Care and Handling of Rotors

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Today's Objectives

- **Help you to use centrifuge systems safely**
- **Ensure maximum life of your investment**
- **Avoid unbudgeted lab expenses**
- **Maximize experiment integrity**

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Centrifugation around since 1948

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There is a wide variety of centrifugation systems

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Correct Rotor Use
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Correct Rotor Use depends on Several Factors

- ✓Use rotors only as part of approved systems
- ✓Properly balance loads
- ✓Understand sample density
- ✓Correct attachment of rotor lids and buckets
- ✓Proper use of tubes, adapters, accessories, and tools

Consult your Operators Manual

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Use rotors only with Approved Systems

- Instruments and rotors are tested as a System (IEC-10-10-2)
- Only approved Rotor-Instrument Systems are proven to be safe
- Using non-approved components can result in
  - Instrument or rotor damage
  - Unbudgeted expense
  - Personal injury

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The energy of an operating centrifuge is enormous . . .

- Situations such as this emphasize the importance of following centrifuge safety and rotor use and care procedures

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Correctly Balance Rotor Loads

At 1,000,000 x *g*,
1 gram weighs 1,000 kg

Which Equals . . .The Weight of a Mini Cooper

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For Ultracentrifuges...

- Balance opposing sample loads within 0.5 grams for fixed angle rotors
- Balance opposing sample loads within 0.2 grams for swinging bucket rotors

Consult your Operators Manual

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For High Performance and Benchtop Centrifuges…

- Balance specification is instrument / rotor dependent
- Some rotors offer imbalance correction
  - 50 to 100 grams!

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Maximum Sample Density for Rotors Is...

1.2 g/mL for most rotors

1.7 g/mL for VTi and NVT rotors

Consult your Operators Manual for information on precipitating gradients

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Any Guesses ??


How About This One ??

Proper Rotor Handling

- **SW Rotors**
  - Buckets: Inspect for proper attachment
  - Handling: Hold SW rotors correctly
  - Installation: Properly attach rotor to Spindle
- **Fixed Angle Rotors**
  - Lid: Tighten correctly
  - Installation: Properly attach rotor to Spindle

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Proper Handling of **SW rotors**

INCORRECT

- Improper handling can lead to
  - Mishooked buckets
  - Disturbed gradients

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Proper Handling of **SW** rotors

CORRECT

- Hold rotor with both hands

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Proper Handling of **SW** rotors

Inspect Buckets Prior to the Run

- Mis-hooked buckets are the leading cause of rotor mishaps in Ultracentrifuges

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Proper Handling of **SW** rotors

- Some rotors, such as the SW-32Ti, have simplified the bucket attachment process

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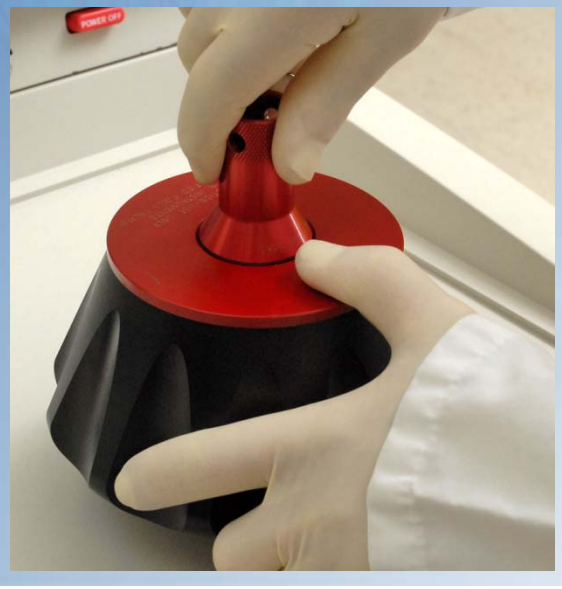

Lid Attachment:

Optima Series

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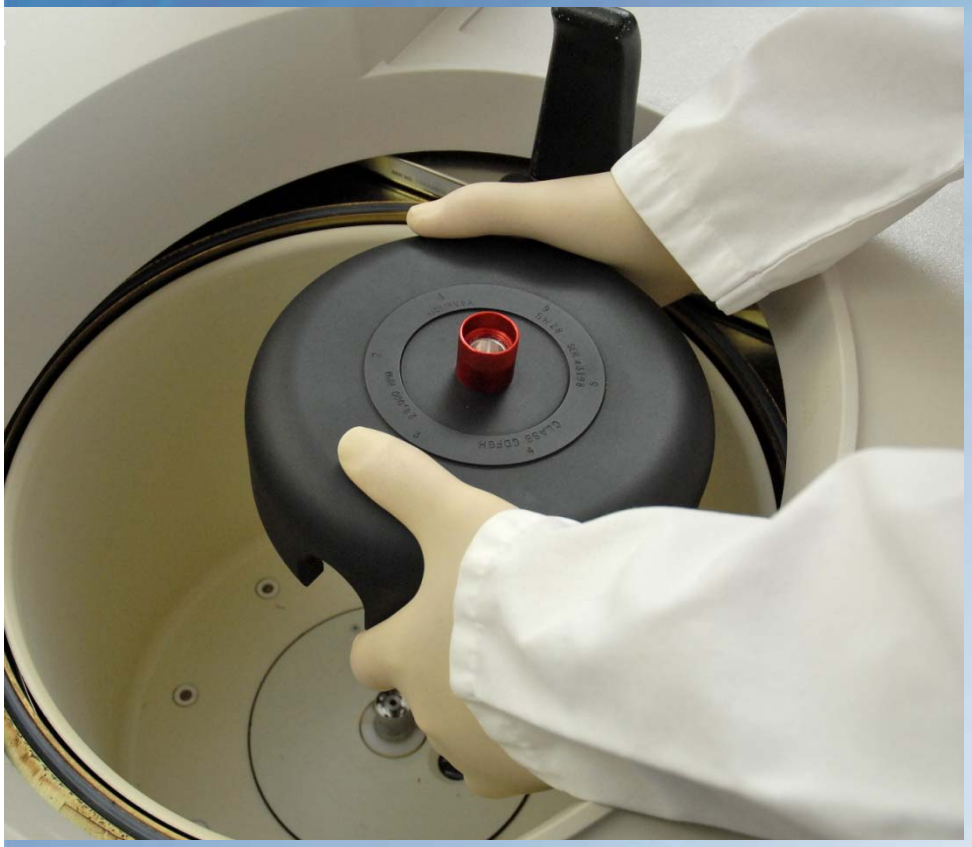

Rotor Attachment:

Optima Series

- Place the rotor straight down onto the spindle
- The rotor is self locking

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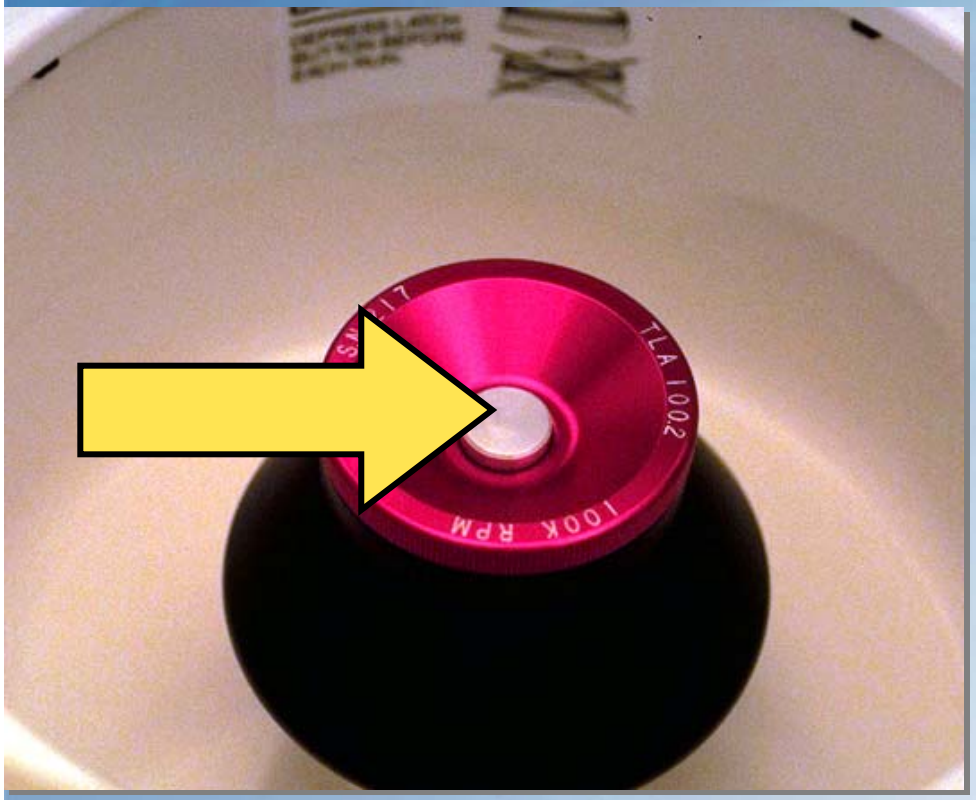

Rotor Attachment: **TL Series**

- For TL series rotors with buttons
- Place the rotor on the spindle

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Rotor Attachment: **TL Series**

- Push the button to lock the rotor onto the spindle

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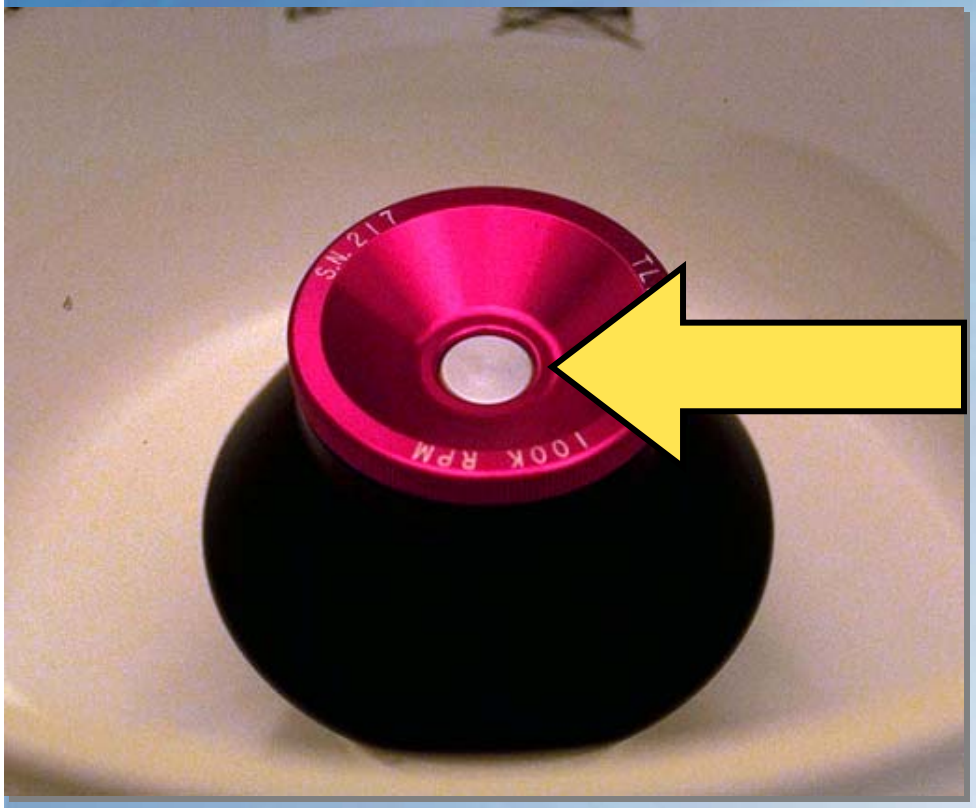

Rotor Attachment: **TL Series**

- Check to ensure proper attachment
- Rotors without locking buttons are self-locking

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Lid Attachment: Bio-safe Rotors

- For rotors with dual knobs:
- First, turn the lower knob clockwise to attach the lid to the rotor
- When the rotor is placed in the centrifuge, tighten the center knob clockwise

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Rotor Attachment:

- For rotors with single knobs:
- When the rotor is placed in the centrifuge, tighten the knob clockwise
- The single knob locks the rotor to the spindle and attaches the lid to the rotor

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Rotor Attachment:

- Turn the locking handle clockwise to attach the rotor to the centrifuge spindle

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Rotor Preparation: **Vertical Rotors**

- Consult the rotor manual for each vertical rotor for correct use of tools

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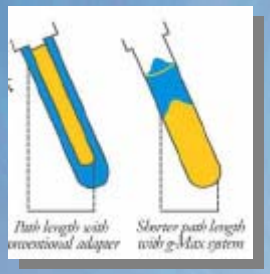
Tubes, Bottles and Adapters



- A vast selection of tubes, bottles, adapters and other accessories are available for use in your centrifuge
- Consult the rotor manual for correct use of tubes, bottles, and adapters
- *Improper labware use is a leading cause of rotor mishaps*

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Tubes, Bottles and Adapters

- Use only the tubes, bottles, and adapters listed in the rotor manual or Rotors and Tubes guides
- Third-party tubes and bottles may not handle the high *g*-forces of your centrifuges
- Be aware of proper filling levels and cap usage instructions

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Proper Use of Tools

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Proper Tools

- Consult your rotor manual for guidance on proper use of tools for rotors and tubes

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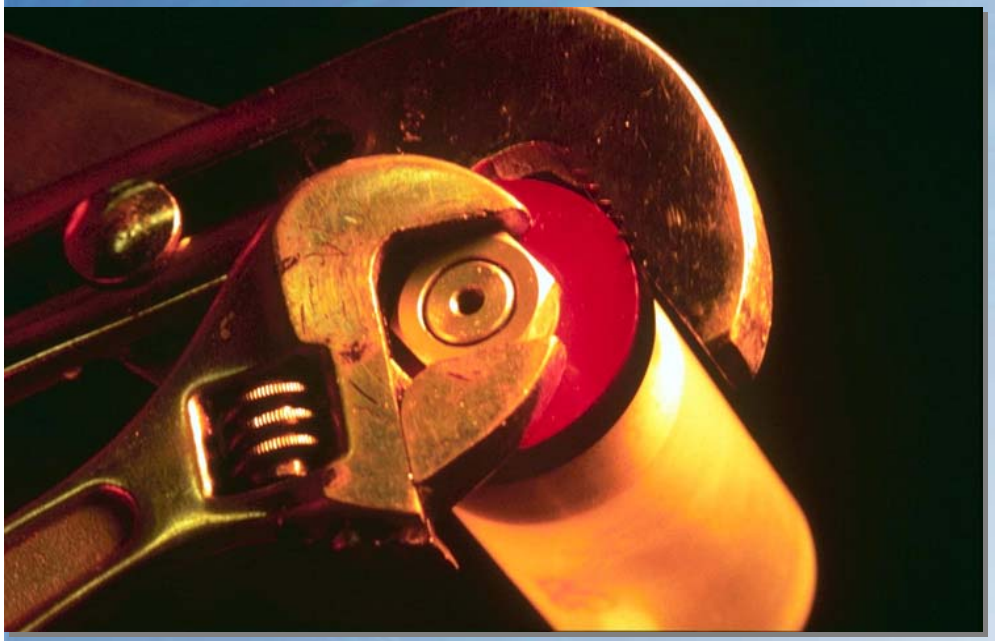
Improper Tools



- Improper tool use can damage parts and cause a safety hazard for centrifuge users

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Rotor Care and Maintenance

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Proper Cleaning Utensils

BCI Rotor Cleaning Kit

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Cleaning procedure

- Wash rotor frequently – at least weekly
- Remove O-rings before washing
- Use mild detergent, such as Solution 555, and soft brushes (both are available in the BCI Rotor Cleaning Kit)
- Thoroughly rinse with distilled water
- Air-dry upside down
- Re-lubricate O-rings with vacuum grease
- Re-lubricate metal threads with Spinkote

Consult your Operators Manual

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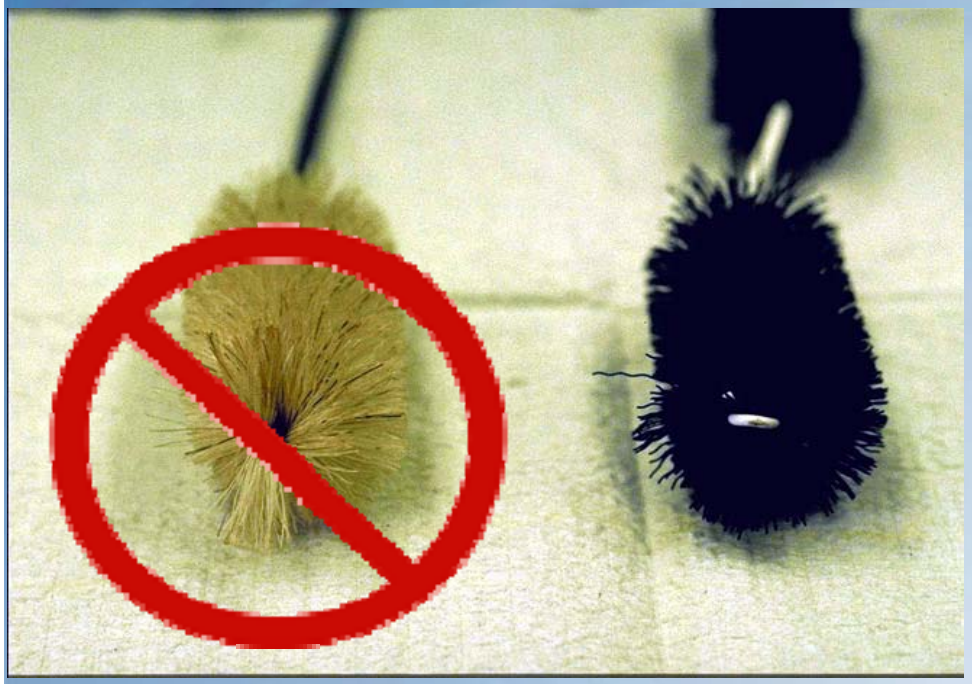
Proper Brushes



- Improper bushes can scratch and damage rotor tube cavities

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Inspect Periodically

- Inspect rotor body and tube cavities
  - Pitting, rough spots, cracks or damage
  - White deposits may indicate stress corrosion
  - Discoloration
- Lubricate rotor and components as indicated in rotor manual
- Inspect O-rings for cuts, abrasions, or flattened areas; replace if damaged
- Inspect and replace overspeed disk if damaged
- Contact Field Service if you have questions

Consult your Operators Manual

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Stress Corrosion

Over time, the combination of tensile load and environment creates stress corrosion, which significantly reduces the service life of the metal, specifically aluminum alloys.

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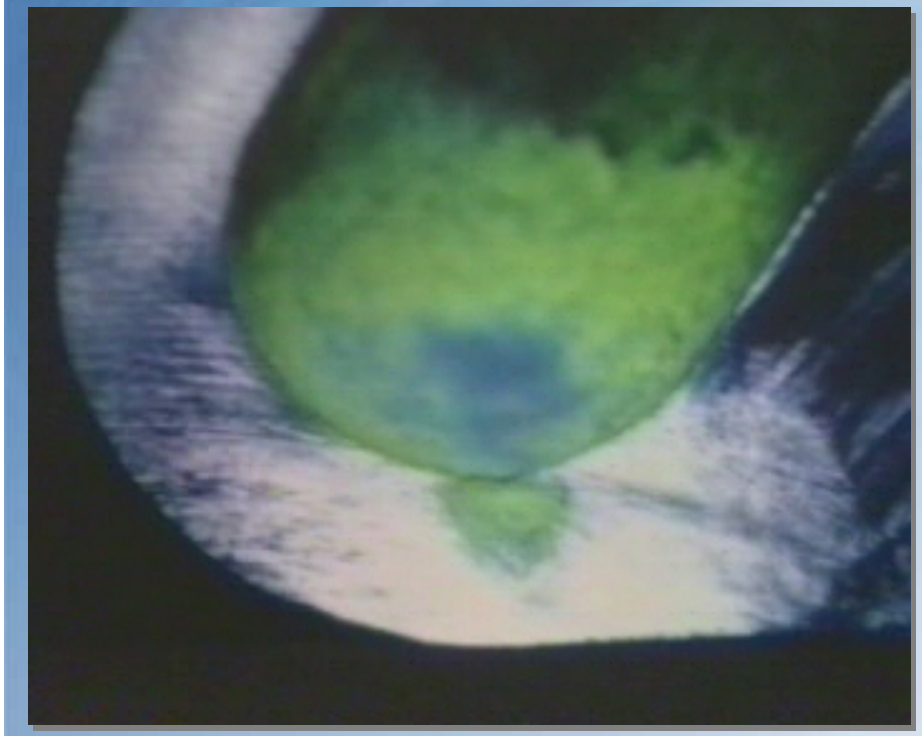
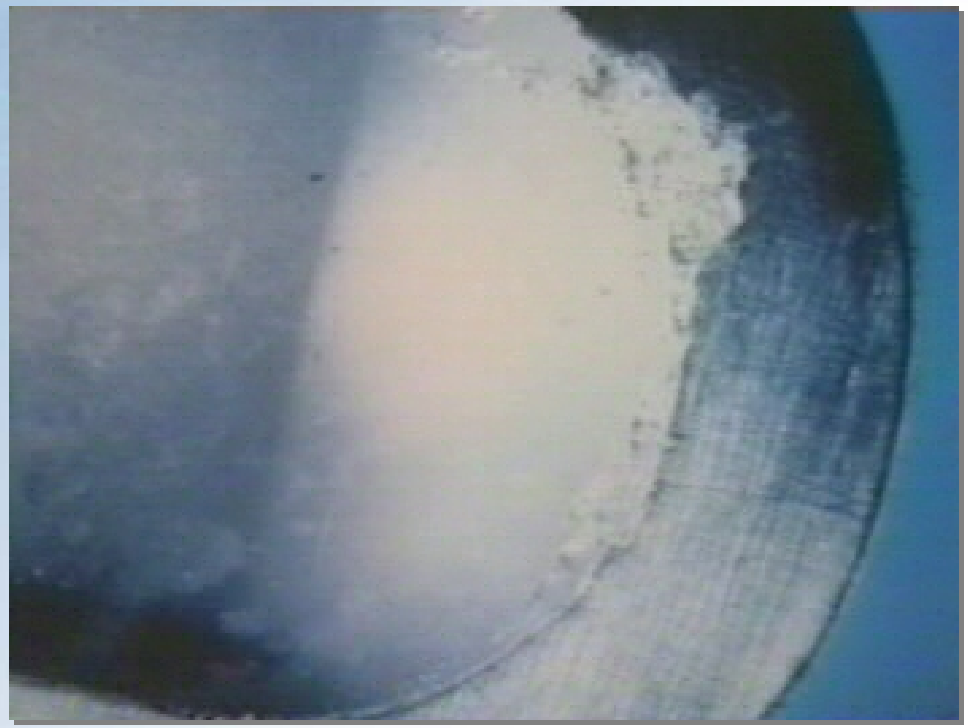
CORROSION
can destroy aluminum rotors





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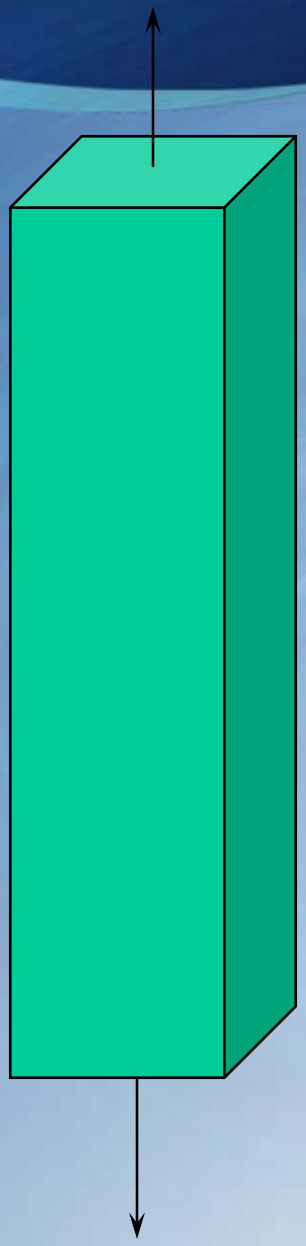

NO CORROSIVE ATTACK

LOAD = 6000 lbs

LOAD = 26,700 N

AREA = 1.00 sq in

AREA = 6.45×10^{-4} m^2

STRESS = 6000 lbs/sq in

STRESS = 4.14×10^{7} N/m^2

STRESS = 41.4 MPa

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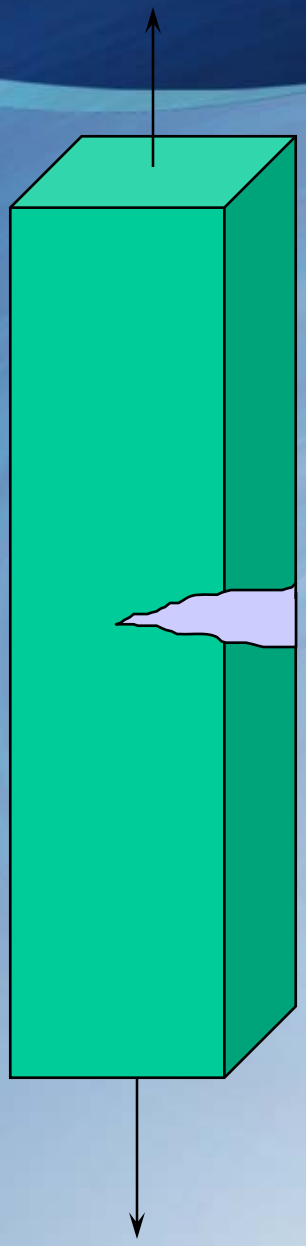

CORROSIVE ATTACK

LOAD = 6000 lbs

LOAD = 26,700 N

AREA = 0.60 sq in

AREA = 3.87×10^{-4} m^2

STRESS = 10,000 lbs/sq in

STRESS = 6.90×10^{7} N/m^2

STRESS = 69.0 MPa

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Points to Remember

- Anodized aluminum is corrosion resistant, not corrosion proof
- Although titanium and carbon composite rotors are highly corrosion resistant, these rotors may have anodized aluminum components
- Consult chemical compatibility charts

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Proper Lubrication is Important

- Periodically lubricate O-rings with vacuum grease
- Lubricate threaded portions of rotor with Spinkote
- Lubrication maintains vacuum sealing and enhances smooth operation of components

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Overspeed Disk Replacement

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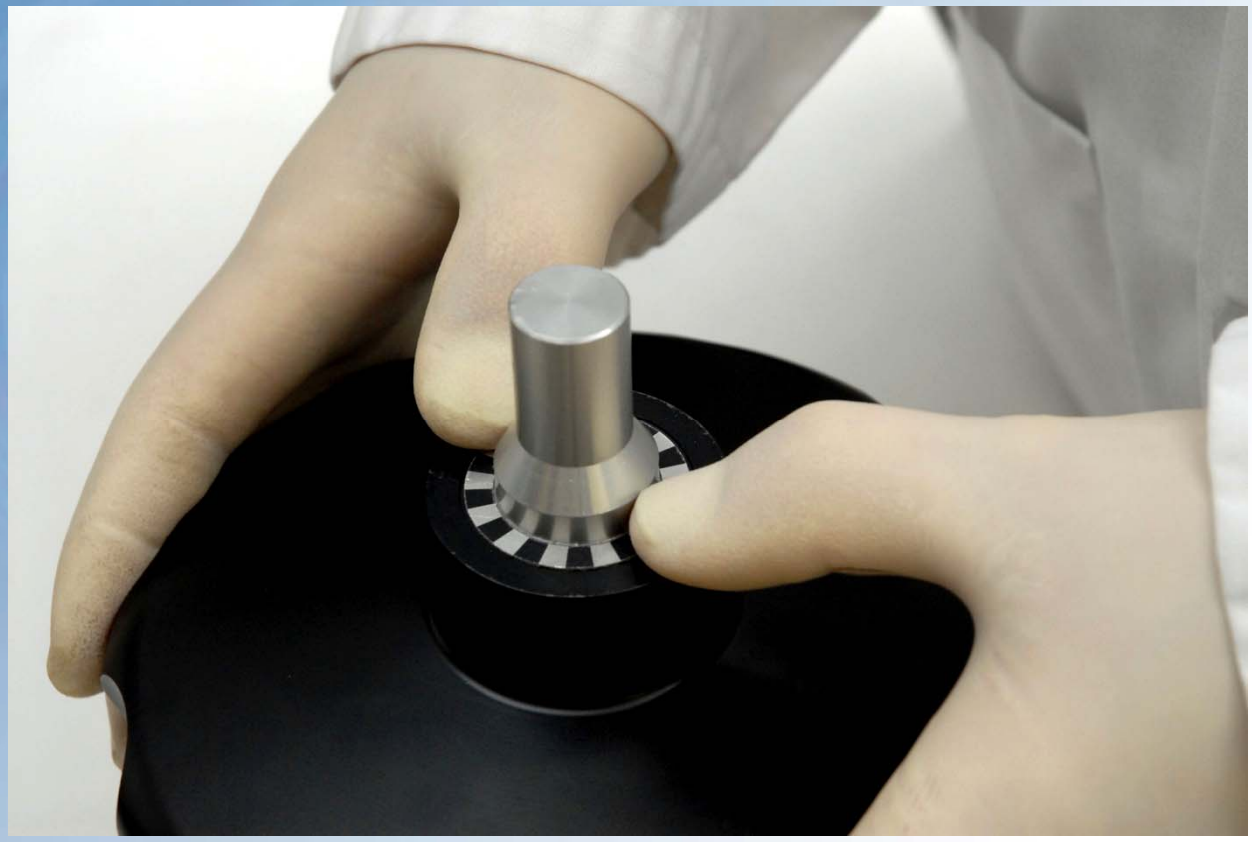
Overspeed Disk Replacement



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Periodically Inspect Rotor Hub Pins

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Decontamination

- Radioactive material
  - Use a cleaning agent that will not harm anodized aluminum
- Toxic or Pathogenic contamination
  - Follow appropriate procedures outlined by your Laboratory Safety Officer

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Sterilization

- Follow procedures outlined by your Laboratory Safety Officer
  - Most metal components can be autoclaved up to 1 hour at 121°C (up to 30 minutes for most composite rotors; see manual)
  - Cold methods – 70% ethanol, 6% hydrogen peroxide – can be used
    - ✓Bleach may discolor anodized surfaces

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Rotor Storage

- Store rotors upside-down to ensure that condensation does not collect in tube cavities
- Store rotors in a dry environment
- Remove all tube adapters from tube cavities before storage

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Run Logging

- **Run Logging is not required for warranty**
- **Using a logbook can help lab managers track rotor and instrument usage patterns**

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Rotor Care Review

- Use proper cleaning solutions
- Use proper cleaning brushes
- Use proper storage techniques
- Read the rotor instruction manual
- Ask your Field Engineer

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Out-of-Warranty Rotors and Rotor Retirement

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Rotor Life and Rotor Warranty

- Rotor life is not related to warranty period
- Rule-of-thumb rotor lifetimes
  - Optima Ultracentrifuge rotors
    - ✓FA and VTi rotors: 12 years
    - ✓SW rotors: 10 years
  - High Performance Centrifuge rotors
    - ✓JA rotors: 15 years

When in doubt, consult with Service to determine safe rotor usage

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After Sales Support

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Field Rotor Inspection Program

- Check if available as part of your service agreement
- Ensures a long service life for your rotors
- Increases lab safety
- Minimizes lab down time
- Minimizes repair and replacement expenses

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Rotor Inspection by Factory-Trained Inspectors

The inspector will

- Examine your rotors with non-destructive techniques
- Indicate possible repairs or modifications to run protocols
- Recommend rotor retirement based on condition, run cycles, or age
- Advise on care and handling techniques

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What's In It For You?

- **Helps you use centrifuge systems safely**
- **Ensures maximum life of your investment**
- **Avoids unbudgeted lab expenses**
- **Helps assure experiment integrity**
- **Helps insure against loss of valuable sample and lab preparation time**

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Any Questions ?

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Thank You!

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