Care and Handling of Rotors
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

The First Ultracentrifuge
Spinco Model L
There is a wide variety of centrifugation systems
Correct Rotor Use
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*
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
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.
Correctly Balance Rotor Loads

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

Which Equals . . . The Weight of a Mini Cooper
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
For High Performance and Benchtop Centrifuges...

- Balance specification is instrument / rotor dependent

- Some rotors offer imbalance correction
  - 50 to 100 grams!

*Consult your Operators Manual*
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
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
Proper Handling of SW rotors

INCORRECT

- Improper handling can lead to
  - Mishooked buckets
  - Disturbed gradients
Proper Handling of SW rotors

**CORRECT**

- Hold rotor with both hands
Proper Handling of SW rotors

Inspect Buckets Prior to the Run

- Mis-hooked buckets are the leading cause of rotor mishaps in Ultracentrifuges
Proper Handling of SW rotors

- Some rotors, such as the SW-32Ti, have simplified the bucket attachment process
Lid Attachment: Optima Series
Rotor Attachment: Optima Series

- Place the rotor straight down onto the spindle
- The rotor is self locking
Rotor Attachment: TL Series

- For TL series rotors with buttons
- Place the rotor on the spindle
Rotor Attachment: TL Series

- Push the button to lock the rotor onto the spindle
Rotor Attachment: TL Series

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

- Turn the locking handle clockwise to attach the rotor to the centrifuge spindle
Rotor Preparation: Vertical Rotors

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

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

- Improper tool use can damage parts and cause a safety hazard for centrifuge users.
Rotor Care and Maintenance
Proper Cleaning Utensils

BCI Rotor Cleaning Kit
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
Proper Brushes

- Improper bushes can scratch and damage rotor tube cavities
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*
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.
CORROSION can destroy aluminum rotors
NO CORROSIVE ATTACK

LOAD = 6000 lbs
LOAD = 26,700 N
AREA = 1.00 sq in
AREA = 6.45 x 10^{-4} m^2
STRESS = 6000 lbs/sq in
STRESS = 4.14 x 10^7 N/m^2
STRESS = 41.4 MPa
CORROSIVE ATTACK

LOAD = 6000 lbs
LOAD = 26,700 N

AREA = 0.60 sq in
AREA = 3.87 x 10^{-4} m^2

STRESS = 10,000 lbs/sq in
STRESS = 6.90 x 10^7 N/m^2
STRESS = 69.0 MPa
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
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

Consult your Operators Manual
Overspeed Disk Replacement
Overspeed Disk Replacement
Overspeed Disk Replacement
Overspeed Disk Replacement
Periodically Inspect Rotor Hub Pins
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
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
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
Run Logging

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

- Use proper cleaning solutions
- Use proper cleaning brushes
- Use proper storage techniques
- Read the rotor instruction manual
- Ask your Field Engineer
Out-of-Warranty Rotors and Rotor Retirement
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*
After Sales Support
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
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
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
Any Questions?
Thank You!