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Centrifuge Rotor Maintenance and Safety

Tom Egan
Centrifugation Team Leader
Northeast Region

Centrifuge and Rotor Safety

This presentation is designed to:

- Promote laboratory safety
- Improve knowledge of centrifugation
- Understand and respect the forces generated in centrifuges
- Inform of latest technologies

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Why Should I Be Concerned about Rotors?

- I've been using centrifuges for years and never had a problem
- I only use benchtop centrifuges
- My rotors look fine
- I never run the rotors to full speed
- I always fill out the ultracentrifuge log book

Benchtop Centrifuges

- Typically spin 50-ml and 15-ml conical tubes
- Common rotors have a max. capacity of 750-ml
- Usually run in the 2,000 to 3,000 RPM range
- Low Speed = Low Concern Right?

Wrong!

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Benchtop Centrifuges

A fully loaded bucket on the Legend XT rotor weighs 1,650 grams (3.64 pounds)

Spinning this at its maximum speed generates 4,816 x g

This is the equivalent of **17,530 pounds!**

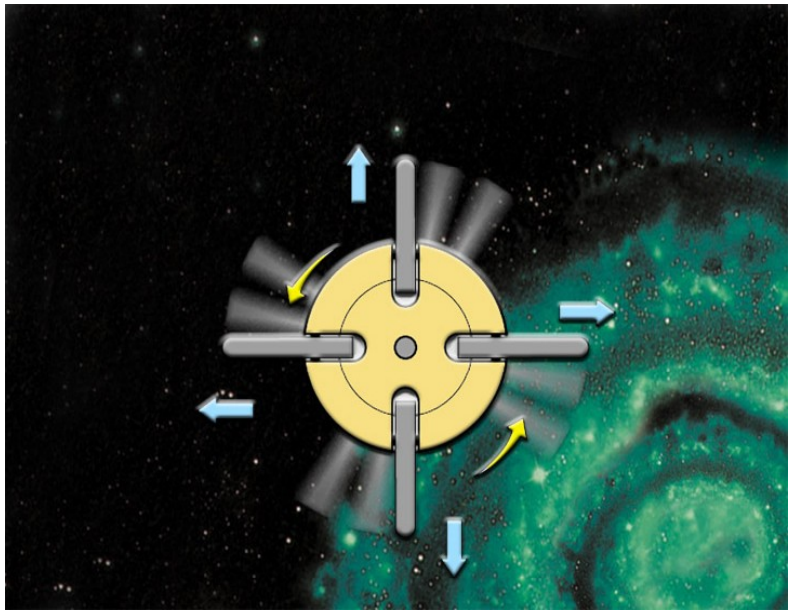
Over 8.5 tons

Per Bucket

Travelling 30 MPH

In Each Direction

On a Bench top



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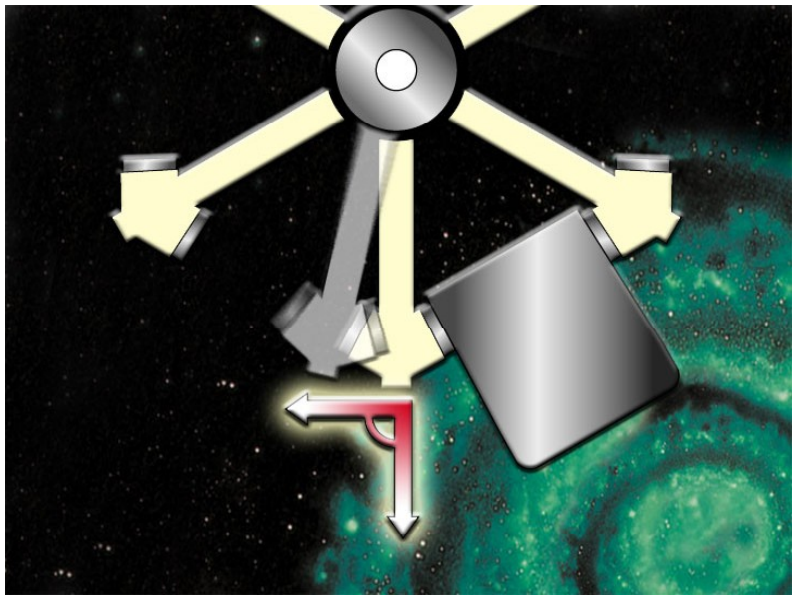
Benchtop Centrifuges – Best Practices

Now That We Have Your Attention:

- Keep your rotors clean (Rinse, Rinse, Rinse)
- Check for chemical compatibility (NO BLEACH!!)
- Lubricate the pins and trunions
- Stay balanced
- Very Important:
Always Run ALL the Buckets



Benchtop Centrifuges

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Superspeed Centrifuges

Now We Add a Little More Power:

The F8S (6 x 1-liter) rotor running at top speed (15,150 x will generate…

34,845 pounds

- Over 17 tons per cavity
- Four and a half H-1 Hummers

- Travelling at 70 MPH
- 209,070 pounds total (27 H1 Hummers)

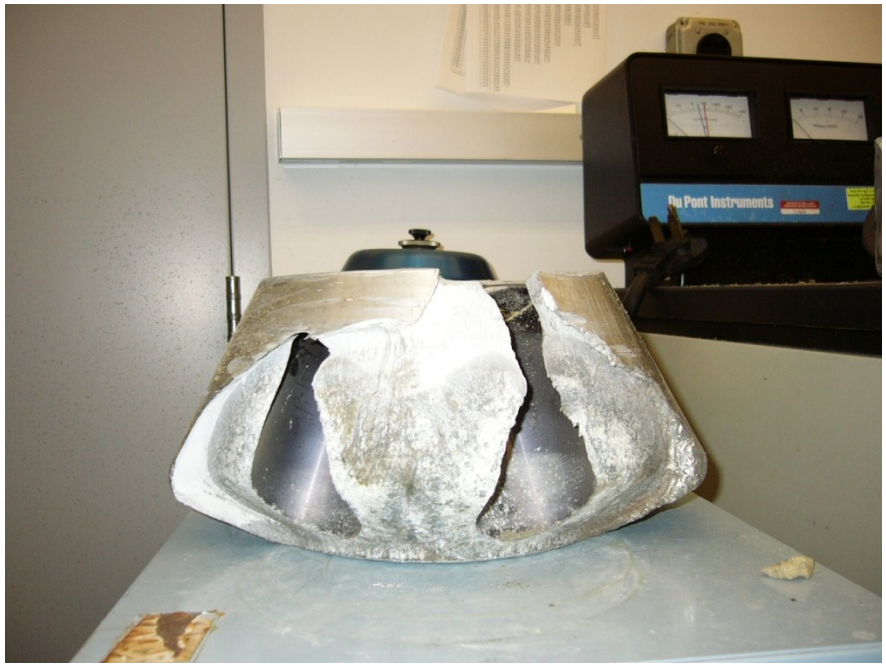
Superspeed Centrifuges

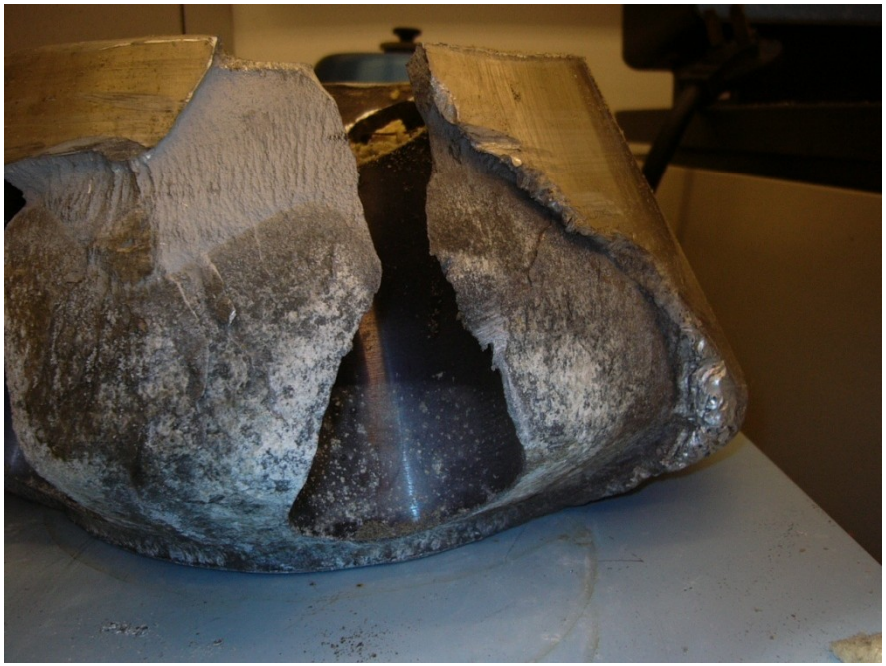
The instruments are manufactured to contain this force in the event of an accident.

But when a rotor fails, it can get ugly…

Superspeed Centrifuge

Old GSA rotor at 5,000 RPM





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Superspeed Centrifuges

Damage is rarely just the rotor

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Superspeed Rotors - Age

Age, Metal Fatigue and Corrosion will Destroy Superspeed Rotors

The most obvious sign of age is a non-anodized (silver) rotor

Superspeed Rotors - Age

- The age of some rotors can be identified by the first 2 digits of the serial number

- Others (especially benchtops) require careful record keeping from time of purchase.

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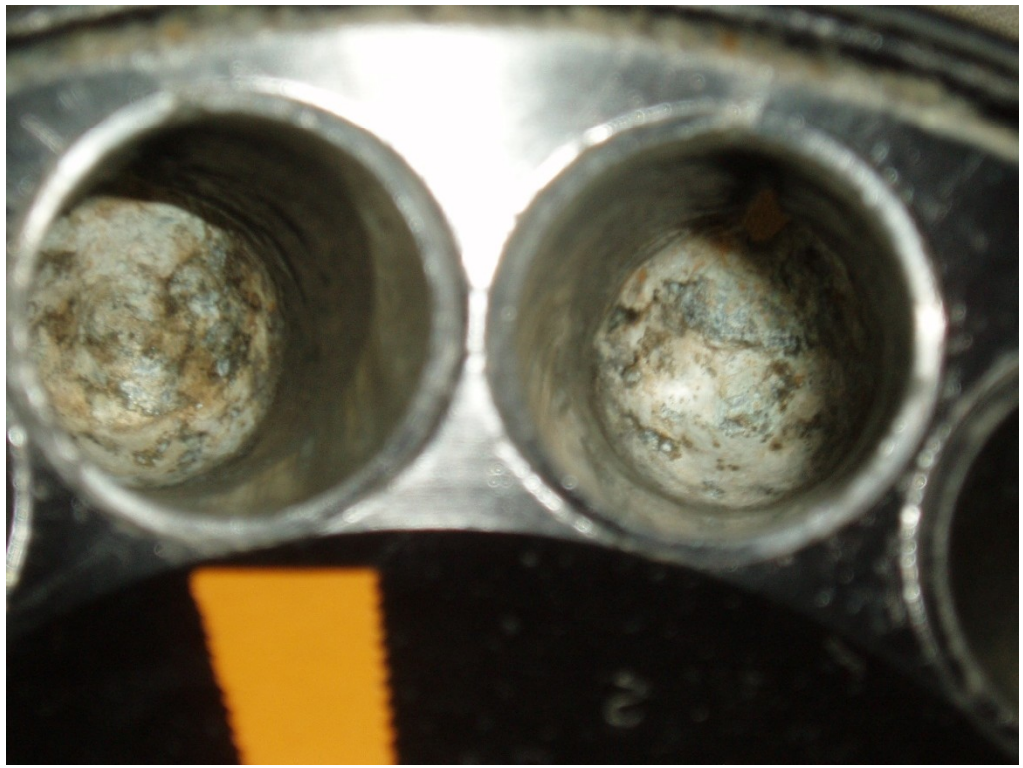
So How Old Is It Safe ?

Rotor Material	Warranty	Finite Life
Plastic	5 years	5 Years/30,000 runs
Aluminum (Super-Speed)	7 years	14-years
Aluminum (Ultra)	5 years/2000 runs	5 years/2000 runs
Titanium	5 years/5000 runs	10 years/5000runs
Titanium (swinging bucket)	5 years/2000 runs	5 years/2000 runs
Carbon Fiber	15 years	Indefinite

Superspeed Rotors - Corrosion

Check inside the rotor cavities for signs of corrosion



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Superspeed Rotors - Corrosion

Sometimes you don't have to look too hard…

Yes…They were still in use!!

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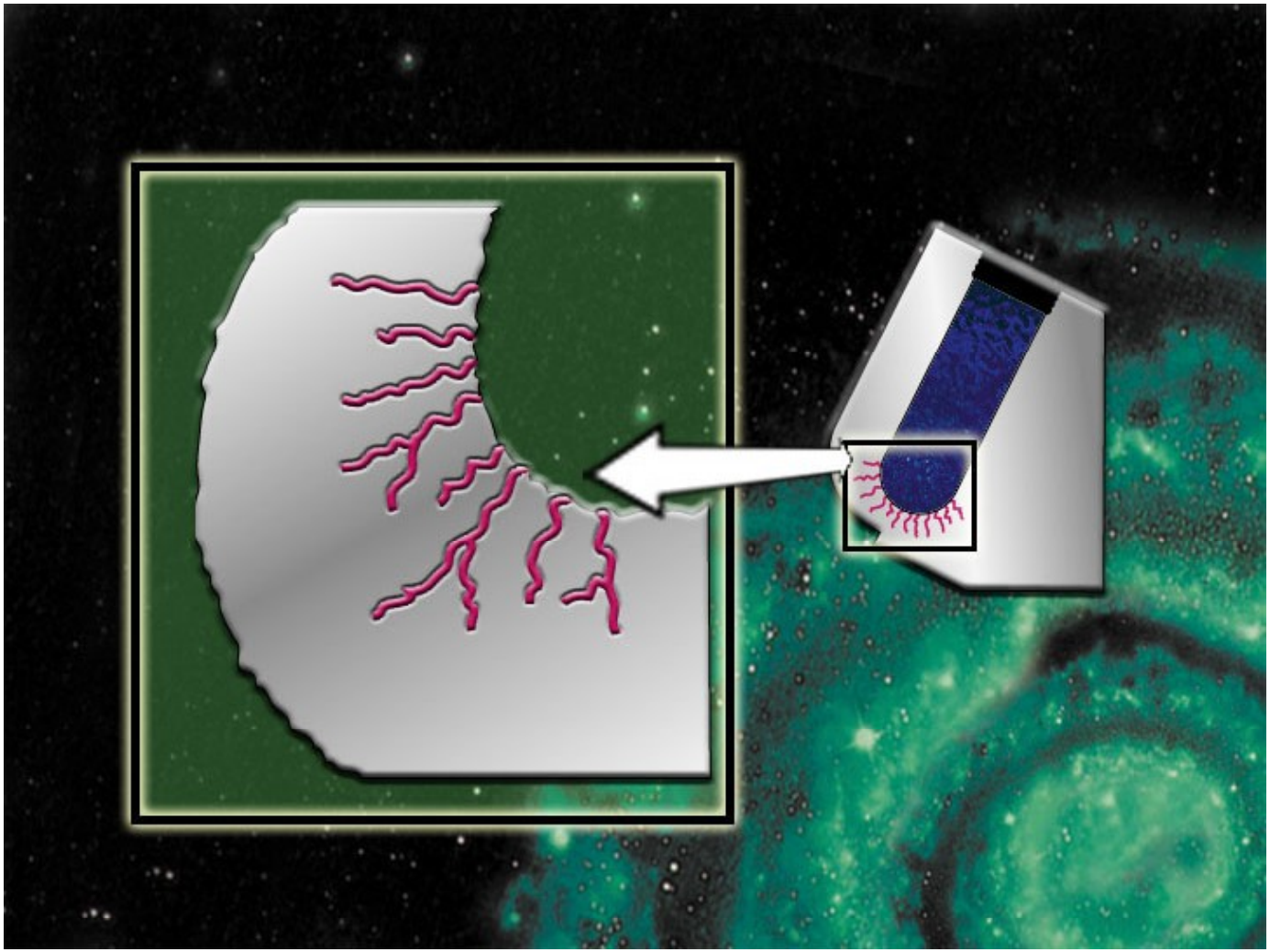
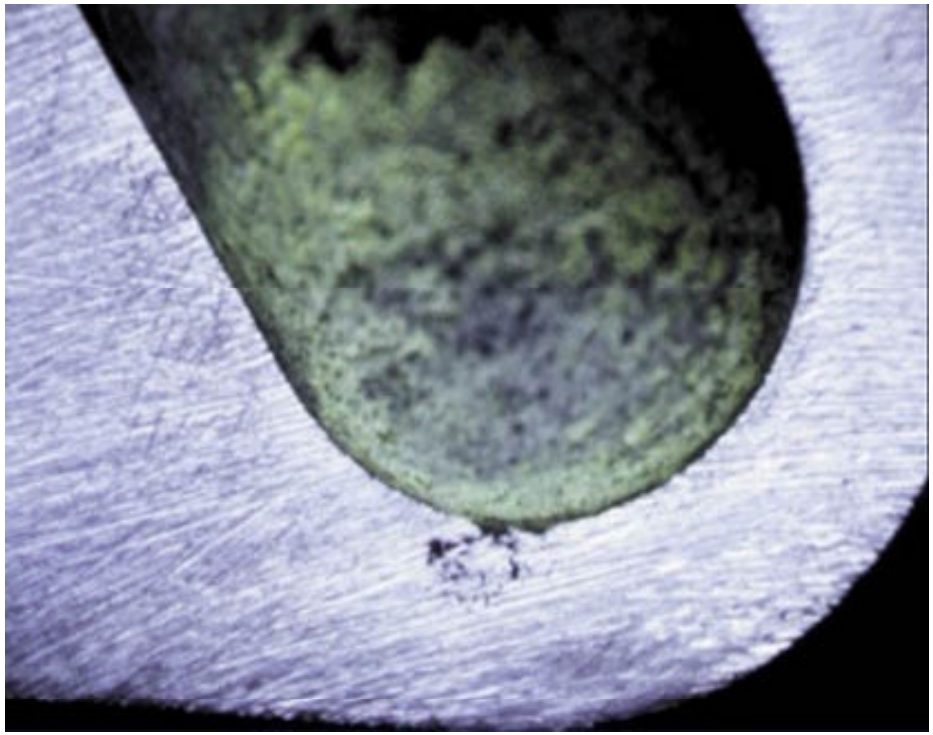
The Effects of Corrosion



The Effects of Corrosion

- The real danger is often unseen…



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Superspeed Centrifuges – Best Practice

The best prevention of metal rotor accidents is proper maintenance:

- Remove all bottles and adapters from the rotor
- Rinse the rotor with distilled water after each run
- Use 1% non-alkaline detergent and soft brush for build-up
- Turn upside-down on paper to allow complete drying
- Lubricate o-rings with vacuum grease and metal threads with anti-galling grease
- **Have a yearly rotor inspection**

by a trained professional

Superspeed Centrifuges – Avoid Problems

The best way to avoid corrosion and metal fatigue is to use carbon fiber rotors.

- ✓ Available in all sizes
- ✓ Achieves similar speeds and g-force
- ✓ Accepts the same tubes and bottles
- ✓ Improved performance for some rotors
- ✓ Unique designs and tube options
- ✓ **No** Corrosion and **No** Metal fatigue
- ✓ 15-year warranty (Never need to be retired!)
- ✓ Can be used in both Beckman and Sorvall centrifuges
- ✓ Available for benchtop centrifuges
- ✓ Lowspeed, superspeed and ultra
- ✓ Can be repaired

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Old Superspeed Instruments

It’s not just rotors that hare potentially hazardous…

Older centrifuges are manufactured with mercury switches, temperature sensors and Freon refrigeration

Old Superspeed Instruments

Older door latches were modified in early 1970s to assure rotor containment…

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Ultracentrifuges

Now things get real exciting…

Today's full size ultracentrifuges will generate 800,000 x g and micro ultracentrifuges will generate over 1,000,000 x g!

It is metal fatigue, not corrosion, that will cause an ultra rotor to fail.

This means they "look" pristine right up to the point of *failure*.

Ultracentrifuges – Metal Fatigue

How bad could it be?

Ultracentrifuges

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Ultracentrifuges – Swinging Bucket Rotors

Ultracentrifuges – Swinging Bucket Rotors

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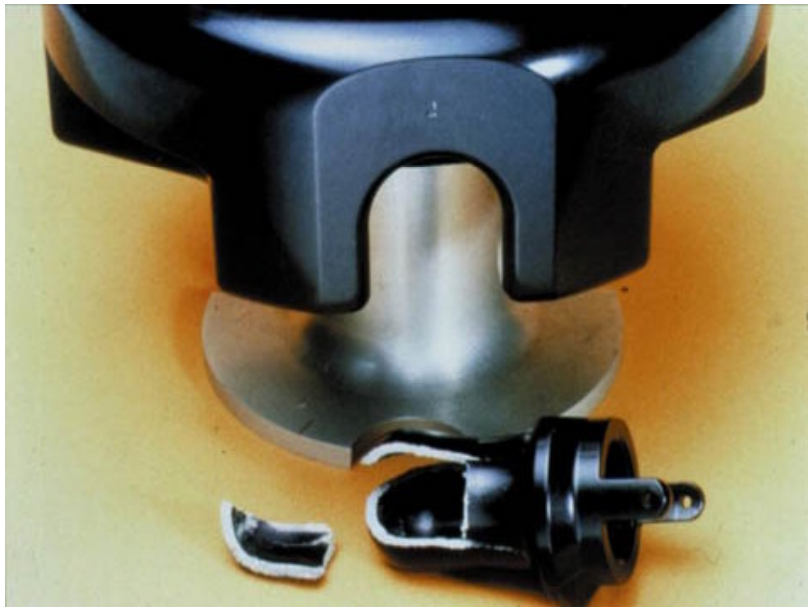
Ultracentrifuge Rotor- Best Practices

- Assure that buckets are properly attached
- Be sure that tubes can withstand speeds
- Do not over-fill or under-fill tubes
- Be wary of over-density and precipitation in gradients
- Follow manufacturer's recommendation for derating



Review - Centrifuge and Rotor Maintenance

For Table Top Centrifuges:

o Follow manufacturer's recommendation for securing the instrument

o Be sure to balance the load

o Clean and lubricate pins and trunions

o Assure that the buckets are in place and swing freely

o Remove the adapters and clean the buckets

Review - Centrifuge and Rotor Maintenance

For superspeed centrifuges:

o Follow the manufacturer's recommendation for securing the centrifuge

o Balance the load

o Be sure the lid is secure to the rotor (do NOT run without!)

o Be sure the rotor is secured to the spindle

o Inspect the rotors for salt build-up and damage

o Lubricate threads and O-rings

o Clean up spills

o Do not overfill / under fill tubes

Review - Centrifuge and Rotor Safety

For Ultracentrifuges:

o Be sure to balance the rotor load

o Assure the tubes you use will withstand the top g-force

o Are the tubes sealed?

o Keep AND REVIEW a rotor log

o Follow manufacturer's recommendation for rotor deration

o Double check swinging buckets

o Be aware of density limits

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Rotor Care – What it Means In Practice

Before each run:

- Is my rotor corrosion-free?
- Is the anodising intact?
- Is the rotor within its service life?
- Are the ‘O’ rings in place and not degraded?
- Are samples balanced and loaded?
- Is the rotor secure?
- Is the lid in place?

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Questions??