

Centrifuges are instruments used to separate mixtures, based on particle size and density, by spinning the mixtures at high speed. Improperly used or maintained centrifuges can cause serious injuries or potential exposures due to the release of aerosols and physical hazards such as dropping heavy equipment, electrical shock, and/or explosion.

Category	Microcentrifuge	Low Speed	High Speed	Ultracentrifuge
Sample Volume Size (per tube/bottle)	2.0 mL	1.5 mL – 200 mL	1.5 mL – 2000 mL	250 mL
RPM	26,000	2,000 - 8,000	14,000 - 24,000	35,000 - 150,000
Size	Small	Medium – Large	Medium – Very Large	Medium – Very Large
Location	Bench Top	Bench Top or Floor	Bench Top or Floor	Bench Top or Floor
Physical Hazard	Low	Moderate	High	Very High

## **COMMON LABORATORY CENTRIFUGES**

## HAZARDS

#### Aerosols

Aerosols are very small liquid droplets or particles that can remain suspended in air, and potentially inhaled depending on their size. Procedures that impart energy to a microbial suspension will produce aerosols. Therefore, aerosols can be created when filling centrifuge tubes, removing plugs or caps from tubes, pipetting, resuspending pellets, and during centrifugation itself. Without proper containment, aerosols from hazardous materials such as biological, chemical or radioactive materials can be released into the centrifuge chamber or rotor when force is exerted on tubes, vials, or microplates, or when they are broken or damaged during centrifugation. These aerosols can also be released into the laboratory environment if centrifuge is opened before they have settled.

## **Explosions**

Explosions can occur from rotor failure, unbalanced rotors, and using the incorrect tubes. Rotors are prone to metal fatigue over time, especially those used in ultracentrifuges at high speed. Metal fatigue can lead to cracks and distortions in the rotor. Some chemicals that remain in the rotor from leaking samples or used to clean the rotor can also cause corrosion.

## **Electric Shock**

Overloading a circuit with high current devices can cause electrical shock injury and potentially a fire. All centrifuges must be properly grounded.



## SAFE WORK PRACTICES

The use of safe work practices when operating a centrifuge should be based on the manufacturer's user manual, the laboratory-specific SOPs, and general best practices for safe centrifuge operation as provided in this document.

### Ventilation

Proper ventilation decreases potential accumulation and exposure to aerosols by refreshing the air in the laboratory several times an hour. Laboratory windows and doors should never remain ajar, especially when experiments are in process or equipment are in use.

### Containment

Primary containment equipment such as the biological safety cabinet (BSCs) and chemical fume hood can be used to capture aerosols generated during centrifugation. BSCs can be used to operate smaller centrifuges or open/close equipment (*e.g. tubes, microplates, sealed rotors, buckets with safety cups*) inside of them. Chemical fume hoods can also be used to contain aerosols, but they should not be used for infectious materials since they cannot filter the air.

### **Centrifuge Safety Measures**

NOTE: If you have questions about the safety of a specific sample container, centrifuge or any of its parts, you should consult the manufacturer prior to performing any work with these items.

• Door Lock System

An interlocking system that latches the lid of the centrifuge. It helps prevent injuries by stopping the lid from opening while the rotor is spinning.

- Aerosol Containment
  - <u>Sealed Rotors</u> create a seal between the rotor lid and rotor base for aerosol containment.
  - <u>Safety Caps or Cups</u> enclose swing arm rotor buckets or microplate holders for aerosol containment.
  - <u>O-rings</u> are ring-shaped gaskets used to seal connections. These can prevent aerosol release when maintained properly.
- Sample Container Selection
  - Sample containers, such as ultracentrifuge tubes and conical vials, should be specifically designed for use in a centrifuge and made of plastics that can withstand the force exerted on them without breaking or leaking.
  - Sample containers should not be reused for centrifuging.
  - Sample containers should not be made of glass.
- In-line High Efficiency Particulate Air (HEPA) Filter
  - High-speed centrifuge chambers are connected to a vacuum pump. If there is breakage or accidental aerosol release, the pump and pump oil can become



contaminated. A HEPA filter should be placed between the centrifuge inner chamber and vacuum pump to reduce the likelihood of contamination in the vacuum pump system.

- HEPA filters can also be used to filter centrifuge exhaust.
- Administrative Controls
  - Review the Manufacturer's User Manual and Instructions prior to operating the centrifuge.
  - Develop and review the Laboratory-specific Standard Operating Procedures (SOPs) for each centrifuge model and the materials used including emergency procedures.
  - Ensure all centrifuge users are trained on all applicable SOPs.
     Establish a routine inspection and maintenance schedule based on manufacturers' recommendations for each centrifuge and rotor. An inspection or maintenance schedule includes but is not limited to:

Inspections	Maintenance			
Frayed power cords	Apply grease to the seals			
Improperly latching lids	Clean & disinfect periodically			
Missing O-rings	<ul> <li>Maintain a logbook for all high-speed and ultracentrifuges.</li> </ul>			
<ul> <li>Dry, cracked seals, gaskets, or O- rings</li> </ul>	Check the logbook for:			
Rotor cracks, scratches or dents	<ul> <li>Operator, date, and time</li> <li>Rotor type and serial number</li> </ul>			
Rotor corrosion or pitting	<ul> <li>Run time and temperature</li> </ul>			
Frayed power cords	<ul> <li>Speed (g-force or RPM)</li> </ul>			



# **CENTRIFUGE FAILURE**

Safe centrifugation requires balanced loading of the centrifuge rotor regardless of the number of positions. Unbalanced tubes can lead to permanent damage of the centrifuge and can be hazardous, particularly when operating at higher centrifugation speeds. If the centrifuge begins to shake or wobble, it is off balance and you should stop it immediately.

The precision of the balancing becomes progressively critical as the intended centrifugation speed increases. In most cases, the rotor should contain an even number of tubes. When working with an odd number of sample tubes use a balance or blank tube of the same weight as the opposing tube. Opposing tubes must be located 180 degrees from each other to achieve balance.

### In the event of centrifuge damage or failure:

- If you hear an unusual noise or the centrifuge begins to shake or "walk," abort the run if safe to do so.
- Once the noise or vibration stops, follow your laboratory-specific SOPs to assess and address the cause.
- If you are unable to abort the run, leave the area and post signage that the area is off limits so no one else enters the room.
- Notify your supervisor and EHS immediately.

## In the event of a spill or release:

If you suspect there was a spill or aerosol, release or you open the centrifuge and notice a spill or compromised sample container:

- Close the centrifuge lid and turn it off.
- Notify everyone in the area and your supervisor immediately.
- Leave the lab and close the door on your way out.
- Post a spill sign on the door stating 'do not enter' and identifying the biohazardous material.
- Leave the area for at least 30 minutes to allow aerosols to settle.
- Submit an Incident Report to EHS.

Once the aerosols have settled, clean up the spill using appropriate PPE and decontaminant.

- Clean and decontaminate centrifuge interior, rotors, safety cups or buckets following your laboratory-specific SOPs.
- Place any contaminated PPE and all clean-up materials in the appropriate biological waste container.
- Wash hands and any exposed skin surfaces with soap and water.



	DO		DO NOT
•	Verify the centrifuge, rotors, sample containers, and accessories are appropriate for the sample type and application	•	Overfill tubes and containers. The volume in the container should not exceed ¾ of its capacity to avoid leakage
•	Leave sufficient free space on each side and behind the centrifuge to facilitate proper ventilation	•	Use the centrifuge with the lid or rotor lid open
•	Place centrifuges in equipment rooms to minimize lab staff exposure to noise	•	Exceed the recommended run speed
•	Precise balancing of sample tubes is critical especially when using a high speed or ultracentrifuge	•	Stop a spinning rotor with your hand
•	Use tubes with secured lids e.g. screw- tops	•	Re-use disposable sample tubes
•	When centrifuging biological hazards, always exercise caution and load and open rotors in a BSC	•	Use cracked or damaged tubes/bottles or rotors with visible damage or wear
•	Consult the centrifuge manual or manufacturer for information on the specific types/models of rotors to use with your centrifuge	•	Open sealed rotors or safety cups outside of a BSC when centrifuging potentially hazardous materials