



Allegra X-22 Series Centrifuges

Instruction Manual



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CERTIFICATION

To ensure full system quality, Beckman Coulter Allegra X-22 Series centrifuges have been manufactured in a registered ISO 9001 facility. They have been designed and tested to meet the laboratory equipment standards and regulations (only when used with Beckman Coulter rotors) of CSA and CE Mark.

International symbols that may be displayed on the centrifuge are illustrated and described on the reverse side of the cover page.

SCOPE OF MANUAL

This manual is designed to familiarize you with the Beckman Coulter Allegra X-22 Series benchtop centrifuges, their functions, specifications, operation, and routine operator care and maintenance.

- The following introductory pages contain the instrument specifications, as well as space, electrical, and temperature conditions required for optimal centrifuge performance. A list of available rotors is also included.
- Section 1 provides a brief physical and functional description of the centrifuge and the operating controls and indicators.
- Section 2 contains instructions for installing and connecting the centrifuge.
- Procedures for operating the centrifuge are summarized in Section 3.
- Section 4 lists possible error messages and/or malfunctions, together with probable causes and corrective actions required.

- Procedures for operator care and maintenance are presented in Section 5, as well as a brief list of supplies and replacement parts.

We recommend that you read this entire manual, especially the SAFETY NOTICE and all safety-related information, before operating the centrifuge or performing instrument maintenance.

 **NOTE**

If the centrifuge is used in a manner other than specified in this manual, the safety and performance of this equipment could be impaired. Further, the use of any equipment other than that intended for use by Beckman Coulter has not been evaluated for safety. Use of any equipment not specifically recommended in this manual is the sole responsibility of the user.

CONVENTIONS

NOTES, CAUTIONS, AND WARNINGS

Certain symbols are used in the manual to call out safety related and other important information. These are reproduced and described below and/or on the inside of the front cover.

 **NOTE**

Used to call attention to information that should be followed during installation, use, and/or servicing of the equipment.



CAUTION

Used to indicate a potential hazardous situation which, if not avoided, may result in minor or moderate injury and/or mechanical damage. It is also used to alert against unsafe practices.

**WARNING**

Used whenever an action or condition may potentially cause serious personal injury or loss of life. Mechanical damage may also result.

**WARNING**

Indicates high voltage or risk of electric shock. Turn the power switch off and disconnect the equipment from the main power source. Refer servicing of all areas displaying either symbol to a service personnel.

TYPOGRAPHIC CONVENTIONS

Certain typographic conventions are used throughout this manual to distinguish names of user interface components, such as keys and displays.

- *Key names* (for example, **START** or **ENTER**) appear in boxes.
- *Display names* (for example, **TEMP°C** or **SPEED**) appear in bold type.
- *Cursor keys*, used to increment values up or down when setting parameters, are shown as up and down arrows (**▲** or **▼**).

CFC-FREE CENTRIFUGATION

To ensure minimal environmental impact, no CFCs are used in the manufacture or operation of Allegra X-22 Series centrifuges.

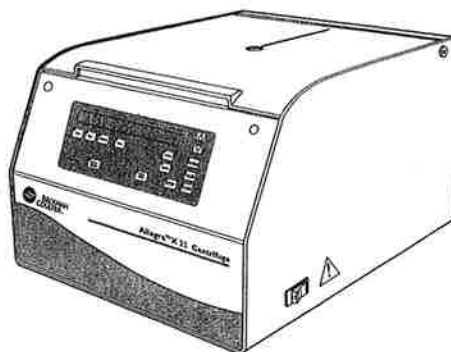
RADIO INTERFERENCE

This instrument has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with this instruction manual, may cause interference to radio communications. Operation of this equipment in a residential area may cause interference, in which case the user will be required to correct the interference at his or her own expense.

CANADIAN REGULATIONS

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus as set out in the radio interference regulations of the Canadian Department of Communications.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de Classe A prescrites dans le règlement sur le brouillage radioélectrique édicté par le Ministère des Communications du Canada.



NONREFRIGERATED MODEL SPECIFICATIONS

Only values with tolerances or limits are guaranteed data. Values without tolerances are informative data, without guarantee.

Speed

Set speed 0 to 14 500 rpm (in 100-rpm increments)
or equivalent RCF

Time

Set time to 9 hr 59 min or continuous (∞)
Time display time remaining in run (timed run)
or ∞ and elapsed time (continuous run)

Acceleration 10 acceleration profiles

Deceleration 10 deceleration profiles

Ambient temperature range 4 to 35°C

Humidity restrictions <80% (noncondensing)

Dimensions

Width 46 cm (18.1 in.)

Depth 55 cm (21.7 in.)

Height, door closed 35.5 cm (14.0 in.)

Height, door open 78.7 cm (31.0 in.)

Weight 48 kg (106 lb)

Clearances (sides) 7.6 cm (3.0 in.)

Electrical requirements 50 Hz, 230 VAC, 2.4 A; 60 Hz, 120 VAC, 4.5 A;
50/60 Hz, 100 VAC, 5.5 A

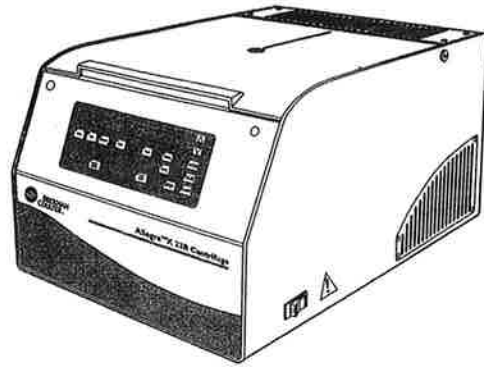
Maximum heat dissipation into room

under steady-state conditions 1638 Btu/h (0.48 kW)

Noise level 0.91 m (3 ft) in front of instrument (approx.) <70 dBA

Installation category II

Pollution degree 2



REFRIGERATED MODEL SPECIFICATIONS

Only values with tolerances or limits are guaranteed data. Values without tolerances are informative data, without guarantee.

Speed

Set speed. 0 to 15 500 rpm (in 100-rpm increments)
or equivalent RCF

Time

Set time. to 9 hr 59 min or continuous (∞)
Time display. time remaining in run (timed run)
or ∞ and elapsed time (continuous run)

Temperature

Temperature setting. -20 to $+40^{\circ}\text{C}$ (in 1°C increments)
Operating range. 2 to 40°C ¹
Ambient temperature range. 10 to 35°C

Humidity restrictions. $<80\%$ (noncondensing)

Acceleration. 10 acceleration profiles

Deceleration. 10 deceleration profiles

Dimensions

Width. 46 cm (18.1 in.)

Depth. 70.7 cm (27.8 in.)

Height, door closed. 37 cm (14.6 in.)

Height, door open. 81.3 cm (32.0 in.)

Weight. 78 kg (172 lb)

Clearances (sides). 7.6 cm (3.0 in.)

Electrical requirements. 50 Hz, 230 VAC, 5.5 A; 60 Hz, 120 VAC, 10.5 A;
50/60 Hz, 100 VAC, 12.6 A

Maximum heat dissipation into room

under steady-state conditions. 3311 Btu/h (0.97 kW)

Noise level 0.91 m (3 ft) in front of instrument (approx.). ≤ 64 dBa

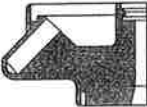
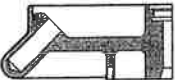



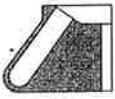

Installation category. II

Pollution degree. 2

¹ Temperature range depends on rotor in use and speed (see applicable rotor manual).


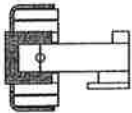
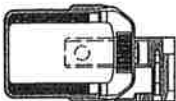
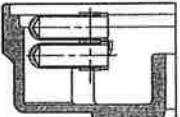
AVAILABLE ROTORS

See the applicable rotor manual for information on rotor use, care and maintenance, and rotor accessories.

| Rotor Profile and Description | Refrigerated | | Nonrefrigerated | | Max Capacity (mL) | Rotor Part Number/ Rotor Manual Number |
|---|--------------|------------------------|-----------------|------------------------|--|---|
| | Max RPM | Max RCF ($\times g$) | Max RPM | Max RCF ($\times g$) | | |
|  F2402H* Fixed Angle 45° Angle $r_{\max} = 82$ mm | 15 500 | 22 065 | 14 500 | 19 309 | 24 \times 1.5/2.0 <i>no adaptus</i> | 361171 GS-TB-021 |
|  FX301.5 Fixed Angle $r_{\max} = 100$ mm | 14 000 | 21 952 | 13 200 | 19 515 | 30 \times 1.5/2.0 | 392274 MMR-TB-002 |
|  F0630 Fixed Angle 30° Angle $r_{\max} = 78$ mm | 15 300 | 20 450 | 14 500 | 18 367 | 6 \times 30 | 361231 GS-TB-014 |
|  F0850 Fixed Angle 25° Angle $r_{\max} = 94$ mm | 10 000 | 10 528 | 9 000 | 8 528 | 8 \times 50 | 346640 GS-TB-003 |
|  F0685 Fixed Angle 25° Angle $r_{\max} = 97$ mm | 10 000 | 10 864 | 8 000 | 6 953 | 6 \times 85 | 364650 GS-TB-008 |
|  F1010 Fixed Angle 35° Angle $r_{\max} = 76$ mm | 15 300 | 19 926 | 14 500 | 17 896 | 10 \times 10 <i>no adaptus</i> | 361221 GS-TB-007 |
|  C0650 (Conical) Fixed Angle 25° Angle $r_{\max} = 92$ mm | 9 500 | 9 299 | 9 000 | 8 346 | 6 \times 50 | 364670 GS-TB-009 |

* Certified for biocontainment by Porton Down U.K.

Introduction

| Rotor Profile and Description | Refrigerated | | Nonrefrigerated | | Max Capacity (mL) | Rotor Part Number/ Rotor Manual Number |
|--|--------------|---------------|-----------------|---------------|--------------------------------------|---|
| | Max RPM | Max RCF (× g) | Max RPM | Max RCF (× g) | | |
|  <p>C1015 (Conical) Fixed Angle 25° Angle $r_{\max} = 93$ mm</p> | 9 500 | 9 400 | 9 000 | 8 437 | 10 × 15 | 364680 GS-TB-011 |
|  <p>S2096 Microtiter $r_{\max} = 110$ mm</p> | 3 000 | 1 109 | 3 000 | 1 109 | 6 ea. 96 × 0.3 mL 2 ea. 96 × 2 mL | 361111 GS-TB-005 |
|  <p>SX4250 Swinging Bucket $r_{\max} = 172$ mm</p> | 4 500 | 3 901 | 4 200 | 3 398 | 4 × 250 | 392243 GS22-TB-002 |
|  <p>SX241.5 Swinging Bucket $r_{\max} = 74$ mm</p> | 14 000 | 16 244 | 12 500 | 12 950 | 24 × 1.5/2.0 | 392271 MMR-TB-003 |

Description

This section provides a brief physical and functional description of the Beckman Coulter Allegra X-22 Series centrifuges. The operating controls and indicators are also described; instructions for their use are in Section 3. Chemical compatibilities of materials listed in this manual can be found in Chemical Resistances (publication IN-175). Refer to the applicable rotor manuals for rotor descriptions.

INSTRUMENT FUNCTION AND SAFETY FEATURES

INSTRUMENT FUNCTION

The Beckman Coulter Allegra X-22 Series benchtop centrifuges generate centrifugal forces required for a wide variety of applications. Together with any of several Beckman Coulter rotors designed specifically for use in these centrifuges, the instrument applications include:

- Routine processing such as sample preparations, pelleting, extractions, purifications, concentrations, phase separations, receptor binding, and column centrifugations.
- Processing large numbers of small-volume samples in multiwell plates for concentrating tissue-culture cells, cloning and replicate studies, *in-vitro* cytotoxicity studies, receptor binding, and genetic engineering experimentation.
- Rapid sedimentation of protein precipitates, large particles, and cell debris.
- Binding studies and separation of whole blood.
- Cell isolation.

The centrifuges are microprocessor-controlled, providing interactive operation. The instrument design features a brushless three-phase drive system,

automatic rotor overspeed identification system, and a choice of acceleration/deceleration rates. The refrigerated models also have temperature control systems. User messages and a series of audible tones alert the operator to conditions that may need attention. (Instructions for disabling the audible tones are in Section 3.)

MODELS

The centrifuge is available in both nonrefrigerated and refrigerated models. See the SPECIFICATIONS listed above for the operating differences between the refrigerated and nonrefrigerated models. Unless indicated otherwise, information in this manual is the same for both models.

SAFETY FEATURES

Instrument safety features include:

- The door has an electromechanical door-locking mechanism to prevent operator contact with spinning rotors. When the door is closed it locks automatically. It can be unlocked only by pressing the **(OPEN DOOR)** key, and opened only when the power is on and the rotor is at rest. Two independent monitoring systems prevent the door from opening if the rotor is spinning.
- A steel barrier surrounds the rotor chamber to provide full operator protection.
- An overspeed system continuously monitors the rotor during centrifugation. The system includes a magnetic sensor on the drive motor and magnets imbedded in the rotors. Throughout the run, checks are made to ensure that the rotor does not exceed set speed.
- An imbalance detector monitors the rotor during the run, causing automatic shutdown if rotor loads are severely out of balance. At low speeds, an incorrectly loaded rotor can cause imbalance. Rotor instability can also occur if the centrifuge is moved while running, or if it is not resting on a level surface.
- The centrifuge feet, made of rubber, have been designed to minimize possible rotation in the event of a rotor mishap.

NAME RATING PLATE

The name rating plate is affixed to the rear of the centrifuge. Check that the line voltage agrees with the voltage listed on this name rating plate before connecting the centrifuge. Always mention the serial number and the model number shown when corresponding with Beckman Coulter regarding your centrifuge.

CHASSIS

HOUSING

The centrifuge housing is made of sheet steel, finished with urethane paint. The control panel is covered by a protective overlay made of coated polycarbonate.

DOOR

The door is made of a solid sheet of stainless steel, encased in foam molding. In the center of the door are a window for strobe viewing and a one-way air release valve that allows air to exit, but not enter, the centrifuge chamber. The door is secured to the housing by solid shafts. An electromechanical door lock system prevents operator contact with spinning rotors and prevents run initiation unless the door is shut and latched. The door is locked when a run is in progress and can be opened only when the rotor is stopped. (A light-emitting diode [LED] on the **OPEN DOOR** key lights up when the door can be opened.) In the event of a power failure, the door lock can be manually tripped for sample recovery (see Section 4, TROUBLESHOOTING).

ROTOR CHAMBER

The rotor chamber is shown in Figure 1-1. The drive shaft, mounting plate, rubber boot surrounding the drive shaft, thermistor, and rotor detector are visible in the chamber bottom. A gasket system around the chamber opening ensures sealing. (Instrument gaskets have not been designed as bioseals for aerosol containment.)

DRIVE

The asynchronous three-phase direct-drive motor is brushless for clean, quiet operation. A tie-down screw is used to attach the rotor to the drive shaft. The resilient suspension ensures that loads will not be disturbed by vibration, and prevents damage to the drive shaft if an imbalance occurs during centrifugation. Maximum braking may be selected to reduce deceleration time, allowing fast processing of samples; alternately, delicate gradients may be preserved using slower deceleration.

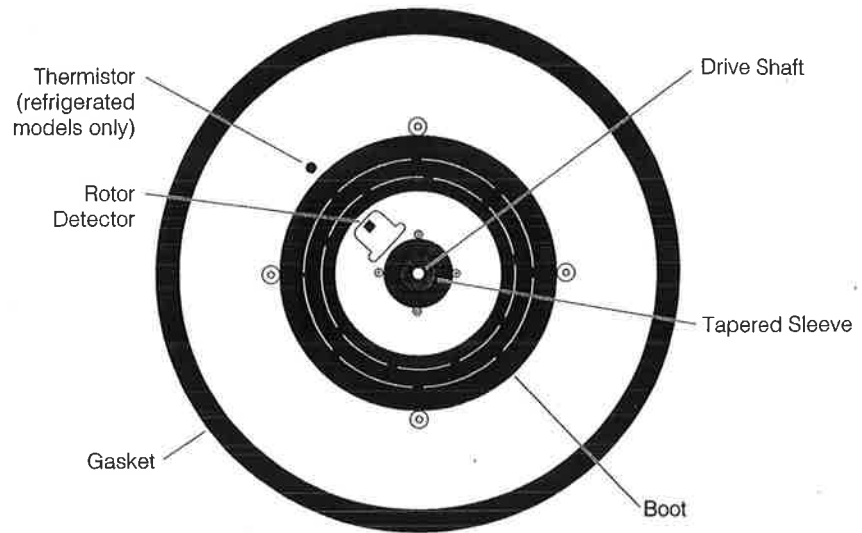


Figure 1-1. Interior View of the Rotor Chamber

**TEMPERATURE SENSING
AND CONTROL
(refrigerated models only)**

With the power on, the temperature control system is activated when the door is closed. The run temperature can be set between -20 and $+40^{\circ}\text{C}$ in refrigerated models. If no set temperature is entered, the centrifuge automatically selects the last entered temperature. (For the first run of a new centrifuge, the instrument selects 20°C as its operating temperature.) A thermistor in the rotor chamber continuously monitors chamber temperature. The micro-processor calculates the required chamber temperature to maintain the selected rotor temperature.

NOTE

In the unlikely event of a complete cooling system failure, the drive will switch off if the chamber temperature goes above 50°C . Restarting the centrifuge will not be possible until the chamber is cooled.

CONTROLS AND INDICATORS

POWER SWITCH

The power switch is located on the centrifuge right side panel (see Figure 1-2). This two-position rocker switch (I, on; O, off) controls electrical power to the centrifuge.

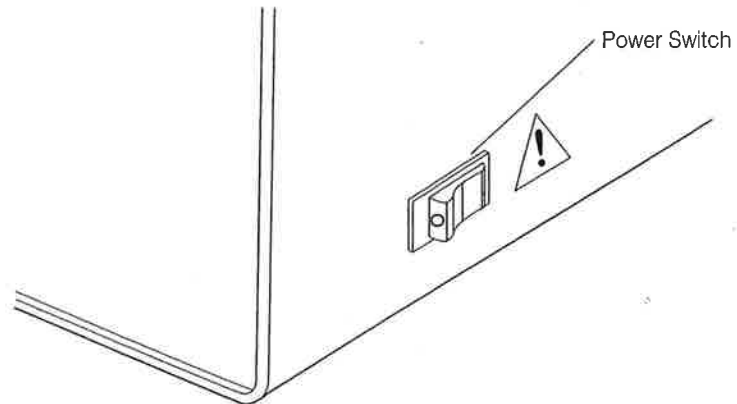


Figure 1-2. The Power Switch

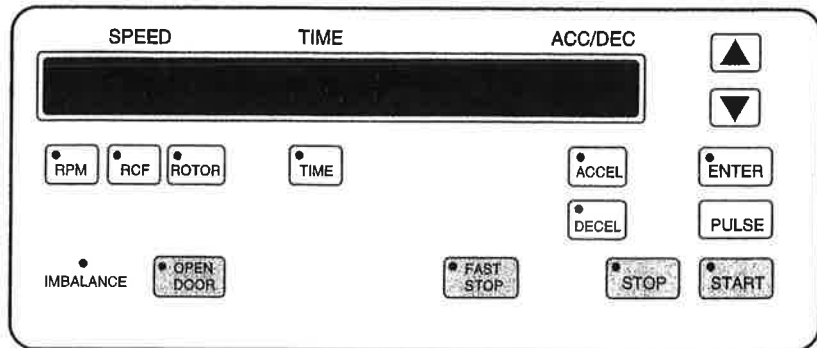
NOTE

The power must be turned on before the chamber door can be opened.

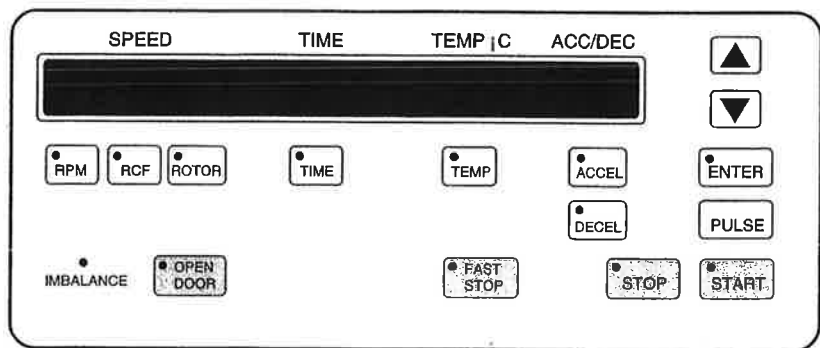
CONTROL PANEL

The control panel (Figure 1-3), mounted at an angle on the centrifuge front for easy visibility and access, comprises touch keys—system keys and programming keys—and digital displays. The panel also contains an **IMBALANCE** light that flashes if rotor loads are severely out of balance.

Description



Allegra X-22

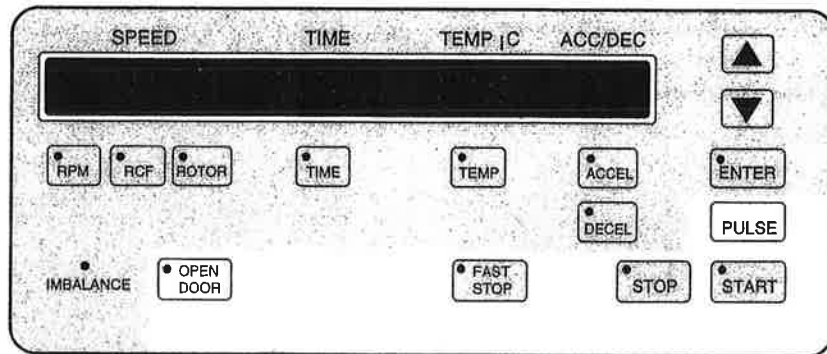


Allegra X-22R

Figure 1-3. The Control Panels

System Keys

The centrifuge operation is controlled through the system keys. Each key (except the PULSE key) has an LED in the upper left corner that lights to indicate that the key can be activated.



(START) Pressing the **(START)** key causes the centrifuge run to begin. This key can also be used to abort a deceleration process and restart the centrifuge.

(STOP) The **(STOP)** key can be pressed to end a run. The centrifuge decelerates to a complete stop according to the preselected deceleration curve. Deceleration can be terminated and the centrifuge restarted by pressing **(START)** again. The centrifuge emits a series of audible tones when the rotor reaches 0 rpm. (Instructions for disabling the tones are in Section 3.)

(FAST STOP) Pressing the **(FAST STOP)** key causes the centrifuge to decelerate to a complete stop at the maximum rate. The deceleration cannot be interrupted; the centrifuge can only be restarted after the rotor stops and the door is opened and closed.

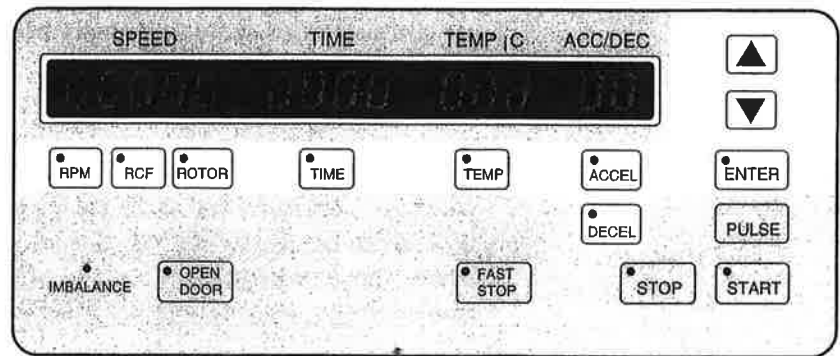
(OPEN DOOR) Pressing the **(OPEN DOOR)** key unlatches the centrifuge door locks and allows the door to be opened. The centrifuge will accept this command *only when the rotor is completely stopped* and the **(OPEN DOOR)** key LED is lit.

(PULSE) Pressing the **(PULSE)** key causes the installed rotor to accelerate at the maximum rate up to the set speed for short-duration runs (as long as the key is pressed). Deceleration, at the maximum rate, begins when the key is released.

Program Keys

The program keys are used to set run parameters (a program consists of all of the parameters for a run). Except for the cursor and **(ENTER)** keys, program keys are located beneath the applicable digital displays, which show the parameters as they are input. Each key (except for the cursor keys) has an LED in the upper left corner that lights to indicate operational readiness. The LEDs also blink if an incorrect parameter is entered.

Description



▲ ▼ (Cursor Keys)

The cursor keys are up and down arrow keys (▲ and ▼), which can be pressed to increment values up or down when setting parameters.

ENTER

Parameter (speed, time, temperature, and acceleration or deceleration curve) changes made while a run is in progress must be verified by pressing the **ENTER** key.

RPM

When the **RPM** key is pressed the last digit in the **SPEED** display (0) flashes, indicating that the speed can be entered in increments of 100 revolutions per minute (rpm). After the run starts, the actual rpm of the rotor is displayed.

RCF

The **RCF** key can be used to select the speed setting by required relative centrifugal field (RCF). The corresponding rpm is automatically calculated and displayed during the run. If the **RCF** key is pressed during the run, the RCF value is shown in the **SPEED** display.

ROTOR

The centrifuge memory contains a list of the rotors that can be used, together with default parameters for each rotor. When the **ROTOR** key is pressed the number of the rotor used in the previous run is shown on the **SPEED** display. The rotor list can be scrolled through, using the cursor keys, until the required rotor number appears.

TIME

The **TIME** key is used to select the run duration. When the **TIME** key is pressed, the last digit on the **TIME** display flashes, indicating that the time can be entered with the cursor keys.

- Timed run — Run time up to 9 hours and 59 minutes can be set. If the minutes parameter exceeds 59, it is automatically converted into hours.
- Continuous run — If a run time of less than 1 minute or more than 9 hours and 59 minutes is selected, continuous operation is activated. Time is not counted down, and the run will continue until the **STOP** or **FAST STOP** key is pressed.

TEMP
(refrigerated models only)

The **TEMP** key is used to select run temperature on refrigerated model centrifuges. When the **TEMP** key is pressed, the **TEMP°C** display flashes, indicating that the temperature can be entered with the cursor keys. Temperature can be set between -20 and $+40^{\circ}\text{C}$. The operating temperature range is $+2^{\circ}\text{C}$ to $+40^{\circ}\text{C}$, depending on the rotor used and the speed selected.

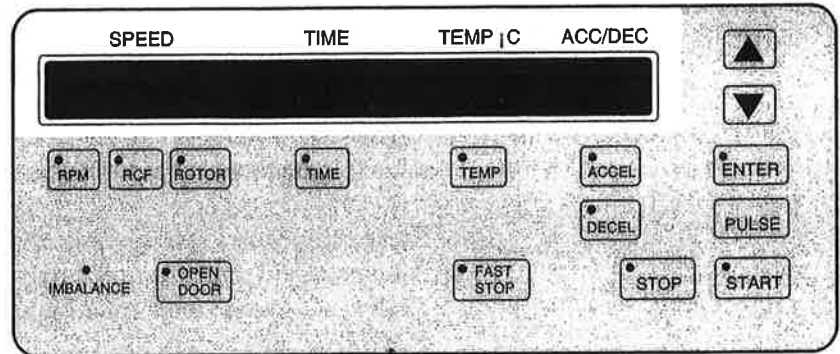
ACCEL

The **ACCEL** key is used to select acceleration rates that will protect delicate gradients. When the **ACCEL** key is pressed, the **ACC/DEC** display flashes, indicating that one of ten preset rates can be entered with the cursor keys (9 is the fastest rate and 0 is the slowest rate). Acceleration rates are described in Table 3-1 (in Section 3).

DECEL

The **DECEL** key is used to select deceleration rates that will maintain optimum separation while protecting delicate gradients. When the **DECEL** key is pressed, the **ACC/DEC** display flashes, indicating that one of ten preset rates can be entered with the cursor keys (9 is the fastest rate and 0 is a no-brake coast to stop). Deceleration rate selections are described in Table 3-1 (in Section 3).

Digital Displays



Digital displays indicate rotor speed, run time, rotor chamber temperature, and numbers that represent selected acceleration and deceleration profiles. When the power is turned on, they show the operating parameters of the most recent run performed before the power was turned off. The displays serve a dual purpose.

- When the run parameters are being set (the input mode), the displays show the set values (those selected by the operator). When a run-parameter key (for example, **TIME** or **RPM**) is pressed, the appropriate display flashes to indicate that data can be entered.
- The *actual* (real-time) operating conditions of the centrifuge are displayed during the run, after **START** is pressed.

NOTE

Error messages (see Section 4) also appear on the displays, when applicable. The centrifuge emits a series of audible tones to alert the user to an error condition.

SPEED

- *In input mode* the **SPEED** display shows the value of the parameter being set, depending on the programming key pressed (**RPM**), (**RCF**), or (**ROTOR**). For example, if the **ROTOR** programming key is pressed, a rotor number appears on the **SPEED** display.
- *During centrifugation*, the **SPEED** display shows the speed of the rotor in rpm. If the **RCF** key is pressed while the centrifuge is running, the RCF value is displayed.

TIME

- During a *timed run* (between 1 minute and 9 hours, 59 minutes), the **TIME** display begins counting down when the rotor starts to spin and continues the countdown until deceleration begins. The **TIME** display indicates the remaining run time in hours and minutes.
- During a *continuous run* (less than 1 minute or more than 9 hours, 59 minutes selected), countdown time is not displayed. Instead, the infinity (∞) symbol, indicating continuous operation, lights up and the **TIME** display shows time elapsed since the run start. After 9 hours and 59 minutes the timer will reset to 0 and continue counting elapsed time.

TEMP°C
(refrigerated models
only)

During standby (that is, the centrifuge is turned on but not spinning) and operation, the **TEMP°C** display shows the actual temperature inside the rotor chamber ($\pm 2^\circ\text{C}$ at an ambient temperature of 20°C).

ACC/DEC

The **ACC/DEC** display shows the acceleration curve that was selected for the run. The deceleration curve number can be displayed by pressing the **DECEL** key.

Installation

This section contains instructions for installing and connecting the centrifuge. Check that required clearances and electrical power are available.

**WARNING**

These centrifuges each weigh 48 kg/106 lb (nonrefrigerated model) or 78 kg/172 lb (refrigerated model.) DO NOT attempt to lift or move one of them without assistance from a lifting device or another person.

INSTALLING THE INSTRUMENT

**WARNING**

Do not place the centrifuge near areas containing flammable reagents or combustible fluids. Vapors from these materials could enter the centrifuge air system and be ignited by the motor.

**WARNING**

Maintain a 7.6-cm (3-in.) clearance envelope around the centrifuge while it is running. No persons should be within this clearance boundary while the centrifuge is operating. Do not handle or store hazardous materials within the 30-cm (1-ft) area surrounding the centrifuge.

The centrifuge ships in a cardboard box on a wooden pallet. For easy access, remove the top of the box, the foam insert on top of the centrifuge, and then the upper part (sides) of the box and set them aside. Then, *with the help of another person*, move the centrifuge from the pallet to its final position. (Note the warning on page 2-1 regarding centrifuge weight.)

Position the centrifuge on a level surface, such as a sturdy table or laboratory bench that is able to support the weight of the centrifuge (refer to SPECIFICATIONS) and resist vibration. Make sure that the centrifuge front feet are fully supported on the table.

- Locate the centrifuge in an area with sufficient ventilation to allow for heat dissipation.
- Check that there are 7.6-cm (3-in.) clearances at the sides of the centrifuge to ensure sufficient air circulation. Dimensions are shown in Figure 2-1. Additional clearance is required on the right side to allow access to the power switch.
- Ambient temperatures during operation should not be lower than 10°C (50°F) or higher than 35°C (95°F) for refrigerated models, or lower than 4°C (39.2°F) or higher than 35°C (95°F) for nonrefrigerated models. Relative humidity should not exceed 80% (noncondensing).

 **NOTE**

During transport between areas with varying temperatures, condensation may occur inside the centrifuge. Allow sufficient drying time before running the centrifuge.

TRANSPORTATION SAFETY DEVICES

A sheet of foam rubber is installed in the rotor chamber at the factory. A hole in the center of the foam stabilizes the drive shaft during transport. On receipt of the centrifuge, remove the foam and store it in case future relocation of the centrifuge is necessary.

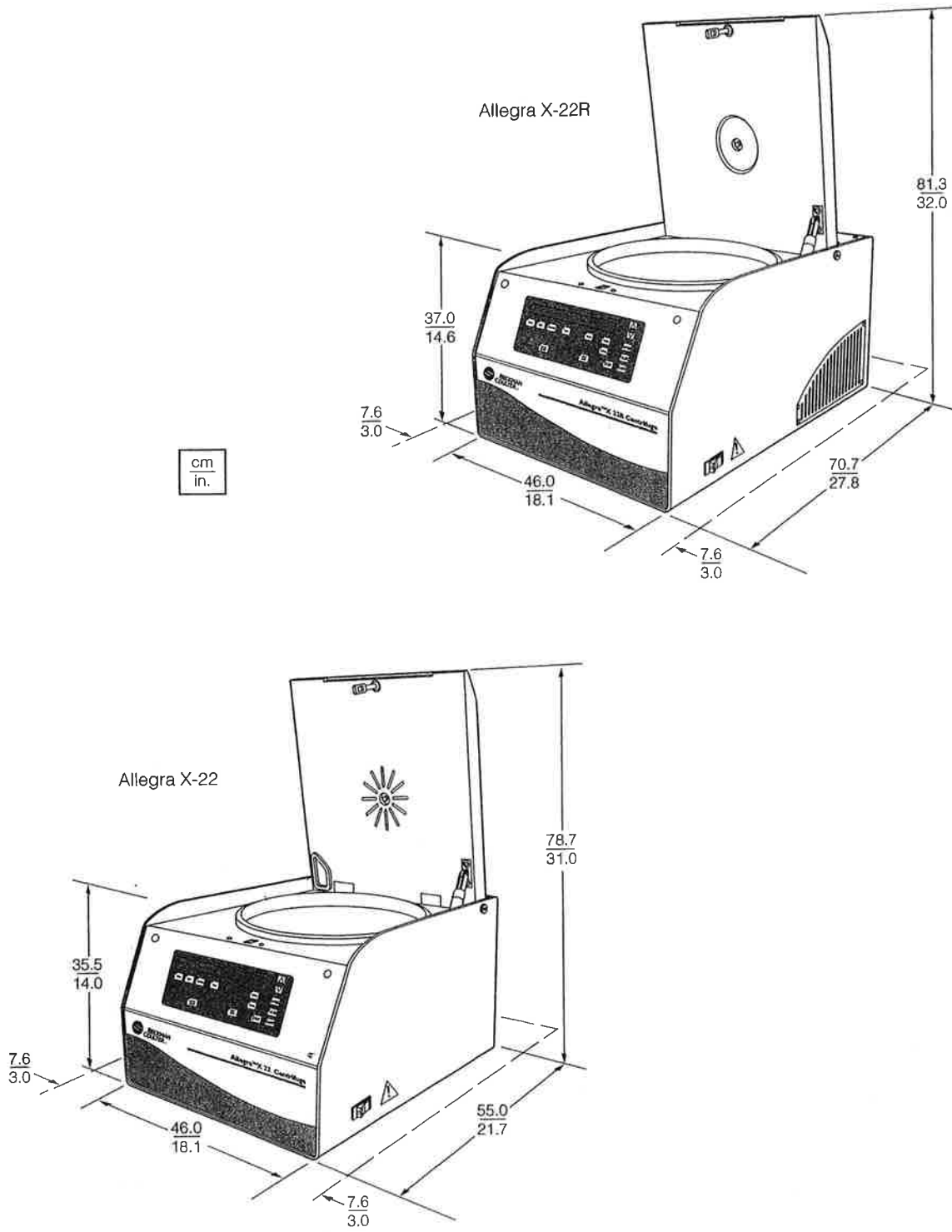


Figure 2-1. Dimensions of the Nonrefrigerated and Refrigerated Centrifuges

ELECTRICAL REQUIREMENTS

See the specifications on page xi (nonrefrigerated centrifuges) or page xii (refrigerated centrifuges) for centrifuge electrical requirements.

Make sure the voltage and frequency imprinted on the name rating plate affixed to the back of the centrifuge agree with the line voltage and frequency of the outlet used. (Refrigeration will not function properly if the frequency [Hz] does not match the name rating plate.) Plug in both ends of the centrifuge power cord. If there is any question about voltage, have a qualified service person measure it under load while the drive is operating.

To ensure safety, the centrifuge should be wired to a remote emergency switch (preferably outside the room where the centrifuge is housed, or adjacent to the exit from that room), in order to disconnect the instrument from the main power source in case of a malfunction.

A 1.8-m (6-ft) power cord with grounded plug is supplied with the centrifuge.



WARNING

To reduce the risk of electrical shock, this equipment uses a three-wire electrical cord and plug to connect the centrifuge to earth-ground.

To preserve this safety feature:

- **Make sure that the matching wall outlet receptacle is properly wired and earth-grounded. Check that the line voltage agrees with the voltage listed on the name rating plate affixed to the centrifuge.**
 - **Never use a three-to-two wire plug adapter.**
 - **Never use a two-wire extension cord or a two-wire non-grounding type of multiple-outlet receptacle strip.**
-

TEST RUN

 **NOTE**

The centrifuge must be plugged in and the power switch turned to on position (I) before the door can be opened.

We recommend that you make a test run to ensure that the centrifuge is in proper operating condition following shipment. See Section 3 for instructions on operating the centrifuge.

After completing the test run, return the pre-addressed warranty card included with this literature. This will validate the centrifuge warranty and ensure your receipt of further information regarding new accessories and/or modifications as they become available.

This section contains operating procedures for the centrifuge, using any of the Beckman Coulter rotors designed for use in these centrifuges. Refer to the applicable rotor manual for instructions on preparing the rotor for centrifugation. To prevent condensation, keep the centrifuge door closed and the power turned off (O) when the centrifuge is not in use.

 **NOTE**

If the centrifuge is used in a manner other than that specified in this manual, the safety and performance of this equipment could be impaired.



WARNING

Normal operation may involve the use of solutions and test samples that are pathogenic, toxic, or radioactive. Operator error or tube failure may generate aerosols. Do not run potentially hazardous materials in this centrifuge unless all appropriate safety precautions are taken. Always use the appropriate rotors and adapters.

Handle all infectious samples according to good laboratory practices and methods to prevent the spread of disease. Ask your laboratory safety officer to advise you about the level of containment required for your application and about the proper decontamination or sterilization procedures to follow if fluids escape from containers. Biosafe containment should be used when Risk Group II materials (as identified in the World Health Organization *Laboratory Biosafety Manual*) are handled; materials of a higher group require more than one level of protection. Because spills may generate aerosols, observe proper safety precautions for aerosol containment.



WARNING

The centrifuge must not be used in the vicinity of flammable liquids or vapors, and such materials should not be run in the centrifuge. During operation you should come within the 7.6 cm (3-in.) clearance envelope only to adjust instrument controls, if necessary. Never bring any flammable substances within the 30-cm (1-ft) area surrounding the centrifuge. Do not lean on the centrifuge or place items on the centrifuge while it is operating.

RUN PROCEDURE

The following detailed operating procedures are summarized at the end of this section. If you are an experienced user of this centrifuge, you can turn to the summary for a quick review of operating steps.

PREPARATION AND LOADING

For fast temperature equilibration, cool or warm the rotor to the required temperature before the run.

NOTE

For high-speed runs at temperatures of 20°C or higher, prime the refrigeration system (refrigerated models) by running the instrument at 10°C for 5 to 10 minutes beforehand to prevent overheating.

NOTE

Before installing the rotor, lubricate it following the instructions in the rotor manual.

1. Check the name rating plate for the correct voltage, then plug the power cord into the wall receptacle.
2. Press the power switch to on (I).

3. Press the **OPEN DOOR** key and lift the door up; it will remain in the open position.
4. Use the T-handle wrench to turn the rotor tie-down screw to the left (counterclockwise). Remove the tie-down screw.
5. Make sure that the tapered sleeve is in place at the base of the centrifuge drive shaft before installing the rotor (see Figure 3-1). The rotor rests on the sleeve while spinning, and will not operate properly if the sleeve is missing. Wipe the sleeve to be sure that it is clean and dry.

NOTE

If the tapered sleeve comes off, it must be replaced by a Beckman Coulter Field Service representative. See the last page of this manual (back of the warranty page) for contact information.

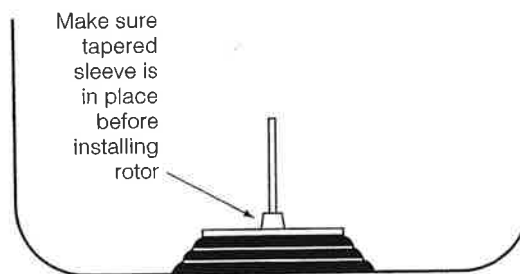


Figure 3-1. Tapered Sleeve Position

**CAUTION**

Do not drop the rotor onto the drive shaft. The shaft can be damaged if the rotor is forced sideways or dropped onto it. Install the rotor by centering it over the shaft and carefully lowering it straight down.

6. Install the rotor (see Figure 3-2) according to the instructions in the applicable rotor manual. Always run the rotor with a balanced load. (If you are using a swinging bucket rotor, fill all positions on the yoke of a swinging bucket rotor with buckets.)

SWINGING BUCKET ROTOR

FIXED ANGLE ROTOR

Lower the yoke straight down onto the drive shaft

Lower the rotor straight down onto the drive shaft

Tighten the tie-down screw clockwise onto the drive shaft

Tighten the tie-down screw clockwise onto the drive shaft

Seat filled buckets on the yoke pins

Attach the lid and tighten with the T-handle wrench (firmly hand-tighten the knob on rotors with no bolt for the T-handle wrench)

Figure 3-2. Installing a Rotor

7. Attach the tie-down screw to the drive shaft by turning it to the right (clockwise).
8. Use the T-handle wrench to tighten the tie-down screw on the shaft.

**CAUTION**

If the rotor is left in the centrifuge between runs, make sure the rotor is seated on the drive shaft and the tie-down screw is tight before each run. (Remove the rotor from the centrifuge if a long period between runs is anticipated.)

9. If using a fixed-angle rotor with a lid, attach the lid. Tighten the lid with the T-handle wrench. For rotors without a bolt for the T-handle wrench, tighten the knurled knob firmly by hand.

NOTE

Fixed-angle rotors can be centrifuged without lids attached when longer tubes are used.

10. Close the centrifuge door and push firmly down on both sides of the door front until you hear a clicking (latching) sound.

**ENTERING RUN
PARAMETERS**

When the power is applied for the initial use (no previous runs), default values will be displayed (see Figure 3-3). After the initial use, the parameters of the latest previous run will be displayed when power is applied.

When run parameters for a rotor have been entered, as described below, they will be retained in the centrifuge memory and can be recalled by simply entering the rotor number. The recalled program can then be used for the current run or can be altered as required.

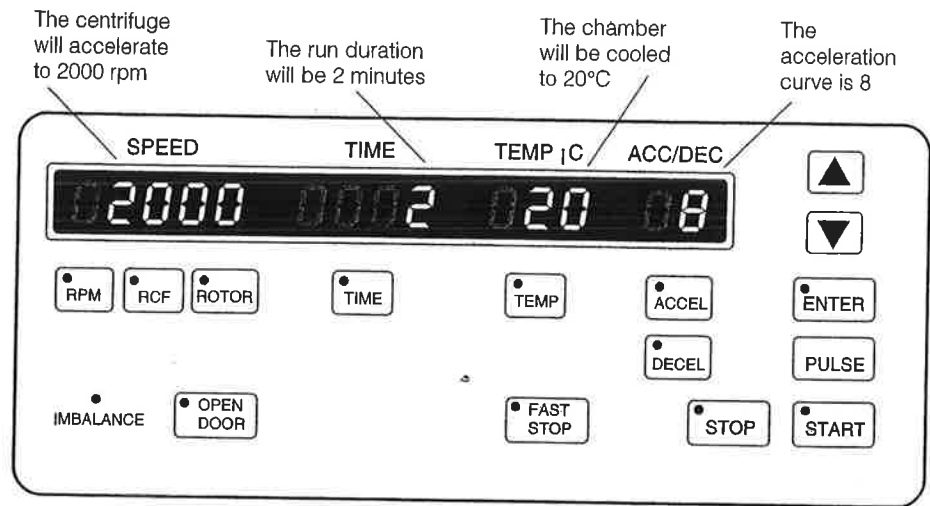


Figure 3-3. Default Parameters. The control panel shown is a refrigerated model; default values are the same for the nonrefrigerated model, except there is no temperature indication.

Selecting a Rotor Number

Each rotor that can be run in the centrifuge has a rotor number; the number is engraved on the rotor (and on the lid of fixed angle rotors). The centrifuge internal memory contains a list of all rotors that can be run in the centrifuge, together with acceptable run parameters for each rotor. If you enter an unauthorized rotor number then press the **(START)** key, an error message will be displayed and the run will be aborted shortly after the rotor starts spinning.

1. Press the **(ROTOR)** key.

A rotor number (the last rotor previously centrifuged) will appear on the **SPEED** display.

2. Press the **▲** or **▼** cursor key until the number of the rotor in use is displayed.
3. Press **(ENTER)**.

Nominal parameter values (time, temperature, speed, acceleration and deceleration curves) for the selected rotor will be displayed. You can use these parameters or set new values for the run.

Setting Run Speed

Centrifuge speed can be set for up to the maximum rated speed of the selected rotor. Either revolutions per minute (rpm) or relative centrifugal field (RCF) can be used to select speed. During centrifugation, the **SPEED** display indicates the actual run speed (rpm) of the rotor.

Setting RPM

1. Press the **(RPM)** key.

The last digit on the **SPEED** display (0) will flash, indicating that the rpm can be entered (in 100-rpm increments) with the cursor keys.

2. Press the **▲** or **▼** cursor key until the required rpm is displayed.

The corresponding RCF will be automatically calculated by the centrifuge, but the rpm value will be displayed during the run. (You can check the RCF during the run by pressing the **(RCF)** key while the centrifuge is running.)

Setting RCF

1. Press the **(RCF)** key.

The last digit on the **SPEED** display (0) will flash, indicating that the RCF can be entered.

2. Press the **▲** or **▼** cursor key until the required RCF is displayed.

The corresponding rpm will be automatically calculated and the centrifuge will run at the calculated speed. The rpm value will be displayed during the run. (You can check the RCF during the run by pressing the **(RCF)** key while the centrifuge is running.)

Setting Run Time

Run time can be set for either a timed run or continuous operation.

- *Timed run* — Time can be set for up to 9 hours and 59 minutes (if the minutes parameter entered exceeds 59, it is automatically converted into hours). During centrifugation, the **TIME** display begins counting down when the rotor starts to spin and continues the count-down until deceleration begins. The **TIME** display shows the time remaining in the run, in hours and minutes. When the time display reaches zero, the run ends.
- *Continuous run* — If a run time of less than 1 minute or more than 9 hours and 59 minutes is selected, continuous operation is activated. Time is not counted down during continuous operation; instead, the infinity (∞) symbol, indicating continuous operation, lights up and time elapsed since the run start is displayed. The run will continue until the **(STOP)** or **(FAST STOP)** key is pressed.

1. Press the **TIME** key.

The last digit on the **TIME** display will flash, indicating that the time can be entered with the cursor keys.

2. Press the **▲** or **▼** cursor key until the required run duration is displayed.

Setting Run Temperature (refrigerated models only)

Run temperature can be set between -20 and $+40^{\circ}\text{C}$. The typical operating range is from $+2^{\circ}\text{C}$ to 40°C , depending on the rotor and speed selected.

NOTE

Temperatures may vary slightly between instruments. If sample temperature is crucial, test temperature settings on your instrument using water samples.

1. Press the **TEMP** key.

The **TEMP** $^{\circ}\text{C}$ display will flash, indicating that the temperature can be entered with the cursor keys.

2. Press the **▲** or **▼** cursor key until the required run temperature is displayed.

NOTE

For runs at other than room temperature, refrigerate or warm the rotor beforehand for fast equilibration. For low-temperature runs, precool the centrifuge by running a 30-minute cycle at the required temperature (with a precooled rotor installed) with the speed set at about 2000 rpm.

Setting Acceleration Rate

The **ACCEL** key is used to select acceleration rates that will protect delicate gradients. When the **ACCEL** key is pressed, the **ACC/DEC** display flashes, indicating that one of the 10 preset acceleration rates can be entered with the cursor keys. The selected rate will depend on the type of run you are performing. For pelleting runs, where sample mixing is not a concern, maximum acceleration (setting 9) can be used. However, if delicate gradients are being run, a lower setting may be needed. Acceleration rates are listed in Table 3-1.

*Table 3-1. Acceleration/Deceleration Times (in minutes:seconds).
Times are approximate; actual times will vary depending on the rotor in use,
the rotor load, run speed, and voltage fluctuations.*

| Curve | Refrigerated Models | | | | Nont Refrigerated Models | | | |
|-------|--|--------|------------------------------------|-------|--|-------|------------------------------------|-------|
| | Swinging Bucket Rotors (4 500 rpm)* | | Fixed Angle Rotors (15 500 rpm) | | Swinging Bucket Rotors (4 200 rpm)* | | Fixed Angle Rotors (14 500 rpm) | |
| | Accel | Decel | Accel | Decel | Accel | Decel | Accel | Decel |
| 9 | 0:36 | 0:29 | 0:40 | 0:51 | 0:30 | 0:22 | 0:38 | 0:48 |
| 8 | 0:39 | 0:32 | 1:26 | 1:24 | 0:33 | 0:26 | 1:23 | 1:19 |
| 7 | 0:56 | 0:54 | 2:44 | 2:41 | 0:48 | 0:46 | 2:33 | 2:31 |
| 6 | 1:39 | 1:37 | 5:18 | 5:16 | 1:32 | 1:27 | 4:58 | 4:55 |
| 5 | 2:23 | 2:23 | 7:53 | 7:51 | 2:13 | 2:11 | 7:24 | 7:21 |
| 4 | 3:08 | 3:06 | 10:27 | 10:26 | 2:56 | 2:52 | 9:48 | 9:45 |
| 3 | 4:37 | 4:36 | 15:37 | 15:35 | 4:18 | 4:15 | 14:37 | 14:35 |
| 2 | 9:08 | 9:06 | 31:09 | 31:06 | 8:33 | 8:26 | 29:08 | 29:06 |
| 1 | 13:38 | 13:34 | 46:43 | 46:36 | 12:45 | 12:38 | 43:40 | 46:36 |
| 0 | 18:11 | coast† | 62:17 | coast | 16:59 | coast | 58:10 | coast |

* Maximum speed for the S2096 microtiter rotor is 3000 rpm; acceleration and deceleration times will decrease accordingly.

† Deceleration setting 0 is a no-brake coast to stop and in some cases may take less time than deceleration setting 1.

1. Press the **ACCEL** key.

The **ACC/DEC** display will flash, indicating that the selected rate number can be entered with the cursor keys.

2. Press the ▲ or ▼ cursor key until the required number is displayed.

Setting Deceleration Rate

The **DECEL** key is used to select deceleration rates that will maintain optimum separation. When the **DECEL** key is pressed, the **ACC/DEC** display flashes, indicating that one of the ten preset deceleration rates can be entered with the cursor keys. The selected rate will depend on the type of run you are performing. For pelleting runs, where sample mixing is not a concern, maximum brake (setting 9) can be used. However, if delicate gradients are being run, a lower brake setting may be needed. Deceleration rates are listed in Table 3-1.

1. Press the **DECEL** key.

The **ACC/DEC** display will flash, indicating that the selected number can be entered with the cursor keys.

2. Press the ▲ or ▼ cursor key until the required number is displayed.

STARTING A RUN

The run can be started using the parameters in memory from a previous run, or using new or changed parameters that you enter using the procedure described above.

1. Check that all parameters are correct and the door is shut and latched.
2. Press the **(ENTER)** key, then the **(START)** key.

As the run begins, the instrument rotor identification system compares the rotor in the chamber to the entered rotor number and the speed entered. An incorrect rotor identification, or set speed greater than the *rotor's maximum permitted speed*, will result in an error code and the centrifuge will shut down. (See Section 4, TROUBLESHOOTING, for information on error codes.) The error must be cleared and an appropriate speed entered before the centrifuge can be started. Throughout the run, checks are made to ensure that the rotor does not exceed set speed.

- The **SPEED** display indicates the rotor speed in rpm. (The RCF can be checked by pressing the **(RCF)** key.)
- A blinking LED at the bottom of the **TIME** display indicates that the run is in progress. This display also shows the time remaining in the run (or ∞ and elapsed time for continuous operation).



WARNING

Do not attempt to override the door interlock system while the rotor is spinning.



CAUTION

Do not lift or move the centrifuge while the rotor is spinning. Do not place items on the centrifuge during operation.

PULSE FUNCTION

The pulse function, accessed by pressing the **(PULSE)** key, is used for short-duration runs as follows.

- When the **(PULSE)** key is pressed, the rotor accelerates at maximum rate to the set speed and continues to spin as long as the **(PULSE)** key is pressed. (The current run time, acceleration, and deceleration settings are overridden by the pulse function.) When the **(PULSE)** key is

released, the rotor begins decelerating to 0 rpm using maximum deceleration. Using the pulse function eliminates the need to press the **(START)** and **(STOP)** keys.

- When the **(PULSE)** key is pressed, the TIME display begins displaying the elapsed seconds. When the **(PULSE)** key is released, the seconds stop accumulating. The ACCEL/DECEL display continues to show the user-entered settings during a pulse run even though the maximum rates are used.
- If the **(PULSE)** key is pressed while the rotor is running at set speed, the rotor continues running at speed until the **(PULSE)** key is released. When the **(PULSE)** key is released, the rotor begins decelerating to 0 rpm using maximum deceleration.
- The centrifuge memory retains the parameters of the last run performed before the **(PULSE)** key was pressed. At the end of a pulse run, after the centrifuge door is opened and closed the previous run parameters are displayed.

CHANGING PARAMETERS DURING A RUN

While a run is in progress, run parameters (speed, time, temperature, and acceleration or deceleration rate) can be altered without stopping the run. Run duration can also be changed from continuous to a specified time period, or from a specified time period to continuous.

NOTE

The deceleration rate cannot be changed after deceleration starts.

Use the program keys as described under ENTERING RUN PARAMETERS, above, to change parameters. Parameter changes made during a run must be verified by pressing the **(ENTER)** key. For example, to change run speed during centrifugation:

1. Press the **(RPM)** key.

The last digit on the **SPEED** display will flash, indicating that the rpm can be raised or lowered with the cursor keys.

2. Press the **▲** or **▼** cursor key until the required rpm is displayed.

3. Press the **(ENTER)** key.

The current rpm value will be displayed, changing to the new value as the rotor accelerates or decelerates to the new speed selected. The corresponding RCF will be automatically calculated by the centrifuge.

STOPPING A RUN

A timed run will end automatically when the **TIME** display counts down to zero. The centrifuge will emit a series of audible tones when the rotor reaches 0 rpm. (Instructions for disabling the audible tones are on page 3-13.) To end a run in progress for any reason:

1. Press the **(STOP)** key for normal deceleration as selected by the deceleration curve.

(or)

Press the **(FAST STOP)** key for deceleration at the maximum rate (see Table 3-1).

NOTE

If you press **(FAST STOP)** the deceleration process cannot be interrupted; the centrifuge can be restarted only after the rotor comes to a complete stop and the door is opened and closed.

2. After the rotor stops spinning and the **(OPEN DOOR)** light comes on, press the **(OPEN DOOR)** key to release the door latches, then open the door.

NOTE

To prevent chamber icing, use a sponge to wipe condensation out of the chamber bowl between runs.

UNLOADING

NOTE

When you remove the rotor, make sure that the tapered sleeve from the centrifuge drive shaft does not come out with the rotor. If the tapered sleeve is inside the rotor drive hole, call Beckman Coulter Field Service (1-800-551-1150 in the United States).

After completing a run, unload the rotor following the instructions in the applicable rotor manual.



CAUTION

If disassembly reveals evidence of leakage, you should assume that some fluid escaped the rotor. Apply appropriate decontamination procedures to the centrifuge and accessories.

DISABLING THE AUDIBLE TONES

The audible tones (beeps) that sound at the end of each run and if an error occurs may be turned on and off by following the steps below (rotor must be at 0 rpm).

1. Press the **(STOP)** key and hold for 3 seconds until the word "Beep" appears in the display.
2. Press either the up **▲** or down **▼** cursor key to turn the beeps on or off. (The word "on" or "off" is displayed to indicate the current setting. The arrow keys toggle between on and off settings.)
3. Press **(ENTER)** to save the selection.

SUMMARY OF RUN PROCEDURES

For runs at other than room temperature, refrigerate or warm the rotor beforehand for fast equilibration. For low-temperature runs, precool the centrifuge by running a 30-minute cycle (with a precooled rotor installed) at the required temperature with the speed set at 2000 rpm.

1. Press the POWER switch to on (I). Open the centrifuge door (press the **(OPEN DOOR)** key and lift the door up).
2. Make sure that the tapered sleeve is in place at the base of the centrifuge drive shaft before installing the rotor. The rotor will not operate properly if the sleeve is missing.
3. Install the rotor according to the instructions in the applicable rotor manual. *Always run the rotor with a balanced load.*
4. Close the centrifuge door and push firmly down on it until you hear the latch engage.
5. Enter run parameters:
 - Select a rotor number — **(ROTOR)**, ▲ or ▼, **(ENTER)**
 - Set run speed — **(RPM)**, ▲ or ▼; or **(RCF)**, ▲ or ▼
 - Set run duration — **(TIME)**, ▲ or ▼
 - Set run temperature — **(TEMP)**, ▲ or ▼
 - Select acceleration rate (0 through 9) — **(ACCEL)**, ▲ or ▼
 - Select deceleration rate (0 through 9) — **(DECEL)**, ▲ or ▼
6. Check that all parameters are correct and the door is shut and latched, then press **(ENTER)**, then **(START)**.



WARNING

Never attempt to override the door interlock system while the rotor is spinning.



CAUTION

Do not lift or move the centrifuge while the rotor is spinning.

7. Wait for the set time to count down to zero, or end the run by pressing either the **(STOP)** key or the **(FAST STOP)** key.
8. After the rotor stops spinning and the **(OPEN DOOR)** light comes on, press the **(OPEN DOOR)** key to release the door latch; open the door.
9. Unload the rotor according to instructions in the applicable rotor manual.



CAUTION

If disassembly reveals evidence of leakage, you should assume that some fluid escaped the rotor. Apply appropriate decontamination procedures applied to the centrifuge and accessories.

Troubleshooting

This section lists possible malfunctions, together with probable causes and corrective actions required. Maintenance procedures are contained in Section 5. For any problems not covered here contact Beckman Coulter Field Service.

 **NOTE**

It is your responsibility to decontaminate the centrifuge, as well as any rotors and accessories, before requesting service by Beckman Coulter Field Service.

USER MESSAGES

 **CAUTION**

If the message SEr appears on the display, do not press any keys while the message is displayed. Turn the centrifuge power off (O) and back on (I) to clear the message. This message indicates that you have inadvertently accessed the service mode. Pressing any keys while in this mode could erase the centrifuge memory and critically interfere with future operation.

If a problem occurs during operation, the rotor will decelerate to a stop, an error code will appear on the **SPEED** display, and the centrifuge will emit a series of audible tones to alert the operator to the error condition. Messages may result from incorrect input or from an equipment malfunction. Refer to Table 4-1 to determine the nature of the problem and recommended actions. If you are unable to correct the problem, call

Beckman Coulter Field Service. To help diagnose and correct the problem, gather as much information about the situation as you can:

- Write down the error number that appears on the display.
- Note the operating situation when the error occurred (rotor in use, speed, load type, etc.).
- Note any unusual environmental and/or operating conditions (ambient temperature, voltage fluctuations, etc.).
- Add any other information that may be helpful.

 **NOTE**

Instructions for disabling the audible tones are in Section 3.

OTHER POSSIBLE PROBLEMS

Possible malfunctions that may not be indicated by diagnostic messages are described in Table 4-2, along with probable causes and corrective actions required. Possible causes for each problem are listed in the probable order of occurrence. Perform the recommended corrective action in sequence, as listed. If you are unable to correct the problem, call Beckman Coulter Field Service.

Table 4-1. Error Message Chart.
*If the recommended action does not correct the problem, call Beckman Coulter Field Service.**

| Error Number | Problem | Result | Recommended Action |
|---|--|--|---|
| 1 through 23, 25 and 26, 28 through 30, 32, 36, 39 and 40, 44 through 60, 63 through 68 | Microprocessor or mechanical malfunction | Deceleration to full stop; run cannot be restarted | After rotor comes to a complete stop, turn the power off (O), then back on (I) to reset. |
| 23 and 24, 27, 31, 33 through 35, 37 and 38, 41 through 43, 62 | Microprocessor or mechanical malfunction | Deceleration to full stop; run cannot be restarted | After rotor comes to a complete stop, open and close the centrifuge door, then restart. |
| 69 through 77 | Microprocessor malfunction | Run cannot start until error is cleared | Turn the power off (O), then back on (I) to reset. |
| 78 through 80 | Error during closing of door | Run cannot start | <ol style="list-style-type: none"> 1. Remove debris in latch 2. Close lid quickly. 3. Turn the power off (O), then back on (I) to reset. |
| 81 | "Door open" detected during run | Maximum deceleration to full stop | After rotor comes to a complete stop, shut the centrifuge door, turn the power off (O), then back on (I) to reset. |
| 82, 83 | Door does not open | — | See EMERGENCY ACCESS, below |
| 84 | Heat sink overtemperature | Deceleration to full stop | <ol style="list-style-type: none"> 1. Check that ambient temperature is within the limits shown in SPECIFICATIONS. |
| 85 through 87 | Rotor chamber overtemperature (refrigerated models) | Deceleration to full stop | <ol style="list-style-type: none"> 2. Check air inlets and exhausts for obstructions. <p>After the motor has cooled, restart. If the problem persists, call Beckman Coulter Field Service.</p> |
| 90 through 96 | Temperature sensor malfunction (refrigerated models) | Maximum deceleration to full stop | Turn the power off (O), then back on (I) to reset. |
| 98 | Rotor not recognized | Maximum deceleration to full stop | Check that the installed rotor is usable in the centrifuge. If incorrect, install an authorized rotor; if rotor is authorized and problem persists, call Beckman Coulter Field Service. |
| 99 | Rotor recognized but incorrect | Maximum deceleration to full stop | Input correct parameters for the rotor in use, then restart. |

* In the United States, call 1-800-551-1150; outside the U.S., contact your local Beckman Coulter office.

Table 4-2. Troubleshooting Chart

| Problem | Problem/Result | Recommended Action |
|---|--|--|
| Imbalance LED lights and rotor decelerates to stop | <ol style="list-style-type: none"> 1. Rotor is out of balance 2. Centrifuge is misaligned (tilted) 3. Centrifuge was moved during operation 4. Drive error (mechanical damage) | <ol style="list-style-type: none"> 1. Check to be sure the rotor is in good condition and is loaded symmetrically around the center of rotation, with containers of equal weight and density opposite each other. 2. Align the centrifuge on the bench or table. 3. After the rotor comes to a complete stop, open and close the centrifuge door, then restart. 4. Call Beckman Coulter Field Service. |
| Rotor cannot achieve set speed | <ol style="list-style-type: none"> 1. Line voltage below rating 2. Electrical failure 3. Motor failure | <ol style="list-style-type: none"> 1. Have a qualified service person measure line voltage while the instrument is operating. 2. Make sure both ends of the power cord are securely connected; call Beckman Coulter Field Service. 3. Call Beckman Coulter Field Service. |
| Door will not open | <ol style="list-style-type: none"> 1. Rotor spinning 2. Power not on 3. Source power failure 4. Latch stuck | <ol style="list-style-type: none"> 1. Wait until the rotor stops. 2. Plug in the power cord; turn power on (I). 3. See EMERGENCY ACCESS, below. 4. See EMERGENCY ACCESS, below. |
| Displays are blank | <ol style="list-style-type: none"> 1. Power not on 2. Electrical failure 3. Fuse blown | <ol style="list-style-type: none"> 1. Plug in the power cord; turn power on (I). 2. Make sure both ends of the power cord are securely connected; call Beckman Coulter Field Service. 3. System fuses cannot be replaced by the user. Call Beckman Coulter Field Service. |
| TEMP °C display flashes (refrigerated models) | Chamber temperature is >25°C higher than selected temperature | Precool rotors before running at low temperatures. Precool rotor chamber by running a 30-minute cycle at the desired temperature with the speed set at about 2000 rpm. If a lower temperature deviation alert is required, contact Beckman Coulter Field Service. |
| Chamber does not reach selected temperature (refrigerated models) | Centrifuge cannot maintain selected temperature for rotor in use at speed selected | Refer to applicable rotor manual for temperature and speed requirements. Also, precool rotors before running at low temperatures. Precool rotor chamber by running a 30-minute cycle at the desired temperature with the speed set at 2000 rpm. |

EMERGENCY ACCESS

If the facility power fails only momentarily, the centrifuge will resume operation when power is restored and the rotor will return to set speed. However, if the rotor comes to a complete stop you will have to restart the run when the power is restored. In the event of an extended power failure, it may be necessary to trip the door-locking mechanism manually to remove the rotor and retrieve your sample.



WARNING

Any maintenance procedure requiring removal of a panel exposes the operator to the possibility of electrical shock and/or mechanical injury. Therefore, turn the power off and disconnect the instrument from the main power source, and refer such maintenance to qualified service personnel.

1. Turn the power switch to off (O) and disconnect the power cord from the main power source.



WARNING

Never attempt to override the door interlock system while the rotor is spinning.

2. Make sure that the rotor is not spinning. Do not proceed if there is any sound or vibration coming from the drive.
3. Use a small flat-blade screwdriver to pry off the two round screw-hole covers on the centrifuge front panel (see Figure 4-1). Set the covers aside.
4. Insert a Phillips-head screwdriver through one of the exposed holes in the centrifuge front panel and loosen the screw. Repeat for the other screw. Do not remove the screws.
5. Move the centrifuge forward on the bench until the two screws on the bottom of the centrifuge are accessible. Use a Phillips-head screwdriver to remove the two screws. Set them aside.

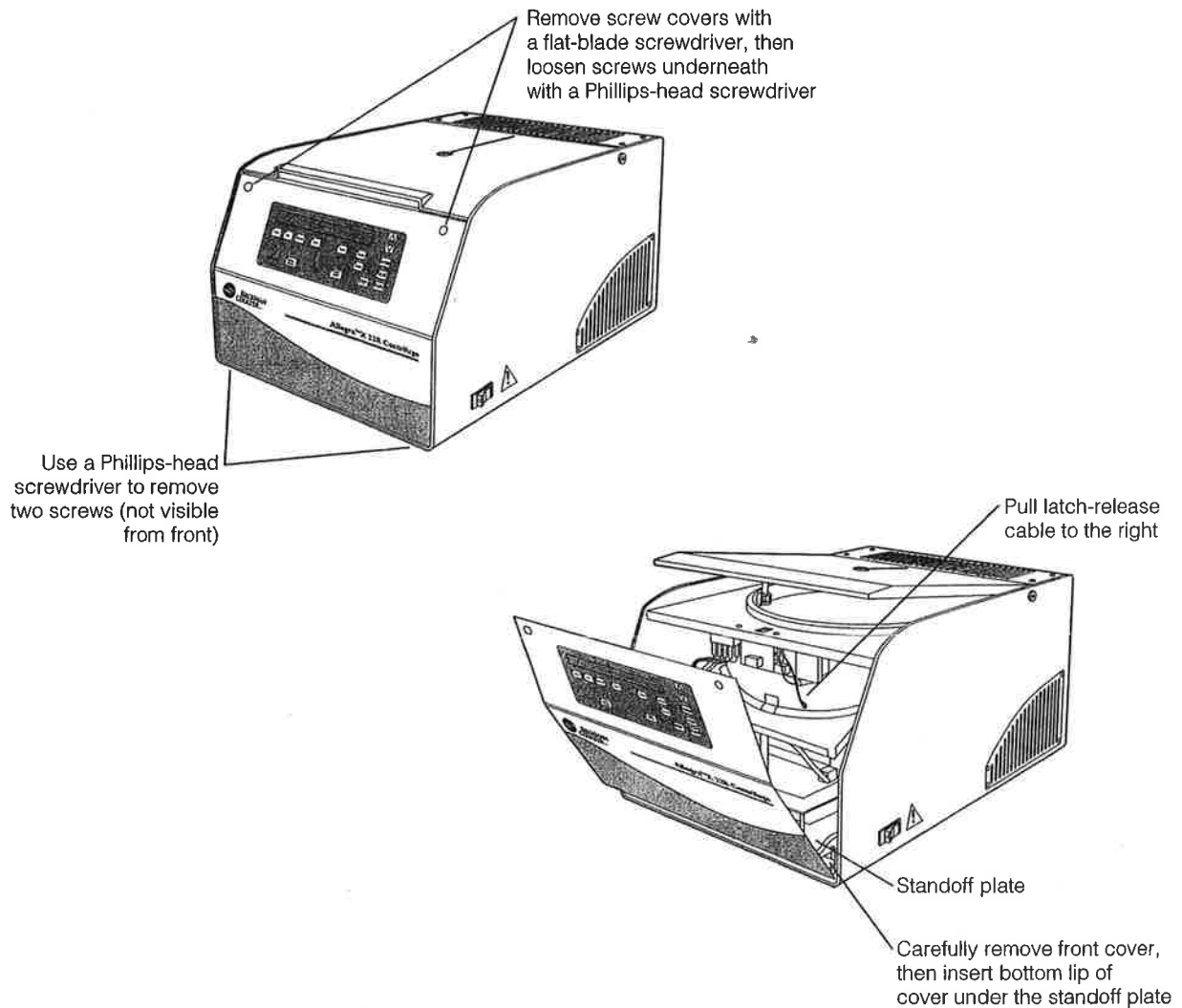


Figure 4-1. Emergency Door Release

6. Carefully lift the centrifuge front cover until the bottom releases, then pull the top towards you slightly. To support the cover, insert the cover bottom lip under the standoff plate inside the centrifuge.



CAUTION

Do not allow the cover to hang down supported only by the exposed power and grounding wires or the wires will be damaged.

7. Pull the latch-release cable firmly to the right until the latches release and the door opens.

If the rotor is still spinning, close the door and wait until it stops before attempting to remove it.



WARNING

Never try to slow or stop the rotor by hand.

After removing the rotor, replace the front panel by following the instructions above, in reverse order.

Care and Maintenance

For maintenance not covered in this manual, contact Beckman Coulter Field Service. User messages are discussed in Section 4, TROUBLE-SHOOTING. Refer to the applicable rotor manual and to Chemical Resistances (publication IN-175) for instructions on the care of rotors and their accessories.

 **NOTE**

It is your responsibility to decontaminate the centrifuge, as well as any rotors and accessories, before requesting service by Beckman Coulter Field Service.

 **WARNING**

Any maintenance procedure or servicing of this equipment that requires removal of any covers can expose parts which involve the risk of electric shock or personal injury. Make sure that the power switch is off (O) and the centrifuge is disconnected from the main power source, and refer such servicing to qualified service personnel.

Do not use alcohol or other flammable substances in or near operating centrifuges.

MAINTENANCE

PREVENTIVE MAINTENANCE

The following procedures should be performed regularly to ensure continued performance and long service life of the centrifuge.

- Regularly inspect the interior of the rotor chamber for accumulations of sample, dust, or glass particles from broken sample tubes. Clean as required (see CLEANING, below), as these accumulations can result in rotor vibrations.
- Regularly check the air intake and exhaust vents for obstructions. Keep vents clear and clean.
- Use a sponge to wipe condensation out of the chamber bowl between runs to prevent chamber icing (refrigerated models). If chamber icing occurs, defrost before use.
- To prevent the rotor from sticking, lubricate the drive shaft with Spinkote at least once a month, and after each cleaning.

REPLACING THE ROTOR CHAMBER GASKET

If the gasket (961806) around the rotor chamber opening becomes damaged or worn, replace it as follows. (See Figure 5-1.)

1. Remove the gasket by pulling it up and away from the opening.
2. Install the new gasket by positioning the groove in the gasket over the rim of the opening.
3. Press the gasket around the opening so that the rim is seated in the gasket groove.

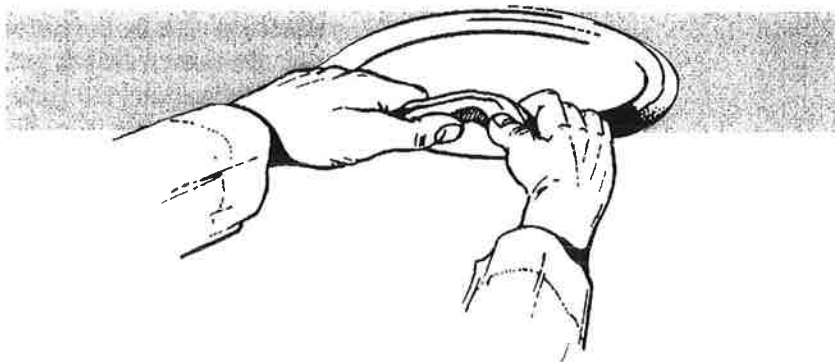


Figure 5-1. Replacing the Rotor Chamber Gasket

CLEANING

Frequent cleaning is recommended to prolong the life of the centrifuge. *Always clean up spills when they occur to prevent corrosives or contaminants from drying on component surfaces.*

- To prevent accumulations of sample, dust, and/or glass particles from broken sample tubes, keep the interior of the rotor chamber clean and dry by frequent wiping with a cloth or paper towel.
- Clean the drive shaft, shaft cavity, threads, and the tie-down screw at least once a week using a mild detergent such as Beckman Solution 555™ and a soft brush. Dilute the detergent 10 to 1 with water. Rinse thoroughly and dry completely. Lubricate the drive shaft with Spinkote after cleaning.
- Wash the bowl using a mild detergent such as diluted Solution 555. Rinse thoroughly and dry completely. If a cleaning solution other than Solution 555 is used, consult *Chemical Resistances* (publication IN-175) or contact the cleaning-solution vendor to verify that the solution will not damage the centrifuge.
- Clean the centrifuge case and door by wiping with a cloth dampened with diluted Solution 555. Do not use acetone or other solvents.

TUBE BREAKAGE

If a glass tube breaks, and all the glass is not contained in the bucket or rotor, it will be necessary to thoroughly clean the interior of the chamber bowl.



WARNING

Be careful when examining or cleaning the sealing gasket or chamber, as sharp glass fragments may be embedded in their surfaces.

- Examine the gasket to make sure that no glass particles are retained in it. Carefully remove any glass particles that may remain.
- Carefully wipe away any glass particles that remain in the bowl.

DECONTAMINATION

If the centrifuge and/or accessories are contaminated with radioactive or pathogenic solutions, perform appropriate decontamination procedures. Refer to *Chemical Resistances* (IN-175) to be sure the decontamination method will not damage any part of the centrifuge.

STERILIZATION AND DISINFECTION

The centrifuge is finished with urethane paint. Ethanol (70%)* may be used on this surface. See *Chemical Resistances* for more information regarding chemical resistance of centrifuge and accessory materials.

While Beckman Coulter has tested these methods and found that they do not damage the centrifuge, no guarantee of sterility or disinfection is expressed or implied. When sterilization or disinfection is a concern, consult your laboratory safety officer regarding proper methods to use.

STORAGE AND TRANSPORT

STORAGE

Before storing a centrifuge for an extended period, return it to its original shipping container to protect it from dust and dirt. Reinsert the shipping foam (removed at time of centrifuge installation) into the chamber, making sure the drive shaft is stabilized in the hole in the foam. Temperature and humidity conditions for storage should meet the environmental requirements described under SPECIFICATIONS.

RETURNING A CENTRIFUGE

Before returning a centrifuge or accessory for any reason, prior permission (a Returned Goods Authorization form) must be obtained from Beckman Coulter, Inc. Contact your local Beckman Coulter office to obtain the RGA form and for packaging and shipping instructions.

To protect our personnel, it is the customer's responsibility to ensure that all parts are free from pathogens and/or radioactivity. Sterilization and decontamination must be done before returning the parts.

All parts must be accompanied by a signed note, plainly visible on the outside of the box, stating that they are safe to handle and that they are not contaminated with pathogens or radioactivity. Failure to attach this notification will result in return or disposal of the items without review of the reported problem.

* Flammability hazard. Do not use in or near operating centrifuges.

SUPPLY LIST

Refer to the applicable rotor manual for materials and supplies needed for rotors.

NOTE

To obtain copies of referenced publications, contact Beckman Coulter, Inc., Technical Publications Department, 1050 Page Mill Road, Palo Alto, CA 94304, U.S.A. (telephone 650-859-1753; fax 650-859-1375).

Contact Beckman Coulter Sales (1-800-742-2345 in the United States; worldwide offices are listed at the back of this manual) for information about ordering parts and supplies. For your convenience, a partial list is given below.

REPLACEMENT PARTS

| | |
|--------------------------------|--------|
| Power cord (60-Hz) | 392221 |
| Power cord (50-Hz) | 392227 |
| Rotor chamber gasket | 392201 |
| Rotor tie-down screw | 361367 |
| T-handle wrench | 361371 |

SUPPLIES

| | |
|---|--------|
| Spinkote lubricant (2 oz) | 306812 |
| Silicone vacuum grease (1 oz) | 335148 |
| Beckman Solution 555 (1 qt) | 339555 |

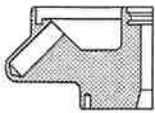
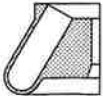

Rotor Manuals Addendum Regarding Use of Rotors in Allegra X-22 Series Centrifuges

The following rotors can be used in the Allegra X-22 Series centrifuges. (The rotors are also compatible with all centrifuges specified in the current rotor manuals.)

- F1010
- F0850
- F0685
- F0630
- F2402H
- C1015
- C0650
- S2096

The maximum speeds and *g*-forces for the F1010, F0850, C1015, C0650, and S2096 rotors in Allegra X-22R Series centrifuges are the same as those listed in the current rotor manuals. The maximum speeds and *g*-forces for the F0685, F0630, and F2402H rotors when used in the Allegra X-22 Series centrifuges are shown below.

*Maximum Speeds and g-Forces for the F2402H, F0630, and F0685 Rotors
when used in Allegra X-22 Series Centrifuges*

| Rotor Profile and Description | Allegra X-22R Centrifuge (Refrigerated) | | Allegra X-22 Centrifuge (Nonrefrigerated) | | Max Capacity (mL) |
|--|--|---------------------------|--|---------------------------|-------------------------|
| | Max RPM | Max RCF ($\times g$) | Max RPM | Max RCF ($\times g$) | |
|  F2402H Fixed Angle 45° Angle $r_{\max} = 82$ mm | 15 500 | 22 065 | 14 500 | 19 309 | 24 \times 1.5/2.0 |
|  F0630 Fixed Angle 30° Angle $r_{\max} = 78$ mm | 15 300 | 20 450 | 14 500 | 18 367 | 6 \times 30 |
|  F0685 Fixed Angle 25° Angle $r_{\max} = 97$ mm | 10 000 | 10 864 | 8 000 | 6 953 | 6 \times 85 |

NEW ADAPTERS

New adapters have been added to the accessory lists of the F2402H, F0685, F0850, and F1010 rotors, as shown below. These adapters have been tested to the maximum speeds of the rotors when used in the Allegra X-22 Series centrifuges.

F2402H Rotor

| Part Number | Tube Description | Tube Volume | Capacity (bucket) | Capacity (rotor) | Pack of |
|-------------|------------------------|---------------------|-------------------|------------------|---------|
| 361247 | 5 × 45 mm 7 × 40 mm | 0.25 mL 0.40 mL | 1 | 24 | 24 |
| 364690 | 18 × 28 mm | 0.50 mL/ 0.75 mL | 1 | 24 | 24 |

F0685 Rotor

| Part Number | Tube Description | Tube Volume | Capacity (bucket) | Capacity (rotor) | Pack of |
|-------------|--------------------------|-------------|-------------------|------------------|---------|
| 347539 | 29 × 104 mm round bottom | 50 mL | 1 | 6 | 6 |
| 392270* | 17 × 100 mm conical | 15 mL | 1 | 6 | 6 |
| 392268* | 28.5 × 120 mm conical | 50 mL | 1 | 6 | 6 |
| 392616 | 18 × 106 mm round bottom | 15 mL | 1 | 6 | 6 |

*The F0685 rotor must be run without the lid when these adapters are used.

F0850 Rotor

| Part Number | Tube Description | Tube Volume | Capacity (bucket) | Capacity (rotor) | Pack of |
|-------------|---------------------|-------------|-------------------|------------------|---------|
| 870329 | 17 × 120 mm conical | 15 mL | 1 | 6 | 12 |

F1010 Rotor

| Part Number | Tube Description | Tube Volume | Pack of |
|-------------|-----------------------------|-------------|---------|
| 342602 | rubber pad for tube removal | 6.5 mL | 12 |