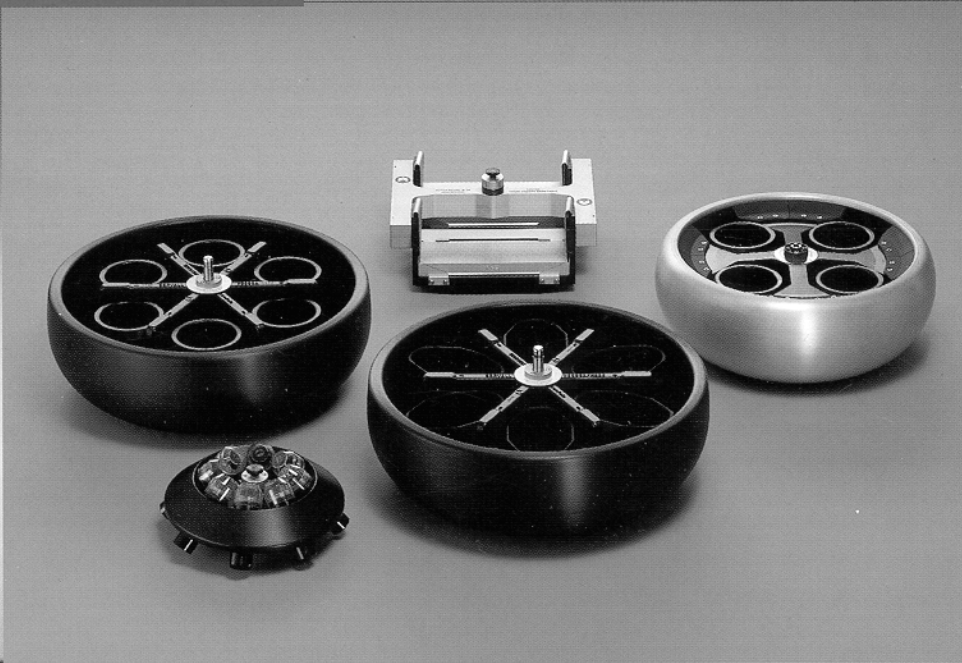
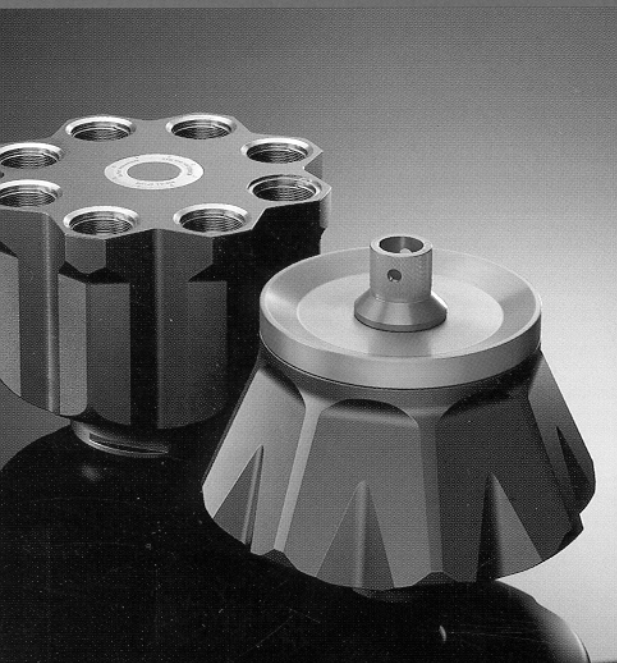


SORVALL® Rotor Care Guide

SORVALL®
Expect more than performance.



SORVALL® rotors meet the high standards we set for all products. The precision-engineered design of each rotor, the laboratory-tested operating procedures that accompany it and the worldwide network of technical support, customer service and field service personnel ensure the safe and productive operation of your **SORVALL®** centrifuge. Good maintenance, however, plays a major role in protecting your rotor and extending its life. This guide is designed to assist you in a program of regular rotor care and inspection... the best way to protect your rotor investment!

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ROUTINE EVALUATION AND CARE OF YOUR ROTOR

EVALUATION

Rotors are frequently damaged in use. In order to determine if they can be repaired, consideration is given to the location and extent of the damage, age of the rotor and overall general rotor condition. A differentiation should be made between light scratches and gouges. A light scratch will not affect safe operation of the rotor as long as:

- there is no corrosion around the scratch site
- the base metal has not been removed or gouged
- the scratch is in a low stress area
- there are no exposed fibers on carbon fiber rotors.

Inspect the rotor visually every time you use it and schedule a thorough inspection by a trained Field Service Engineer as part of your annual preventive instrument maintenance program. A Field Service Engineer can inspect the rotor to determine if corrosion has initiated a crack in the rotor body. Any indication of a crack is cause for immediate rotor replacement. If the rotor is damaged in a low stress area, the chances for an effective repair are better.

A thorough inspection by a trained SORVALL Field Service Engineer will determine if your rotor:

- is safe for continued operation
- can be repaired
- should be sent to SORVALL for a more extensive evaluation
- should be replaced immediately.

HANDLING

Improper installation may cause a rotor failure. Be extremely careful when handling parts of the rotor. Make sure that you lock lowspeed, superspeed, and **SUPRASpeed®** rotors to the spindle, if applicable, and that buckets are properly seated on their pins. Always use the tightening tool on ultraspeed locking knobs and body caps. The proper rotor extractor tool should be used to remove a rotor that can not be removed from the drive. (See extractor tool table, page 13.) If the rotor is dropped or struck against a hard surface, it can be permanently damaged. Avoid putting anything inside the rotor that could scratch or nick the surface.

STRESS

Ultraspeed rotors experience the highest level of stress of all rotors. If an ultraspeed rotor is run above its rated speed, it probably has exceeded its yield point. In this event, the metal is permanently stressed and rotor life is severely compromised. Lowspeed, Superspeed, and **SUPRASpeed** rotors

experience a much lower level of stress than ultraspeed rotors. Consequently, when properly maintained they have a longer life. But these lower speed rotors can also reach a point where the number of runs and the speed of those runs have fatigued them. This point varies from rotor to rotor. With heavy use it normally takes a number of years to reach. But don't be fooled — corrosion, improper handling and misuse will often require that you retire your rotor long before normal fatigue becomes a problem.

MISSING PAINT/ANODIZING

Missing paint will not affect the life of a titanium rotor or carbon fiber rotor. However, if there is missing anodize, the rotor should be reanodized at the factory. If corrosion is evident on an aluminum rotor, the rotor should be inspected by a SORVALL Field Service Engineer for evaluation. (Due to the construction of aluminum swinging bucket rotors, it is not possible to repair missing anodizing.)

DROPPED ROTORS

Deformation caused by dropping the rotor cannot be repaired. The rotor should be replaced.

OVERHEATED ROTORS

An aluminum ultraspeed rotor or rotor component that has been heated above 100° C should be replaced.

Lowspeed, superspeed and **SUPRASpeed®** aluminum rotors, and carbon fiber rotors can be autoclaved to 121° C. Indications of an overheated rotor are melted bottles, other melted plastic or a rotor that is too hot to touch. Short runs (less than 10 minutes) are not likely to cause overheating. Titanium rotors can withstand much higher temperatures and are not likely to be damaged by heat generated in the centrifuge. Stainless steel rotors can withstand high temperatures and are not likely to be damaged by heat generated in the centrifuge.

OVERSPEED CRITERIA

It is necessary to operate the rotor within the stated guidelines for speed. If an ultraspeed rotor exceeds its maximum rated speed by more than 6%, the rotor must be removed from service immediately.

Proper Maintenance

CORROSION

Corrosion, pitting and even minor surface imperfections all affect the life of the rotor. Any surface damage increases stress locally and makes it difficult to predict at what point the rotor material could fail.

Figure 1 shows a SORVALL® HS-4 rotor that appears to be clean and well-maintained. However, an enlargement of the tube cavity of this rotor, shown in **Figure 2**, clearly illustrates heavy corrosion, which resulted in premature rotor failure.

The tube cavity is especially susceptible to corrosion. Corrosion in this area reduces the thickness of the metal at the bottom of the cavity and produces an uneven or irregular surface creating locally high stresses, increasing the potential for rotor failure. Check the cone for cracks and corrosion.

Figure 3 graphically charts the stress distribution in a typical fixed angle rotor section. Stress distribution is an important consideration when trying to evaluate the extent of damage in the rotor.

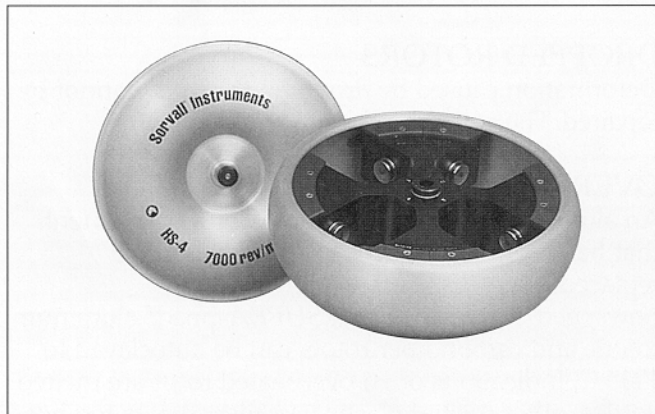


FIGURE 1 – SORVALL HS-4 rotor.

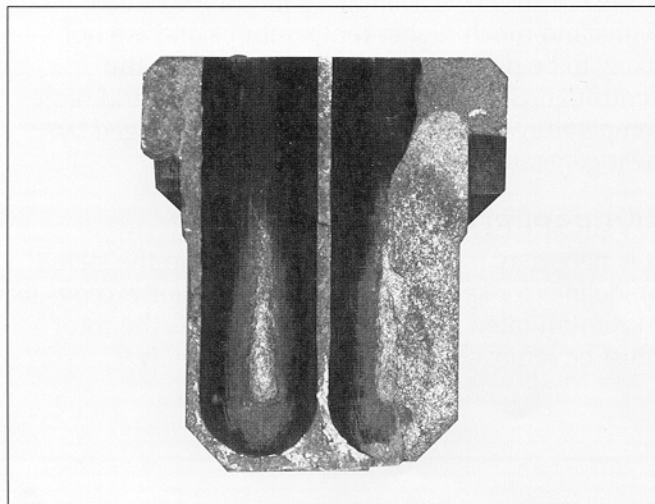


FIGURE 2 – Enlargement of an HS-4 tube cavity showing heavy corrosion.

SURFACE CORROSION is an ordinary chemical attack on the material of the rotor. Highly visible results of chemical reactions on the rotor surface are oxidation, rusting, discoloration or pitting. The most common chemical causing harmful effects is chloride, whether it is in the form of ammonium salts or as subtle a form as hand perspiration.

STRESS CORROSION is not always visible. It can result when chemical attack causes cracks and pitting. This chemical attack propagates inward, accelerated by the stress the rotor experiences during centrifugation. If stress corrosion is not detected, it will weaken the rotor or bucket without warning, and it can result in catastrophic rotor failure.

Although all SORVALL® centrifuges are designed to withstand and contain the force of a rotor failure, such accidents are costly in terms of the time lost repairing or replacing the rotor, damage to the centrifuge, and the loss of valuable samples and data. Carbon fiber rotors do not exhibit stress corrosion but some chemicals may weaken the rotor.

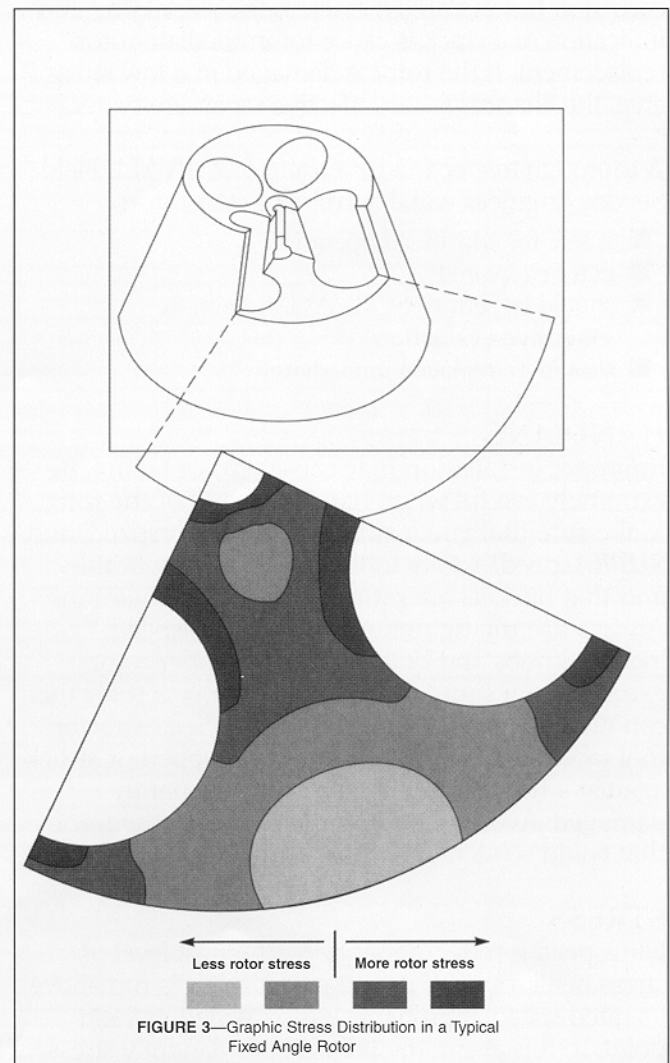


FIGURE 3—Graphic Stress Distribution in a Typical Fixed Angle Rotor.

CLEANING

Corrosion can be avoided by following a routine maintenance program after each rotor use, thereby prolonging the rotor's useful life. Clean your rotors, lids, adapters and any associated parts with a 1% solution of a mild non-alkaline detergent such as dishwashing liquid, rinse with distilled water and dry thoroughly with a soft cloth. Do not use strong alkaline laboratory detergent on aluminum rotors. If encrusted material is present, remove it with a soft, twisted-bristle brush, using the 1% non-alkaline soap solution. For lowspeed and superspeed swinging bucket rotors, keep the bucket trunnion pins clean and lubricated. SORVALL provides a Rotor Cleaning Kit, Catalog No. 12259 for lowspeed rotors and Catalog No. 92362 for superspeed and ultraspeed rotors. As part of a weekly maintenance schedule, lubricate o-rings with vacuum grease and metal rotor threads with anti-galling grease.

NOTE: Refer to *Chemical Compatibility Charts in the SORVALL® Product Guide*.

Although aluminum rotors are protected with an anodized coating, an additional coating of paste wax will prolong the life of the original coating. For best results, repeat this procedure at least once a month, or more often if your procedures involve organic materials that can remove the coating.

Also, any moisture left on the rotor can initiate corrosion, so remember to store your dried rotors upside down to avoid gathering condensation in the cavity or bucket bottom.

DECONTAMINATION

Given the nature of samples processed in a rotor, either biological or radioactive contamination is possible. For biological contamination of rotors, a 2% glutaraldehyde solution, ethylene oxide, or ultraviolet radiation are the recommended methods of sterilization. Do not use chlorine bleach on aluminum rotors. When autoclaving, rotor components should be separated. Autoclaving is not recommended for SORVALL® Ultraspeed aluminum rotors. If sterilization is not necessary, a 70% solution of ethanol can be used. Most commercially available radioactivity decontaminants are not compatible with aluminum or anodized coatings. Therefore, they must not be used. For a rotor that may be contaminated by a radioactive sample, use a solution of equal parts of 70% ethanol, 10% SDS, and water. Follow with ethanol rinses, and water rinses, then dry with a soft cloth. Do not immerse SUPER-LITE® rotors. Spin rotor to remove liquid.

SUPER-LITE® composite rotors are not compatible with ethylene oxide. See rotor instruction manual for additional information.

SORVALL® centrifuge rotors are designed and engineered for safe and reliable operation. ALL SORVALL® centrifuges can withstand and contain the force of a rotor failure, and all are supported by a worldwide network of technical support, customer service, and field service personnel, who will help you keep your SORVALL® rotors in top operating condition.

These experts, as well as other SORVALL scientists, have developed a body of working knowledge unparalleled in the industry — knowledge that enables us to help you meet your research goals in several ways by:

- introducing timely new biotechnology research products tailored directly to your needs
- constantly working to improve existing products and services
- helping you obtain the solutions you need through strong applications support.

You have one-on-one access to this working knowledge through your SORVALL Field Service Engineer. You can rely on your Field Service Engineer to:

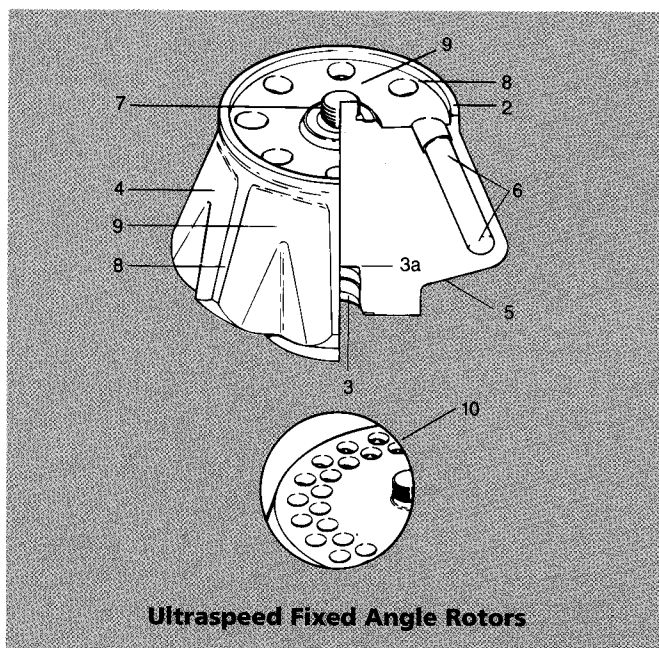
- respond quickly
- have extensive "hands-on" experience
- have the replacement parts you need
- make knowledgeable recommendations for troubleshooting, proper operation, and routine maintenance of your instrument.

ROTOR INSPECTION PROCEDURES

SORVALL offers a variety of instrument maintenance plans so you can choose the package tailored to your needs. The plans ensure you receive qualified instrument and rotor inspections at regular intervals, prompt repair service and the benefits of the latest engineering updates and retrofits. Rotor inspection can be scheduled outside of the maintenance agreements as well.

Illustrations in this section are generic views of fixed angle, vertical, swinging bucket, and zonal rotors. The drawings point out the primary considerations involved in properly evaluating each type of rotor. Parts of the rotor that are subject to corrosion or damage are indicated with numbered call-outs, along with an explanation of the relative severity of the problem. For example, large areas of corrosion in a high stress area, such as the tube cavity, indicate that the rotor should be replaced immediately. The primary purpose of this section is to help you protect your investment in rotors and safeguard against conditions that could lead to rotor failure.

Because samples processed in the rotor may cause either biological or radioactive contamination, SORVALL requires that the rotor be thoroughly cleaned and decontaminated, with Decontamination Certificate attached before it can be inspected or serviced by SORVALL personnel. Survey equipment will not detect any radioactivity. If decontamination is not required, note this on the certificate. Decontamination Certificates are found in the rotor instruction manual or you may contact a SORVALL representative.



SORVALL® FIXED ANGLE ROTORS

1. Lid Assembly (Not shown)

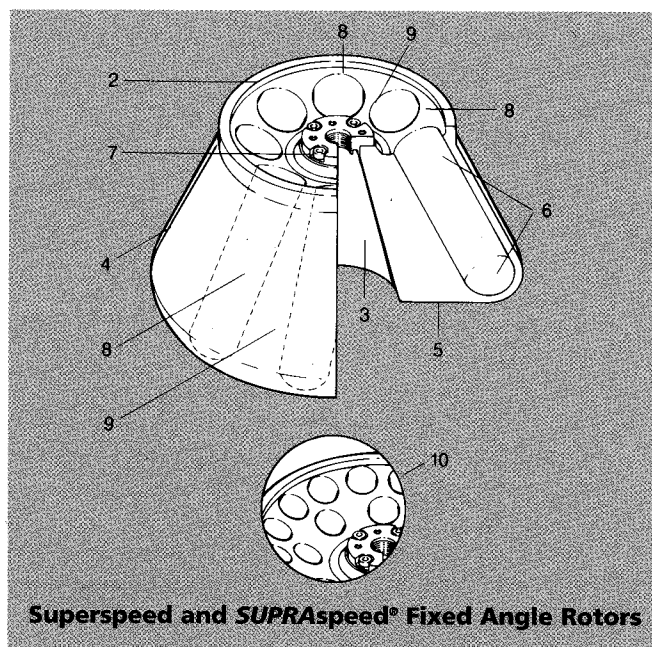
Damage to the lid assembly of these rotors can usually be repaired. Some parts can be replaced by your SORVALL Field Service Engineer. Refer to the Rotor Parts Service Manual (Catalog No. 25359) for a listing of parts that can be replaced. The lid may also be returned to for repair. lubricate lid assembly threads and o-rings weekly with anti-galling grease (Catalog No. 61556). Check lid for cracks.

2. Lid Sealing Area

If the damage occurred because the rotor was dropped, the rotor should be replaced. On an ultraspeed or bio-containment rotor, damage to the lid sealing area cannot usually be repaired. The rotor should be sent to SORVALL for evaluation. On a superspeed aluminum fixed angle rotor, minor damage to the lid sealing area can be repaired if sealing is not critical.

3. Cone Area

The cone area is a highly stressed area which must be inspected carefully for damage or cracks, particularly at area 3a. If there is any damage in this area on an ultraspeed rotor, the rotor should be replaced. On a superspeed rotor, if there is any damage in the area where the drive spindle contacts the rotor, the rotor should be replaced. Light scoring outside this area can be repaired, but spiral scoring cannot be repaired and the rotor should be replaced. If there is damage to the pins in the rotor adapter, the adapter can be



replaced by your SORVALL Field Service Engineer.

NOTE: the GSA and GS-3 rotors must be returned to SORVALL for adapter repair.

4. Rotor Body

Inspect carefully for scratches. Heavy gouges on the surface of an aluminum rotor indicate the rotor should be sent to SORVALL for inspection and evaluation and reanodizing. Light surface scratches should also be routinely inspected to ensure that corrosion has not begun. If scratches or gouges are found on a titanium rotor, note the location, and determine if they are in high, critical or low stress areas.

5. Bottom of Rotor

Stresses increase toward the center of the rotor. It may be possible to repair minor scratches toward the outside of the rotor; the proximity of the damage to the tube cavity is also a factor in whether or not the rotor can be repaired. The rotor should be returned for an evaluation.

6. Tube Cavity

On an aluminum rotor, if there is light speckling from corrosion in the bottom of the tube cavity, a trained Field Service Engineer should inspect the rotor. If no cracks are found, the rotor can be reanodized by SORVALL. Heavier corrosion cannot be repaired on an aluminum rotor and the rotor should be replaced. (Titanium rotors are not likely to corrode.) On both aluminum and titanium rotors, heavy scratches or scoring in the tube cavity indicates the rotor should be replaced. Cracked or de-laminated composite rotors must be returned to SORVALL for evaluation.

7. Thread Area or Adapter Area

Damage to the threads on an ultraspeed centrifuge rotor cannot be repaired. The rotor should be replaced. On superspeed aluminum fixed angle rotors, the area around the drive adapter is highly stressed. The adapter should be removed and the area inspected for corrosion. If any significant corrosion is found, the rotor should be replaced.

8. Critical Stress Area

Damage in this area cannot usually be repaired on an ultracentrifuge rotor. The rotor can be returned for an evaluation. For a superspeed aluminum fixed angle rotor, if there is any damage in this area and the rotor is over five years old, the rotor should be replaced. Damage on a newer rotor can be evaluated by SORVALL. Only very minor surface scratches can be repaired.

9. Low Stress Area

Minor damage in between the tube cavities can usually be repaired, because it occurs in a low stress area. The rotor should be returned for an evaluation and reanodization or painting.

10. Dual Row Rotors

Rotors with dual rows are highly stressed. Because of this, damage to these rotors cannot usually be repaired. The rotor may be returned for evaluation.

SORVALL® LOWSPEED FIXED ANGLE ROTORS

1. Lid Assembly

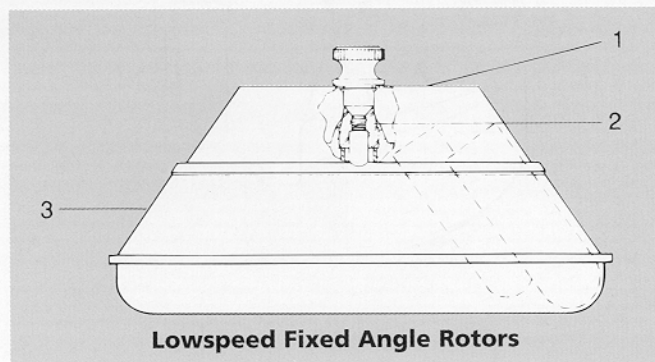
Damage to the lid assembly of these rotors can usually be repaired. Some parts can be replaced by your Field Service Engineer. Refer to the *Rotor Parts Service Manual* (Catalog No. 25359) for a listing of parts that can be replaced. The lid may also be sent to SORVALL for repair. Lubricate lid assembly threads weekly with anti-galling grease (Catalog No. 61556).

2. Drive Adapter

Damage to 5/8" adapters *can* be repaired. 3/4" (or square drive) adapters *cannot* be repaired, and should be sent to SORVALL for replacement.

3. Shell Damage

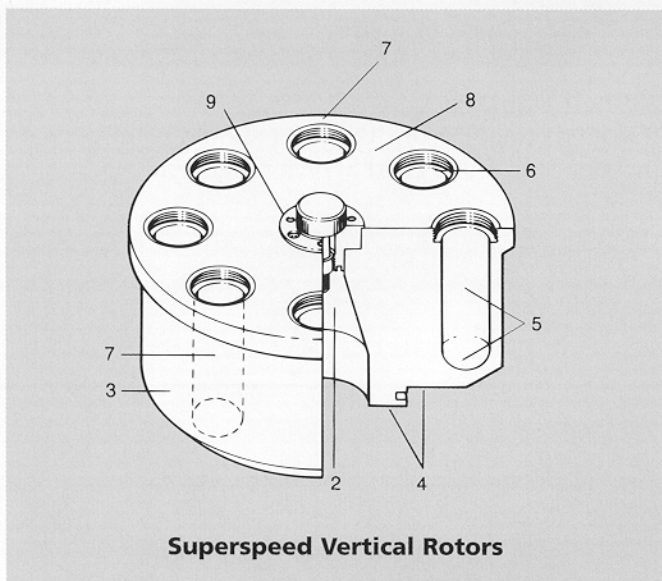
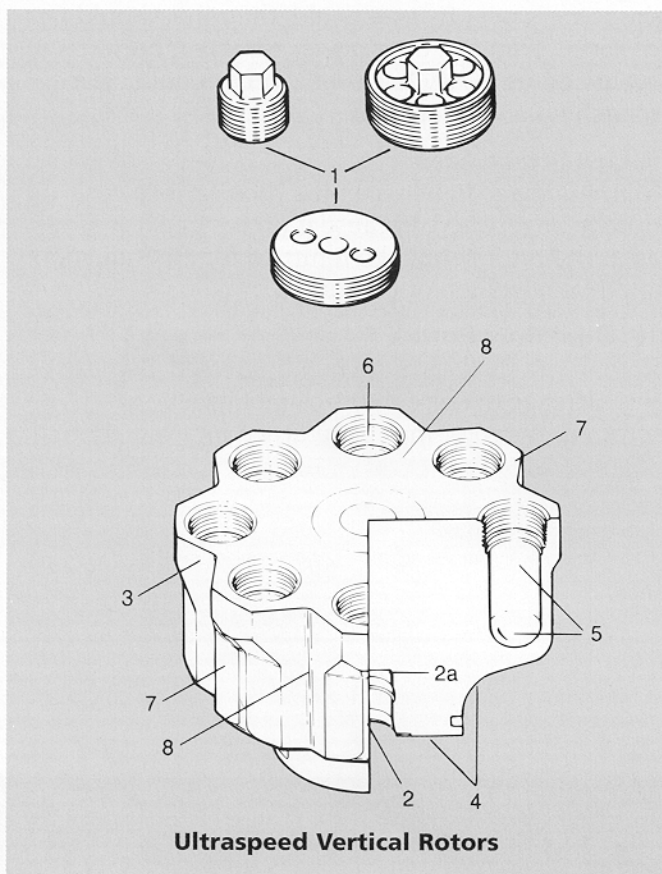
If shell damage occurs, the rotor should be inspected by your SORVALL Field Service Engineer.



SORVALL® VERTICAL ROTORS

1. Sealing Cap Assembly

Check the cap for thread wear. If all the anodize is worn off the threads, the cap must be replaced. Lubricate cap threads and o-rings (optional sealing assembly) with a light film of anti-galling grease (Catalog No. 61556) before each run. Check for cracks near hex.

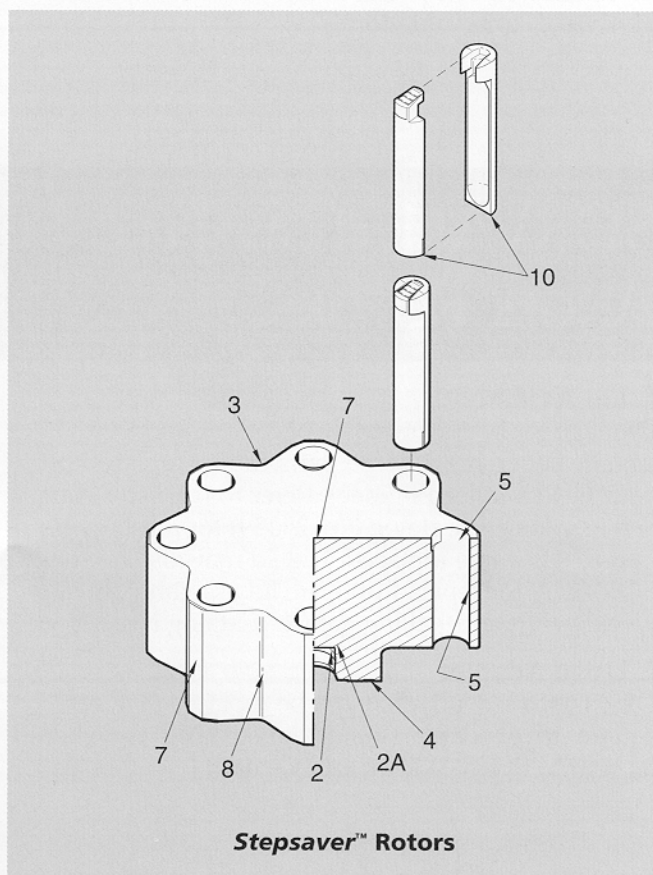


2. Cone Area

The cone area is a highly stressed area which must be inspected carefully for damage or cracks, particularly in area 2a. If there is any damage in this area on an ultraspeed rotor, the rotor should be replaced. On a superspeed rotor, if there is any damage in the area where the drive spindle contacts the rotor, the rotor should be replaced. Light spiral scoring outside this area can be repaired, but vertical or heavy spiral scoring cannot be repaired and the rotor should be replaced. If there is damage to the pins in the rotor adapter, the adapter can be replaced by your Field Service Engineer.

3. Rotor Body

Inspect carefully for scratches. Heavy gouges on the surface of an aluminum rotor indicate the rotor should be sent to SORVALL for inspection and evaluation and reanodizing. Light surface scratches should also be routinely inspected to ensure that corrosion has not begun. If scratches or gouges are found on a titanium rotor, note the location, and determine if they are in high, critical or low stress areas.



4. Bottom of Rotor

Stresses increase toward the center of the rotor. It may be possible to repair minor scratches toward the outside of the rotor; the proximity of the damage to the tube cavity is also a factor in whether or not the rotor can be repaired. The rotor should be sent to SORVALL for an evaluation.

5. Tube Cavity

On an aluminum rotor, if there is light speckling from corrosion in the bottom of the tube cavity, a trained Field Service Engineer should inspect the rotor. If no cracks are found, the rotor can be reanodized by SORVALL. Heavier corrosion cannot be repaired on an aluminum rotor, and the rotor should be replaced.

(Titanium rotors are not likely to corrode.) On both aluminum and titanium rotors, heavy scratches or scoring in the tube cavity indicates the rotor should be replaced.

6. Thread Area

Check for damaged threads. Thread damage cannot be repaired; the rotor should be replaced.

7. Critical Stress Area

If there is any damage in this area on a rotor over five years old, the rotor should be replaced. If there is damage in this area, the rotor should be returned for an evaluation and reanodizing. Only very minor surface scratches can be repaired.

8. Low Stress Area

Minor damage in between the tube cavities can usually be repaired because it occurs in a low stress area. The rotor should be returned for an evaluation and reanodization or painting.

9. Adapter Area

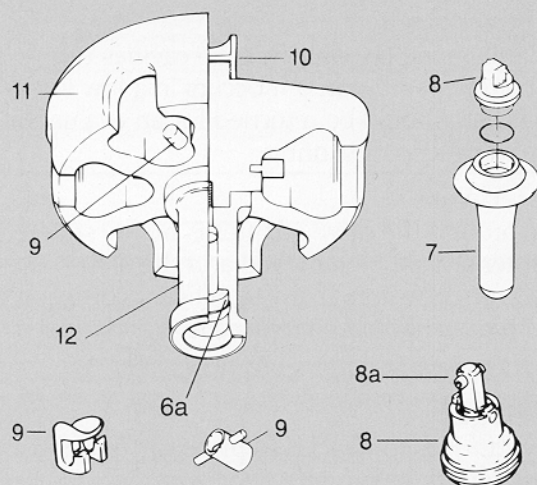
The area around the drive adapter is highly stressed. The adapter should be removed and the area inspected for corrosion. If any significant corrosion is found, the rotor should be replaced.

NOTE: This applies to superspeed rotors only.

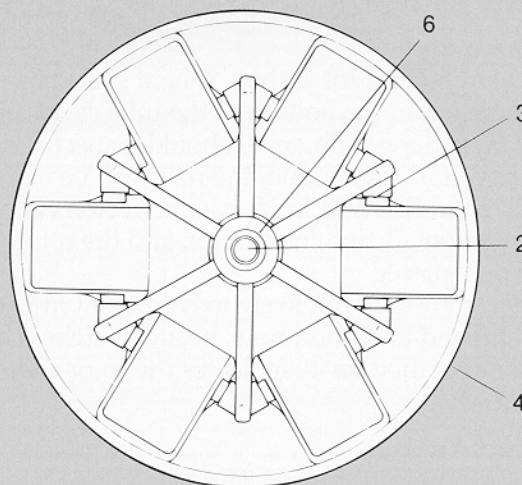
10. Cartridges

Inspect cartridges for cracks. Replace cartridges if any cracks are found.

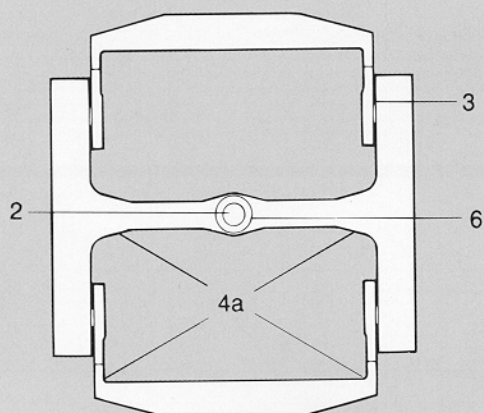
SORVALL® SWINGING BUCKET ROTORS



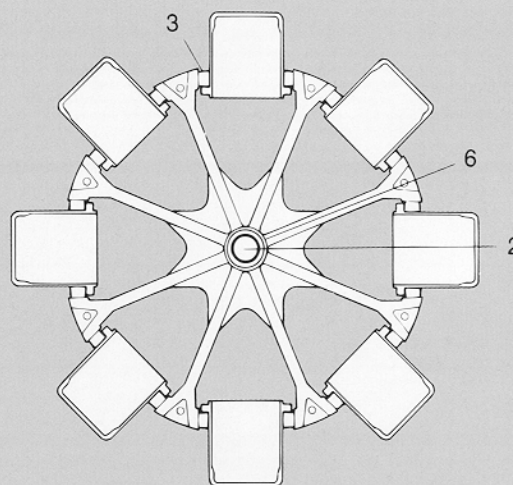
**Ultrspeed, MicroUltrspeed, *SUPRA*speed®
Swinging Bucket Rotors**



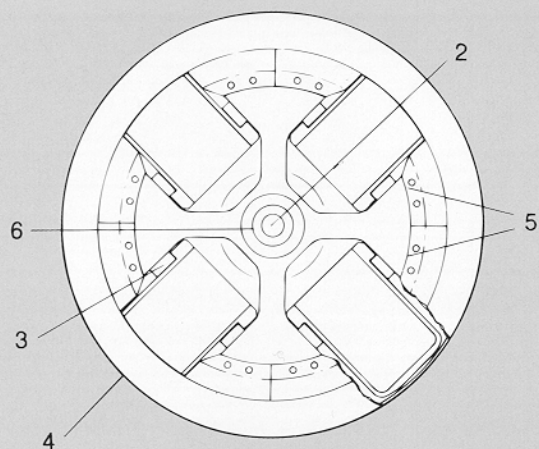
**Lowspeed Windshielded Swinging Bucket Rotors
without Yoke Extenders**



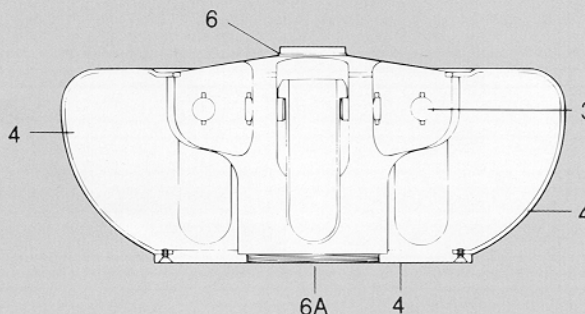
RIA Tube Rack Rotors



**Lowspeed and Superspeed Nonwindshielded
Swinging Bucket Rotors**



**Lowspeed and Superspeed Windshielded
Swinging Bucket Rotors with Yoke Extenders**



**Superspeed Windshielded Swinging
Bucket Rotors, Profile View**

1. Lid Assembly (Not shown)

Damage to the lid assembly of these rotors can usually be repaired. Some parts can be replaced by your Field Service Engineer. Refer to the *Rotor Parts Service Manual* (Catalog No. 25359) for a listing of parts that can be replaced. The lid can also be sent for repair. Inspect lid o-ring, bucket caps and covers for cracks where applicable and lubricate o-rings periodically with a light film of high vacuum grease (Catalog No. 65937 [white]). Lubricate lid assembly threads weekly with anti-galling grease (Catalog No. 61556 [brown]).

2. Rotor Locking Stud

Inspect carefully for damage to the threads or a bent shaft. Check for binding as the stud is tightened. Replacement parts are available.

NOTE: This piece is not used on all rotors.

3. Bucket Seats and Pins

Check lowspeed and superspeed rotor body and bucket seats for cracks. Replacement buckets and carriers are available for most rotors. Check for cracks in the pin area. Damage to the pins cannot be repaired.

NOTE: Use only black buckets in the H-6000A, HBB-6 and HBB-12 Rotors— Do not use silver buckets. When processing in only two positions in the H-4000 and HG-4L Rotors, always run with 4 buckets in place. Silver buckets for H-4000 and HG-4L rotors should be inspected by a Field Service Engineer.

4. Shell Damage

If Lowspeed or Superspeed shell damage is minor, baskets may still swing freely. However, this slightly damaged shell may cause vibration that will wear the drive and affect separations.

NOTE: Inspect the bottom plate of the HB-4 Rotor for cracks or corrosion. If there is any damage on the bottom plate, or corrosion on the inside area of the shell, the rotor should be returned for repair. HB-4 Rotors with split shells cannot be repaired due to age.

4a. Rotor Body

RIA Tube Rack Rotors only (HL-2, HL-2B) — check the marked areas carefully for cracks. Damage to

the carriers or the rotor body cannot be repaired. The rotor should be replaced.

5. Yoke Extenders

Examine this area carefully for corrosion. On the HG-4L Rotor, check to make sure that the single-screw yoke extenders have been replaced with the two-screw version. If not, the rotor should be updated. Return the rotor to for an evaluation. Do NOT attempt to remove the yoke extenders.

6. Adapter

Check for damage to the pins. Replace the adapter if the pins are damaged.

6a. Cone Area

The cone area is a highly stressed area which must be inspected carefully for damage or cracks, particularly at area 6a. If there is any damage in this area on an ultraspeed rotor, the rotor should be replaced. On a superspeed rotor, if there is any damage in the area where the drive spindle contacts the rotor, the rotor should be replaced. Light spiral scoring outside this area can be repaired, but vertical or heavy spiral scoring cannot be repaired and the rotor should be replaced. If there is damage to the pins in the rotor adapter, the adapter can be replaced by your SORVALL Field Service Engineer.

7. Ultraspeed and SUPRASpeed Rotor Buckets

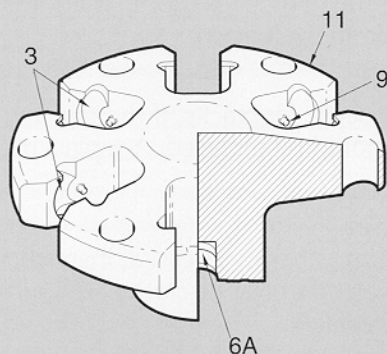
On ultraspeed and SUPRASpeed aluminum and titanium swinging bucket rotors, damage to a bucket cannot be repaired. The bucket must be replaced. It is necessary to return the entire set for rebalancing.

NOTE: TST 60.4 buckets are not replaceable.

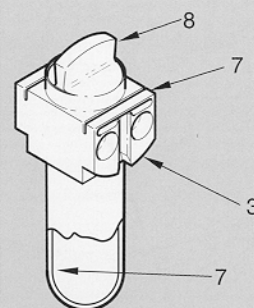
8. Ultraspeed and SUPRASpeed Rotor bucket Caps

On ultraspeed and SUPRASpeed aluminum and titanium swinging bucket rotors, damage to the bucket caps cannot be repaired. Caps must be replaced as a set. It is also necessary to return the entire set of buckets for balancing when ordering replacement caps.

NOTE: On the AH-650 rotor, bucket caps should be checked periodically for loose pins. (8a)



Surespin™ Ultraspeed Swinging Bucket Rotor



Surespin™ Rotor Bucket

9. Ultraspeed and SUPRAspeed® Rotor Bucket Hangers

On ultraspeed and SUPRAspeed aluminum and titanium swinging bucket rotors, if the bucket hangers are damaged, most can be replaced. Surespin™ bucket hangers can not be repaired or replaced. The rotor should be returned for evaluation and repair.

10. Ultraspeed and SUPRAspeed Rotor Knob

Minor damage to the knob is not critical. If the damage is severe, it should be evaluated by SORVALL.

11. Ultraspeed and SUPRAspeed Rotor body

On ultraspeed and SUPRAspeed aluminum and

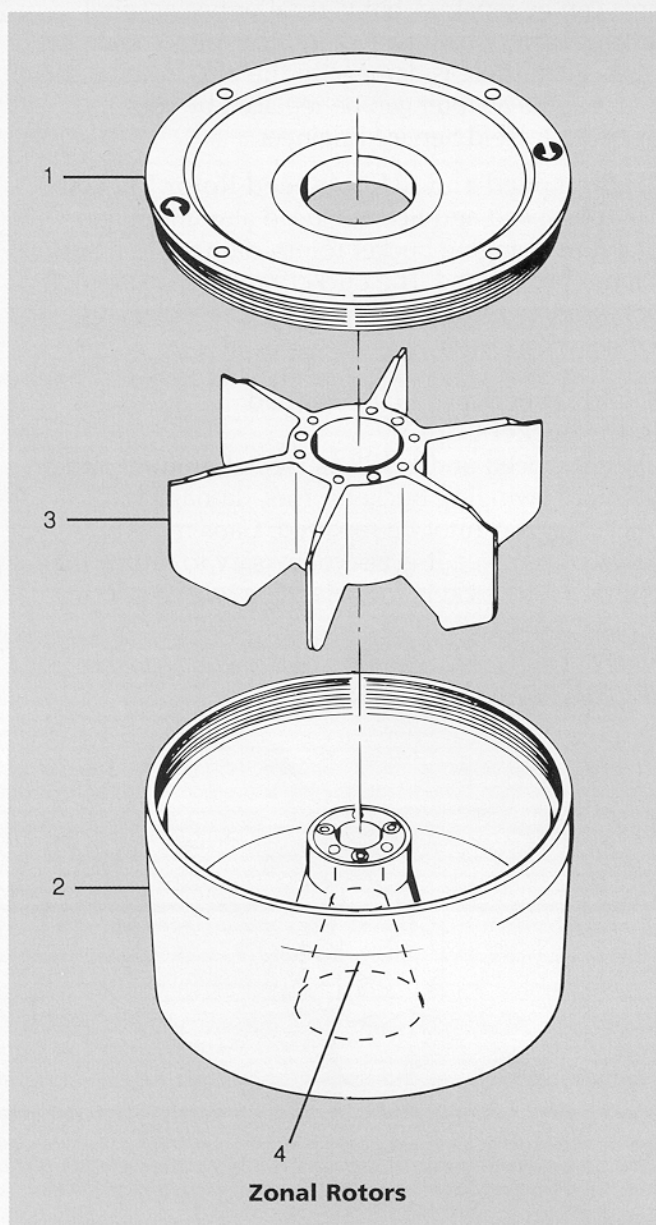
titanium swinging bucket rotors, the rotor body is highly stressed. any damage to it should be evaluated by SORVALL. In most cases, it is not possible to repair damage to the rotor body.

12. Ultraspeed and SUPRAspeed Pedestal

On ultraspeed and SUPRAspeed aluminum and titanium swinging bucket rotors, stresses in the pedestal are fairly low. Minor damage can be repaired. The rotor should be returned for an evaluation.

NOTE: An epoxy compound is found in the shell of the H-4000, HG-4L, H-6000A, HBB-6 and H-12000 rotors. This is required to balance the rotor. It should not be removed.

SORVALL® ZONAL ROTORS



1. Lid Assembly

Inspect the thread area carefully for damage. Damage cannot usually be repaired in this area. The rotor should be returned for an evaluation. Inspect lid o-ring for cracks and lubricate periodically with a light film of high vacuum grease (Catalog No. 65937). Lubricate lid assembly threads with anti-galling grease (Catalog No. 61556), before each use.

NOTE: The Rotor Cover for the SORVALL® TZ-28 must be fully engaged to ensure safe operation and a proper seal. Check the seating by examining the clearance between the rotor body and the rotor cover. To engage the cover, turn the rotor cover clockwise until it drops onto the threads; then turn it counterclockwise until hand tight. Tighten securely with the wrench handle assembly. When properly seated, clearance should be no more than .025 inches or .64 mm.

2. Rotor body

Inspect the thread area carefully for damage. Damage cannot usually be repaired in this area. Nicks or scratches on the o-ring sealing surfaces will affect sealing properties. Repair in this area is also unlikely. If any damage is found, the rotor should be returned for an evaluation.

3. Septa

Inspect the septa for cracks. If there is any damage, the septa should be replaced. A replacement part is available.

4. Cone Area

The cone area is highly stressed; inspect carefully for damage. If any damage or cracks are found, the rotor should be replaced.

ROTOR WARRANTIES

ULTRASPEED ROTORS

A. Warranty for SORVALL® ULTRASPEED Rotors

SORVALL® Swinging-Bucket and aluminum fixed-angle rotors are warranted to substantially conform with the published specifications for the Product on the date of order, for 1,000 runs to any speed up to the maximum indicated speed on the rotor body. The warranty is then extended to an additional 1,000 runs at any speed to a maximum of 90% of that indicated on the rotor body.

SORVALL vertical, zonal, and titanium fixed-angle rotors are warranted against defects in material and workmanship for 5,000 runs to any speed up to the maximum indicated speed on the rotor body.

CONDITIONS

1. This warranty is valid for five years from the date of shipment to the original buyer by SORVALL or an authorized SORVALL representative.
2. This warranty extends only to the original buyer from SORVALL or the original buyer from an authorized SORVALL representative and this warranty may not be assigned or extended to a third person without the written consent of SORVALL.
3. This warranty covers the rotor only and SORVALL 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.
4. This warranty is void if the rotor is (i) operated or maintained in a manner contrary to the instructions in the manual for the rotor or ULTRASPEED centrifuge in use, (ii) used in a SORVALL® ULTRASPEED centrifuge that has been modified without the written permission of SORVALL, or (iii) not maintained in accordance with any handling or operating instructions supplied by SORVALL, or which has been subjected to unusual physical or electrical stress, misuse, abuse, negligence or accidents.
5. Warranty is void unless rotor speed is properly reduced for certain fluid densities, gradients, tube assemblies, and adapters as described in the rotor operating instructions.
6. Should a SORVALL® ULTRASPEED centrifuge be damaged due to the failure of a rotor covered by this warranty, SORVALL will supply, free of charge, (i) all parts required for repair, and (ii) if the instrument is currently covered by a SORVALL warranty or service agreement, all labor necessary for repair of the ULTRASPEED centrifuge.
7. Rotor bucket sets purchased or obtained concurrently with, or subsequent to, the purchase or obtaining of a Swinging-Bucket rotor are warranted only for a period coincidental with that of the rotor for which the buckets are used.
8. Zonal rotor accessories purchased concurrently with, or subsequent to, the purchase of a zonal rotor are warranted only for a period coincidental with that of the rotor for which the accessories are to be used.
9. In the event of a rotor failure, it shall be determined to SORVALL's satisfaction that the cause of the failure did not result from negligence, misuse or abuse, or failure to follow the manufacturer's operating instructions.

CONDITIONS

1. A log book of rotor use must be adequately maintained in accordance with the requirements of the manufacturer and be available for inspection.
2. The rotor must be available for visual, X-ray or any other inspection deemed necessary by SORVALL at the time of the assumption of the warranty by SORVALL.
3. Satisfactory proof of existing warranty from original manufacturer for the Beckman or Kontron rotor to be warranted must be supplied to an authorized SORVALL representative.
4. The user must maintain a log book of rotor use in accordance with SORVALL's requirements.
5. SORVALL assumes no obligation under this warranty if repairs or modifications are made to the rotor without such repairs or modifications being brought to SORVALL's attention in writing and receipt acknowledged.
6. This warranty is void if the rotor is operated or maintained in a manner contrary to the instructions in the manual for the rotor or centrifuge in use.

7. This warranty covers the rotor only and SORVALL shall not be liable for the damage to accessories or ancillary supplies including but not limited to (i) tubes, (ii) tube caps, (iii) tube adapters, or (iv) tube contents.
8. The overspeed decal affixed to the rotor must be an approved type, free from excess wear, and changed to reflect any derating where appropriate.
9. SORVALL will impose any normal derating policy, as dictated by the manufacturer, and reserves the right to derate any rotor either temporarily or permanently as its experience dictates.
10. In the event of a rotor failure, it shall be determined to SORVALL's satisfaction that the cause of the failure did not result from negligence, misuse or abuse, or failure to follow the manufacturer's operating instructions.
11. If a Beckman or Kontron rotor under warranty fails, SORVALL will, at its option:
 - a. provide a comparable rotor manufactured by SORVALL, or
 - b. make a payment to the user on the basis of rotor replacement price computation established by the manufacturer.
12. Should a SORVALL® ULTRASPEED centrifuge be damaged due to the failure of a rotor covered by this warranty, SORVALL will supply free of charge, (i) all parts required for repair and (ii) if the instrument is currently covered by a SORVALL warranty or service agreement, all labor necessary for repair of the ULTRASPEED centrifuge.

THE WARRANTIES SET FORTH HEREIN ARE THE SOLE WARRANTIES, EXPRESS OR IMPLIED, GIVEN BY SORVALL IN CONNECTION WITH THE SORVALL® ULTRASPEED ROTOR AND SORVALL DISCLAIMS ALL OTHER WARRANTIES, INCLUDING WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, DESIGN, SUITABILITY FOR USE, INSTALLATION OR OPERATION, AND NONINFRINGEMENT OF THIRD PARTY RIGHTS. SORVALL SHALL IN NO EVENT BE LIABLE FOR ANY SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES WHATSOEVER, EVEN IF SORVALL HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES, AND THE OBLIGATIONS OF SORVALL SET FORTH HEREIN ARE THE SOLE OBLIGATIONS AND LIABILITIES OF SORVALL WITH RESPECT TO THE PRODUCT SUBJECT TO THIS WARRANTY. THE LIABILITY OF SORVALL HEREUNDER FOR ALL CLAIMS SHALL NOT EXCEED THE AMOUNT PAID BY BUYER TO SORVALL OR SORVALL'S AUTHORIZED REPRESENTATIVE FOR THE GOODS FOR WHICH THE LIABILITY IS CLAIMED. REPRESENTATIONS OR WARRANTIES MADE BY ANY PERSON, INCLUDING SORVALL'S DEALERS AND REPRESENTATIVES, WHICH ARE INCONSISTENT OR IN CONFLICT WITH THE WARRANTIES SET FORTH HEREIN SHALL NOT BE BINDING ON SORVALL UNLESS REDUCED TO A WRITING APPROVED BY AN EXPRESSLY AUTHORIZED OFFICER OF SORVALL.

MICRO-ULTRASPEED ROTORS

SORVALL® Micro-Ultracentrifuge Rotors are warranted, subject to the conditions specified below and in the warranty clause of the SORVALL terms and conditions of sale in effect at the time of sale, against defects in materials or workmanship for five (5) years at any speed up to the maximum speed of the rotor (properly reduced for certain fluid densities, fluid gradients, tube assemblies, and adapters as described in these operating instructions).

CONDITIONS

- a. This warranty is valid for five (5) years from the date of shipment to the original buyer by SORVALL or by any authorized SORVALL representative.
- b. This warranty extends only to the original buyer and may not be assigned or extended to a third person without written consent of SORVALL.
- c. This warranty covers the rotor only and SORVALL 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.
- d. This warranty is void if the rotor is (i) operated or maintained in a manner contrary to the instructions in the manual for the rotor or centrifuge in use, or (ii) used in a SORVALL® Micro-Ultracentrifuge that has been modified without the written permission of SORVALL.
- e. Should a SORVALL® Micro-Ultracentrifuge be damaged due to the failure of a rotor covered by this warranty, SORVALL will supply free of charge, (i) all centrifuge parts required for repair and (ii) if the centrifuge is currently covered by a SORVALL warranty or service agreement, all labor necessary for the repair of the centrifuge.

REPLACEMENT COST

- a. A defective rotor less than one (1) year old will be replaced free of charge.
- b. A defective rotor over one (1) year old will be replaced by SORVALL at its then current list price less a credit based on the age of the rotor.

The replacement price for the rotor shall be calculated as follows:

Replacement Cost = Current List Price X Age of Rotor (Years) / 5 Years

THE FOREGOING OBLIGATIONS ARE IN LIEU OF ALL OTHER OBLIGATIONS AND LIABILITIES INCLUDING NEGLIGENCE AND ALL WARRANTIES, OF MERCHANTABILITY OR OTHERWISE, EXPRESSED OR IMPLIED IN FACT OR BY LAW AND STATE OUR ENTIRE AND EXCLUSIVE LIABILITY AND BUYER'S EXCLUSIVE REMEDY FOR ANY CLAIM OR DAMAGES IN CONNECTION WITH THE SALE OR FURNISHING OF GOODS OR PARTS, THEIR DESIGN, SUITABILITY FOR USE, INSTALLATION OR OPERATION. SORVALL WILL IN NO EVENT BE LIABLE FOR ANY SPECIAL OR CONSEQUENTIAL DAMAGES WHATSOEVER, AND OUR LIABILITY UNDER NO CIRCUMSTANCES WILL EXCEED THE CONTRACT PRICE FOR THE GOODS FOR WHICH LIABILITY IS CLAIMED.

SUPRASPEED ROTORS

SORVALL® SUPRASPEED® Rotors are warranted to substantially conform with the published specifications for the Product on the date of order, against defects in workmanship for five (5) years at any speed up to the maximum speed of the rotor (properly reduced for certain fluid densities, fluid gradients, tube assemblies, and adapters).

CONDITIONS

- a. This warranty is valid for five (5) years from the date of shipment to the original buyer by SORVALL or an authorized SORVALL representative.
- b. This warranty extends only to the original buyer from SORVALL or the original buyer from an authorized SORVALL representative and this warranty may not be assigned or extended to a third person without the written consent of SORVALL.
- c. This warranty covers the rotor only and SORVALL 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.
- d. This warranty is void if the rotor is (i) operated or maintained in a manner contrary to the instructions in the manual for the rotor or centrifuge in use, (ii) used in a SORVALL® Centrifuge that has been modified without the written permission of SORVALL, or (iii) not maintained in accordance with any handling or operating instructions supplied by SORVALL, or which has been subjected to unusual physical or electrical stress, misuse, abuse, negligence or accidents.
- e. Should a SORVALL® Centrifuge be damaged due to the failure of a rotor covered by this warranty, SORVALL will supply, free of charge (i) all centrifuge parts required for repair and (ii) if the centrifuge is currently covered by a SORVALL warranty or service agreement, all labor necessary for repair of the centrifuge.

SUPERSPEED FLOORMODEL ROTORS

SORVALL® SUPERSPEED Floormodel Rotors are warranted to substantially conform with the published specifications for the Product on the date of order, against defects in materials or workmanship for seven (7) years at any speed up to the maximum speed of the rotor (properly reduced for certain fluid densities, fluid gradients, tube assemblies, and adapters).

CONDITIONS

- a. This warranty is valid for seven (7) years from the date of shipment to the original buyer by SORVALL or an authorized SORVALL Representative.
- b. This warranty extends only to the original buyer from SORVALL or the original buyer from an authorized SORVALL representative and this warranty may not be assigned or extended to a third person without the written consent of SORVALL.
- c. This warranty covers the rotor only and SORVALL 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.
- d. This warranty is void if the rotor is (i) operated or maintained in a manner contrary to the instructions in the manual for the rotor or centrifuge in use, (ii) used in a SORVALL® Centrifuge that has been modified without the written permission of SORVALL, or (iii) not maintained in accordance with any handling or operating instructions supplied by SORVALL, or which has been subjected to unusual physical or electrical

stress, misuse, abuse, negligence or accidents.

- e. Should a SORVALL® Centrifuge be damaged due to failure of a rotor covered by this warranty, SORVALL will supply, free of charge, (i) all centrifuge parts required for repair and (ii) if the centrifuge is currently covered by a SORVALL warranty or service agreement, all labor necessary for repair of the centrifuge.

SUPERSPEED TABLETOP ROTORS

SORVALL® SUPERSPEED Tabletop Rotors are warranted to substantially conform with the published specifications for the Product on the date of order, against defects in materials or workmanship for seven (7) years at any speed up to the maximum speed of the rotor (properly reduced for certain fluid densities, fluid gradients, tube assemblies, and adapters).

CONDITIONS

- a. This warranty is valid for seven (7) years from the date of shipment to the original buyer by SORVALL or an authorized SORVALL Representative.
- b. This warranty extends only to the original buyer from SORVALL or the original buyer from an authorized SORVALL representative and this warranty may not be assigned or extended to a third person without the written consent of SORVALL.
- c. This warranty covers the rotor only and SORVALL 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.
- d. This warranty is void if the rotor is (i) operated or maintained in a manner contrary to the instructions in the manual for the rotor or centrifuge in use, (ii) used in a SORVALL® Centrifuge that has been modified without the written permission of SORVALL, or (iii) not maintained in accordance with any handling or operating instructions supplied by SORVALL, or which has been subjected to unusual physical or electrical stress, misuse, abuse, negligence or accidents.
- e. Should a SORVALL® Centrifuge be damaged due to failure of a rotor covered by this warranty, SORVALL will supply, free of charge, (i) all centrifuge parts required for repair and (ii) if the centrifuge is currently covered by a SORVALL warranty or service agreement, all labor necessary for repair of the centrifuge.

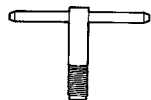
LOWSPEED FLOOR MODEL AND TABLETOP ROTORS

SORVALL® LOWSPEED and TABLETOP Rotors are warranted to substantially conform with the published specifications for the Product on the date of order, against defects in materials or workmanship for seven (7) years at any speed up to the maximum speed of the rotor (properly reduced for certain fluid densities, fluid gradients, tube assemblies, and adapters).

CONDITIONS

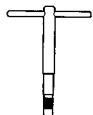
- a. This warranty is valid for seven (7) years from the date of shipment to the original buyer by any authorized SORVALL Representative.
- b. This warranty extends only to the original buyer from SORVALL or the original buyer from an authorized SORVALL representative and this warranty may not be assigned or extended to a third person without the written consent of SORVALL.
- c. This warranty covers the rotor only and SORVALL 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.
- d. This warranty is void if the rotor is (i) operated or maintained in a manner contrary to the instructions in the manual for the rotor or centrifuge in use, (ii) used in a SORVALL® Centrifuge that has been modified without the written permission of SORVALL, or (iii) not maintained in accordance with any handling or operating instructions supplied by SORVALL, or which has been subjected to unusual physical or electrical stress, misuse, abuse, negligence or accidents.
- e. Should a SORVALL® Centrifuge be damaged due to failure of a rotor covered by this warranty, SORVALL will supply, free of charge, (i) all centrifuge parts required for repair and (ii) if the centrifuge is currently covered by a SORVALL warranty or service agreement, all labor necessary for repair of the centrifuge.

ROTOR EXTRACTOR TOOLS



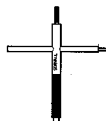
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F-28/50, F-28/36, F-28/13, SE-12, SA-300, SS-34,
SM-24, F-20/MICRO, SA-600, SH-MT, SH-80,
SH-3000, SV-288, SV-80, ST-H750, RTH-750,
RTH-250, TZ-28



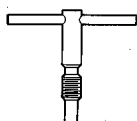
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F-16/250, GSA, SLA-1500, GS-3,
SLA-3000, HS-4



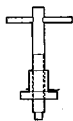
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HG-4L



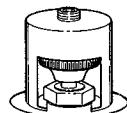
Catalog No. **09033**

HB-6, HB-4



Catalog No. **11445**

H-4000, H-6000A, HBB-6, HBB-12, HL2B,
H-2000B, H-12000



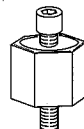
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S-20/17, S-20/20, S-20/36



Catalog No. **68078**

H-1000B



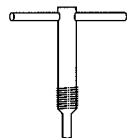
Catalog No. **12935**

F-12/M.18



Catalog No. **12989**

FA-MICRO



Catalog No. **76818**

SLA-600TC, SLA-1000, SL-50T, SLC-250T
SL-250T, ST-MICRO, ST-H50, SL-50RT, ST-H50

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SORVALL products meet or exceed the most stringent quality and product safety standards: CE for the European Union and UL, cUL or CSA standards for North America.

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