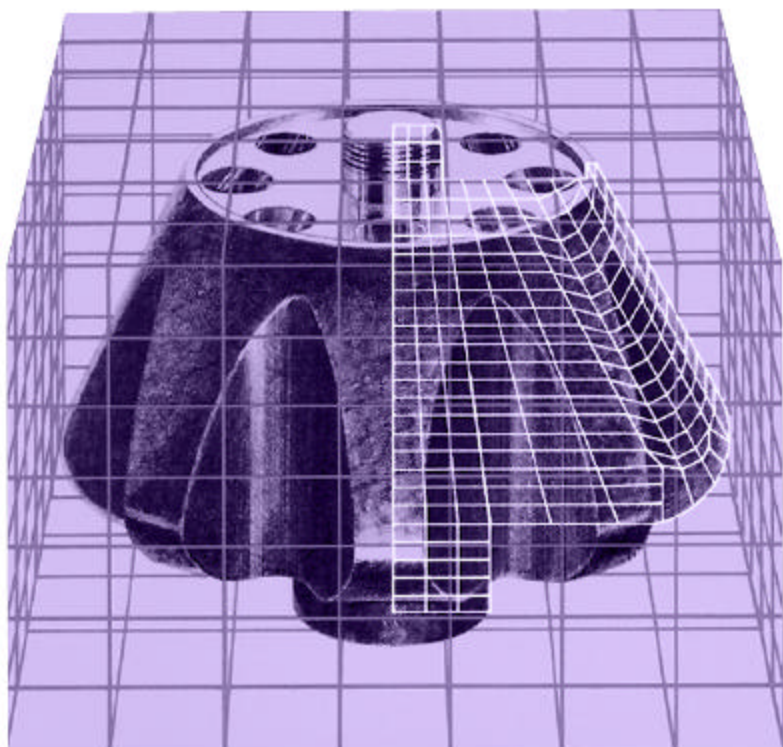


# Rotor Safety Guide



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# Introduction

Most of us appreciate the need for careful design, handling, and maintenance of certain kinds of laboratory equipment - the optics of a spectrophotometer, for instance. It may not be obvious, however, that anything as substantial-looking as a centrifuge rotor must be designed to exacting specifications, and properly maintained during use in order for it to fulfill its life expectancy.

If you consider that during rotation an ultracentrifuge rotor may experience 1,000,000 times the force of gravity, it becomes apparent that seemingly minor flaws will assume much greater significance at these *g*-forces. In effect, one gram will “weigh” 1000 kilograms, and a tiny flaw in a critical part may generate stresses greater than the rotor was designed to withstand.

The three factors that govern a safe life for any rotor are:

- Expert design and manufacture
- Proper care and handling during use
- Retirement, when damage or fatigue make continued use unsafe

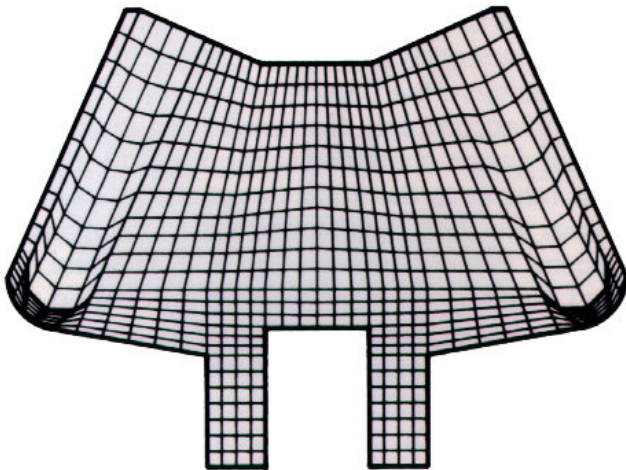
We hope this booklet will clarify these points. Because after you purchase a rotor, its safety largely depends on *you*, the person responsible for its use, maintenance, and retirement.



## Design of a Rotor

Rotors are designed to meet the needs of the research, medical, bio-industrial and bioprocessing communities. After Beckman Coulter product planning and marketing define a potential, it is transformed into a design concept and an extensive exploratory phase study is undertaken. If the concept survives this study phase, the actual design process begins.

First, computer modeling studies are conducted, using a powerful computer work-station system. This computer capability, and techniques such as three-dimensional finite element analysis and solid modeling, enable our engineers to model the stress that the proposed rotor will be subjected to in use. An example of such a computer-generated finite element analysis is shown in Figure 1. Since the rotor is just one part of a dynamic system, the characteristics of the centrifuge and the drive must also be considered. Thus, a vibrational analysis of the proposed rotor/drive system is also considered at this point.



*Figure 1. Computer-Generated Model for Finite Element Stress Analysis of a Fixed Angle Rotor*

Concurrently with the computer modeling, our materials and metallurgy laboratory conducts material property studies to determine which alloy and heat treatment to use. Composite materials may be used to reduce the weight of high-energy rotors, or to increase sample capacity and rotor efficiency. To simulate conditions of actual use, specimens of the alloys under consideration are subjected to cyclic stress (or fatigue) testing. Tensile strength tests, as well as metallographic analyses, are performed on some sample forgings. Meanwhile, manufacturing and technology transfer engineers are reviewing the design for ease of manufacture.

Prototype rotors are then fabricated from the chosen alloy and tested by both nondestructive and destructive test methods. In a specially constructed blockhouse, the prototypes are repeatedly cycled up to maximum speed to verify their design life. They are also intentionally run to destruction at the maximum speed attainable by the test centrifuge. Videotapes of these single-cycle burst tests are reviewed to check the vertical and horizontal containment of the rotor-centrifuge combination.

In the reliability lab, engineers load samples, assemble, and run the rotor to be sure no difficult or awkward handling methods are required. And our applications scientists use the prototype rotor to verify that it will achieve the particle separations it was designed for. Some of these tests may reveal the need for design changes. In that case, the rotor returns to the initial design stage and new prototypes are made and submitted to the entire test cycle. When all criteria are met, the final design is turned over to manufacturing for production.

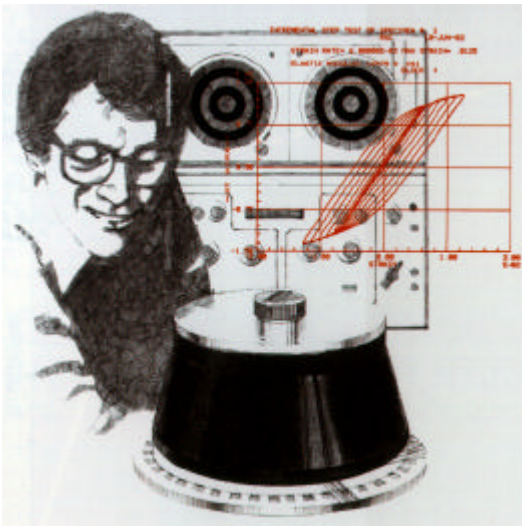
Of course, rotors in production are also inspected as they progress from the forging stage to finished product. As a final test of quality control, each rotor is balanced, run at the maximum rated speed, and its stability checked before it is released for sale.

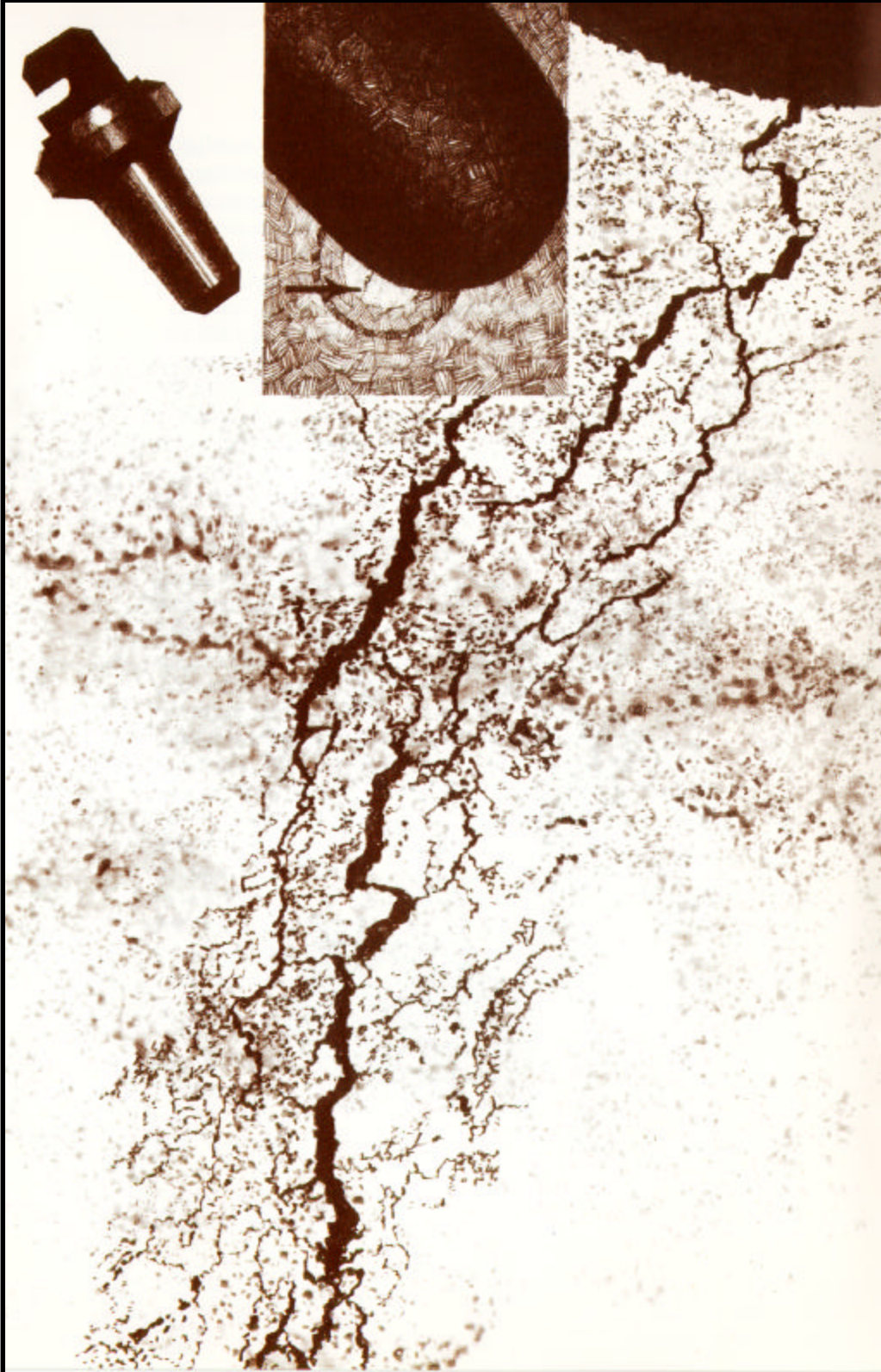
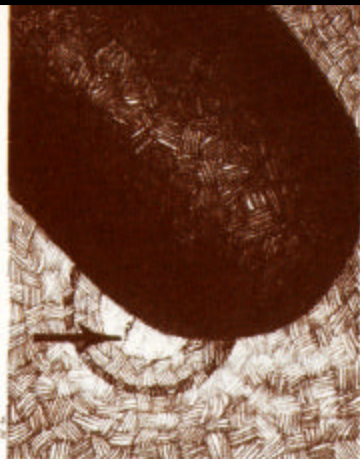
Every High Performance and Benchtop rotor also receives a special “high stress test” to insure it will have a long and safe life. This “high stress test” produces stresses that are far greater than the maximum possible stresses to the rotor when you use it in your centrifuge.

Our confidence in these design and test procedures enables us to warrant our rotors and centrifuges against defects in materials and workmanship. However, each warranty is based on the concept of a Beckman Coulter-designed and tested rotor/centrifuge system, in which the characteristics of the rotor, drive, instrument, and containment have been carefully matched to insure safe operation conditions. Since it is impractical for us to subject other manufacturers’ rotors and centrifuges to the tests just described, *Beckman Coulter does not warrant its rotors when operating in other centrifuges, and does not warrant its centrifuges when used with other manufacturers’ rotors.*

Using the proper rotor and centrifuge combinations will meet the laboratory equipment standards and regulations of UL, C-UL and CE Mark. Note that CE Marked instruments must be used with the approved rotors to

maintain CE Marking - using other rotors *will void* the CE Marking. Refer to your instrument manual for the approved rotor list.





## Why Rotors Fail

The most careful design may not protect a rotor against misuse or abuse when it is in service. The centrifuge user should understand something about the causes of rotor failure in order to prevent it.

**Stress** - The centrifugal force created by high rotational speeds generates the load or stress on the metal of the rotor, which causes it to stretch and change in size. Figure 2 is a plot of stress against this dimensional change (strain) for a typical rotor alloy. The first section of the curve is the *elastic* region, where the alloy will return to its original dimensions after the load is removed. At a certain level of stress, however, the elastic limit of the

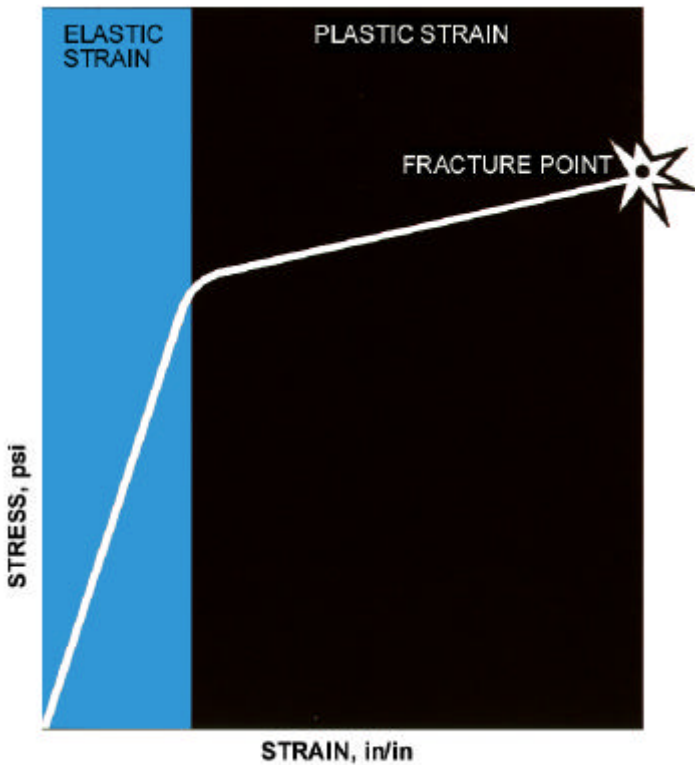


Figure 2. Stress/Strain Plot of a Typical Rotor Alloy.

alloy will be exceeded: the rotor will *not* regain its original size and shape at the end of the run. Plastic damage has occurred which may initiate a failure of the rotor at some point. The maximum speed and sample density ratings designated by Beckman Coulter for each rotor are intended to prevent this type of damage and should always be observed.

**Metal Fatigue** - Any metal structure, following a certain number of stress cycles, will eventually suffer fatigue. When a rotor is repeatedly run up to operating speed and then decelerated, the cyclic stretching and relaxing of the metal cause changes in its microstructure. Depending on how close to the elastic limit of the metal the rotor is operated, and how many alternating stress cycles it experiences, these small changes will eventually become microscopic cracks. With continued use, the cracks will enlarge, and failure of the rotor will ultimately occur.

You may have noticed that Beckman Coulter provides a different type of warranty for its ultracentrifuge rotors than it does for its lower speed rotors. Metal fatigue is one consideration in determining these warranty provisions. To meet demanding operating requirements, many ultracentrifuge rotors are designed close to the elastic limits of their alloys. Because these rotors may fail due to metal fatigue if used for more than a certain number of runs or hours, the useful rotor lifetime is based on a lower number of years of usage than the J Series or Benchtop Series rotors.

Rotors for lower speed centrifuges, such as the Beckman Coulter J6, J2 and Avanti J series, however, are designed to operate far below the elastic limits of their alloys. Consequently, the useful lifetime on these rotors is a longer time period. See the table on the next page for an overview on the warranty period and retirement recommendations for each class of rotor.

## Warranty and Retirement Recommendations

	Warranty Years	Retire After Years	Retire After Runs
<b>Ultracentrifuge Rotor</b>			
Swinging Bucket.	5	10	2400
Aluminum Fixed Angle	5	10	2400
Zonal & Continuous Flow	5 yrs or 2000 runs	10	2000
Component Test & Rock Core	5 yrs or 2000 runs	10	2000
Titanium F/A, VTi & NVT	5	12	6000
VC-53 Composite	6	12	7200
VAC-50 Al Composite	5	12	3000
Analytical, Aluminum	5	10	2400
Analytical, Titanium	5	12	6000
TL & ML Series	5	12	NA
Airfuge Rotors	1	10	NA
<b>J Series Rotors</b>			
Avanti J Series	7	<b>15</b>	<b>50,000</b>
J2/6 Series Rotors	7	<b>15</b>	<b>50,000</b>
JLA-10.500, 8.1000 & 9.1000 cannisters	7	7	NA
* Cannisters have retirement date engraved on them			
<b>Benchtop Rotors</b>			
Allegra 6/GS-6, Spinchron Series	7	10	NA
Allegra 21 Series, Allegra 64, Avanti 30, GS-15 Series, Spinchron 15 Series Rotors	1	10	NA
H6002 Rotor	7	10	NA
GH-3.7 Rotor	7	7	NA
MicroFuge Series Rotors	1	10	NA
MicroFuge 18 Rotor	1	1	NA

*Beckman Coulter rotor warranties are shown in full at the end of this booklet.*

**Stress Corrosion** Corrosion, the attack on metal surfaces by moisture, chemicals, or alkaline solutions such as cesium chloride or other salts, is an aluminum rotor's worst enemy (see Figure 3). The resultant pitting reduces the amount of metal available to bear stress during operation at speed. When this occurs in a highly stressed area, the bottom of a cell hole in a fixed angle rotor, for example, the increased load on the remaining metal results in a so-called stress concentrator. Repeated use will cause cracks to develop, and failure of the rotor will result.

This combination of stress and corrosion is called *stress corrosion*. It will cause failure sooner and at a much lower level of stress than if the rotor were undamaged by corrosion. Stress corrosion is the primary cause of failure of aluminum rotors, especially as they age. Suggestions for avoiding it are discussed in the next section.

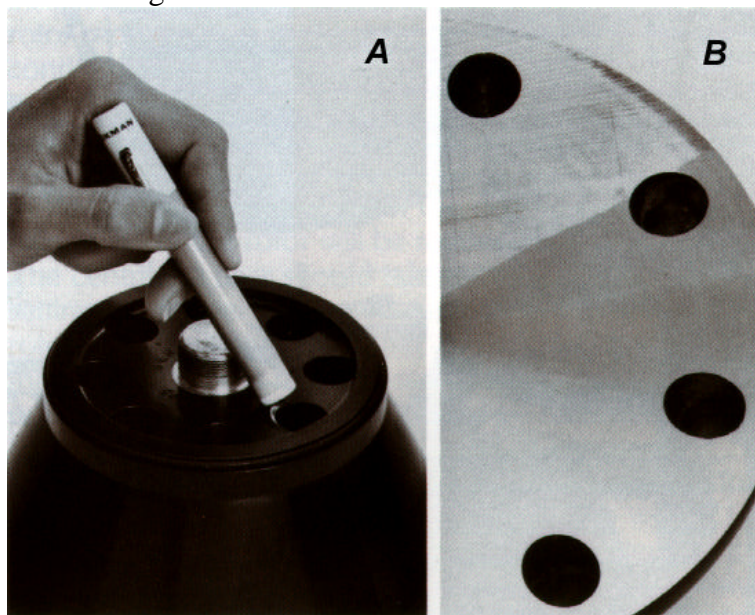
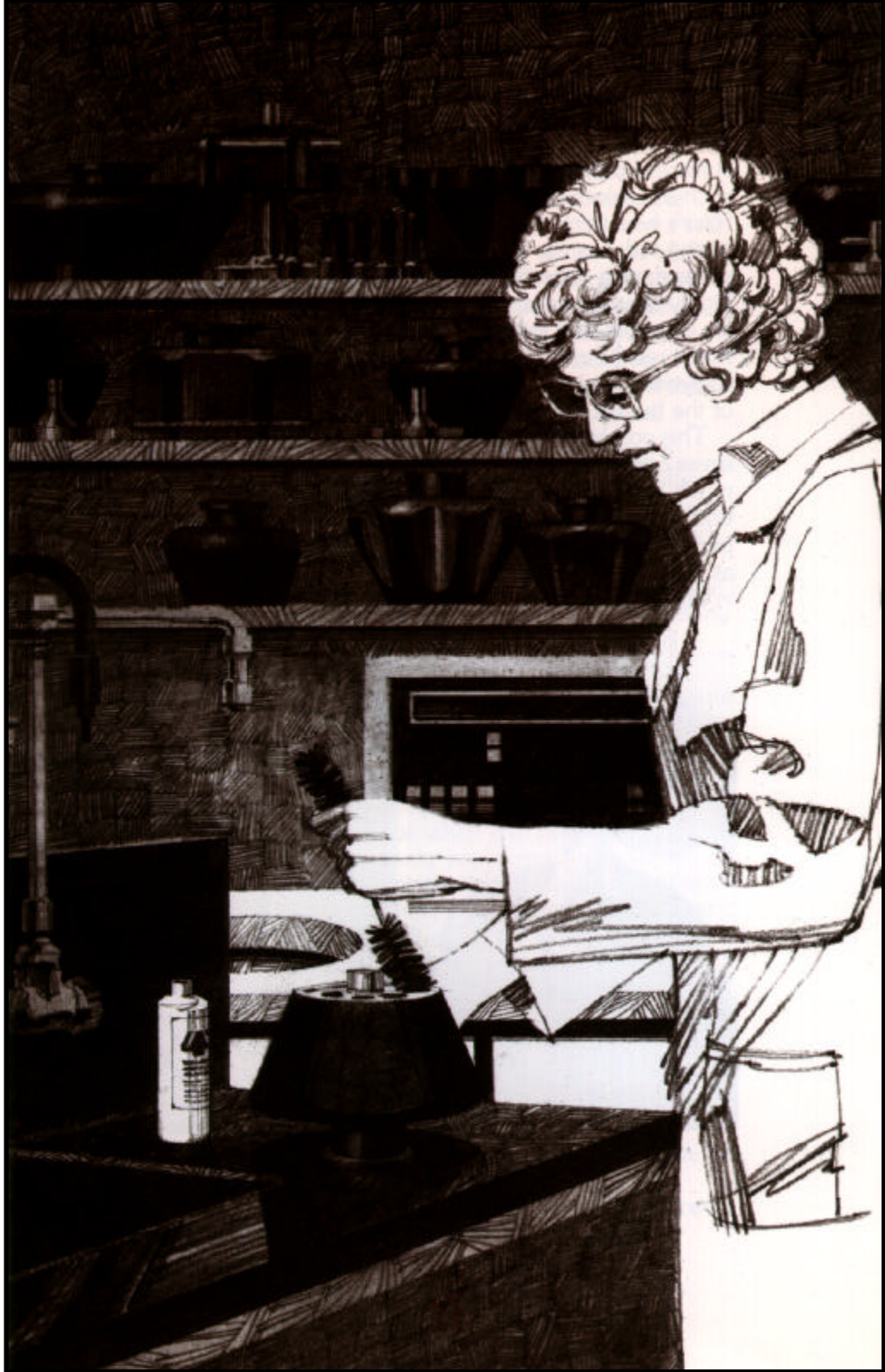


Figure 3. Corroded Aluminum Rotor. **A.** Corrosion at bottom of the tube cavities may be visible when illuminated by penlight. **B.** Aluminum rotor cut away to show pitting at the bottom of tube cavities



## Proper Use and Maintenance

All rotors are designed to carry a maximum load at a specific maximum speed. Since even one run made under conditions of excessive stress may significantly reduce the fatigue life of a rotor, it is important to abide by the operational specifications published in each rotor manual. Speed reductions required for running high-density solutions, plastic adapters, or stainless steel tubes should always be observed. Sample loads must be balanced and swinging bucket rotors must not be run with missing buckets, and sample loads should be balanced. For the rotors that utilize carbon-fiber composite cannisters, all cannisters must be used at all times, even if there is no bottle inside the cannister.

Each Beckman Coulter ultracentrifuge rotor carries an overspeed disk that prevents it from exceeding its maximum rated speed through operator error or instrument malfunction. But it is the user's responsibility to be sure that the *correct* disk is on the bottom of the rotor, that the disk is in good condition, or that a speed-derating disk is installed if and when the warranty conditions requires it. A well-kept rotor log is also essential for continued safe operation of an ultracentrifuge.

Rotors for the Beckman Coulter J6 and J2 series of centrifuges, on the other hand, are protected from dangerous single-cycle overspeed condition by windage or by the power limitations of the drive. The Avanti J series centrifuges have a rotor identification system, which uses windage/rotor inertia measurements or special magnets to automatically limit the maximum speed setting of the instrument. The centrifuge user should take care to prevent overspeeding by setting the proper run speed each time, because the fatigue life of the rotor will be reduced by this. Since these rotors are warranted for a specific time period, it is not necessary to log their usage. The

purchase date of each rotor should be recorded, however, and kept on permanent file. Note that the purchase date may be somewhat different from the manufacturing date shown in the rotor serial number. There is an expiration date permanently marked on some rotors and rotor accessories. The component must not be used beyond its expiration date under any circumstances.

Most rotors are fabricated from titanium or aluminum alloys, materials that have high strength-to-weight ratios. Titanium has another desirable characteristic: it is quite resistant to corrosion. Aluminum is less expensive, but far more susceptible to corrosion. If a rotor will be frequently used with corrosive salt solutions, such as cesium chloride or potassium bromide, a titanium rotor may be a better choice. Note that even if the rotor is made from a titanium alloy, other components, including lids, knobs, spacers, caps, and plugs may be made from aluminum alloys because of design considerations. These components are also susceptible to corrosion and should be cared for following the recommendations for aluminum rotors (see below).

All Beckman Coulter aluminum rotors are anodized with a thin coat of aluminum oxide that protects the underlying metal as long as this oxide layer remains unbroken. If it is scratched or otherwise damaged, however, corrosion will occur. Thus some precautions must be taken when cleaning these rotors after use.

First, rotor cavities and buckets must never be cleaned with an ordinary bottle brush with sharp wire ends. Any contact with these or other sharp instruments could easily damage the anodized layer, creating a site for stress corrosion to begin. Special plastic-coated brushes available from Beckman Coulter should be used instead.

Alkaline detergents or cleaning solutions, which may remove the anodized coating, must be avoided. (Most commercially available solutions designed for radioactive decontamination are *highly alkaline*.) A mild detergent\*,

such as Beckman 555, will not attack the anodized surface. If corrosive materials have been run or spilled on the rotor, wash it immediately. Particular care should be taken when aluminum swinging bucket rotors or aluminum fixed angle rotors have been used with uncapped tubes containing cesium chloride or other salts. Any salt crystals will corrode the metal unless carefully washed away. Only the buckets of a swinging bucket rotor should be washed. The body of the rotor should never be immersed; the hanger mechanisms are hard to dry and can rust. After the rotor has been cleaned and thoroughly rinsed with water, it should be air-dried with buckets or cavities upside down.

All fixed angle vertical tube and near-vertical tube rotors should be stored upside down, with the lids or plugs removed. Swinging bucket rotors should be stored with the bucket caps removed. Store all rotors in a dry environment, not in the centrifuge. Any moisture or other contamination present during storage is a potential source of corrosion.

There are manuals\* covering rotors and tubes for preparative ultracentrifuges, tabletop ultracentrifuges, and J2, J6 and Avanti J series centrifuges that every user should read as well as the instruction manual that accompanies each rotor. These publications cover operation, cleaning lubrication, and storage in more detail.

\*A list of suitable detergents is given in the Appendix A: Chemical Resistances in the following publications. This information is also available in *Chemical Resistances*, IN-175. This list of common laboratory chemicals and their effect on rotor and tube materials should always be consulted if the possible interaction is in doubt.

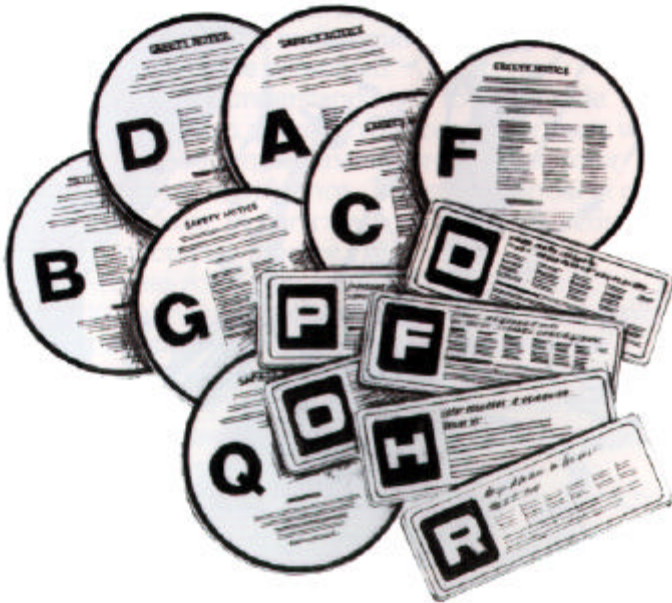
*Rotors and Tubes for Preparative Ultracentrifuges*,  
publication LR-IM

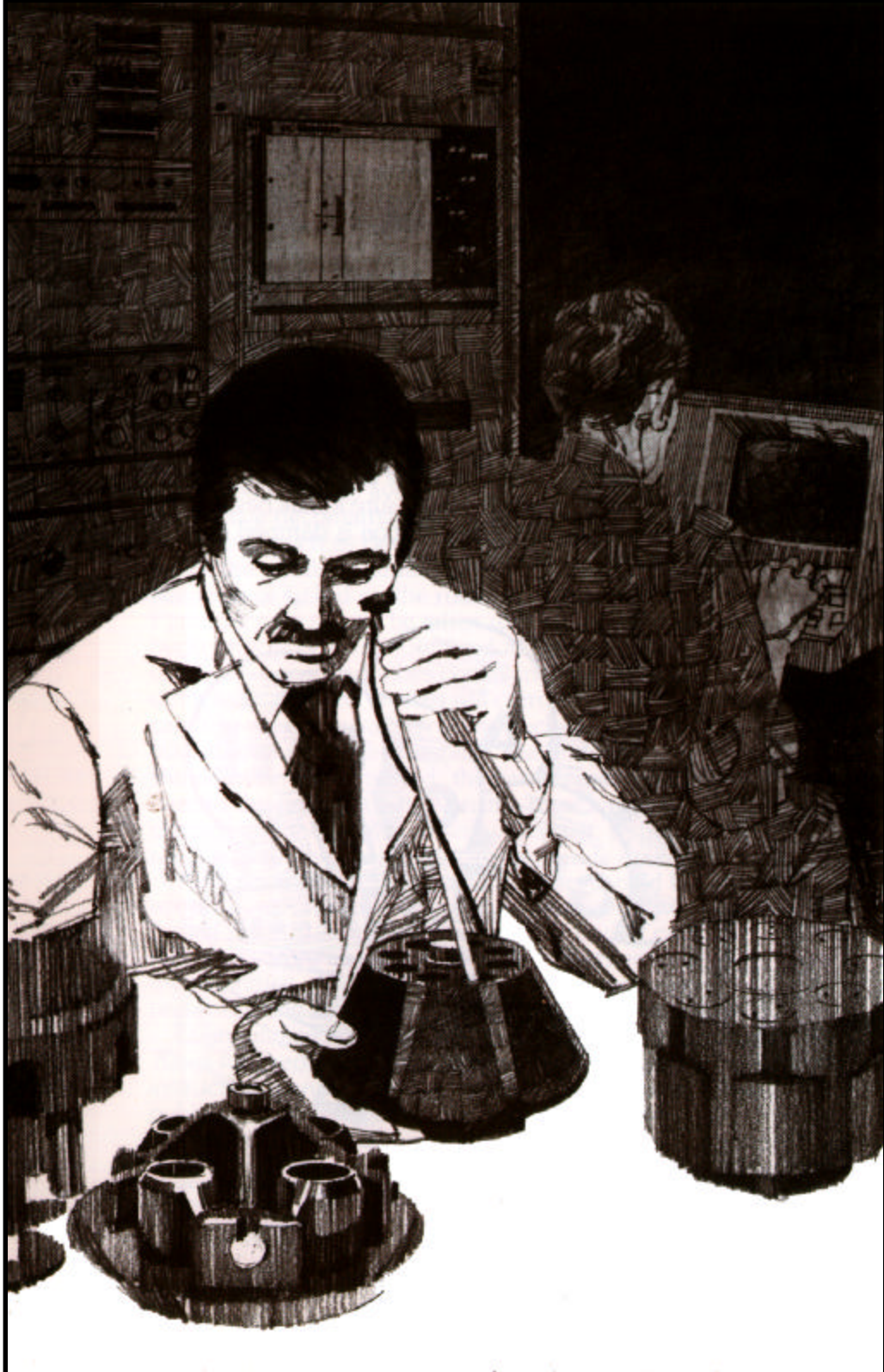
*Rotors and Tubes for Tabletop Preparative Ultracentrifuges*,  
publication TLR-IM

*Rotors and Tubes for J2, J6, and Avanti J Series Centrifuges*,  
publication JR-IM

# Ultracentrifuge Classification Program

All Beckman Coulter ultracentrifuges are classified according to the rotors that can be safely used in them. Rotor/ultracentrifuge compatibility is a function of the rotor chamber size, the type of overspeed protection, the kind of chamber door and barrier ring, and the updating, if any, the ultracentrifuge has received. Before running a rotor, check the classification decal on top of your instrument to be sure it matches that of the rotor selected. This classification is stamped on the lid or top of all Beckman Coulter rotors.





## **Field Rotor Inspection Program (FRIP)**

This program has two purposes: to prevent premature failures by detection of stress corrosion, metal fatigue, wear or damage to anodized coatings, and to instruct laboratory personnel in the proper care of rotors. The FRIP program is available to all owners of Beckman Coulter J, Avanti J, L, TL, ML and Optima series centrifuges. Contact your local Beckman Coulter Field Service Office for arrangements.

At your request, a specially trained Beckman Coulter representative will come to your lab and examine all your rotors. Using nondestructive methods (fiber-optics borescopy), they may find signs of corrosion or other damage. If so, they will recommend repair or replacement, and a potentially costly failure may be prevented.

A formal presentation is also given to provide information about maintenance procedures and rotor damage and its significance. The stress corrosion of aluminum rotors, in particular, can be greatly reduced by good laboratory practice.

Sometimes rotor corrosion is so bad it is easily visible to the naked eye (see Figure 3). At other times, it is less apparent. If you have doubt about the condition of a single Beckman Coulter rotor, you may return it to the factory in Palo Alto, California or in Galway, Ireland, where it will be inspected free of charge. Before shipping the rotor, you must contact the nearest Beckman Coulter office for specific instructions. A written statement must accompany each rotor, indicating that it is safe to handle (free of any pathogenic or radioactive contamination).

## Out-of-Warranty Rotors and Rotor Retirement

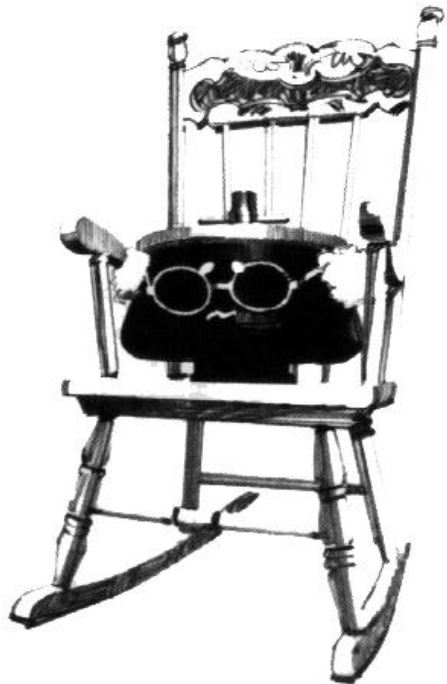
Every rotor, no matter how well designed or well cared for, will someday reach the point where it may fail during operation. Metal fatigue, invisible to the naked eye, will have taken its toll with every use. When the warranty period has expired, consideration should be given to the retirement of the rotor.

Beckman Coulter ultracentrifuges are designed to contain the physical destruction that results from the mechanical failure of a Beckman Coulter rotor. However, the risk of losing valuable samples and severely damaging the instruments makes the use of out-of-warranty rotors a costly gamble. Rotors used in Beckman Coulter J6, J2 and Avanti J series centrifuges have been designed and tested to insure a normal fatigue life that extends beyond the number of cycles that

could ever be run during the 7-year warranty cycle.

However, after many years of use, there will inevitably be some corrosion or stress corrosion. At some point, the combination of such damage and metal fatigue could make the rotor vulnerable to a failure.

Although a rotor may appear to be in good condition, once the warranty period has been reached you should consider retiring the rotor. In all cases we urge



you to follow the rotor retirement recommendations shown earlier in this document.

Some rotor components have a warranty period that is the same as their expiration date. Because these components are highly stressed there is a strong possibility that the component could fail with prolonged use. It is essential that the component is taken out of service and retired once the expiration date has been reached. Some of the components that have expiration dates include carbon-fiber cannisters, carriers and some labware. The expiration date or manufacturing date is usually engraved or molded into the component. Refer to the individual rotor bulletins for specific information on the expiration dates.

## **Special Warranty for Preparative Ultracentrifuge Rotors**

All Beckman 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

TL & ML 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 or an authorized Beckman 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.
- 3) This warranty covers the Beckman Centrifuge Systems only (including but not limited to the centrifuge, rotor, and accessories) and Beckman shall not be liable for damage to or loss of the user's sample, non-Beckman tubes, adapters, or other rotor contents.
- 4) This warranty is void if the Beckman Centrifuge System is determined by Beckman to have been operated or maintained in a manner contrary to the instructions in the operator's manual(s) for the Beckman 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 rotor in a centrifuge not of Beckman manufacture, or if the rotor is used in a Beckman centrifuge that has been modified without the written permission of Beckman, or is used with carriers, buckets, belts, or other devices not of Beckman manufacture.
- 7) Rotor parts subject to wear, including but not limited to rotor O-rings, VTi, NVT™, TLV, TLN, and MLN 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 rotor is determined by Beckman to be defective, Beckman 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 centrifuge is damaged due to a failure of a rotor covered by this warranty, Beckman 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), and (ii) if the centrifuge is currently covered by a Beckman warranty or Full Service Agreement, all labor necessary for repair of the centrifuge.
- 3) If a Beckman rotor covered by this warranty is damaged due to a malfunction of a Beckman ultracentrifuge covered by an Ultracentrifuge System Service Agreement, Beckman will repair or replace the rotor free of charge.
- 4) If a Beckman rotor covered by this warranty is damaged due to a failure of a Beckman tube, bottle, tube cap, spacer, or adapter, covered under the Conditions of this Warranty, Beckman 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 rotor or instrument due to the failure or malfunction of a non-Beckman tube, bottle, tube cap, spacer, or adapter is not covered under this warranty, although Beckman 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 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.

## **Special Warranty for Zonal, Continuous Flow, Component Test, and Rock Core Ultracentrifuge Rotors**

All Beckman Zonal, Continuous Flow, Component Test, and Rock Core ultracentrifuge rotors are warranted against defects in materials or workmanship for 2000 runs or 5 years (No Proration), whichever occurs first, subject to the Warranty Conditions stated below.

### **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 or an authorized Beckman 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.
- 3) This warranty covers the Beckman Centrifuge Systems only (including but not limited to the centrifuge, rotor, and accessories) and Beckman shall not be liable for damage to or loss of the user's sample, non-Beckman tubes, adapters, or other rotor contents.
- 4) This warranty is void if the Beckman Centrifuge System is determined by Beckman to have been operated or maintained in a manner contrary to the instructions in the operator's manual(s) for the Beckman 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) Rock Core Rotor bucket sets purchased concurrently with or subsequent to the purchase of a Rock Core Rotor are warranted only for a term co-extensive with that of the rotor body for which the bucket sets are purchased.
- 6) Rotor cores and liners purchased concurrently with or subsequent to the purchase of a Zonal or Continuous Flow Rotor are warranted only for a term co-extensive with that of the rotor for which the cores and liners are purchased.
- 7) This warranty does not cover the failure of a Beckman rotor in a centrifuge not of Beckman manufacture, or if the rotor is used in a Beckman centrifuge that has been modified without the written permission of Beckman, or is used with carriers, buckets, belts, or other devices not of Beckman manufacture.
- 8) Rotor parts subject to wear, including but not limited to rotor O-rings, rotor tube-cavity plugs and gaskets, caps, 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.
- 9) Use of a log book or other means of determining rotor usage is required.

### **Repair and Replacement Policies**

- 1) If a Beckman rotor is determined by Beckman to be defective, Beckman 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 centrifuge is damaged due to a failure of a rotor covered by this warranty, Beckman 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), and (ii) if the centrifuge is currently covered by a Beckman warranty or Full Service Agreement, all labor necessary for repair of the centrifuge.

- 3) If a Beckman rotor covered by this warranty is damaged due to a malfunction of a Beckman ultracentrifuge covered by an Ultracentrifuge Full Service Agreement with rotor coverage, Beckman will repair or replace the rotor free of charge.
- 4) If a Beckman rotor covered by this warranty is damaged due to a failure of a Beckman tube, bottle, tube cap, spacer, core, or adapter, covered under the Conditions of this Warranty, Beckman 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 rotor or instrument due to the failure, or malfunction of a non-Beckman tube, bottle, tube cap, spacer, or adapter, is not covered under this warranty, although Beckman 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 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 will provide free mechanical and metallurgical inspection in Palo Alto, California, USA, of any Beckman 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.

## Special J Series Rotor Warranty

Subject to the conditions specified below and the warranty clause of the Beckman Coulter terms and conditions of sale 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 J series 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.

### Replacement

Any product claimed to be defective must, if requested by Beckman Coulter, be returned to the factory, transportation charges prepaid, and will be returned to Buyer with the transportation charges collect unless the product is found to be defective, in which case Beckman Coulter will pay all transportation charges.

A defective rotor will be replaced by Beckman Coulter at its then current list price less a credit based upon the age of the rotor (years since date of purchase). The Buyer shall not receive credit until the claimed defective rotor is returned to Beckman Coulter's Centrifuge Development Center at Palo Alto, California, or delivered to a Beckman Coulter Field Service representative.

The replacement price (cost to Buyer) for the respective rotor shall be calculated as follows:

### Conditions

$$\text{Replacement price} = \text{Current rotor list price} \times \frac{\text{years}}{7}$$

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 con tents.
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 is operated in a Beckman centrifuge that has been improperly disassembled, repaired, or modified.

### Disclaimer

IT IS EXPRESSLY AGREED THAT THE ABOVE WARRANTY SHALL BE IN LIEU OF ALL WARRANTIES OF FITNESS AND OF THE WARRANTY OF MERCHANT-ABILITY AND THAT BECKMAN COULTER 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.

### **Special Allegra 6/GS-6/Spinchron Series Rotor Warranty**

Subject to the conditions specified below and the warranty clause of the Beckman terms and conditions in effect at the time of sale, Beckman 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 an Allegra 6/GS-6/SPINCHRON series centrifuge rotor to the original buyer by Beckman or by an authorized representative, provided that investigation and factory inspection by Beckman discloses that such defect developed under normal and proper use. Should a Beckman centrifuge be damaged due to a failure of a rotor covered by this warranty, Beckman will supply free of charge all centrifuge parts required for repair.

#### **Conditions**

1. Except as otherwise specifically provided herein, this warranty covers the rotor only and Beckman 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.
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 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 centrifuge that has been improperly disassembled, repaired, or modified.
4. Rotor bucket sets purchased concurrently with or subsequent to the purchase of a horizontal rotor are warranted only for a term coextensive with that of the rotor for which the bucket sets are purchased.

#### **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 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.

## **Allegra 21 Series, Allegra 64, Avanti 30, GS-15 Series, and Spinchron 15 Series Rotor Warranty**

Subject to the conditions specified below and the warranty clause of the Beckman terms and conditions in effect at the time of sale, Beckman agrees to correct either by repair, or, at its election, by replacement, any defects of material or workmanship which develop within one (1) year after delivery of an Allegra 21 series, Allegra 64, Avanti 30, GS-15 series, or Spinchron 15 series centrifuge rotor to the original buyer by Beckman or by an authorized representative, provided that investigation and factory inspection by Beckman discloses that such defect developed under normal and proper use. Should a Beckman centrifuge be damaged due to a failure of a rotor covered by this warranty, Beckman will supply free of charge all centrifuge parts required for repair.

### **Conditions**

1. Except as otherwise specifically provided herein, this warranty covers the rotor only and Beckman 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.
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 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 is operated in a Beckman centrifuge that has been improperly disassembled, repaired or modified.
4. Rotor bucket sets purchased concurrently with or subsequent to the purchase of a horizontal rotor are warranted only for a term coextensive with that of the rotor for which the bucket sets are purchased.

### **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 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.

## **Microfuge Series Rotor Warranty**

Subject to the conditions specified below and the warranty clause of the Beckman terms and conditions in effect at the time of sale, Beckman agrees to correct either by repair or, at its election, by replacement, any defects of material or workmanship which develop within one (1) year after delivery of a Microfuge ® series centrifuge rotor to the original buyer by Beckman or by an authorized representative, provided that investigation and factory inspection by Beckman discloses that such defect developed under normal and proper use. Should a Beckman centrifuge be damaged due to a failure of a rotor covered by this warranty, Beckman will supply free of charge all centrifuge parts required for repair.

### **CONDITIONS**

1. Except as otherwise specifically provided herein, this warranty covers the rotor only and Beckman 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.
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 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 centrifuge that has been improperly disassembled, repaired, or modified.
4. Rotor bucket sets purchased concurrently with or subsequent to the purchase of a horizontal rotor are warranted only for a term coextensive with that of the rotor for which the bucket sets are purchased.

### **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 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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## **DS-625-C**