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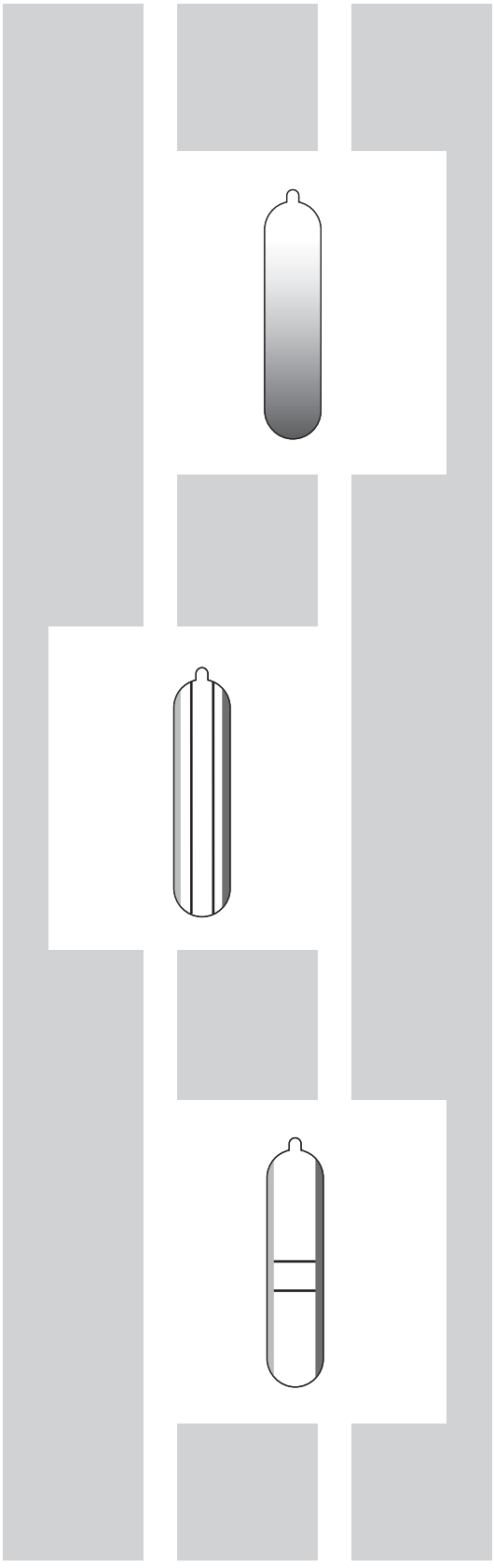
November 2007



VTi 90 Rotor

Used In Beckman Coulter Class H, R, and S Preparative Ultracentrifuges

Printed in the U.S.A.
CA-1107-.2-FNG

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 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 ultracentrifuge.

Although rotor components and accessories made by other manufacturers may fit in the VTi 90 rotor, their safety in this rotor cannot be ascertained by Beckman Coulter. Use of other manufacturers' components or accessories in the VTi 90 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.

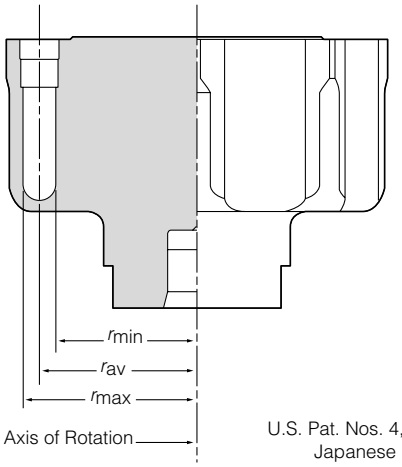
Do not run an empty rotor. Place filled tubes in at least two opposing cavities. Make sure that filled containers are loaded symmetrically into the rotor and that opposing tubes are filled to the same level with liquid of the same density. Make sure that cavities in use have the proper spacers inserted before installing the rotor plugs.

If disassembly reveals evidence of leakage, you should assume that some fluid escaped the rotor. Apply appropriate decontamination procedures to the centrifuge and accessories if pathogenic or radioactive materials are involved.

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.

VTi 90 ROTOR



U.S. Pat. Nos. 4,102,490; 4,290,550; 4,235,367
Japanese Pat. Nos. 1,469,154; 1,457,500

SPECIFICATIONS

Maximum speed	90 000 rpm
Density rating at maximum speed	1.7 g/mL
Relative Centrifugal Field* at maximum speed	
At r_{max} (71.1 mm)	645 000 × *g*
At r_{av} (64.5 mm)	585 000 × *g*
At r_{min} (57.9 mm)	525 000 × *g*
k factor at maximum speed	6
Conditions requiring speed reductions	see RUN SPEEDS
Number of tube cavities	8
Available tubes	see Table 1
Nominal tube dimensions (largest tube)	13 × 51 mm
Nominal tube capacity	5.1 mL
Nominal rotor capacity	40.8 mL
Approximate acceleration time to maximum speed (fully loaded)	9 min
Approximate deceleration time from maximum speed (fully loaded)	8 1/2 min
Weight of fully loaded rotor	5.5 kg (12 lb)
Rotor material	titanium

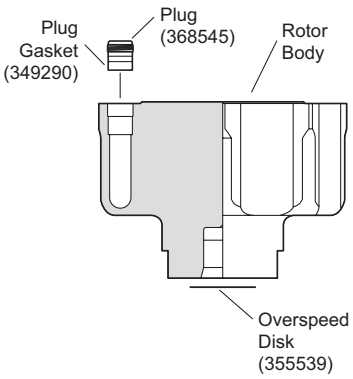
* Relative Centrifugal Field (RCF) is the ratio of the centrifugal acceleration at a specified radius and speed ($r\omega^2$) to the standard acceleration of gravity (g) according to the following formula:

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

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

The VTi 90, rated for 90 000 rpm, is designed to centrifuge up to eight tubes in an upright position. Used in Beckman Coulter class H, R, and S preparative ultracentrifuges, the rotor develops centrifugal forces that can efficiently band DNA or isolate proteins on density gradients. Up to 40.8 mL of gradient and sample can be centrifuged per run.

The rotor is made of titanium and is finished with black polyurethane paint. A tube spacer and hex-cavity rotor plug hold each tube in the rotor, and a plug gasket forms a closure around each plug. Rotor plugs are black-anodized aluminum, and spacers are black-anodized aluminum for Quick-Seal® tubes and gold-anodized aluminum for OptiSeal™ tubes. Because of the weight of the rotor, drive pins are not required in the rotor drive hub cavity.

For overspeed protection, a photoelectric detector in the ultracentrifuge monitors the overspeed disk on the rotor bottom and shuts down the run if speeds exceeding 90 000 rpm are detected.

See the Warranty at the back of this manual for warranty information.

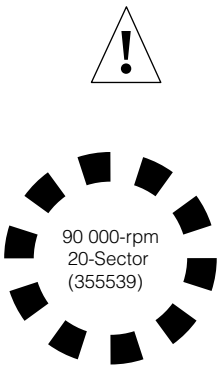
PREPARATION AND USE

Specific information about the VTi 90 rotor is given here. Information common to this and other rotors is contained in Rotors and Tubes for Preparative Ultracentrifuges *(publication LR-IM), which should be used together with this manual for complete rotor and accessory operation. Publication LR-IM is included in the literature package with this rotor manual.*

NOTE

Although rotor components and accessories made by other manufacturers may fit in the VTi 90 rotor, their safety in this rotor cannot be ascertained by Beckman Coulter. Use of other manufacturers' components or accessories in the VTi 90 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



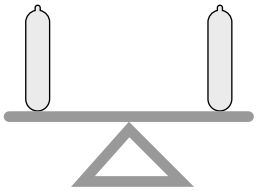
Read the Safety Notice page at the front of this manual before using the rotor.

1. Inspect the rotor plugs and gaskets for damage—the high forces generated in this rotor can cause damaged components to fail.
2. Make sure that the rotor is equipped with the correct overspeed disk. If the disk is missing or damaged, replace it according to the instructions in *Rotors and Tubes.*
3. Verify that only the tubes and accessories listed in Table 1 are being used. Check the chemical compatibilities of all materials used (refer to Appendix A in *Rotors and Tubes).*

ROTOR PREPARATION

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

1. Be sure that the plug threads are clean and lightly but evenly lubricated with Spinkote™ lubricant (306812) to ensure a proper seal by minimizing thread friction.
2. Set the rotor in the rotor vise (342705), which should be bolted or clamped to a rigid surface.



3. Load the filled and plugged or sealed tubes symmetrically into the rotor (see page 8 for tube information). If fewer than eight tubes are being run, they must be arranged symmetrically in the rotor (see Figure 1). *Opposing tubes must be filled to the same level with liquid of the same density.*

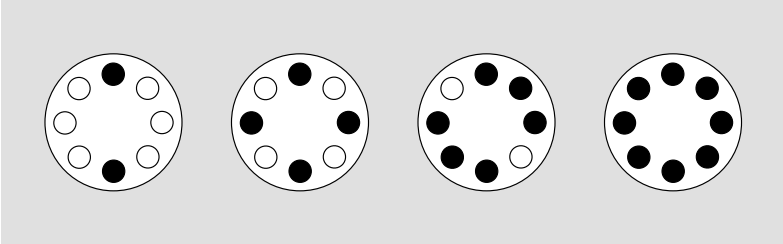
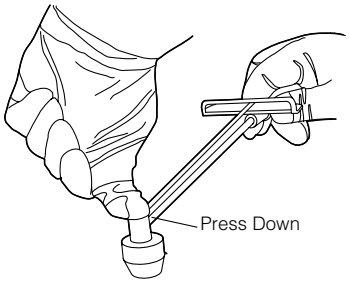


Figure 1. Arranging Tubes in the Rotor. Two, four, six, or eight tubes can be centrifuged per run if they are arranged in the rotor as shown.

4. Complete loading by placing the correct spacers (and floating spacers, if applicable) over the tubes. It is important that each cavity being used is completely filled.

5. Insert a rotor plug (368545), gasket-end down, over each spacer and screw it in.



NOTE

Do not use rotor plugs in empty cavities.

6. Using the hex plug adapter (976959) and torque wrench (858121), tighten each rotor plug to 13.6 N•m (120 in.-lb). *To avoid stripping the plugs, apply downward pressure to the hex plug adapter while tightening the plugs.* Do not overtighten plugs; the top surface of each rotor plug should be flush with the surrounding rotor surface.

OPERATION

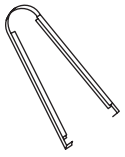
1. Carefully place the rotor on the drive hub.
2. Refer to the instrument instruction manual for ultracentrifuge operation.
3. For additional operating information, see the following:
   - RUN TIMES, page 9, for using *k* factors to adjust run durations.
   - RUN SPEEDS, page 11, for information about speed limitations.
   - SLOW ACCELERATION/DECELERATION, page 11, for information about using slow acceleration and deceleration for gradient stability.
   - SELECTING CsCl GRADIENTS, page 13, 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.

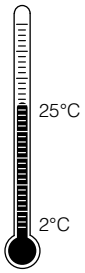
1. Remove the rotor from the centrifuge by lifting it straight up and off the drive hub.
2. Return the rotor to the rotor vise. Remove the plugs with the torque wrench. *To avoid stripping the plugs, apply downward pressure to the hex plug adapter while loosening the plugs.*
3. Use the appropriate removal tool (see the SUPPLY LIST) to remove the spacers and tubes.



Tube
Removal Tool
(361668)

TUBES

The VTi 90 rotor uses only OptiSeal and Quick-Seal tubes; use only the tubes and accessories listed in Table 1. Refer to *Rotors and Tubes* for information on the chemical resistances of tube and accessory materials. OptiSeal and Quick-Seal tubes are disposable and should be discarded after a single use.



Temperature Limits

- Plastic tubes 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 tubes are frozen before use, make sure that they are thawed to at least 2°C prior to centrifugation.

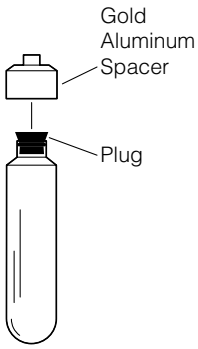
Table 1. Available Tubes for the VTi 90 Rotor. Use only the items listed here.

Tube			Required Accessory			
Dimensions and Volume	Description	Part Number	Description	Part Number	Tube Rack	Max Speed/ RCF/ *k* Factor
13 × 51 mm 5.1 mL	Quick-Seal Ultra-Clear	344075 (pkg/50)	aluminum spacer	342883	348122	90 000 rpm 645 000 × *g* 6
13 × 51 mm 5.1 mL	Quick-Seal polyallomer	342412 (pkg/50)	aluminum spacer	342883	348122	90 000 rpm 645 000 × *g* 6
13 × 51 mm 4.9 mL	OptiSeal polyallomer	362185* (pkg/56)	gold-anodized aluminum spacer	362198	360534	90 000 rpm 645 000 × *g* 6
13 × 31.5 mm 3.5 mL	Quick-Seal polyallomer	349621 (pkg/50)	aluminum spacer	342883	348122	90 000 rpm 645 000 × *g* 6
			floating spacer†	356866		
13 × 25 mm 2 mL	Quick-Seal polyallomer	345829 (pkg/50)	aluminum spacer	342883	348122	90 000 rpm 645 000 × *g* 6
			floating spacer	345827		

* Includes disposable plastic plugs.

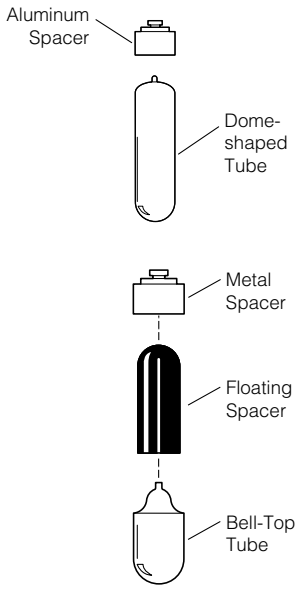
† Floating spacers, part of the *g*-Max system of tube support, are made of Noryl, a registered trademark of GE Plastics.

OptiSeal™ Tubes



OptiSeal tubes come with plastic plugs and can be quickly and easily prepared for use without tools or heat. With the tube spacer and rotor plug in place, the combination of *g* force and hydrostatic pressure during centrifugation ensures a tight, reliable seal that protects your samples. 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 the tube to deform, disrupting gradients and sample bands. Refer to *Using OptiSeal™ Tubes* (publication IN-189), included in each package of OptiSeal tubes, for detailed information on the use and care of OptiSeal tubes.

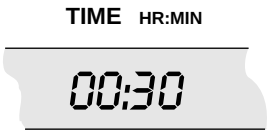
Quick-Seal Tubes



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.

- 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 and make the tube difficult to remove.
- Some of the Quick-Seal tubes listed in Table 1 are part of the *g*-Max™ system, which 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 in this rotor without reduction in *g* force. For detailed information on the *g*-Max system see publication DS-709.
- Refer to *Rotors and Tubes* for detailed information on the use of Quick-Seal tubes.

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:

$$k_{adj} = k\left(\frac{90\,000}{\text{actual run speed}}\right)^2 \quad (4)$$

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).

SLOW ACCELERATION/DECELERATION

Vertical banding of sample and gradient formation occurs with centrifugation. With deceleration, tube contents reorient back to horizontal position. For gradient stability *when preformed gradients are used*, select slow acceleration as follows:

ACCEL PROFILES

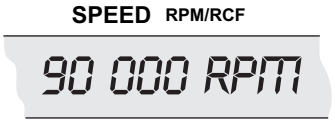
- in Optima L-XP and XL series ultracentrifuges, select a slow acceleration profile.
- in Optima L series ultracentrifuges, select SLOW ACCEL.

For the stability of *all gradients during deceleration*, do the following:

DECEL PROFILES

- in Optima L-XP and XL series ultracentrifuges, select a slow deceleration profile.
- in Optima L series ultracentrifuges, select SLOW DECEL.
- in L7 series ultracentrifuges, set the brake switch in the 800 rpm position.

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.

Speeds must be reduced under the following circumstances:

1. If nonprecipitating solutions more dense than 1.7 g/mL are centrifuged, the maximum allowable run speed must be reduced according to the following equation:

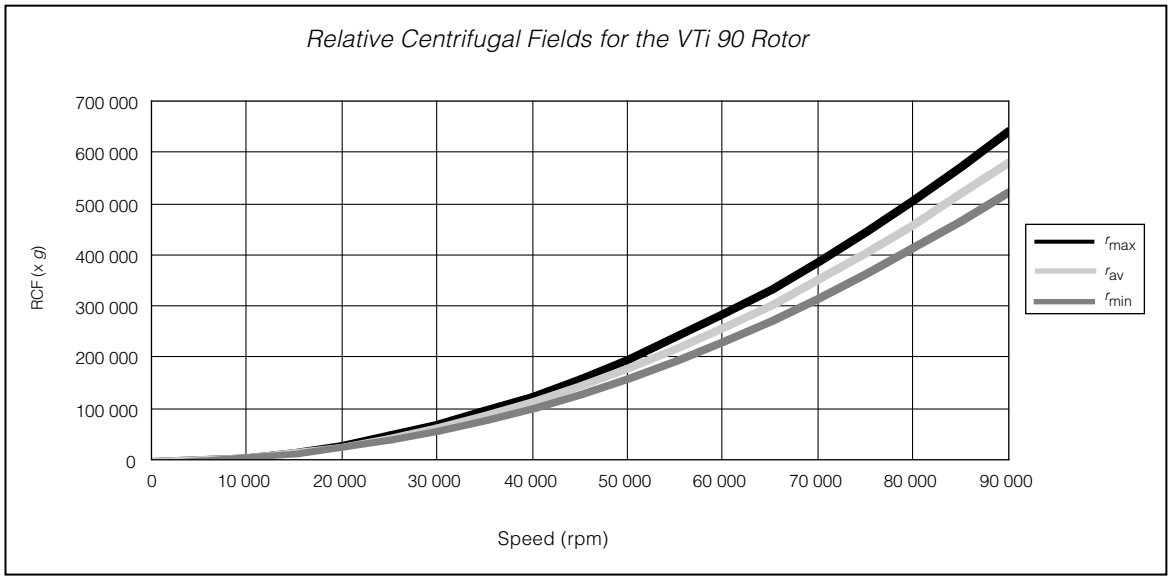
$$\text{reduced maximum speed} = (90\,000 \text{ rpm}) \sqrt{\frac{1.7 \text{ g/mL}}{\rho}} \qquad (6)$$

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

Table 2. Relative Centrifugal Fields for the VTi 90 Rotor (13.5-mL Tubes). 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 (x *g*)			*k* Factor*
	At r_{max} (71.1 mm)	At r_{av} (64.5 mm)	At r_{min} (57.9 mm)	
90 000	645 000	585 000	525 000	6
85 000	575 000	522 000	469 000	7
80 000	510 000	462 000	415 000	8
75 000	448 000	406 000	365 000	9
70 000	390 000	354 000	318 000	11
65 000	336 000	305 000	274 000	12
60 000	287 000	260 000	233 000	14
55 000	241 000	219 000	196 000	17
50 000	199 000	181 000	162 000	19
45 000	161 000	146 000	131 000	20
40 000	128 000	116 000	104 000	22

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



load. *Note, however, that the use of this formula may still produce maximum speed figures that are higher than the limitations imposed by the use of certain tubes or adapters.* In such cases, use the lower of the two figures.

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. Precipitation during centrifugation would alter the density distribution of CsCl and this would change the position of the sample bands. Figure 2, together with the description and examples below, show how to reduce run speeds when using CsCl gradients.

SELECTING CsCl GRADIENTS

NOTE

The curves in Figure 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.

Solid CsCl has a density of 4 g/mL, and if precipitation during centrifugation may cause rotor failure. Precipitation will also alter density distribution, and therefore sample separation. In general, lower speeds provide better resolution, but longer run times will be required to achieve particle separation and gradient equilibrium. Curves are provided up to the maximum rated speed of the rotor.

Rotor speed is used to control the slope of a CsCl density gradient, and must be limited so that CsCl precipitation is avoided. Figure 2a gives the CsCl concentration-limiting curves for full tubes. The reference curves in Figure 2b show equilibrium gradients that result from centrifugation using the maximum densities allowed by Figure 2a. Each curve in Figure 2b is within the density limits allowed for the VTi 90 rotor: each curve was generated for a single run speed using the maximum allowable homogeneous CsCl densities that avoid precipitation at that speed. Figure 2c gives the gradients that result from centrifugation using lower-than-maximum-allowable CsCl concentrations. These reduced-density curves can be used to make particles band more towards the middle of a tube, where volume

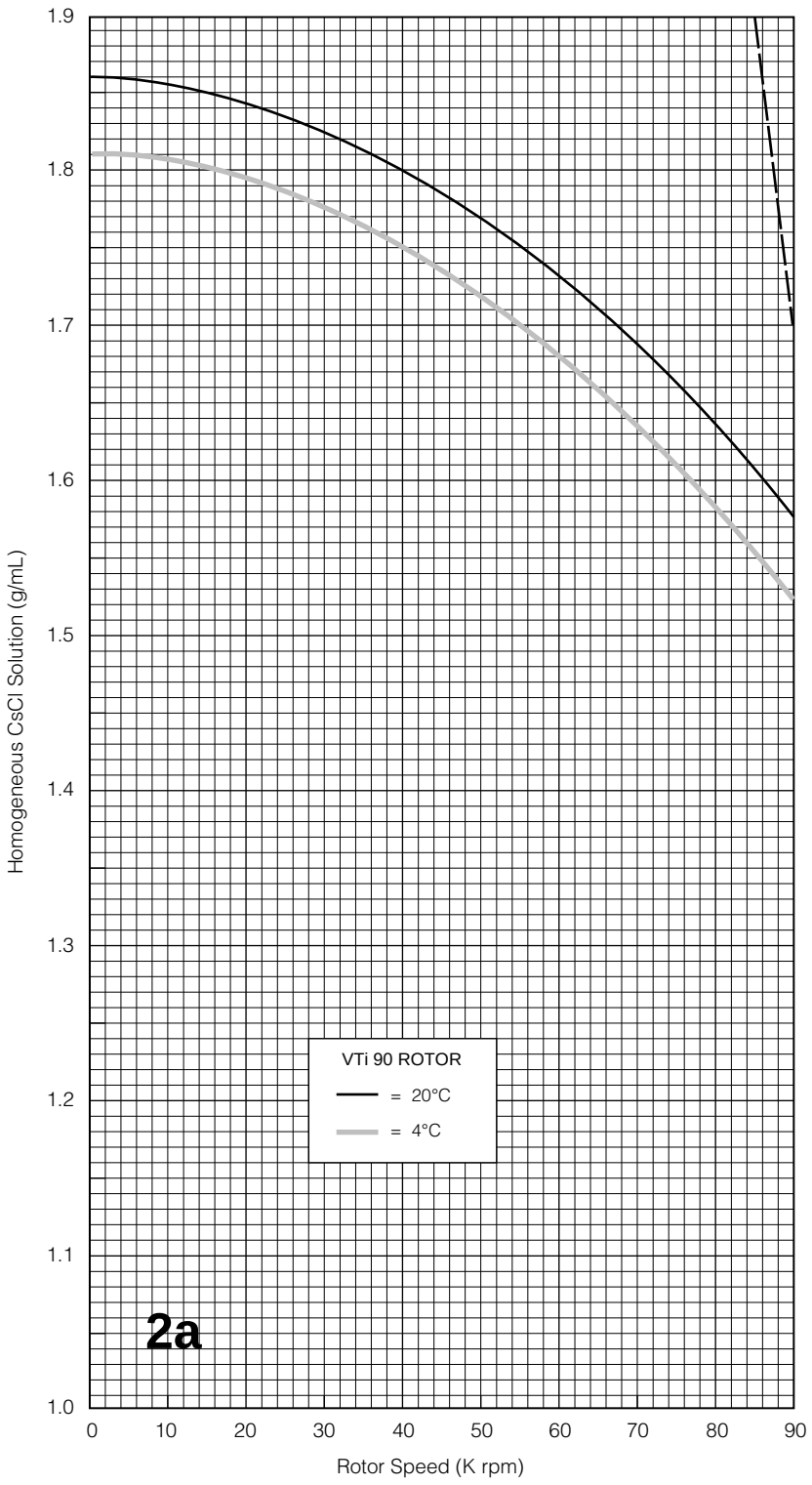


Figure 2a. Precipitation Curves for the VTi 90 Rotor. Using combinations of rotor speeds and homogeneous CsCl solution densities that intersect on or below these curves ensures that CsCl will not precipitate during centrifugation. If gradient and sample solutions do not completely fill the tube, add mineral oil to fill. (Do not use an oil overlay in Ultra-Clear tubes.) The dashed line is a representation of equation (6), and is shown here to illustrate the inability of that equation to predict CsCl precipitation.

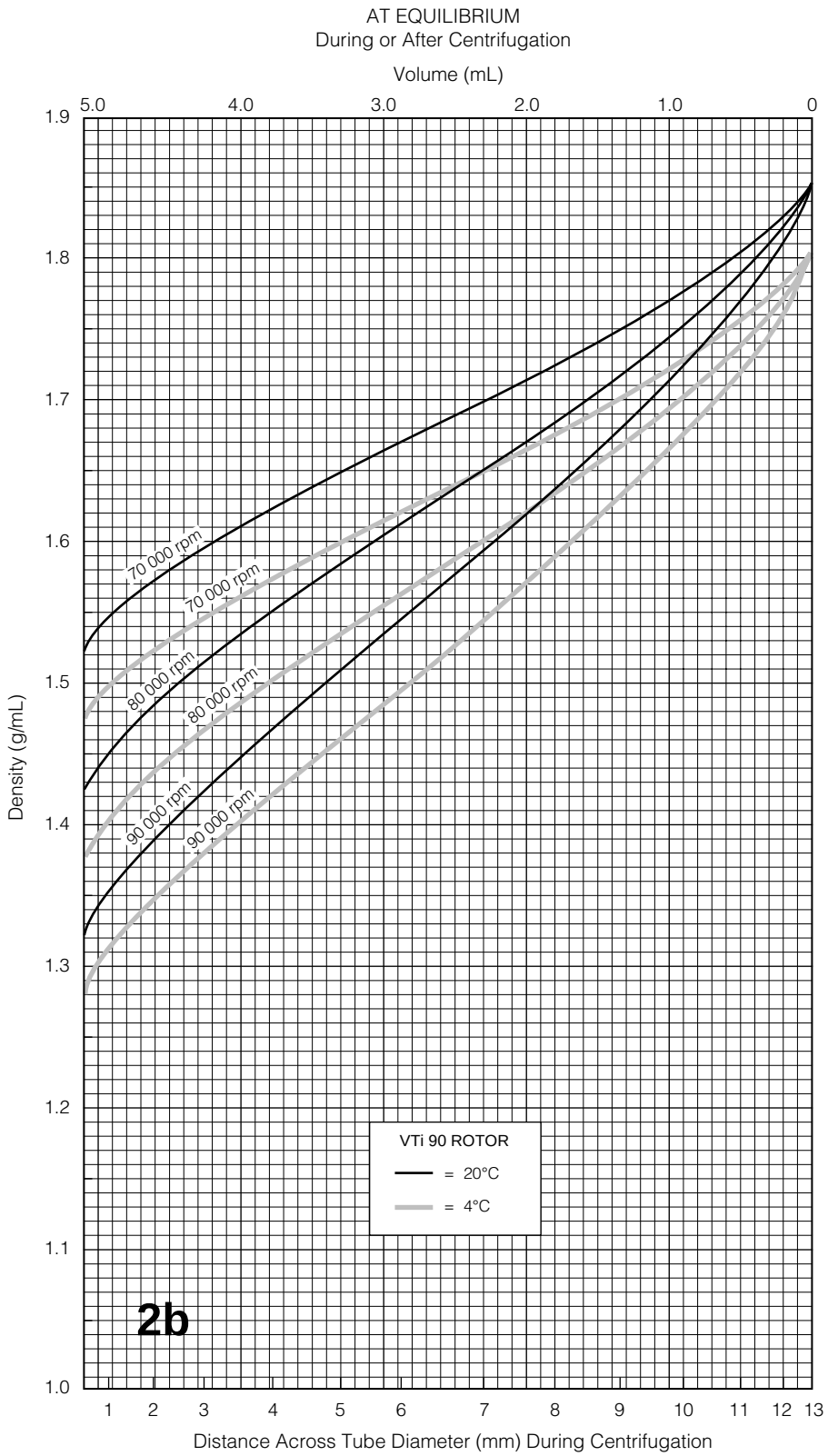


Figure 2b. CsCl Gradients at Equilibrium for the VTi 90 Rotor. Centrifugation of homogeneous CsCl solutions at the maximum allowable speeds (from Figure 2a) results in gradients presented here.

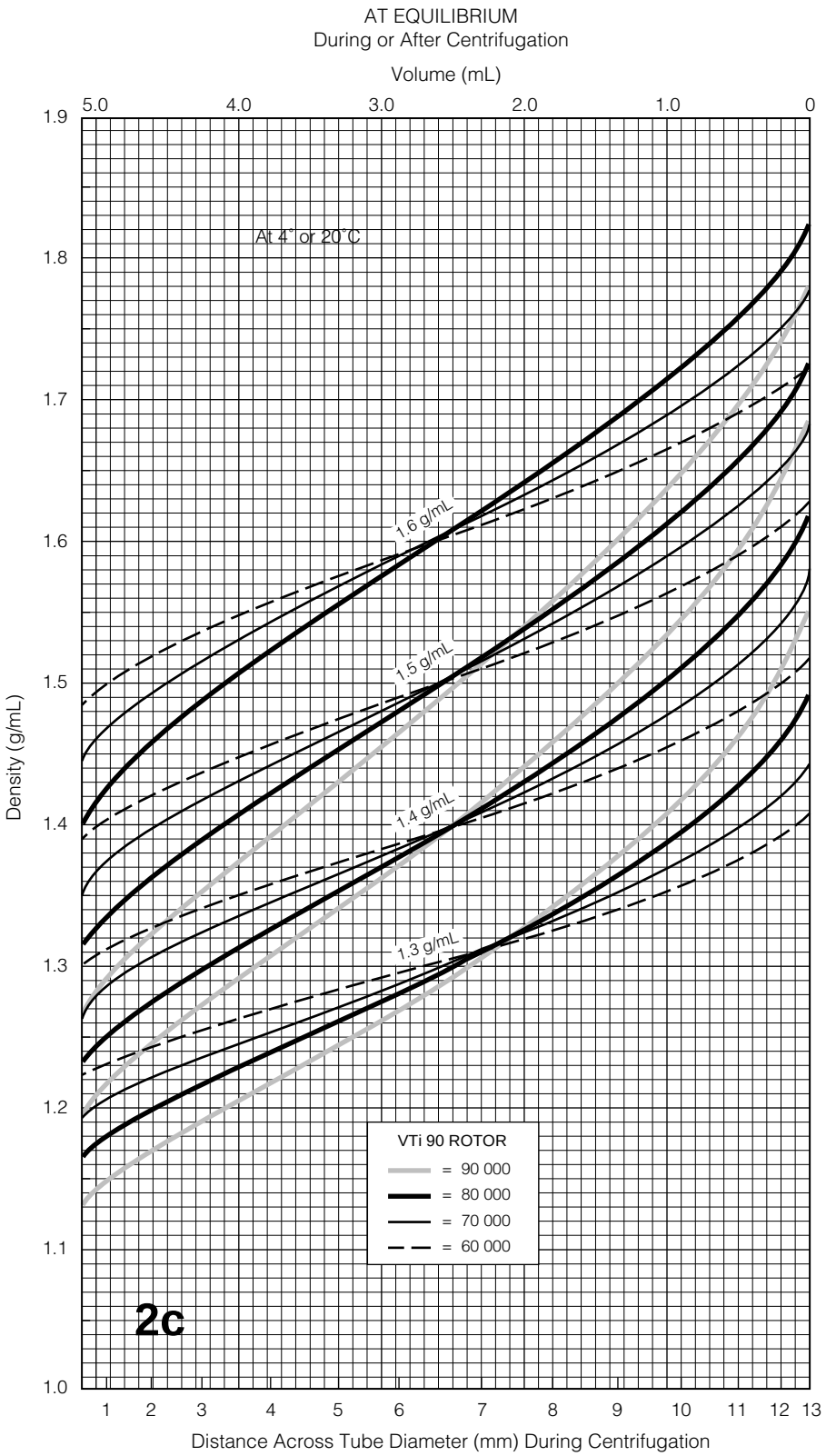


Figure 2c. CsCl Gradients for Lower Densities. Densities used to generate curves are printed along the curves. Note that at 4°C, only three curves (60 000 rpm, 70 000 rpm, and 80 000 rpm) are shown for 1.6 g/mL because CsCl would precipitate at higher speeds.

between bands will be greatest. (The gradients in Figures 2b and 2c 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.)

TYPICAL EXAMPLES FOR DETERMINING CsCl RUN PARAMETERS

Example A: Knowing homogeneous CsCl solution density (1.64 g/mL) and approximate particle buoyant densities (1.70 and 1.65 g/mL), at 20°C, where will particles band?

1. In Figure 2a, find the curve that corresponds to the required run temperature (20°C). The maximum allowable rotor speed is determined from the point where this curve intersects the homogeneous CsCl density (80 000 rpm).

2. In Figure 2b, 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 (lower axis of Figure 2b) at equilibrium during centrifugation. After centrifugation, the bands will reorient (top axis).

If the required gradient curve is not presented in Figure 2b, interpolate between the nearest curves and draw it in. For example, for a run at 75 000 rpm, the curve should be drawn between the 70 000- and 80 000-rpm curves. The same particles will band along this curve about one-half and one-third of the way from the right edge of the figure. Using the horizontal axis, it can be estimated that these particles will be about 1.5 mm apart at equilibrium during centrifugation. They will be separated by 0.75 mL (top axis).

Example B: Knowing particle buoyant densities (1.600 and 1.610 g/mL), how do you achieve the best separation?

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

2. Select the curve at the temperature (20°C) that gives the best particle separation. Particles will band at points across the tube diameter where the sketched lines intersect this curve (lower axis) at equilibrium during centrifugation. After centrifugation the bands will reorient (top axis).

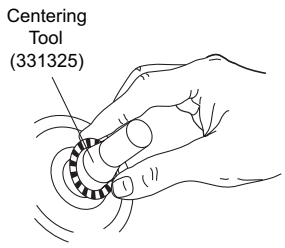
3. Note the run speed along the selected curve.

4. 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 case the 1.6-g/mL 70 000-rpm curves in Figure 2c give the best separation. These curves intersect the particle buoyant densities in such a way that particles band about 0.5 mm apart at equilibrium during centrifugation (lower axis). They are separated by about 0.2 mL (upper axis). Bands are located in the middle of the tube.

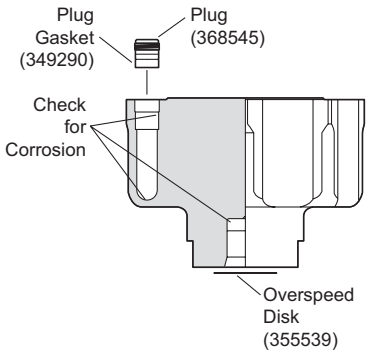
CARE AND MAINTENANCE

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.



- Regularly inspect the overspeed disk. If it is scratched, damaged, or missing, replace it. Replacement instructions are in *Rotors and Tubes*.

- Regularly inspect the rotor plugs (368545) for wear (worn threads will have a shiny appearance). Replace worn plugs.

- Regularly lubricate the metal threads in the rotor plugs with a thin, even coat of Spinkote lubricant. Failure to keep these threads lubricated can result in damaged threads. Replace rotor plugs (as a set) if they show signs of wear.

- The rotor plug gaskets (349290) require no maintenance except cleaning. Replace damaged gaskets. To replace the plug gasket, use the sharpened end of a cotton swab or similar nonmetallic tool to pry the gasket from the plug. *Do this carefully so that the plug is not damaged.* The new gasket snaps onto the grooved end of the plug.

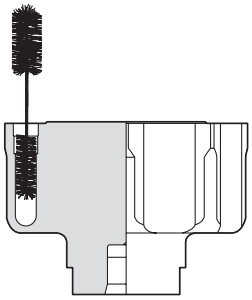
Refer to Appendix A in *Rotors and Tubes* for the chemical resistances of rotor and accessory materials. Your Beckman Coulter representative provides contact with the Field Rotor Inspection Program and the rotor repair center.

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, plugs, and spacers 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.

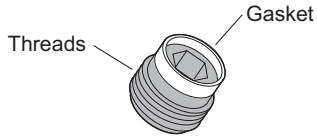


NOTE

Do not wash rotor components in a dishwasher. Do not soak in detergent solution for long periods, such as overnight.

2. Rinse the cleaned rotor and components with distilled water.

3. Air-dry the rotor upside down. *Do not use acetone to dry the rotor.*

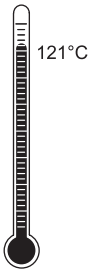


Clean plug threads as necessary. Use a brush and concentrated Solution 555. Rinse and dry thoroughly, then lubricate lightly but evenly with Spinkote to coat all threads.

DECONTAMINATION

If the rotor or other components are contaminated with toxic or pathogenic materials, follow appropriate decontamination procedures as outlined by your laboratory safety officer. Check Appendix A in *Rotors and Tubes* to be sure the decontamination method will not damage any part of the rotor.

STERILIZATION AND DISINFECTION



- The rotor and all rotor components can be autoclaved at 121°C for up to an hour. Remove the plugs from the rotor and place the rotor, plugs, and spacers in the autoclave upside down.
- Ethanol (70%)* 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.

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.

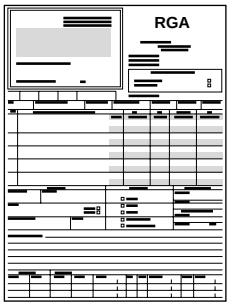
OptiSeal and Quick-Seal tubes are disposable and should be discarded after a single use.

STORAGE

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

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

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,
- 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.

Call 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) for detailed information on ordering parts and supplies. For your convenience, a partial list is given below.

REPLACEMENT ROTOR PARTS

VTi 90 rotor assembly	356135
Rotor plug	368545
Rotor plug gasket	349290
Overspeed disk (90 000 rpm)	355539
Rotor vise assembly	342705

OTHER

Tubes and accessories	see Table 1
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 kit, 50 Hz (Canada)	367803
Tube Topper rack (13-mm dia. tubes)	348122
Torque wrench	858121
Hex plug adapter	976959
Tube removal tool	361668
Floating spacer removal tool	338765
Spinkote lubricant (1 oz)	306812
Silicone vacuum grease (2 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.

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BECKMAN COULTER®

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