Centrifuge Safety

These guidelines may be used as a template in developing a lab-specific standard operating procedure for the use of centrifuges in the lab.

Annual Review Date:

Principal Investigator: **Phone number:**

Room & Building:

Emergency Contact Information:

STATEMENT OF UNDERSTANDING AND COMPLIANCE

I confirm that I have read and understand the Centrifuge Safety Guidelines and will comply with the procedures and policies.

Name/Title	Signature	Date

Rotors on high-speed centrifuge and ultracentrifuge units are subject to mechanical stress that can result in rotor failure. Improper loading and balancing of rotors can cause the rotors to break loose while spinning. Improper preparation and loading of potentially hazardous samples can result in leaks and aerosolization of potentially hazardous samples. For these reasons, centrifuges must be properly used and maintained.

1. TRAINING AND REPAIR

- Before using any centrifuge, review the owner's manual. If a manual is not available, obtain a copy from the manufacturer. 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.
- A Centrifuge Safety training DVD is available for viewing; contact JABSOM EHSO.
- Be familiar with unsafe situations or equipment operating conditions before beginning operations on the centrifuge.
- Centrifuges should be repaired only by the manufacturer or an authorized dealer representative. Do not attempt repairs. Centrifuges in need of repair should be tagged and locked-out while awaiting service.

2. ROTOR CARE AND USE

- Rotors and other exposed parts of centrifuges should always be kept clean, free of chemicals, chemical residues, and infectious substances. Metal rotors in contact with moisture for extended periods of time may result in corrosion and equipment damage. It is important that the rotor is left clean and dry after each use. Wash rotor with mild detergent and warm water using a nylon bottle brush if necessary. Dry the rotor thoroughly. In some cases, the manufacturer may

recommend storing rotors upside down with the cover and tubes removed to prevent water from pooling inside of equipment.

- Do not autoclave rotors at temperatures above 100ºC.
- To prevent corrosion, do not expose aluminum rotor components to strong acids or bases, alkaline lab detergents, or salts (chlorides) or 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 burns.
- Damaged rotors must not be used. If the rotor is dropped, it should be taken out of service immediately and sent to the supplier for examination.
- Wipe drive surfaces prior to installing the rotor.
- 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).
- It is recommended that a log book be kept for the centrifuge in order to determine the life and maintenance schedule of the rotor. The log should detail the number of runs, hours, age of the rotor, the rotation speed per run, and dates of servicing.
- High speed rotor heads are prone to metal fatigue. 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.
- Balance the rotor to within the limits specified (ensure materials of similar densities are in opposite positions of the rotor).
- At times it may be necessary to de-rate rotor speed (defined as "reducing the maximum safe speed at which a manufacturer states a rotor should be used"). De-rate the rotor speed whenever:
  - The rotor speed, temperature of a combination of the speed and temperature during operation exceeds the solubility of the gradient material and causes it to precipitate; or
  - The compartment load exceeds the maximum specified by the manufacturer; or
  - 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 log for each rotor. Failure to reduce rotor speed under these conditions can cause rotor failure.

3. 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 (1/2 gram at 1G is roughly equivalent to 250 Kg at 500,000G'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), especially for potentially infectious samples or otherwise hazardous samples.

4. PRECAUTIONARY MEASURES

- 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. Serious injury may result. Ensure centrifuge has a safety locking device in place.
- Always wait at least 10-30 minutes after the centrifuge has completely stopped to allow any aerosolized leakage to settle, especially if the samples are potentially infectious.
- If there are signs of tube breaks or leakage, 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. If infectious material was placed in the centrifuge, implement procedures for appropriate decontamination and cleanup of equipment, including preventing personnel exposure. Cleaning and disinfection of tubes, rotors, and other components requires considerable care. No single method is suitable for all parts/items and the various manufacturer's recommendations must be followed to avoid rotor fatigue, distortion, and corrosion.
- After use, tubes, rotors, and centrifuge interiors should be cleaned and/or disinfected.
- Clean up spills immediately using appropriate spill response procedures.

5. INFECTIOUS MATERIAL CENTRIFUGATION

- Review the protocol and plan the task carefully
- Take all safety precautions
- Always use safety centrifuge cups
- Check the integrity of the "O" rings before every use.
- Use a HEPA-filtered safety centrifuge cabinet and ensure the HEPA filters are changed according to manufacturer's recommendations OR at least annually.
- Place a sign on the unit notifying others of the contents and who to contact in case of emergency.
- Wait at least 10-30 minutes after the centrifuge has completely stopped before opening the lid.
- Don the appropriate PPE before opening the centrifuge lid and checking to ensure there are no signs of leakage. A leaked container could result in aerosolization of an infectious material, which, could lead to occupational exposure.
- If there are signs of leakage, close the lid and contact JABSOM EHSO immediately.
- If there are no signs of leakage carefully remove the rotor and transfer to a biosafety cabinet before opening (microcentrifuges usually do not have removable rotors).

6. HISTORY OF CENTRIFUGE ACCIDENTS

In 1998, a laboratory at Cornell University was seriously damaged when the rotor of an ultracentrifuge failed while in use, due to the G forces from the high rotation speed. Milk samples were run in a Beckman ultracentrifuge for over an hour when the accident occurred. The safety shielding in the unit failed to contain all the metal fragments and the half-inch thick sliding steel door on the top of the unit buckled which allowed fragments, including the steel rotor top, to escape. Flying metal fragment damaged surrounding walls, the ceiling, and other nearby equipment. The shock wave blew out the laboratory's windows and shook items off shelves. Fortunately the room was unoccupied at the time and there were no injuries. The cause of the accident was believed to be the use of a model of rotor that was not approved by Beckman or use in this particular model. Rotors on high-speed centrifuges and ultracentrifuges are subject to powerful mechanical stress that can result in rotor failure. It is important that everyone inspects the rotors before use for any distress or damage, load and balance the rotors properly, cleans the rotors after use, and know the proper operating procedures for the specific unit they are operating.

Picture of centrifuge accident at Cornell University

Picture of rotor failure at Ottawa University

References: Information contained in this SOP was gathered from the following sources: University of California-Berkeley, University of California-San Diego, University of Nebraska – Lincoln.