

Laboratory Ergonomics: Microtomes, cryostats, cell counters, micro-manipulation, lifting, and glove boxes

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In this final article of the Laboratory Ergonomics series, we discuss laboratory tasks and equipment that are often a source of repetitive and traumatic strains.

Microtomes

Manual rotary microtome use in laboratories requires many repetitive functions. A lab technician using 40-50 blocks a day will turn the microtome wheel at least 1000 times. This is not only repetitive, but requires force as well. Other related tasks such as replacement of specimens and use of a trimming wheel add to the problem.^{1,2,3} In order to reduce the stresses and repetitive nature of this work, consider the following options:

- Rotate tasks and take frequent short breaks every 20 minutes.
- Use a fully adjustable chair with adequate back support and a footrest.
- Place the microtome on an appropriate height work bench for standing or sitting. Refer to the last article for correct heights.
- If sitting, make sure there is adequate clearance for legs and thighs.
- Reduce force when operating the handwheel.
- Retrofit the existing handle with an adapter that will allow the operator to use the handwheel in a pistol grip, thus alleviating repetitive wrist flexion and extension.
- Adjust the feed wheel position to reduce stress.
- Use motorized cutting.
- Use an external control unit like a front pedal instead of the hand-operated wheel.
- Apply padding to the work surface and edge to eliminate sharp edges.
- Purchase an automatic microtome when feasible.



Photo courtesy of Vibrotome

Cryostats^{1,3,4}

- Consider using an automatic foot operated cryostat when frequent cryosectioning is performed.
- Use a fully adjustable chair with adequate back support and a footrest.
- Apply padding to the edge of the cryostat to reduce contact stress.
- Take short stretch breaks every 20 minutes.
- Avoid placing utensils such as forceps inside the cryostat. This will keep utensils at room temperature and reduce cold exposure to the hands and fingers.

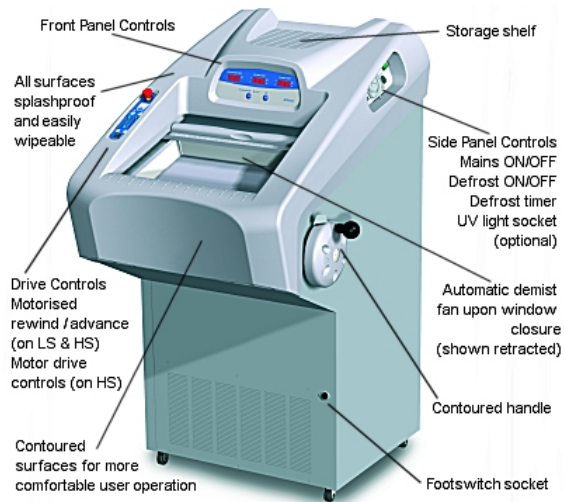


Illustration courtesy of Jencons

Cell Counters^{1,3,5}

- Use an edge protector and/or wrist rest to reduce stress on forearm and wrist. (See Resources below).
- Reduce the force needed to strike the manual counter.
- Take frequent, short breaks.
- Rotate tasks among several people.
- Use an adjustable chair or stool with solid footrest.
- Purchase an electronic differential tally counter to replace manual counters. Soft keys permit accurate and fast counting with decreased hand fatigue. Or purchase a "light touch" manual counter.



Photo courtesy of Daigger Lab Equipment

Flow Cytometers^{1,3,4}

The use of a flow cytometer requires frequent lateral bending, neck and back flexion, and arm extension. This is due to the receiving port being located on the bottom of the flow cytometer. The operator must sit in awkward positions to see the controls. Implement the following recommendations to control hazards associated with flow cytometer use:

- Raise the flow cytometer by placing a block between it and the workbench.
- Purchase an electric or hydraulic adjustable table so that each lab technician will be able to adjust the height most comfortably for them.
- Use a fully adjustable chair or stool with footrest.
- Position the VDT display so the top of the screen is approximately at eye level.

Glove Boxes^{1,4}

Working in glove boxes or anaerobic chambers requires working with extended arms and frequent side reaching, both very tiring for the shoulders and arms. The thick gloves force the user to grip objects more firmly. Where possible, the following are recommended to control ergonomic hazards:

- Move all needed materials for the experiment from the side chamber to the main chamber to reduce side reaching.
- Use highly absorbent hand powder for glove comfort.
- Rotate tasks to avoid long continuous use of glove boxes.
- Consider use of a sit/stand seat to alleviate stress on the low back.
- Take frequent mini-breaks (3-5 minutes for every 20-30 minutes of glove box work) to perform stretching exercises and relieve strain from the shoulders and improve circulation to the shoulders, arms, and hands.
- Use anti-fatigue mats when using the glove box in a standing position. (Refer to: Products > Lab Supplies)

Micro-manipulation and fine motor skills^{1,3,4,5,6,7}

Many laboratory procedures require repetitive use of the finger and wrists. For example, removing caps and screw-off vials, reaching into bins, and using forceps all require use of small muscle groups that tire quickly or awkward postures that cause strains. Small dissections under a microscope require use of small tools and small muscles of the hands and arms.

- Use plastic vials with fewer threads to reduce twisting motion when capping and uncapping lids.
- Use small pieces of foam tubing to prevent soreness on fingertips and to distribute the force over a greater surface area, reducing compressive forces on soft tissue. (See Resources below for foam tubing).

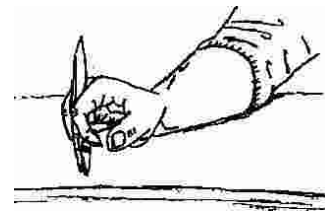
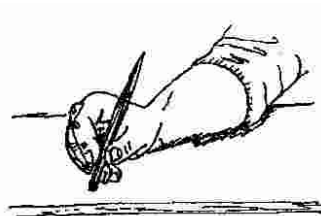


Forceps grip enlarged with foam tubing.
Courtesy of Reference 6.



Dissecting Needle grip enlarged with foam tubing
Courtesy of Reference 6.

- Alternate using forceps between the first and second fingers, and the thumb and first finger to reduce the use of the thumb. The thumb is used repeatedly in almost every lab task.



- Tilt storage bins toward you to reduce wrist flexion while reaching for supplies.
- Take short breaks and do hand, wrist, and forearm exercises. (See the web pages with Stretches).
- Use pre-printed computer-generated labels to avoid labeling small test tubes and vials by hand.

- When writing in lab notebooks is required, use pens and pencils that fit your hand, a slantboard, and a padded edge protector. For pens and pencil recommendations, go to the Products > Office Supplies web page. For slantboard recommendations, look at the bottom of the web page: Products > Document Holders.
- Modify tools that do not allow you to maintain straight wrists or require pinch gripping. See Reference 6 for excellent illustrated ideas on tool modification. Three rules for tool modification are:
 - 1) Build up the part of the tool that your hand holds to fit your hand better and to reduce a pinch grip.
 - 2) Change the angle of the handle so you can hold the tool with a straight wrist.
 - 3) Use non-slip materials to reduce the force needed to hold the tool in position.
- Share workload between the right and left hands.
- Choose the right tool for the job.
- Ensure tools are in proper working order.

Lifting

Centrifuge rotors.^{1,3,4} Centrifuge rotors can weight up to 35 lbs. and are awkward in shape, posing the risk of strains during lifting.

- Use a team approach in removing centrifuge rotors. No matter how big or strong someone is, it is best to lift with two people.
- Design a harness to wrap around the rotor and attach straps on each side of the rotor. Two people can pull the rotor out from the centrifuge with the harness, reducing low back flexion and decreasing the load by half. Or implement a pulley system attached to the ceiling above the centrifuge.
- Use a cart to transport rotors.
- Look for manufacturers who produce lighter-weight rotors.

Heavy equipment and supplies.^{1,4}

- Learn proper lifting techniques. (Prevention > Other Occupations > Basic Back Rules)
- Place heavy equipment on an elevated stand or use lifting tools when needed.

Overhead lifting.^{1,4}

- Store heavy objects on shelves below shoulder height when possible.
- Use a stable footstool or stepladder to reach objects stored on shelves.
- Avoid asymmetric lifting (twisting while lifting). The object should be directly in front of you when you lift.
- Store frequently used materials on shelves no higher than shoulder height.
- Store frequently used materials close to you to avoid reaching. Use rotating carousels when appropriate.

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3. *NIEHS Health and Safety Guide to Laboratory Ergonomics, Chapter 1: Ergonomic Disorders Commonly Found Among Laboratory Personnel*, National Institute of Environmental and Health, <http://www.niehs.nih.gov/odhsb/ergoguid/chapi.htm>

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<http://www.cdc.gov/od/ohs/Ergonomics/labergo.htm>
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<http://www.uhs.berkeley.edu/facstaff/ergonomics/lab/index.shtml>
7. *Laboratory Ergonomics Tips*, Environmental Health & Safety, Stanford University.
http://www.stanford.edu/dept/EHS/prod/researchlab/lab/laboratory_ergonomics.html

RESOURCES:

Cell Counters:

Daigger Lab Equipment & Supplies, 620 Lakeview Parkway, Vernon Hill, IL 60061. 800-621-7193. <http://www.daigger.com/catalog/product?deptId=Counters&prodId=24567A>

Foam tubing:

GripWorks, Sinclair & Rush, Inc, 123 Manufacturers Dr., Arnold, Missouri 63010. 800-347-4783. <http://www.gripworks.com/foam-grips.htm>

Microtomes and Cryostats:

Sciscope Instrument Co., 407 Highway One West, Iowa City, Iowa 52246. 319-338-1107.
<http://www.sciscope.com/refmicro.php>

Jencons Laboratory Equipment and Supplies, 800 Bursca Drive, Suite 801, Bridgeville, PA 15017 http://www.jenconsusa.com/products_specs_1.cfm?id=66#TOP

Vibratome, 5918 Evergreen Blvd., St. Louis, MO 63134. 314-522-8671.
<http://www.vibratome.com/vib/vibsite/ViewProduct.asp?idproduct=067018&catdesc=Vibratome+Microtomes+%28Vibratome%29&subcatdesc=Vibratome+Instruments%2C+110+Volt%2C+50%2F60+Hz&idsubcategory=181&catthreeid=605>

Cryostat Foot Pedal: Prod #10190-5. <http://www.tedpella.com/100acces.htm#10190-5>

Worksurface edge cushioning:

AliMed, SoftEdge (\$34/6 ft.), 800-225-2610.

http://www.alimed.com/product_detail.cfm?VMID=2&FamilySKU=70459