# Centrifuge Safety

A laboratory centrifuge can be an important tool in the university lab. It can also be a dangerous instrument if used or maintained improperly. Most hazards associated with centrifugation stem from one of two sources: mechanical conditions, and processing hazardous materials. This fact sheet discusses both of these categories and presents methods for controlling the risks associated with them.

## MECHANICAL

*Centrifuge failure, likely due to metal fatigue. (Courtesy of C. Whittaker, MIT)*

### Stress

Centrifugal force puts a load on the rotor, causing stretching or a change in the dimensions of the metal. Each rotor is designed to withstand a certain amount of stress and return to its original dimensions. However, if that amount of stress is exceeded, the rotor will not return to its original shape and size. This causes minute cracks and other wear that will deteriorate the rotor over time, leading to possibly dangerous consequences. To prevent stress, the following practices are strongly recommended:

- Always ensure that loads are evenly balanced before a run.
- Always observe the manufacturers maximum speed and sample density ratings.
- Always observe speed reductions when running high density solutions, plastic adapters, or stainless steel tubes.

### Fatigue

Even when manufacturers' recommendations are closely followed, metal rotors will suffer fatigue. Repeated cyclical stretching and relaxation will cause changes in the metal's microstructure, resulting in eventual cracks and failure. Centrifuge manufacturers typically give both an expiration date (beyond which the rotor should not be used under any circumstance) and a maximum number of runs. To prevent mechanical rotor failure due to fatigue, observe the following:

- Never use a rotor past the manufacturer's expiration or safe-service date.
- Keep a rotor-use log to prevent overuse. (Note: some newer equipment may have datalogging capability. Consult the manufacturer's instructions for specific recordkeeping requirements.)

### Corrosion

Many rotors are made from either titanium or aluminum alloy, chosen for their advantageous mechanical properties. While titanium alloys are quite corrosion-resistant, aluminum alloys are not. Note that although a rotor may be made of titanium alloy, other centrifuge components may be made from aluminum due to design considerations. When corrosion occurs, the metal is weakened and less able to bear the stress from the centrifugal force exerted during operation. The combination of stress and corrosion causes the rotor to fail more quickly and at lower stress levels than an uncorroded rotor. To prevent corrosion, observe the following:

- Select titanium-alloy or comparable rotors for areas where corrosive solutions, like KBr, will be used regularly.

- Never clean rotors or associated parts with abrasive wire brushes.
- Avoid using alkaline detergents or cleaning solutions on aluminum parts. (Note: most solutions designed for radioactive decontamination are highly alkaline. See the Hazardous Samples section below for more detail.)
- If corrosive or alkaline materials have been run or spilled, be sure to wash affected parts of the centrifuge immediately and allow them to air dry.
- Store the rotor away from the centrifuge in a dry area, with all cavities facing downward to prevent the accumulation of moisture.

**Other points to prevent a mechanical rotor failure:**

- Use only rotors compatible with your centrifuge. Consult the operating manual for a list of compatible rotors for each centrifuge.
- Never attempt to open the door while the rotor is spinning or attempt to stop the rotor by hand.
- Do not attempt to move the centrifuge while it is in operation.
- Inspect the rotor before use and any time the rotor may have been subject to damage (i.e. dropped). Do not use the rotor if any cracks, rough spots, pitting, discolorations, or other abnormalities are present. Contact the manufacturer for details and service.
- Consider maintaining a service contract with a manufacturer's representative.

## HAZARDOUS SAMPLES

Centrifugation of hazardous samples may result in exposure to chemical, biological, or radioactive agents. Careful consideration must be given to work practices to avoid hazards. The following is a list of practices that should be followed whenever hazardous materials are centrifuged:

- When possible, samples should be aspirated rather than poured from centrifuge tubes.
- Load and unload hazardous samples in ventilated enclosures (biosafety cabinet for biological specimens, ducted biosafety cabinet for hazardous chemicals, etc.)
- Centrifuges used with hazardous aerosols and under a vacuum should be fitted with an appropriate in-line filter to protect the vacuum pump. (Contact the manufacturer for retrofits.)
- When hazardous samples are centrifuged, contain samples in safety cups, sealed tubes, or safety rotors.
- When safety containers are not available, centrifuge in a ventilated enclosure or evacuate the chamber before opening the lid via a vacuum port.
- Wait at least 10 minutes after the centrifuge has stopped to allow any aerosols generated in the chamber to settle.
- Clean and decontaminate all parts after each use, according to the manufacturer's instructions. (Note: some rotors may be autoclaved. Check with the manufacturer.)
- Develop standard operating procedures (SOPs) to minimize contamination and exposure. This is especially important when using radioactive materials, as many commercially prepared radioactive decontamination agents are highly alkaline and may subject metals to corrosion.

## SPILLS AND LEAKS

Occasionally samples may spill or leak inside the centrifuge due to failure of the rotor or associated centrifuge parts. Anytime a sample containing hazardous materials has leaked inside the centrifuge this should be treated as an emergency and the following steps should be followed:

- Close the centrifuge lid immediately with the samples remaining inside and turn the centrifuge off.
- It may be necessary to vacate the lab depending on the nature of the spilled material and its ability to generate an aerosol. When the lab must be vacated, secure the room such that others cannot gain access. Post signage indicating restricted entry.
- All personnel should decontaminate themselves and seek medical attention as necessary.
- Notify principal investigators, lab supervisors, and coworkers as quickly as possible about the issue.
- Form a plan for decontamination using guidelines outlined in the Standard Operating Procedures discussed above.
- Wait at least 30 minutes before entering the lab to allow aerosols to settle and decontaminate according to plan.

You can read about a spill involving infectious material in a centrifuge by clicking here . The researcher involved in this incident was exposed to a BL3 pathogen (later classified as a BL4 pathogen directly as a result of this event) and became very ill from exposure to a spill in a centrifuge.

The Department of Environmental Health and Safety (EH&S) may be contacted for technical assistance at:

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| (617) 495-2060 | Cambridge/Allston |
| (617) 432-1720 | Longwood/Southboro |

Material for this document came from the following sources:

WEB:

http://www.ehs.cornell.edu/lrs/Centrifuge/RotorSafetyGuide.PDF
http://www.yale.edu/oehs/bbpstuff/censpill.htm

PRINT:

Clark, D. E. "Safety and the Laboratory Centrifuge." *Chemical Health and Safety.* 2001. 8(6):7-13.

McRae, M. A. (2001) "Centrifuge Safety." In *Handbook of Chemical Health and Safety.* Ed. R.J. Alaimo. Washington, DC :Oxford University Press, 2002. 265-271.

AUDIO/VISUAL:

*Centrifugation Hazards.* Videocassette. Howard Hughes Medical Institute, 1995. 9 mins.