UC RIVERSIDE | Environmental Health & Safety

MICROTOME SAFETY PROGRAM

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INTRODUCTION

Microtomes (manual, semiautomatic, and automatic) are devices that are used to cut tissues into extremely thin sections. There are several types of microtomes available. The most commonly used microtomes are rotary, sliding, and freezing (Cryostat). Microtomes can present a sharp hazard, freezing hazard, and expose personnel to infectious agents or other hazards if not used properly.

OBJECTIVES

The objectives of this program are to ensure that researchers working with microtomes are aware of the regulations, hazards, and controls used to minimize risks to themselves and the laboratory.

RESPONSIBILITIES

Environmental Health and Safety

EH&S is responsible for providing information and guidance to laboratories with regard to the regulations and safety procedures associated with microtomes.

Principal Investigators (PIs)

The PI is responsible for maintaining safety protocols in their laboratory spaces. This involves making sure their laboratory personnel are properly trained for hazards that may be present in the laboratory, and that training is documented. The PI is also responsible for making sure that all safety precautions are being upheld in their laboratory space, including use of Standard Operating Procedures (SOPs) and adherence to the Personal Protective Equipment (PPE) policy. The PI ensures that the equipment in their space is regularly maintained. While a PI may delegate tasks

related to safety to members of their laboratory, the ultimate responsibility of safety in the space remains with the PI.

Laboratory Personnel

Laboratory Personnel are individuals who work in the laboratory. Laboratory personnel are required to follow all safety protocols in the laboratory as outlined by the PI, including following SOPs and wearing required PPE. Any changes to established procedures should be approved by the PI before making the change.

TYPES OF MICROTOMES

There are different types of microtomes, each designed to address unique requirements. Here are 7 of the most commonly used microtomes.

1. Rotary Microtomes

   Rotary microtomes are the most common option for laboratories. These devices section paraffin-embedded tissue samples within the range of 0.5 to 60 micrometers (µm). These machines are relatively simple in design, consisting of a weighted handwheel, sample chuck and blade assembly.

   Many rotary microtomes have motorized sectioning and foot pedals. These allow the user to step on a pedal and conduct automatic sectioning, saving the user effort and ensuring consistent sections. Microtomes equipped with foot pedals must have guards to lock out/prevent accidental foot pedal operation.

2. Cryostat Microtomes

   Cryostat microtomes operate similarly to rotary microtomes, except sectioning occurs in a controlled, enclosed freezer. To prepare tissue for cryosectioning, fixed or fresh samples must be embedded in a mold filled with aqueous-based medium, and rapidly frozen. Freezing and embedding the sample achieves a similar aim to epoxy or paraffin embedding: hardening the sample to stabilize it before sectioning. This allows cryostat microtomes to section extremely thin slices of the sample.

3. Sliding Microtomes

   The sliding microtomes' primary purpose is to section the same type of samples as rotary microtomes. However, they are also effective in sectioning hard materials like wood, with the proper blade. They also have varying size range, offering greater flexibility than a regular rotary microtome. As the name implies, the blade of a sliding microtome is mounted on a slide. It moves down the slide to the fixed sample holder, sectioning off a layer with each stroke.

4. Saw Microtome

   Saw microtomes are ideal for sectioning hard, brittle samples like bone, teeth, or wood. As such, they are typically used in biological and environmental research labs or in forensic labs. Samples are mounted against a spinning blade recessed within the unit. Some have diamond blades to ensure clean sections of even the hardest samples. As the blade spins, a low-pressure water jet continuously keeps the blade from overheating. Saw microtomes produce the thickest sections of any microtome, not allowing for any sections thinner than 30 µm.

5. Vibrating Microtome

The purpose of vibrating microtomes is to section soft, fresh samples (such as brain, nerve, and spinal cord tissue) that are free of wax. This microtome and sample combination ensures the cell morphology remains intact. The vibration allows for the sample to be sectioned with less pressure than it would normally require, ultimately minimizing damage to the cell morphology of the samples. Fresh samples sectioned are usually over 30 µm thick while fixed samples are over 10 µm.

6. Laser Microtome

   Laser microtomes are the only options that offer non-contact microtomy, which is vital for applications where the sample's cell morphology must remain unaltered. Samples can be cut in their native state without requiring any sample preparation beforehand. Since they do not use physical blades, they can slice virtually any type of sample from bone to soft tissue.

7. Ultramicrotome

   Ultramicrotomes were designed to produce sections for transmission electron microscopy (TEM) which requires sections to be slimmer than 150 nm.

CALIFORNIA REGULATION FOR WORKING WITH MICROTOMES

California/OSHA Standard 3558 applies to microtome usage. The standard covers safe use, training requirements of operators, and proper adjustment, removal, replacement, or maintenance activities involved with microtomes. For more information, visit https://www.dir.ca.gov/title8/3558.html

RISKS ASSOCIATED WITH MICROTOMES

There are several risks associated with using microtomes depending on the type of microtomes and the materials being sectioned.

- Lacerations or cuts from sharp blades
- Injuries from moving parts
- Exposure to biological hazards or bloodborne pathogens from unfixed tissues
- Exposure to chemical hazards from fixatives
- Burns from extended contact with the cold (cryostat microtomes/cryotomes)

General risk mitigation measures are as follows:

Engineering Controls

- For manually operated microtomes, ensure that the rotary wheel is locked in place before manipulating the blade or specimen.
- For automatic microtomes, perform lock out/tag out (LOTO) before manipulating the blade or specimen.
- For microtomes with foot treadles, ensure a guard is present and the treadle is placed out of the way to prevent accidental activation before manipulating the blade or specimen.
- Use mechanical devices such as forceps to handle blades**. Never use your fingers to handle the blade.**

Administrative Controls

- Users must thoroughly read and understand the microtome's manufacturer's operating manual.

- Laboratories should develop a standard operating procedure (SOP) for their specific use and instrument. The SOP should cover the following topics:
    - Blade hazards, sharp safety, and injury prevention
    - Proper placement, use, removal, cleaning, and disposal of blades
    - Appropriate personal protective equipment (PPE)
    - Other potential hazards associated with the material being handled (i.e. bloodborne pathogens or other infectious agents in unfixed tissues, chemical fixatives, frozen materials, etc.)
    - Safe operations and use
    - Ergonomics
    - Incident/injury response and reporting
- Laboratories must provide training to users on the above referenced SOP and ensure that they have read the manufacturer's operating manual prior to use. The training should be documented in a written document. See EH&S website for a Spotlight on Safety about microtomes with a sample training template/acknowledgement form: https://ehs.ucr.edu/document/sos-microtome. Training records must be kept for 3 years after an individual leaves the lab.
- Prior to use of after any changes to the setup or SOP, reference and perform the **Microtome Hazard Safety Checklist** attached at the end of this document. If any item is marked "No", correct the hazard and note the date corrected before resuming use of the microtome.

Personal Protective Equipment (PPE)

Note that the following are basic PPE requirements per UC PPE Policy.

- **Eye Protection:** Safety glasses/goggles are always required when working in a lab. Where there may be risk of splashes or flying debris, consider goggles or face shields to increase eye protection.
- **Hand Protection:** Gloves must be worn when handling hazardous materials. Gloves should be chosen on the basis of the hazard (biological vs chemical vs cold temperatures). Consider cut-resistant gloves for handling blades and cryogenic gloves for handling frozen specimens or touching cold components. Disposable gloves should be worn under **AND OVER** these specialty gloves to protect these gloves from biological or chemical hazards.
- **Body Protection:** Full length pants or equivalent, closed toe/closed heel shoes, and a lab coat are required in all lab spaces.

SAFE OPERATING PROCEDURES

Set-Up

- Prior to operating the microtome, proper PPE should be worn (see above): safety glasses/goggles (or face shield if required), lab coat, and disposable gloves. Cryogenic gloves or cut-resistant gloves may be required based on risk.
- Lock the wheel, lock out/tag out the equipment, or ensure foot treadle is guarded and out of accidental activation range.
- Gather materials and tools required for the procedure and place them near the microtome.
- Load the tissue block/specimen and position it first, if possible. Consider using forceps or other appropriate tool(s) to manipulate the specimen to minimize cross contamination of gloves.
- Place the blade in the holder. Manipulate/handle the blade with forceps or cut-resistant gloves. **Never use your fingers to handle the blade directly**.

- Cover the blade with foam or other material when loading the tissue block/specimen and positioning it if blade has to be placed before the specimen/tissue block.

Operation/Sectioning

- Position and retrieve sections using brushes or other applicable tools. Never use fingers to manipulate the specimens or sections.
- Maintain at least a minimum 1 inch clearance distance between the user's hands and any moving parts or blade.
- Be trained and familiar with emergency procedures if you need to stop the sectioning. Do not continue sectioning if a hazard/danger is present.

Clean Up

- Always clean the equipment between users and at the end of each session.
- Lock wheels, lock out/tag out the equipment, or ensure foot treadle is guarded and out of accidental activation range.
- Use forceps, other tools, or cut-resistant gloves to remove the blade.
- Discard the blade directly into a sharps container. If you plan to re-use the blade, it should be placed in a container with the appropriate disinfectant to soak for the appropriate contact time. After soaking, use forceps and other tools to remove any residue and rinse thoroughly with water. Store blades in a blade box that is a closed hard-walled container to prevent accidental contact.
- Use forceps and other tools to remove any stray shavings from the interior of the microtome and place them in the appropriate waste container.
- Clean and decontaminate the interior components with the appropriate disinfectant. Use a cloth or appropriate material, manipulated with forceps, to scrub and clean surfaces. For hard-to-reach areas, consider using a handled brush soaked with disinfectant.
- Soak up any residual disinfectant and rinse with 95% ethanol (if compatible and appropriate). Allow the equipment to air dry completely before using it again.
- If bringing in outside vendors for equipment repair or maintenance, ensure that the microtome is properly locked/guarded and decontaminated BEFORE the vendor arrives.
- Keep areas around microtomes clean and neat to minimize cross-contamination.

EMERGENCY PROCEDURES

Always use extreme caution due to the potential for serious injuries.

In the event of an injury requiring immediate medical care,
CALL 911 for emergency assistance!

Exposure or Injuries

Any exposures or injuries should be treated promptly with first aid followed by medical evaluation, as appropriate. While the primary hazard associated with microtomes are cuts or lacerations from the blades, other injuries or exposures can occur. It is important to understand other hazards associated with using microtomes.

Skin:

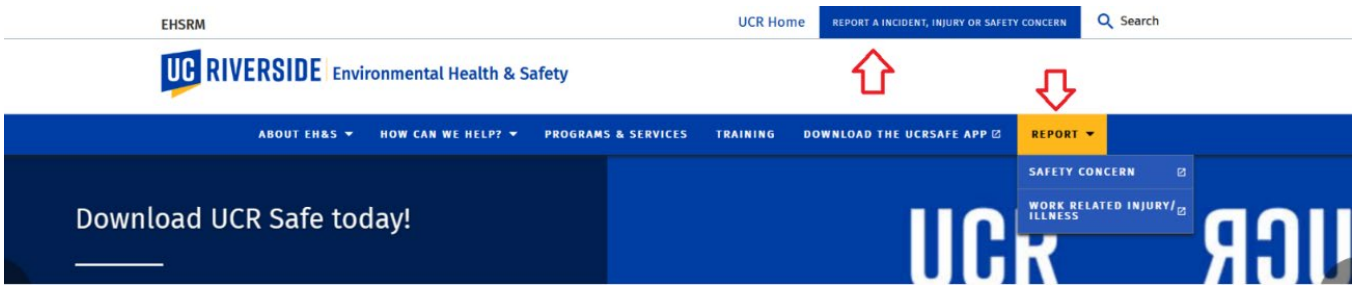
1. Rinse/wash cuts with copious amounts of water for at least 5 minutes. If specimens contained biological or chemical hazards, use a gentle hand soap in addition to water.

2. Apply clean gauze or bandage to the wound.
3. If the wound continues to bleed excessively, call 911 or seek professional medical care.
4. For minor cuts, monitor the wound and seek professional medical care if there are signs of infection or irritation (i.e. increased redness, pain, swelling, bleeding, or if you develop a fever). For cuts involving specimens containing biological or chemical hazards, always seek professional medical evaluation to determine if post-exposure prophylaxis is required.
5. For freezing burns, cover the area loosely with clean gauze/bandage and seek professional medical evaluation and care.

Eye:

1. Immediately flush the eyes with water! Flush eyes at the emergency eyewash station for 15 minutes. Occasionally lift the upper and lower eyelids to ensure thorough rinsing.
2. Call 911 or seek professional medical care if eyes are irritated or eyesight is compromised.
3. Seek medical evaluation if exposed to biological or chemical hazards.

For any exposures or injuries, notify your supervisor **AND** EH&S by calling (951) 827-5528 or submitting an online report using the "**Report a incident, injury or safety concern**" link at the top of any EH&S webpage (https://ehs.ucr.edu/report).



REFERENCES

California/OSHA Standard 3358
https://www.dir.ca.gov/title8/3558.html

UC Irvine Safety Moment: Microtome and Cryostat Safety
https://ehs.uci.edu/safety/pdfs/microtome-and-cryostat-safety.pdf

UC Davis SafetyNet 146: Microtome Use Hazards and Precautions
https://safetyservices.ucdavis.edu/safetynet/microtome-use-hazards-and-precautions

RESOURCES

Examples of vendors selling cut-resistant gloves. Choose gloves that provide high cut protection balanced with dexterity and tactile sensitivity.

https://www.fishersci.com/shop/products/pip-kut-gard-dyneema-cut-resistant-gloves-cut-level-5/p-4891786

https://www.grainger.com/category/safety/hand-arm-protection/safety-gloves/cut-resistant-gloves

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MICROTOME HAZARD SAFETY CHECKLIST

Surveyor Name:_____ Survey Date:_____

Principal Investigator:_____ Building/Room:_____

If "No" is selected, correct the hazard and note the date.

	YES	NO	N/A	DATE CORRECTED
Microtomes shall be used, operated, and maintained by qualified persons in accordance with the manufacturer's recommendations				
Microtome operators are trained in the requirements of Section 3358, Microtomes consistent with Section 3203, Injury and Illness Prevention Program				
Blades are handled according to manufacturer's guidelines when installing or removing. Use forceps or other appropriate tool(s)				
During operation, a **minimum** clearance of 1 inch shall be maintained between the operator's hands and any moving parts or blade (point of operation) of the microtome				
Tissue sections or sections of any other material sliced by the microtome shall only be retrieved using forceps and/or other appropriate tool(s)				
Microtome blades must be stored in original or other proper storage containers to avoid personnel injury or equipment damage				
During microtome setup, the sample is positioned first then the blade is inserted, if possible				
When applying the brake, ensure that it is tight. Many injuries are caused by brake slippage				
Blade guards must be in place when leaving the microtome, even for a short period of time				
When operating microtomes, the foot treadle shall be positioned to avoid accidental activation				
When not in use, the foot treadle of each electrically-powered microtome must be guarded by a cover or guard that will prevent unintended operation.				
The adjustment, removal, replacement or maintenance activities of microtomes shall be performed using equipment specific lockout/tagout procedures				
Other				