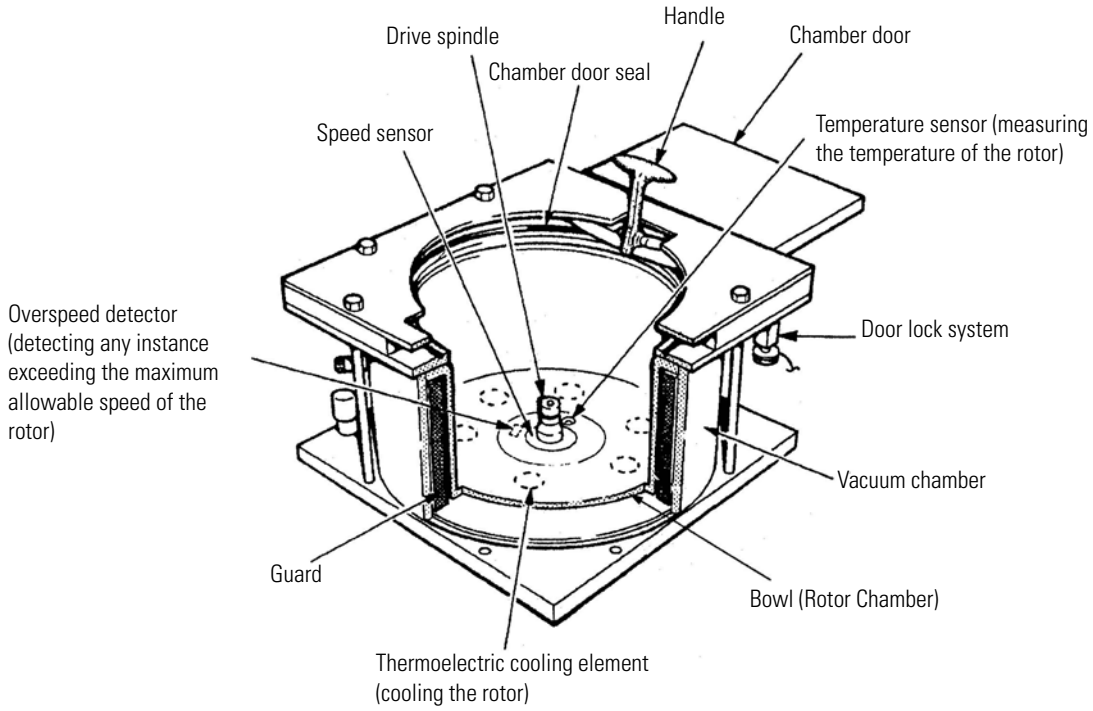


Figure 1-4 Rotor chamber

Note If sample or water drops to the window of the temperature sensor, it may cause an incorrect detection. Whenever the sensor is wet, wipe it with a clean, dry cloth. Take care not to scratch the surface of the sensor.

Safety devices

(1) Containment

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

(2) Imbalance detector

If during operation the vibration of the rotor becomes excessive due to serious imbalance or improper bucket setting, the imbalance detector detects the situation and decelerates the rotor immediately. However, the ultracentrifuge is designed to tolerate imbalance associated with visual balancing-it is equipped with an imbalance tolerant drive. (For more information on the balancing of rotors, see Section 2-1-2, “Preparing tubes/bottles and rotor”.)

(3) Door lock system

The chamber door automatically locks for safety while the rotor is spinning. When the power supply is off, the door remains locked. The door can only be opened and closed when the rotor is at rest and the rotor chamber is vented. Unless the door is closed, the rotor will not start rotating except in zonal mode. To open the door in the event of a power failure, see Section 2-7, “When power failure occurs”.

(4) Speed sensor and overspeed detector

For protection in the event of entry errors the ultracentrifuge is provided with an automatic system to stop the rotor when its speed exceeds the maximum allowable speed. If a speed higher than the maximum permitted speed is set, the ultracentrifuge will detect the mistake before the speed reaches 3000 rpm, and then will display an alert message and decelerate the rotor to a stop.

Rotor adapter

Overspeed Decal

The overspeed decal located on the rotor base has alternating black and white bands. The number of bands corresponds to the maximum permitted speed of the rotor. (See Fig. 1-5.)

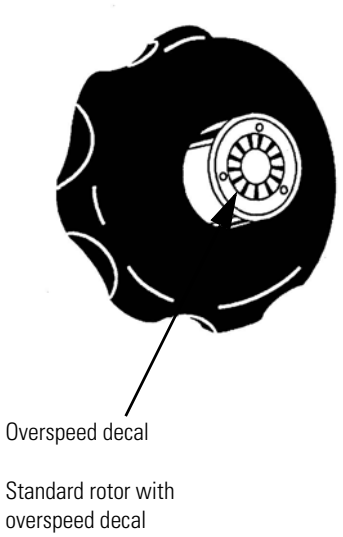


Figure 1-5 Standard rotor

To protect the overspeed decal, be sure to store the rotor on the rotor stand provided. (See Fig. 1-6.)

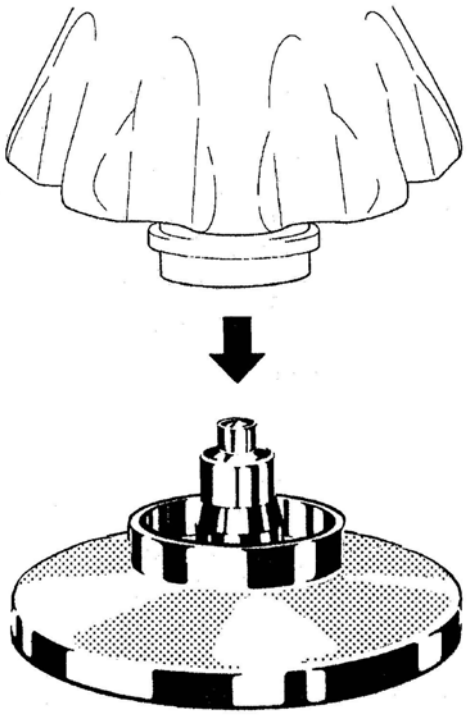
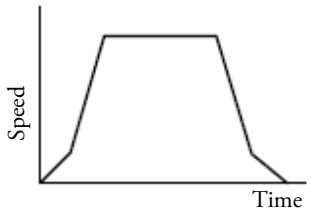
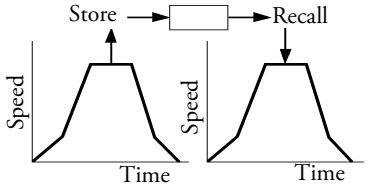
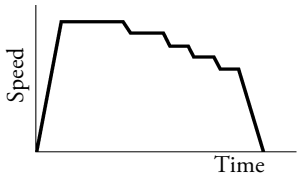
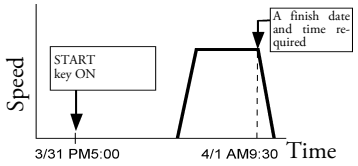
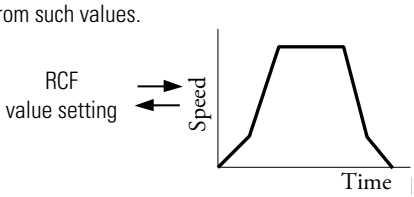
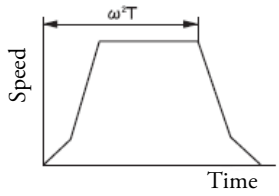
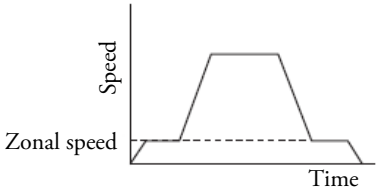


Figure 1-6 Rotor stand

Operation

The Sorvall WX Ultra series ultracentrifuges are capable of operation in more than one mode to meet a wide range of applications. The outline of each available mode is given below:

		Outline	Reference
Normal operation			Section Normal operation
Optional features	Programmed operation	You can store set run conditions in memory for later use in repeated operation. 	Section How to use the FUNCTION field Section Programmed operation
	Step-mode operation	More than one normal operation can be combined into a sequence of operations or step for successive centrifugation. 	Section Step-mode operation
	RTC (real-time control) operation	Run starts or completes at a required date and time. 	Section RTC (real-time control) feature
	RCF (centrifugal force) value display setting	This feature calculates centrifugal force (RCF) values from set speed. It can also calculate reversely, i.e., finding speed from such values. 	Section Displaying and setting RCF

Optional features	ω^2T setting	Calculates and displays the running time from the set values of speed and ω^2T. 	Section Setting w2T.
	Zonal operation	Zonal operation is a mode of operation using a zonal rotor. 	Section Zonal operation.

Run preparation

WARNING

1. Never use any materials capable of producing flammable or explosive vapors, or extreme exothermic reactions.
2. When using radioactive, toxic, or pathogenic materials, be aware of all characteristics of the materials and 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.

CAUTION Do not place fluids inside, on top of, or close to the centrifuge---spillage can result in electrical or mechanical failure.

Starting up the ultracentrifuge

Before setting run conditions, display the run screen (screen for setting run conditions)

(1) Displaying the Run Screen (screen for setting run conditions)

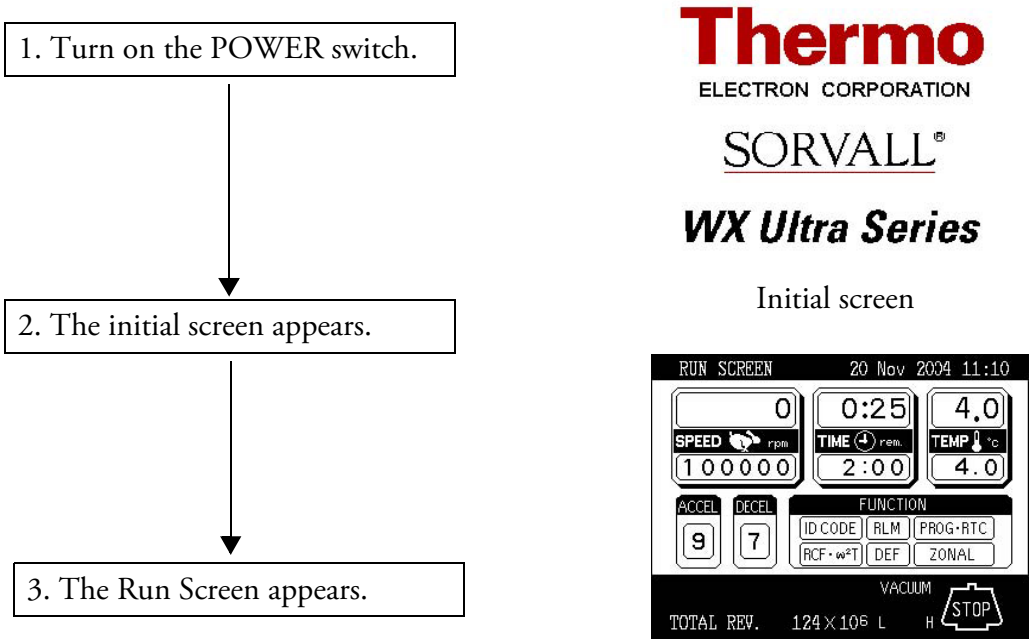


Figure 2-1 Initial screen, and run screen

Preparing tubes/bottles and rotor

The Sorvall WX Ultra series ultracentrifuges allow you to balance, by eye, tubes or bottles containing a sample solution and then centrifuge them. Make sure that the difference between meniscus levels of sample solution in tubes or bottles in within 5 mm (0.197 in) (See fig. 2-2).

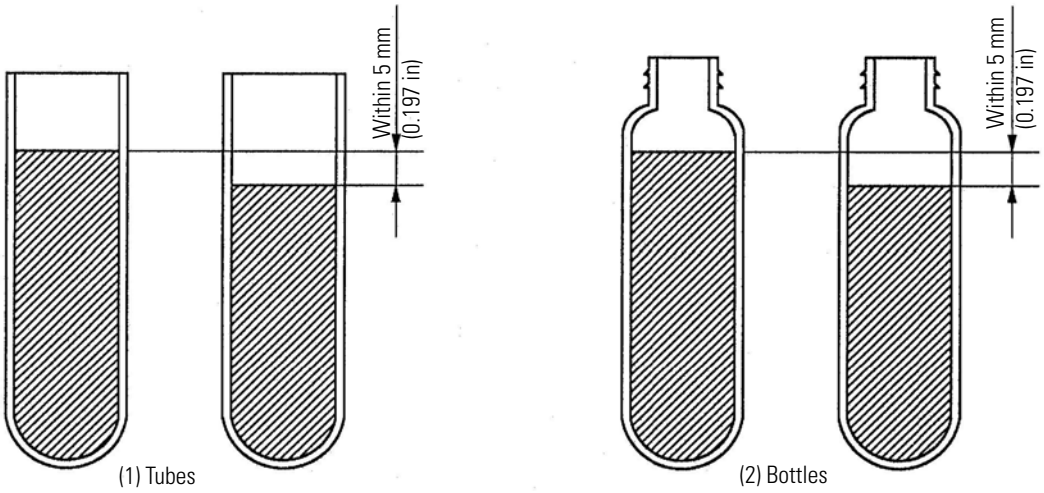


Figure 2-2 Balancing tubes/bottles containing a sample solution

To prevent tube or bottle failure, some tube and rotor combinations cannot be run to the maximum speed of the rotor when partially filled. The tube or bottle must be full in the following cases:

1. When a thin tube or seal tube is used.
2. When a thick tube is used for swinging rotor.
3. When a bottle is used 100,000 x g or more.

Basic operation

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

CAUTION

1. Do not operate the keyboard with a ball-point pen or a sharp object.
2. Do not continue to operate the centrifuge if abnormal sounds occur during operation. Immediately discontinue use of the centrifuge and contact Thermo Service.

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, while the bottom row displays the set run conditions.
The acceleration (ACCEL) and the deceleration (DECEL) fields display set conditions.

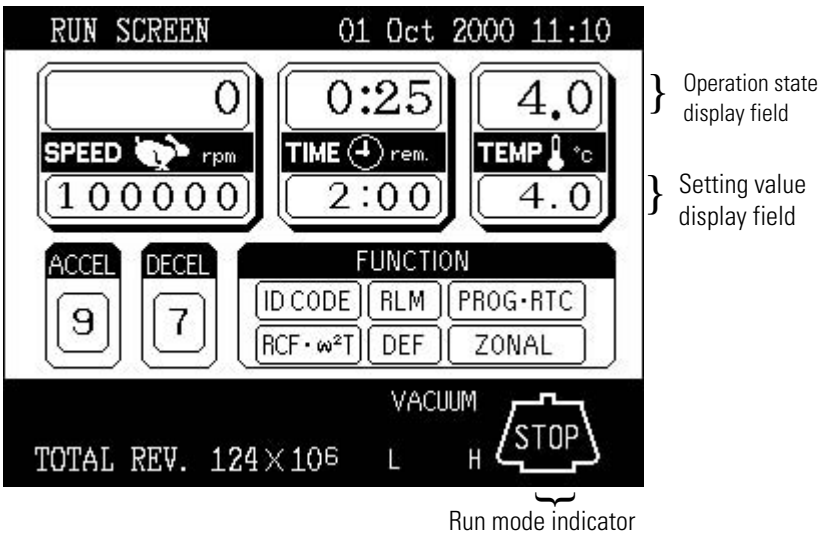


Figure 2-3 Run screen

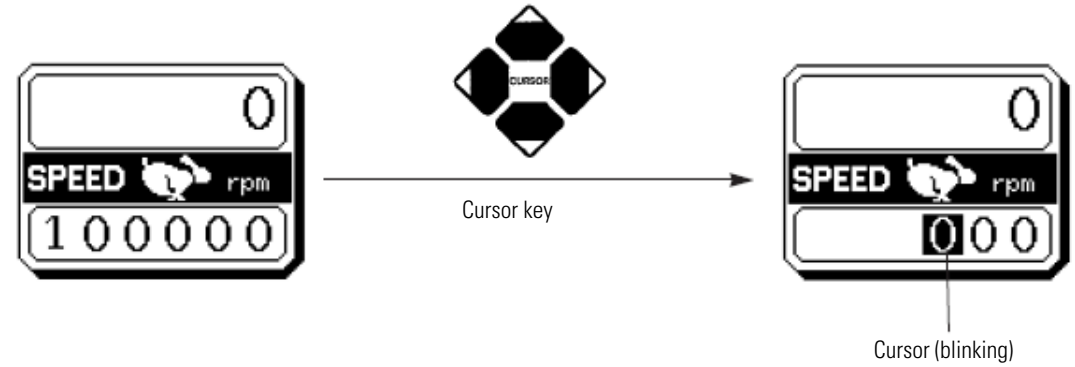
[**Cursor key**]

Pressing the cursor key will highlight the field where changes can be made. (This blinking/highlighted 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. Determined 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 determined input state, and the numerical part of the setting field will blink a 0 (or numerical value) 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 determined input state.

Note When the screen is in a determined input state without a cursor (when the Run Screen is on after power-up), if you wish to enter a numerical value in a specified parameter field, press a cursor key (either of the upward, downward, right, and left arrow keys), move the cursor to the specified parameter field, then enter the value.
The cursor keys display and move a cursor. Once a cursor appears, pressing a cursor key moves the cursor to the corresponding direction (upward, downward, rightward, or leftward).



The system does not accept a numerical input.

(1) Determined input state

The system accepts a numerical input. Use cursor keys to move to the next setting item.

(2) Input wait state

Figure 2-4 Setting indicator

Note

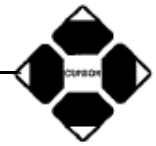
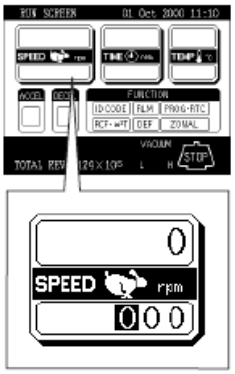
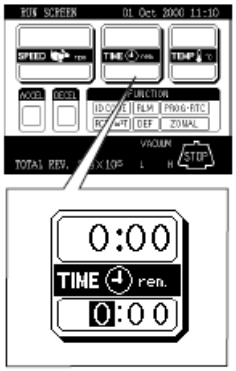
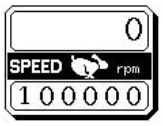
1. If you enter the wrong value, press CE key to return to the input wait state.
   If you have pressed ENTER key, press a cursor key, enter the device into an input wait state, then enter the correct value.
2. When setting two or more run conditions, you do not have to press ENTER key after each setting. Pressing the cursor key will enter the setting, thus making the system wait for a new input.
3. If the system is running in (HOLD) and you want to set it to shut down at a future time, enter a new time setting while the instrument is 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

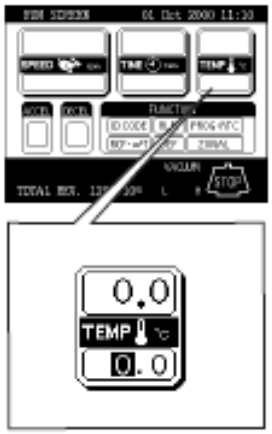
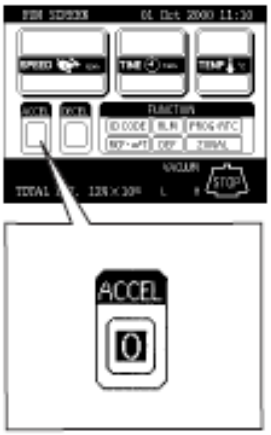
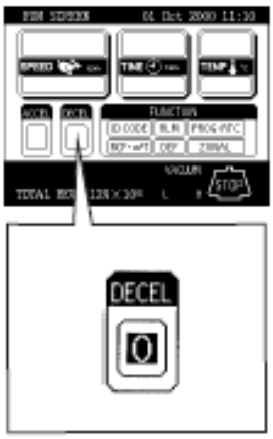
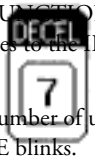
How to set speed, running time, temperature, and other parameters

Here are some examples and descriptions:

Setting item	RPM (SPEED	Running time (TIME)
Typical setting	100,000 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.	2 hours 30 minutes
	2	Use cursor keys to move the cursor to the status indicator. (The arrows indicate the directions the cursor can be moved.. Arrow 		The system enters an input wait state. 
	3	The cursor in the setting item field blinks for about 30 seconds. Blinking means that the system enters an input wait state.		
	4	Use numeric keys to enter a setting. 7 8 9 4 5 6 1 2 3 0 ⁄: HOLD/FREE CE ENTER Entered numbers are moved to the left every time a new number is entered.	1 0 0 0 The last two digits are fixed.	2 ⁄: 3 0 Press the " ⁄: " key to move the cursor to the "minutes" position. For a continuous run, press HOLD/FREE.
	5	Make a check, then press ENTER. After pressing a cursor key, you can still enter a setting similarly to the ENTER key. Use CE to cancel an input.	Set it to 100,000 rpm. 	Set it to 2:30 (2 hours 30 minutes).
Setting range and units			Can be set to any value in the range from 1,000 rpm to maximum speed in increments of 100 rpm.	Can be set to any value up to 99 hours 59 minutes in increments of 1 minute.

Temperature (TEMP)	**Acceleration (ACCEL)**	**Deceleration (DECEL)**
4.5 °C	**9**	**7**
Enters an input wait state.	Enters an input wait state.	Enters an input wait state.

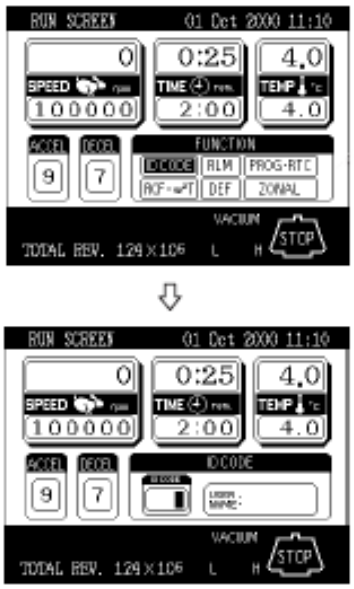
The cursor blinks at one place. 		
4 ·/: 5 When one decimal place is not required, you do not need to enter ·/:. If you press ·/:, it becomes a “decimal place” input and the machine waits for an input of decimal places.	9	FUNCTION field 7 For free coast, press HOLD/FREE. Display: F
Set it to 4.5 °C. 	Set it to 9 	Set it to 7.  • The FUNCTION field switches to the ID CODE field. • The number of units of ID CODE blinks.
Can be set to any value in the range from 0 to 40 °C in increments of 0.1 °C.	1 to 9	1 to 9 + free coast (F) • The entered number is not displayed on the screen. * is displayed instead of the number.

>> After the registered ID CODE is entered, the name (USER NAME) corresponding to the ID CODE is displayed.

Setting user ID code

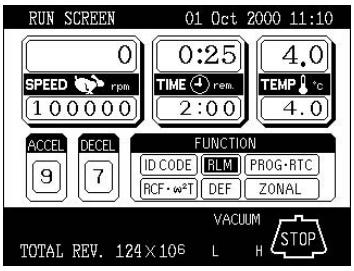
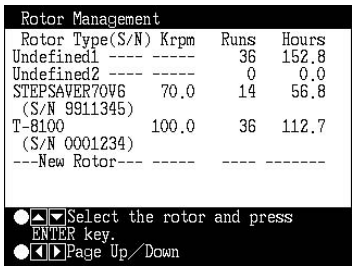
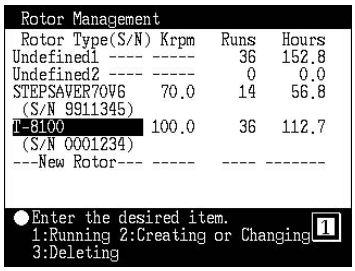
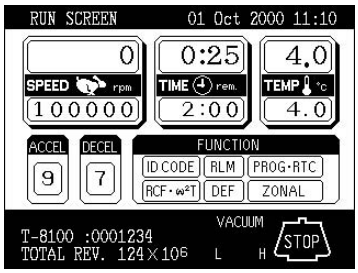
The USER ID CODE is a number to identify each user and can be set in up to 4 digits.
When the user ID CODE is entered, the user record will be stored in the memory of the centrifuge and can be printed if a printout operation is done (optional).
Entering a user ID CODE may not be always required for operation (Lockout feature optional). If the centrifuge is not equipped with the optional lockout feature and the user does not need to be identified, the centrifuge can be operated without an ID CODE.

- To use a name (user name) corresponding to the user ID code or ID code, it must be registered. For the registration method, see Section User list.

Step	Key operation	Screen display and considerations
1	On the Run Screen, use cursor keys to move the cursor to ID CODE and press the ENTER key.	 • The display switches to the rotor control field, which displays the Rotor List screen.
2	Use numeric keys to enter ID CODE (4 digits). (When entering 0123) 0 1 2 3 ENTER ID code	 • The display switches back to the Run Screen and "T-8100-1234" is displayed in the message field.
3	Press the ESC key on the keyboard to return to the FUNCTION field.	

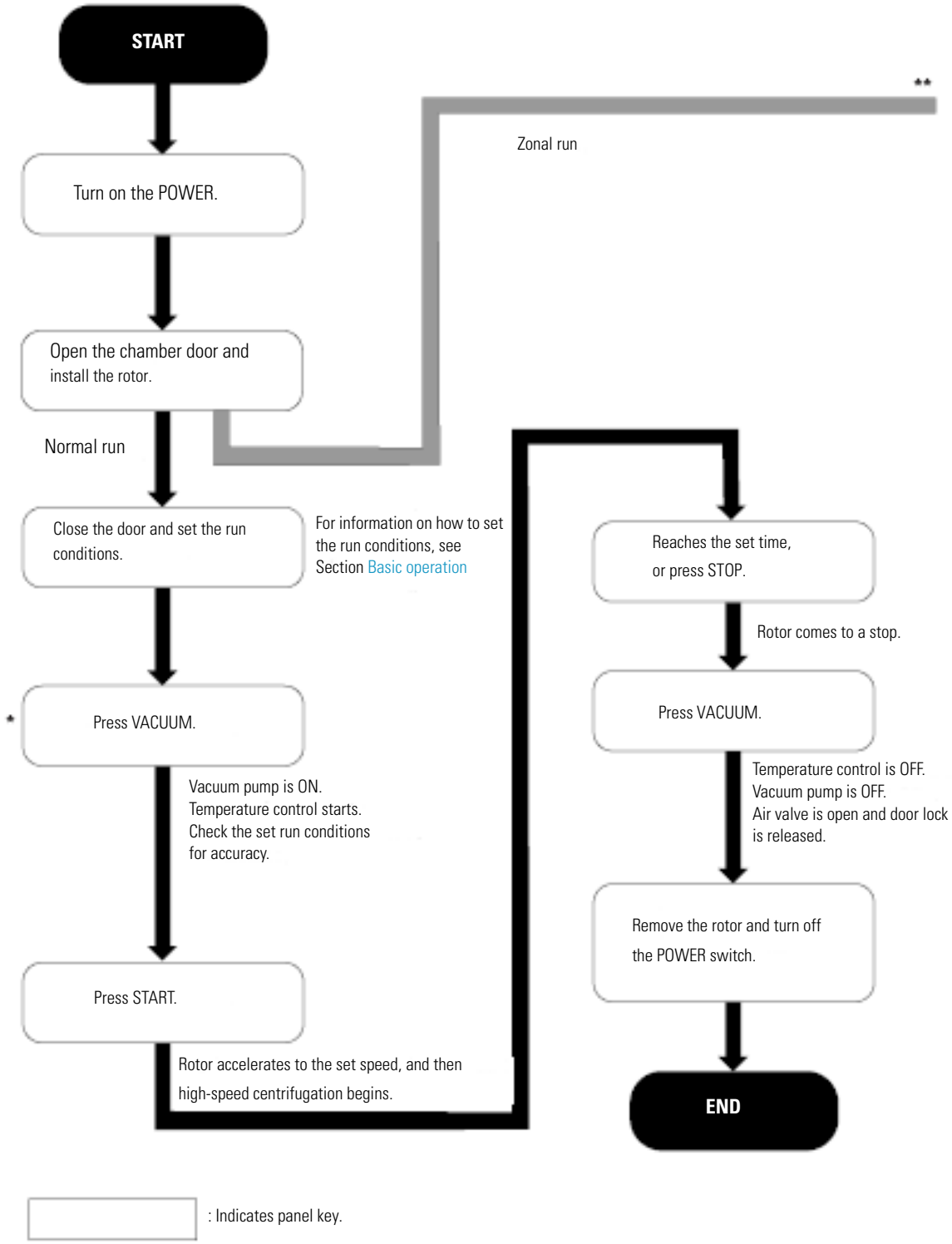
Using Rotor Life Management

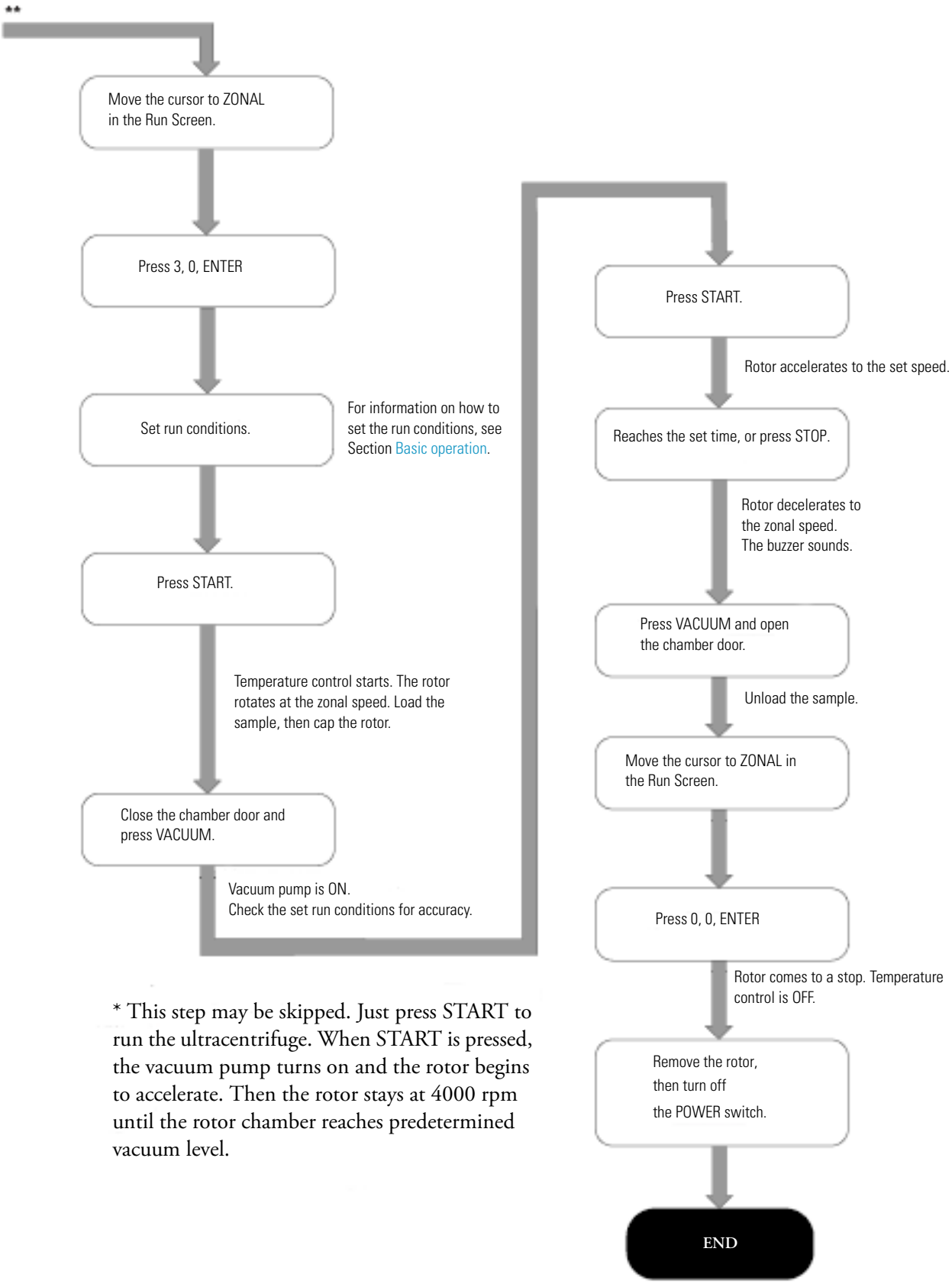
The rotor type and serial number may be set in rotor management to allow for rotor logging within the centrifuge. Whether the rotor type and serial number for a particular rotor have been set or not, it does not affect the normal operation of the ultracentrifuge. However, you are advised to set the rotor type and serial number of the rotor for each run to allow effective rotor life management. Any registered rotor that does not have its rotor type and serial number set will appear as an undefined rotor in the displayed list (“Undefined rotor 1”).
You can use a particular rotor as undefined if you need to manage the rotor separately from the other defined rotors in terms of the number of runs made and accumulated run time (“Undefined rotor 2”).
For more information on rotor life management, see Section Rotor management.

Step	Key operation	Screen display and considerations
1	On the Run Screen, use cursor keys to move the cursor to RLM and press the ENTER key.) ENTER	
2	On the rotor control field, use the left and right arrow keys and to select each page.	
3	Use the up and down arrow keys to move the cursor to the row of the rotor type to be used and press the ENTER key. ENTER In this example, the cursor moves to “T-8100-1234”.	
	Select “Running”. 1 ENTER	

Basic operating procedure

There are two basic modes of operation, normal and zonal. The procedures for these two modes are shown in Fig. 2-5.





* This step may be skipped. Just press START to run the ultracentrifuge. When START is pressed, the vacuum pump turns on and the rotor begins to accelerate. Then the rotor stays at 4000 rpm until the rotor chamber reaches predetermined vacuum level.

Figure 2-5 Basic operating procedure

Normal operation

Given 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.

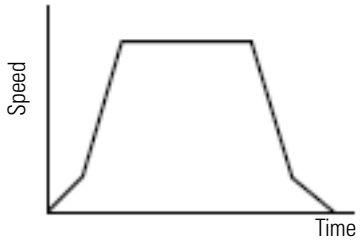


Figure 2-6 Normal operation mode

Step	Operation and keystrokes	Unit operation and considerations
1	Turn on the POWER switch on this machine.	>> The panel display lights up. >> The door is unlocked.
2	Open chamber door and make sure chamber is dry.	
3	Install the rotor.	>> Before installation, read the rotor instruction manual carefully.
4	Set run conditions.	>> See Section Setting run conditions and set run conditions.
5	Press VACUUM key. (optional) 	>> 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. (1) In a low vacuum ▶ (1 indicator) (2) In an intermediate vacuum ▶▶ (2 indicators) (3) In a high vacuum ▶▶▶ (3 indicators) >> If the rotor compartment has moisture or frost on it, it takes a long time to reach a high vacuum. In that case, wipe it off with a clean, dry cloth or sponge. >> If the sample is sensitive to a temperature rise, do not press the START key until the chamber is at high vacuum level.
6	Press START key 	>> The rotor starts spinning. >> The timer begins operating. >> The rotor accelerates to the set speed. >> This ultracentrifuge waits at 4,000 rpm until an intermediate vacuum is reached.

7	The specified centrifugation time elapses (time-out). Or press STOP key. 	>> The rotor decelerates and stops.
8	The rotor brakes or coasts to a stop.	>> Beeps to indicate that the rotor has stopped.
9	Press VACUUM key. 	>> The vacuum stops, the air leak valve gets activates, and the rotor chamber reaches atmospheric pressure. >> The door unlocks, and is able to be opened and closed.
10	Take out the rotor.	

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

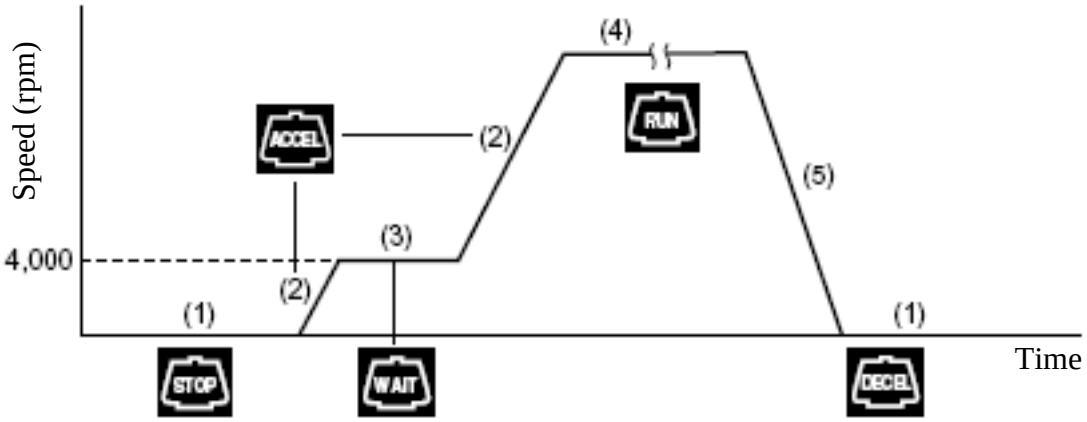


Figure 2-7 Displays of run modes

Note Use the vacuum key to avoid prolonged vacuum wait time at 4,000 rpm when the ambient temperature is low.

Zonal operation

Zonal operation is a mode of operation using a zonal rotor or continuous flow rotor for density gradient centrifugation with large amounts of sample or continuous sedimentation of particles from a large volume sample.

The following zonal rotors are available for operation in the Sorvall WX Ultra series ultracentrifuges:

TZ-28 sealed zonal rotor
TCF-32 continuous flow zonal rotor

The TZ-28 can only be operated in a sealed zonal mode. Dynamic loading/unloading or continuous flow operation **IS NOT** allowed.
The TCF-32 zonal rotor can be operated in a continuous flow mode requiring dynamic loading and unloading. The rotor comes with a kit to modify the Sorvall WX Ultra series.

The continuous flow zonal operation consists of the following three stages:

1. Centrifugation at low speed, called the zonal speed *, the gradient or sample being loaded in this stage.
2. Acceleration to set speed and separation of the sample, or
3. Centrifugation at zonal speed, the sample and or gradient being unloaded in this stage.

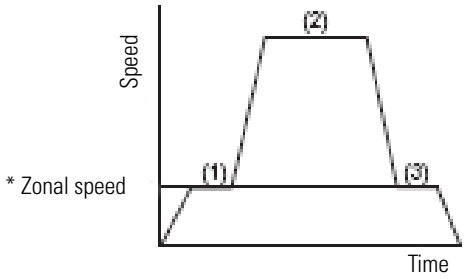
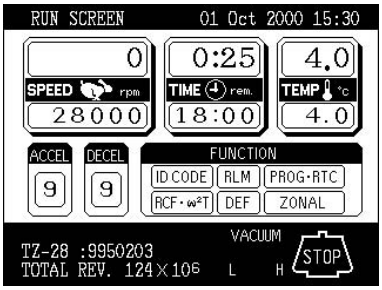


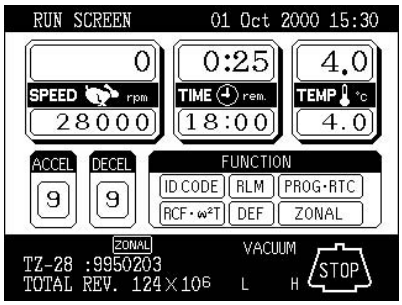
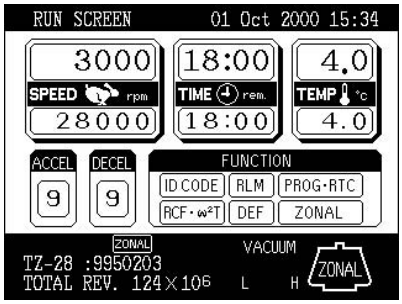
Figure 2-8 Zonal operation mode

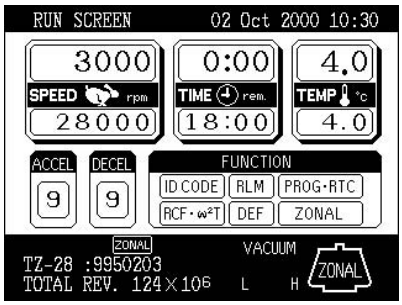
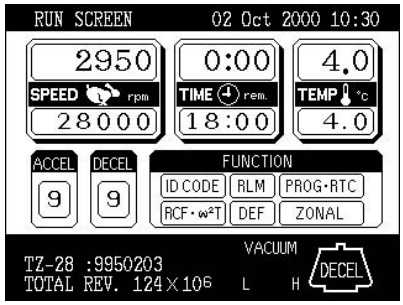
* Zonal speed: The zonal speed is one that is required for loading and unloading the sample.
The zonal speed is normally set at 3,000 rpm, but it can be set in the range from 2,000 to 3,000 rpm in increments of 100 rpm to obtain the required speed. For details of how to change zonal speed, see Section User Customizations.

WARNING When operating the centrifuge with the door open and the rotor spinning, eliminate all possibility of contact with the rotor. Remove any objects not essential to operating procedures which could either catch on or drop into the spinning rotor (that is, neckties, rings, bracelets, watches, long sleeves, or any loose articles in breast pockets).

The following explains how to perform a zonal run.

Step	Operation and keystrokes	Unit operation and considerations
1	Install the zonal rotor on the drive spindle.	>> See zonal rotor manual.  • The characters ZONAL are displayed in the message display field on the screen and the zonal operation mode is set.

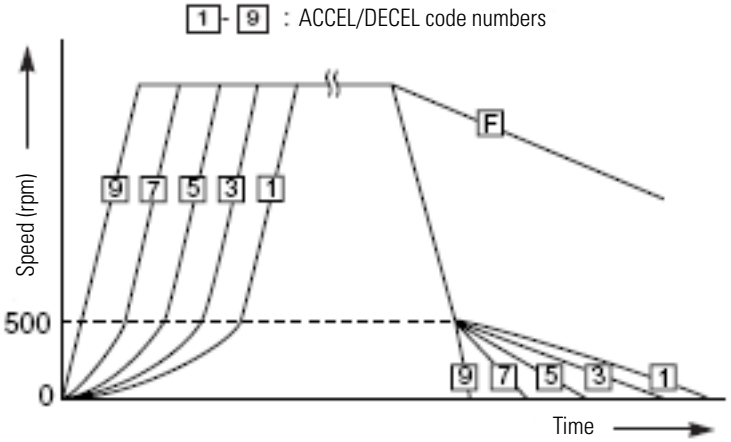
2	On the Run Screen, move the cursor to ZONAL and enter the following by operating numeric keys to set the zonal operation mode. 3 0 ENTER	 • Rotor begins to accelerate to the zonal speed. • Temperature control begins.
3	Set the run conditions.	>> For details, see Section Basic operation.
4	Press the START key. START	 **Note** The time being consumed at zonal speed is not counted as part of the run.
5	Install the seal assembly on the rotor.	>> For details, see zonal rotor manual.
6	Load the sample and the gradient solution.	
7	Install the cap assembly on the rotor.	
8	Close the chamber door.	
9	Press the VACUUM key. (This step may be omitted.) VACUUM	>> Vacuum pump begins to work. >> Chamber door is locked.
10	Press the START key again. START	>> Rotor begins to accelerate to the set speed. **Note** The run time is counted from when the START key is pressed. The instrument can also count only the time elapsing while the rotor is spinning at high speed. This is possible by changing the run time setting range. For details, see Section "Run time range setting" on page 2-80.
11	If you need to stop the run before the set time elapses, press the STOP key. STOP	>> Rotor is decelerated to the zonal speed and then the buzzer sounds.
12	Press the VACUUM key. VACUUM	>> Vacuum pump stops working and air enters the rotor chamber. >> Door lock is released.

13	Open the chamber door.	>> For details, see zonal rotor manual.
14	Remove the cap assembly	
15	Install the seal assembly and unload the sample.	
16	On the Run Screen, move the cursor to ZONAL in the FUNCTION field and enter the following by operating numeric keys to set the normal operation mode. 0 0 ENTER	>> Rotor decelerates to a stop.  **Note** During the zonal mode, the rotor will not decelerate even if the STOP key is pressed during the rotor's spinning at the zonal sped.
17	Be sure that the rotor is at rest, then remove the rotor.	>> If the rotor is still spinning, do not remove it. Wait until it comes to a complete stop.

Note By changing to the NORMAL mode when loading and unloading the sample, you can decelerate the rotor to a stop.

Acceleration and deceleration rates

In order to meet various experimental protocols, the acceleration and deceleration rates can be adjusted between 0 to 500 rpm.
The figure and table below show the relationship between ACCEL/DECEL code numbers selected and resulting approximate acceleration/deceleration times.



Code No.	Acceleration time (minutes) from rest to 500 rpm	Deceleration time (minutes) from 500 rpm to rest
9	Minimum time*	Minimum time*
8	1	1
7	2	2
6	3	3
5	4	4
4	5	5
3	6	6
2	7	7
1	8	8
F	-	Coasting deceleration

* Minimum time is the time for accelerating or decelerating by the driving motor with maximum torque. this time depends on the type of rotor in use.

The following are typical examples of application of acceleration and deceleration rates

	Suggested code nos.		Characteristic of separation
	ACCEL	DECEL	
Density gradient centrifugation using a vertical rotor	5	7	The sample and gradient in tubes reorient during acceleration and deceleration. Therefore, the sample and gradient can become mixed, especially in wide tubes, if you use rapid acceleration or deceleration.
DNA separation by CsCl isopycnic separation (self-forming gradients)	9	7	You can operate at maximum acceleration because the density gradient is not 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	8	8	The sample and gradient do not reorient. Therefore, mixing of the layers is less than that in the case of using a vertical rotor.

Note For a swinging bucket, there is no difference with regard to turbulence if ACCEL/DECEL is less than or equal to 8. However, when the mode for long acceleration time is selected, (1, 2, 3), an imbalance alarm indicator may light.

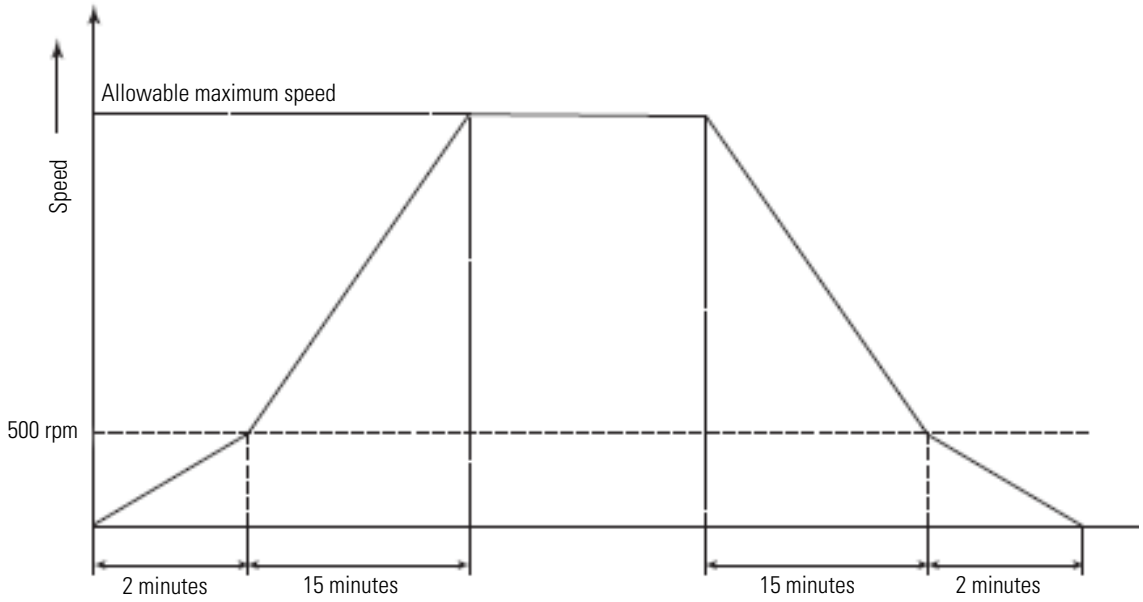


Figure 2-9 Operation with setting ACCEL = 0 and DECEL = 0

How to use the FUNCTION field

This ultracentrifuge incorporates a number of features. These features are displayed and specified in the FUNCTION field.
The FUNCTION field is extended as shown in the following figure.

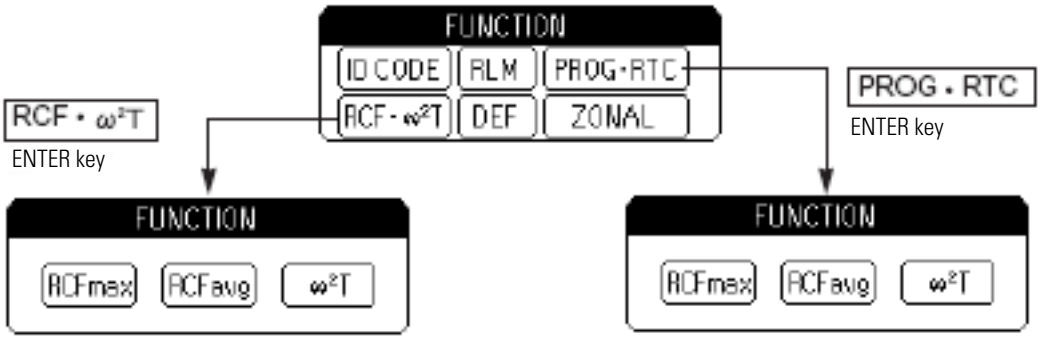


Figure 2-10 FUNCTION field

ID CODE:	Sets an ID code.
RLM:	Switches the Run Screen to the rotor management field.
PROG:	Programs, stores, and recalls run conditions. This feature also offers a step-mode operation: a continuous run of multiple run conditions.
RTC:	Sets a start time or a finish time and runs the ultracentrifuge at a desired date and time.
RCF_{max}:	Maximum centrifugal force for the maximum radius $\mathbf{r}_{max}$ of the rotor used. This feature is used to cause the system to automatically calculate and display RCF_{max}. It also sets an RCF_{max} value and calculates the speed.
RCF_{avg}:	Causes the system to automatically calculate and display the average centrifugal force RCF_{avg} for the average radius $\mathbf{r}_{avg}$ of the rotor used. It also sets an RCF_{avg} value and calculates the speed.
ω^2T:	Performs an $r\omega^2T$ run and arithmetic operations.
DEF:	Turns on and off the defroster.
ZONAL:	Selects between zonal operation and normal operation.

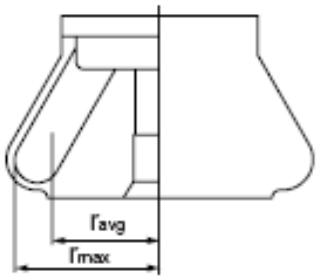


Figure 2-11 Rotor radius

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. You therefore cannot activate PROG.

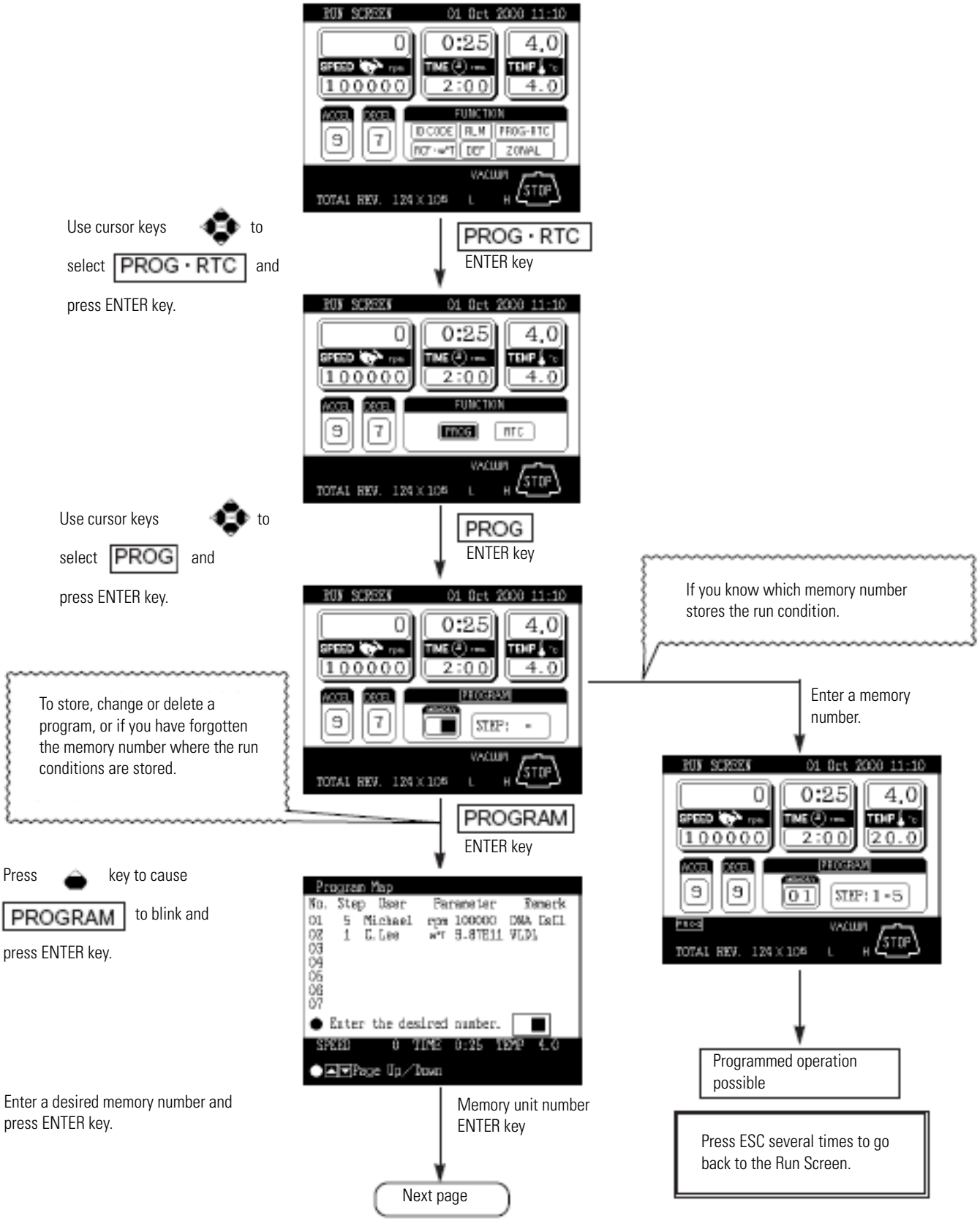
Programmed operation

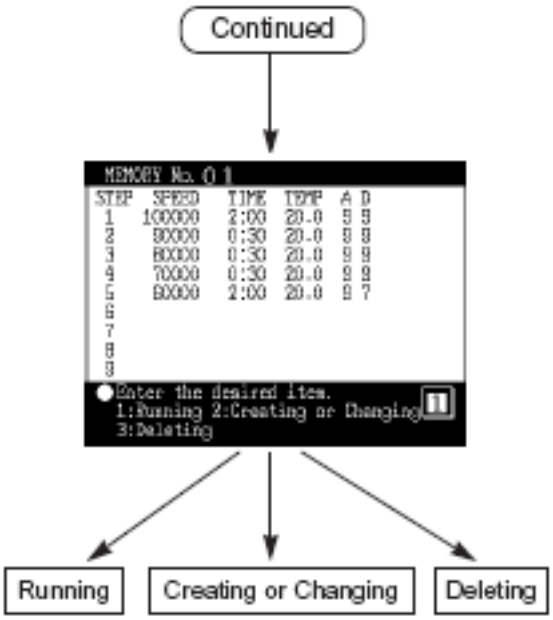
This ultracentrifuge has a programmed operation feature that stores run conditions. Storing run conditions which you often use allows you to recall those conditions as often as you wish, thus saving time in setting. (The saved run conditions will remain in effect even after the power switch is turned off.)
This centrifuge incorporates the program areas indicated below. It has twenty memory areas and nine steps in each memory number.
Accordingly, twenty patterns of run conditions can be stored and each memory can store nine steps. Running this machine with each memory number retaining multiple steps will allow you to change the speed, run time, temperature, and others while in operation. (Step-mode operation).

Memory 1	Step 1	Step 2	• • • • • •	Step 9
Memory 2	Step 1	Step 2	• • • • • •	Step 9
Memory 3	Step 1	Step 2	• • • • • •	Step 9
•	•	•	• • • • • •	•
•	•	•	• • • • • •	•
•	•	•	• • • • • •	•
•	•	•	• • • • • •	•
•	•	•	• • • • • •	•
Memory 20	Step 1	Step 2	• • • • • •	Step 9

Figure 2-12 Program areas

Basic operation of the programmed operation feature

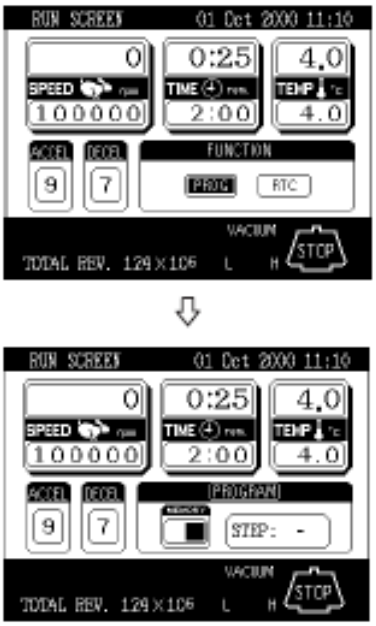
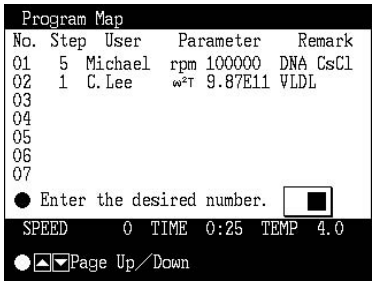
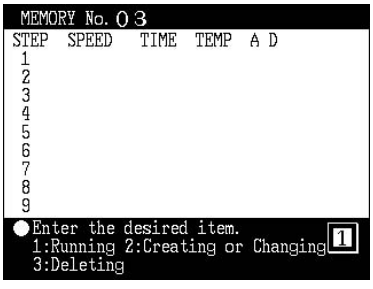




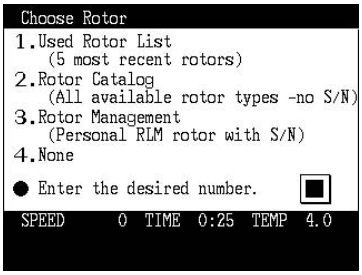
Note You cannot create, change, or delete a program while in running. Perform these operations while not in running. However, you can search the memory screen every time.

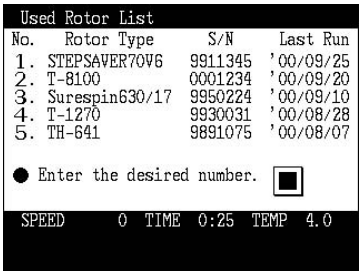
1. Programming procedure for run conditions (creating or changing)

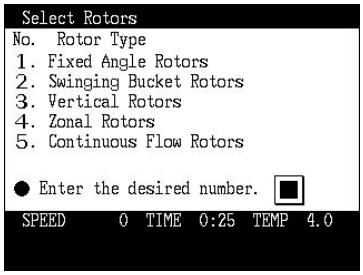
Shown below is the procedure for storing (creating) or changing a run condition.

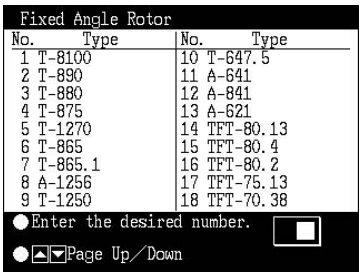
Step	Key operation	Screen display and considerations
1	While in the Run Screen, use the cursor keys to move the cursor to PROG • RTC and press ENTER key. Then, move the cursor to PROG and press ENTER key.	 • The FUNCTION field switches to the PROGRAM field. • The MEMORY No. setting field blinks.
2	Press the upward cursor key to cause PROGRAM to blink, then press ENTER key.	 • The display switches to the Program Map screen and the MEMORY No. selection field blinks. >> 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 3, press 3 ENTER	 • The memory screen you have just specified appears.
4	Select "Creating or Changing." 2 ENTER	 • The message field in the bottom row switches to what is shown in the figure to the left.

<table>
<tr>
<td>5</td>
<td>Enter a desired condition.
For example, select “SPEED”.

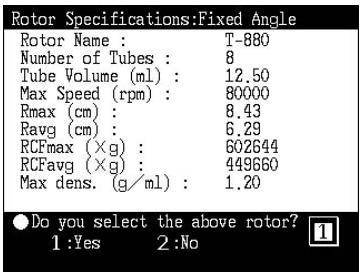
1 ENTER</td>
<td> 
</td>
<td>• The display switches to the Choose Rotor screen.</td>
</tr>
<tr>
<td rowspan="3">6</td>
<td>Select a desired rotor.
To select a desired rotor from the “Used Rotor List”:

1 ENTER</td>
<td> 
</td>
<td>• The display switches to the Used Rotor List screen.
• You can search for the rotor number you need in the order starting with the latest date/time.</td>
</tr>
<tr>
<td>To select a desired rotor from the “Rotor Catalog”:
(1) Select “Rotor Catalog”.

2 ENTER</td>
<td> 
</td>
<td>• The display switches to the Select Rotors screen.</td>
</tr>
<tr>
<td>(2) Select Fixed Angle Rotor in the rotor types.
(When using fixed angle rotor T-880)

1 ENTER</td>
<td> 
</td>
<td>• The display switches to the Fixed Angle Rotor list screen.</td>
</tr>
<tr>
<td>(3) Select fixed angle rotor T-880.

3 ENTER

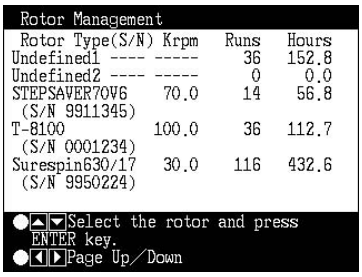
(4) Select “Yes”.</td>
<td> 
</td>
<td>• The specifications of the T-880 are displayed.</td>
</tr>
</table>

<table>
<tr>
<td rowspan="3">6</td>
<td>To select a desired rotor from the “Rotor Management”:
(1') Select “Rotor Management”.

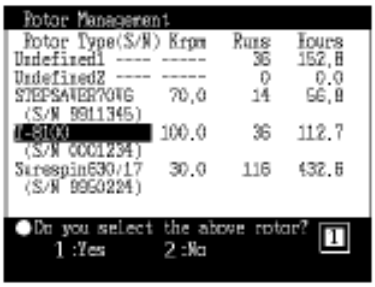
3 ENTER

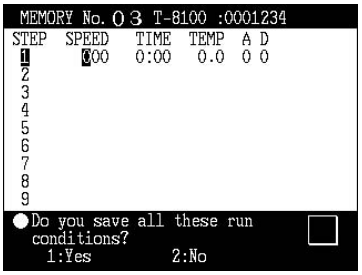
(2') Select a desired rotor using the upward or downward cursor key
▲ ▼ .
(When using fixed angle rotor T-8100)
▼ • • ENTER

(3') Select “Yes”.

1 ENTER</td>
<td>


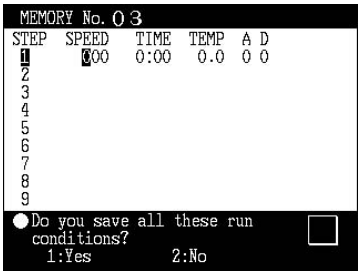
• The display switches to the Rotor Management screen and the Rotor List is displayed.

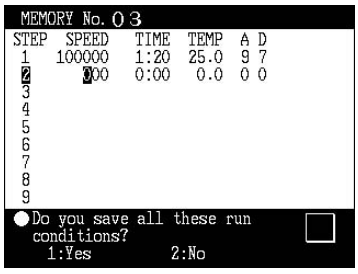




• The rotor type you have just entered appears in the top row in the screen.

• The SPEED field in the SPEED priority screen blinks.</td>
</tr>
<tr>
<td>To select no rotor:
Select “None”.

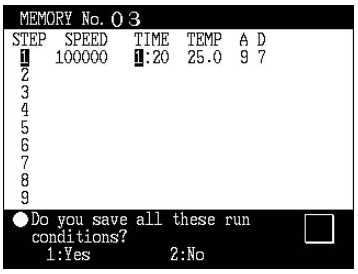
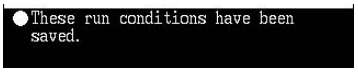
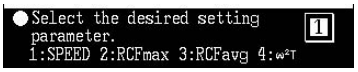
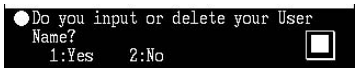
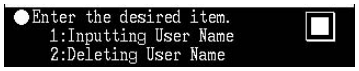
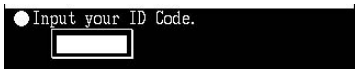
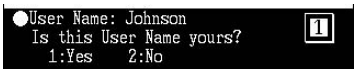
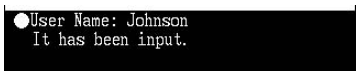
4 ENTER</td>
<td>


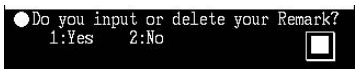
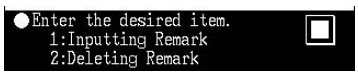
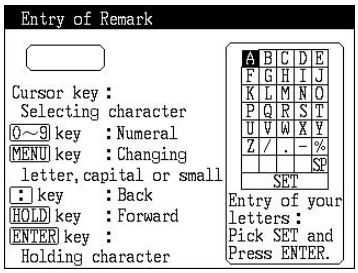
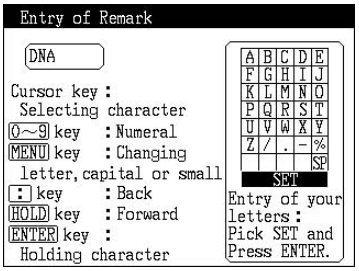
• The SPEED field in the SPEED priority screen blinks.</td>
</tr>
<tr>
<td>7</td>
<td>Enter values into SPEED (RCF_{max} or RCF_{avg} or ω^2T), TIME, TEMP, A (ACCEL), and D (DECEL).
Example
1 0 0 0 ▶
1 : 2 0 ▶
2 5 ▶
9 ▶
7 ▼ (Downward cursor key)</td>
<td>


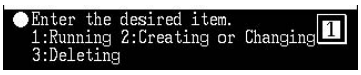
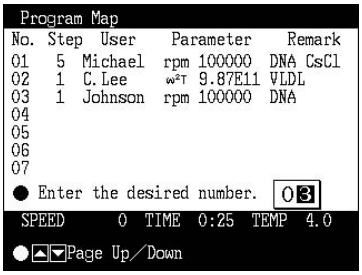
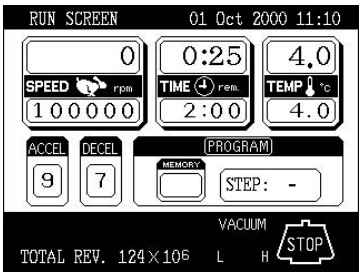
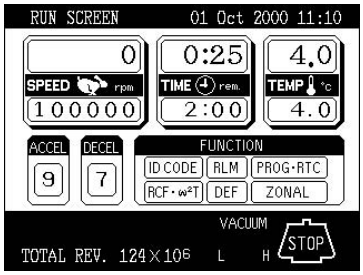
• When you finish entering run conditions for step 1, step 2 enters into an input wait state.

>> To enter run conditions in multiple steps in a step-mode operation, continue the operation from the above. (See Section Step-mode operation.)

>> You cannot skip a step. (You cannot enter anything in step 2 with nothing entered into step 1.)</td>
</tr>
</table>

	To change a run condition, use cursor keys to move to the item you want to change and then enter a value.	 • This diagram shows what you will get if you move the cursor and enter the TIME field into an input wait.
8	Press the downward cursor key to blink the value part of the message field in the bottom row. Then select "Yes". Yes 1 ENTER No 2 ENTER	>> If you select "Yes":  • 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 3 is completed. >> If you select "No", the message field in the bottom row switches to what you see in process 4. Select a new setting. 
9	After entering memory run conditions, perform an entry operations for User Name. (1) Press the ESC key. (2) When attaching User Name to the memory run conditions, select "Yes". 1 ENTER	>> When you press ESC key, the bottom row message is displayed. (1) A selection field as to whether User Name should be input or deleted appears.  (2) A selection field for selecting either inputting or deleting appears. 
	(3) Select "Inputting User Name". 1 ENTER (4) Enter 4 digits of the ID CODE that is already registered. □ □ □ □ ENTER ID code (5) Check User name and select "Yes". 1 ENTER	(3) The display switches to the ID CODE input field.  (4) The display switches to the User Name check field.  (5) The display switches to the Registration completion message field. 

10	Add Remark to the run conditions in the memory. (1) Press the ESC key. (2) To add Remark to the run conditions in the memory, select "Yes". 1 ENTER (3) Select "Inputting Remark". 1 ENTER (4) Enter Remark in 8 characters or less. (5) After entering the characters for Remark, move the cursor to SET and press the ENTER key to register the character string. (6) Check the contents of Remark and select "Yes". 1 ENTER	>> When you press ESC key, the bottom row message is displayed. (1) A selection field to input or delete Remark appears.  (2) A selection field to select either inputting or deleting appears.  (3) The display switches to the Remark registration field.  (4) Remark is entered from the left.  (5) The display switches to the Remark check field. (6) The display switches to the registration completion message field.

11	When the storing is over, press ESC key several times.	>> The first push on ESC key switches the message display in the bottom row to what you see in process 3 as shown below. To run this centrifuge, select Running.  >> Pushing ESC key a second time displays the Program Map screen shown in process 3.  • Make sure that the condition is stored in memory number 3. >> The third push on ESC key switches you back to the Run Screen (program screen).  >> The fifth push on ESC key switches you back to the Run Screen (FUNCTION field). 

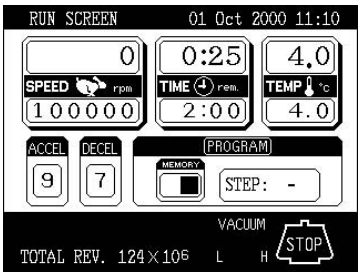
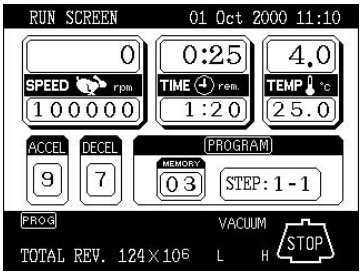
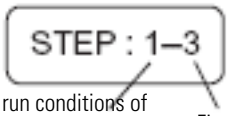
Note

1. If you make and store changes in a memory area that already stores run conditions, the previous conditions are replaced by the new conditions.
2. You cannot store a run condition while running (while the rotor is spinning). Always perform this function while not running.

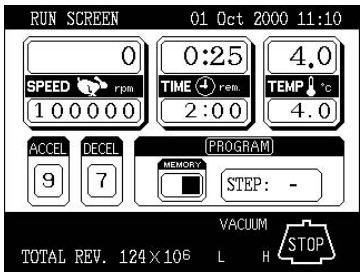
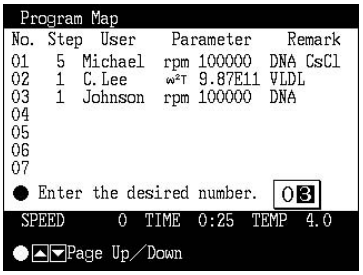
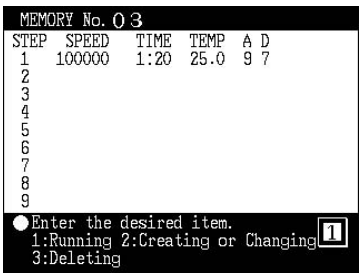
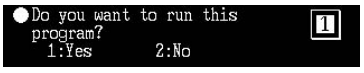
2. How to perform a programmed operation

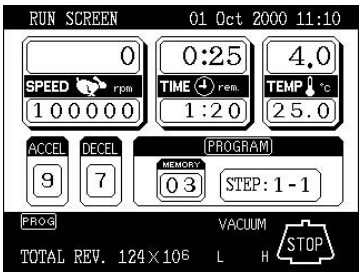
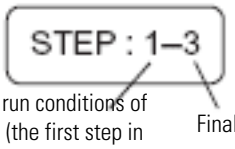
Shown below is how to perform a “programmed operation”, that is, how to recall a stored set of run conditions and run this centrifuge accordingly.

(a) If you know which memory unit number you need

Step	Key operation	Screen display and considerations
1	Turn on the POWER switch on the centrifuge.	>> The panel display appears. >> The door unlocks.
2	Install a rotor.	>> Install the rotor securely on the shaft.
3	While in the Run Screen, use cursor keys to move the cursor to PROG • RTC and then press ENTER key. Next, move the cursor to PROG and press ENTER key.	 • The FUNCTION 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 number 3, press 3	 • The run conditions in memory appear in the respective fields. >> The message field in the bottom row displays PROG. >> If the STEP field displays what is shown below, this means that the memory unit you have just called stores multiple run conditions (stepmode feature). For details, see Section Step-mode operation.  In the Run Screen, the run conditions of this step are displayed (the first step in this case). Final step >> The system only accepts numbers 1-20.
5	Run the centrifuge under normal operation without making changes to the run conditions.	>> Run this machine according to Normal operation. >> 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.

(b) 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.	>> The panel display appears. >> The door unlocks.
2	Install a rotor.	>> Install the rotor securely on the shaft.
3	While in the Run Screen, use cursor keys to move the cursor to PROG • RTC and then press ENTER key. Then, move the cursor to PROG and press ENTER key.	 • The FUNCTION 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.	 • The display switches to the Program Map screen and the MEMORY No. selection field blinks.
5	Use numeric keys to enter the memory number where you have stored data. To call memory number 3, press 3 ENTER	 • The image of the specified memory number appears. >>If the contents of the memory number you have just recalled is not what you want, press ESC to switch back to the Program Map screen and then call another memory unit number.
6	If you get the memory number you want, select Running. 1 ENTER	 • The message field in the bottom row switches to what you see below.

7	To run the centrifuge, select "Yes". Yes 1 ENTER No 2 ENTER	>> If you select "Yes"  • The display switches back to the Run Screen. • The run conditions in memory appear in the respective fields. >> 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 Section Step-mode operation.  In the Run Screen, the run conditions of this step are displayed (the first step in this case). Final step >> If you select "No", the message field in the bottom row displays what you see in process 5. Select a new condition.
8	Start running the centrifuge under normal operation with no changes made to the run conditions.	>> Run this machine according to Section Normal operation. >> If you make changes to the run conditions (such as SPEED and TIME) after recalling a program, the program you have just recalled will be canceled. You must recall the program again to use it.

Note

1. To check the contents (run conditions) of the memory number for the program while in running, follow processes 3 through 5 in (b) "If you do not know which memory unit 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 Section RTC (real-time control) feature), first recall 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, you cannot recall the program memory after setting RTC.

Step-mode operation

This ultracentrifuge incorporates a step-mode operation feature, which stores two or more 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. This section explains how to make settings by showing some examples.

(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	100,000 rpm	90,000 rpm	80,000 rpm
Run time	3 h	2 h	1 h
Temperature	20 C	20 C	20 C
Acceleration mode	9	9	9
Deceleration mode	9	9	7

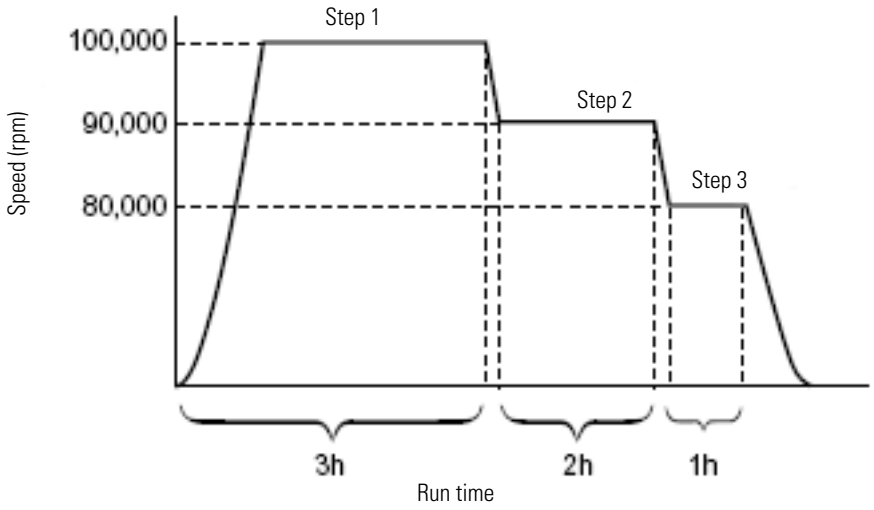
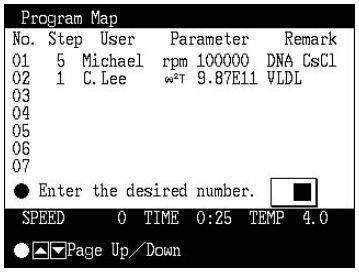
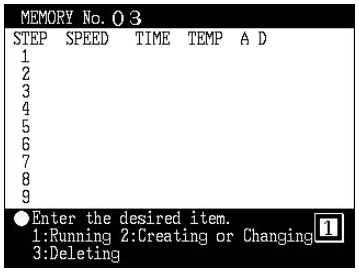
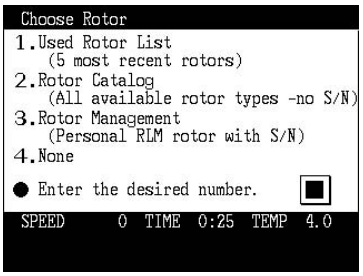
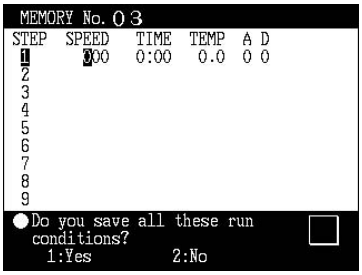
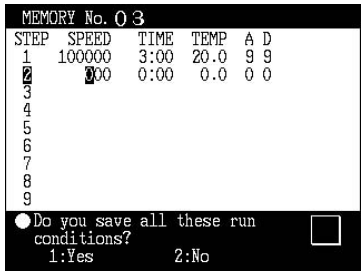
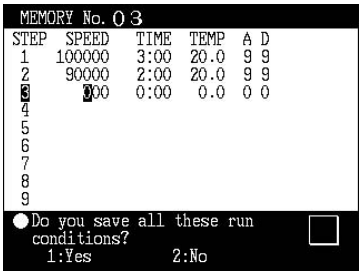


Figure 2-13 A typical step-mode run

Step	Key operation	Screen display and considerations
1	While in the Run Screen, use the cursor keys to move the cursor to PROG • RTC and press ENTER key. Then move the cursor to PROG and press ENTER key.	 • The FUNCTION 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.	 • The display switches to the Program Map screen and the MEMORY No. selection field blinks. • To store a new condition, enter it into an empty memory number.
3	Use numeric keys to enter the memory unit number you want to store. To store data in memory number 3, press 3 ENTER	 • The image of the specified memory number appears.

4	Select "Creating or Changing." 2 ENTER	 • The message field in the bottom row switches to what you see on your left-hand side.
5	Enter a desired condition. To select SPEED, press 1 ENTER	 • The display switches to the Choose Rotor screen.
	To select no rotor, press. 4 ENTER	 • The display switches to the SPEED priority setting field and the SPEED area blinks. >> To select and enter RCF_{max} or RCF_{avg}, see Section 1. Programming procedure for run conditions (creating or changing)
6	Specify run conditions for step 1. 1 0 0 0 3 2 0 9 9 Downward cursor key	 • 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. 9 0 0 2 2 0 9 9 Downward cursor key	 • The entry of run conditions for step 2 is complete.

8	Lastly, specify run conditions for step 3. 8 0 0 ● 1 ● 2 0 ● 9 ● 7 ▼ Downward cursor key	MEMORY No. 0 3 STEP SPEED TIME TEMP A D 1 100000 3:00 20.0 9 9 2 90000 2:00 20.0 9 9 3 80000 1:00 20.0 9 7 4 300 0:00 0.0 0 0 5 6 7 8 9 ●Do you save all these run conditions? 1 1:Yes 2:No • The entry of run conditions for step 3 is complete and step 4 is ready for input.
9	Press the downward cursor key ▼ to blink the value part of the message field in the bottom row. Then select "Yes". Yes 1 ENTER No 2 ENTER	>> If you select "Yes": ●These run conditions have been saved. If you select "No", the message field in the bottom row switches to what you see in process 4. Input a new setting. ●Select the desired setting parameter. 1 1:SPEED 2:RCFmax 3:RCFavg 4:ω²T
10	After entering step-mode run conditions, perform an entry operations for User Name. (1) Press the ESC key. (2) When attaching User Name to the memory run conditions, select "Yes". 1 ENTER (3) Select "Inputting User Name". 1 ENTER (4) Enter 4 digits of the ID CODE that is already registered. □□□□ ENTER ID code (5) Check User Name and select "Yes". 1 ENTER	>> When you press ESC key, the bottom row message is displayed. (1) A selection field as to whether User Name should be input or delete appears. ●Do you input or delete your User Name? 1 1:Yes 2:No (2) A selection field for selecting either inputting or deleting appears. ●Enter the desired item. 1 1:Inputting User Name 2:Deleting User Name (3) The display switches to the ID CODE input field. ●Input your ID Code. (4) The display switches to the User Name check field. ●User Name: Johnson Is this User Name yours? 1 1:Yes 2:No (5) The display switches to the Registration completion message field. ●User Name: Johnson It has been input.

<table>
<tr>
<td>11</td>
<td>Add Remark to the run conditions in the memory.
(1) Press the ESC key.

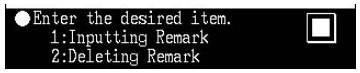
(2) To add Remark to the run conditions in the memory, select “Yes”.
1 ENTER

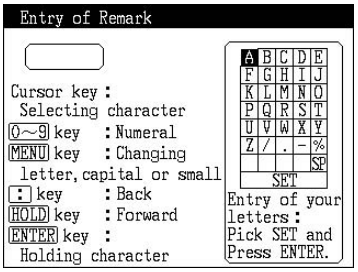
(3) Select “Inputting Remark”.
1 ENTER

(4) Enter Remark in 8 characters or less.

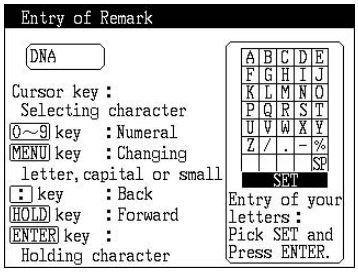
(5) After entering the characters of Remark, move the cursor to SET and press the ENTER key to register the character string.

(6) Check the contents of Remark and select “Yes”.</td>
<td>>> When you press ESC key, the bottom row message is displayed.
(1) A selection field to input or delete Remark appears.

(2) A selection field to select either inputting or deleting appears.
 

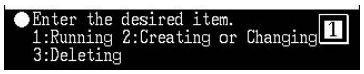
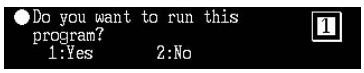
(3) The display switches to the Remark registration field.
 

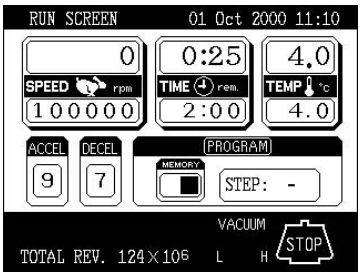
• The message field in the bottom row switches to what is shown in the diagram on your lefthand side, and the storing of the run conditions in the appropriate memory number is completed.

(4) Remark is entered from the left.
 

(5) The display switches to the Remark check field.

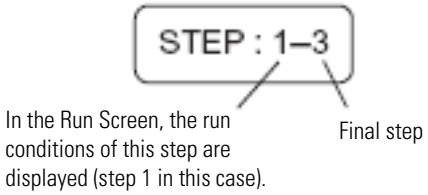
(6) The display switches to the registration completion message field.

</td>
</tr>
<tr>
<td>12</td>
<td>Press ESC key when the storing is over.
ESC</td>
<td> 
</td>
</tr>
<tr>
<td>13</td>
<td>Select “Running”.
1 ENTER</td>
<td> 
</td>
</tr>
</table>

14	To run the centrifuge, select Yes. Yes 1 ENTER No 2 ENTER	>> If you select "Yes":  • 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. >> If you select "No", the message field in the bottom row displays what you see in process 10. Make the selection again.
15	Start running the centrifuge under normal operation with no changes made to the operational conditions.	>> Run the centrifuge according to Normal operation. >> 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.

1. Step display

The PROGRAM field displays steps as follows:



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

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

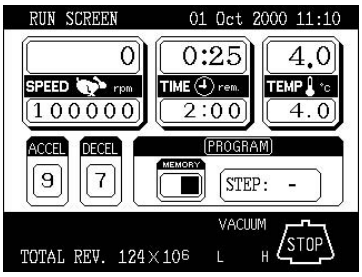
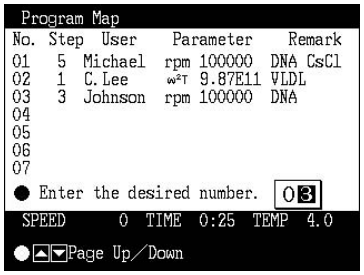
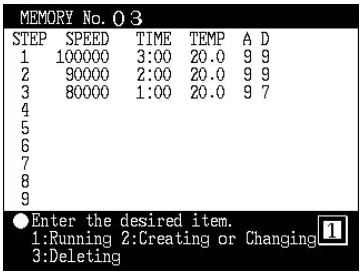
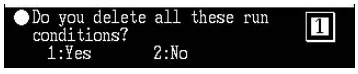
Thus, you can see at a glance how many steps are stored in the specified memory and which step the centrifuge is following.

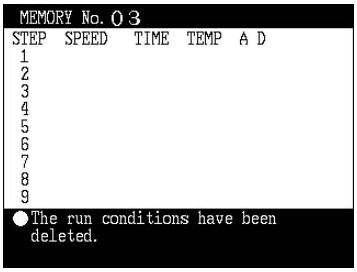
2. While the instrument is running (while the rotor is spinning), you cannot store a stepmode run condition. Always perform this function while not in running.
3. To check the contents (run conditions) of a step-mode program memory number, follow processes 1 through 3. To get back to the Run Screen after the check, press ESC key.
4. To perform a combination of a step mode run with an RTC (real-time control) run (see Section RTC (real-time control) 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 number 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 the instrument is running, you cannot delete a program memory number.

Step	Key operation	Screen display and considerations
1	While in the Run Screen, use cursor keys to move the cursor to PROG • RTC and press ENTER key. Then move the cursor to PROG and press ENTER key.	 • The FUNCTION 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.	 • The display switches to the Program Map screen and the MEMORY No. field blinks.
3	Use numeric keys to enter the memory unit number you want to delete. To delete memory unit 3, press 3 ENTER	 • The image of the memory unit you have just specified appears.
4	Select “Deleting”. 3 ENTER	 • The message field in the bottom row switches to what you see on your left.

5	To delete this memory number, select Yes. Yes 1 ENTER No 2 ENTER	>> If you select "Yes".  • The system deletes all run conditions in memory number 3. (While in step mode, all steps get deleted.) >> If you select "No", the screen switches to what you see in process 3. Make the selection again.
6	Press ESC several times to move back to the Run Screen.	>> If you delete a memory number, you can no longer run the centrifuge according to that number.

(3) Other procedures

1. Making changes to the run conditions
   Call the memory number you want to make changes to and make the changes. Alternatively, 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 number 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 number that contains multiple steps.
   Store (register) run conditions for the intermediate step and later steps in another memory number. Then recall the memory number 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 detect it in the step 1 run and display the "SPEED" alarm.
   Double-check the speed of all steps and correct any wrong ones.

4. Stopping the centrifuge in operation
   Press STOP. The rotor stops and the system does not move to the next step.

RTC (real-time control) feature

The Sorvall WX Ultra series ultracentrifuges contain an internal clock, allowing you to run the machine at a specified start or finish time for centrifugation. This feature for running the machine at a specified time is called the RTC (real-time control) feature.
Below is an example of how to perform an RTC run.

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

1. Rotor: T-8100
2. RPM: 100,000 rpm
3. Separation time: 4 hours

4. Control temperature: 4 °C
5. Acceleration mode: 9
6. Deceleration mode: 7

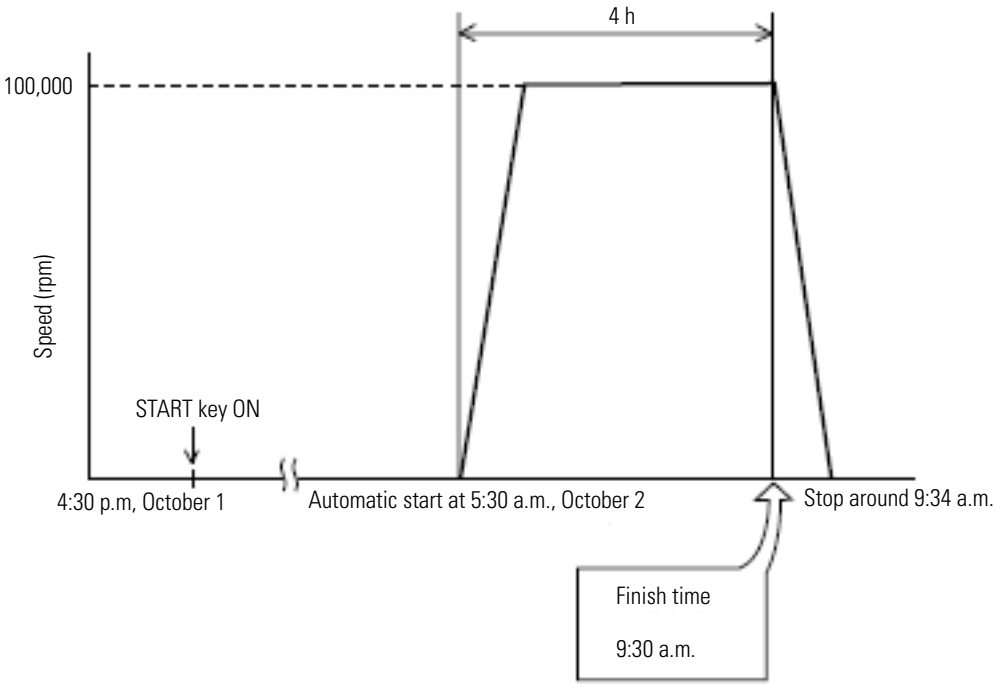
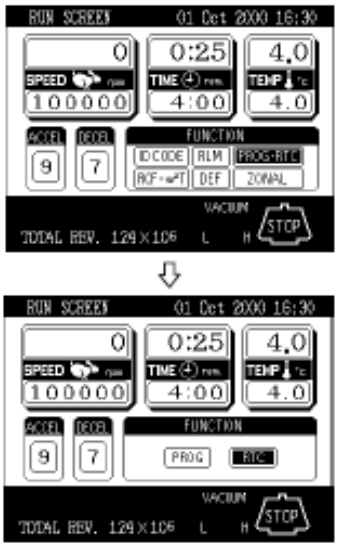
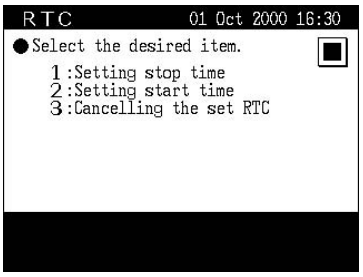
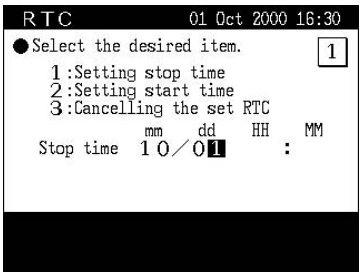
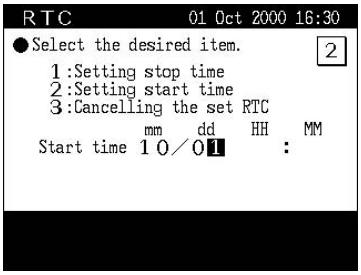
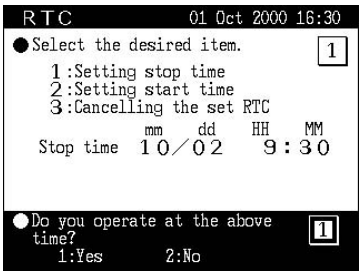
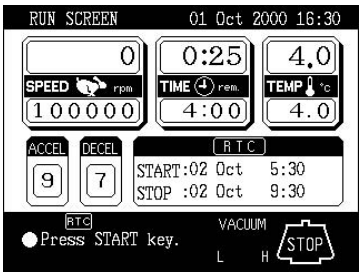


Figure 2-14 A typical RTC run

In this example, you set the above run conditions (2) through (6), set the finish time for RTC run to 9:30 a.m., October 1 and start the centrifuge.
(You can make an identical setting by setting the start time to 5:30 a.m. instead of setting the finish time to 9:30 a.m.)

1. How to perform an RTC run

Step	Key operation	Screen display and considerations
1	Set operational conditions while in the Run Screen. Use cursor keys to enter the SPEED part into an input wait, then press 1 0 0 0 ● 4 ● 4 ● 9 ● 7 ● ● ● Move the cursor to PROG • RTC and press ENTER key. ENTER	
2	Move the cursor to RTC and press ENTER key. ● ENTER	 • The display switches to the RTC Setup screen.
3	Select the item you wish to set. To select the “Setting stop time”, press 1 ENTER	>> Setting the “Setting stop time”  • The “dd” item blinks. “mm” and “dd” indicate the current date as a default. >> Setting the “Setting start time”  • 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.

4	Use cursor keys and numeric keys to enter month, day, hours, and minutes. Then, press ENTER key.	 • Blink the PROG • RTC in the FUNCTION field. • To specify the run time (centrifugation time), do not set HOLD. Use ten keys to enter the run time instead. >> 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 ahead.
5	If you are sure that you have made the correct settings, select Yes. Yes 1 ENTER No 2 ENTER	>> If you select "Yes"  • 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	Check the RTC setting in the Run Screen, then press START key. The RTC run does not get activated unless you press START key.	>> Run this machine according to Section Normal operation. >> 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" (and vacuum comes on), condition causing the centrifuge to wait until the set time comes. This centrifuge will turn the rotor automatically at the specified time and run it for the specified period. • The run mode in the message display field switches to "DELAY".

1. For an RTC run, the run mode indicator on the display panel displays the following:

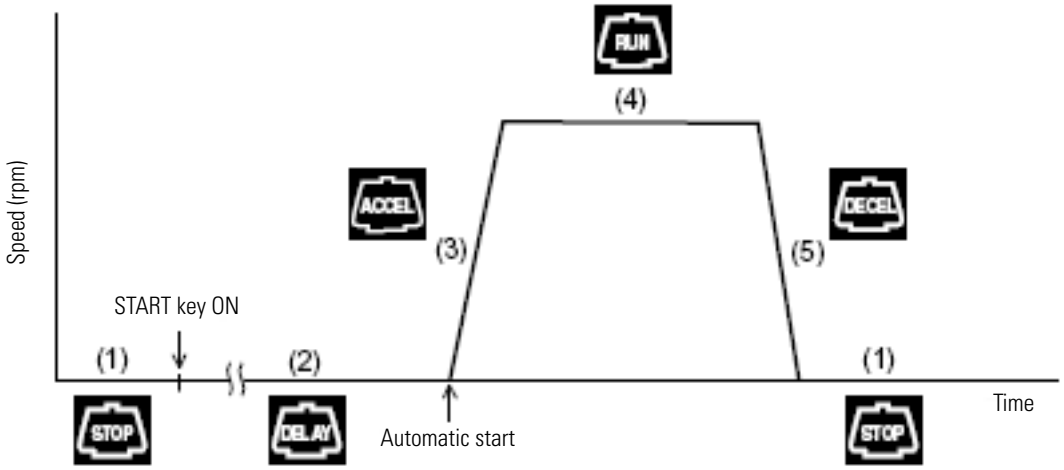
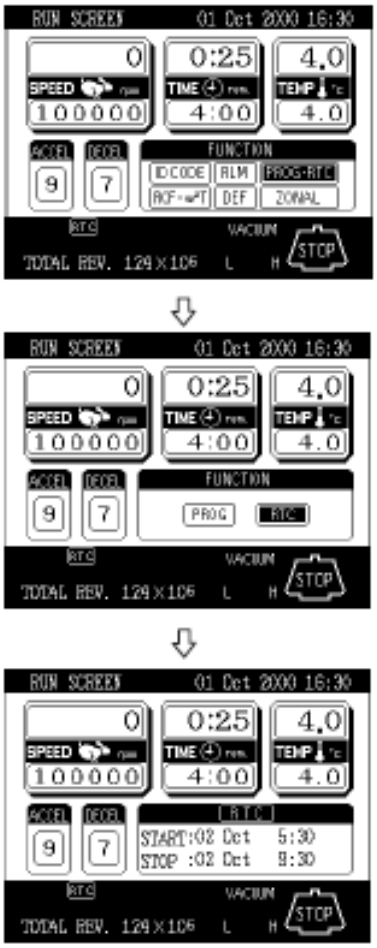
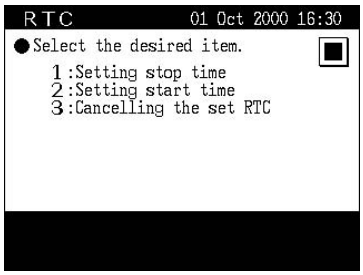


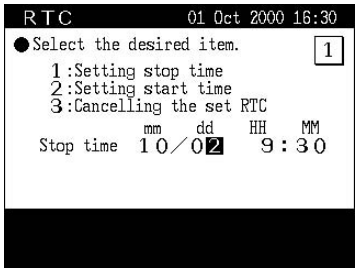
Figure 2-15 Run mode display (RTC)

2. You cannot make an RTC setting in any of the following cases:
   a. When the Run Screen is set to HOLD (continuous run)
      Set the run time (centrifugation time) not to HOLD but to a numerical value.
   b. When it is past the start time
      Set the start time to a time later than the current time.
   c. 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 recall 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.

Making changes to 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.

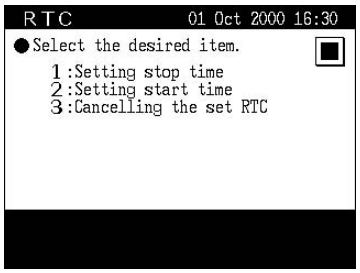
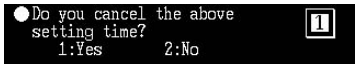
Step	Key operation	Screen display and considerations
1	(1) While in the Run Screen, use cursor keys to move the cursor to PROG • RTC and then press ENTER key. (2) Use cursor keys to move the cursor to RTC and then press ENTER key.	 • The FUNCTION field switches to the RTC field. >> The message indicator displays RTC.
2	Press cursor keys to blink RTC and then press ENTER key. ENTER	

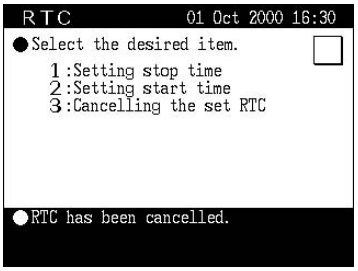
3	Making a change to date and time settings (1) Select "Setting stop time" or "Setting start time". To change the "Setting stop time", press 1 ENTER	 • The screen switches to a screen where you can enter a stop time (or start time).
	(2) Perform process 4 and later ones in 1. How to perform an RTC run mentioned above and change the date and time settings.	See Section 1. How to perform an RTC run.

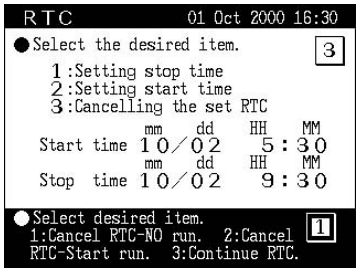
Canceling the RTC settings

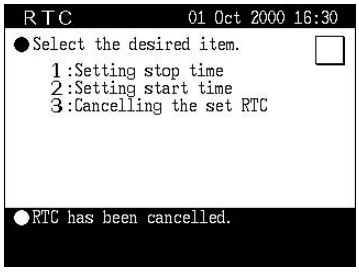
The canceling procedure varies depending on whether the RTC run is started (START is pressed) or not.

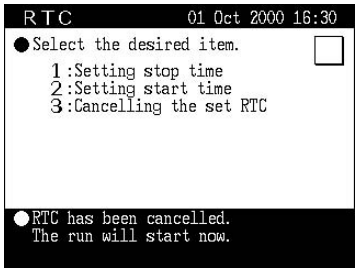
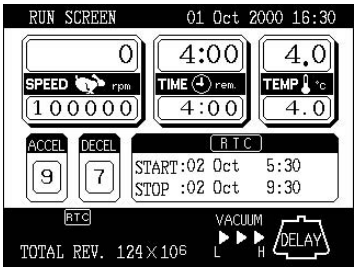
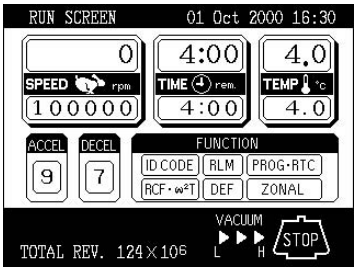
Step	Key operation	Screen display and considerations
1	(1) While in the Run Screen, use cursor keys to move the cursor to PROG • RTC and then press ENTER key. (2) Use cursor keys to move the cursor to RTC and then press ENTER key.	 • The FUNCTION field switches to the RTC field. >> The message indicator displays RTC.

<table>
<tr><td>2</td><td>Press cursor keys to blink RTC and then press ENTER key.
 </td><td> 
</td></tr>
<tr><td rowspan="3">3</td><td>[Before starting the RTC run]
(1) Select “Deleting the set RTC”.
 </td><td> 

• The message indicator in the bottom row changes.</td></tr>
<tr><td>(2) Select “Yes”.
 </td><td>>>If you select “Yes”
 

• The RTC setting has been canceled.
>> If you select “No”, you will get the display you see in process 2. Make a selection again.</td></tr>
<tr><td>[After starting the RTC run]
(1') Select “Deleting the set RTC”.
 </td><td> 

• The message indicator in the bottom row changes.</td></tr>
<tr><td>(2') i) Select “Cancel RTC-NO run”.
 </td><td> 
</td></tr>
</table>

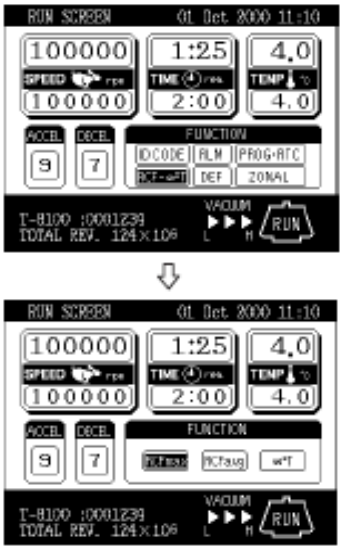
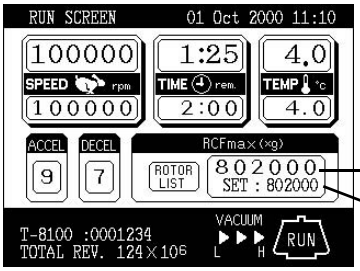
	ii) Select “Cancel RTC-Start run”. 2 ENTER	
	iii) Select “Continue RTC”.	
	(3) Press ESC after process (2') i) or ii). ESC	 • The display switches back to the Run Screen. >> The RTC in the message indicator in the bottom row disappears.

Displaying and setting RCF

This 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. Given below is a description of how to display and set RCF.

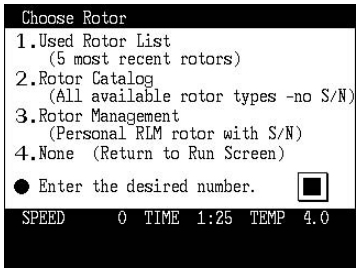
1. How to display an RCF value

- When the rotor to be used is already identified (when rotor type is displayed in the message display field)

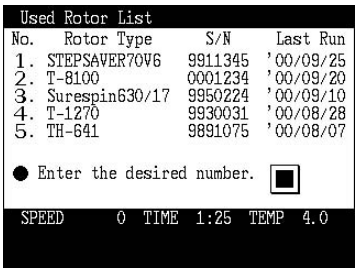
Step	Key operation	Screen display and considerations
1	While in the Run Screen, set a speed.	>> See Section Setting run conditions.
2	Use cursor keys to move the cursor to RCF • ω^2T and press ENTER key.	 • The FUNCTION field switches to what is shown in the diagram to the left, and the RCF_{max} field blinks.
3	Move the cursor to RCF_{max} (or RCF_{avg}) and press ENTER key.	 • The RCF display field displays the RCF value of the rotor. RCF display field RCF setting field >> The RCF value associated with the set speed you have just entered in process 1 appears in the RCF setting field.

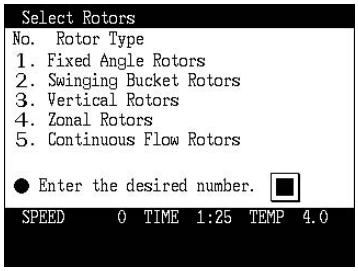
Note Press ESC key to cancel the RCF field.

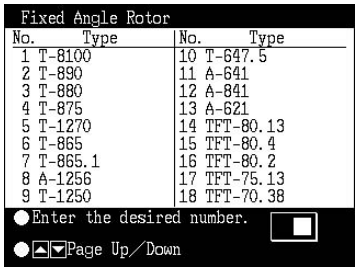
- When the rotor to be used is not identified (when rotor type is displayed in the message display field)

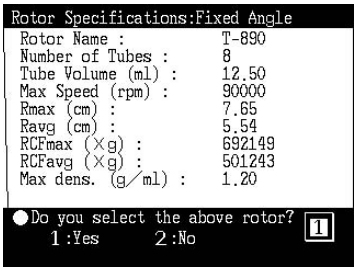
Step	Key operation	Screen display and considerations
1	Set the speed on the Run Screen.	>> See Section Setting run conditions.
2	(1) Use cursor keys to move the cursor to RCF • ω^2T and press the ENTER key. (2) Use cursor keys to move the cursor to RCF_{max} (or RC F_{avg}) and press the ENTER key.	 • The contents of the display in the FUNCTION field change. • The RCF_{max} area blinks. • The FUNCTION field switches to the RCF field. • ROTOR LIST blinks.
3	Check that ROTOR LIST blinks and press the ENTER key. ENTER	

<table>
<tr>
<td rowspan="4">4</td>
<td>Select a desired rotor. To select a desired rotor from the “Used Rotor List”:

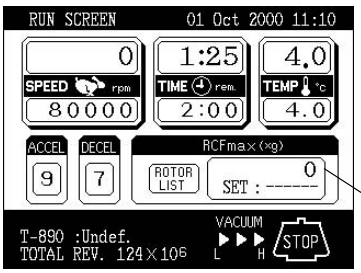
1 ENTER</td>
<td> 
</td>
<td>• The display switches to the Used Rotor List screen.
• You can search for the rotor number you need in the order starting with the latest date/time.</td>
</tr>
<tr>
<td>To select a desired rotor from the “Rotor Catalog”:
(1) Select “Rotor Catalog”.

2 ENTER</td>
<td> 
</td>
<td>• The display switches to the Rotor List screen.</td>
</tr>
<tr>
<td>(2) Select Fixed Angle Rotors in the rotor types.
(When using fixed angle rotor T-890)

1 ENTER</td>
<td> 
</td>
<td>• The fixed angle rotor list is displayed.</td>
</tr>
<tr>
<td>(3) Select fixed angle rotor T-890.

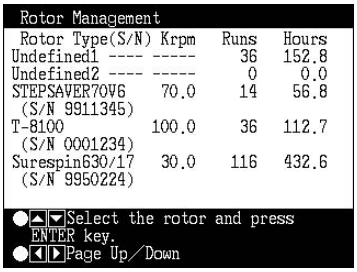
2 ENTER</td>
<td> 
</td>
<td>• The specifications of the T-890 rotor are displayed.

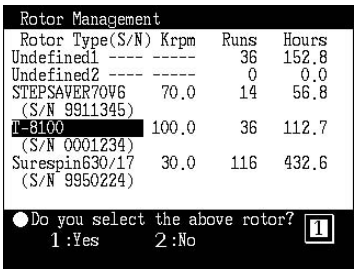
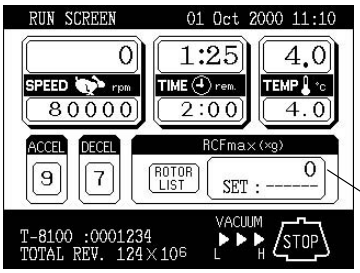
• The display switches to the Choose Rotor screen.</td>
</tr>
<tr>
<td>4</td>
<td>(4) After checking the specifications of the rotor, select “Yes”.

1 ENTER</td>
<td>>> When you select “Yes”
 

RFC display field
• The RCF value of the running rotor is displayed in the RCF display field.

>> When you select “No”, the display goes to the same as the display of process 4 (2).</td>
<td>• The display switches back to the Run Screen and the selected rotor type is displayed in the message display field of the bottom row.</td>
</tr>
</table>

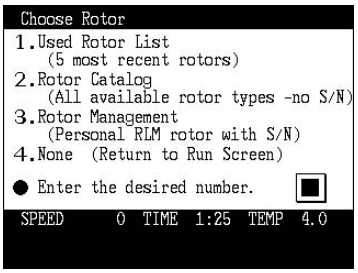
<table>
<tr>
<td>4</td>
<td>To select a desired rotor from the “Rotor Management”:
(1') Select “Rotor Management”.
3 ENTER</td>
<td> 

• The display switches to the Rotor Management screen and the Rotor List is displayed.</td>
</tr>
<tr>
<td></td>
<td>(2') Select a desired rotor using the upward or downward cursor key
.
(When using fixed angle rotor T-8100)
ENTER</td>
<td> 
</td>
</tr>
<tr>
<td></td>
<td>(3’) Select “Yes”.
1 ENTER</td>
<td> 

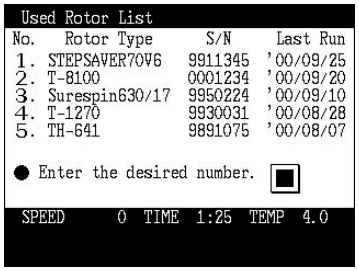
RFC display field
• The display switches back to the Run Screen and the selected rotor type is displayed in the message display field of the bottom row.
>> The RCF value of the running rotor is displayed in the RCF display field.</td>
</tr>
</table>

How to set an RCF value

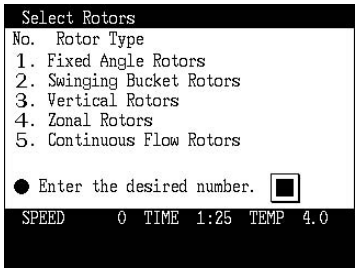
Enter a rotor number and an RCF value, and the machine will calculate, set, and display the speed. Shown below is the procedure.

Step	Key operation	Screen display and considerations
1	While in the Run Screen, set a speed.	>> See Section Setting run conditions.
2	(1) While in the Run Screen, use cursor keys to move the cursor to RCF • ω^2T and press ENTER key. (2) Move the cursor to RCF_{max} (or RCF_{avg}) and press ENTER key.	 • The FUNCTION field switches to what is shown in the diagram to the left. • The RCF_{max} field blinks. • The FUNCTION field switches to the RCF field. • The ROTOR LIST field blinks.
3	Check that ROTOR LIST blinks and press the ENTER key.	 • The display switches to the Choose Rotor screen.

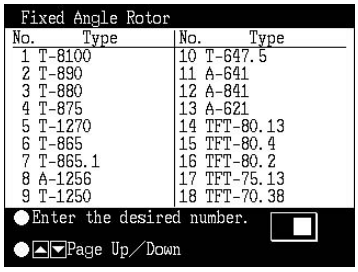
<table>
<tr><td rowspan="4">4</td><td>Select a desired rotor.
To select a desired rotor from the “Used Rotor List”:
(1) Enter No. that is found in the Rotor List.

1 ENTER</td><td> 

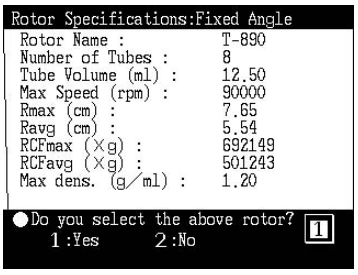
• The display switches to the Used Rotor List screen.
• You can search for the rotor number you need in the order starting with the latest date/time.</td></tr>
<tr><td>To select a desired rotor from the “Rotor Catalog”:
(1)' Select “Rotor Catalog”.

2 ENTER</td><td> 

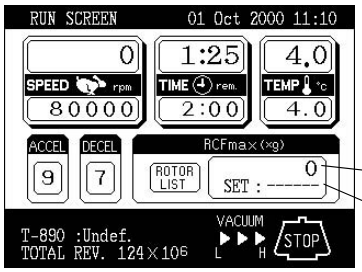
• The display switches to the Rotor List screen.</td></tr>
<tr><td>(2)' Select Fixed Angle Rotors in the rotor types.
(When using fixed angle rotor T-890)

1 ENTER</td><td> 

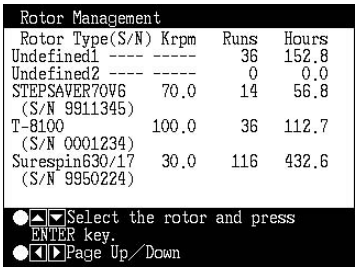
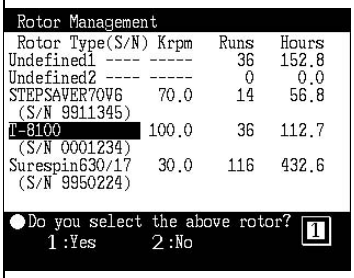
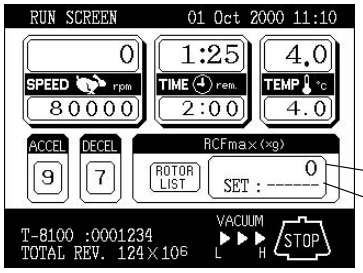
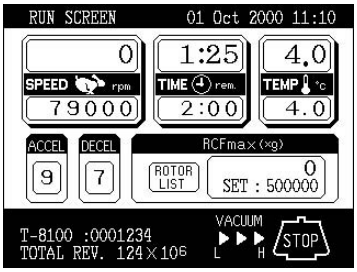
• The angle rotor list is displayed.</td></tr>
<tr><td>(3)' Select fixed angle rotor T-890.

3 ENTER</td><td> 

• The specifications of the T-890 rotor are displayed.</td></tr>
<tr><td></td><td>(4') After checking the specifications of the rotor, select “Yes”.

1 ENTER</td><td>>> When you select “Yes”
 

• The display switches back to the Run Screen and the selected rotor type is displayed in the message display field of the bottom row.
RCF display field
RCF setting field
>> The RCF value corresponding to the currently set speed is displayed in the RCF setting field.
(--- --- --- --- --- ---: Displayed at the initial time of no setting.)
>> When you select “No”, the display goes to the same as the display of process 4 (2'). Perform setting again.</td></tr>
</table>

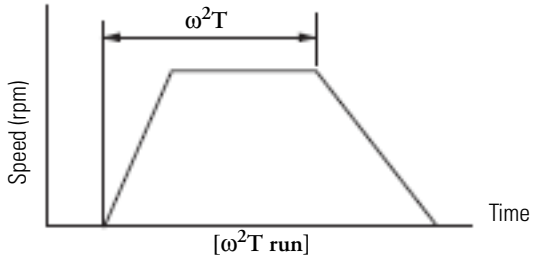
4	To select a desired rotor from the "Rotor Management": (1) Select "Rotor Management". 3 ENTER	 • The display switches to the Rotor Management screen and the Rotor List is displayed.
	(2) Select a desired rotor using the upward or downward cursor key (When using fixed angle rotor T-8100) ENTER	
	(3) Select "Yes". 1 ENTER	 • The display switches back to the Run Screen and the selected rotor type is displayed in the message display field of the bottom row. RCF display field RCF setting field >> The RCF value corresponding to the currently set speed is displayed in the RCF setting field. (--- --- --- --- --- ---: Displayed at the initial time of no setting.)
5	Use cursor keys to move the cursor to the RCF setting field, and enter a desired centrifugal force. Example: RCFmaX = 5000 x 100g 5 0 0 0 ENTER	 • The value you have just entered appears in the RCF setting field. • Based on the rotor and RCF value, the system automatically calculates the speed and displays it in the SPEED display field. • Specify the RCF value to hundreds. 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.

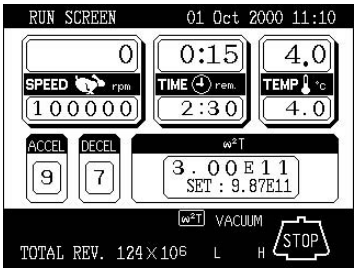
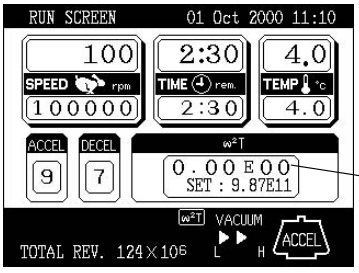
Note

1. Press ESC key to cancel the RCF field.
2. When you run this centrifuge at a speed determined based on an RCF value, a slight rounding may occur (of up to 2%) between the set RCF value and the actual value, because the speed setting is set in increments of 100 rpm.

Setting ω^2T

This machine is provided with a function to perform an ω^2T run. To perform an ω^2T run, set the ω^2T value instead of the run time.



Step	Key operation	Screen display and considerations
1	Set the Speed in the Run Screen.	>> See Section Setting run conditions.
2	(1) Use cursor keys to move the cursor to RCF • w²T on the Run Screen and press the ENTER key. (2) Use cursor keys to move the cursor to w²T and press the ENTER key.	 • The contents of the display in the FUNCTION field change. • ω²T blinks. • The FUNCTION field switches to the ω²T field. ω²T display field ω²T setting field
3	Use cursor keys to move the cursor to the w²T setting field and enter a desired w²T value. Example: 9.87 x 1011 9 ⁄: 8 7 ● 1 1 ENTER	 • The value you entered is displayed in the ω²T setting field. • The time value is calculated from the speed and the ω²T value and the run time is displayed in the Time Setting field.
4	When you press START key, the machine starts to perform an w²T run.	 • Arithmetic and integral operations are performed in the ω²T display field. **ω²T display field**

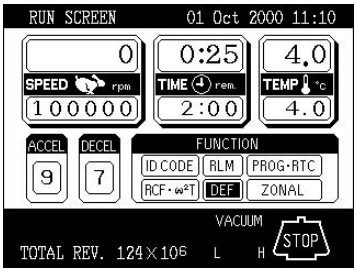
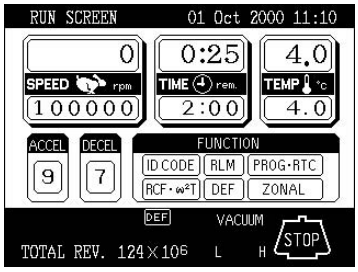
Note When the ω^2T display field reaches the set value of ω^2T, the machine decelerates and stops. During deceleration, the ω^2T display field continues to accumulate value until the rotor stops and the run ends.

Defrost function

If the chamber door is left open between low temperature runs, moisture from the ambient air humidity can condense (and even freeze) on the cold evaporator chamber walls. The potential for condensation increases as the ambient air temperature and humidity increases. If a run is performed with a significant amount of moisture in the evaporator chamber, the length of time required to reach a high vacuum will be increased.

To minimize condensation, when the evaporator chamber is cold, we recommend that you keep the chamber door closed as much as possible. If moisture does accumulate, before performing the next run, we recommend that you wipe the chamber dry. For situations where condensation has frozen to the chamber walls, a defrost function is provided as a convenient means to melt ice buildup so that the moisture can then be removed.

How to use the defrost function:

Step	Key operation	Screen display and considerations
1	Use cursor keys to move the cursor to DEF on the Run Screen.	 • Use cursor keys to highlight the DEF function.
2	With DEF highlighted, press the ENTER key.	 • DEF blinks in the message field to notify that a defrost operation and vacuum has started. • Vacuum indicators will also be displayed.

Defrost operation will heat the evaporator gradually and after the lapse of 10 minutes, the defrost operation and vacuum ends automatically. (After the end of the defrost operation, the DEF display in the message field disappears.) During the defrost operation, DEF in the message display field in the bottom row on the Run Screen blinks. To abort or end the Defrost Function, highlight DEF and press ENTER. To turn off vacuum, press vacuum key.

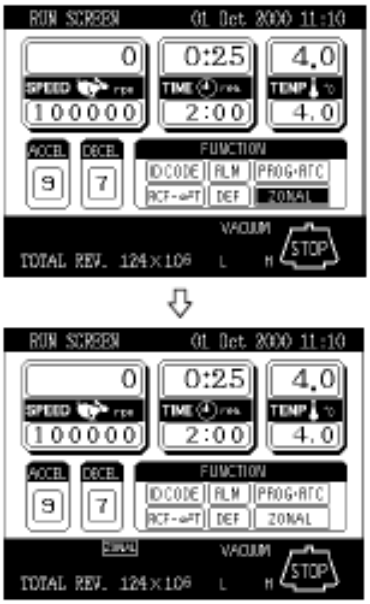
Note

1. Before starting defrost operations, wipe away any moisture and close the door.
2. The temperature rise of the rotor due to defrost operations (for 10 minutes) should be 1 C or less.
3. During rotor acceleration or at set speed, defrost can be set but the defrost function is not available.
4. If DEF is selected during accel or set speed, it will not function until the run times out or stop is pressed.

Setting and resetting zonal operation

Selection between normal operation and zonal operation is performed by special operations using the FUNCTION field on the Run Screen.

1. Setting zonal operation

Step	Key operation	Screen display and considerations
1	On the Run Screen, use cursor keys to move the cursor to ZONAL in the FUNCTION field, and press 3 0 ENTER or 3 0 ENTER	 • ZONAL is displayed in the message field so that the machine is ready to start zonal operation.

2. Resetting zonal operation

Step	Key operation	Screen display and considerations
1	On the Run Screen, use cursor keys to move the cursor to ZONAL in the FUNCTION field, and press 0 0 ENTER or 0 0 ENTER	 • ZONAL in the message field disappears and the machine status switches to normal operation.

Note If no key operation is performed for 30 seconds, the cursor disappears and any entry is disabled. At that time, press the cursor key to cause the cursor to blink once again.

Rotor management

It is very important to manage the life of each rotor you use with the ultracentrifuge. The warranted life of the rotor is different depending on the type of rotor, the material the rotor is fabricated from and the policy of the manufacturer of the rotor. The warranted life of a Thermo Ultracentrifuge rotor is defined by a maximum number of runs. Other manufacturers use a combination of either the maximum number of runs or a maximum number of hours to limit the warranted life of the rotor.

For some rotors, there exists a primary and a secondary life. The primary life is defined as the initial usage at speeds up to the maximum rated speed of the rotor. Once this primary life is expended, the rotor has a secondary life at speeds up to a derated maximum speed of the rotor-typically 90% of the initial maximum rated speed.

Rotor life management

In order to comply with warranty requirements, rotor use must be documented in a rotor log book provided with the ultracentrifuge.

Additionally, the Sorvall WX Ultra series ultracentrifuges have the capability to keep track of the number of runs and hours of use for each rotor. This information can be used to automatically notify the user of the need for deration at the end of the primary life and to preclude the use of rotors once their warranted life as defined by these parameters have come to an end.

To utilize this feature, each time a rotor is used it must be recorded by the ultracentrifuge. To do this, a rotor must be initially registered in the Rotor Management software. Each time the rotor is used in the Sorvall WX Ultra series ultracentrifuge, it must be selected from the Rotor Management Screen prior to starting the run. Additionally, should the rotor be used in other ultracentrifuges, the Rotor Management information can be edited to record this usage. Rotors may also be deleted from the Rotor Management Screen if they are no longer to be used.

If you use the rotor beyond its maximum permitted life, a serious accident may occur. (For more information, see rotor instruction manual.)

Automatic rotor deration

You can register a rotor in the ultracentrifuge before use. After the rotor has been registered, you can utilize the rotor management feature of the ultracentrifuge each time a run is made using the rotor. When the registered rotor comes close to the end of its life, the ultracentrifuge indicates it by displaying a message on the screen. When the rotor reaches its primary life, the ultracentrifuge derates its maximum permitted speed and inserts [] at the right side of the rotor S/N. Once the maximum permitted speed is derated, the actual speed of the rotor is automatically restricted within the new limits.

Note The rotor life management data stored in the ultracentrifuge is not covered by the warranty. When a rotor is used with the ultracentrifuge, be sure to record the rotor management data in the rotor log book. (You can also paste a printout in the log book.) If the rotor log book is not maintained correctly, the rotor will not be warranted.

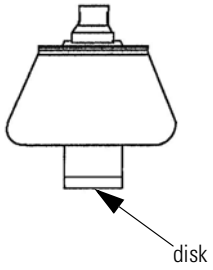
Automatic rotor exclusion

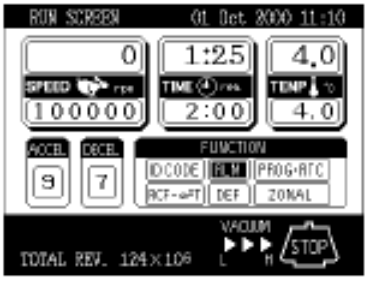
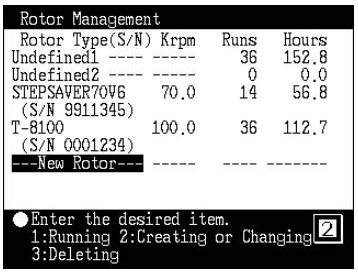
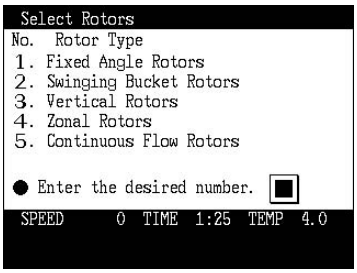
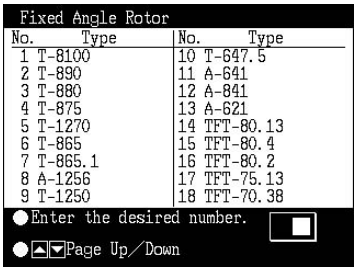
When a registered rotor reaches the end of its life, the ultracentrifuge indicates it by displaying a message on the screen. Subsequent runs of this registered rotor are precluded.

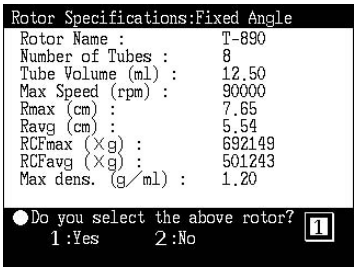
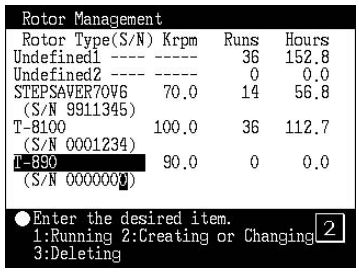
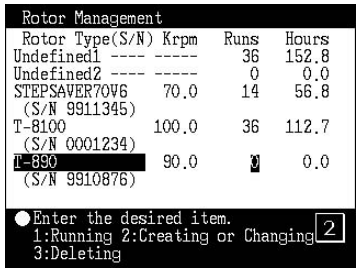
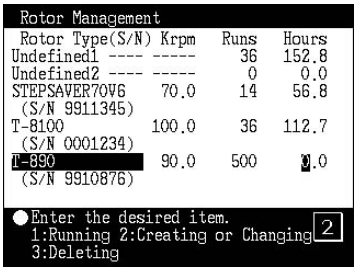
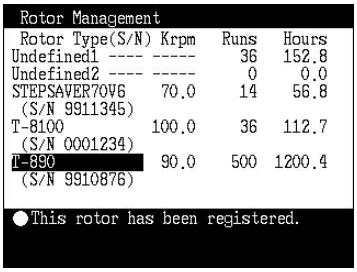
Registering a rotor

A standard rotor can be registered when you use the rotor management feature of the ultracentrifuge. If the rotor has not been registered, the feature does not operate for the rotor. To register a rotor, use the procedure described below.

As an example, suppose that you need to register a fixed angle rotor with the following data, and that it has been used with an ultracentrifuge of a different model from the one mentioned below:
Model: T-890 Serial number: 9910876
Total number of runs thus far made: 500
Total number of hours thus far spent in the runs: 1200 hours, 24 minutes



Step	Key operation	Screen display and considerations
1	While in the Run Screen, use the cursor keys to move the cursor to RLM and press ENTER key. Switch each page of the Rotor List by using the left and right arrow keys (and).	 • The display switches to the Rotor Management screen and the Rotor List is displayed.
2	Use the cursor keys (and) to move the cursor to the line that is not yet registered (New Rotor), and press the ENTER key.	
3	Select “Creating or Changing”. 2 ENTER	 • The display switches to the Rotor List screen.
4	Select “Fixed Angle Rotor” in the Rotor List screen. 1 ENTER	 • The display switches to the Fixed Angle Rotor List screen

5	Select “T-890” rotor. 2 ENTER		• Specifications of the T-890 rotor are displayed.
6	After checking the specifications of the rotor, enter “Yes”. 1 ENTER		• The display switches to the Rotor Management screen. • You can enter a serial number of the rotor.
7	As the cursor has been moved to the S/N field, enter serial No. of the rotor by using numeric keys. (Do not press the ENTER key.) 9 9 1 0 8 7 9 Registration of an unused rotor is finished by pressing the ENTER key.		• The cursor moves to the Runs field. You can enter the total number of runs.
8	Enter the total number of runs in the Runs field. (Do not press the ENTER key.) 5 0 0		• The cursor moves to the Hours field. You can enter the number of hours.
9	Enter the total number of hours in the Hours field by using numeric keys. (Do not press the ENTER key.) Note: Enter this running time up to one decimal place in units of hour. 1200 hours 24 minutes ---> 1200.4 1 2 0 0 ⁄: 4		
10	Press the ENTER key. ENTER		

Thus the rotor has been registered.

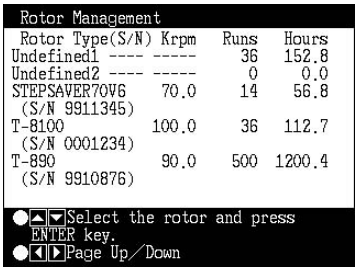
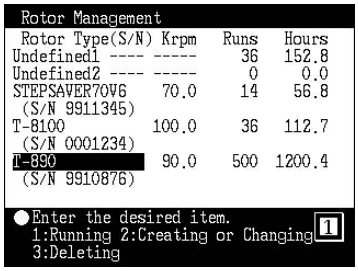
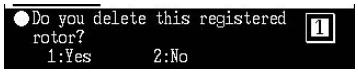
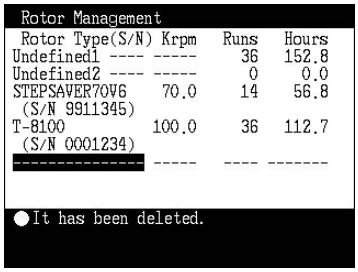
Note When the ENTER key is pressed in the above steps “7” to “9”, “0” is registered as a numeric value in each step. When the serial number must be corrected, the rotor must be deleted once and the value must be reentered from step “1”. (See the next page.)
In the steps “7” to “9”, it is possible to change the value repeatedly by moving the cursor with the arrow keys unless the ENTER key is pressed.

Deleting a registered rotor

If a registered rotor becomes unnecessary, you can delete it from ultracentrifuge memory.

Note Once a registered rotor is deleted, all of the life management data for the rotor will be lost.

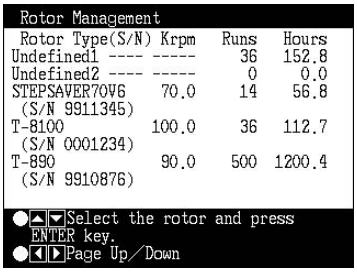
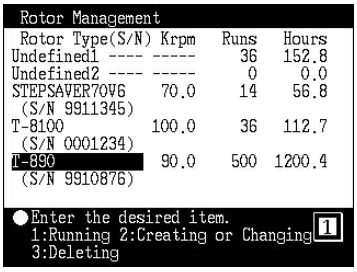
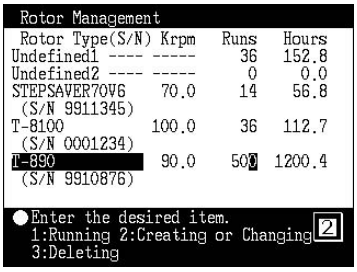
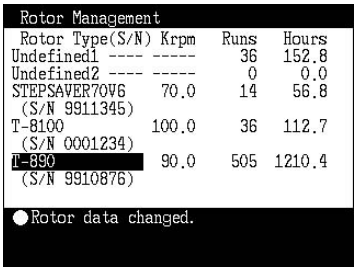
As an example, suppose that you need to delete the T-890 fixed angle rotor registered in the previous section.

Step	Key operation	Screen display and considerations
1	While in the Run Screen, use the cursor keys to move the cursor to RLM and press ENTER key.	 • The display switches to the Rotor Management screen.
2	Use cursor keys to move the cursor to the T-890 line to be deleted and press the ENTER key.	
3	Select “Deleting” by pressing the following keys. 3 ENTER	
4	Select “Yes” by pressing the following keys. 1 ENTER	 >> If you select “No”, you will get the display you see in process 2.

Updating the existing data for a rotor

When a rotor is registered in the Sorvall WX Ultra series ultracentrifuges without a Rotor Management function, both Total number of runs and Total number of hours can be updated. The updated value is accepted only when it is greater than the registered value. It must not be smaller than the registered value.

To update the existing life management data for a standard rotor, perform the following procedure:

Step	Key operation	Screen display and considerations
1	While in the Run Screen, use the cursor keys to move the cursor to RLM and press ENTER key.	 • The display switches to the Rotor Management screen.
2	Use cursor keys to move the cursor to the T-890 line to be updated and press the ENTER key.	
3	Select “Creating and Changing” by pressing the following keys. 2 ENTER	 • In the Runs field, the cursor waits for an input.
4	Enter the updated total number of runs and the total number of hours by using numeric keys. Total number of runs 500.0 ---> 505.0 Total number of hours 1200.4 ---> 1210.4 5 0 5 . 1 2 1 0 / 4 . ENTER	

Thus, the current total number of runs and hours have been updated.

When power failure occurs

DANGER Before removing the cover, top deck, or other components. for maintenance, be sure to turn off the POWER switch of the centrifuge. Then unplug the power cord from the wall outlet, and wait at least three minutes to avoid the risk of electrical shock.

WARNING

1. Never open the door during rotation.
2. Never touch the rotor during rotation.

CAUTION Never conduct operations in a manner other than as described in this operation manual.

1. Rotation of the rotor

The rotor coasts to a stop. If the power is restored when the current speed is more than 500 rpm, the rotor will be automatically accelerated to the set speed. If it is restored when the current speed is less than 500 rpm, the rotor will decelerate to a stop.

2. Displays on the panel

All displays on the panel go out. The set values are all backed up by battery during the power failure. When the power is restored, the displays will come on as before the power failure; the set values will be restored; and the message “Power failure” will appear in the message display.

3. Removing the rotor from the ultracentrifuge

First open the chamber door, then remove the rotor according to the following procedure:
(1) Check that the rotor is at rest. Listen carefully for any sounds coming from the drive.

WARNING It can take more than three hours for the rotor to come to a complete stop because the rotor chamber is under vacuum.
Before opening the door, wait until the rotor comes to a stop.

(2) Then unplug the power cord from the wall outlet, and wait at least three minutes to avoid the risk of electrical shock.

(3) Remove the four M5 hexagon head bolts fixing the front cover from both sides and pull down the front cover by pulling its lower side forward. Then, remove the front cover.
The upper side of the front cover is an insertion type but not a screw fixing type.

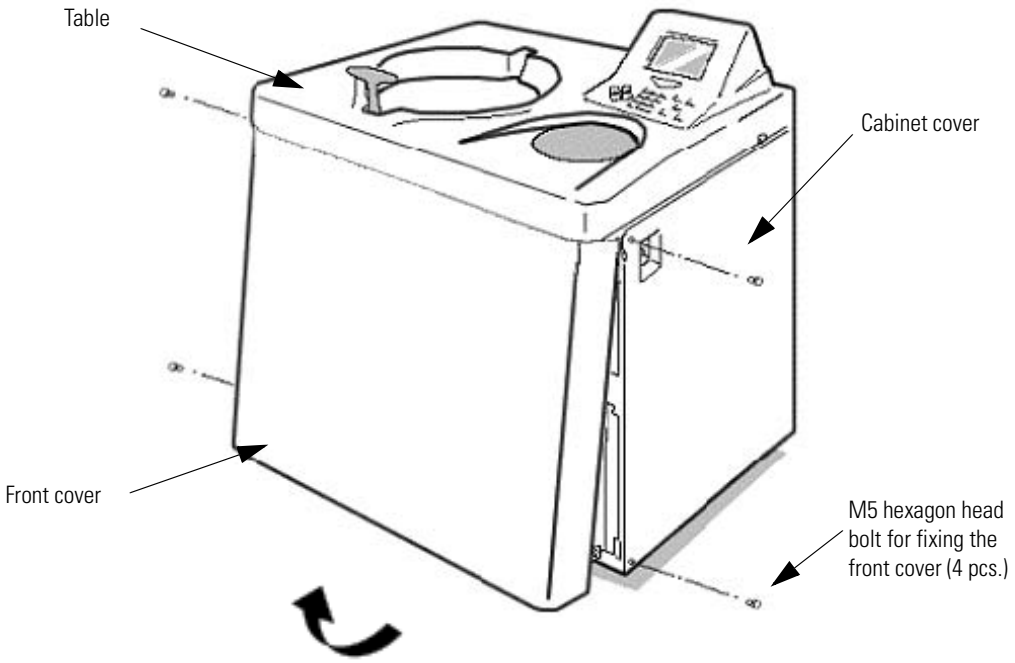


Figure 2-16 Removing the front cover

(4) Open the air vent (by turning the vacuum release screw on the left of the vacuum chamber counterclockwise) to let air into the rotor chamber. When the pressure in the rotor chamber reaches atmospheric pressure, do not forget to tighten the vacuum release screw as it was before. (See Fig. 2-16.)

(5) Pull the door unlock wire on the right of the vacuum chamber and, at the same time, push the door handle. Then the door opens. When opening the door, confirm that the rotor is not rotating. If it is still rotating, immediately close the door.

WARNING Never touch the rotor while it is rotating.

(6) Remove the rotor. After the removal, close the air vent and put the front cover back to the ultracentrifuge. Insert the top surface of the front cover in the bottom surface of the front side of the table and put the bottom surface of the front cover on the support plate of the front cover by reversing the removing procedure. Attach it on the frame with four M5 hexagon head bolts.

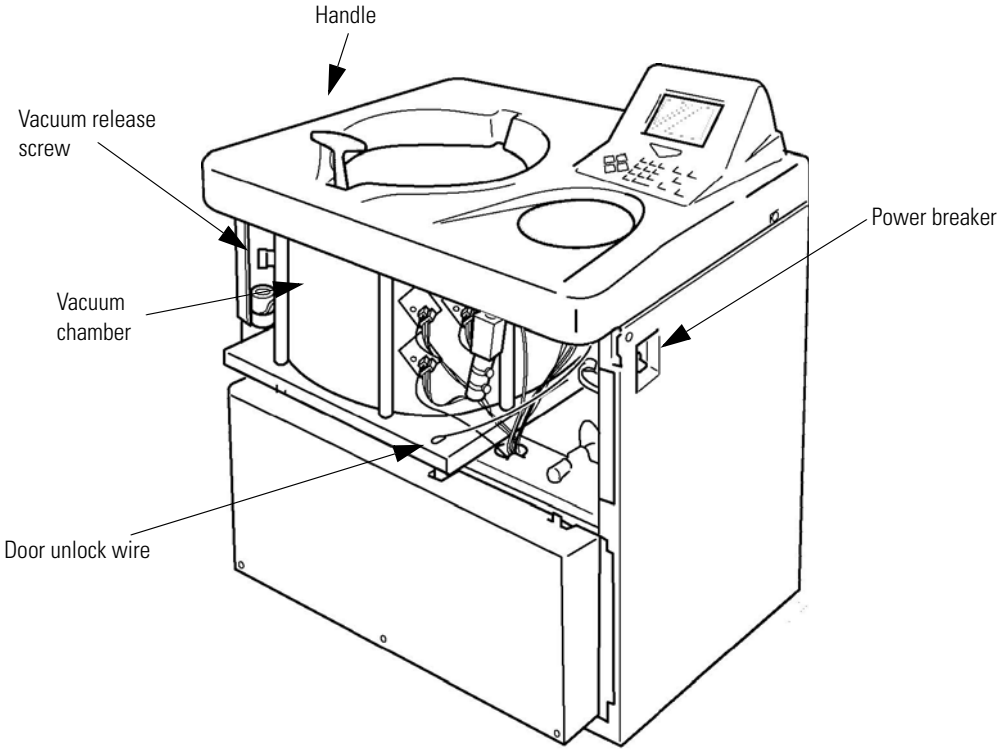


Figure 2-17 Ultracentrifuge with the front cover removed

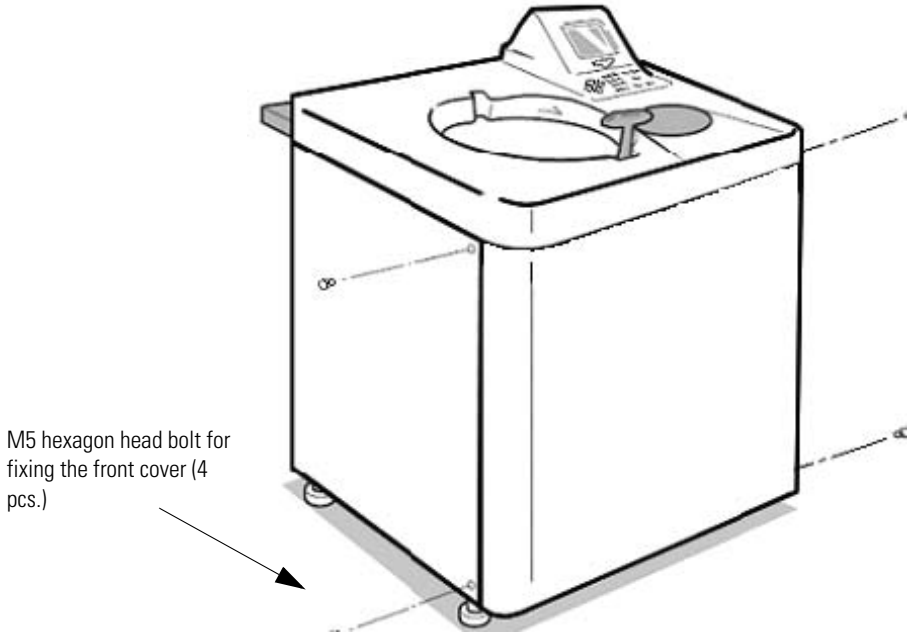


Figure 2-18 Installing the front cover

(7) Turn on the power breaker.

WARNING When the centrifuge will not be used for a long time, keep the power breaker off.

Features of the menu screen

Press MENU key on the key board, and the Menu Screen will appear. This feature is designed to allow you to use the Sorvall WX Ultra series with additional options including:
(1) Centrifuge scheduler
(2) User list
(3) Alarm information
(4) Rotor catalog
(5) User customization routines
Key in the number of the item you wish to use and press the ENTER key, and the respective screen will appear.

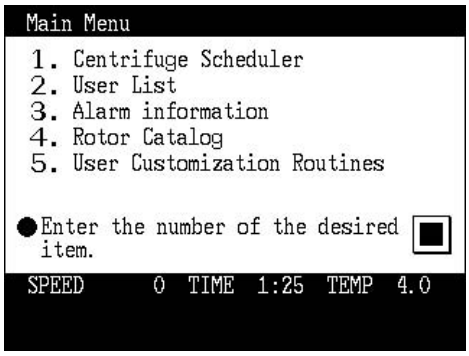
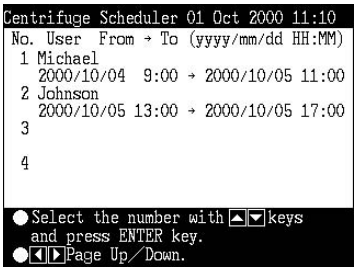
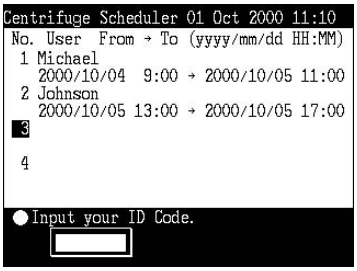


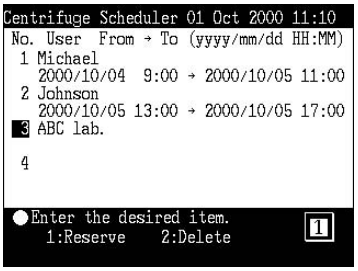
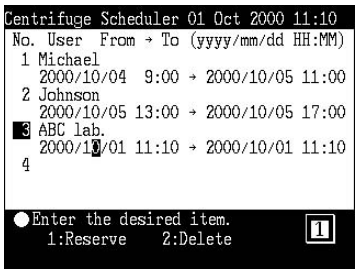
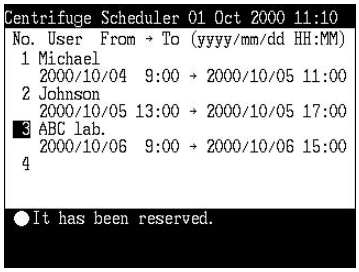
Figure 2-19 Menu screen

Centrifuge scheduler

Scheduled centrifuge operation can be reserved.

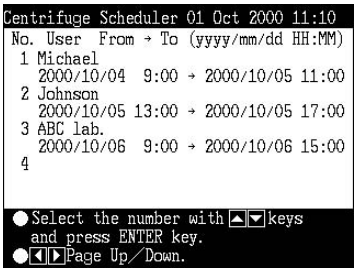
1. Reservation of scheduled centrifuge operation

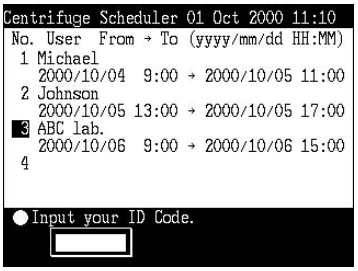
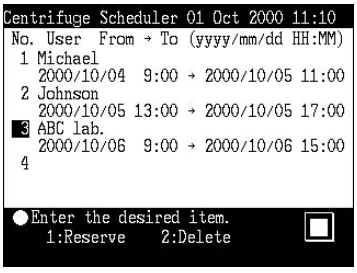
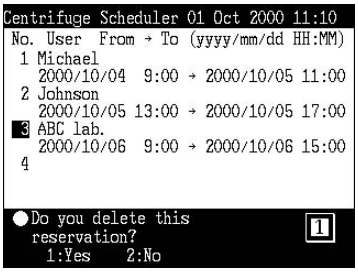
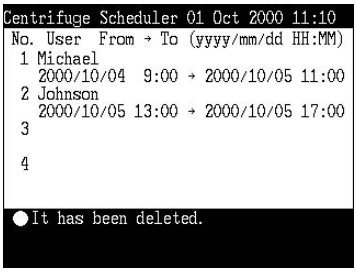
Step	Key operation	Screen display and considerations
1	On the Menu Screen, select a centrifuge operation schedule. 1 ENTER	 • The Menu Screen switches to the Centrifuge Reservation screen.
2	Use cursor keys to move the cursor to No. you desire. (In this example, No.3 is selected as new reservation.) • • ENTER	 • The ID Code input field is displayed in the message field of the bottom row.

3	Enter an ID Code that is already registered. (4-digit number) □□□□ ENTER ID code	 • The User Name corresponding to the ID Code is displayed. (In this example, ABC lab. is displayed.)
4	Select "Reserve". 1 ENTER	 • The current date/time is displayed at the reservation time of the specified reservation No.3.
5	Use cursor keys to move the cursor to the position at which you want to change the date/time of reservation, and enter a number by using numeric keys.	
6	At the desired date/time of reservation, press the ENTER key. ENTER	**Note** Enter a time later than the current time.

2. Deleting the centrifuge reservation

You can cancel the operation schedule that is already reserved. This cancellation of reservation is limited to the reserving person proper (with the same ID Code).
The reserved operation schedule will be deleted from the centrifuge reservation list after the lapse of the scheduled date/time regardless of operation/non-operation of the centrifuge.

Step	Key operation	Screen display and considerations
1	On the Menu Screen, select a centrifuge operation schedule. 1 ENTER	 • The Menu Screen switches to the Centrifuge Reservation screen.

2	Use cursor keys to move the cursor to reservation No. you want to delete. (In this example, No. 3 is selected.) • • ENTER		• The ID Code input field is displayed in the message field in the bottom row.
3	Enter the ID Code of the reserving person proper. (4-digit number) ENTER ID code		• When the ID Code is accepted, the reserve/delete selection message is displayed in the message field of the bottom row.
4	Select “Delete”. 2 ENTER		• The confirmation message is displayed in the bottom row.
5	Select “Yes”. 1 ENTER		• The No.3 reservation display disappears from the centrifuge reservation list and the reservation delete completion message is displayed in the bottom row.

User list

The Centrifuge User List screen is displayed. This screen allows you to register, change, and delete any ID code and user name.

- ID code and user name

ID Code	Password comprised of a 4-digit number. This number is not displayed when the centrifuge is operated. The mark * is displayed instead of the number.
User Name	Character string of 8 digits or less. The user name corresponding to the ID Code is displayed on the screen. Alphabetical upper-case and lower-case characters and several types of special characters are available.

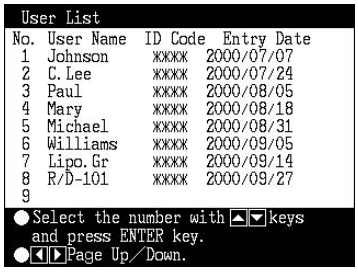
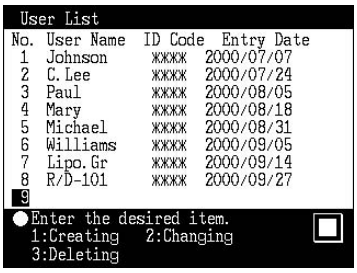
- Using example of ID code and user name

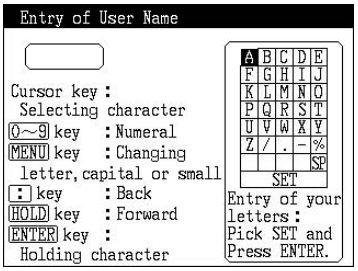
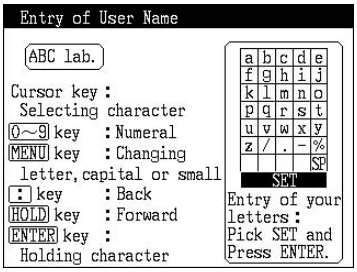
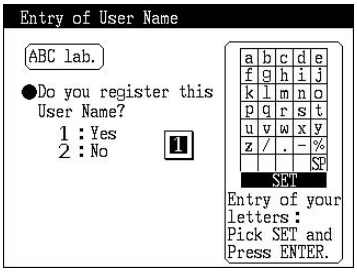
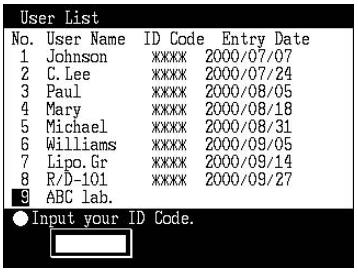
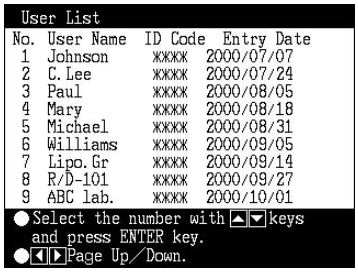
If ID Code is used when the centrifuge is operated:

1. The user can be known on the screen when the centrifuge is operated.
2. The user record is left in the centrifuge and the usage status for each user can be printed (printer: optional).
3. The User Name can be attached to the user's original programmed operation and the user's own program memory can be checked.
4. Reservation can be attained by the operation schedule table with the User Name attached.

Note Registration of ID Code and User Name is not always required for operation.
If the user does not need to be identified, the centrifuge can be operated without entering ID Code and User Name.

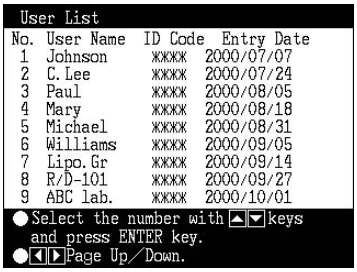
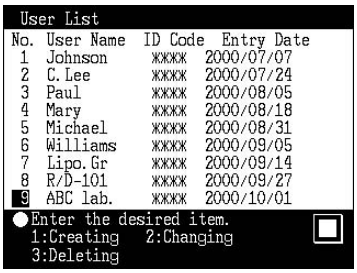
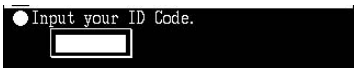
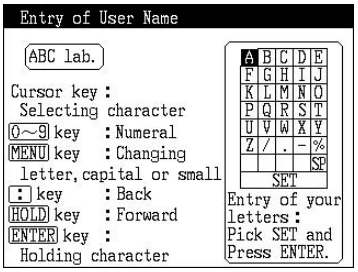
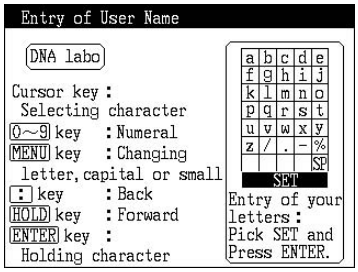
1. Registration of user name

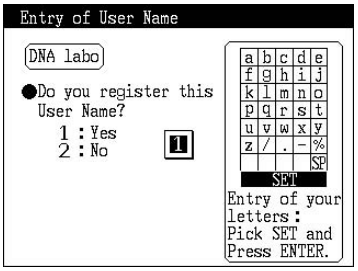
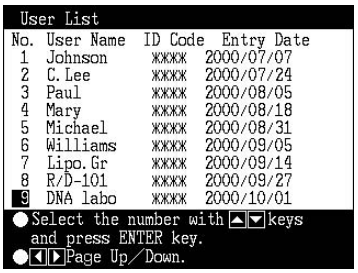
Step	Key operation	Screen display and considerations
1	Select "User List" on the Menu Screen. 2 ENTER	 • The Menu Screen switches to the User List Screen. • For registration select unregistered number.
2	Use cursor keys to move the cursor and press the ENTER key. (For registration, select No.9.) · · ENTER	 • The inquiry message to ask what to do in the message field is displayed.

3	Select “Creating”. 1 ENTER		• The User List screen switches to the User Name screen.
4	Use cursor keys to highlight a character and press the ENTER key to select it.		• Screen for entry of characters
5	After completion of the entry of characters, use cursor keys to move the cursor to SET and press the ENTER key to register the character string.		• The cursor is positioned at SET. • The confirmation message is displayed.
6	Select “Yes”. 1 ENTER		• The ID Code input field is displayed in the message field of the bottom row.
7	Enter the ID Code (4 digits) by using numeric keys and press the ENTER key. □ □ □ □ ENTER ID code	v 	• Enter the ID Code and press the ENTER key, and the date of registration will be displayed. • The mark * is displayed instead of the ID Code on the screen.

2. Change of User Name

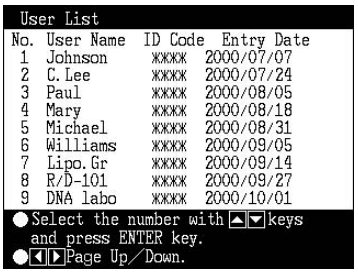
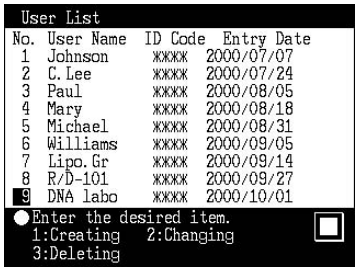
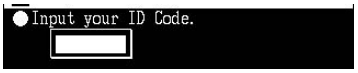
Note Changing a User Name is limited to the person (with the same ID Code) who registered it and wants to change it.

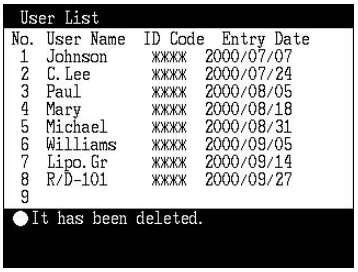
Step	Key operation	Screen display and considerations
1	On the Menu Screen, select "User List". 2 ENTER	 • The Menu Screen switches to the User List screen. • For a change, select a registered No.
2	Use cursor keys to move the cursor and press the ENTER key. (Select No.9.) • • ENTER	 • The inquiry message to ask what to do in the message field of the bottom row is displayed.
3	Select "Changing". 2 ENTER	 • The ID Code input field is displayed in the User List screen.
4	Enter the ID Code used for registering No.9 by using numeric keys.	 • The User List screen switches to the User Name Registration screen.
5	Change the User Name according to the indication given on the screen.	 • Character string input status

6	After entering characters, use cursor keys to move the cursor to SET and press the ENTER key to register the character string.		• The cursor is positioned at SET. • The confirmation message is displayed.
7	Select “Yes”. 1 ENTER		• The changed User Name is displayed together with its date of registration on the User List screen.

3. Deleting a user name setting

Note Deleting a User Name is limited to the person (with the same ID Code) who registered it.

Step	Key operation	Screen display and considerations	
1	On the Menu Screen, select “User List”. 2 ENTER		• The Menu Screen switches to the User List screen.
2	Use cursor keys to move the cursor to No.9 and press the ENTER key. (The User Name and ID Code of No.9 are deleted.) • • ENTER		• The inquiry message to ask what to do is displayed in the message field.
3	Select “Deleting”. 3 ENTER		• The ID code input field is displayed.

4	Enter the ID Code used for registering No.9 by using numeric keys.	 • The confirmation message is displayed.
5	Select “Yes”. 	 • The User Name and ID Code of No.9 disappear. >> When you select “No.” the display switches back to the screen display of Step 2.
6	Press the ESC key. 	>> The User List screen switches to the Menu Screen.

Alarm information

The Alarm Information screen displays the contents of the alarm signals and what to do when such signals occur. If an alarm signal occurs while you are using this centrifuge, you can use this screen to take immediate action. For details, see Section 4 Troubleshooting.

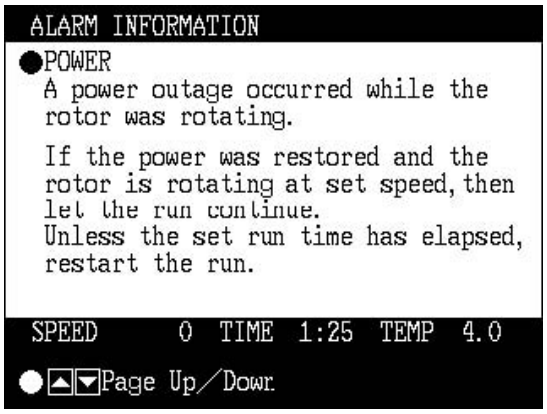
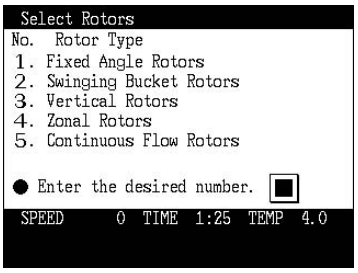
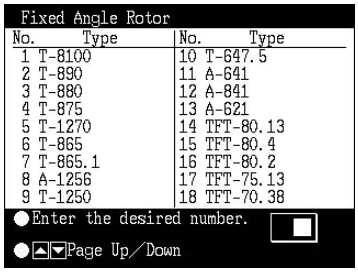
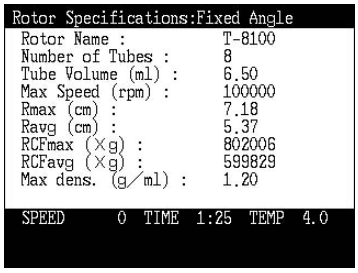


Figure 2-20 Alarm Information screen

Rotor catalog

You can refer to rotor types and rotor specifications that are available.

Step	Key operation	Screen display and considerations
1	On the Menu Screen, select "Rotor Catalog". 4 ENTER	 • The display switches to the Rotor List screen.
2	To refer to the fixed angle rotor P100AT2, select "Fixed Angle Rotors" on the Rotor List screen. 1 ENTER	 • The display switches to the Fixed Angle Rotor List screen.
3	Select the "T-8100" rotor. 1 ENTER	 • Specifications of the T-8100 rotor is displayed.
4	Press the ESC key several times to go back to the Run Screen. ESC	>> The Rotor Specification screen switches to the Run Screen.

User Customizations

You can specify the language in which displays are given, set the current time, adjust screen contrast, and make other settings, all of which enable you to easily run the centrifuge.

1. Instrument identification number

This function is intended to enter a centrifuge identification number (ID number).
You can enter a number of up to 8 digits. The centrifuge identification number is printed when the machine log is output to the printer (printer: optional).
The same identification number is also used as the centrifuge identification number for managing log data by using the operation log management program (option) on a PC.
The identification number is not factory-set. Unless you need it specially, use it as it is.

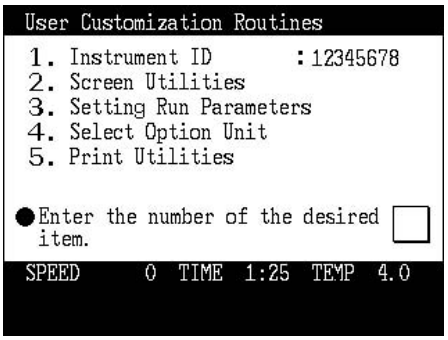


Figure 2-21 User Customizations screen

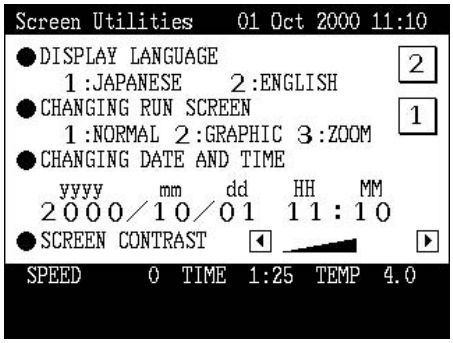


Figure 2-22 Screen Utilities screen

2. Screen Utilities settings

1. Display language and select Japanese or English.
Key in the number of the desired language and press ENTER key.

2. Changing from the Run Screen
>> Normal: Displays the Run Screen.
>> Graphics and zoom:
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. 2-23 or 2-24.
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.

Figure 2-23 Graphics screen

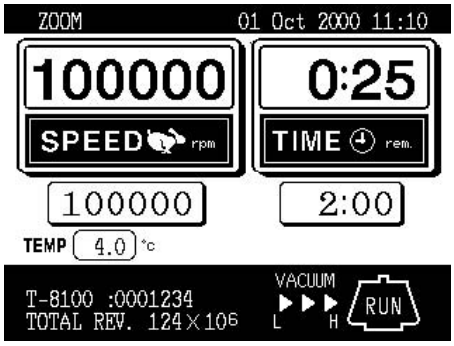


Figure 2-24 Zoom screen

3. Changing date and time
Use this option to precisely set the current time setting of the internal clock.
Set an exact date and time for RTC operation.
Use cursor keys and numeric keys and then press ENTER to make a setting.

4. Screen contrast
Use cursor keys and to adjust the contrast.

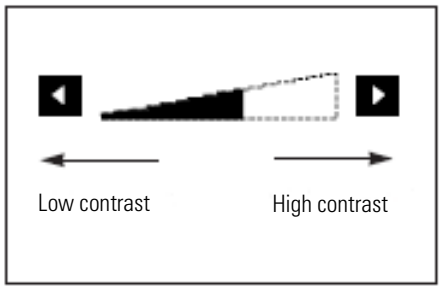


Figure 2-25 Contrast adjustment

Note
>> To get back to the Run Screen, press ESC several times.
>> 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. Setting run parameters

(1) Run Time display
This function selects either “Time elapsed” or “Remaining time” as the time display in the run status.
When you select “Time elapsed”, “lapse” is displayed in the time display frame on the screen.
When you select “Remaining time”, “rem.” is displayed in the same frame.

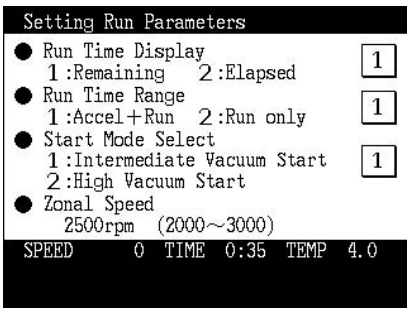


Figure 2-26 Run Condition setting screen

(2) Run Time range
This function selects one of the following two items as the running time setting range in the normal operation mode or zonal operation mode:
>> Accel + Run
Time from pressing the START key to a start of deceleration: T1 (ordinary running time).

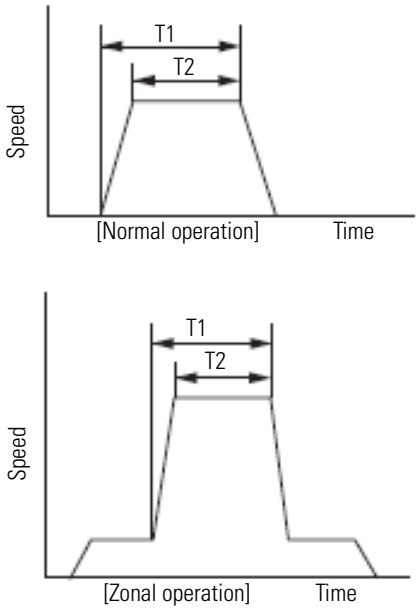


Figure 2-27 Run time range setting

Note The vacuum waiting time is not counted in the normal operation. To eliminate the run time difference in the high vacuum start mode, vacuum the rotor chamber up to a high degree during the rotor stop and then start the operation.

>> Run
Time from reaching to the set speed to a start of deceleration: T2

(3) Start mode select
This function allows you to select one of the following values as the degree of vacuum in the process from the vacuum wait to accelerationto the set speed:
>> Medium vacuum: Approx. 133 Pa (ordinary)
>> High vacuum: Approx. 13 Pa

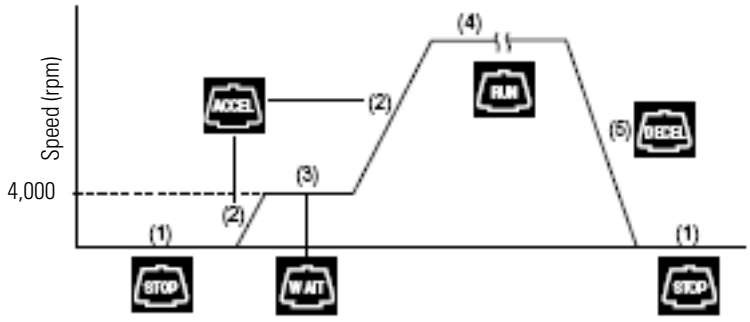


Figure 2-28 Vacuum waiting operation mode

(4) Zonal speed
This function can change (in units of 100 rpm) the zonal speed in the range of 2,000 to 3,000 rpm. For the zonal speed, see Section Zonal operation)

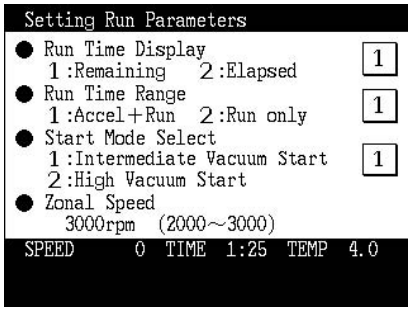


Figure 2-29 Run condition setting screen

4. Select option unit

This function allows you to set one of the following optional units through the RS232C.
1) Printer
2) Compass Centrifugation Software
3) Unused

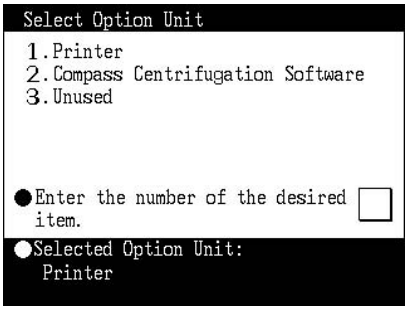


Figure 2-30 Optional Unit connection screen

Note When "Unused" is selected in the optional unit setting, machine log data will be deleted in the order starting with the oldest data and new data will be stored in the memory if the machine log data exceeds the memory area capacity of the centrifuge. For managing such machine log data, be sure to set an optional unit. When such an optional unit has been set, the printer printout or PC data input request message is displayed if the machine log data exceeds the memory area capacity.

Print utilities (option)

This submenu option is used to print the various information maintained in the ultracentrifuge on the optional printer. The information includes run records, rotor usages, memory contents, etc. When you select "5. PRINT UTILITIES" from the "user customization routines" submenu, this submenu option starts working and displays the PRINT UTILITIES screen.

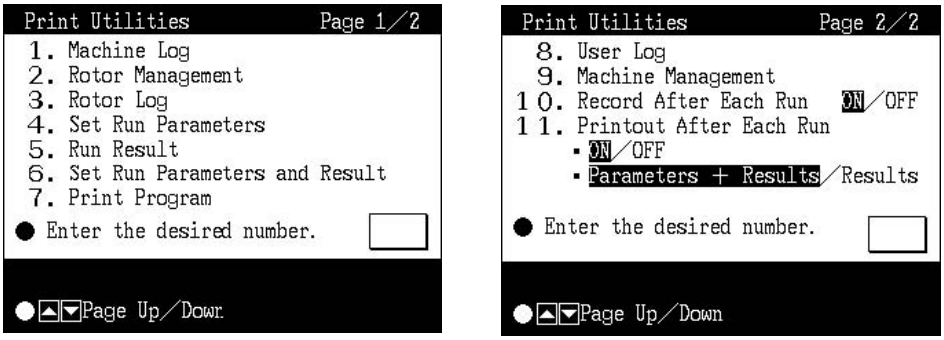
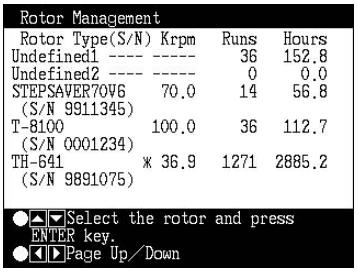
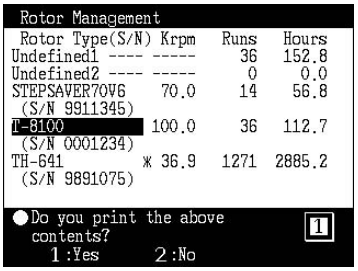


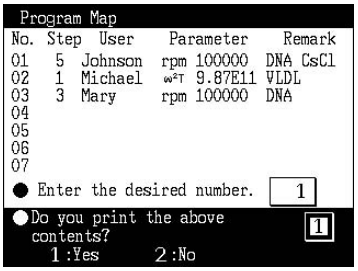
Figure 2-31 PRINT UTILITIES Screen

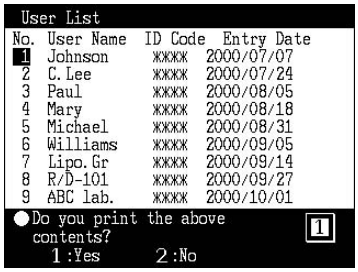
Note

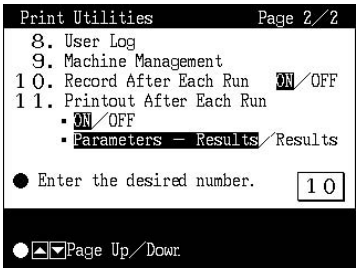
- Select "1. Printer" of "4. Select Option Unit" in the User Customization Routines screen. Refer to Section User Customizations.

Operating procedure

No.	Item	Operating procedure
1	Machine Log	(1) Select the corresponding item number on the Print Utilities Menu screen.
2	Rotor Management	
3	Rotor Log	(1) On the Print Utilities Menu screen, select "3. Rotor Log".  • The display switches to the Rotor Management screen. (2) On the Rotor Management screen, move the cursor to select a rotor and press the ENTER key.  (3) Select "1: Yes" as print permission.
4	Set run parameters	(1) Select the corresponding item number on the Print Utilities menu screen.
5	Run result	
6	Set run parameters and result	

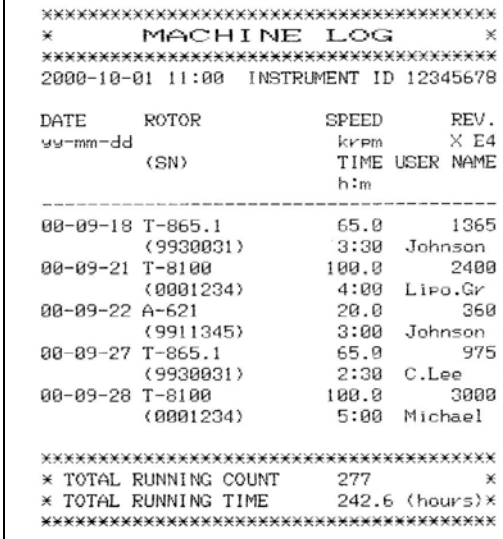
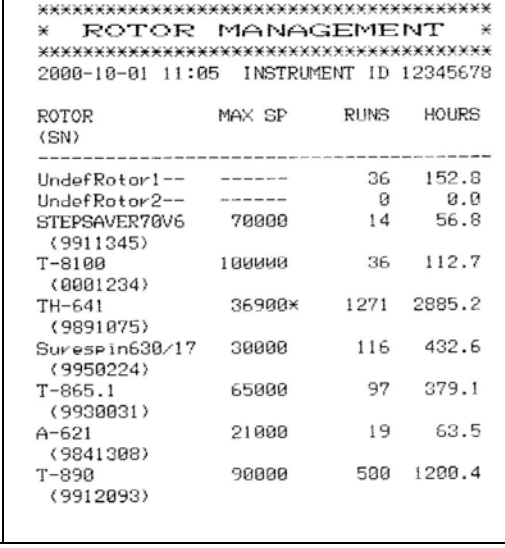
<table>
<tr><td>7</td><td>Print program</td><td>(1) On the Print Utilities menu screen, select “7. Print Program”.
 

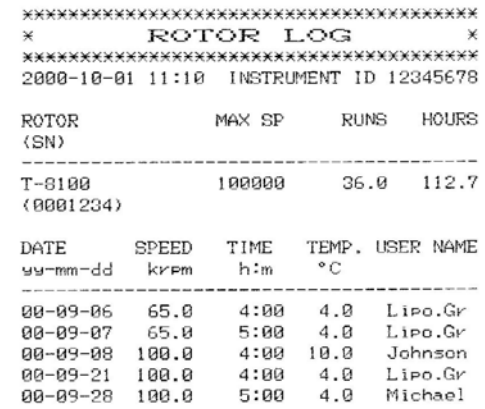
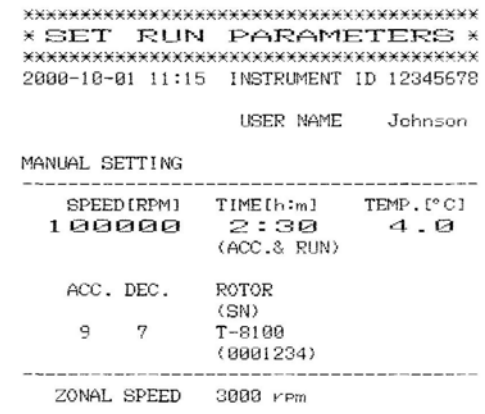
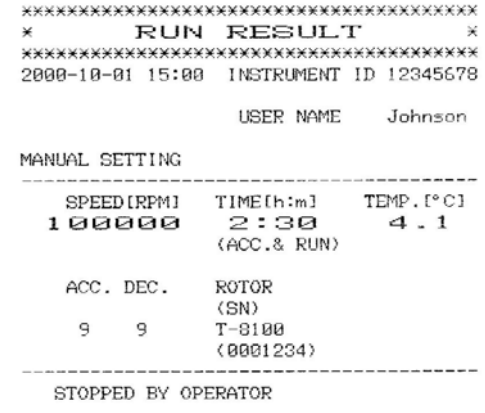
• The display switches to the Program Map screen.
(2) Select a program No. to be printed.</td></tr>
<tr><td>8</td><td>User log</td><td>(1) On the Print Utilities Menu screen, select “8. User Log”.
 

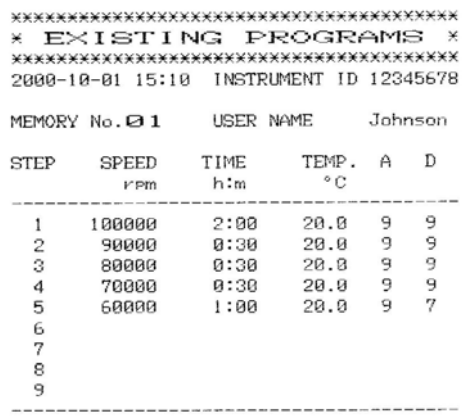
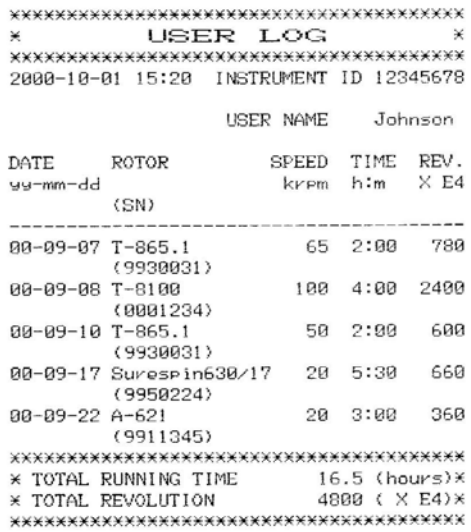
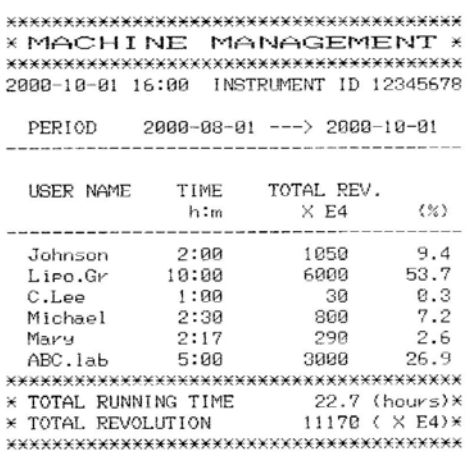
• The display switches to the User List screen.
(2) Move the cursor to select a User Name and perform printing.</td></tr>
<tr><td>9</td><td>Machine Management</td><td>(1) On the Print Utilities menu screen, select “9. Machine Management”.</td></tr>
<tr><td>10</td><td>Record after each run</td><td rowspan="2">(1) On the Print Utilities menu screen, select the corresponding item number.
 

(2) Move the cursor and select a setting condition.</td></tr>
<tr><td>11</td><td>Printout after each run</td></tr>
</table>

Contents of print utilities

No.	Item	Example printout
1	CENTRIFUGE RUN RECORDS >> Ultracentrifuge run records for a maximum of 40 runs can be printed out at a time. >> Once the ultracentrifuge run records are printed out, they are gone. Therefore, if necessary, save the produced printout for future reference.	 ********** * MACHINE LOG * ********** 2000-10-01 11:00 INSTRUMENT ID 12345678 DATE ROTOR SPEED REV. yy-mm-dd krpm X E4 (SN) TIME USER NAME h:m --- 00-09-18 T-865.1 65.0 1365 (9930031) 3:30 Johnson 00-09-21 T-8100 100.0 2400 (0001234) 4:00 Lipo.Gr 00-09-22 A-621 20.0 360 (9911345) 3:00 Johnson 00-09-27 T-865.1 65.0 975 (9930031) 2:30 C.Lee 00-09-28 T-8100 100.0 3000 (0001234) 5:00 Michael ********** * TOTAL RUNNING COUNT 277 * * TOTAL RUNNING TIME 242.6 (hours)* **********
2	RUN RECORDS OF ALL ROTORS >> Run records of all the rotors registered are printed out. >> When a rotor reaches its primary life, an asterisk ([*]) is displayed at the right of the maximum speed and the maximum rated speed is derated by 10%.	 ********** * ROTOR MANAGEMENT * ********** 2000-10-01 11:05 INSTRUMENT ID 12345678 ROTOR MAX SP RUNS HOURS (SN) --- UndefRotor1-- ------ 36 152.8 UndefRotor2-- ------ 0 0.0 STEPSAVER70V6 70000 14 56.8 (9911345) T-8100 100000 36 112.7 (0001234) TH-641 36900* 1271 2885.2 (9891075) Surespin630/17 30000 116 432.6 (9950224) T-865.1 65000 97 379.1 (9930031) A-621 21000 19 63.5 (9841308) T-890 90000 500 1200.4 (9912093)

3	RUN RECORDS OF A ROTOR >> Run records of a particular rotor are printed out; a maximum of 20 runs can be printed out at a time. >> When you select this option, a list of registered rotors is displayed. Move the cursor to the rotor the run records of which you want to print out, and then press the ENTER key. >> Once the run records of the run are printed out, they are gone. Therefore, if necessary, save the produced printout for future reference.	 ROTOR LOG 2000-10-01 11:10 INSTRUMENT ID 12345678 ROTOR (SN) MAX SP RUNS HOURS T-8100 (0001234) 100000 36.0 112.7 DATE yy-mm-dd / SPEED krpm / TIME h:m / TEMP. °C / USER NAME 00-09-06 65.0 4:00 4.0 Lipo.Gr 00-09-07 65.0 5:00 4.0 Lipo.Gr 00-09-08 100.0 4:00 10.0 Johnson 00-09-21 100.0 4:00 4.0 Lipo.Gr 00-09-28 100.0 5:00 4.0 Michael
4	SET RUN PARAMETERS PRINTOUT >> The currently set run parameters are printed out.	 SET RUN PARAMETERS 2000-10-01 11:15 INSTRUMENT ID 12345678 USER NAME Johnson MANUAL SETTING SPEED[RPM] 100000 TIME[h:m] 2:30 (ACC.& RUN) TEMP.[°C] 4.0 ACC. 9 DEC. 7 ROTOR (SN) T-8100 (0001234) ZONAL SPEED 3000 rpm
5	RUN RESULT PRINTOUT >> The result of the last run made is printed out.	 RUN RESULT 2000-10-01 15:00 INSTRUMENT ID 12345678 USER NAME Johnson MANUAL SETTING SPEED[RPM] 100000 TIME[h:m] 2:30 (ACC.& RUN) TEMP.[°C] 4.1 ACC. 9 DEC. 9 ROTOR (SN) T-8100 (0001234) STOPPED BY OPERATOR
6	RUN CONDITION/LOG OUTPUT >> The up-to-date run log is printed out together with the run conditions. >> Set run parameters and results.	Same as the examples of Nos. 4 and 5.

7	LISTING OF ALL EXISTING PROGRAMS >> A list of all the programs in the ultracentrifuge is printed out.	
8	USER LOG OUTPUT >> The centrifuge user's run log is printed out up to 20 runs. >> Once the user log is output, the previous run record is deleted and cannot be printed out once again.	
9	MACHINE MANAGEMENT OUTPUT >> The running time and the total number of revolutions are totaled for each user. Regarding the total number of revolutions, the ratio (%) of each user in the total number of revolutions is calculated and printed out. >> Totalization is performed in the period from the previous printout to the current printout. After the printout, totalized data is cleared.	

Automatic run result printing

This capability of the ultracentrifuge automatically performs the following services:

1) Automatic printing of run records
Ultracentrifuge run records are retained in the run record buffer. This buffer can hold a maximum of 40 records at any given time. When the buffer becomes full, all of the 40 records are automatically printed out, except when the PRINTOUT AFTER EACH RUN options is toggled on. In this case, the result of the last run made is printed out, followed by all the run records in the buffer.

Note When the RECORD AFTER EACH RUN option is toggled off, ultracentrifuge runs are not recorded in the run record buffer (See page 2-79). Therefore, even if the 40th run in a sequence is completed, the run records, including the 40th, will not be automatically printed out.

2) Automatic printing of run records of rotor
When the number of runs using a particular rotor with the ultracentrifuge has reached 20, the retained run records for the rotor will be automatically printed out.

3) Printout after each run
When the PRINTOUT AFTER EACH RUN option is toggled on, the result of a run is automatically printed out upon completion of that run. The printout produced is exactly the same as that produced by selecting “5. RUN RESULT PRINTOUT”.

Printer fault handling

If a fault condition occurs that causes the printing in progress to be interrupted, do the following:

	Contents of error	Process (Executing the following processing permits printing out from the beginning.)
1	Centrifuge power OFF	The record is left in the centrifuge memory. After power is restored, you can print them.
2	Printer power OFF (Dead battery)	The power lamp blinks at intervals of about 0.5 sec and the printer is put into an offline mode. Connect the AC adapter attached to the printer. When data remains in the buffer memory, the online lamp blinks. Do not turn off the power supply but connect the AC adapter as quickly as possible. In the online, the remaining data will be printed out.
3	No print paper	The offline lamp blinks. When paper is set, the offline lamp changes from the blinking state to the lighting state. Press the online switch, and the printer will start to print.

Note By clearing the “printer paper exhausted” fault, you can continue the operation of the ultracentrifuge. However, if the number of runs of the ultracentrifuge has reached 40, or if the number of runs of the rotor in use has reached 20, then continuing the operation will result in the loss of the oldest record.

Lockout (optional)

Note When installing the Lockout Procedure for the first time, all memory is cleared. If obtaining Lockout Option after centrifuge has been installed, it will be necessary for service to record and then re-enter pertinent memory information such as total revolutions, total running count, and total running time. In the function field, all rotor life management (RLM) and program (PROG) information must also be recorded and re-entered.
If you have the Printer (optional), you can printout the above information and then re-enter it later.

Logon

1. Turn ON centrifuge
2. Instead of a Run Screen, you will see a screen that shows two blank areas to input an ID Code and Password.
3. A User or Lab Manager inputs ID Code and Password, then presses ENTER.

Note The entered ID Code number WILL NOT be displayed on the screen, you will see **** in its place.

4. The Run Screen will now appear and centrifuge is ready to use.

Adding or Changing Lab Manager and User Names

1. Turn ON centrifuge.
2. Instead of a Run Screen, you will see a screen that shows two blank areas to input an ID Code and Password.
3. Lab Manager inputs ID Code and Password, then presses ENTER.

Note The entered ID Code number WILL NOT be displayed on the screen, you will see **** in its place.

4. Run Screen now appears.
5. Press MENU, #2 (User List), then press ENTER.
6. Use down cursor key to select a number between 1 and 40 (can take up to 40 users), then press ENTER. 1 - 3 are reserved for lab managers, only they can add or delete users (4 - 40).
7. Press #1 (Creating), then press ENTER.
8. Use cursor keys to select letters for User's name, press enter after each letter. Then use down cursor key to SET, press ENTER.
9. Press ENTER (Yes, register this User Name).
10. The number 1 is highlighted, press ENTER.
11. Input ID Code (4 digits), then press ENTER.
12. Input Password, then press ENTER.
13. Repeat step 6 thru 10 to input additional users.
14. Once completed, hit ESC until Run Screen appears --- move cursor key to Logoff, then press ENTER.

Maintenance

Before conducting any maintenance, always read the following:

DANGER Before removing the cover, top deck, or other components. for maintenance, be sure to turn off the POWER switch of the centrifuge. Then unplug the power cord from the wall outlet, and wait at least three minutes to avoid the risk of electrical shock.

WARNING

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 has been used with toxic, radioactive, or pathogenic materials, clean it by following the Service Decontamination Policy in this section.
3. If the instrument, rotor and/or accessories require servicing by Thermo either at the customer's site or at Thermo's facilities, disinfect and decontaminate it following the Service Decontamination Policy in this section.

CAUTION Do not operate the instrument in any way other than specified in this manual. If you encounter any problem with the instrument, call an authorized Thermo Field Representative.

Rotor chamber

To maintain the rotor chamber, follow the instructions given below:

1. When the ultracentrifuge is not in use, keep the rotor chamber ventilated.
2. If the bowl is moist, wipe it with a clean, dry cloth or sponge.
3. If the rotor chamber is dirty, wipe it with a clean cloth or sponge dampened with a diluted solution of mild, non-alkaline detergent. While doing this, be careful not to touch the window of the temperature sensor.
4. If the door seal o-ring is dusty or scratched, high vacuum level will not be obtainable. Always keep the door seal o-ring clean. When the ultracentrifuge is used frequently, take out the door seal o-ring and wipe it with a clean, soft cloth and then put a light coat of vacuum grease on it every three to four months (ordinarily, once a year). If the door seal o-ring is damaged, replace it. Wipe the groove for the door seal o-ring with a clean, soft cloth dampened with alcohol or a similar solvent.

Drive spindle

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

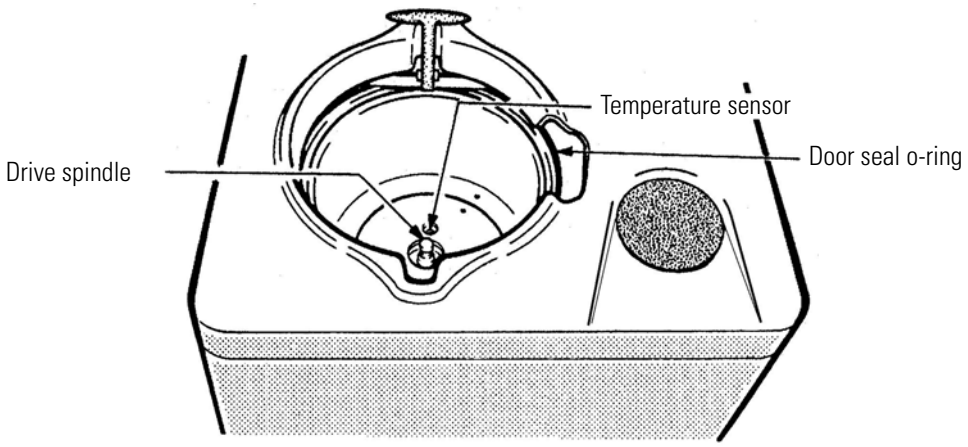


Figure 3-1 Rotor chamber

Cabinet

Use a mild, non-alkaline detergent and water to wipe the top deck and cabinet panels clean.

Replacement parts

To order replacement parts, contact your local authorized Thermo representative. 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 ultracentrifuge you are using.

Service decontamination policy

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.

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:

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 a radioactive or biological hazard, the sender will be contacted for instructions as to disposition of the 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.

Troubleshooting

Before troubleshooting, always read the following:

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

WARNING

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 has been used with toxic, radioactive, or pathogenic materials, clean it by following the Service Decontamination Policy in Section 3.
3. If above described instrument, rotor and/or accessories requires servicing by Thermo or agent authorized by Thermo either at the customer's site or at the Thermo agent facilities, disinfection and/or decontamination is the user's responsibility.
   Make sure to notify the service representative of the use of such materials then.

CAUTION Do not operate or run the instrument in any way other than specified in this manual. If you encounter any problem with the instrument, call an authorized Thermo Field Service Representative.

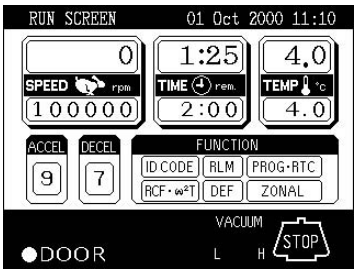
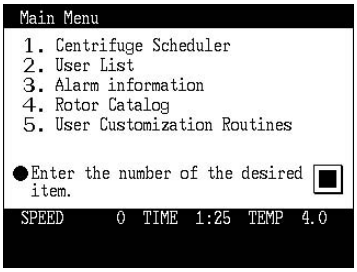
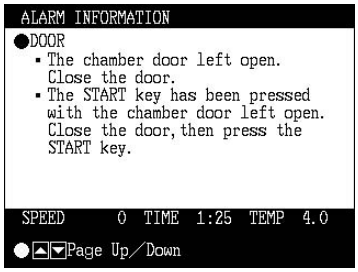
This ultracentrifuge incorporates a “self-diagnosis feature” that diagnoses the cause of any problem which may occur when you start the centrifuge or while in operation.

Alarm indicators

If any trouble occurs, this machine gives a buzzer sound and display an alarm message in the message field of the Run Screen to warn of the trouble.

This machine incorporates the Alarm Information screen designed to allow you to take immediate action when such an alarm signal is given. You can open the Alarm Information screen as indicated in the following example:

1. Searching for Alarm Information

No.	Key operation	Screen display and considerations
1	A "DOOR" alarm signal occurs.	 • An alarm message appears in the message field of the Run screen.
2	Press MENU key. MENU	 • The display switches to the Menu screen.
3	Select "ALARM INFORMATION". 3 ENTER	 • 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, remove the cause of the problem as described below and press CE key. You will then be able to resume your centrifugation.
If the alarm message persists even after you have done what is specified below, contact a Thermo service representative.

Alarm	Cause	Action
DOOR	1. The VACUUM or START key has been pressed with the chamber door left open.	• 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 (due to, for instance, sample leakage).	• Wipe off the moisture from inside the rotor chamber. • Clean the door seal o-ring, then apply a thin coat of vacuum grease. (Refer to Section 3-1.) • Check if the sample is leaking from the rotor and/or tubes. • If no operation sound is produced from the vacuum pump, check the breaker of the pump.

ROTOR	1. The rotor is not seated on spindle.	• Install 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.	• 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.	• Set the speed within the permitted limits.
POWER	1. A power outage occurred while the rotor was rotating.	• Unless the set run time has elapsed, restart the run. • If the power was automatically restored and the rotor is rotating at set speed, then let the run continue.
	Refer also to Section When power failure occurs.	

Diagnosed problems - requiring maintenance

When a problem except those listed in Section 4-1 is reported on the message display at the bottom of the screen, call your authorized Thermo representative and communicate the displayed problem message.

Note When the "No. 13 Unexpected MPG pulse" alarm occurs, the related problem code is impossible to clear until the rotor stops.

Non-diagnosed problems

If the ultracentrifuge does not function even if no problems are reported, do the following:

Symptom	Cause	Remedy
The ultracentrifuge cannot be energized by turning ON the POWER switch.	The circuit breaker connected to the ultracentrifuge is tripped.	• Reset the circuit breaker, and turn on the POWER switch.
The rotor cannot be held at the correct temperature.	Poor vacuum	• Check whether the oil of the vacuum pump needs replacing. • Clean or replace the door seal o-ring.
	The room temperature is higher than 35 C.	• If there is an air-conditioner working near the ultracentrifuge, run it at a lower room temperature setting. • If there is no air-conditioner working near the ultracentrifuge, lower the set speed.
	The rotor surface contains drops of water.	• Wipe water off the rotor with a soft cloth.
	The window part of the temperature sensor contains drops of water.	• Wipe water off the temperature sensor with a soft cloth being careful not to touch the sensor with your finger.

Preinstallation

CAUTION An authorized Thermo Field Service Engineer must perform installation and electrical modifications of the centrifuge or the centrifuge warranty will be void.

The information on these two pages describes the location requirements and the electrical services that you must make provision for prior to installation of the centrifuge by an authorized Thermo Field Service Engineer. The requirements may be modified, if necessary, to comply with state or local ordinances.

Location Requirements

To permit free air circulation, the location must allow space for the physical size of the centrifuge (see figure 5-1), 5.5 cm on the sides plus an additional 20 cm or more behind the centrifuge.

The operating temperature range is 10 to 35 C. If the room temperature rises above 35 C, the temperature of the rotor may become too high. Avoid installing the ultracentrifuge in direct sunlight or near any other heat-generating machine/equipment, which might reduce the ultracentrifuge cooling capacity.

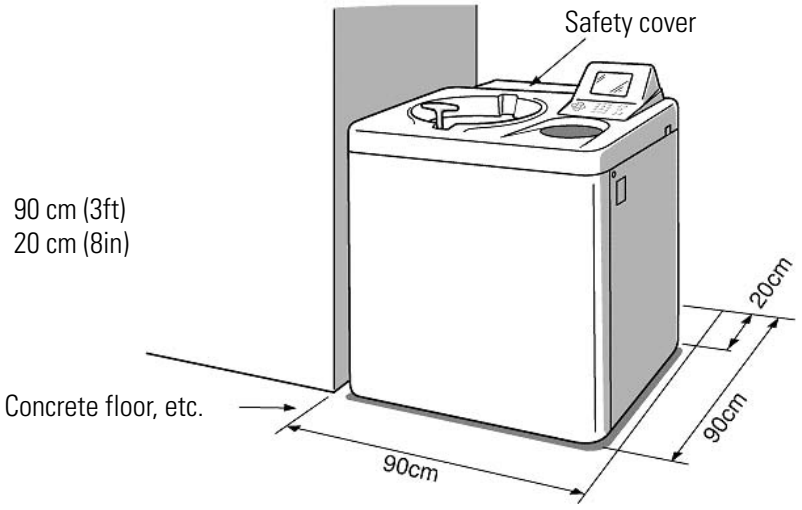


Figure 5-1 Place of installation

WARNING No one should (nor should any hazardous contaminants) be allowed in the surrounding floor space, (30 cm or 1 ft.) during the operation of the ultracentrifuge.

Electrical requirements

The centrifuge must be connected to the power source that is specified on the nameplate on the left side of the instrument panel.

The centrifuge can be wired for split two-phase or split three-phase application and international color coding of wires used, as appropriate. If required, wiring will be done when the centrifuge is installed.

To avoid electrical shock, only a qualified service specialist should test or modify the electrical circuits in the centrifuge.

The centrifuge is equipped with a three meter (eleven foot) power cord with a NEMA 6-30P (Hubbell No. 9331) plug to fit a NEMA 6-30R (Hubbell No. 9330) wall receptacle. The power cord conforms with current UL and IEC Standards for single phase. For connection to other receptacles, the power cord may need replacement. Follow local electrical codes.

The centrifuge has a 20 A circuit breaker (ON/OFF power switch). A separate line disconnect switch is not needed, unless required by local code.

Leveling

Note Leveling is required (after moving the centrifuge) to avoid rotor imbalance during operation.

1. Turn the four leveling screws with a wrench to lift the caster about 10 to 20 mm (0.4 to 0.8 in) off the floor as shown in Fig. 5-2.
2. Turn on the POWER switch and open the chamber door. Then turn off the switch again. If the power cord is not yet connected, remove the front cover and then open the door according to the instructions given in Section When power failure occurs.

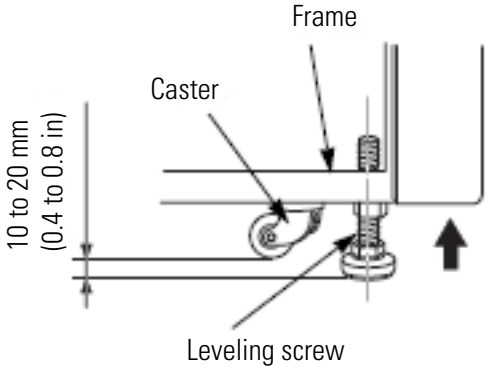


Figure 5-2 Leveling adjustment

3. Place the level (part no. 45216) across the top of the drive shaft in the rotor chamber (see Fig. 5-3). Turn the four leveling screws until the bubble in the level indicates the instrument is level.

4. When the instrument is level, check that the four leveling screws are secured to the floor.

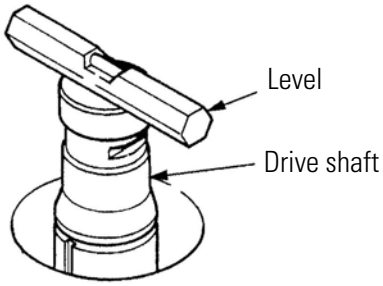


Figure 5-3 Level placement

Moving the ultracentrifuge

CAUTION Before moving the ultracentrifuge, be sure to remove the rotor from the drive shaft and store it in a safe place.

When moving the ultracentrifuge, disconnect the power cord and unscrew the leveling screws with a wrench to lower the caster to the floor. Raise the leveling screws enough to remove the leveling pads, then move the ultracentrifuge. After moving, be sure to install and level the instrument again.

Specifications

Model	Sorvall WX Ultra Series		
	Sorvall WX 100 Ultra	Sorvall WX 90 Ultra	Sorvall WX 80 Ultra
Maximum speed	100,000rpm	90,000rpm	80,000rpm
Maximum RCF	802,006 x g (T-8100)	692,149 x g (T-890)	602,644 x g (T-880)
Speed control accuracy	±10 rpm (1,000 rpm to maximum speed)		
Acceleration/deceleration control	About 5 minutes from 0 to 100,000 rpm or vice versa (P100AT2)		
Rotor temperature control/display accuracy	±0.5°C set temperature is from 0°C to 40°C		
Set speed	1,000 rpm to maximum speed in increments of 100 rpm		
Vacuum system	Oil rotary vacuum pump and oil diffusion pump combined Ultimate vacuum: below 0.01Torr (1.33 Pa) (This value reaches within 20 minutes after the rotor starts rotating.)		
Noise level	53 dB (A scale) (measured 1m in front of the instrument at the set speed of the rotor)		
Maximum heat dissipation into room	1kW/hr		
Cooling method	Thermo-module cooling (CFC-free)		
User interaction means	Color liqiud crystal display (color-256), touch panel, and keyboard		
Interface	RS232C X 1CH		
Dimensions	Width:790 mm; depth:690 mm; height:1,000 mm Depth with safety cover mounted:890 mm Height to table:850 mm		
Weight	400 kg		
Power requirement	Single phase 50/60 Hz 208,220 Vac+/-10 %, 20A maximum (normally 8A) 230,240 Vac+/-10 %, 16A maximum (normally 7A)		
Environment conditions	Ambient temperature for operation: 2°C to 40°C With maximum relative humidity of 80% at 31°C, linearly decreasing to 50% at 40°C. Ambient Temperature for performance guarantee: 10°C to 30°C The unit is intended for indoor use only Maximum altitude of 2000 meters. Pollution degree 2 Overvoltage category II		

The Sorvall WX Ultra series centrifuges are manufactured and tested according to the following regulations of EMC:

- EN 61326
- EN 61000-3-2

- EN 61000-3-3

(*) EMC: Electromagnetic compatibility

The Sorvall WX Ultra series centrifuges satisfy CE marking requirements. The CE marking is an international symbol, which shows that the product conforms to EC directives.
Standards concerning these directives are as follows:

- Product Safety (EN 61010-1 and EN 61010-2-020)
- Electromagnetic compatibility (EN 61326-1)

Supply list

The items listed below are those supplied with the ultracentrifuge.

Item name	Part no.	Q'ty	Item drawing	Remarks
Instruction manual	45912	1		
Vacuum grease	65937	1		
Vacuum pump oil	45128	1		Supplied in 1-liter NEO VAC containers (MR100)
M5 screw		3		
Hex. bar wrench		1		
Rotor rubber mat		1		

Optional items

Item name	Part no.	Q'ty	Item drawing	Remarks
Funnel	45215	1		
Vinyl tube	45214	1		
Cleaning bar		1		
Door seal O-ring	45664	1		

Service Decontamination Policy

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.

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:

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 Care and 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 a radioactive or biological hazard, the sender will be contacted for instructions as to disposition of the 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.

WEEE Compliance

This product is required to comply with the European Union's Waste Electrical & Electronic Equipment (WEEE) Directive 2002/96/EC. It is marked with the following symbol:

Thermo Electron has contracted with one or more recycling/disposal companies in each EU Member State, and this product should be disposed of or recycled through them. Further information on Thermo Electron`s compliance with these Directives, the recyclers in your country, and information on Thermo Electron products which may assist the detection of substances subject to the RoHS Directive are available at **www.thermo.com/WEEERoHS**

Condensed operating instructions

Sorvall® WX Ultra series ultracentrifuge

These instructions are intended to be used only as a guide to operate the Sorvall WX Ultra series ultracentrifuge. We recommend that you

read the Instruction Manual thoroughly, particularly all WARNINGS and CAUTIONS, before operating the ultracentrifuge.

Before the run

Turn the ultracentrifuge power ON. Open the chamber door and wipe the chamber dry. Place the rotor carefully on the drive spindle. No further adjustment or locking isnecessary.

Normal operating procedure

1. Using the keyboard cursor keys, input the desired run conditions as follows:
   Press a cursor key to enter the system into a wait state (blinking means the system is waiting for input).
   Use the cursor keys to move to the run condition to be changed (SPEED, TIME, TEMP, ACCEL, DECEL).
   Use the numeric keys to enter a new setting. (Entered numbers are moved to the left every time a new number is entered.)
   Use the cursor keys (not the ENTER key) to move between fields as run conditions are entered.
2. After all conditions are set, press ENTER. (Use CE to cancel an input.)
3. Press START. When START is pressed, the run mode indicator in the bottom right corner will begin to blink “ACCEL” denoting acceleration. Once top speed is reached, the indicator will blink “RUN”.

End of run

A timed run automatically ends when selected time has elapsed. To end a run with HOLD selected or to end a timed run before the selected time has elapsed, press STOP.
When STOP is pressed, the run mode indicator in the bottom right corner of that key will display a DECEL run status icon to begin denoting deceleration. When the rotor comes to a complete stop, a STOP icon is displayed. To retrieve samples, press VACUUM, allow the vacuum to fully release, then open the chamber door.

To save, create or delete a program, or to use any of the options in the Function Field or Menu, consult the Operating Manual for complete instructions.

Chemical Compatibility Chart

CHEMICAL / MATERIAL	ALUMINUM	ANODIC COATING for ALUMINUM	BUNA N	CELLULOSE ACETATE BUTYRATE	POLYURETHANE ROTOR PAINT	COMPOSITE Carbon Fiber/Epoxy	DELRIN®	ETHYLENE PROPYLENE	GLASS	NEOPRENE	NORYL®	NYLON	PET[1], POLYCLEAR®,CLEARCRIMP®CCCLEARCRIMP®	POLYALLOMER	POLYCARBONATE	POLYESTER, GLASS THERMOSET	POLYTHERMIDE	POLYRTHYLENE	POLYPROPYLENE	POLYSULFONE	POLYVINYL CHLORIDE	RULON A®, TEFLON®	SILICONE RUBBER	STAINLESS STEEL	TITANIUM	TYGON®	VITON®
2-mercaptoethanol	S	S	U	-	S	M	S	-	S	U	S	S	U	S	S	-	S	S	S	S	U	S	S	S	S	S	S
Acetaldehyde	S	-	U	U	-	-	-	M	-	U	-	-	-	M	U	U	U	M	M	-	M	S	U	-	S	-	U
Acetone	M	S	U	U	S	U	M	S	S	U	U	S	U	S	U	U	U	S	S	U	U	S	M	M	S	U	U
Acetonitrile	S	S	U	-	S	M	S	-	S	S	U	S	U	M	U	U	-	S	M	U	U	S	S	S	S	U	U
Alconox®	U	U	S	-	S	S	S	-	S	S	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S	S	U
Allyl Alcohol	-	-	-	U	-	-	S	-	-	-	-	S	-	S	S	M	S	S	S	-	M	S	-	-	S	-	-
Aluminum Chloride	U	U	S	S	S	S	U	S	S	S	S	M	S	S	S	S	-	S	S	S	S	S	M	U	U	S	S
Formic Acid (100%)	-	S	M	U	-	-	U	-	-	-	-	U	-	S	M	U	U	S	S	-	U	S	-	U	S	-	U
Ammonium Acetate	S	S	U	-	S	S	S	-	S	S	S	S	S	S	S	U	-	S	S	S	S	S	S	S	S	S	S
Ammonium Carbonate	M	S	U	S	S	S	S	S	S	S	S	S	S	S	U	U	-	S	S	S	S	S	S	M	S	S	S
Ammonium Hydroxide (10%)	U	U	S	U	S	S	M	S	S	S	S	S	-	S	U	M	S	S	S	S	S	S	S	S	S	M	S
Ammonium Hydroxide (28%)	U	U	S	U	S	U	M	S	S	S	S	S	U	S	U	M	S	S	S	S	S	S	S	S	S	M	S
Ammonium Hydroxide (conc.)	U	U	U	U	S	U	M	S	-	S	-	S	U	S	U	U	S	S	S	-	M	S	S	S	S	-	U
Ammonium Phosphate	U	-	S	-	S	S	S	S	S	S	S	S	-	S	S	M	-	S	S	S	S	S	S	M	S	S	S
Ammonium Sulfate	U	M	S	-	S	S	U	S	S	S	S	S	S	S	S	S	-	S	S	S	S	S	S	U	S	S	U
Amyl Alcohol	S	-	M	U	-	-	S	S	-	M	-	S	-	M	S	S	S	S	M	-	-	-	U	-	S	-	M
Aniline	S	S	U	U	S	U	S	M	S	U	U	U	U	U	U	U	-	S	M	U	U	S	S	S	S	U	S
Sodium Hydroxide (<1%)	U	-	M	S	S	S	-	-	S	M	S	S	-	S	M	M	S	S	S	S	S	S	M	S	S	-	U
Sodium Hydroxide (10%)	U	-	M	U	-	-	U	-	M	M	S	S	U	S	U	U	S	S	S	S	S	S	M	S	S	-	U
Barium Salts	M	U	S	-	S	S	S	S	S	S	S	S	S	S	S	M	-	S	S	S	S	S	S	M	S	S	S
Benzene	S	S	U	U	S	U	M	U	S	U	U	S	U	U	U	M	U	M	U	U	U	S	U	U	S	U	S
Benzyl Alcohol	S	-	U	U	-	-	M	M	-	M	-	S	U	U	U	U	U	U	U	-	M	S	M	-	S	-	S
Boric Acid	U	S	S	M	S	S	U	S	S	S	S	S	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S
Cesium Acetate	M	-	S	-	S	S	S	-	S	S	S	S	-	S	S	-	-	S	S	S	S	S	S	M	S	S	S

CHEMICAL	MATERIAL	ALUMINUM	ANODIC COATING for ALUMINUM	BUNA N	CELLULOSE ACETATE BUTYRATE	POLYURETHANE ROTOR PAINT	COMPOSITE Carbon Fiber/Epoxy	DELRIN®	ETHYLENE PROPYLENE	GLASS	NEOPRENE	NORYL®	NYLON	PET[1], POLYCLEAR®, CLEARCRIMP®CCCLEARCRIMP®	POLYALLOMER	POLYCARBONATE	POLYESTER, GLASS THERMOSET	POLYTHERMIDE	POLYRTHYLENE	POLYPROPYLENE	POLYSULFONE	POLYVINYL CHLORIDE	RULON A®, TEFLON®	SILICONE RUBBER	STAINLESS STEEL	TITANIUM	TYGON®	VITON®
Cesium Bromide		M	S	S	-	S	S	S	-	S	S	S	S	S	S	S	-	-	S	S	S	S	S	S	M	S	S	S
Cesium Chloride		M	S	S	U	S	S	S	-	S	S	S	S	S	S	S	-	-	S	S	S	S	S	S	M	S	S	S
Cesium Formate		M	S	S	-	S	S	S	-	S	S	S	S	S	S	S	-	-	S	S	S	S	S	S	M	S	S	S
Cesium Iodide		M	S	S	-	S	S	S	-	S	S	S	S	S	S	S	-	-	S	S	S	S	S	S	M	S	S	S
Cesium Sulfate		M	S	S	-	S	S	S	-	S	S	S	S	S	S	S	-	-	S	S	S	S	S	S	M	S	S	S
Chloroform		U	U	U	U	S	S	M	U	S	U	U	M	U	M	U	U	U	M	M	U	U	S	U	U	U	M	S
Chromic Acid (10%)		U	-	U	U	S	U	U	-	S	S	S	U	S	S	M	U	M	S	S	U	M	S	M	U	S	S	S
Chromic Acid (50%)		U	-	U	U	-	U	U	-	-	-	S	U	U	S	M	U	M	S	S	U	M	S	-	U	M	-	S
Cresol Mixture		S	S	U	-	-	-	S	-	S	U	U	U	U	U	U	-	-	U	U	-	U	S	S	S	S	U	S
Cyclohexane		S	S	S	-	S	S	S	U	S	U	S	S	U	U	U	M	S	M	U	M	M	S	U	M	M	U	S
Deoxycholate		S	S	S	-	S	S	S	-	S	S	S	S	S	S	S	-	-	S	S	S	S	S	S	S	S	S	S
Distilled Water		S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Dextran		M	S	S	S	S	S	S	-	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	M	S	S	S
Diethyl Ether		S	S	U	U	S	S	S	U	S	U	U	S	U	U	U	U	U	U	U	U	U	S	S	S	S	M	U
Diethyl Ketone		S	-	U	U	-	-	M	-	S	U	-	S	-	M	U	U	U	M	M	-	U	S	-	-	S	U	U
Diethylpyrocarbonate		S	S	U	-	S	S	S	-	S	S	U	S	U	S	U	-	-	S	S	S	M	S	S	S	S	S	S
Dimethylsulfoxide		S	S	U	U	S	S	S	-	S	U	S	S	U	S	U	U	-	S	S	U	U	S	S	S	S	U	U
Dioxane		M	S	U	U	S	S	M	M	S	U	U	S	U	M	U	U	-	M	M	M	U	S	S	S	S	U	U
Ferric Chloride		U	U	S	-	-	-	M	S	-	M	-	S	-	S	-	-	-	S	S	-	-	-	M	U	S	-	S
Acetic Acid (Glacial)		S	S	U	U	S	S	U	M	S	U	S	U	U	U	U	U	M	S	U	M	U	S	U	U	S	-	U
Acetic Acid (5%)		S	S	M	S	S	S	M	S	S	S	S	S	M	S	S	S	S	S	S	S	M	S	S	M	S	S	M
Acetic Acid (60%)		S	S	U	U	S	S	U	-	S	M	S	U	U	M	U	S	M	S	M	S	M	S	M	U	S	M	U
Ethyl Acetate		M	M	U	U	S	S	M	M	S	S	U	S	U	M	U	U	-	S	S	U	U	S	M	M	S	U	U
Ethyl Alcohol (50%)		S	S	S	S	S	S	M	S	S	S	S	S	U	S	U	S	S	S	S	S	S	S	S	M	S	M	U
Ethyl Alcohol (95%)		S	S	S	U	S	S	M	S	S	S	S	S	U	S	U	-	S	S	S	M	S	S	S	U	S	M	U
Ethylene Dichloride		S	-	U	U	-	-	S	M	-	U	U	S	U	U	U	U	U	U	U	-	U	S	U	-	S	-	S
Ethylene Glycol		S	S	S	S	S	S	S	S	S	S	S	S	-	S	U	S	S	S	S	S	S	S	S	M	S	M	S
Ethylene Oxide Vapor		S	-	U	-	-	U	-	-	S	U	-	S	-	S	M	-	-	S	S	S	U	S	U	S	S	S	U
Ficoll-Hypaque®		M	S	S	-	S	S	S	-	S	S	S	S	-	S	S	-	S	S	S	S	S	S	S	M	S	S	S
Hydrofluoric Acid (10%)		U	U	U	M	-	-	U	-	-	U	U	S	-	S	M	U	S	S	S	S	M	S	U	U	U	-	-
Hydrofluoric Acid (50%)		U	U	U	U	-	-	U	-	-	U	U	U	U	S	U	U	U	S	S	M	M	S	U	U	U	-	M

CHEMICAL / MATERIAL	ALUMINUM	ANODIC COATING for ALUMINUM	BUNA N	CELLULOSE ACETATE BUTYRATE	POLYURETHANE ROTOR PAINT	COMPOSITE Carbon Fiber/Epoxy	DELRIN®	ETHYLENE PROPYLENE	GLASS	NEOPRENE	NORYL®	NYLON	PET[1], POLYCLEAR®, CLEARCRIMP®CCCLEARCRIMP®	POLYALLOMER	POLYCARBONATE	POLYESTER, GLASS THERMOSET	POLYTHERMIDE	POLYRTHYLENE	POLYPROPYLENE	POLYSULFONE	POLYVINYL CHLORIDE	RULON A®, TEFLON®	SILICONE RUBBER	STAINLESS STEEL	TITANIUM	TYGON®	VITON®
Hydrochloric Acid (conc.)	U	U	U	U	-	U	U	M	-	U	M	U	U	M	U	U	U	-	S	-	U	S	U	U	U	-	-
Formaldehyde (40%)	M	M	M	S	S	S	S	M	S	S	S	S	M	S	S	S	U	S	S	M	S	S	S	M	S	M	U
Glutaraldehyde	S	S	S	S	-	-	S	-	S	S	S	S	S	S	S	-	-	S	S	S	-	-	S	S	S	-	-
Glycerol	M	S	S	-	S	S	S	S	S	S	S	S	S	S	S	S	-	S	S	S	S	S	S	S	S	S	S
Guanidine Hydrochloride	U	U	S	-	S	S	S	-	S	S	S	S	S	S	S	-	-	S	S	S	S	S	S	U	S	S	S
Haemo-Sol®	S	S	S	-	-	-	S	-	S	S	S	S	S	S	S	-	-	S	S	S	S	S	S	S	S	S	S
Hexane	S	S	S	-	S	S	S	-	S	S	U	S	U	M	U	S	S	U	S	S	M	S	U	S	S	U	S
Isobutyl Alcohol	-	-	M	U	-	-	S	S	-	U	-	S	U	S	S	M	S	S	S	-	S	S	S	-	S	-	S
Isopropyl Alcohol	M	M	M	U	S	S	S	S	S	U	S	S	U	S	U	M	S	S	S	S	S	S	S	M	M	M	S
Iodoacetic Acid	S	S	M	-	S	S	S	-	S	M	S	S	M	S	S	-	M	S	S	S	S	S	M	S	S	M	M
Potassium Bromide	U	S	S	-	S	S	S	-	S	S	S	S	S	S	S	S	S	S	S	-	S	S	S	M	S	S	S
Potassium Carbonate	M	U	S	S	S	S	S	-	S	S	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S
Potassium Chloride	U	S	S	-	S	S	S	S	S	S	S	S	S	S	S	-	S	S	S	S	S	S	S	U	S	S	S
Potassium Hydroxide (5%)	U	U	S	S	S	S	M	-	S	S	S	S	-	S	U	S	S	S	S	S	S	S	M	U	M	S	U
Potassium Hydroxide (conc.)	U	U	M	U	-	-	M	-	M	S	S	-	U	M	U	U	U	S	M	-	M	U	-	U	U	-	U
Potassium Permanganate	S	S	S	-	S	S	S	-	S	S	S	U	S	S	S	M	-	S	M	S	U	S	S	M	S	U	S
Calcium Chloride	M	U	S	S	S	S	S	S	S	S	S	S	S	S	M	S	-	S	S	S	S	S	S	M	S	S	S
Calcium Hypochlorite	M	-	U	-	S	M	M	S	-	M	-	S	-	S	M	S	-	S	S	S	M	S	M	U	S	-	S
Kerosene	S	S	S	-	S	S	S	U	S	M	U	S	U	M	M	S	-	M	M	M	S	S	U	S	S	U	S
Sodium Chloride (10%)	S	-	S	S	S	S	S	S	-	-	-	S	S	S	S	S	-	S	S	S	S	-	S	S	M	-	S
Sodium Chloride (sat'd)	U	-	S	U	S	S	S	-	-	-	-	S	S	S	S	S	-	S	S	-	S	-	S	S	M	-	S
Carbon Tetrachloride	U	U	M	S	S	U	M	U	S	U	U	S	U	M	U	S	S	M	M	S	M	M	M	M	U	S	S
Aqua Regia	U	-	U	U	-	-	U	-	-	-	-	-	U	U	U	U	U	U	U	-	-	-	-	-	S	-	M
Solution 555 (20%)	S	S	S	-	-	-	S	-	S	S	S	S	S	S	S	-	-	S	S	S	-	S	S	S	S	S	S
Magnesium Chloride	M	S	S	-	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	M	S	S	S
Mercaptoacetic Acid	U	S	U	-	S	M	S	-	S	M	S	U	U	U	U	-	S	U	U	S	M	S	U	S	S	S	S
Methyl Alcohol	S	S	S	U	S	S	M	S	S	S	S	S	U	S	U	M	S	S	S	S	S	S	S	M	S	M	U
Methylene Chloride	U	U	U	U	M	S	S	U	S	U	U	S	U	U	U	U	U	M	U	U	U	S	S	M	U	S	U
Methyl Ethyl Ketone	S	S	U	U	S	S	M	S	S	U	U	S	U	S	U	U	U	S	S	U	U	S	S	S	S	U	U
Metrizamide®	M	S	S	-	S	S	S	-	S	S	S	S	-	S	S	-	-	S	S	S	S	S	S	M	S	S	S
Lactic Acid (100%)	-	-	S	-	-	-	-	-	-	M	S	U	-	S	S	S	M	S	S	-	M	S	M	S	S	-	S

CHEMICAL	MATERIAL	ALUMINUM	ANODIC COATING for ALUMINUM	BUNA N	CELLULOSE ACETATE BUTYRATE	POLYURETHANE ROTOR PAINT	COMPOSITE Carbon Fiber/Epoxy	DELRIN®	ETHYLENE PROPYLENE	GLASS	NEOPRENE	NORYL®	NYLON	PET[1], POLYCLEAR®, CLEARCRIMP®CCCLEARCRIMP®	POLYALLOMER	POLYCARBONATE	POLYESTER, GLASS THERMOSET	POLYTHERMIDE	POLYRTHYLENE	POLYPROPYLENE	POLYSULFONE	POLYVINYL CHLORIDE	RULON A®, TEFLON®	SILICONE RUBBER	STAINLESS STEEL	TITANIUM	TYGON®	VITON®
Lactic Acid (20%)		-	-	S	S	-	-	-	-	-	M	S	M	-	S	S	S	S	S	S	S	M	S	M	S	S	-	S
N-Butyl Alcohol		S	-	S	U	-	-	S	-	-	S	M	-	U	S	M	S	S	S	S	M	M	S	M	-	S	-	S
N-Butyl Phthalate		S	S	U	-	S	S	S	-	S	U	U	S	U	U	U	M	-	U	U	S	U	S	M	M	S	U	S
N, N-Dimethylformamide		S	S	S	U	S	M	S	-	S	S	U	S	U	S	U	U	-	S	S	U	U	S	M	S	S	S	U
Sodium Borate		M	S	S	S	S	S	S	S	S	S	S	U	S	S	S	S	-	S	S	S	S	S	S	M	S	S	S
Sodium Bromide		U	S	S	-	S	S	S	-	S	S	S	S	S	S	S	S	-	S	S	S	S	S	S	M	S	S	S
Sodium Carbonate (2%)		M	U	S	S	S	S	S	S	S	S	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S
Sodium Dodecyl Sulfate		S	S	S	-	S	S	S	-	S	S	S	S	S	S	S	-	S	S	S	S	S	S	S	S	S	S	S
Sodium Hypochlorite (5%)		U	U	M	S	S	M	U	S	S	M	S	S	S	M	S	S	S	S	M	S	S	S	M	U	S	M	S
Sodium Iodide		M	S	S	-	S	S	S	-	S	S	S	S	S	S	S	-	-	S	S	S	S	S	S	M	S	S	S
Sodium Nitrate		S	S	S	-	S	S	S	S	S	S	S	S	S	S	S	S	-	S	S	S	S	S	U	S	S	S	S
Sodium Sulfate		U	S	S	-	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	M	S	S	S
Sodium Sulfide		S	-	S	S	-	-	-	S	-	-	-	S	S	S	U	U	-	-	S	-	-	-	S	S	M	-	S
Sodium Sulfite		S	S	S	-	S	S	S	S	M	S	S	S	S	S	S	M	-	S	S	S	S	S	S	S	S	S	S
Nickel Salts		U	S	S	S	S	S	-	S	S	S	-	-	S	S	S	S	-	S	S	S	S	S	S	M	S	S	S
Oils (Petroleum)		S	S	S	-	-	-	S	U	S	S	S	S	U	U	M	S	M	U	U	S	S	S	U	S	S	S	S
Oils (Other)		S	-	S	-	-	-	S	M	S	S	S	S	U	S	S	S	S	U	S	S	S	S	-	S	S	M	S
Oleic Acid		S	-	U	S	S	S	U	U	S	U	S	S	M	S	S	S	S	S	S	S	S	S	M	U	S	M	M
Oxalic Acid		U	U	M	S	S	S	U	S	S	S	S	S	U	S	U	S	S	S	S	S	S	S	S	U	M	S	S
Perchloric Acid (10%)		U	-	U	-	S	U	U	-	S	M	M	-	-	M	U	M	S	M	M	-	M	S	U	-	S	-	S
Perchloric Acid (70%)		U	U	U	-	-	U	U	-	S	U	M	U	U	M	U	U	U	M	M	U	M	S	U	U	S	U	S
Phenol (5%)		U	S	U	-	S	M	M	-	S	U	M	U	U	S	U	M	S	M	S	U	U	S	U	M	M	M	S
Phenol (50%)		U	S	U	-	S	U	M	-	S	U	M	U	U	U	U	U	S	U	M	U	U	S	U	U	U	M	S
Phosphoric Acid (10%)		U	U	M	S	S	S	U	S	S	S	S	U	-	S	S	S	S	S	S	S	S	S	U	M	U	S	S
Phosphoric Acid (conc.)		U	U	M	M	-	-	U	S	-	M	S	U	U	M	M	S	S	S	M	S	M	S	U	M	U	-	S
Physiologic Media (Serum, Urine)		M	S	S	S	-	-	S	-	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Picric Acid		S	S	U	-	S	M	S	S	S	M	S	U	S	S	S	U	S	S	S	S	U	S	U	M	S	M	S
Pyridine (50%)		U	S	U	U	S	U	U	-	U	S	S	U	U	M	U	U	-	U	S	M	U	S	S	U	U	U	U
Rubidium Bromide		M	S	S	-	S	S	S	-	S	S	S	S	S	S	S	-	-	S	S	S	S	S	S	M	S	S	S
Rubidium Chloride		M	S	S	-	S	S	S	-	S	S	S	S	S	S	S	-	-	S	S	S	S	S	S	M	S	S	S
Sucrose		M	S	S	-	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S

CHEMICAL	MATERIAL	ALUMINUM	ANODIC COATING for ALUMINUM	BUNA N	CELLULOSE ACETATE BUTYRATE	POLYURETHANE ROTOR PAINT	COMPOSITE Carbon Fiber/Epoxy	DELRIN®	ETHYLENE PROPYLENE	GLASS	NEOPRENE	NORYL®	NYLON	PET[1], POLYCLEAR®, CLEARCRIMP®CCCLEARCRIMP®	POLYALLOMER	POLYCARBONATE	POLYESTER, GLASS THERMOSET	POLYTHERMIDE	POLYRTHYLENE	POLYPROPYLENE	POLYSULFONE	POLYVINYL CHLORIDE	RULON A®, TEFLON®	SILICONE RUBBER	STAINLESS STEEL	TITANIUM	TYGON®	VITON®
Sucrose, Alkaline		M	S	S	-	S	S	S	-	S	S	S	S	S	S	U	S	S	S	S	S	S	S	S	M	S	S	S
Sulfosalicylic Acid		U	U	S	S	S	S	S	-	S	S	S	U	S	S	S	-	S	S	S	-	S	S	S	U	S	S	S
Nitric Acid (10%)		U	S	U	S	S	U	U	-	S	U	S	U	-	S	S	S	S	S	S	S	S	S	M	S	S	S	S
Nitric Acid (50%)		U	S	U	M	S	U	U	-	S	U	S	U	U	M	M	U	M	M	M	S	S	S	U	S	S	M	S
Nitric Acid (95%)		U	-	U	U	-	U	U	-	-	U	U	U	U	M	U	U	U	U	M	U	U	S	U	S	S	-	S
Hydrochloric Acid (10%)		U	U	M	S	S	S	U	-	S	S	S	U	U	S	U	S	S	S	S	S	S	S	S	U	M	S	S
Hydrochloric Acid (50%)		U	U	U	U	S	U	U	-	S	M	S	U	U	M	U	U	S	S	S	S	M	S	M	U	U	M	M
Sulfuric Acid (10%)		M	U	U	S	S	U	U	-	S	S	M	U	S	S	S	S	S	S	S	S	S	S	U	U	U	S	S
Sulfuric Acid (50%)		M	U	U	U	S	U	U	-	S	S	M	U	U	S	U	U	M	S	S	S	S	S	U	U	U	M	S
Sulfuric Acid (conc.)		M	U	U	U	-	U	U	M	-	-	M	U	U	S	U	U	U	M	S	U	M	S	U	U	U	-	S
Stearic Acid		S	-	S	-	-	-	S	M	S	S	S	S	-	S	S	S	S	S	S	S	S	S	M	M	S	S	S
Tetrahydrofuran		S	S	U	U	S	U	U	M	S	U	U	S	U	U	U	-	M	U	U	U	U	S	U	S	S	U	U
Toluene		S	S	U	U	S	S	M	U	S	U	U	S	U	U	U	S	U	M	U	U	U	S	U	S	U	U	M
Trichloroacetic Acid		U	U	U	-	S	S	U	M	S	U	S	U	U	S	M	-	M	S	S	U	U	S	U	U	U	M	U
Trichloroethane		S	-	U	-	-	-	M	U	-	U	-	S	U	U	U	U	U	U	U	U	U	S	U	-	S	-	S
Trichloroethylene		-	-	U	U	-	-	-	U	-	U	-	S	U	U	U	U	U	U	U	U	U	S	U	-	U	-	S
Trisodium Phosphate		-	-	-	S	-	-	M	-	-	-	-	-	-	S	-	-	S	S	S	-	-	S	-	-	S	-	S
Tris Buffer (neutral pH)		U	S	S	S	S	S	S	-	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Triton X-100®		S	S	S	-	S	S	S	-	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Urea		S	-	U	S	S	S	S	-	-	-	-	S	S	S	M	S	S	S	S	-	S	S	S	M	S	-	S
Hydrogen Peroxide (10%)		U	U	M	S	S	U	U	-	S	S	S	U	S	S	S	M	U	S	S	S	S	S	S	M	S	U	S
Hydrogen Peroxide (3%)		S	M	S	S	S	-	S	-	S	S	S	S	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S
Xylene		S	S	U	S	S	S	M	U	S	U	U	U	U	U	U	M	U	M	U	U	U	S	U	M	S	U	S
Zinc Chloride		U	U	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	U	S	S	S
Zinc Sulfate		U	S	S	-	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Citric Acid (10%)		M	S	S	M	S	S	M	S	S	S	S	S	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S

[1]Polyethyleneterephthalate

Key

S Satisfactory

M M = Moderate attack, may be satisfactory for use in centrifuge depending on length of exposure, speed involved, etc.; suggest testing under actual conditions of use.

U U = Unsatisfactory, not recommended.

-- Performance unknown; suggest testing, using sample to avoid loss of valuable material.

Chemical resistance data is included only as a guide to product use. Because no organized chemical resistance data exists for materials under the stress of centrifugation, when in doubt we recommend pretesting sample lots.

WARRANTY

THERMO FISHER 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 Fisher Scientific warrants each Sorvall WX Ultra series 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 Fisher Scientific agrees to correct, either by repair or, at Thermo Fisher Scientific's selection, 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 Fisher Scientific discloses that such defect developed under normal and proper usage. The exceptions and conditions mentioned above are the following:

1. 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 Fisher Scientific and part of the instrument sold fails to give reasonable service for a reasonable period of time, Thermo Fisher Scientific will, at its selection, 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 Fisher Scientific, after Thermo Fisher Scientific 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 Fisher Scientific

2. All items claimed defective must be returned to Thermo Fisher Scientific, transportation charges prepaid, and will be returned to Buyer with transportation charges prepaid. Thermo Fisher Scientific 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 Fisher Scientific.

3. Thermo Fisher Scientific 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 warranty and subject to the foregoing exceptions and conditions, Thermo Fisher Scientific warrants the drive assembly of the Sorvall WX Ultra series ultracentrifuge to be free from defects in material or workmanship for ten (10) years (without proration) from the date of 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 Thermo Fisher Scientific or by a service representative authorized, in writing, by Thermo Fisher Scientific. If any defect should happen to the drive unit within the afore said warranty period, the defective drive unit shall be replaced at no cost to the Buyer.

Extended Warranties are conditional on the instrument being correctly maintained by authorized Service Representatives on an annual basis.

THERMO FISHER SCIENTIFIC 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 Thermo Fisher Scientific, which are inconsistent or in conflict with the terms of this warranty (including but not limited to the limitations of the liability of Thermo Fisher Scientific as set forth above), shall not be binding upon Thermo Fisher Scientific unless reduced to writing and approved by Thermo Fisher Scientific.

NO CLAIM OF ANY KIND, WHETHER IT IS TO GOODS DELIVERED OR FOR NON DELIVERY 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 Thermo Fisher Scientific in writing. Goods shall not be returned to Thermo Fisher Scientific without Thermo Fisher Scientific's permission.

Terms may vary by country. Please contact your local sales office for further information.

Contact Information

United States	866-9-THERMO
	+1 866 984 3766
Canada	+1 866 984 3766
Austria	+43 1 801 400
Belgium	+32 2 482 30 30
Germany	08001 536 376
	+49 6184 90 6940
France	+33 2 2803 2180
Italy	+39 02 02 95059 434-254-375
Netherlands	+31 76 571 4440
Nordic / Baltic Countries	+35 89 329 100
Russia/CIS	+7 (812) 703 42 15

Spain	+34 932 23 09 18
Portugal	+34 932 23 09 18
Switzerland	+41 44 454 12 12
UK / Ireland	+44 870 609 9203
China	+86 21 6865 4588
	+86 10 8419 3588
India	1800 22 8374
	+91 22 6716 2200
Japan	+81 45 453 9220
Other Asian Countries	+852 2885 4613
Other Countries	+49 6184 90 6940
	+33 2 2803 2180