

## **F3602 Rotor**



**Used in the Beckman Coulter  
Allegra 64R, Avanti 30,  
Allegra 21 Series, Spinchron 15 Series,  
and GS-15 Series Centrifuges**



## SAFETY NOTICE

This safety notice summarizes information basic to the safe use of the rotor described in this manual. The international symbol displayed above is a reminder to the user that all safety instructions should be read and understood before operation or maintenance of this equipment is attempted. When you see the symbol on other pages of this publication, pay special attention to the safety information presented. Observance of safety precautions will also help to avoid actions that could damage or adversely affect the performance of the rotor.



Handle body fluids with care because they can transmit disease. No known test offers complete assurance that such fluids are free of micro-organisms. Some of the most virulent—Hepatitis (B and C) viruses, HIV (I–V), atypical mycobacteria, and certain systemic fungi—further emphasize the need for aerosol protection. Handle other infectious samples according to good laboratory procedures and methods to prevent spread of disease. Because spills may generate aerosols, observe proper safety precautions for aerosol containment. Do not run toxic, pathogenic, or radioactive materials in this rotor without taking appropriate safety precautions. 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.



The rotor and accessories are not designed for use with materials capable of developing flammable or explosive vapors. Do not centrifuge such materials in nor handle or store them near the centrifuge.



This rotor was developed, manufactured, and tested for safety and reliability as part of a Beckman Coulter centrifuge/rotor system. Its safety or reliability cannot be assured if used in a non-Beckman Coulter centrifuge or in a Beckman Coulter centrifuge that has been modified without Beckman Coulter's approval.



Although rotor components and accessories made by other manufacturers may fit in the F3602 rotor, their safety in this rotor cannot be ascertained by Beckman Coulter. Use of other manufacturers' components or accessories in the F3602 rotor may void the rotor warranty and should be prohibited by your laboratory safety officer. Only the components and accessories listed in this publication should be used in this rotor.



Make sure that filled containers are loaded symmetrically into the rotor and that opposing bottles or tubes are filled to the same level with liquid of the same density.



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



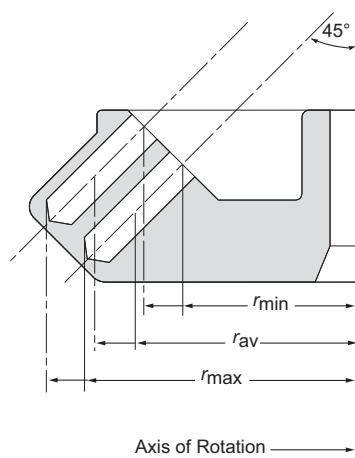
Never exceed the maximum rated speed of the rotor and labware in use. Refer to the section on RUN SPEEDS.



Do not use sharp tools on the rotor that could cause scratches in the rotor surface. Corrosion begins in scratches and may open fissures in the rotor with continued use.

# F3602 ROTOR

## SPECIFICATIONS



### Maximum speed

Allegra 64R/Avanti 30	22 000 rpm*
Allegra 21R/GS-15R/Spinchron 15R	14 000 rpm
Allegra 21/GS-15/Spinchron 15	12 500 rpm
Density rating at maximum speed	1.2 g/mL
Critical speed range <sup>†</sup>	500 to 700 rpm
Relative Centrifugal Field <sup>‡</sup> at maximum speed at $r_{\max}$	

	Outer Row (87.0 mm)	Inner Row (77.0 mm)
Allegra 64R/Avanti 30	$47\,618 \times g$	$41\,666 \times g$
Allegra 21R/GS-15R/ Spinchron 15R	$19\,283 \times g$	$16\,873 \times g$
Allegra 21/GS-15/Spinchron 15	$15\,373 \times g$	$13\,451 \times g$
$k$ factor	224	
Conditions requiring speed reductions	see RUN SPEEDS	
Number of tube cavities	36	
Available bottles and tubes	see Table 1	
Nominal tube dimensions	11 × 45 mm	
Nominal tube capacity (largest tube)	2 mL	
Nominal rotor capacity	72 mL	
Approximate acceleration time to maximum speed (fully loaded)	2 min	
Approximate deceleration time from maximum speed (fully loaded)	1 min	
Weight of fully loaded rotor	1.7 kg (3.7 lb)	
Rotor and lid material	aluminum	

\* Allegra 64R/Avanti 30 @ 4°C ..... 19 500 rpm ( $32\,700 \times g$ )

<sup>†</sup> The critical speed range is the range of speeds over which the rotor shifts so as to rotate about its center of mass. Passing through the critical speed range is characterized by some vibration.

<sup>‡</sup> Relative Centrifugal Field (RCF) is the ratio of the centrifugal acceleration at a specified radius and speed ( $r\omega^2$ ) to the standard acceleration of gravity ( $g$ ) according to the following formula:

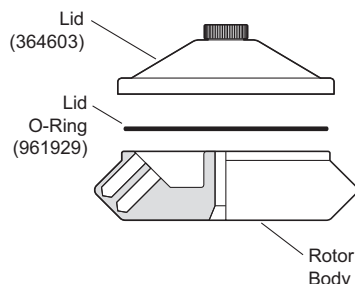
$$\text{RCF} = \frac{r\omega^2}{g}$$

where  $r$  is the radius in millimeters,  $\omega$  is the angular velocity in radians per second ( $2\pi \text{ RPM} / 60$ ), and  $g$  is the standard acceleration of gravity ( $9807 \text{ mm/s}^2$ ). After substitution:

$$\text{RCF} = 1.12 r \left( \frac{\text{RPM}}{1000} \right)^2$$

## DESCRIPTION

*This Beckman Coulter rotor has been manufactured in an ISO 9001 or 13485 facility for use with the specified Beckman Coulter centrifuges.*



The F3602, rated for 22 000 rpm, is a fixed angle rotor designed to centrifuge up to thirty-six 1.5 to 2.0-mL reaction vials, as well as 250 to 750  $\mu$ L vials, in two concentric rows at a 45-degree angle to the axis of rotation. Used in the Beckman Coulter Allegra 64R, Avanti 30, Allegra 21 series, GS-15 series, and Spinchron 15 series centrifuges, the rotor develops centrifugal forces that can efficiently pellet subcellular organelles, viruses, bacteria, mitochondria, chloroplasts, or algae. Up to 72 mL of gradient and sample volume can be centrifuged per run.

The rotor and lid are made of aluminum and are anodized for corrosion resistance—the rotor is black and the lid is blue. A lubricated O-ring in the rotor maintains atmospheric pressure in the rotor during centrifugation. A tie-down screw is used to secure the rotor to the centrifuge drive hub.

The centrifuge identifies rotor speed during the run by means of a magnetic speed sensor system in the rotor chamber and magnets imbedded in the rotor. The overspeed system ensures that the rotor does not exceed its permitted speed.

Refer to the Warranty at the back of this manual for warranty information.

## PREPARATION AND USE

*Specific information about the F3602 rotor is given here. Information about the centrifuge is contained in the centrifuge manual, which should be used together with this manual for complete centrifuge, rotor, and accessory operation.*

**NOTE**

Although rotor components and accessories made by other manufacturers may fit in the F3602 rotor, their safety in this rotor cannot be ascertained by Beckman Coulter. Use of other manufacturers' components or accessories in the F3602 rotor may void the rotor warranty and should be prohibited by your laboratory safety officer. Only the components and accessories listed in this publication should be used in this rotor.

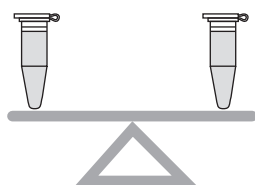
**PRERUN SAFETY CHECKS**

*Read the SAFETY NOTICE at the front of this manual before using the rotor.*

1. Make sure that the rotor, lid, and all tubes and accessories are clean and show no signs of corrosion or cracking.
2. If fluid containment is required, *use capped tubes*. All containers carrying physiological fluids should be capped, and not overfilled, to prevent leakage.
3. Check the chemical compatibilities of all materials used (refer to *Chemical Resistances*, publication IN-175).

**ROTOR PREPARATION**

*For runs at other than room temperature, refrigerate or warm the rotor before the run for fast equilibration.*



1. Be sure that the metal threads in the rotor are clean and lightly but evenly coated with Spinkote lubricant (306812).
2. Load the filled containers symmetrically into the rotor (see page 8 for tube information). If fewer than thirty-six tubes are being run, they must be arranged symmetrically in the rotor. *Opposing tubes must be filled to the same level with liquid of the same density.* Maximum allowable imbalance is 6 grams.

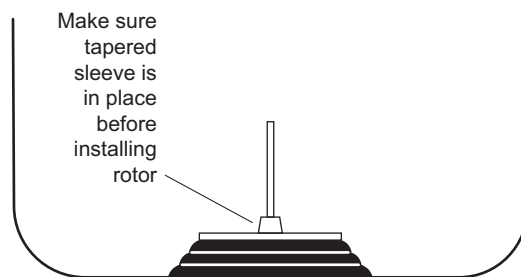
**NOTE**

The cap hinges must be oriented so that they do not interfere with closure of the rotor lid.

## OPERATION

**NOTE**

In Allegra 21 series, GS-15 series, or Spinchron 15 series centrifuges, make sure that the tapered sleeve is in place at the base of the centrifuge drive shaft (see Figure 1) before installing the rotor. The rotor rests on the sleeve while spinning, and will not operate properly if the sleeve is missing.

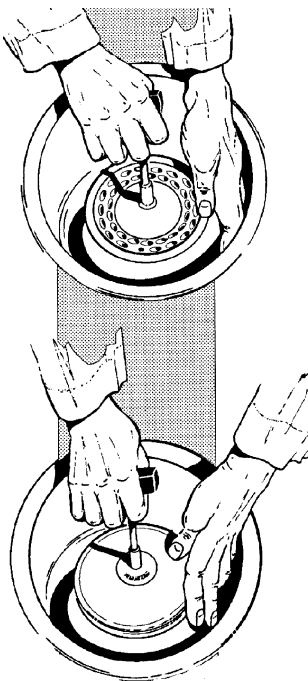


*Figure 1. Tapered Sleeve Position*

Precool the rotor in the centrifuge or in a refrigerator before use—especially before short runs—to ensure that the rotor reaches the set temperature. A suggested precooling cycle is a minimum of 30 minutes at 2000 rpm with the temperature set at 0°C.

**NOTE**

Temperatures may vary slightly between centrifuges. If sample temperature is crucial, test temperature settings on your instrument using water samples. For runs at other than room temperature, refrigerate or warm the rotor beforehand for fast equilibration.



1. Ensure that the rotor tie-down screw (361367) is in good condition and the threads are free of foreign matter.

**CAUTION**

*Do not drop the rotor onto the drive shaft. The shaft can be bent or damaged if the rotor is forced sideways or dropped onto the shaft.*

2. Center the rotor over the drive shaft and carefully lower it straight down.
3. Secure the rotor to the drive shaft with the tie-down screw. Tighten the screw by turning it to the right (clockwise) with the T-handle rotor wrench (361371).
4. Put the lid in place and tighten it with the T-handle rotor wrench.
5. Refer to the instrument instruction manual for centrifuge operation. See RUN SPEEDS, page 9, for information about speed limitations.

**REMOVAL AND SAMPLE RECOVERY****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.*

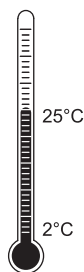
1. Use the T-handle rotor wrench to release the rotor lid. Remove the lid.
2. Using the T-handle rotor wrench, turn the tie-down screw to the left (counterclockwise) to release the rotor.
3. Remove the rotor by lifting it straight up and off the drive shaft.
4. Remove the tubes.

#### **NOTE**

In Allegra 21 series, GS-15 series, or Spinchron 15 series centrifuges, 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, remove it and put it back on the drive shaft (see Figure 2).

## TUBES

The F3602 rotor holds up to thirty-six 250- $\mu$ L to 1.8-mL reaction-vials in the adapters listed in Table 1. The rotor also holds 750- $\mu$ L vials in adapters and 2.0-mL vials.



### Temperature Limits

- Plastic containers have been centrifuge tested for use at temperatures between 2 and 25°C. For centrifugation at other temperatures, pretest containers under anticipated run conditions.
- If plastic containers are frozen before use, make sure that they are thawed to at least 2°C before centrifugation.



Table 1. Available Beckman Coulter Tubes for the F3602 Rotor

Description	Dimensions	Volume	Part Number	Adapter	Max Speed (rpm)
polyethylene tube with attached cap	11 × 45 mm	1.8 mL	340196 (pkg/500)	364701 (pkg/12)	10 000
polypropylene tube with cap	11 × 40 mm	1.5 mL	343169 (pkg/500)	364701 (pkg/12)	22 000
polypropylene tube with cap (natural)	11 × 40 mm	1.5 mL	357448 (pkg/500)	364701 (pkg/12)	22 000
polyethylene tube, plain	7 × 40 mm	400 µL	314326 (pkg/1000)	361247 (pkg/24)	11 500
polyethylene tube, Heparin-Lithium Fluoride coated	7 × 40 mm	400 µL	652824 (pkg/1000)	361247 (pkg/24)	11 500
polyethylene tube, Heparin-Lithium coated	7 × 40 mm	400 µL	652825 (pkg/1000)	361247 (pkg/24)	11 500
polyethylene tube, Heparin-Lithium Fluoride coated	5 × 45 mm	250 µL	652821 (pkg/1000)	361247 (pkg/24)	11 500
polyethylene tube, Heparin-Lithium coated	5 × 45 mm	250 µL	652822 (pkg/1000)	361247 (pkg/24)	11 500
polyethylene tube, plain	5 × 45 mm	250 µL	652823 (pkg/1000)	361247 (pkg/24)	11 500
polypropylene tube with cap	7 × 30 mm	250 µL	342865 (pkg/1000)	361247 (pkg/24)	11 500

## RUN SPEEDS



The centrifugal force at a given radius in a rotor is a function of speed. Comparisons of forces between different rotors are made by comparing the rotors' relative centrifugal fields (RCF). When rotational speed is adjusted so that identical samples are subjected to the same RCF in two different rotors, the samples are subjected to the same force. The RCF at each speed is automatically calculated by the centrifuge software; if the RCF is entered, the centrifuge calculates the equivalent revolutions per minute (rpm).

The maximum run speed listed in the rotor specifications is for operation when all conditions are within the standard specifications. Speeds must be reduced under the following circumstances:

- When certain plastic tubes are used, reduce rotor speed to prevent tube breakage. Follow the manufacturers' recommendations regarding maximum speed capacity for the tubes. Because the strength of tubes can vary between lots, and depend on handling and usage, Beckman Coulter highly recommends that you pretest these tubes in this rotor (using water instead of valuable sample) to determine optimal operating conditions.
- If nonprecipitating solutions more dense than 1.2 g/mL are centrifuged, the maximum allowable run speed must be reduced according to the following equation:

$$\text{reduced maximum speed} = (22\,000 \text{ rpm}) \sqrt{\frac{1.2 \text{ g/mL}}{\rho}}$$

where  $\rho$  is the density of the tube contents. This speed reduction will protect the rotor from excessive stresses due to the added tube load.

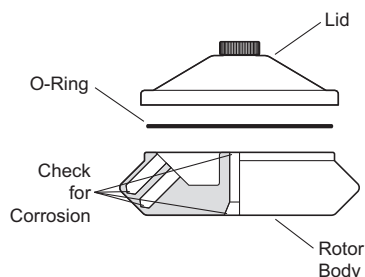
- *Further speed limits must be imposed* when self-forming-gradient salts are centrifuged, as the equation does not predict concentration limits/speeds that are required to avoid precipitation of salt crystals.

## CARE AND MAINTENANCE

### MAINTENANCE

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*Do not use sharp tools on the rotor, as they can scratch the anodized surface. Corrosion begins in scratches and may open fissures in the rotor with continued use.*



- Periodically (at least monthly) inspect the rotor, especially inside cavities, for rough spots, cracks, pitting, white powder deposits (frequently aluminum oxide), or heavy discoloration. If any of these signs are evident, do not run the rotor. Contact your Beckman Coulter representative for information about the Field Rotor Inspection Program and the rotor repair center.
- Before using the tie-down screw, check it for damage such as stripped threads. Replace it if it is damaged.

- Regularly apply a thin, even coat of Spinkote lubricant (306812) to the rotor drive hole to prevent rotor sticking.

Refer to *Chemical Resistances* for the chemical compatibilities of rotor and accessory materials. Your Beckman Coulter representative provides contact with the Field Rotor Inspection Program and the rotor repair center.

## CLEANING

*Wash the rotor and rotor components immediately if salts or other corrosive materials are used or if spillage has occurred. Do not allow corrosive materials to dry on the rotor.*

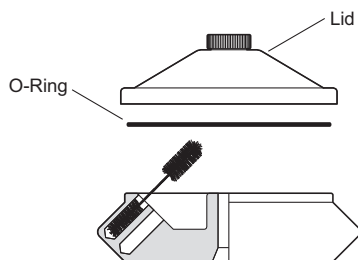


Under normal use, wash the rotor frequently (at least weekly) to prevent buildup of residues. If the rotor is left in the centrifuge for long periods of time, remove it at least once a month for cleaning and lubrication.

1. Remove the O-ring and wash the rotor, lid, and O-ring in a mild detergent, such as Beckman Solution 555 (339555), that won't damage the rotor. The Rotor Cleaning Kit (339558) contains two plastic-coated brushes and two quarts of Solution 555 for use with rotors and accessories. Dilute the detergent 10 to 1 with water.

### NOTE

Do not wash the rotor components or accessories in a dishwasher. Do not soak components in detergent solution for long periods of time, such as overnight.



2. Rinse the cleaned rotor and components with distilled water.
3. Air-dry the rotor and lid upside down. *Do not use acetone to dry the rotor.*
4. Lightly but evenly lubricate the rotor drive-hole threads with Spinkote (306812).
5. Apply a thin, even coat of silicone vacuum grease (335148) to the O-ring, then replace it in the groove in the outer rim of the lid.

Clean metal threads every 6 months, or as necessary. Use a brush and concentrated Solution 555. Rinse and dry thoroughly, then lubricate lightly but evenly with Spinkote to coat all threads.

## DECONTAMINATION

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If the rotor (and/or accessories) becomes contaminated with radioactive material, decontaminate it using a solution that will not damage the anodized surfaces. Beckman Coulter has tested a number of solutions and found two that do not harm anodized aluminum: RadCon Surface Spray or IsoClean Solution (for soaking),<sup>1</sup> and Radiacwash.<sup>2</sup>

### NOTE

IsoClean can cause fading of colored anodized surfaces. Use it only when necessary and remove it promptly from rotor surfaces.

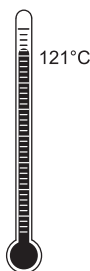
While Beckman Coulter has tested these methods and found that they do not damage the rotor or components, no guarantee of decontamination is expressed or implied. Consult your laboratory safety officer regarding the proper decontamination methods to use.



If the rotor or accessories are contaminated with toxic or pathogenic solutions, follow appropriate decontamination procedures. Check *Chemical Resistances* to be sure the decontamination method will not damage any part of the rotor.

## STERILIZATION AND DISINFECTION

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- The rotor and all rotor components can be autoclaved at 121°C for up to one hour. Remove the lid from the rotor and place the rotor, lid, and O-ring in the autoclave upside down.
- Ethanol (70%)<sup>3</sup> or hydrogen peroxide (6%) may be used on all rotor components, including those made of plastic. Bleach (sodium hypochlorite) may be used, but may cause discoloration of anodized surfaces. Use the minimum immersion time for each solution, per laboratory standards.

<sup>1</sup> In U.S.A., contact Nuclear Associates (New York); in Eastern Europe and Commonwealth States, contact Victoreen GmbH (Munich); in South Pacific, contact Gammasonics Pty, Ltd. (Australia); in Japan, contact Toyo Medic Co. Ltd. (Tokyo).

<sup>2</sup> In U.S.A., contact Biodex Medical Systems (Shirley, NY); internationally, contact the U.S. office to find the dealer nearest you.

<sup>3</sup> Flammability hazard. Do not use in or near operating centrifuges.

While Beckman Coulter has tested these methods and found that they do not damage the rotor or components, 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.

Refer to publication IN-192, included in each box of tubes or bottles, for tube and bottle sterilization and disinfection procedures.

## **STORAGE**

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When the rotor is not in use, store it in a dry environment (not in the centrifuge) with the rotor lid removed to allow air circulation so moisture will not collect in the tube cavities.

## RETURNING A ROTOR

Before returning a rotor or accessory for any reason, prior permission (a Returned Goods Authorization form) must be obtained from Beckman Coulter, Inc. This RGA form, which may be obtained from your local Beckman Coulter sales office, should contain the following information:

- rotor serial number,
- history of use (approximate frequency of use),
- reason for the return,
- original purchase order number, billing number, and shipping number, if possible,
- name and phone number of the person to be notified upon receipt of the rotor or accessory at the factory, and
- name and phone number of the person to be notified about repair costs, etc.

To protect our personnel, it is the customer's responsibility to ensure that the parts are free from pathogens and/or radioactivity. Sterilization and decontamination must be done before returning the parts. Smaller items (such as tubes, bottles, etc.) should be enclosed in a sealed plastic bag.

*All parts must be accompanied by a note, plainly visible on the outside of the box or bag, 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.***

Use the address label printed on the RGA form when mailing the rotor and/or accessories.

Customers located outside the United States should contact their local Beckman Coulter office.

## SUPPLY LIST

### NOTE

Publications referenced in this manual can be obtained by calling Beckman Coulter at 1-800-742-2345 in the United States, or by contacting your local Beckman Coulter office.

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

## REPLACEMENT ROTOR PARTS

F3602 rotor assembly . . . . .	364600
Lid assembly . . . . .	369354
O-ring . . . . .	961929
Tie-down screw . . . . .	361367
T-handle rotor wrench . . . . .	361371

## SUPPLIES

Tubes and accessories . . . . .	see Table 1
Adapter for 750- $\mu$ L vials (pkg/12) . . . . .	364690
Spinkote lubricant (2 oz) . . . . .	306812
Silicone vacuum grease (1 oz) . . . . .	335148
Rotor Cleaning Kit . . . . .	339558
Beckman Solution 555 (1 qt) . . . . .	339555





# **BENCHTOP ROTOR WARRANTY**

Subject to the conditions specified below and the warranty clause of the Beckman Coulter, Inc., terms and conditions in effect at the time of sale, Beckman Coulter agrees to correct either by repair or, at its election, by replacement, any defects of material or workmanship which develop within seven (7) years after delivery of a benchtop centrifuge rotor to the original buyer by Beckman Coulter or by an authorized representative, provided that investigation and factory inspection by Beckman Coulter discloses that such defect developed under normal and proper use. Should a Beckman Coulter centrifuge be damaged due to a failure of a rotor covered by this warranty, Beckman Coulter will supply free of charge all centrifuge parts required for repair.

2. This warranty is void if the rotor has been subjected to customer misuse such as operation or maintenance contrary to the instructions in the Beckman Coulter rotor or centrifuge manual.
3. This warranty is void if the rotor is operated with a rotor drive unit or in a centrifuge unmatched to the rotor characteristics or operated in a Beckman Coulter centrifuge that has been improperly disassembled, repaired, or modified.
4. Thermoplastic rotors or components used in some benchtop centrifuges are warranted for one (1) year from date of purchase.

## **CONDITIONS**

1. Except as otherwise specifically provided herein, this warranty covers the rotor only and Beckman Coulter shall not be liable for damage to accessories or ancillary supplies including but not limited to (i) tubes, (ii) tube caps, (iii) tube adapters, or (iv) tube contents.

## **DISCLAIMER**

IT IS EXPRESSLY AGREED THAT THE ABOVE WARRANTY SHALL BE IN LIEU OF ALL WARRANTIES OF FITNESS AND OF THE WARRANTY OF MERCHANTABILITY AND THAT BECKMAN COULTER, INC. SHALL HAVE NO LIABILITY FOR SPECIAL OR CONSEQUENTIAL DAMAGES OF ANY KIND WHATSOEVER ARISING OUT OF THE MANUFACTURE, USE, SALE, HANDLING, REPAIR, MAINTENANCE, OR REPLACEMENT OF THE PRODUCT.

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Beckman Coulter, Inc. • 250 S. Kraemer Blvd. • Brea, California 92821 U.S.A.  
Sales and Service: 1-800-742-2345 • Internet: [www.beckmancoulter.com](http://www.beckmancoulter.com) • Printed in USA

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