

Centrifuge Safety Factsheet

Centrifuges are used in various laboratories across Iowa State University (ISU). A centrifuge is a machine with a rapidly rotating container that applies centrifugal force to separate its contents based on density. If centrifuges are not properly operated, they may injure or expose users to hazardous aerosols. According to the Occupational Health and Safety Administration (OSHA), the majority of all centrifuge accidents result from user error.

Operation Checklist

<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA	Don appropriate PPE based on the materials you are using. Minimum PPE required: safety glasses, lab coat, long pants, fully enclosed shoes, and gloves.
<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA	Inspect electrical cords and plugs for defects.
<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA	Confirm centrifuge is directly plugged into an electrical socket that has been properly grounded. Do not connect to an extension cord or power strip.
<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA	Ensure a sturdy, level worksurface prior to operation. Do not move the centrifuge while it is running.
<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA	Avoid locating the centrifuge near areas where vibration may cause items to fall off nearby shelves.
<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA	If applicable, place centrifuge in a fume hood, glovebox, biosafety cabinet, or other engineering control to prevent inhalation exposure.
<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA	Inspect tubes or containers for cracks or flaws before using them.
<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA	Confirm the rotor is clean and properly seated. Do not use rotors which show any signs of corrosion and/or cracks.
<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA	Verify buckets and tubes are matched sets, properly fitted, dry, and clean.
<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA	Use only rotors and accessories which have been approved by vendors for the specific centrifuge model(s).
<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA	Biosafety Level 2 or higher material(s) must use sealed tubes, O-ring sealed rotors, or O-ring sealed safety buckets to contain potential spills and prevent aerosols.
<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA	For Radiological Hazards: label as "Caution – Radioactive Material," before removing the label Perform contamination survey. Use appropriate shield, use tubes with screw caps and o rings.
<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA	Do not centrifuge explosive or flammable materials or substances which could react violently with one another.
<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA	Ensure the tube/container volume does not exceed 75%. Do not overfill centrifuge tubes or containers.
<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA	Balance the centrifuge by mass and not volume. Use a scale to help accurately balance tubes. Refer to <i>Balancing a Centrifuge</i> below.
<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA	Properly secure the lid and do not open the lid while the rotor is moving.
<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA	Ensure that the selected rotor speed does not exceed the maximum recommended by the manufacturer.
<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA	Once the centrifuge has reached its desired operational speed, observe if there are any signs of mechanical failure, wobbling, or shaking. If any are observed stop the centrifuge immediately. This will only stop power to the rotor which will still spin until it is slowed to a stop by friction.
<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA	When centrifuging infectious and/or Biohazardous materials, tubes must be opened inside a biosafety cabinet. It is recommended to allow 10 minutes after the rotor stops moving before opening to prevent potential aerosolization.

How Does a Centrifuge Work?

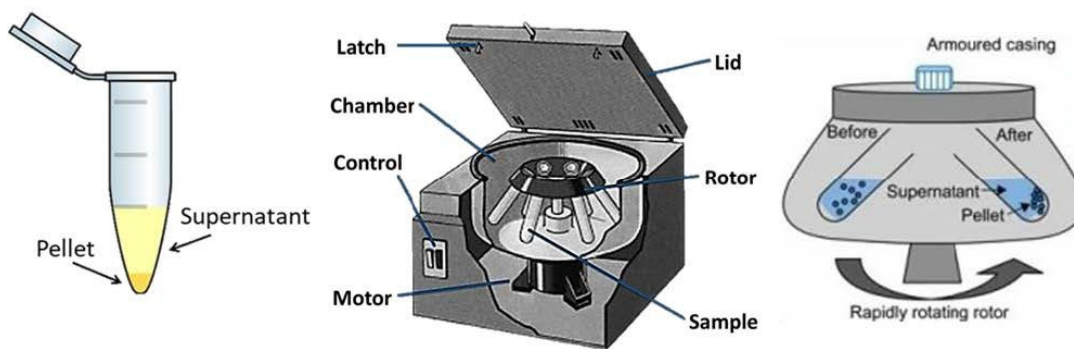


Figure 1. Source: University of California, Irvine Standard Operating Procedure: Centrifuge

Explanation: Centrifugal force is the outward pull you feel when you spin around in circles. The faster you spin the higher the force.

Cause: Gravitational force will cause particles of higher density than the solvent to sink, and those less dense to float to the top.

When a centrifuge is complete, remove tubes carefully as to not mix up the particles again. The particles in your sample will be in the bottom of the tube, called the pellet, and the liquid on top is called the supernatant.

Factors to Consider When Selecting a Centrifuge

Speed: The higher the speed of the centrifuge the higher centrifugal force. Account for the model's speed capacity when selecting the appropriate centrifuge for your project. Units for speed are either RPM (revolutions per minute) or RCF, which is related to g-force.

Size: The size of centrifuge depends on speed required, tube size or volume of the sample, and space available in the laboratory.

- Benchtop: Provides a smaller footprint and offers general purpose or wide range use.
- Floor: Offer greater sample capacity and can achieve higher speeds.

Temperature: Some models have temperature control options such as refrigeration.

Tube Type and Size: Verify that the tube is rated for use in a centrifuge and the speed, or it could break in the centrifuge.

- Adapters can be used to provide support.

Ensure the centrifuge is used for its intended use only.



Figure 2. Source: University of California, Irvine Standard Operating Procedure: Centrifuge

Balancing a Centrifuge

Balance: The amount of liquid needs to be equally distributed both in sample weight and placement. If you are centrifuging various types of samples use a balance to ensure a proper weighted balance.

- Across: If you have a tube that doesn't have a partner across from it, use an extra tube with a similar volume as a balance.
- Equally distributed in rotor (for example, a triangle configuration)

Unbalanced samples may cause significant equipment damage and injure the operator and other laboratory personnel. This becomes increasingly important at very high rotor speeds.

Pay attention to the centrifuge alarms and digital displays for warning signs. Most relatively newer centrifuge models have electronic imbalance recognition systems.

There are different configurations you can use to balance the centrifuge. See examples below:

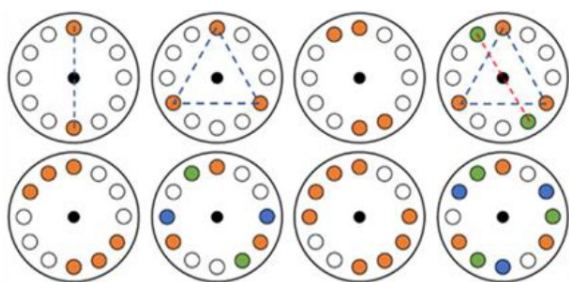


Figure 3. Source: University of California, Irvine Standard Operating Procedure: Centrifuge

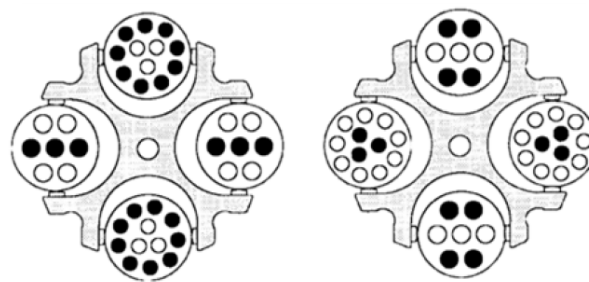


Figure 4. Source: University of California, Irvine Standard Operating Procedure: Centrifuge

Maintenance

- Check the equipment manual for recommended maintenance and be familiar with the different settings.
 - To avoid injury, workers should follow the manufacturer's operating instructions for each make and model of centrifuge that they use.
- Inspect critical components, and look for signs of wear, including scratches, or effects of chemical exposure on the rotor.
 - When working with corrosive materials (salt solutions, acids, bases), the accessory parts and vessel must be cleaned carefully.
 - Never use a centrifuge if parts of its cover panels are damaged or missing.
- Centrifuges and accessories must be cleaned regularly or when contaminated. Use neutral cleaning solutions and a soft cloth.
- Keep the centrifuge properly lubricated.
 - O-rings are the main source of protection against sample leakage and must be lubricated prior to installation of a new rotor or following cleaning.
 - Any threaded components should be cleaned regularly and lubricated with an approved grease to ensure proper operation and to prevent cross-threading and corrosion.
- It is recommended to keep a log of run time for ultracentrifuges to determine when a rotor should be retired.
- Contact a qualified service technician for additional maintenance or repairs.
 - Some vendors provide annual Preventative Maintenance (PM) if under a maintenance contract.
 - Some high-speed centrifuges (example Ultra-centrifuges) are required to be certified. Ensure it is certified according to the manufacturer's recommendation.

References

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