# RC-5C Plus
## User´s Manual


Analyze • Detect • Measure • Control™

PN 74559 - 9

Thermo
SCIENTIFIC

# *OPERATING INSTRUCTIONS*

# SORVALL® RC-5C PLUS

## Superspeed Centrifuge

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

SORVALL®

PN 74559-9
Issued February 2007

This manual is a guide for use of the

# *SORVALL® RC-5C PLUS Superspeed Centrifuge*

Data 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 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.

Publications prior to the Issue Date of this manual may contain data in apparent conflict with that provided herein. Please consider all data in this manual to be the most curent.

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

***WARNING*** informs the operator of a hazard or an unsafe practice that could result in personal injury, affect the operator's health, or contaminate the environment.

***CAUTION*** informs the operator of an unsafe practice that could result in damage of equipment.

***NOTE*** highlights essential information.

***CAUTION*** and ***WARNING*** are accompanied by a hazard symbol  and appear in the left sidebar near the information they correspond to.

# Important Safety Information

**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 this manual.**

## WARNING

Use specified SORVALL® rotors only. Use of another manufacturer's rotor can cause rotor failure which could result in personal injury and/or centrifuge damage.

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. In the event of a tube failure, a rotor without a biocontainment seal cannot protect you from particles dispersed into the air; if a rotor fails, the centrifuge cannot protect you from particles dispersed into 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.

Never use any material capable of producing flammable or explosive vapors or creating extreme exothermic reactions.

Never exceed the maximum rated speed of the installed rotor; to do so can cause rotor failure.

Always reduce (derate) rotor speed as instructed in this manual whenever:

- the rotor speed/temperature combination exceeds the solubility of the gradient material and causes it to precipitate.
- the compartment load exceeds the maximum allowable compartment load specified. See Chapter 4, Operation.

Failure to reduce rotor speed under these conditions can cause rotor failure.

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 materials), and do not work on top of or next to the centrifuge.

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.

Do not attempt to open the chamber door when the rotor is spinning; never override or otherwise disable any of the safety systems of the centrifuge.

## CAUTION

Do not operate or precool a rotor at the critical speed, as this will have a detrimental effect on centrifuge component life. See Appendix, Rotor Information Table, for critical speeds of rotors.

Do not operate the centrifuge with the rotor out of balance. Operating the rotor out of balance can cause damage to the centrifuge drive assembly.

Do not operate the centrifuge unless the rotor is properly seated on the drive spindle and locked in place. See the rotor instruction manual.

Locate the centrifuge on a level surface to avoid rotor imbalance during operation.

The centrifuge can be damaged if it is connected to the wrong voltage. Check the voltage before plugging the centrifuge into a power source. Thermo is not responsible for incorrect installation. See Chapter 2.

Always maintain the centrifuge in the recommended manner. See Chapter 5, Care and Maintenance.

# Table of Contents

Page

## Chapter 4. OPERATION



## Chapter 5. CARE AND MAINTENANCE



## APPENDIX

# Table of Contents (continued)

## List of Illustrations



## List of Tables

# Chapter 1: INTRODUCTION & DESCRIPTION

This manual provides you with the information you will need to operate and maintain your SORVALL® RC-5C PLUS Superspeed Centrifuge. If you encounter any problem concerning either operation or maintenance that is not covered in the manual, please contact our Technical Support Group for assistance. In the United States, call toll-free 800-522-7746; outside the United States, contact your local distributor or agent for SORVALL® products. SORVALL® product information is available on our internet web site at **http://www.*thermo*.com** or **http://www.*thermo*.de**.

## Centrifuge Description

The RC-5C PLUS is a high-speed (to 21 000 rpm) centrifuge used to separate substances of different densities at controlled temperatures. Some of the outstanding features of the RC-5C PLUS are:

- A high-performance brushless dc drive motor.
- Relative Centrifugal Force (RCF, or *g*-force) calculator. It allows you to calculate RCF before a run and display RCF at any time during a run.
- Automatic temperature compensation for all compatible SORVALL® superspeed rotors.
- Integrator ($\int\omega^2 dt$). It can be used either as a control or a display or both. When used as a control, the centrifuge will shut down based on a preselected integral value rather than a preselected time and when used as a display, the accumulated integral value will be displayed during and after a timed run.
- Automatic rate-controlled slow start and slow stop.
- Refrigeration system charged with CFC-free SUVA® refrigerant.
- Automatic diagnostic indicators to alert of a system malfunction, plus other indicators that let you know system status.
- Automatic self-test routine by the microcomputer. Every time the centrifuge is started, the microcomputer will go through a routine check to ensure its proper performance.

The centrifuge can be operated in several modes or a combination of modes. Run conditions are selected by setting the switches on the front control panel, and during operation, actual run conditions are indicated on easy-to-read displays. For your protection, system interlocks keep the centrifuge from starting if the chamber door is open, and prevent the door from being opened if a run is in progress and the rotor is spinning. System interlocks will also automatically terminate a run in progress if a system malfunctions.

The RC-5C PLUS drive system has a directly coupled, fan-cooled brushless dc motor designed to provide long life without the need to change motor brushes. The high-torque motor provides smooth, quiet operation at all speeds, while delivering precise speed control and exceptional acceleration and braking performance. The gyro-action self-centering drive design allows users to, in many cases, balance the centrifuge tubes by "eye" rather than by weighing them.

The refrigeration system, charged with environmentally-friendly CFC-free SUVA® refrigerant, offers reliable performance similar to earlier SORVALL® superspeed centrifuges. The high-capacity refrigeration system is a low temperature, hermetically-sealed unit that consists of a compressor, a condenser, an evaporator/rotor chamber, and interconnecting tubing. During operation, the refrigeration system will maintain selected temperatures within the range specified for the centrifuge.

The RC-5C PLUS accepts the SORVALL® superspeed rotors listed in the Rotor Information Table in the Appendix.

Refer to figure 1-1 to identify the parts of the RC-5C PLUS.

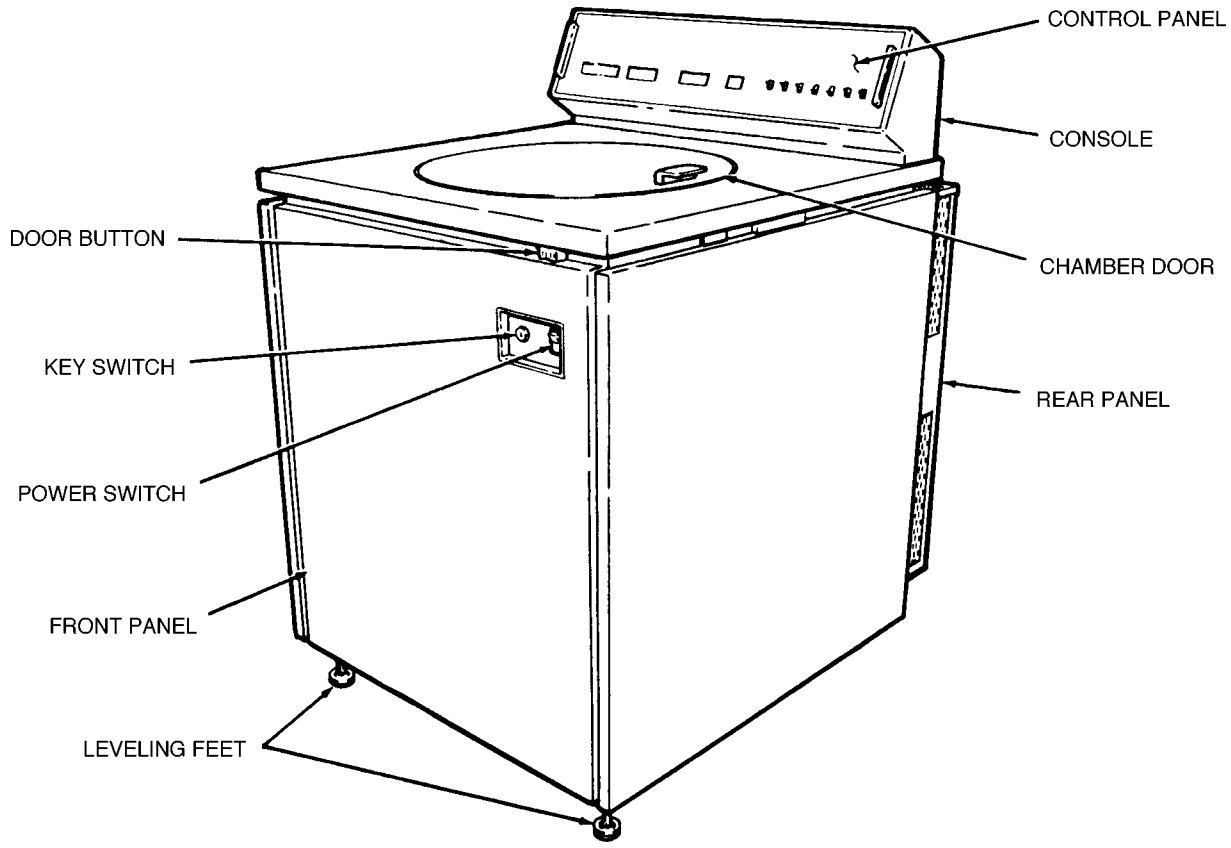



*Figure 1-1 Centrifuge Parts Location and Identification*

# Centrifuge Specifications

| | |
|---|---|
| Run Speed[1] | |
| Speed Selection Range (rpm) | 50 to 21 000 |
| Speed Control Accuracy | ±1% or 100 rpm, whichever is greater |
| Maximum Relative Centrifugal Force | 51 427 *g* |
| Run Temperature | |
| Temperature Selection Range | –20 to +40°C |
| Temperature Control Range | +2 to +40°C[2,3] |
| Temperature Control Accuracy | ±2°C[3,4] |
| Run Time Selection Range | 0 to 99 hr, 59 min or Hold |
| Ambient Temperature Range | +15 to +38°C[3] |
| Mass (Weight) | 362 kg (800 lb) |
| Dimensions | |
| Width | 76 cm (30 in) |
| Height to top of control console | 114 cm (45 in) |
| Depth | 99 cm (39 in) |
| Noise Level | <62 dB[5] |
| Heat Output | 4 kW[6] (13 500 Btu/h[6]) |
| Electrical Requirements | |
| Input Power (single phase, 30 A) | 240 V, 50 Hz<br>230 V, 60 Hz<br>230 V, 50 Hz<br>220 V, 50 Hz<br>208 V, 60 Hz<br>200 V, 60 Hz<br>200 V, 50 Hz |
| (polyphase, 30 A) | 230 V, 50 Hz |

1 Speed in revolutions per minute (rpm) is related to angular velocity, $\omega$, according to the following:

$$\omega = (\text{rpm})\left(\frac{2\pi}{60}\right) = (\text{rpm})\,(0.10472)$$

Where $\omega$ = rad/s. All further references in this manual to speed will be designated as rpm.

2 May vary at very low speeds (below approximately 2000 rpm).

3 The centrifuge will operate at ambient temperatures up to 38°C, but refrigeration system performance may be less than optimal above 25°C.

4 After the centrifuge system has reached equilibrium.

5 For the SE-12 rotor at 21 000 rpm, measured 3 feet from the front panel at an approximated operator's height.

6 For the SS-34 rotor spinning 20 000 rpm at 4°C, after it has reached equilibrium. Other rotors, speeds, and temperatures cause the heat output to vary.

# Centrifuge Specifications *(continued)*

Electrical Requirements, continued

Receptacles

- for 230 V, 50Hz, single phase . . . . . 3-pin IEC 60309
- for all other single phase . . . . . NEMA 6-30R
  (for NEMA 6-30P grounded plug, supplied)
- for 230 V, 50Hz, polyphase . . . . . 5-pin IEC 60309

# Centrifuge Accessories

The following items are provided with the centrifuge:

| Catalog No. | Description |
|---|---|
| 74567 | Condensed Operating Instructions |
| 74559 | Instruction Manual |
| 68025 | 9/16-inch Wrench |
| 91499 | NORMAL/ZONAL Key |

# Chapter 2: INSTALLATION

After you receive your centrifuge, inspect it for damage before using it. The RC-5C PLUS centrifuge must be installed in a location that meets all of the electrical, location, and environment requirements that are specified below and on the next page. Installation instructions are on page 2-3.

## Inspection

As soon as you receive your RC-5C PLUS, carefully inspect it for any shipping damage that may have occurred. If you find any damage, please report it immediately to the transportation company and file a damage claim, then notify Thermo. If any parts are missing, contact one of the Thermo district offices or the local representative of SORVALL® products. You will find a list of offices on the back cover of this manual.

## Electrical Requirements

The appropriate power source must be available to plug the centrifuge into. Check the nameplate on the back panel of the centrifuge to determine the electrical configuration of your centrifuge, which should be one of the following:

| | |
|---|---|
| 200V, 60Hz, 30A, single phase | 230V, 60Hz, 30A, single phase |
| 200V, 50Hz, 30A, single phase | 230V, 50Hz, 32A, single phase |
| 208V, 60Hz, 30A, single phase | 230V, 50Hz, 32A, polyphase |
| 220V, 50Hz, 30A, single phase | 240V, 50Hz, 30A, single phase |

**CAUTION**

The centrifuge can be damaged if it is connected to the wrong line voltage, or if line voltage varies more than ±10% of its nominal value. Check the voltage before plugging the centrifuge into any power source. Thermo is not responsible for improper installation.

Check the supply line voltage with a voltmeter, then verify that the voltage indicated on the nameplate is in agreement with the measured line voltage. If the measured line voltage is not within 10% of the voltage specified on the nameplate, do not connect the power cord and operate the centrifuge. Damage to the centrifuge may result. To connect the centrifuge to a voltage other than what is specified on the nameplate (including polyphase), it will have to be rewired and its power cord may have to be replaced. Contact Thermo to have a Field Service Engineer do the rewiring.

*Single phase* RC-5C PLUS Centrifuges are equipped with a three-wire power cord with three-prong connector to fit a NEMA 6-30P receptacle or equivalent or, on 230V 50Hz centrifuges, an IEC 60309-type three-pin receptacle (32A, 2-pole and earth). 230V 50Hz *polyphase* RC-5C PLUS Centrifuges are equipped with a four-wire power cord with five-pin connector to fit an IEC 60309-type five-pin receptacle (32 A, 3-pole, neutral and earth).

A qualified technician may change the power cord to meet local electrical code requirements; the green and yellow wire is the ground and must be connected to the centrifuge frame.

A dedicated circuit is required. The ON/OFF main power switch is a 30-Amp circuit breaker; however, for emergency disconnect purposes, we recommend a separate means of power interruption in a remote location.

## Environment Requirements

Ambient air temperature at the centrifuge air inlets must be between 15°C to 38°C (59°F to 100°F), with relative humidity ≤90%, for the centrifuge to operate. If the ambient air temperature is above 25°C, the centrifuge may not maintain low temperatures at high speeds, therefore, avoid areas near heat sources (for example, heating pipes and radiators). Also, avoid close grouping of centrifuges or other heat-producing laboratory equipment.

The centrifuge is intended for use in 1) a Pollution Degree 2 Environment, 2) an installation category II supply circuit, 3) at a maximum altitude of 2000 meters, and 4) for indoor use only.

## Location Requirements

Locate the RC-5C PLUS centrifuge on a level floor. In addition to considering ambient temperature (see environment requirements, above), allowing adequate space for air circulation is important for the centrifuge to function properly. To ensure free air circulation, the centrifuge must be positioned so that no air vents are blocked, in a location that allows an additional 10 cm (4 inches) clearance from all sides of the centrifuge.

**CAUTION**

Leave adequate space for air flow around the centrifuge and make sure no vents are blocked. Blocking the air flow entering and/or exiting the centrifuge can result in reduced performance, overheating and possible centrifuge damage.

For safety, personnel should know that centrifuges routinely deal with high energy levels and could move suddenly in the unlikely event of a rotor failure. Laboratory management procedures should require that no person or any hazardous materials are within a "clearance envelope" boundary of 300 mm (12 inches) from the centrifuge while it is operating. During centrifuge operation, personnel should be instructed not to lean on or move the centrifuge, not to stay within the clearance envelope longer than necessary for operational reasons, and not to deposit potentially hazardous materials within the clearance envelope.

# Installation

**WARNING**

The RC-5C PLUS Centrifuge weighs 362 kg (800 lb). Take the necessary precautions when installing and moving the centrifuge to avoid personal injury and/or damage to the centrifuge.

**CAUTION**

The centrifuge can be seriously damaged if it is operated when it is not level.

**WARNING**

The front feet must be used as explained in this section to lift the casters off the floor. This will help minimize centrifuge movement in the event of a rotor failure.

Install the RC-5C PLUS centrifuge as follows, observing all electrical, location, and environment requirements listed on the preceding pages:

1. *If you are installing a new centrifuge*, remove any packaging.
2. Roll centrifuge into position, then turn the two front feet (one at each corner) to lower them so that they both touch the floor.
3. If the chamber door is not already open, open it by following the emergency sample recovery procedure in Chapter 5.
4. Install a rotor on the drive spindle WITHOUT its lid. Place a level on the center hub of the rotor.
5. Using the 9/16-inch wrench provided, alternately turn the two front feet to raise or lower the front corners of the centrifuge until the centrifuge is level and both feet bear weight. ***Read the CAUTION/WARNING.***
6. Remove the level and the rotor from the rotor chamber.
7. Plug the centrifuge into the appropriate electrical outlet.

# Chapter 3: CONTROLS, DISPLAYS & INDICATORS

This chapter describes the RC-5C PLUS centrifuge controls, displays, and indicators and includes their locations and functions.

## Controls, Displays, & Indicators

The RC-5C PLUS control switches are used to select desired run parameters and, during a run, digital displays indicate actual run conditions, such as estimated sample temperature, rotor speed, remaining or elapsed run time or accumulated integral value. Indicators light up, as required, to show that you have selected certain run conditions (for example, HOLD or $\int\omega^2 dt$) or to let you know when the centrifuge is not functioning properly.

Refer to figure 3-1 for the location of the controls, displays, and indicators described in this chapter.

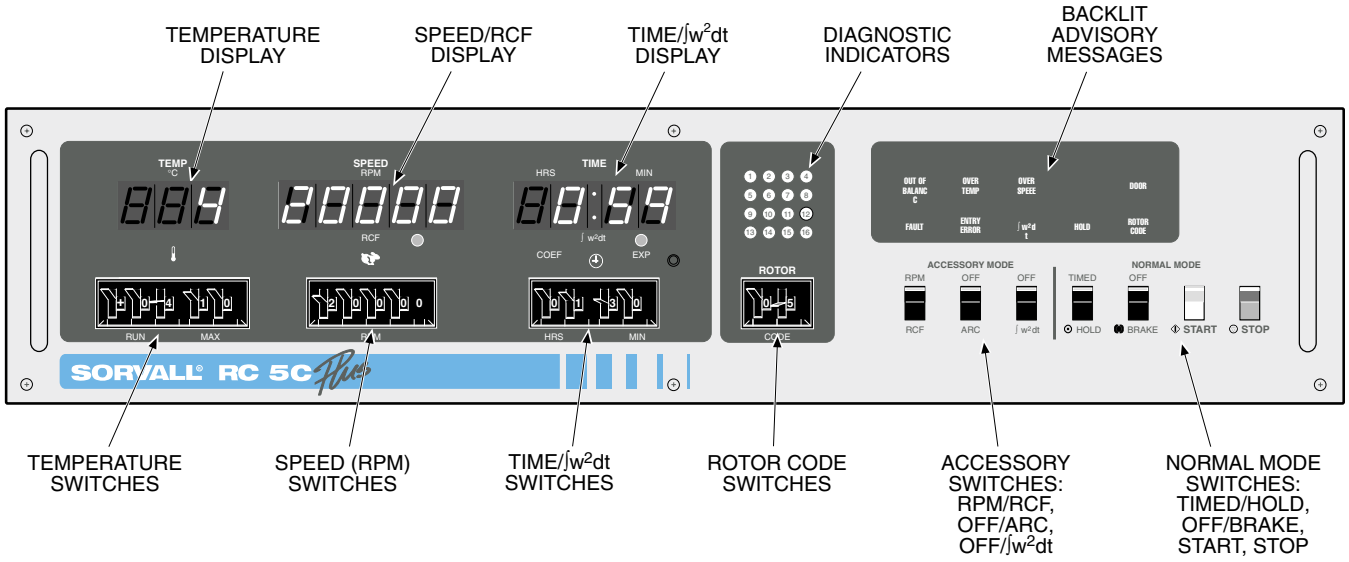
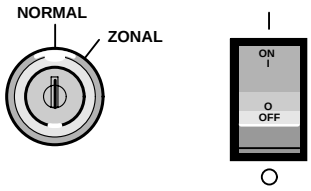



*Figure 3-1. RC-5C PLUS Control Panel*




## Key Switch and Power Switch

The key switch and power switch are located in the upper right-hand corner of the front cabinet panel. The key switch is set using the key that is supplied with the centrifuge; the position of this switch determines the mode of centrifuge operation. The key should be kept in the NORMAL position unless you need to dynamically load the TZ-28 zonal rotor. The power switch (30 A circuit breaker) is an ON/OFF toggle switch that, when set to ON, applies power to the centrifuge.

## Temperature Switches and Display

The temperature display indicates estimated sample temperature.

The RUN temperature switch is used to set desired sample temperature. The MAX temperature switch is used to set the overtemperature, which is the maximum permissible sample temperature. (If the sample temperature exceeds this limit, the centrifuge will shut off and the OVERTEMP message will light.)

## Speed Switches, Display, & Indicator

The Speed/RCF display indicates rotor speed in rpm (revolutions per minute) or RCF (relative centrifugal force, commonly referred to as *g* force) when the RPM/RCF switch is pressed to RCF.

The indicator below the display lights when the RPM/RCF switch is pressed to RCF.

The RPM switches are used to set the desired run speed.

## *Time/$\int\omega^2 dt$ Switches, Display, & Indicator*

The Time/$\int\omega^2 dt$ display shows one of the following values during a run: (1) accumulated run time if the TIMED/HOLD switch is set to HOLD, (2) remaining run time if the TIMED/HOLD switch is set to TIMED and the OFF/$\int\omega^2 dt$ switch is set to OFF, or (3) accumulated integral value if the OFF/$\int\omega^2 dt$ switch is set to $\int\omega^2 dt$. Time values are displayed in hours and minutes and integral values are displayed as a coefficient and an exponent (for example, 15 20 means $1.5 \times 10^{20}$).

The indicator below the display will light if the OFF/$\int\omega^2 dt$ switch is set to $\int\omega^2 dt$.

The Time/$\int\omega^2 dt$ switches are used to select either the desired length of run time (hours and minutes) or the desired integral value (coefficient and exponent), depending on the setting of the OFF/$\int\omega^2 dt$ switch when the START switch is pressed. The centrifuge will shut off when the preselected value is achieved, provided the TIMED/HOLD switch is set to TIMED (if the switch is set to HOLD, the run will continue until STOP is pressed).

## *Rotor Code Switches*

The code number of the rotor in use must be set on these switches for proper automatic temperature compensation, speed control, and RCF calculation. At the beginning of each run, the ROTOR CODE message light will flash on and off to remind you to enter the proper code number.

## *TIMED/HOLD Switch*

The setting of this switch determines how the run will end:

- If the TIMED/HOLD switch is set at TIMED when the START switch is pressed, the run will end when the preselected length of time has elapsed or the preselected integral value has accumulated, depending on the setting of the OFF/$\int\omega^2 dt$ switch.

- If set at HOLD when the START switch is pressed, the run will continue until you press the STOP switch. If the setting is changed from TIMED to HOLD during a run, the run will not end until you press the STOP switch.

## OFF/BRAKE Switch

When the OFF/BRAKE switch is set to BRAKE, the rotor will brake (rather than coast) all the way from set speed to 0 rpm at the end of the run, unless the OFF/ARC switch is set to ARC; if this is the case, the rotor will brake from set speed to 768 rpm, then continue to decelerate to 0 rpm at a controlled rate.

When the OFF/BRAKE switch is set to OFF the rotor will coast all the way from set speed to 0 rpm at the end of the run, unless the ARC is on; if this is the case it will coast to 768 rpm, then continue to decelerate at the controlled rate.

## START Switch

The START switch starts the run when is it pressed.

## STOP Switch

The STOP switch ends the run when it is pressed.

## RPM/RCF Switch

This switch is normally set to RPM, which causes the SPEED display to show rotor speed. When pressed down to RCF during a run, the SPEED display numbers will change from the current rotor speed to the current relative centrifugal force (RCF, commonly referred to as *g* force) value. To be sure that the RCF value is correct, make sure the proper rotor code number is set on the ROTOR CODE switches. When the RPM/RCF switch is released, the display will change back to show rotor speed.

This switch can also be used to calculate RCF values before a run has been started (see Chapter 4).

## OFF/ARC Switch

When the OFF/ARC switch is set to ARC it causes an automatic rate-controlled slow start from 0 rpm to 512 rpm and a slow stop from 768 rpm to 0 rpm. The setting of the OFF/BRAKE switch will determine the rate of deceleration from set speed down to 768 rpm—if it is set to OFF, the rotor will coast from set speed to 768 rpm; if it is set to BRAKE, the rotor will brake from set speed to 768 rpm.

If the OFF/ARC switch is set to OFF, the rotor will accelerate to set speed at the normal (maximum) rate, then it will decelerate from set speed down to 0 rpm in accordance with the setting of the OFF/BRAKE switch.

## OFF/$\int\omega^2 dt$ Switch

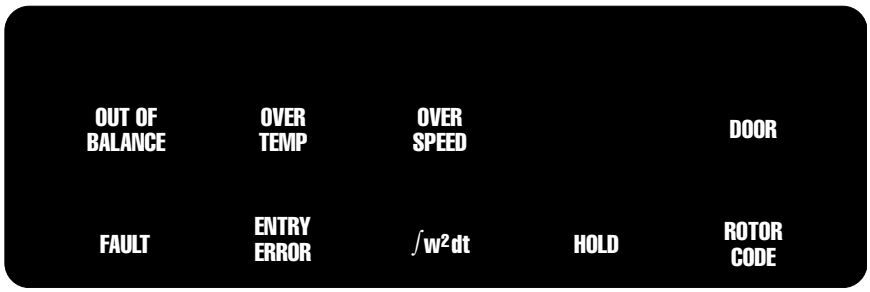
- If the OFF/$\int\omega^2 dt$ switch is set to $\int\omega^2 dt$ and the TIMED/HOLD switch is set at TIMED when the START switch is pressed, the TIME display will show accumulated integral value during the run and the run will end when the preselected integral value has accumulated.

- If the OFF/$\int\omega^2 dt$ switch is set to $\int\omega^2 dt$ and the TIMED/HOLD switch is set at HOLD when the START switch is pressed, the TIME display will show accumulated run time and the run will continue until you press the STOP switch. However, the setting on the switches has been interpreted as an integral value rather than time; therefore, if you change the setting of the TIMED/HOLD switch to TIMED during the run, the display will change to show accumulated integral value and the run will end when the set value is reached.

- If the OFF/$\int\omega^2 dt$ switch is set to OFF when the START switch is pressed, the centrifuge will operate in either a timed mode or a continuous run (HOLD) mode, depending on the setting of the TIMED/HOLD switch. The TIME display will show either remaining run time (TIMED) or accumulated run time (HOLD). During a TIMED run, the accumulated integral value can be displayed by changing the setting of this switch to $\int\omega^2 dt$ (the run will still be controlled by time, not integral). Even though the run is controlled by time, the integral value accumulates from the time the START switch is pressed until the rotor decelerates to 0 rpm at the end of the run.

- At the end of any TIMED run (but before the START switch is pressed again), the integral recall value for the run can be displayed by changing the OFF/$\int\omega^2 dt$ switch to $\int\omega^2 dt$. If you know the integral recall value of a particular run, you can then duplicate the run by selecting the integrator mode and setting the switches for the integral value (see Integrator Mode in Chapter 4).

## *Backlit Advisory Messages*




The RC-5C PLUS has nine operator advisory messages on the control panel. These messages are backlit; each message lights only when the condition that it represents exists. The meaning of each message is given below, along with the corrective action.

### OUT OF BALANCE

Indicates excessive rotor imbalance. Run in progress terminated. Remove the rotor and balance it according to the directions in the rotor instruction manual, then restart the run.

### OVERTEMP

Indicates run terminated because the chamber temperature exceeded the desired maximum run temperature selected on the MAX temperature switch. Some problems that could cause this are:

- run temperature setting may be too low for the rotor/speed combination; check rotor instruction manual to verify temperature setting,
- room ambient temperature is above 25°C, or
- inadequate air circulation (see Location Requirements, page 2-1).

Check each of these possible causes before notifying your Thermo Field Service Engineer of the problem.

### OVERSPEED

Indicates the detected speed is greater than 22 000 rpm and run in progress terminated. If the ENTRY ERROR message is also lit, see page 4-11 for possible cause. Otherwise, notify your Thermo Field Service Engineer of the overspeed condition.

### DOOR

Indicates one of the following:

- Pressed START with the centrifuge chamber door open and the key switch set to NORMAL. The centrifuge will not start. Close the chamber door and start the centrifuge.
- Rotor speed is above 1500 rpm with the chamber door open and the key switch set to ZONAL. Run in progress terminated. Notify Thermo Field Service Engineer.
- Rotor is spinning with the chamber door open and the key switch set to NORMAL. Run in progress terminated. Notify Thermo Field Service Engineer.

### FAULT

Blinks on and off whenever a diagnostic indicator lights up; the indicator represents a condition that has caused the run to end (diagnostic indicators number 1-8) See Diagnostic Indicators later in the chapter.

### ENTRY ERROR

Lights when a wrong entry has been made on one of the control settings. See page 4-11 for a list of possible entry errors.

### $\int\omega^2 dt$

Indicates that you have selected the integral ($\int w^2 dt$ ) mode; the setting on the TIME switches is interpreted as an integral value rather than a time.

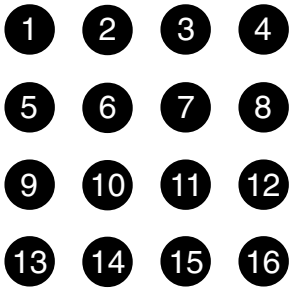
### HOLD

Indicates that the TIMED/HOLD switch is set at HOLD and the run will continue until you press the STOP switch.

### ROTOR CODE

Blinks on and off for a few seconds at the beginning of each run as a reminder to enter the proper rotor code number (see Table 4-1).

## *Diagnostic Indicators*




These indicators, numbered 1 through 16, help troubleshoot a problem when the centrifuge is not operating properly. When any of the indicators light, it means a problem exists that is affecting the operation of the centrifuge. Each indicator represents a different problem; some problems will cause the centrifuge to shut off, others will not, depending on the seriousness of the problem. Of the sixteen indicators, only eleven (1-12) are currently being used; the other five are there for future use, if needed. The meaning of each light is given below, along with the corrective action.

**1** CONTROL SYSTEM FAILURE
Turn the main power off and back on, then restart the run. If the light comes on again, notify your Thermo Field Service Engineer.

**2** PROGRAM FAILURE
Notify Thermo Field Service Engineer.

**3** MEMORY SYSTEM FAILURE
Notify Thermo Field Service Engineer.

**4** DRIVE SYSTEM FAILURE
Notify Thermo Field Service Engineer.

**6** NO ROTOR
The microcomputer has detected a sudden and sustained increase in rpm, because there was no rotor installed when the START switch was pressed. The centrifuge ran for a few seconds then shut off. Install a rotor and restart the run.

**7** REFRIGERATION SYSTEM FAILURE
There was no apparent drop in chamber temperature thirty seconds after the refrigeration system started to cool. Notify your Thermo Field Service Engineer.

**8** TEMPERATURE SENSOR FAILURE
Chamber air temperature sensor has failed. Notify your Thermo Field Service Engineer.

**9** TEMPERATURE SENSOR FAILURE
Chamber wall temperature sensor has failed. Notify your Thermo Field Service Engineer.

**10** COMPUTER SYSTEM FAILURE
The computer has received erroneous information. The condition will clear and the light will go out if the problem is momentary. If the condition persists, notify your Thermo Field Service Engineer.

11 TACHOMETER ERROR
The computer has detected changes in rpm that are beyond the normal range, indicating that the tachometer input frequency is unstable. The condition will clear and the light will go out if the problem is momentary. If the condition persists, notify your Thermo Field Service Engineer.

12 REGISTER OVERFLOW
This problem could be momentary; if it is, the condition will clear and the light will go out. Also, a wrong entry on one of the control switches may cause this light to come on—if the ENTRY ERROR message is lit, check all control settings. If the condition persists, notify your Thermo Field Service Engineer.

5 NOT USED

13 NOT USED

14 NOT USED

15 NOT USED

16 NOT USED

# Chapter 4: OPERATION

This chapter provides step-by-step instructions on how to set the centrifuge power ON, open the chamber door, and perform a run in the normal mode. It also describes the rate control, zonal, and integrator modes of operation and how to precool the rotor. *Read and observe the Important Safety Information supplied on page iii at the front of this manual.*

The chapter contains supplementary information on how to calculate relative centrifugal force (RCF); how to do a test run for low speed and low temperature operation; and what will cause an ENTRY ERROR. The controls and displays referred to in this chapter are described in detail in Chapter 3.

## Setting the Centrifuge Power ON

**WARNING**
DO NOT operate the GSA, GS-3, and the F16/250 rotors in the RC-5C PLUS Superspeed Centrifuge.

The centrifuge power ON/OFF switch is located in the upper-right corner of the front cabinet panel, below the control panel (see figure 1-1). Press the top of the switch to set the centrifuge power ON.

## Opening the Chamber Door

Press the door release button (located under the right-front corner of the top deck, see figure 1-1) to release the door latch and open the chamber door.

## Normal Mode Operation

**WARNING**
When loading the rotor, be sure not to exceed the maximum compartment mass of the rotor (see the Rotor Information Table in the Appendix). If maximum compartment mass is exceeded, the maximum operating speed must be lowered (see Reducing Speed for Rotor Compartment loads in Excess of Design Mass later in this chapter). Failure to do so can cause rotor failure, which could result in centrifuge damage and personal injury.

**CAUTION**
Failure to load and install the rotor in accordance with the rotor instruction manual could result in damage to the centrifuge. The rotor cover must be on and locked in place and the rotor must be locked to the drive spindle.

The normal mode of operation should be used for most RC-5C PLUS centrifuge runs. (EXCEPTIONS: To slowly accelerate or decelerate fragile gradients or samples, see Rate Control [ARC] Operation. To dynamically load a zonal rotor, see Zonal Mode Operation. To control a run with the integrator, see Integrator Mode Operation.)

To perform a normal centrifuge run, the centrifuge power must be set ON and a rotor must be loaded and installed according to the instructions in the rotor manual ***(read the WARNING and the CAUTION)***. If the sample temperature during the centrifuge run is critical, we recommend that you precool the rotor and chamber as described on page 4-7 before beginning this procedure.

**NOTE** The controls and displays referred to in this procedure are defined in Chapter 3.

If the ENTRY ERROR message lights at any time during this procedure, refer to page 4-11 for possible causes.

1. Set the main power switch to ON.

2. Set the RUN and MAX temperature switches to the desired run temperature and maximum temperature. The MAX temperature setting should be for a value that is at least 5°C higher than the RUN temperature setting.

**NOTE** For optimal temperature control at RUN temperatures below ambient, both the rotor and the rotor chamber should be at the desired RUN temperature before the run is started. If the rotor was precooled in the centrifuge, the chamber will already be at the desired temperature. If the rotor was precooled by some other means, you should wait until the temperature display indicates the desired RUN temperature before starting the run. The run will not start as long as the displayed temperature is greater than the MAX temperature setting.

3. Set the key switch on the front panel to NORMAL.

4. Open the chamber door.

5. If applicable, make sure the rotor cover is installed on the rotor and, for fixed-angle rotors, secured.

6. Place the rotor on the drive spindle and lock it in place by turning the rotor locking knob counterclockwise.

7. Set the ROTOR CODE switches for the proper ROTOR CODE number (see Table 4-1).

8. Close the chamber door.

9. Set the RPM switches for the desired run speed.

## Table 4-1. Rotor Codes

| Rotor Code | Rotor | Rotor Code | Rotor | Rotor Code | Rotor |
|---|---|---|---|---|---|
| *Fixed-Angle* | | 06 | SE-12 | 17 | S-20/20 |
| 05 | SS-34 | 12 | SH-MT | 16 | S-20/36 |
| 27 | SLA-1000 | 09 | SM-24 | 29 | SH-3000 -buckets |
| 26 | SA-300 | 14 | F-28/13 | 31 | SH-3000 -microplates |
| 36 | SA-512 | 15 | F-28/36 | *Vertical/Zonal* | |
| 04 | SA-600 | 24 | F-28/50 | 01 | SV-288 |
| 37 | SA-800 | 25 | F-20/MICRO | 02 | SV-80 |
| 32 | SLA-600TC | *Swinging-Bucket* | | 11 | TZ-28 |
| 28 | SLA-1500 | 23 | HB-6 | 21 | TZ-28/DL -dynamic load |
| 30 | SLA-3000 | 07 | HB-4 | *Continuous Flow* | |
| 34 | SLC-1500 | 08 | HS-4 | 19 | SS-34/KSB-R |
| 35 | SLC-3000 | 13 | SH-80 | 20 | TZ-28/GK |
| 33 | SLC-4000 | 18 | S-20/17 | | |

10. Make sure the OFF/$\int\omega^2 dt$ switch is set to OFF.

11. Set the TIMED/HOLD switch:

    - For a timed run, set the switch to TIMED, then set the HRS and MIN switches for the desired length of run time.

    - For a continuous run, set the switch to HOLD (the setting on the HRS and MIN switches is ignored). When HOLD is selected, the HOLD message indicator light will come on.

12. Set the OFF/BRAKE switch to the desired setting (refer to Chapter 3). Set the OFF/ARC switch to OFF.

***WARNING***

Do not leave rotors or other objects on centrifuge surfaces during operation.

13. Press the START switch. (The ROTOR CODE advisory message will blink for a few seconds as a reminder to set the proper ROTOR CODE number.)

***NOTE*** To end a run in HOLD or before the selected run time has elapsed, press the STOP switch.

If you want to see the accumulated integral value anytime during a TIMED run, change the setting of the OFF/$\int\omega^2 dt$ switch to $\int\omega^2 dt$. As long as you change the setting of this switch AFTER the START switch is pressed it will not have any affect on how the run will end - the run will still end when the preselected time has elapsed.

***CAUTION***

To reduce the possibility of samples freezing, remove the rotor from the centrifuge chamber as soon as possible after it stops spinning.

14. After the rotor has come to a stop and the door has unlatched, open the chamber door and remove the rotor. ***Read the CAUTION.***

***NOTE*** We recommend keeping the chamber door closed after the rotor has been removed to inhibit the formation of condensation on the chamber walls.

***The run can be repeated*** with the same parameters by installing the rotor, closing the chamber door, and pressing START. The selected speed, time, and temperature are retained from previous run.

# Rate Control (ARC) Operation

The automatic rate control (ARC) accessory provides a slow, controlled acceleration from 0 to 512 rpm and a slow, controlled deceleration from 768 to 0 rpm. The ARC should be used when centrifuging gradients or fragile pellets. To do a rate-controlled run, follow the Normal Mode Operation procedure, except set the OFF/ARC switch to ARC in Step 12 to activate the rate control.

**WARNING**

When loading the rotor, be sure not to exceed the maximum compartment mass of the rotor (see the Rotor Information Table in the Appendix). If maximum compartment mass is exceeded, the maximum operating speed must be lowered (see Reducing Speed for Rotor Compartment loads in Excess of Design Mass later in this chapter). Failure to do so can cause rotor failure, which could result in centrifuge damage and personal injury.

**CAUTION**

Failure to load and install the rotor in accordance with the rotor instruction manual could result in damage to the centrifuge. The rotor cover must be on and locked in place and the rotor must be locked to the drive spindle.

**CAUTION**

Do not operate the rotor at its critical speed (see the Rotor Information Table in the Appendix).

# Zonal Mode Operation

The zonal mode of operation must be used when dynamically loading the gradient and sample into a SORVALL® TZ-28 Zonal Rotor. When the zonal mode is activated, the centrifuge will accelerate to a low speed for rotor loading and when loading is complete, accelerate to the set run speed.

## Preparation for Loading

Assemble the TZ-28 rotor according to the instructions in the rotor instruction manual, then:

**NOTE** If desired, precool the rotor in the centrifuge according to the procedure on page 4-7.

***Read the WARNING and the CAUTION.***

1. Set the main power switch to ON.
2. Set the key switch on the front panel to ZONAL.
3. Press the door release button, and open the chamber door.
4. Install the rotor as instructed in the rotor manual. Set the ROTOR CODE switch to 11.
5. Set the RPM switch to the desired loading speed, which must be between 50 and 1400 rpm (1400 rpm is the recommended speed). ***Read the CAUTION.***
6. Set the OFF / $\int \omega^2 dt$ switch to OFF.
7. Set the RUN and MAX temperature switches to the desired run temperature and maximum temperature. The MAX temperature setting should be for a value that is at least 5°C higher than the RUN temperature setting.

**NOTE** For optimal temperature control at RUN temperatures below ambient, both the rotor and the rotor chamber should be at the desired RUN temperature before the run is started. If the rotor was precooled in the centrifuge, the chamber will already be at the desired temperature. If the rotor was precooled by some other means, you should wait until the temperature display indicates the desired RUN temperature before starting the run. The run will not start as long as the displayed temperature is greater than the MAX temperature setting.

9. Set the TIMED/HOLD switch:

   - For a timed run, set the switch to TIMED, then set the HRS and MIN switches for the desired length of run time. The timer will start as soon as you press the START switch; therefore, include the time it will take to load the rotor in the run time you select.

   - For a continuous run, set the switch to HOLD (the setting on the HRS and MIN switches is ignored). When HOLD is selected, the HOLD message indicator light will come on.

10. Set the OFF/BRAKE switch to the desired setting (refer to Chapter 3). If the rotor already has the gradient in it, set the OFF/ARC switch to ARC to activate the rate control; it the rotor is empty, set the switch to OFF.

## Loading

**WARNING**

When operating the centrifuge with the chamber door open and the rotor spinning, remove any articles that could fall into the rotor chamber (for example, jewelry, necktie, objects in shirt pockets). Tie back long hair and roll up shirt sleeves. Do not leave rotors or other objects on centrifuge surfaces during operation.

1. Press the START switch. (The ROTOR CODE advisory message will blink for a few seconds as a reminder to set the proper ROTOR CODE number.)

**NOTE** The timer will start as soon as you press the START switch; therefore, include the time it will take to load the rotor in the run time you select.

2. Wait for the rotor to reach the selected loading speed, then load the rotor according to the instructions in the rotor instruction manual. When the rotor is loaded, disconnect any equipment that was used to load it.

3. Close the chamber door.

4. Set the RPM switches for the desired run speed.

5. Set the OFF/ARC switch to ARC so there will be a rate-controlled slow stop at the end of the run (see Rate Control [ARC] Operation).

## Acceleration and Deceleration

After you have closed the chamber door and set the run speed, the rotor will accelerate to the set speed, run for the selected length of time, then decelerate to a stop. If the run was in the HOLD mode, press the STOP switch to end the run; as soon as you press the STOP switch the rotor will begin to decelerate.

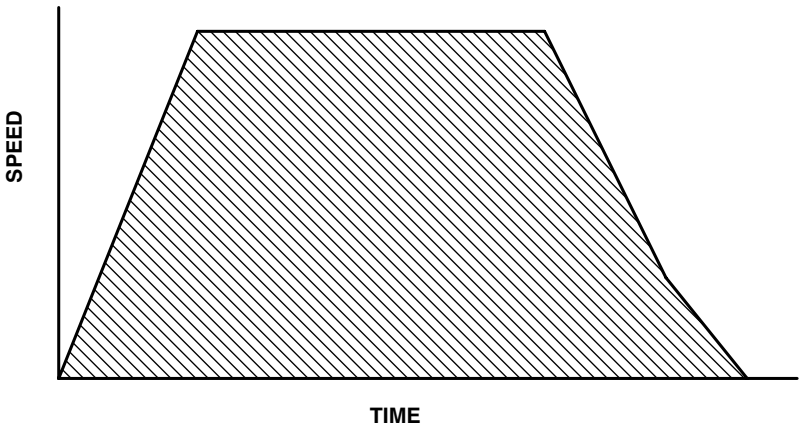
**CAUTION**

To reduce the possibility of samples freezing, remove the rotor from the centrifuge chamber as soon as possible after it stops spinning.

**NOTE** The accumulated integral value can be displayed during a run the same as for a NORMAL run.

# Integrator Mode Operation

The integrator mode can be used in place of the timer to control the length of the centrifuge run. The integral value ($\int\omega^2 dt$) represents the actual centrifuge force generated by the rotor accumulated over time.




$$\int\omega^2 dt = [(\text{rpm}/60)(2\pi)]^2\ (t_2\text{-}t_1)$$

$(t_2\text{-}t_1)$ = time in seconds

*Figure 4-1. Integral Value*

$\int\omega^2 dt$ is the integral value. The integral value is the area under the curve (as represented by the grey area in the drawing above). The larger the integral value, the more total centrifugal force (time and *g* force) applied to the sample. The use of the integrator will compensate for changes in rotor load and other factors that may change the rate acceleration in the RC-5C PLUS. For a more detailed explanation of the advantages of using the integrator, contact the SORVALL® Applications Laboratory.

The RC-5C PLUS allows you to obtain the integral value generated during a normally timed run by pressing the OFF/$\int\omega^2 dt$ switch to $\int\omega^2 dt$ when the run has stopped (see Integral Recall). The integral value can then be used to control subsequent centrifuge runs.

This procedure specifies how to set up a run to be controlled by an integral value. Prepare the rotor according to the instructions in the rotor instruction manual, then follow the instructions below.

**NOTE** If desired, precool the rotor in the centrifuge according to the procedure on page 4-7.

1. Follow Steps 1 through 9 and Step 12 in Normal Mode Operation to install a rotor, set run temperature and speed, and set brake. To use the rate control, see Rate Control (ARC) Operation. ***Follow all WARNINGS and CAUTIONS.***

2. Set the OFF/$\int\omega^2 dt$ switch to $\int\omega^2 dt$.

3. Set the TIMED/HOLD switch to TIMED, then set the COEF and EXP switches for the desired integral value (for example, 15 20 means 1.5 x $10^{20}$).

**NOTE** The TIMED/HOLD switch should never be set at HOLD during an $\int\omega^2 dt$ run; if it is, the display will show accumulated run time, and the run will not end until you press the STOP switch.

4. Press the START switch. The $\int\omega^2 dt$ advisory message on the control panel will light. (The ROTOR CODE advisory message will blink for a few seconds as a reminder to set the proper ROTOR CODE number.)

**NOTE** The setting of the OFF/$\int\omega^2 dt$ switch can be changed to OFF any time during a run to have the display (TIME) show the length of time that has elapsed since the run was started (the numbers in the display will change to represent hours and minutes instead of the integral value). The run will still terminate when the preselected integral value has accumulated.

To end a run before the selected integral value has accumulated, press the STOP switch.

**CAUTION**
To reduce the possibility of samples freezing, remove the rotor from the centrifuge chamber as soon as possible after it stops spinning.

## Integral Recall

At the end of any TIMED run (normal or zonal mode) you can recall the integral value ($\int\omega^2 dt$) at timeout and use this value in the integrator ($\int\omega^2 dt$) mode to duplicate the run. When the rotor has stopped, change the setting of the OFF/$\int\omega^2 dt$ to $\int\omega^2 dt$; the integral value at timeout will appear in the TIME display. The value must be recalled before another run is started or before the main power is set OFF.

## Rotor Precool

If you plan to run a temperature-sensitive sample in the RC-5C PLUS centrifuge, we recommend that you precool the rotor and the centrifuge before loading the sample. This will ensure that the rotor and chamber temperatures are at equilibrium at the start of the run.

**CAUTION**
Failure to load and install the rotor in accordance with the rotor instruction manual could damage the centrifuge. The rotor cover must be on and locked in place and the rotor must be locked to the drive spindle.

1. Set the centrifuge power ON and open the chamber door.

2. Install the empty rotor (with cover installed, if applicable). Lock it to the drive spindle by turning the rotor locking screw counterclockwise. Close the chamber door.

3. Set a run speed of 2000 rpm.

4. Set the TIMED/HOLD switch to HOLD.

5. Set the RUN temperature switch for desired run temperature.

6. Set the MAX temperature switch for a value higher than the temperature displayed to avoid an overtemperature condition.

7. Set all other controls as you would for a normal mode run.

8. Press the START switch. The rotor will accelerate to 2000 rpm and quickly cool to the selected run temperature. It will typically take the rotor 30 minutes to cool, but the actual time will vary depending on the rotor weight and rotor material. When the displayed temperature equals the run temperature setting, stop the run.

9. After the rotor has come to a stop, open the chamber door and remove the rotor lid. Place the samples in the rotor and balance the load as specified in the rotor instruction manual.

10. Re-secure the rotor lid. Lock the rotor to the drive spindle. Close the chamber door.

11. Perform the desired centrifuge run.

## Reducing Speed for Loads in Excess of Design Mass

There is a maximum allowable compartment mass established for each rotor (see the Rotor Information Table in the Appendix or the individual rotor manual). To prevent rotor failure, the total contents of any compartment, including specimen, tubes, sealing assembly, and adapters (if used), must not exceed the specified maximum compartment mass unless rotor speed is reduced proportionately.

**WARNING**

Failure to reduce rotor speed when compartment load exceeds maximum allowable compartment load can lead to rotor failure.

Strict adherence to the maximum allowable compartment mass or reduced rotor speed is required to prevent rotor failure. ***Read the WARNING.*** If the maximum compartment mass is greater than the value specified for the rotor, use the following formula to determine the reduced rotor speed that is required:

$$\text{Reduced Speed} = \text{Maximum Rotor Speed} \times \sqrt{\frac{\text{Maximum Compartment Mass}}{\text{Actual Compartment Mass}}}$$

# RCF Calculation

The RCF accessory is used to calculate relative centrifuge force (RCF, also known as *g*-force) values.

The accessory allows you to quickly determine the speed at which you must run a particular rotor to achieve a desired RCF value. To calculate the speed at a particular RCF:

1. Turn the main power ON but do not start the centrifuge; the rotor must be at 0 rpm to calculate the speed that corresponds to a particular RCF.

2. Set the ROTOR CODE switches for the code number of the rotor you will use. (Rotor codes are given in Table 4-1.)

**NOTE** The RCF values calculated for the SM-24 Rotor (code number 09) are the values for the outer row of the rotor.

3. Hold the RPM/RCF switch down to RCF.

4. The SPEED display will show the RCF value (for the identified rotor) at the speed that is set on the RPM switches.

5. Adjust the speed setting (on the RPM switches) until the desired RCF value appears in the SPEED display; the speed set on the RPM switches is the speed at which you have to run that rotor to achieve the displayed RCF.

**NOTE** If the ENTRY ERROR advisory message lights, you have the speed switches set for a value higher than the maximum speed of the identified rotor. Make sure the correct rotor or rotor code is selected.

The RCF accessory can also be used to view the RCF at a particular speed. Press the RPM/RCF switch down to view the RCF value (it will appear in the SPEED display). The RCF will correspond to the speed set on the RPM switches when rotor is at rest or to the actual speed (shown in the SPEED display) when a run is in progress.

# Test Run for Low Speed and Low Temperature Operation

If the centrifuge is operated at a speed less than 2000 rpm and a temperature 2°C or less, the refrigeration system may have difficulty maintaining the indicated sample temperature within 1°C of the set temperature. This condition may cause the sample to freeze; therefore, when the speed and temperature are set below the values given above, we recommend that you do a test run to determine a temperature setting that will achieve the results you want and prevent the sample from freezing. This test run procedure should be used for every run where the rotor speed and sample temperature are this low because each speed/temperature/rotor combination may give different results.

1. Prepare two tubes or bottles of dispensable fluid and place them in the rotor. Balance the rotor according to the instructions in the rotor instruction manual.

**NOTE** The dispensable fluid should have a freezing temperature well below the desired sample temperature.

2. Set the RUN temperature switch to the desired sample temperature.

3. Install the rotor in the centrifuge and run it for at least two hours at the speed for which the temperature setting is being determined.

4. Stop the centrifuge. Wait for the rotor to stop then immediately open the chamber door and measure the actual sample temperature using an immersible centigrade thermometer.

5. Adjust the RUN temperature switches upward or downward according to the temperature differential between the measured temperature and the set run temperature.

   For example: If the measured sample temperature is -2°C and the set run temperature is +2°C, there is a 4°C differential. To obtain the +2°C sample temperature you should reset the set RUN temperature switches to +6°C. (Setting the higher temperature would prevent the sample from freezing.)

# Entry Errors

Any of the following conditions will cause the ENTRY ERROR advisory message to light:

- The MAX temperature switch is set at or below the value set on the RUN temperature switch. In this case, the MAX temperature that the system will use is the RUN temperature plus seven degrees. Change the MAX temperature setting for a value at least 5°C higher than the RUN temperature setting.

- The RPM switches are set for a speed below 50 rpm. The system will default to a 50 rpm setting. Change the speed setting.

- The RPM switches are set at or above 105% of the maximum speed of the identified rotor. Check the ROTOR CODE setting to make sure you have selected the proper code number and check the speed setting to make sure it is within range for the rotor.

- The TIMED / HOLD switch is set at TIMED, the OFF / $\int\omega^2 dt$ switch is set at OFF, and the TIME (HRS and MIN) switches are set at zero. The run will not start.

- The TIMED / HOLD switch is set at TIMED, the OFF / $\int\omega^2 dt$ switch is set at $\int\omega^2 dt$, and the COEF switch is set at zero. The run will not start.

- The ROTOR CODE switches are set at a number that is not used (see Table 4-1 for numbers that are used); the control values will default to those for a ROTOR CODE setting of "00".

# Chapter 5: CARE and MAINTENANCE

This chapter describes routine maintenance procedures for your RC-5C PLUS Centrifuge. It also includes cleaning and decontamination recommendations and the Service Decontamination Policy. As the user, it is your responsibility to make certain these procedures and recommendations are followed. In addition to these routine procedures, to keep your centrifuge in good working condition and ensure accurate test results, we recommend that you have the centrifuge serviced and have the speed control, timer, temperature control, and rotor imbalance checked annually by a Thermo Field Service Engineer or other qualified service personnel. If further service is needed, contact your Thermo Field Service Engineer.

## Maintenance

**WARNING**

There are no user-serviceable items inside the centrifuge. Because of the high voltages in the centrifuge, anyone who is not properly trained in electronics must not test or repair the electrical circuits.

To gain the most in safety, performance, and useful life from your centrifuge, it is necessary to properly maintain it. Proper maintenance is a simple and inexpensive way to help prevent major failures. In addition to the maintenance described below, a Thermo service contract, which includes a yearly Preventive Maintenance visit, is recommended to keep your centrifuge in good condition.

Table 5-1 suggests a maintenance schedule.

**Table 5-1. Maintenance Schedule**

| Maintenance | Frequency |
|---|---|
| Clean the rotor chamber | Daily or immediately after a spill |
| Wash the tapered spindle | Once a week |
| Clean the cabinet panels | Once a month |
| Have condenser fins cleaned | Once a year or whenever centrifuge is serviced; more often if dust accumulates significantly |
| Check LEDs and indicators | Once a year or whenever the displayed numbers seem erroneous |
| Have ground continuity tested | Once a year or whenever centrifuge is serviced |
| Clean the air inlet on the drive box (wipe with cloth) | Once a month |

# Cleaning and Decontamination

**WARNING**

If hazardous materials have been processed in the centrifuge, observe all necessary precautions when you are cleaning or servicing the centrifuge to avoid the possibility of contamination.

## Rotor Chamber

The rotor chamber should be defrosted and cleaned periodically to maintain efficient cooling. To defrost the chamber, install a rotor, close the chamber door, set the RUN temperature switch for 25°C and set the MAX temperature switch for 30°C, then run the centrifuge until the frost melts. When defrosting is complete, wipe the chamber dry with a damp sponge or cloth.

**CAUTION**

Chlorides (for example, bleach solutions) are extremely harmful to aluminum alloy rotors and can cause stress corrosion cracking. Therefore, do not use chlorides to decontaminate the chamber.

Use 70% ethanol to disinfect the rotor chamber and the rubber door seal or a 2% glutaraldehyde solution to sterilize them, then follow with several deionized water rinses. For general radioactive decontamination, use a solution of equal parts 70% ethanol, 10% SDS, and water. Follow this with ethanol rinses, then deionized water rinses. Dry with a soft absorbent cloth. Dispose of all wash solutions in proper radioactive waste containers.

To prevent condensation from forming in the rotor chamber, keep the chamber door closed when the chamber is cold.

## Tapered Drive Spindle

Wipe the drive spindle with a soft cloth each time a rotor is to be installed to reduce the chance of the rotor sticking. Once a week, wash the drive spindle with warm water.

## Cabinet

Clean the cabinet panels, top deck, and chamber door with a mild, *nonalkaline* detergent and water. Do not use abrasive cleansers.

## Refrigeration System Condenser Fins

**WARNING**

Only a qualified technician should attempt to clean the condenser fins. Before accessing the condenser, technicians should unplug the power cord to avoid exposure to hazardous electrical circuits. Also, the condenser fins are very sharp; to avoid personal injury, technicians should use care when cleaning fins.

To maintain the efficiency of the refrigeration system, the condenser fins (located in the rear of the centrifuge) must be kept free of dust and dirt. Condenser fins should be cleaned with a brush or a vacuum cleaner at least annually, more often if dust accumulates significantly. The fins will bend easily; be very careful when cleaning them. Due to hazards involved, only a qualified technician should attempt to clean the condenser fins.

# Lubrication

All components are prelubricated and require no further lubrication. The refrigeration unit is hermetically sealed and the ball bearings in the centrifuge motor are permanently lubricated.

# LED & Indicator Test

Once a year or whenever displayed numbers seem erroneous, you should test the LEDs and indicators on the control panel to make sure they all work. If even one segment of an LED segment does not work, you could get an incorrect reading in the display.

To test the LEDs and indicators:

1. Set the main power OFF.

2. Set the ROTOR CODE switches to "00" (the setting of all other switches is irrelevant).

3. Set the main power ON. When you do, watch the control panel and make sure the displays and indicators light as follows:

   - the number 8 should light in each digit space across all of the displays,
   - the minus sign should light in the TEMP display,
   - all nine backlit advisory messages should light,
   - diagnostic indicators 1 through 12 should light,
   - the $\int\omega^2 dt$ indicator should light.

***NOTE*** The RCF indicator will not light; to test this indicator, just press the RCF switch.

If any of the LEDs or indicators are not working, contact a Thermo Field Service Engineer to repair it.

# Parts Ordering Information

To order replacement parts, in the United States, call Thermo toll-free 1-800-522-7746; outside the United States, contact the nearest Thermo office (see back cover) or your local representative for SORVALL® products. Be sure to provide a description of the part, centrifuge model, and centrifuge serial number.

For a complete list and description of available SORVALL® centrifuges, accessories, rotors, tubes, bottles, and adapters, please refer to the most current SORVALL® Product Guide. SORVALL® product information is available on our internet web site at **http://www.*thermo*.com** or **http://www.*thermo*.de**.

# Emergency Sample Recovery

**WARNING**

When the main power shuts off, the brake will not operate. Wait until the rotor stops (approximately 15 minutes) before using the mechanical override. Reaching into the rotor chamber before the rotor has stopped spinning could cause personal injury.

If the main power shuts off because of a power failure or a system malfunction while the rotor is spinning, the RC-5C PLUS chamber door will not unlatch. A mechanical override is provided to allow sample recovery in the case of an emergency. This procedure should never be used routinely and is intended for emergency sample recovery only.

The door latch override button is recessed beneath the top deck to the left of the door button (see figure 4-1). To open the chamber door, push the door latch override button with a pencil or similar object and—at the same time—push the door button. The chamber door will open.

**NOTE** The chamber door will not open if the door latch override button and door button are not pushed at the same time.

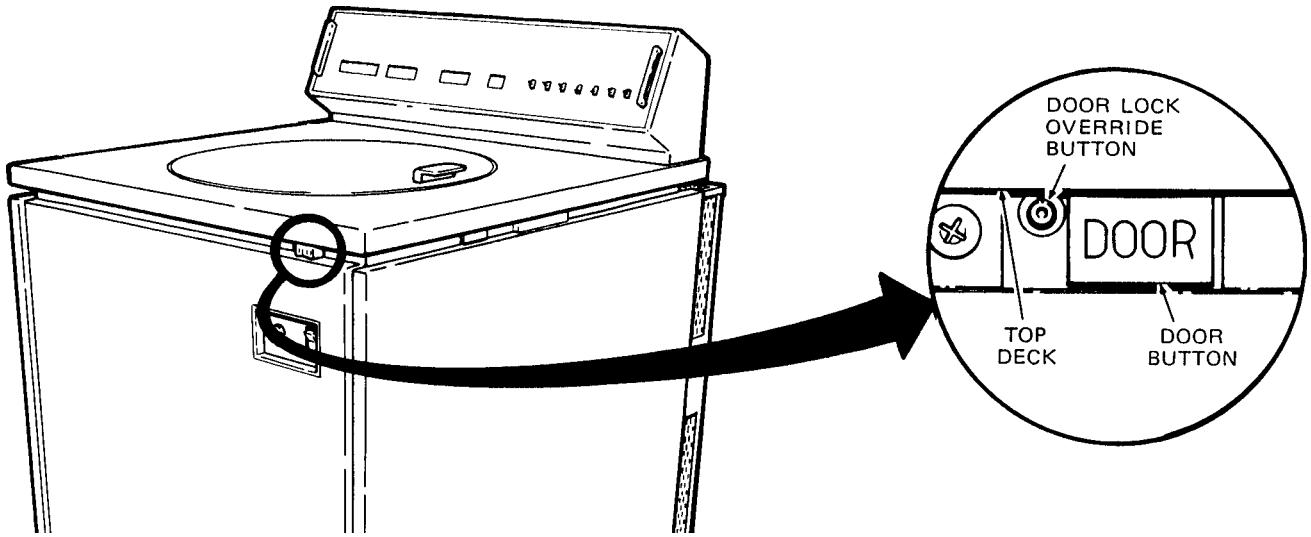



*Figure 4-1. Door Latch Override Button Location*

# Service Decontamination Policy

**WARNING**

Because of the characteristics of the samples likely to be processed in this centrifuge, 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 equipment to be serviced of all encrusted material and decontaminate it (see Care and Maintenance section of centrifuge or rotor instruction manual) 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 the centrifuge or rotor instruction manual contains specific guidance about cleaning and decontamination methods appropriate for the product it describes.

Clean and decontaminate your centrifuge or rotor as follows:

*For superspeed floor model centrifuges:*

a. Remove rotor from the rotor chamber.
b. Remove, wash, and decontaminate motor sealing gasket and pad.
c. Decontaminate lid, rotor chamber, and drive using an appropriate method.
d. Remove all encrusted material from around the motor and drive assemblies.

*For rotors:*

Remove tubes, bottles, and adapters from the rotor and decontaminate rotor using an appropriate method. If tubes or rotor caps are stuck in the rotor, or the rotor lid is stuck, notify Thermo representative; be prepared with the name and nature of the sample so the Thermo Chemical Hazards Officer can decide whether to authorize the rotor's return to a Thermo facility.

Do not leave a loaded rotor locked inside a centrifuge that requires servicing. If, with a loaded rotor installed in the chamber, a centrifuge malfunction makes it so that the chamber door will not open by normal means, follow the Emergency Sample Recovery procedure found in your centrifuge operating instructions manual to gain access to the rotor.

2. Complete and attach Decontamination Information Certificate (in the back of your rotor or instrument manual) to the centrifuge or rotor before servicing.

Decontamination Information Certificates are included with this book. Additional certificates are available from the local Thermo Representative or Field Service Engineer. In the event these certificates are not available, a signed, written statement certifying that the unit has been properly decontaminated, identifying what the contaminants were and outlining the decontamination 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.

If a centrifuge or rotor 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 the centrifuge or rotor must be returned to a Thermo facility:*

1. Contact your Thermo representative to obtain an Equipment Return Decontamination Form; be prepared with the name and serial number of the centrifuge or rotor and the repairs required.

2. Complete the Equipment Return Decontamination Form and return it to Thermo. Upon receipt of a completed form, a Returned Material Authorization Number (RMA Number) will be issued to you.

3. With the RMA Number clearly marked on the outside of packaging, send the items 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 equipment is received at Thermo facilities without a valid RMA Number on the outside of the shipping container and a completed Equipment Return Decontamination Form on file, the equipment will be treated as a potential contamination hazard, and will not be serviced until decontamination certification has been completed. The sender will be contacted for instructions regarding disposition of the equipment in question; all disposition costs will be borne by the sender. If contaminated equipment is received at Thermo facilities, both the carrier and appropriate authorities shall be notified.

**CAUTION**

Do not ship or transport a centrifuge with a rotor installed on the drive spindle. If a centrifuge chamber door cannot be opened using conventional methods, refer to the Emergency Sample Recovery (mechanical override) instructions that are provided in your centrifuge operating manual.

# APPENDIX

# Rotor Information Table

**WARNING**

The SORVALL® RC-5C PLUS can be used with the SORVALL® rotors that are listed in the table below and on the next page *only*. Use of another manufacturer's rotor can cause rotor failure which could result in personal injury and/or centrifuge damage.

| ROTOR | CODE # | MAX SPEED (rpm) | CRITICAL SPEED (rpm) | MAX RCF | K FACTOR [1] | MAX COMPARTMENT MASS (g) | RADIUS MAX (cm) | RADIUS MIN (cm) |
|---|---|---|---|---|---|---|---|---|
| SV-288 | 01 | 20 000 | 1 500 | 40 301 | 210 | 50 | 9.02 | 6.47 |
| SV-80 | 02 | 19 000 | 1 500 | 40 968 | 97 | 6.4 | 10.16 | 8.84 |
| SA-600 | 04 | 16 500 | 950 | 39 412 | 793 | 115 | 12.96 | 5.52 |
| SS-34 | 05 | 20 000 | 1 140 | 47 808 | 750 | 115 | 10.70 | 3.27 |
| SE-12 | 06 | 21 000 | 1 100 | 45 959 | 514 | 30 | 9.33 | 3.81 |
| HB-4 | 07 | 13 000 | 1 100 | 27 712 | 1 667 | 250 | 14.68 | 4.82 |
| HS-4 | 08 | 7 000 | 1 000 | 9 430 | 4 491 | 1 035 | 17.23 | 7.22 |
| SM-24 | 09 | 20 000 | 1 100 | 49 461 [2] | 456 [2] | 27 | 11.07 [2] | 5.38 [2] |
| TZ-28 | 11 | 20 000 | 900 | 42 580 | 612 | 1 620 | 9.53 | 3.62 |
| SH-MT | 12 | 13 730 [3] | 1 400 | 19 141 [3] | 657 [3] | 36.4 | 9.09 [3] | 5.57 [3] |
| SH-80 | 13 | 20 000 | 700 | 45 395 | 400 | 78 | 10.16 | 5.40 |
| F-28/13 | 14 | 19 500 | 1 200 | 48 548 | 294 | 23 | 11.43 | 7.34 |
| F-28/36 | 15 | 18 000 | 1 200 | 41 366 | 479 | 66 | 11.43 | 6.18 |
| S-20/36 | 16 | 8 000 | 350 | 11 510 | 3 176 | 156.6 | 16.10 | 7.21 |
| S-20/20 | 17 | 12 000 | 350 | 20 798 | 1 026 | 115 | 12.93 | 7.21 |
| S-20/17 | 18 | 8 000 | 350 | 11 860 | 3 735 | 130.1 | 16.59 | 6.45 |
| SS-34/KSB | 19 | 20 000 | 1 000 | 47 808 | 401 | — | 10.70 | 5.68 |
| TZ-28/GK | 20 | 19 000 | 900 | 38 428 | 678 | — | 9.53 | 3.62 |
| TZ-28/DL (dynamic loading) | 21 | 20 000 | 900 | 42 580 | 612 | — | 9.53 | 3.62 |
| HB-6 | 23 | 13 000 | 1 000 | 27 617 | 1 765 | 164 | 14.63 | 4.50 |
| F-28/50 | 24 | 19 500 | 800 | 48 718 | 694 | 115 | 11.47 | 4.04 |
| F-20/MICRO | 25 | 20 000 | 1 200 | 51 427 | 187 | 3.0 | 11.51 | 8.57 |
| SA-300 | 26 | 21 000 | 1 100 | 47 634 | 812 | 115 | 9.67 | 2.35 |
| SLA-1000 | 27 | 16 500 | 800 | 35 793 | 1 725 | 400 | 11.77 | 1.84 |
| SLA-1500 | 28 | 14 500 | 750 | 31 916 | 1 579 | 420 | 13.59 | 3.66 |

1 With maximum allowable volume at maximum speed.

2 Outer row.

3 Maximum speed of rotor is 20 000 rpm; actual maximum speed depends on tubes. Values given are typical for 1.5 ml microtubes.

| ROTOR | CODE # | MAX SPEED (rpm) | CRITICAL SPEED (rpm) | MAX RCF | K FACTOR [1] | MAX COMPARTMENT MASS (g) | RADIUS MAX (cm) | RADIUS MIN (cm) |
|---|---|---|---|---|---|---|---|---|
| SH-3000 (buckets) | 29 | 4 350 | 900 | 3 919 | 9 500 | 1 805 | 18.54 | 9.11 |
| SLA-3000 | 30 | 11 000 | 500 | 20 449 | 2 813 | 780 | 15.13 | 3.94 |
| SH-3000 (microplates) | 31 | 4 350 | 900 | 3 175 | —[2] | 987 | 15.02 | —[2] |
| SLA-600TC | 32 | 12 500 | 820 | 25 656 | 987 | 74 | 14.70 | 7.99 |
| SLC-4000 | 33 | 7 000 | 400 | 9 184 | 7 655 | 1 500 | 16.76 | 2.51 |
| SLC-1500 | 34 | 14 000 | 700 | 25 862 | 1 944 | 420 | 13.70 | 3.74 |
| SLC-3000 | 35 | 10 000 | 650 | 17 604 | 3 394 | 780 | 15.76 | 4.12 |
| SA-512 | 36 | 18 500 | 1 000 | 44 040 [3] | 438 [3] | 30 | 11.52 [3] | 6.37 [3] |
| SA-800 | 37 | 19 500 | 1 000 | 42 138 | 652 | 162 | 10.45 | 4.12 |

1 With maximum allowable volume at maximum speed.
2 Will vary depending on number and size of microplates.
3 Outer row.

# Warranty

Thermo Scientific makes no warranty of any kind, expressed or implied, except as stated in this warranty policy.

The SORVALL® RC-5C PLUS Superspeed Centrifuge is warranted to be free from defects in material and workmanship for a period of one year from the date of delivery. The compressor, condenser, evaporator and all interconnecting tubing are warranted to be free of defects in material and workmanship for a period of five years from the date of delivery. Thermo will repair or replace and return free of charge any part which is returned to its factory within said period, transportation prepaid by user, and which is found upon inspection to have been defective in materials or workmanship. This warranty does not apply to any damage to any instrument resulting from: normal wear and tear; misuse; abuse; use of electrical currents or circuits other than those specified on the plate affixed to the instrument; accident; negligence; failure to follow operating instructions; or use of any rotor other than a SORVALL® rotor intended for use in this instrument.

Thermo reserves the right to change, alter, modify, or improve any of its instruments without any obligation whatsoever to make corresponding changes to any instrument previously sold or shipped.

*The foregoing obligations are in lieu of all other obligations and liabilities including negligence and all warranties, of merchantability or otherwise, expressed or implied in fact or by law, and state our entire and exclusive liability and buyer's exclusive remedy for any claim or damages in connection with the sale or furnishing of goods or parts, their design, suitability for use, installation or operation. Thermo will in no event be liable for any special or consequential damages whatsoever, and our liability under no circumstances will exceed the contract price for the goods for which liability is claimed.*

# Glossary

**ARC** Automatic Rate Control. An accessory mode that controls the acceleration and deceleration of a rotor to avoid gradient or pellet disturbance. Automatically sets the optimal acceleration and deceleration rate for each rotor.

**HOLD** feature. A feature that selects a continuous run in place of a run controlled by time in hours and minutes; when it is selected, HOLD keeps (holds) the rotor at the selected run speed until STOP is pressed.

**Integrator Mode** An accessory mode that allows the user to control a run by an integral value rather than time in hours and minutes. The integral value represents the centrifuge force accumulated over time. The mode is activated by setting the OFF / $\int\omega^2 dt$ to $\int\omega^2 dt$.

**Normal Mode** The operation mode that is used to perform most centrifuge runs. The mode is activated by turning the key on the front panel to NORMAL and the OFF / ARC switch and the OFF / $\int\omega^2 dt$ switch to OFF.

**Overtemperature** The maximum estimated sample temperature (MAX) allowed during a centrifuge run; if the temperature in the display exceeds this value, the run will terminate.

**RCF** Relative Centrifugal Force. An accessory that calculates RCF. The force (*g* force) applied to a suspension of particles during centrifugation relative to the force that the earth's gravity would have on them. It is related to speed (rpm) by this equation: RCF = 1.117 x radius (in cm) x (rpm÷1000)$^2$.

**Rotor Code** The number assigned to each rotor model compatible with the centrifuge. The code determines how the centrifuge calculates RCF and controls speed and temperature for the rotor.

**Zonal Mode** An accessory mode that allows the user to dynamically load the SORVALL® TZ-28 Zonal Rotor. The mode is activated by turning the key on the front panel to ZONAL.

# Abbreviations

**A** Ampere

**ARC** Automatic Rate Control

**LED** Light-Emitting Diode

**RCF** Relative Centrifuge Force (*g* force)

# Index



*(continued)*

# Index (continued)

# DECONTAMINATION INFORMATION CERTIFICATE

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

**PLEASE PRINT**

DECONTAMINATION CERTIFIED BY _____ TITLE/POSITION _____

PHONE _____ FAX _____ DEPARTMENT _____

INSTITUTION _____ ADDRESS _____

CITY _____ STATE _____ ZIP _____

INSTRUMENT _____ SERIAL NUMBER _____

ROTOR _____ SERIAL NUMBER _____

PART _____ PART NUMBER _____

HAZARDOUS CONTAMINANT(S) _____ DECONTAMINATION DATE _____

DECONTAMINATION METHOD(S) _____

DECONTAMINATION CERTIFIER'S SIGNATURE _____ DATE _____


# DECONTAMINATION INFORMATION CERTIFICATE

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

**PLEASE PRINT**

DECONTAMINATION CERTIFIED BY _____ TITLE/POSITION _____

PHONE _____ FAX _____ DEPARTMENT _____

INSTITUTION _____ ADDRESS _____

CITY _____ STATE _____ ZIP _____

INSTRUMENT _____ SERIAL NUMBER _____

ROTOR _____ SERIAL NUMBER _____

PART _____ PART NUMBER _____

HAZARDOUS CONTAMINANT(S) _____ DECONTAMINATION DATE _____

DECONTAMINATION METHOD(S) _____

DECONTAMINATION CERTIFIER'S SIGNATURE _____ DATE _____

# DECONTAMINATION INFORMATION CERTIFICATE

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

**PLEASE PRINT**

DECONTAMINATION CERTIFIED BY _____ TITLE/POSITION _____

PHONE _____ FAX _____ DEPARTMENT _____

INSTITUTION _____ ADDRESS _____

CITY _____ STATE _____ ZIP _____

INSTRUMENT _____ SERIAL NUMBER _____

ROTOR _____ SERIAL NUMBER _____

PART _____ PART NUMBER _____

HAZARDOUS CONTAMINANT(S) _____ DECONTAMINATION DATE _____

DECONTAMINATION METHOD(S) _____

DECONTAMINATION CERTIFIER'S SIGNATURE _____ DATE _____

# INSTRUCTIONS

When an instrument that has been used with radioactive, pathogenic, or otherwise hazardous materials requires servicing by Thermo personnel either at the customer's laboratory or at Thermo facilities, the following procedure must be complied with to insure safety of our personnel:

1. The instrument or part to be serviced shall be cleaned of all blood and other encrusted material and decontaminated prior to servicing by our representative. No radioactivity shall be detectable by survey equipment.

2. A Decontamination Information Certificate shall be completed and attached to the instrument or part.

If an instrument or part to be serviced does not have a Decontamination Information Certificate attached to it, and, in our opinion, presents a potential radioactive or biological hazard, our representative will not service the equipment until proper decontamination and certification has been completed. If an instrument is received at our Service facilities and, in our opinion, poses 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 Operation Instructions. Additional certificates are available from your local technical or customer service representative. In the event these certificates are not available, a written statement certifying that the instrument or part has been properly decontaminated and outlining the procedures used will be acceptable.

*NOTE* Thermo Service representatives will indicate on a Customer Service Repair Report if decontamination was required, and if so, what the contaminate was and what procedure was used. If no decontamination was required, it should be so stated.

6/00


# INSTRUCTIONS

When an instrument that has been used with radioactive, pathogenic, or otherwise hazardous materials requires servicing by Thermo personnel either at the customer's laboratory or at Thermo facilities, the following procedure must be complied with to insure safety of our personnel:

1. The instrument or part to be serviced shall be cleaned of all blood and other encrusted material and decontaminated prior to servicing by our representative. No radioactivity shall be detectable by survey equipment.

2. A Decontamination Information Certificate shall be completed and attached to the instrument or part.

If an instrument or part to be serviced does not have a Decontamination Information Certificate attached to it, and, in our opinion, presents a potential radioactive or biological hazard, our representative will not service the equipment until proper decontamination and certification has been completed. If an instrument is received at our Service facilities and, in our opinion, poses 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 Operation Instructions. Additional certificates are available from your local technical or customer service representative. In the event these certificates are not available, a written statement certifying that the instrument or part has been properly decontaminated and outlining the procedures used will be acceptable.

*NOTE* Thermo Service representatives will indicate on a Customer Service Repair Report if decontamination was required, and if so, what the contaminate was and what procedure was used. If no decontamination was required, it should be so stated.

6/00



# INSTRUCTIONS

When an instrument that has been used with radioactive, pathogenic, or otherwise hazardous materials requires servicing by Thermo personnel either at the customer's laboratory or at Thermo facilities, the following procedure must be complied with to insure safety of our personnel:

1. The instrument or part to be serviced shall be cleaned of all blood and other encrusted material and decontaminated prior to servicing by our representative. No radioactivity shall be detectable by survey equipment.

2. A Decontamination Information Certificate shall be completed and attached to the instrument or part.

If an instrument or part to be serviced does not have a Decontamination Information Certificate attached to it, and, in our opinion, presents a potential radioactive or biological hazard, our representative will not service the equipment until proper decontamination and certification has been completed. If an instrument is received at our Service facilities and, in our opinion, poses 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 Operation Instructions. Additional certificates are available from your local technical or customer service representative. In the event these certificates are not available, a written statement certifying that the instrument or part has been properly decontaminated and outlining the procedures used will be acceptable.

*NOTE* Thermo Service representatives will indicate on a Customer Service Repair Report if decontamination was required, and if so, what the contaminate was and what procedure was used. If no decontamination was required, it should be so stated.

6/00

# WEEE Compliance

## Great Britain

**WEEE Compliance.** This product is required to comply with the European Union's Waste Electrical & Electronic Equipment (WEEE) Directive 2002/96EC. It is marked with the following symbol. Thermo Scientific 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 Scientific's compliance with these Directives, the recyclers in your country, and information on Thermo Scientific products which may assist the detection of substances subject to the RoHS Directive are available at **www.thermo.com/WEEERoHS**

## Deutschland

**WEEE Konformittät.** Dieses Produkt muss die EU Waste Electrical & Electronic Equipment (WEEE) Richtlinie 2002/96EC erfüllen. Das Produkt ist durch folgendes Symbol gekennzeichnet. Thermo Scientific hat Vereinbarungen getroffen mit Verwertungs-/Entsorgungsanlagen in allen EU-Mitgliederstaaten und dieses Produkt muss durch diese Firmen widerverwetet oder entsorgt werden. Mehr Informationen über die Einhaltung dieser Anweisungen durch Thermo Scientific, die Verwerter und Hinweise die Ihnen nützlich sein können, die Thermo Scientific Produkte zu identizfizieren, die unter diese RoHS Anweisung fallen, finden Sie unter **www.thermo.com/WEEERoHS**

## Italia

**Conformità WEEE.** Questo prodotto deve rispondere alla direttiva dell'Unione Europea 2002/96EC in merito ai Rifiuti degli Apparecchi Elettrici ed Elettronici (WEEE). È marcato col seguente simbolo. Thermo Scientific ha stipulato contratti con una o diverse società di riciclaggio/smaltimento in ognuno degli Stati Membri Europei. Questo prodotto verrà smaltito o riciclato tramite queste medesime. Ulteriori informazioni sulla conformità di Thermo Scientific con queste Direttive, l'elenco delle ditte di riciclaggio nel Vostro paese e informazioni sui prodotti Thermo Scientific che possono essere utili alla rilevazione di sostanze soggette alla Direttiva RoHS sono disponibili sul sito **www.thermo.com/WEEERoHS**

## France

**Conformité WEEE.** Ce produit doit être conforme à la directive européenne (2002/96EC) des Déchets d'Equipements Electriques et Electroniques (DEEE). Il est merqué par le symbole suivant. Thermo Scientific s'est associé avec une ou plusieurs compagnies de recyclage dans chaque état membre de l'union européenne et ce produit devrait être collecté ou recyclé par celles-ci. Davantage d'informations sur la conformité de Thermo Scientific à ces directives, les recycleurs dans votre pays et les informations sur les produits Thermo Scientific qui peuvent aider le détection des substances sujettes à la directive RoHS sont disponibles sur **www.thermo.com/WEEERoHS**

**CHINA**
Tel.: +86 21 68 65 45 88
+86 10 58 50 35 88

**INDIA**
Tel.: +91 22 55 42 94 94

**JAPAN**
Tel.: +81 454 53 92 20

**OTHER ASIA PACIFIC COUNTRIES**
Tel.: +852 28 85 46 13

---

**AUSTRIA**
Tel.: +43 (1) 80 14 00

**BELGIUM**
Tel.: +32 24 82 30 30

**FINLAND**
Tel.: +35 89 32 91 00

**FRANCE**
Tel.: +33 1 69 18 77 77
+33 2 28 03 20 00

**GERMANY**
Tel.: +49 61 84 90 69 40
+49 61 03 40 81 012

**ITALY**
Tel.: +39 02 95 05 91

**NETHERLANDS**
Tel.: +31 7 65 71 44 40

**SPAIN or PORTUGAL**
Tel.: +34 9 32 23 31 54

**SWITZERLAND**
Tel.: +41 (1) 4 54 12 12

**UNITED KINGDOM or IRELAND**
Tel.: +44 87 06 09 92 03

**Other EUROPE, MIDDLE EAST, or AFRICA**
Tel.: +49 61 84 90 69 40
+33 2 28 03 20 00

**RUSSIA/CIS**
Tel.: +7 09 52 25 11 15

---

**UNITED STATES of AMERICA**
Tel.: +1 800 522 77 46
+1 866 984 37 66

**CANADA or LATIN AMERICA**
Tel.: +1 800 522 77 46
+1 866 984 37 66

**In Other Countries:**
Contact your local **SORVALL**® products distributor or agent.

**Dans les autres pays:**
Contactez votre concessionnaire local des produits **SORVALL**® ou leur representant.

**In anderen Ländern:**
Wenden Sie sich an Ihren örtlichen **SORVALL**®-vertreter.

*E-mail Technical Service Representative for **SORVALL**® brand products at techsupport.led.asheville@thermofisher.com*

---

*Visit our web site at **http://www.sorvall.com** or **http://www.thermo.com***

SORVALL®

Thermo SCIENTIFIC