Standard Operating Procedure (SOP) for Centrifuge and Ultracentrifuge

Dr. Ragauskas group safety meeting

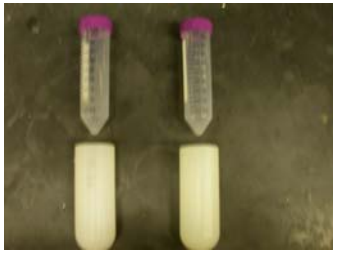
July 22, 2008

BECKMAN
Avanti J-E Centrifuge

BECKMAN
GS-6 Centrifuge

eppendorf
Centrifuge 5804R

Main Parts We Contact: Chamber, Rotors, Shaft (Hub), Rotor Lid, Sample Bottles and Tubes.



Why SOP?

Safety, Safety and Safety

- Rotors on high-speed centrifuge and ultracentrifuge units are subject to mechanical stress that can result in rotor failure.

- In addition, improper loading and balancing of rotors can cause the rotors to break loose while spinning.

- For these reasons, centrifuges must be properly used and maintained.

Training and Repair

- Before using any centrifuge, review the owner's manual. **Do not operate a centrifuge before reading the owner’s manual or before being trained** in the safe use of the centrifuge by an experienced operator.

- **Be familiar with unsafe situations** or equipment operating conditions before beginning operations using centrifuges.

- Centrifuges should be repaired only by the manufacturer or authorized dealer representative. **Do not attempt repairs**. Centrifuges in need of repair should be tagged and locked-out while awaiting service.

Rotor Care and Use

- **Rotors and other exposed parts of centrifuges should always be kept clean free of chemicals and chemical residues**. Metal rotors> moisture> corrosion and equipment damage.
- Do not autoclave rotors at temperatures above 100°C.
- To avoid corrosion, **do not expose aluminum rotor components to strong acids or bases, alkaline lab detergents, or salts (chlorides) of heavy metals (e.g., cesium, lead, silver or mercury).**
- Check that the centrifuge chamber, drive spindle, and tapered mounting surface of the rotor are clean and free of scratches or burrs.
- Damaged rotors must not be used.
- Wipe drive surfaces prior to installing the rotor.




Rotor Care and Use

- Make sure rotor, tubes, and spindle are dry and that the rotor is properly seated and secured to the drive hub. Do not operate the centrifuge without the appropriate rotor cover securely fitted with seals in place.




- If the temperature of the chamber is below room temperature, pre-cool the rotor to the lower temperature before securing the rotor (this will minimize the chance of it seizing to the tapered spindle).
- Always complete the machine log book since the number of hours of operation determines the life of the rotor.

Rotor Care and Use

- Do not exceed the design mass for the maximum speed of the rotor.

  Failure to observe this precaution can result in dangerous and expensive rotor disintegration.
- Never exceed the manufacturer's stated maximum speed for any rotor.

Rotor Profile and Description	Rotor Entry Code	Max RPM[a]	Max RCF (x *g*)	Max Capacity	Rotor Manual Number
JLA-16.250 Fixed Angle, 25° (6 place)  r_{max} = 134 mm	16.25	16 000[e] (14000 @ 2°C)[e]	38 400	6 x 250 mL	J-TB-072

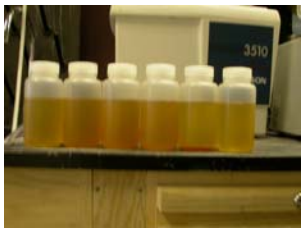
Relative Centrifugal Fields (**RCF**)
$= 1.12r(RPM/1000)^2$

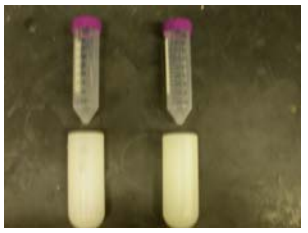
Guidelines

1. Follow the centrifuge manufacturers written instructions.
2. Always balance loads in the centrifuge properly.
3. The operating temperature for these tubes is 0-40ºC.
4. Run a trial. The suitability of these tubes for an application should be established before beginning.
5. Establish the RCF you are using , use the formula RCF = (11.17×10^{-7}) RN^2. R=Radius in mm from centrifuge spindle to bottom point of tube. N=Speed of spindle in RPM.
6. Use appropriate biohazard containment.

RCF Ratings

15mL Polystyrene = 3,000 x g
15mL Polypropylene = 15,500 x g
50mL Polypropylene = 15,500 x g

Rotor Care and Use

- At following situations, it may be necessary to de-rate rotor speed, which is defined as reducing the maximum safe speed at which a manufacturer states a rotor should be used.

  a) the rotor speed, temperature, or a combination of the speed and temperature during operation exceeds the solubility of the gradient material and causes it to precipitate, or;

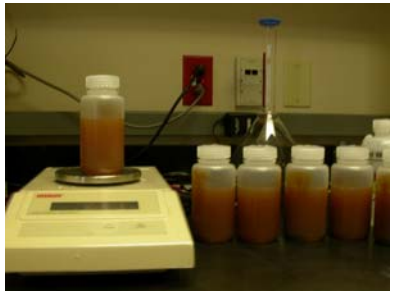
  b) the compartment load exceeds the maximum specified by the manufacturer, or;

  c) when a manufacturer recommends based upon the amount of use the rotor has received, limiting the maximum speed at which the rotor is used to some level below the maximum speed listed for the rotor when it was new. This requires that operators **maintain a comprehensive use log for each rotor**. Failure to reduce rotor speed under these conditions can cause rotor failure.

Rotor Care and Use

- Balance the rotor to within the limits specified (take care that materials of similar densities are in opposite positions of the rotor).




1. Load samples in rotor symmetrically.
2. Weigh the samples in opposite positions closely.

Tube Care

- **Before use, tubes should be checked for cracks**. The inside of cups should be inspected for rough walls caused by corrosion and adhering matter should be removed. **Metal or plastic tubes** (other than nitrocellulose) should be used whenever possible.
- Make sure each tube compartment is clean and corrosion free.
- Tubes must be properly balanced in the rotor (½ gram at 1 G is roughly equivalent to 250 Kg @ 500,000 G's).
- Check compatibility of the tube material to the solvent medium (some solvents may cause the tubes to swell or crack in the rotor).
- Never fill centrifuge tubes above the maximum recommended by the manufacturer.
- Use only correctly fitting tubes.
- Use sealed rotors, sealed buckets, or a guard bowl cover complete with gasket as well as safety centrifuge tubes (tube or bottle carrier with sealable cap or "O"
  ring cap).

Miscellaneous

- Once a run is complete, make sure the rotor has **COMPLETELY STOPPED** before opening the centrifuge lid. Never attempt to open the lid of a centrifuge or slow the rotor by hand while the rotor is in motion.

- If a tube breaks, the centrifuge should be turned off and allowed to stand undisturbed for an appropriate amount of time before opening to allow aerosols to settle. Thirty (30) minutes is a commonly recommended waiting period. Clean and disinfect the rotor. Cleaning and disinfection of tubes, rotors, and other components requires considerable care. No single method is suitable for all items, and the **various manufacturers' recommendations must be followed to avoid rotor fatigue, distortion, and corrosion.**

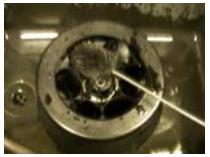
- Clean up spills immediately, using appropriate spill response procedures.

Operating Procedures In Our Lab

- Log in (If got trained).
- Unlock the plug and switch on the machine.
- Set up the parameters, speed, time, temperature, accelerate and brake down speed.
- Open the machine lid and motor lid, check if the motor is properly seated to the drive hub.
- place the balanced bottles or tubes into the rotor, seal and secure the motor with lid, close the machine lid and run the machine.
- After completely stopped, open both machine lid and motor lid and take out the sample bottles or tubes, check whether spilling was happened or not, if there is spill, especially in the strong acid or base, take motor out, wash and dry it, and put back on the drive hub (shaft), close the lid and turn off the machine.







If unusual situation happened?

Table 4-1. Diagnostic Message Chart

Diagnostic Number/ Message	Problem	Result	Recommended Action
P1– Power failure occurred, see manual	Momentary power failure: rotor does not come to a complete stop	Run continues when power resumes	Press (CE) to clear message.
P2– Power failure, see manual	Power failure: rotor speed drops to <500 rpm	Run restarts automatically when power resumes	Press (CE) to clear message.
L1, L2, L5, L6, L11, and L12– Reclose door	Latches are not operating properly	Error message appears; run shuts down with maximum brake	Press down on the door and press (DOOR). If you close the door repeatedly and the problem continues, gently clean the latch area with a lintless swab. Be careful not to damage sensitive electronics in the area. **WARNING: Do not put your fingers into the latch openings.** Press (CE) to clear message.
C1– Rotor temp exceeds 4C above set	Rotor temperature exceeds temperature setting by more than 4°C but less than 8°C	Run continues	Press (CE) to clear message.
C2– Rotor temp exceeds 8C above set	Rotor temperature exceeds temperature setting by more than 8°C	Run shuts down with maximum brake	Call Beckman Coulter service.
C3– Temp, call service	Cannot maintain temperature	Run shuts down with maximum brake	• Check the air filter and replace if dirty (see Section 5, MAINTENANCE). • Call Beckman Coulter service.

Continued—

Table 4-1. Diagnostic Message Chart (continued)

Diagnostic Number/ Message	Problem	Result	Recommended Action
S1 through S14– System error, call service	There is a problem with the system control software, EPROM, or RAM	System shuts down	Call Beckman Coulter service.
H1, H5, H7, and H8– Speed, call service	Speed control problem	Run shuts down with maximum brake; door may not unlock for up to an hour.	Call Beckman Coulter service.
H2, H3, and H11– Speed, call service	Speed control problem	Run stops, usually with no brake	Call Beckman Coulter service.
H4, H6, and H9– Speed error	Accel or decel speed problem	Run continues	Press (CE) to clear message.
I1- Rotor imbalance	Rotor load is severely out of balance	Run shuts down with maximum brake	• Make sure that tubes or bottles are loaded symmetrically in the rotor. • With swinging bucket rotors, remove the buckets and lubricate the pivot pins where the buckets contact as described in the applicable rotor manual. Unlubricated pivot pins can prevent the buckets from reaching horizontal position, which can cause imbalance.
—	During low-temperature runs (near –10°C), ice forms around the door opening	Door will not open at the end of a run	To minimize icing, wipe moisture from the chamber, the chamber gasket and the inner door surface before each run. Keep the door closed as much as possible.

In the running, sometimes, it stops running, and shows on the screen what problem happened, in this situation, the brake doesn’t work, the machine will keep running for a long time until thoroughly stops. Detailedly record the problem and report to representative.