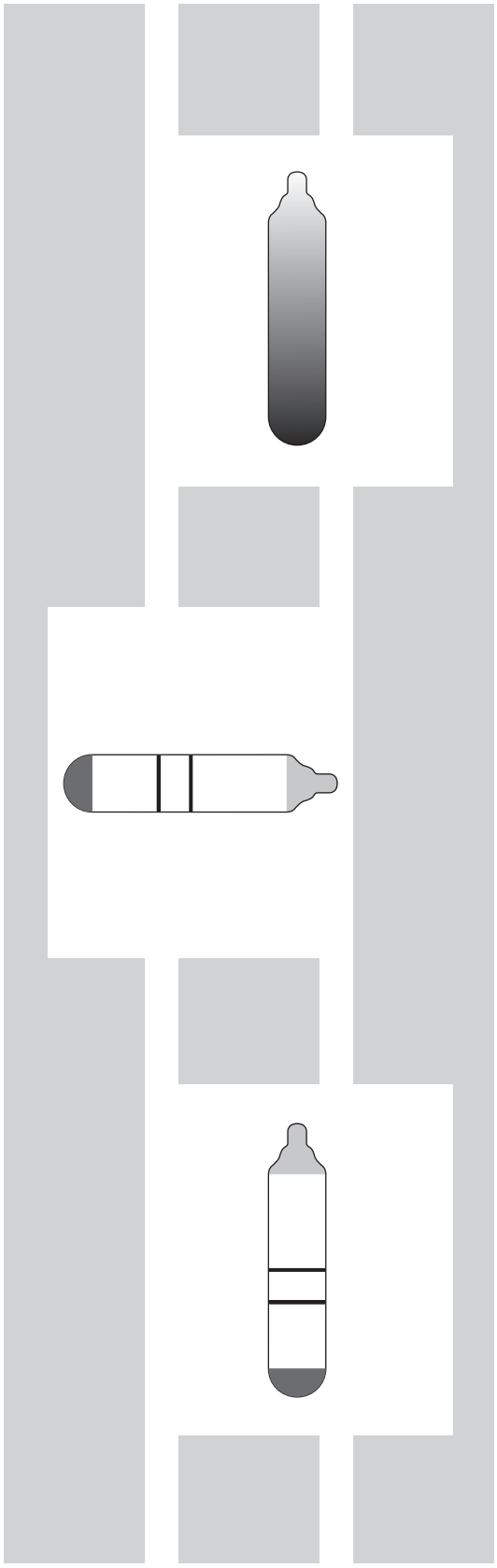
TL-TB-023D
February 2008



MLS-50 Rotor

Used in Beckman Coulter Optima™ MAX, MAX-XP, and MAX-E Tabletop Ultracentrifuges

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 throughout this publication, pay special attention to the specific safety information presented. Observance of safety precautions will also help to avoid actions that could damage or adversely affect the performance of the rotor. This rotor was developed, manufactured, and tested for safety and reliability as part of a Beckman Coulter ultracentrifuge/rotor system. Its safety or reliability cannot be assured if used in a centrifuge not of Beckman Coulter's manufacture or in a Beckman Coulter ultracentrifuge that has been modified without Beckman Coulter's approval.

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 centrifuge 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 ultracentrifuge.

Although rotor components and accessories made by other manufacturers may fit in the MLS-50 rotor, their safety in this rotor cannot be ascertained by Beckman Coulter. Use of other manufacturers' components or accessories in the MLS-50 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.

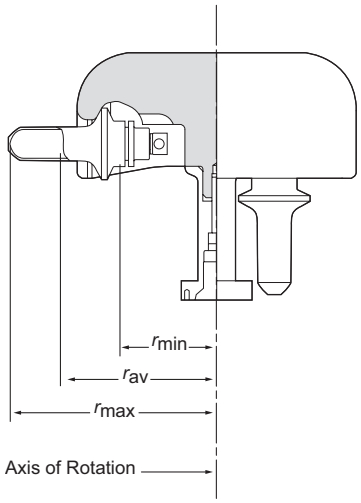
Hook all four buckets, loaded or empty, to the rotor for every run. Make sure that filled containers are loaded symmetrically into the rotor and that opposing tubes are filled to the same level with liquid of the same density. Make sure that buckets containing Quick-Seal tubes have the proper floating spacers inserted (if applicable) before installing the bucket cap.

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

Never exceed the maximum rated speed of the rotor and labware in use. Refer to the section on RUN SPEEDS, and derate the run speed as appropriate.

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.

MLS-50 Rotor



SPECIFICATIONS

Maximum speed	50 000 rpm
Density rating at maximum speed	1.2 g/mL
Relative Centrifugal Field* at maximum speed	
At r_{max} (95.8 mm)	268 000 × *g*
At r_{av} (71.7 mm)	201 000 × *g*
At r_{min} (47.5 mm)	133 000 × *g*
k factor at maximum speed	71
k´ factors at maximum speed (5 to 20% sucrose gradient; 5°C)	
When particle density = 1.3 g/mL	195
When particle density = 1.5 g/mL	178
When particle density = 1.7 g/mL	172
Conditions requiring speed reductions	see RUN SPEEDS
Number of buckets	4
Available tubes	see Table 1
Nominal tube dimensions (largest tube)	13 × 51 mm
Nominal tube capacity (largest tube)	5 mL
Nominal rotor capacity	20 mL
Approximate acceleration time to maximum speed (fully loaded)	8 1/4 min
Approximate deceleration time from maximum speed (fully loaded)	4 min
Weight of fully loaded rotor	1.69 kg (3.73 lb)
Rotor bucket material	titanium
Rotor body material	aluminum

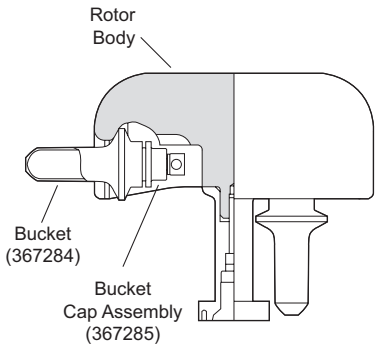
* Relative Centrifugal Field (RCF) is the ratio of the centrifugal acceleration at a specified radius and speed ($r\omega^2$) to the standard acceleration of gravity (g) according to the following formula:

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

where r is the radius in millimeters, ω is the angular velocity in radians per second (2π RPM / 60), and g is the standard acceleration of gravity (9807 mm/s^2). After substitution:

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

DESCRIPTION



This rotor has been manufactured in a registered ISO 9001 or 13485 facility for use with the specified Beckman Coulter ultracentrifuges.

The MLS-50, rated for 50 000 rpm, is a swinging bucket rotor that holds four tubes and is used in Beckman Coulter Optima™ MAX, MAX-XP, and MAX-E tabletop ultracentrifuges. The MLS-50 rotor develops centrifugal forces that are suitable for rate zonal banding of proteins, viruses, and DNA from small sample volumes.

The rotor body and bucket caps are made of aluminum and are anodized for corrosion resistance. The buckets are titanium. Lubricated O-rings made of Buna N maintain atmospheric pressure inside the buckets during centrifugation. Buckets, bucket caps, and rotor body positions are numbered for your convenience. A rotor-retention mechanism on the ultracentrifuge drive hub secures the rotor during the run. When not in the instrument, the rotor body must be supported on its rotor stand to permit the buckets to hang properly.

The centrifuge identifies rotor speed during the run by means of a magnetic speed sensor system in the rotor chamber of the instrument and magnets on the bottom of the rotor. This overspeed protection 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 MLS-50 rotor is given here. Information common to this and other rotors is contained in the manual Rotors and Tubes for Beckman Coulter Tabletop Preparative Ultracentrifuges *(publication TLR-IM), which should be used together with this manual for complete rotor and accessory operation.* Rotors and Tubes *is included in the literature package with this rotor manual.*

NOTE

Although rotor components and accessories made by other manufacturers may fit in the MLS-50 rotor, their safety in this rotor cannot be ascertained by Beckman Coulter. Use of other manufacturers' components or accessories in the MLS-50 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 page at the front of this manual before using the rotor.

1. Make sure that the rotor, buckets, and caps are clean and show no signs of corrosion or cracking.

2. Check the chemical compatibilities of all materials used (refer to Appendix A in *Rotors and Tubes*).

3. Verify that the tubes and accessories being used are listed in Table 1.

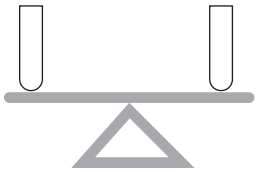
ROTOR PREPARATION

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

1. Before each use of the rotor, make sure that bucket cap threads are lightly but evenly lubricated with Spinkote™ lubricant (306812), and the bucket O-rings are lightly but evenly coated with silicone vacuum grease (335148).

NOTE

Never run a bucket without an O-ring, as it will leak.



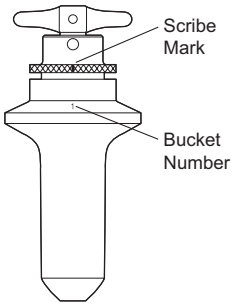
2. Dry the exterior of the filled tubes (see page 8 for tube information), then slide them into the buckets. (Moisture between the bucket and the tube can cause tube collapse and create resistance to tube extraction after centrifugation.) All opposing tubes for a run must be filled to the same level with liquid of the same density.

3. Use the required adapters or floating spacers, if required, to complete the loading operation.

4. Match numbered caps with numbered buckets. Screw the caps into the buckets until there is metal-to-metal contact. Ensure that the scribe mark on each cap is aligned with the engraved bucket number.

NOTE

Two tubes can be run if the filled buckets are attached in opposing positions on the rotor (positions 1 and 3, or 2 and 4), *and the two remaining buckets are also attached*. (If you regularly run only two filled buckets, alternate the placement—positions 1 and 3, then 2 and 4—to ensure even wear on the rotor.)

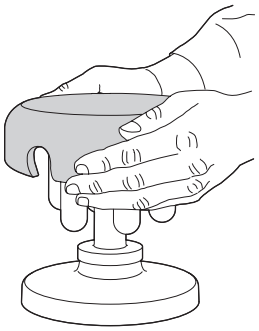


5. Attach numbered bucket assemblies to corresponding rotor body positions. Insert the bucket assembly into the rotor cavity. Attach all buckets, loaded or empty.

NOTE

Remember, all four buckets *must be attached to the rotor*, whether they are loaded or empty. Attach the buckets to the rotor before installing it in the instrument. Trying to attach them after the rotor is installed may cause damage to the drive shaft.

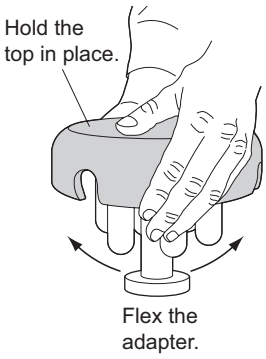
OPERATION



Refer to Rotors and Tubes *for information on installing swinging bucket rotors.*

1. To install the rotor, carefully lift it with both hands and place it on the drive hub.
2. Refer to the instrument instruction manual for ultracentrifuge operation.
3. For additional operating information, see the following:
   - RUN TIMES, page 10, for using *k* factors to adjust run durations
   - RUN SPEEDS, page 11, for information about speed limitations
   - SELECTING CsCl GRADIENTS, page 12, for methods to avoid CsCl precipitation during centrifugation

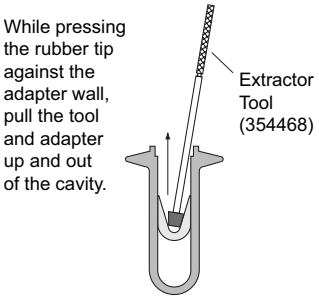
REMOVAL AND SAMPLE RECOVERY



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. Using both hands, remove the rotor from the ultracentrifuge. (If necessary, hold the rotor top rigid while flexing the adapter gently back and forth to release it from the drive hub.)
2. Return the rotor to its stand and detach the buckets from the rotor body.
3. Unscrew the bucket caps, then use a hemostat or tube removal tool to remove the tubes.



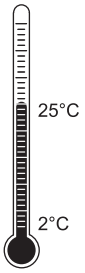
NOTE

If the conical-shaped adapters that support *k*onical™ tubes are difficult to remove after centrifugation, an extractor tool (354468) is available to facilitate removal.

TUBES AND ACCESSORIES

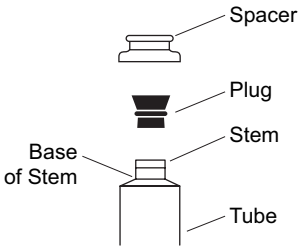
The MLS-50 rotor uses tubes and accessories listed in Table 1. Be sure to use only those items listed, and to observe the maximum speed limits shown. Refer to Appendix A in *Rotors and Tubes* for information on the chemical resistances of tube and accessory materials.

Temperature Limits



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

OptiSeal™ Tubes



OptiSeal tubes come with plastic plugs and can be quickly and easily prepared for use. With the tube spacer in place, the *g* force during centrifugation ensures a tight, reliable seal that protects your samples.

- Place the tubes in the rack and fill each tube to the base of the stem, leaving no fluid in the stem. Overfilling the tube can cause spillage when the plug is inserted or compromise seal integrity. However, too much air can cause excessive tube deformation, disrupting gradients and sample bands.
- Refer to publication IN-189 (*Using OptiSeal™ Tubes*), included in each box of tubes, for detailed information on the use and care of OptiSeal tubes.

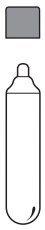
Table 1. Beckman Coulter Tubes and Bottles for the MLS-50 Rotor. Use only the items listed here.

Tube			Required Accessory		Max Speed/ RCF/ *k* Factor
Dimensions and Max Volume	Description	Part Number	Description	Part Number	
13 x 51 mm 5.0 mL	Ultra Clear	344057 (pkg/50)	none	—	50 000 rpm 268 000 x *g* 71
13 x 51 mm 5.0 mL	thinwall polyallomer	326819 (pkg/50)	none	—	50 000 rpm 268 000 x *g* 71
13 x 33 mm 3.3 mL	OptiSeal polyallomer*	361627 (pkg/50)	Ultem† spacer	361678 (pkg/2)	50 000 rpm 268 000 x *g* 42
13 x 51 mm 3.5 mL	thickwall polyallomer	349623 (pkg/25)	none	—	50 000 rpm 268 000 x *g* 71
13 x 51 mm 3.5 mL	thickwall polycarbonate	349622 (pkg/25)	none	—	50 000 rpm 268 000 x *g* 71
13 x 51 mm 3.2 mL	Quick-Seal polyallomer, *k*onical	358647 (pkg/50)	Delrin‡ adapter	358153 (pkg/6)	50 000 rpm 262 000 x *g* 67
			Noryl floating spacer	355535	
13 x 51 mm 3.0 mL	thinwall polyallomer *k*onical	358119 (pkg/50)	Delrin adapter	338153 (pkg/6)	50 000 rpm 262 000 x *g* 67
13 x 25 mm 2.0 mL	Quick-Seal polyallomer	345829 (pkg/50)	Noryl† floating spacer	355535	50 000 rpm 268 000 x *g* 29
5 x 41 mm 0.8 mL	Ultra Clear	344090 (pkg/50	Delrin adapter	356860	46 000 rpm 218 000 x *g* 67

*Includes disposable plug.

†Ultem and Noryl are registered trademarks of General Electric.

‡Delrin is a registered trademark of E.I. DuPont de Nemours & Company.



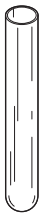
Quick-Seal® Tubes

Quick-Seal tubes must be sealed prior to centrifugation. These tubes are heat sealed and do not need caps; however, spacers are required on top of the tubes when they are loaded into the rotor buckets.

- Fill Quick-Seal tubes leaving a *small* bubble of air at the base of the neck. Do not leave a large air space—too much air can cause excessive tube deformation.
- Refer to *Rotors and Tubes* for detailed information on the use and care of Quick-Seal tubes.

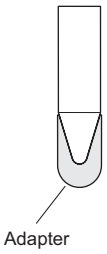
Some of the tubes listed in Table 1 are part of the *g*-Max™ system. The *g*-Max system uses a combination of small bell-top Quick-Seal tubes and floating spacers (also called *g*-Max spacers). This means that you can run the shorter tubes listed in the table in the MLS-50 rotor without reduction in *g* force. Additional information about the *g*-Max system is available in publication DS-709.

Open-Top Tubes



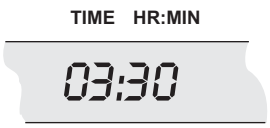
Open-top tubes should be filled to approximately 3.17 mm (0.125 in.) from the tube top for tube support. If necessary, float mineral oil (or some other low-density, immiscible liquid) on top of the tube contents to fill the tube to its maximum volume. (Do not use an oil overlay in Ultra-Clear tubes.)

*k*onical™ Tubes



Polyallomer *k*onical tubes, used to optimize pelleting separations, have a conical tip that concentrates the pellet in the narrow end of the tube. The narrow bottom also reduces the tube's nominal volume and minimizes gradient material requirement. Conical cavity adapters hold the tubes in the rotor buckets.

RUN TIMES



The *k* factor of the rotor is a measure of the rotor's pelleting efficiency. (Beckman Coulter has calculated the *k* factors for all of its preparative rotors at maximum rated speed and using full tubes.) The *k* factor is calculated from the formula:

$$k = \frac{\ln(r_{max}/r_{min})}{\omega^2} \times \frac{10^{13}}{3600} \quad (1)$$

where ω is the angular velocity of the rotor in radians per second ($\omega = 0.105 \times$ rpm), r_{max} is the maximum radius, and r_{min} is the minimum radius.

After substitution:

$$k = \frac{(2.533 \times 10^{11})\ln(r_{max}/r_{min})}{\text{rpm}^2} \quad (2)$$

Use the *k* factor in the following equation to estimate the run time *t* (in hours) required to pellet particles of known sedimentation coefficient *s* (in Svedberg units, *S*).

$$t = \frac{k}{s} \quad (3)$$

Run times can be estimated for centrifugation at less than maximum speed by adjusting the *k* factor as follows:

$$k_{adj} = k\left(\frac{55\,000}{\text{actual run speed}}\right)^2 \quad (4)$$

Run times can also be estimated from data established in prior experiments if the *k* factor of the previous rotor is known. For any two rotors, a and b:

$$\frac{t_a}{t_b} = \frac{k_a}{k_b} \quad (5)$$

For more information on *k* factors see *Use of* k *Factor for Estimating Run Times from Previously Established Run Conditions* (publication DS-719).

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 a number of rotor speeds is provided in Table 2.

Do not select rotational speeds in excess of 50 000 rpm. In addition, speeds must be reduced under the following circumstances:

1. If nonprecipitating solutions more dense than 1.2 g/mL are centrifuged, reduce the maximum allowable run speed according to the following equation:

$$\text{reduced maximum speed} = (50\,000 \text{ rpm}) \sqrt{\frac{1.2 \text{ g/mL}}{\rho}} \qquad (6)$$

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

2. *Further speed limits must be imposed* when CsCl or other self-forming-gradient salts are centrifuged, as equation (6) does not predict concentration limits/speeds that are required to avoid precipitation of salt crystals. Solid CsCl has a density of 4 g/mL, and if precipitated during centrifugation may cause rotor failure. Figures 1 and 2, together with the description and examples below, show how to reduce run speeds when using CsCl gradients.

SELECTING CsCl GRADIENTS

Rotor speed is used to control the slope of a CsCl density gradient, and must be limited so that CsCl precipitation is avoided. Speed and density combinations that intersect on or below the curves in Figure 1 ensure that CsCl will not precipitate during centrifugation in the MLS-50 rotor. Curves are provided at two temperatures: 20°C (black curves) and 4°C (gray curves). Curves in Figures 1 and 2 are provided up to the maximum rated speed of the rotor.

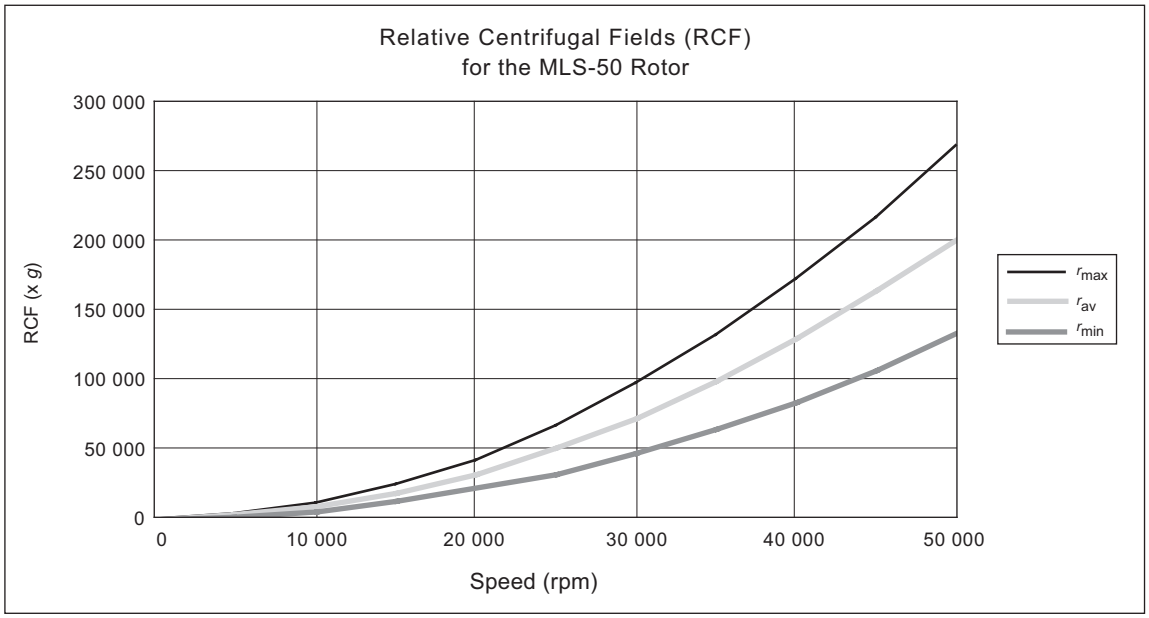
NOTE

The curves in Figures 1 and 2 are for solutions of CsCl salt dissolved in distilled water only. If other salts are present in significant concentrations, the overall CsCl concentration may need to be reduced.

Table 2. Relative Centrifugal Fields for the MLS-50 Rotor.
Entries in this table are calculated from the formula
$RCF = 1.12r\ (RPM/1000)^2$
and then rounded to three significant digits.

Rotor Speed (rpm)	Relative Centrifugal Field (× *g*)			*k* Factor*
	At r_{max} (95.8 mm)	At r_{av} (71.7 mm)	At r_{min} (47.5 mm)	
50 000	268 000	201 000	133 000	71
45 000	217 000	163 000	108 000	88
40 000	172 000	129 000	85 100	111
35 000	131 000	98 400	65 200	145
30 000	96 600	72 300	47 900	197
25 000	67 100	50 200	33 300	284
20 000	42 900	32 100	21 300	444
15 000	24 100	18 100	12 000	790
10 000	10 700	8 030	5 320	1 777

*Calculated for all Beckman Coulter preparative rotors as a measure of the rotor's relative pelleting efficiency in water at 20°C.



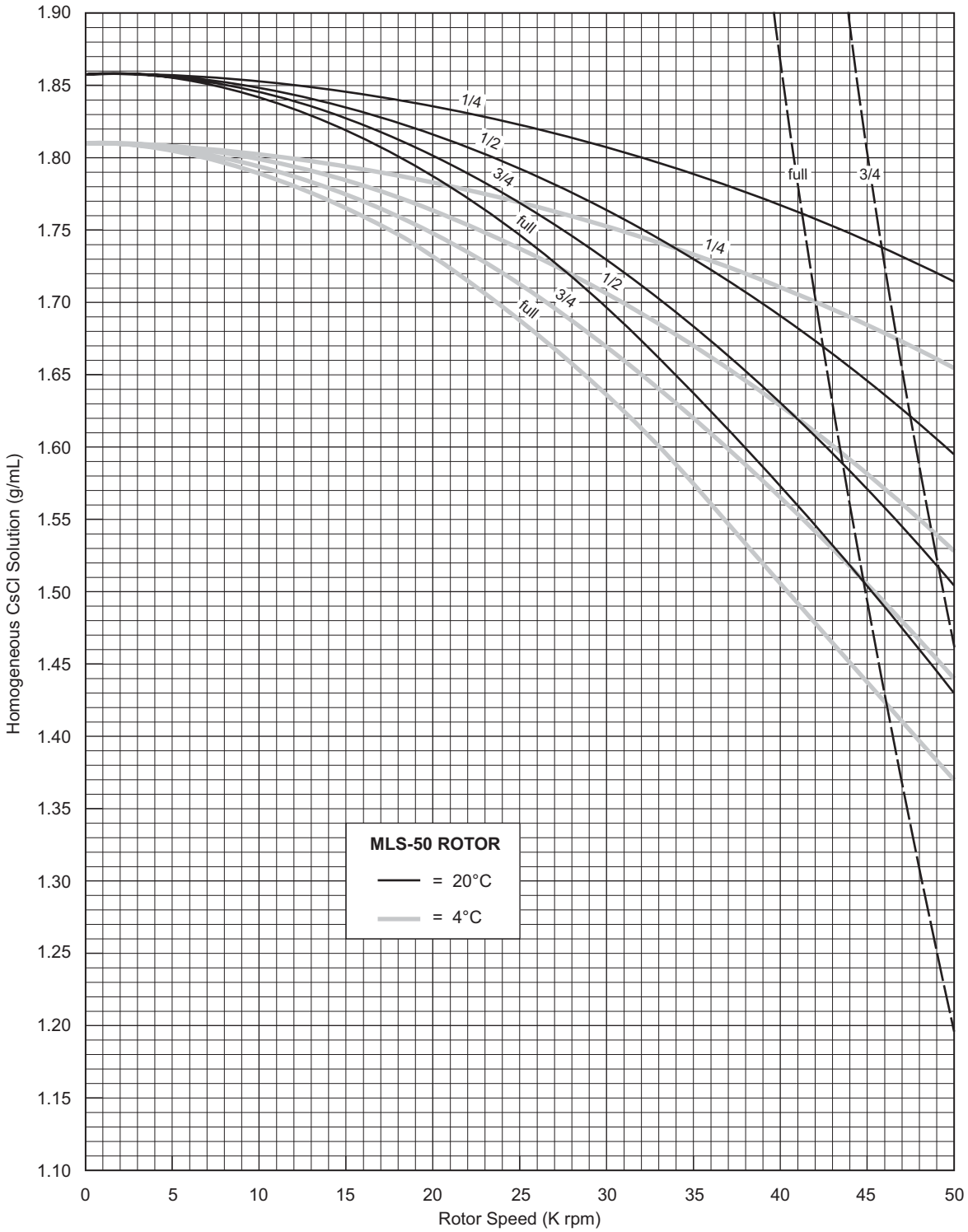


Figure 1. Precipitation Curves for the MLS-50 Rotor.
Using combinations of rotor speeds and homogeneous CsCl solution densities that intersect on or below these curves ensures that CsCl will not precipitate during centrifugation. The dashed lines represent equation (6), and are shown here to illustrate the inability of that equation to guard against CsCl precipitation.

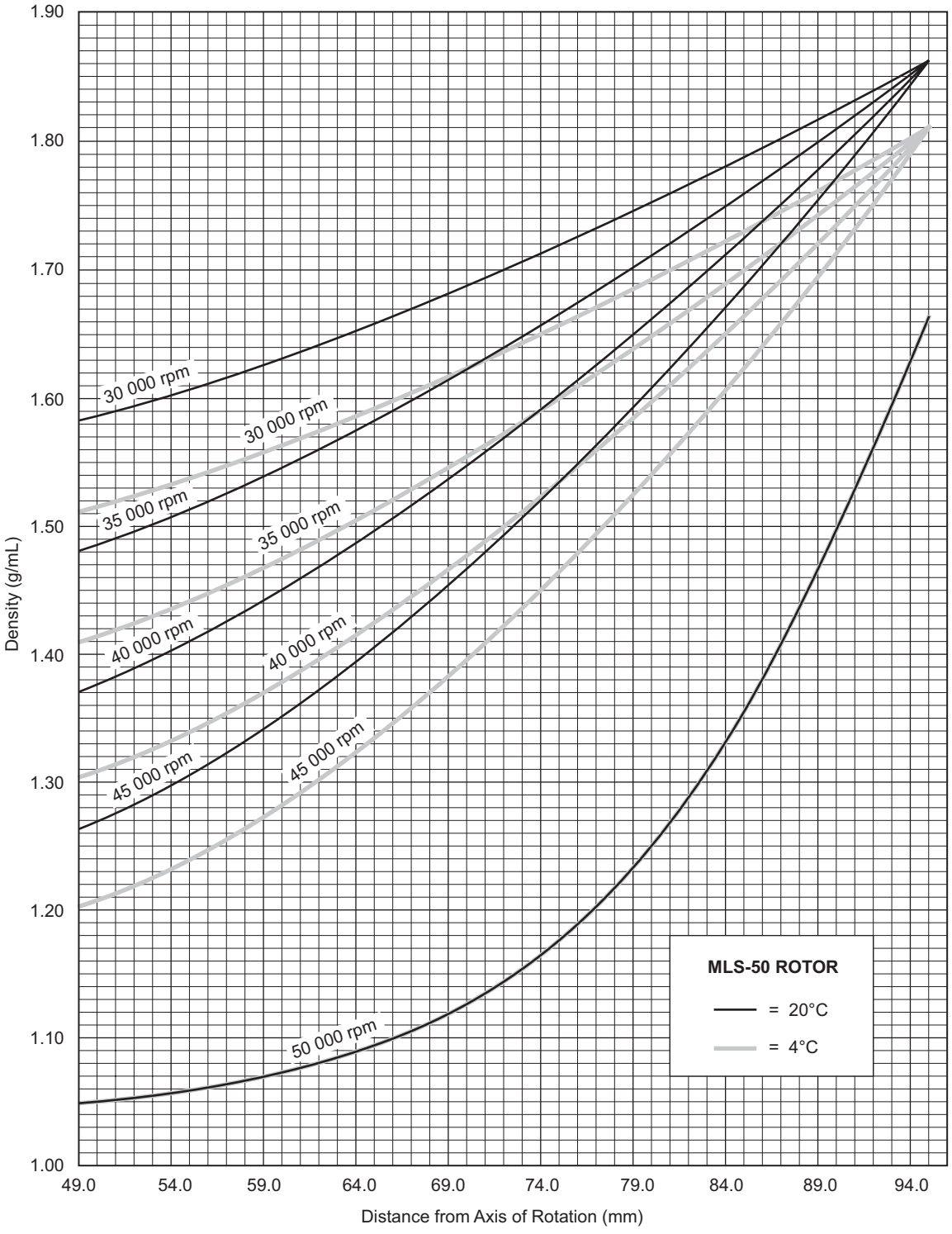
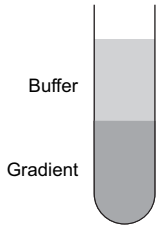


Figure 2. CsCl Gradients at Equilibrium for the MLS-50 Rotor. Centrifugation of homogeneous CsCl solutions at the maximum allowable speeds (from Figure 1) results in gradients presented here. (Note that the 50 000-rpm curves are the same for 4 and 20°C.)

The reference curves in Figure 2 show gradient distribution at equilibrium. Each curve in Figure 2 is within the density limits allowed for the MLS-50 rotor: each curve was generated for a single run speed using the maximum allowable homogeneous CsCl densities that avoid precipitation at that speed. (The gradients in Figure 2 can be generated from step or linear gradients, or from homogeneous solutions. But the total amount of CsCl in solution must be equivalent to a homogeneous solution corresponding to the concentrations specified in Figure 1.) Figure 2 can also be used to approximate the banding positions of sample particles. Curves not shown in the figure may be interpolated.

ADJUSTING FILL VOLUMES



Figures 1 and 2 show that several fill volumes are possible in a tube. If a thinwall tube is partially filled with gradient solution, float mineral oil (or some other low-density, immiscible liquid) on top of the tube contents to fill the tube to its maximum volume. (Do not use an oil overlay in Ultra-Clear tubes.) Note that for a given CsCl density, as the fill level decreases the maximum allowable speed increases. Partial filling may be desirable when there is little sample or when you wish to shorten the run time.

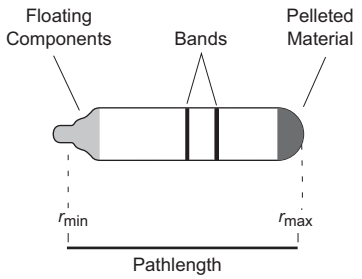
For example, a *half-filled* tube of 1.62-g/mL homogeneous CsCl solution at 4°C may be centrifuged at 41 000 rpm (see Figure 1). The same solution in a *three-quarter-filled* tube may be centrifuged no faster than 35 000 rpm. A tube *full* of the 1.62-g/mL CsCl solution may be centrifuged no faster than 31 000 rpm (curves not shown in the figure may be interpolated).

TYPICAL EXAMPLES FOR DETERMINING CsCl RUN PARAMETERS

Example A: Starting with a homogeneous CsCl solution density of 1.62 g/mL and approximate particle buoyant densities of 1.59 and 1.61 g/mL, at 20°C, where will particles band at equilibrium?

1. In Figure 1, find the curve that corresponds to the desired run temperature (20°C) and fill volume (full). The maximum allowable rotor speed is determined from the point where this curve intersects the homogeneous CsCl density (36 000 rpm).

At Speed



2. In Figure 2, sketch in a horizontal line corresponding to each particle's buoyant density.

3. Mark the point in the figure where each particle density intersects the curve corresponding to the selected run speed and temperature.

4. Particles will band at these locations across the tube diameter at equilibrium during centrifugation.

In this example, particles will band about 67.0 and 70 mm from the tube bottom (r_{max}), about 3 mm of centerband-to-centerband separation.

To determine interband volume in milliliters, use the following equation:

At Rest in Rotor

$$V = \pi r^2 h \qquad (7)$$

where r is the tube radius in centimeters and h is the interband separation in centimeters.

Example B: Knowing particle buoyant densities (for example, 1.49 and 1.52 g/mL), how do you achieve good separation?

At Rest Outside Rotor

1. In Figure 2, sketch in a horizontal line corresponding to each particle's buoyant density.

2. Select the curve at the desired temperature (4°C) that gives the best particle separation.

3. Note the run speed along the selected curve (35 000 rpm).

4. From Figure 1, select the maximum homogeneous CsCl density that corresponds to the temperature and run speed established above. These parameters will provide the particle-banding pattern selected in Step 2.

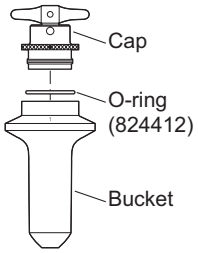
In this example, particles will band at about 62 and 66 mm from the tube bottom (about 4 mm apart).

CARE AND MAINTENANCE

MAINTENANCE

NOTE

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.



- Frequently check the bucket O-rings (824412) for signs of wear. Replace O-rings every 6 months, or whenever worn or damaged. Keep the O-rings lightly coated with silicone vacuum grease (335148).
- Regularly lubricate the bucket cap threads with a thin, even coat of Spinkote lubricant (306812) before every run.

Refer to Appendix A in *Rotors and Tubes* for the chemical resistances 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.

1. Wash the rotor buckets, O-rings, and caps in a mild detergent, such as Beckman Solution 555™, that won't damage the rotor. The Rotor Cleaning Kit contains two plastic-coated brushes and two quarts of Solution 555 (339555) for use with rotors and accessories. Dilute the detergent 10 to 1 with water.
2. Wash the rotor body with a sponge or cloth dampened with a mild detergent, such as Solution 555, diluted 10 to 1 with water.

NOTE

Do not immerse the rotor body or bucket cap in water.

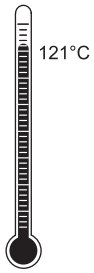
3. Rinse the cleaned rotor and components with distilled water.
4. Air-dry the rotor and buckets upside down. *Do not use acetone to dry the rotor.*

Clean metal threads frequently to prevent buildup of residues and ensure adequate closure. Use a brush and concentrated Solution 555. Rinse and dry thoroughly, then lubricate lightly but evenly with Spinkote to coat all threads.

DECONTAMINATION

If the rotor or other components are contaminated with toxic, radioactive, or pathogenic materials, follow appropriate decontamination procedures as outlined by your laboratory safety officer. Refer to Appendix A in *Rotors and Tubes* to select solutions that will not damage the rotor and accessory materials.

STERILIZATION AND DISINFECTION



- The rotor and all rotor components can be autoclaved at 121°C for up to an hour. Remove the caps from the rotor buckets and place the rotor and buckets in the autoclave upside down.
- Ethanol (70%)[1] 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.

[1] Flammability hazard. Do not use in or near operating ultracentrifuges.

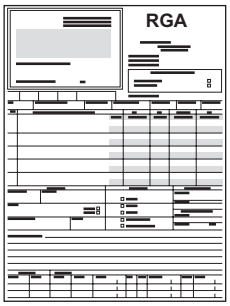
While Beckman Coulter has tested these methods and found that they do not damage the rotor or components, no guarantee of sterility or disinfection is expressed or implied. When sterilization or disinfection is a concern, consult your laboratory safety officer regarding proper methods to use.

Refer to publication IN-192 (included with each box of tubes) for tube sterilization and disinfection procedures. *Quick-Seal, Ultra Clear, and thinwall open-top tubes are disposable and should be discarded after a single use.*

STORAGE

When it is not in use, store the rotor in a dry environment (not in the instrument) with the bucket caps 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 may be obtained from your local Beckman Coulter sales office, and should contain the following information:

- 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 all 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 to:

Beckman Coulter, Inc.
1050 Page Mill Road
Palo Alto, CA 94304

Attention: Returned Goods

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.

Contact Beckman Coulter Sales (1-800-742-2345 in the United States; worldwide offices are listed on the back cover of this manual), or see the Beckman Coulter *Ultracentrifuge Rotors, Tubes & Accessories* catalog (BR-8101, available at www.beckmancoulter.com) for detailed information on ordering parts and supplies. For your convenience, a partial list is given below.

REPLACEMENT ROTOR PARTS

MLS-50 rotor assembly	367279
Buckets (set of 4, with cap assemblies)	367284
Bucket cap assembly	367285
Bucket O-ring	824412
Rotor stand	367278

OTHER

Tubes and accessories	see Table 1
Bucket rack	331313
OptiSeal tube rack	360534
Quick-Seal Cordless Tube Topper kit, 60 Hz	358312
Quick-Seal Cordless Tube Topper kit, 50 Hz (Europe)	358313
Quick-Seal Cordless Tube Topper kit, 50 Hz (Great Britain)	358314
Quick-Seal Cordless Tube Topper kit, 50 Hz (Australia)	358315
Quick-Seal Cordless Tube Topper, 50 Hz (Canada)	367803
Tube Topper rack (13-mm dia. tubes)	348122
Floating spacer removal tool	338765
Tube removal tool (Quick-Seal and OptiSeal tubes)	361668
Extractor tool, conical adapters	354468
Fraction Recovery System (for TL-series tubes)	347828
CentriTube Slicer	347960
CentriTube Slicer blades (pkg of 10)	348299
Spinkote lubricant (2 oz)	306812
Silicone vacuum grease (1 oz)	335148
Rotor Cleaning Kit	339558
Beckman Solution 555 (1 qt)	339555
Rotor cleaning brush	339379

ULTRACENTRIFUGE ROTOR WARRANTY

All Beckman Coulter ultracentrifuge Fixed Angle, Vertical Tube, Near Vertical Tube, Swinging Bucket, and Airfuge rotors are warranted against defects in materials or workmanship for the time periods indicated below, subject to the Warranty Conditions stated below.

Preparative Ultracentrifuge Rotors . . . . . 5 years — No Proration

Analytical Ultracentrifuge Rotors. . . . . 5 years — No Proration

ML and TL Series Ultracentrifuge Rotors . . . . . 5 years — No Proration

Airfuge Ultracentrifuge Rotors . . . . . 1 year — No Proration

For Zonal, Continuous Flow, Component Test, and Rock Core ultracentrifuge rotors, see separate warranty.

Warranty Conditions (as applicable)

1) This warranty is valid for the time periods indicated above from the date of shipment to the original Buyer by Beckman Coulter or an authorized Beckman Coulter representative.

2) This warranty extends only to the original Buyer and may not be assigned or extended to a third person without written consent of Beckman Coulter.

3) This warranty covers the Beckman Coulter Centrifuge Systems only (including but not limited to the centrifuge, rotor, and accessories) and Beckman Coulter shall not be liable for damage to or loss of the user's sample, non-Beckman Coulter tubes, adapters, or other rotor contents.

4) This warranty is void if the Beckman Coulter Centrifuge System is determined by Beckman Coulter to have been operated or maintained in a manner contrary to the instructions in the operator's manual(s) for the Beckman Coulter Centrifuge System components in use. This includes but is not limited to operator misuse, abuse, or negligence regarding indicated maintenance procedures, centrifuge and rotor classification requirements, proper speed reduction for the high density of certain fluids, tubes, and tube caps, speed reduction for precipitating gradient materials, and speed reduction for high-temperature operation.

5) Rotor bucket sets purchased concurrently with or subsequent to the purchase of a Swinging Bucket Rotor are warranted only for a term co-extensive with that of the rotor for which the bucket sets are purchased.

6) This warranty does not cover the failure of a Beckman Coulter rotor in a centrifuge not of Beckman Coulter manufacture, or if the rotor is used in a Beckman Coulter centrifuge that has been modified without the written permission of Beckman Coulter, or is used with carriers, buckets, belts, or other devices not of Beckman Coulter manufacture.

7) Rotor parts subject to wear, including but not limited to rotor O-rings, VTi, NVT™, TLV, MLN, and TLN rotor tube cavity plugs and gaskets, tubing, tools, optical overspeed disks, bearings, seals, and lubrication are excluded from this warranty and should be frequently inspected and replaced if they become worn or damaged.

8) Keeping a rotor log is not mandatory, but may be desirable for maintenance of good laboratory practices.

Repair and Replacement Policies

1) If a Beckman Coulter rotor is determined by Beckman Coulter to be defective, Beckman Coulter will repair or replace it, subject to the Warranty Conditions. A replacement rotor will be warranted for the time remaining on the original rotor's warranty.

2) If a Beckman Coulter centrifuge is damaged due to a failure of a rotor covered by this warranty, Beckman Coulter will supply free of charge (i) all centrifuge parts required for repair (except the drive unit, which will be replaced at the then current price less a credit determined by the total number of revolutions or years completed, provided that such a unit was manufactured or rebuilt by Beckman Coulter), and (ii) if the centrifuge is currently covered by a Beckman Coulter warranty or Full Service Agreement, all labor necessary for repair of the centrifuge.

3) If a Beckman Coulter rotor covered by this warranty is damaged due to a malfunction of a Beckman Coulter ultracentrifuge covered by an Ultracentrifuge System Service Agreement, Beckman Coulter will repair or replace the rotor free of charge.

4) If a Beckman Coulter rotor covered by this warranty is damaged due to a failure of a Beckman Coulter tube, bottle, tube cap, spacer, or adapter, covered under the Conditions of this Warranty, Beckman Coulter will repair or replace the rotor and repair the instrument as per the conditions in policy point (2) above, and the replacement policy.

5) Damage to a Beckman Coulter rotor or instrument due to the failure or malfunction of a non-Beckman Coulter tube, bottle, tube cap, spacer, or adapter is not covered under this warranty, although Beckman Coulter will assist in seeking compensation under the manufacturer's warranty.

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 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.

Factory Rotor Inspection Service

Beckman Coulter, Inc., will provide free mechanical and metallurgical inspection in Palo Alto, California, USA, of any Beckman Coulter rotor at the request of the user. (Shipping charges to Beckman Coulter are the responsibility of the user.) Rotors will be inspected in the user's laboratory if the centrifuge in which they are used is covered by an appropriate Beckman Coulter Service Agreement. Contact your local Beckman Coulter office for details of service coverage or cost.

Before shipping, contact the nearest Beckman Coulter Sales and Service office and request a Returned Goods Authorization (RGA) form and packaging instructions. Please include the complete rotor assembly, with buckets, lid, handle, tube cavity caps, etc. A SIGNED STATEMENT THAT THE ROTOR AND ACCESSORIES ARE NON-RADIOACTIVE, NON-PATHOGENIC, NON-TOXIC, AND OTHERWISE SAFE TO SHIP AND HANDLE IS REQUIRED.

Beckman Coulter Worldwide Biomedical Research Division Offices

AUSTRALIA
Beckman Coulter Australia Pty Ltd
Unit D, 24 College St.
Gladesville, NSW 2111
Australia
Telephone: (61) 2 9844-6000
or toll free: 1 800 060 880
Fax: (61) 2 9844-6096
email: lifescienceaustralia@beckman.com

CANADA
Beckman Coulter (Canada) Inc.
6755 Mississauga Road, Suite 600
Mississauga, Ontario
Canada L5N 7Y2
Telephone: (1) 905 819-1234
Fax: (1) 905 819-1485

CHINA
Beckman Coulter Inc.
Beijing Representative Office
Unit 2005A, 2006-2009, East Ocean Center
Jian Guomenwai Avenue
Beijing 100004
China
Telephone: (86) 10 6515 6028
Fax: (86) 10 6515 6025, 6515 6026

CZECH REPUBLIC
Beckman Coulter Prague
Radiova 1
102 27 Prague 10
Czech Republice
Telephone: (420) 267 00 85 13
Fax: (420) 267 00 83 23

EASTERN EUROPE/
MIDDLE EAST/NORTH AFRICA
Beckman Coulter International S.A.
22, Rue Juste-Olivier
Case Postale 301-303
CH-1260 Nyon, Switzerland
Telephone: (41) 22 365 3707
Fax: (41) 22 365 0700

FRANCE
Beckman Coulter France S.A.
Paris Nord II, 33/66 rue des Vanesses
B.P. 50359
Villepinte, France
95942 ROISSY CDG Cedex
Telephone: (33) 1 49 90 90 00
Fax: (33) 1 49 90 90 10
e-mail: bioresearch.france@beckman.com

GERMANY
Beckman Coulter GmbH
Europark Fichtenhain B-13
47807 Krefeld
Germany
Telephone: (49) 21 51 33 35
Fax: (49) 21 51 33 33
e-mail: bioresearch.de@beckman.com

HONG KONG
Beckman Coulter Hong Kong Ltd.
12th Floor, Oxford House
979 King's Road
Taikoo Place, Hong Kong
Telephone: (852) 2814 7431
Fax: (852) 2873 4511

INDIA
Beckman Coulter India Pvt. Ltd.
Solitaire Corporate Park
3rd Floor - Bldg. 11
Andheri Ghatkopar Link Road
Chakala, Andheri West
Mumbai India 400 098
Telephone: (91) 22 3080 5101

ITALY
Beckman Coulter S.p.a.
Centro Direzionale Lombardo
Palazzo F/1, Via Roma 108
20060 Cassina de' Pecchi
Milano, Italy
Telephone: (39) 02 953921
Fax: (39) 02 95392264

JAPAN
Beckman Coulter K.K.
TOC Ariake West Tower
2-5-7, Ariake, Koto-ku
Tokyo 135-0063 Japan
Telephone: (81) 3 5530 8500
Fax: (81) 3 5404 8436

MEXICO
Beckman Coulter de Mexico S.A. de C.V.
Avenida Popocatépetl #396
Colonia Gral. Pedro Maria Anaya
Codigo Postal 03340
Mexico, D.F. Mexico
Telephone: (001) 52-55-9183-2800

NETHERLANDS
Beckman Coulter Nederland B.V.
Nijverheidsweg 21
3641 RP-Mijdrecht
Postbus 47
3640 AA Mijdrecht
The Netherlands
Telephone: (31) 297-230630
Fax: (31) 297-288082

SINGAPORE
Beckman Coulter Singapore Pte. Ltd.
116 Changi Road
Unit #03-01/02
Singapore 419718
Telephone: (65) 6339 3633
Fax: (65) 6336 6303

SOUTH AFRICA/SUB-SAHARAN AFRICA
Beckman Coulter
Stand 1A Primegro Park
Tonetti Street
1685 Halfway House
Johannesburg
Republic of South Africa
Telephone: (27) 11-805-2014/5
Fax: (27) 11-805-4120
e-mail: beckman@intekom.co.za

SPAIN
Beckman Coulter España S.A.
C/ Caleruega, 81
28033 Madrid, Spain
Telephone: (34) 91 3836080
Fax: (34) 91 3836096
email: bioresearch.espana@beckman.com

SWEDEN
Beckman Coulter AB
Archimedesvaegen 7
Box 111 56
SE-168 11 Bromma
Sweden
Telephone: (46) 8 564 85 900
Telefax: (46) 8 564 85 901

SWITZERLAND
Beckman Coulter International S.A.
22, Rue Juste-Olivier
Case Postale 301-303
CH-1260 Nyon
Switzerland
Telephone: (41) 0800 850 810
Fax: (41) 0848 850 810

TAIWAN
Beckman Coulter Taiwan Inc.
Taiwan Branch
8th Floor
216 Tun Hwa South Road, Section 2
Taipei 106, Taiwan
Republic of China
Telephone: (886) 2 2378 3456
Fax: (886) 2 2377 0408

TURKEY
Beckman Coulter Ltd.
E-5 Yanyol Faith Cad.
81410 Soganlik Kartal
Istanbul
Turkey
Telephone: (90) 216 309 1900
Fax: (90) 216 309 0090

UNITED KINGDOM
Beckman Coulter United Kingdom Ltd
Oakley Court
Kingsmead Business Park
London Road
High Wycombe
Buckinghamshire HP11 1JU
England, U.K.
Telephone: (44) 01494 441181
Fax: (44) 01494 447558
e-mail: beckman_uk@beckman.com

Additional addresses are available at www.beckmancoulter.com.

BECKMAN COULTER®

Beckman Coulter, Inc. • 4300 N. Harbor Boulevard, Box 3100 • Fullerton, California 92834-3100
Sales and Service: 1-800-742-2345 • Internet: www.beckmancoulter.com • Telex: 678413 • Fax: 1-800-643-4366