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EH&S FACT SHEET

Environment, Health and Safety Information for the Berkeley Campus

Ultracentrifuges: Hazards and Precautions

The ultracentrifuge is a commonly used type of laboratory equipment. Rotors are exposed to enormous forces every time they are used. Rotors can fail catastrophically, resulting in destruction of the entire centrifuge and damage to a laboratory. As evidenced by the attached photographs, there is no doubt that serious injury could result should someone be present when a failure occurs. To prevent such failures, all ultracentrifuge manufacturers require that ultracentrifuge users maintain an up to date use log for each rotor, and also require that each time a rotor is used it must be given a thorough visual inspection for any signs of damage or weakness.

To understand the forces involved, a standard "run" for separating components of a cell nucleus disruption might require 55,000 revolutions per minute RPM for 600 minutes. This force easily generates 100,000 times the force of earth's gravity G forces or "Gees" within the sample containers for the entire run. A standard 20-pound fixed chamber ultracentrifuge rotor at these conditions holds over a million joules of energy, which is roughly equivalent to the energy released by exploding several 1" sticks of dynamite. Subjecting a rotor to such forces over time will lead to violent failure, and while centrifuges are designed to contain a rotor failure, they will at the very least be destroyed. The purpose of the use log is to ensure that the amount of stress imposed upon the rotor is known exactly, so that the rotor may be used for its full lifetime without risking excess stress. A rotor can also be "de-rated" by a qualified service technician who establishes a new, lower RPM and G force limit. This can extend the rotor's useful life as long as it is never exposed to conditions that exceed the reduced rating.

Ultracentrifuge Safety

In order ensure safety, ultracentrifuge users should do the following:

- Read carefully and re read if it has been a long time between uses the manufacturer's instructions for use and care of each rotor you use. Different manufacturers of very similar rotors may have different requirements based upon rotor characteristics that you may not be able to see. You must understand the applications and limitations of each individual rotor.

- Take your time and visually inspect each rotor for any signs of damage, corrosion, or weakness before you use it, every time you use it.

- Be careful to keep the rotor chamber or swinging bucket pairs correctly balanced, and make sure that the rotor cover is attached correctly. Enter each rotor use in the log when the run is completed, immediately clean up any spills that occur anywhere on the ultracentrifuge or rotor, and dry the rotor before oxidation can occur.

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• Have the rotor inspected per the manufacturer's direction by qualified service technicians.

• If corrosive solutions are used, be sure to wash and air dry the rotor prior to reuse. If hazardous materials biohazardous, radioactive, or chemical are spilled, decontaminate the rotor before re use. Also, be sure to clean the centrifuge before it is serviced.

• If biohazardous samples are run in a centrifuge, an aerosol may exist in the containers. These sample containers should be opened in a biological safety cabinet. When working with biohazardous samples, use tubes with o rings, centrifuge safety cups, or biosafety lids for fixed angle rotors.

The pictures below are of two rotor failures that occurred at other universities. The first three show damage from a failure at Cornell University in December, 1998, and the fourth is from a failure at Massachusetts Institute of Technology MIT in January 1999. Both institutions have made the photos and incident descriptions available on the web.

Cornell's can be seen at
http://www.ehs.cornell.edu/lrs/Centrifuge/CentrifugeDamages.htm

Rotor Failure at Cornell University in December 1998

1. Centrifuge Exterior - Cornell

2. Centrifuge Interior - Cornell

3. Laboratory Damage - Cornell (note shelving torn from the wall)

and MIT's at:
http://web.mit.edu/charliew/www/centrifuge.html

Rotor Failure at MIT

4. Centrifuge Interior - MIT

EH&S Can Help

If you need assistance or have questions about using ultracentrifuges or this Fact Sheet, please call EH&S at 642 3073.