

MACHINE SHOP SAFETY POLICY

**THE WYSS INSTITUTE
FOR
BIOLOGICALLY INSPIRED ENGINEERING**



Prepared By:

**Environmental Health & Engineering, Inc.
117 Fourth Avenue
Needham, MA 02494-2725**

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LIST OF ABBREVIATIONS AND ACRONYMS

CFR	Code of Federal Regulations
CLSB	Center for Life Science Boston
CNC	Computer numerical controlled
EH&S	Environmental Health and Safety
OSHA	U.S. Occupational Safety and Health Administration
PPE	Personal Protective Equipment
RPM	Revolutions per minute
SOP	Standard Operating Procedure
UV	ultraviolet
Wyss Institute	The Wyss Institute for Biologically Inspired Engineering

CONTACT INFORMATION

Name/Title	Phone Number	E-mail
Christopher Neal, CHMM, Manager of Environmental Health and Safety	617-432-7222 (office) or 617-293-0333 (cell)	cneal@eheinc.com
Jessica Healey, M.S., Biosafety Officer	774-244-7018 (cell)	jhealey@eheinc.com
Betsy Gilman-Duane, M.S., RBP, CBSP, Project Manager	800-825-5343*	bgduane@eheinc.com
Biosafety Emergency Response Pager	781-597-9786	
Mary Tolikas, Wyss Operations Director	978-457-5191	mary.tolikas@wyss.harvard.edu
Jean Lai, Assistant Director for Operations	617-432-7097	jean.lai@wyss.harvard.edu
Martin Montoya-Zavala, Wyss Laboratory Manager	617-233-9281	martin.montoya@wyss.harvard.edu
Occupational Health Departments:		
Harvard Medical School (HMS)	617-432-1370	
Children's Hospital Boston (CHB)	617-355-7580	
Beth Israel Deaconess Medical Center (BIDMC)	617-632-0710	
Dana-Farber Cancer Institute (DFCI)	617-632-3016	
Boston University (BU)	617-353-6630	
Massachusetts Institute of Technology (MIT)	617-253-8552	
Massachusetts General Hospital (MGH)	617-726-2217	
Brigham and Women's Hospital (BWH)	617-732-6034 or 617-732-8501	[617-732-6034 for injuries involving biological exposures; 617-732-8501 for all other injuries]
University of Massachusetts (UMass) Medical School:		
Employee Health University Campus	774-441-6263	
Employee Health Memorial Campus	508-334-6238	
Employee Health 210 Lincoln Street	508-793-6400	
Harvard University Police Department (HUPD)	617-432-1212	
BMR Security: Main Entrance to CLSB Building	617-232-0102 or 617-202-8957	
New Research Building (NRB) Security: For lockouts and escorts	617-432-6119	
Harvard Custodial Services	617-432-1901	
Chemical Waste pickup: Triumvirate	617-667-5143	clschemicals@bidmc.harvard.edu
Biological Waste/Sharps pickup (Janitronics)	781-647-5570	
ABLE Engineering (Building Maintenance)	617-735-4399	
Emergency Response Contractor: Clean Harbors Environmental Services, Inc.	800-645-8265	
Triumvirate contact: Dennis Colarusso	617-715-8920	

* **NOTE:** 800-825-5343 is the phone number for the main switchboard for Environmental Health & Engineering, Inc. (EH&E), which is the company supplying biosafety support. Please specify the employee when the person answers the phone. For biosafety emergencies, please call the biosafety emergency response pager.

EMERGENCY REPORTING

For any emergency, contact the HUPD at 617-432-1212.

For medical emergencies call 911, then HUPD with the exact location of the emergency.

For lock-outs or walking escorts anywhere **on campus**, call NRB Security at 617-432-6119.

EMERGENCY HOSPITALS

For Harvard, CHB, BWH, DFCI, MGH affiliated personnel: **BWH**

For BIDMC affiliated personnel: **BIDMC**

For MIT affiliated personnel: **MIT Medical**

For BU affiliated personnel: **Boston Medical Center**

For UMass Medical School personnel: **no preferred hospital; whichever is most convenient**

Note: For MIT and BU affiliated personnel, patients should be taken to the nearest available hospital if necessary.

1.0 PURPOSE

The purpose of this document is to provide safety guidelines and policies to be followed while working in the Wyss Institute for Biologically Inspired Engineering (Wyss Institute) light machine shops in the Center for Life Science Boston (CLSB) rooms 528A and 531, and 3D prototyping sites at 60 Oxford Street in Cambridge in order to provide a safe and healthy workplace and maintain compliance with the Occupational Safety and Health Act of 1970 and with regulations of the U.S. Department of Labor. The full U.S. Occupational Safety and Health Administration (OSHA) standard, including regulations on machine guarding, lockout/tagout, hand and power tools, electrical safety, and other machine safety requirements, can be found at the following link: <http://www.osha.gov/comp-links.html>.

This document does not cover other activities conducted within the Wyss Institute facility and is limited to activities being performed in the CLSB machine shops and 3D prototyping areas at 60 Oxford Street in Cambridge. In addition, welding is not included in this document and is not permitted at Wyss Institute laboratory facilities.

2.0 RESPONSIBILITY, AUTHORITY, AND RESOURCES

2.1 ENVIRONMENTAL HEALTH AND SAFETY OFFICE

The Environmental Health and Safety (EH&S) office has the responsibility for providing guidance to ensure the safety and health of the employees conducting work in Wyss Institute laboratories and the visitors to the Wyss Institute.

The duties of the EH&S Office include:

1. Work with platform leaders and Wyss machine shop staff to develop and implement appropriate Standard Operating Procedures (SOPs) and training for machine use.
2. Retain documentation of training on this policy for CLSB facility users.
3. Work with Wyss machine shop staff to monitor safe use of the machine.
4. Advise Wyss machine shop staff concerning adequate facilities and procedures under the applicable regulations.
5. Inspect the machine shop on an annual basis to ensure that the SOPs are being used and enforced within the machine shop.
6. Review this document periodically and update, as needed.

The EH&S office may call upon researchers, Wyss machine shop staff, Wyss administrators, and platform leaders to provide specific information concerning work being conducted within the machine shop.

2.2 WYSS INSTITUTE ADMINISTRATORS AND PLATFORM LEADERS

Wyss Institute administrators and platform leaders should ensure that all safety policies and procedures outlined in this document are followed by laboratory personnel and that all staff under their direction is trained in safe work practices appropriate to the machine shop. Platform leaders or their designees should ensure that the following duties are performed:

- Prior to installing new equipment, notify the EH&S Office and outline what equipment and procedures will be used.
- Ensure that work is conducted in accordance with this document.

- Identify any toxic chemicals or other hazards (e.g., biological, radioactive) that will be brought into the machine shop.
- Prepare SOPs for use of equipment/hazardous materials when this use involves alternate procedures not specified in these guidelines. The SOP shall include a description of the alternate procedures and an assessment of alternate controls that will be used.
- Define hazardous operations, designate safe practices, and select protective equipment or engineering controls.
- Ensure that program and support staff receives instructions and training in safe work practices, use of personal protective equipment (PPE), and in procedures for dealing with accidents or emergencies.
- Ensure that employees fully understand the training received.
- Ensure that all personnel obtain the protective equipment or engineering controls necessary for the safe performance of their job.
- Ensure that the required safety practices and techniques are being employed through periodic assessment and evaluations.
- Coordinate with the EH&S Office for workplace evaluations that include air samples, swipes, or other tests to determine the amount and nature of airborne and/or surface contamination. The EH&S Office will inform employees of the results and use data to aid in the evaluation and maintenance of appropriate machine shop conditions.
- Assist the Wyss Institute EH&S Office when appropriate.
- Investigate accidents and report them to the EH&S Office. Include recommendations for procedures that will minimize the occurrence of a similar accident.
- Ensure that action is taken to correct work practices and conditions that may result in accidents and incidents.
- Properly dispose of unwanted and/or hazardous chemicals and other hazardous materials.
- Document and maintain compliance with all local, state, and federal regulatory requirements. (The EH&S Office will provide periodic updates of new regulations pertaining to the machine shop.)

- Make copies of this document and any project-specific SOPs available to the program and support staff.

2.3 STAFF MEMBERS, VOLUNTEERS, AND STUDENTS

Staff members are those staff under the direction of the platform leader or Wyss administrator. Staff members not under the direction of the platform leader or Wyss administrator, but who are in an area under their direction, must also follow all procedures outlined in this document and any additional SOPs in effect in that area. Non-employees, such as volunteers and visiting scientists, are equally subject to the document, as described below.

The primary responsibility of the employee is to follow the procedures in this document and all SOPs. These include the following:

- Read and understand all safety documentation provided by the EH&S Office, including this manual.
- Understand and follow all machine shop SOPs.
- Understand all training received.
- Understand the function and proper use of all engineering controls and PPE. Wear PPE when mandated or necessary.
- Report, in writing, any significant problems arising from the implementation of the SOPs or this Machine Shop Safety Policy.
- Report all facts pertaining to any accident and any action or condition that may exist that could result in any accident.
- Contact the Wyss administrator, the platform leader, or the EH&S Office if any of the above procedures are not clearly understood.

3.0 EDUCATION AND TRAINING

The EH&S Office, David Breslau or Paul Machado will provide safety training to all researchers who will be working in the CLSB machine shops. Researchers working in the 3D prototyping areas will receive machine proficiency training from the Harvard Physics Department. All researchers trained in both areas will be required to review this Machine Shop Safety Policy.

Training should be provided as soon as possible and always within 30 days of hire for new employees who will be working in the machine shop, and annually thereafter. For CLSB, the name of each person trained shall be recorded together with the training contents, date, and the trainer in the EH&S Office. Training documentation for the 3D prototyping sites is maintained by the Laboratory Manager.

It is the responsibility of the Wyss administrator and the platform leader to assure that all staff members working in the machine shop attend the required training session. It is the Wyss administrator's responsibility to alert the EH&S Office of a new employee who will be working in the machine shop. Further, if English is not the primary language spoken by a staff member, the Wyss administrator should ensure that an interpreter accompanies the non-English speaking staff to the machine shop training session.

4.0 GENERAL MACHINE SHOP RULES

This chapter will cover general practices that must be followed in order to maintain a safe and effective working environment in the machine shop. Specific rules about PPE selection, electrical and fire safety, and specific machines/tools are outlined in the following chapters.

4.1 CLEANLINESS

- Work areas will be kept clean and uncluttered, and the floor will be kept free of scraps and oil.
- Floors will be kept clear of objects or cords that could cause someone to trip. Cords should be taped to the floor to eliminate a trip hazard, if necessary.
- Equipment and tools must be cleaned after use.
 - All tools must be returned to their proper storage locations at the end of the day.
 - Do not use tools that are damaged or in disrepair. They should be repaired or replaced prior to next use.
 - All power tools must be turned off and unplugged before cleaning, repairing, or making any adjustments.
 - Machines that are in use on consecutive days by an individual user may postpone cleanup until project completion, but must be cleaned as needed to prevent excessive buildup of debris or malfunctioning.
- Spilled liquids must be cleaned up immediately.
 - Call 617-432-1212 to report large-volume or hazardous spills.

4.2 COMPRESSED AIR

Under Title 29 Code of Federal Regulations (CFR) Section 1910.242(b), the following rules will be followed when using compressed air for cleaning.

- Compressed air must not be used to clean your clothing or yourself.
- Compressed air will not be directed at other people.
- Compressed air used for cleaning work areas, such as work benches, table saws, and drill presses, shall not exceed 30 pounds per square inch at the outlet.
- Chip guarding will be used and appropriate eye protection will be worn when using compressed air.

4.3 GENERAL SAFETY RULES

- Read the operator's manual, or comparable literature, before using any power tool.
- Do not use any tool unless you have been trained to do so.
- Inspect tools before each use, and replace or repair any damaged tools or parts before using.
- Never use damaged tools.
- Do not repair tools unless you are trained to do so.
- Only use tools and attachments for the purpose for which they were designed.
- Always select the correct tool, bit, cutter, or grinder for the material that you are working with.
- Never alter a tool unless trained to do so in a safe manner.
- Never use power tools before they have reached operating speed or while they are coming to a stop.
- Never force objects into the moving parts of a machine.
- Never force tools by applying too much pressure.
- Always secure work pieces with clamps or vise to keep them from moving.
- Keep hands away from cutting edges and moving parts.
- Never leave machines or power tools running unattended unless machine is fully enclosed.
- Never operate machine tools while using personal electronic devices (e.g., cell phones, iPods) or wearing headphones.

5.0 PERSONAL PROTECTIVE EQUIPMENT

PPE is designed to prevent personal injury. Examples of PPE include safety glasses or goggles, face shields, safety shields, gloves, respirators, and hearing protection. It is the responsibility of the Wyss administrator and/or platform leader to ensure that laboratory staff is using necessary safety equipment.

5.1 PROTECTIVE CLOTHING

When working with a potentially hazardous material, protective clothing is required.

- Protective clothing is chosen, with the aid of the EH&S Office, on the basis of the proposed hazard and medical condition of the user.
- Loose clothing, such as neckties, sweaters, flowing sleeves, lanyards, necklaces and other loose/dangling jewelry shall not be worn in the machine shop.
- Rings, bracelets, wristwatches and related items should be removed prior to machine use.
- Do not use heavy work gloves in close proximity to moving machinery. "Surgical" type gloves (those that have low tear strength) are permissible.
- Shorts or pants with cuffs should be avoided during shop use.
- Long hair must be tied back.
- Closed-toed shoes will be worn in the machine shop at all times.
- Reusable protective clothing, such as work gloves, face shields, and respirators, must be visually inspected prior to use to ensure that they are in good condition.

5.2 EYE PROTECTION

Safety glasses or goggles must be worn in the machine shop.

Ordinary prescription glasses are not designed to provide adequate protection against occupational hazards. Prescription safety glasses are recommended for employees who must routinely wear safety glasses in lieu of fitting safety glasses over their personal glasses.

Additional eye or face protection may be required when there is a potential for hazardous materials, including chemicals, ultraviolet light radiation, and wood, metal, and plastic shavings or particulates, to come in contact with the eyes or face. Examples of eye/face protection include safety glasses, goggles, and face shields. All protective eye and face devices must meet the American National Standards Institute Z87.1-1989 standard.

5.3 PROTECTIVE GLOVES

When working with electrical, temperature, or mechanical/physical hazards, appropriate work gloves (e.g., cryogenic gloves, electrical safety gloves) are required. When working with hazardous chemicals, such as solvents and corrosive materials, chemical-resistant gloves are required. Reference the Wyss Institute Chemical Hygiene Plan for further information about the correct selection and usage of gloves when working with chemical hazards.

5.4 RESPIRATORS

If respiratory protection is used or required, including the use of N95 respirators, the Wyss Institute Respiratory Protection Program must be followed. The use, selection, and training for any required respirators, if applicable, is the responsibility of the Wyss administrator, the platform leader (or their designee), the employee, and the EH&S Office. Dust masks may be worn for personal comfort, but are not designed for or approved by the National Institute for Occupational Safety and Health for protection against hazardous chemicals or biological agents.

5.5 OTHER PERSONAL PROTECTIVE EQUIPMENT

Other PPE, such as hearing protection, shall be used as needed. Prior to wearing hearing protection, or if new equipment is installed that may present a noise issue, contact the EH&S office.

NOTE: PPE should not be worn in common areas

(Cafeterias, bathrooms, kitchen areas, outside, conference rooms, break rooms, elevators, etc.)

6.0 ELECTRICAL SAFETY

Electricity poses a serious workplace hazard. Electrical current passing through the human body can cause electrical shock and result in burns, muscle damage and other physical injury, and nervous/respiratory system damage or failure.

In order to minimize risk from electricity, the following procedures should be followed:

- Avoid using electrical devices in wet conditions.
- Use Ground Fault Circuit Interrupters when possible and in all wet locations.
- Use the correct wiring and connectors.
- Avoid long-term (e.g., more than one month) use of extension cords.
- Use and maintain tools properly. **Do NOT use damaged or improperly modified electrical tools or devices.**
- Avoid wearing items such as watch bands, jewelry, etc. that could come into contact with exposed, energized parts.
- Always check cords for wear and damage, and replace any damaged cords.
- Never use a 3-wire cord with a 2-wire plug.
- Never remove the third prong to make a 3-prong plug fit a 2-prong outlet.
- Do not overload outlets.
- Do not use attached electrical cords to move equipment.
- Always verify that the power is off before making repairs to electrical equipment.
Lockout/tagout procedures must be used to ensure power is off.

Researchers should not attempt to repair fuse boxes or high-voltage equipment. If there is an electrical problem in the machine shop, contact ABLE Engineering at 617-735-4399. If electrical equipment is damaged or appears unsafe, do not use it and report the situation to the EH&S Office.

7.0 MACHINERY/MACHINE GUARDING

7.1 GUIDELINES FOR SPECIFIC MACHINES

See Appendix A for a list of machines currently in use.

7.1.1 Drill Press

- Always wear eye protection when using the drill press.
- Check the drill press head and table before starting. If the drill press head and table are not secure, or damaged, do not begin work until they have been repaired.
- Select the correct speed for the material and drill being used.
- Remove the chuck key immediately after tightening or removing a drill. Failure to remove the chuck key can lead to serious injury if the machine is turned on.
- Keep hands clear of all moving parts.
- All work pieces must be secured with either a drill vise or C-clamps. Failure to secure the work piece can damage the drill and injure the operator.
- If the drill pulls the work piece loose from the clamps, turn off the drill press. Once the drill press has stopped, remove the work piece from the press.
- Always make sure the drill press is stopped before removing the work piece, chips, or cuttings.

7.1.2 Table Saw

- Always wear eye protection.
- Only use the correct blades for the materials being cut.
- Never feed materials into the blade with your fingers in line with the blade.
- If the saw clogs or jams, make sure that the power is completely off before removing the jam.

7.1.3 Milling Machine

- Do not use the table as a work bench or storage place. Damaging the table will cause the machine to malfunction.

- Be sure you know how to stop the milling machine quickly before operating the machine.
- Make sure that power feed controls are in the neutral position before turning on the machine.
- Handle cutters carefully. Protective gloves may be recommended.
- Secure the work piece firmly in the vice or with appropriate clamps.
- Keep hands on the controls while the machine is running.
- Never try to feel a finished surface while the cut is being taken.

7.1.4 Lathe

- Roll up loose sleeves, and do not wear lanyards, neckties, or other loose items while operating the lathe.
- Be certain the work piece is set up securely and tightly.
- Remove the chuck key immediately after each use. If the chuck key is left in the chuck and the lathe is activated, the key can become a fast moving projectile and potentially cause serious injury.
- Keep hands on the controls while the lathe is running during manual operation only. If lathe is being used in computer numerical control mode, all operator interactions should be at the control panel.
- Keep hands away from chips as they may be sharp or hot.
- Regulate the depth of cut according to the size and type of material.
- Use tools that are properly ground for the particular job.
- Never try to feel a finished surface while the work piece is spinning.
- Stand to one side of the revolving faceplate to avoid being hit by flying objects.

7.1.5 Laser Cutter

- Wear ultraviolet (UV)-protective safety eye-wear when using the laser cutter. Do not directly stare at UV light.
- Secure the edges of flexible materials with tape or a heavier scrap material. Be sure to place scraps where they will not interfere with the laser head.

- Always monitor your work until the entire cut is finished.
- If you notice that your material is being scorched or is producing visible smoke or flame, stop the laser cutter. You may need to lower the power setting, increase the speed setting or re-check your focus. Do not restart the laser cutter until the material is no longer smoking.
- After your job finishes cutting, the enclosure lid must be left shut for at least 10 – 15 seconds to allow for any smoke or fumes to be exhausted.

7.1.6 Grinder

- Ensure that the grinder is mounted securely.
- Always use the work rest, and maintain its distance within 1/8" of grinding wheel.
- Maintain the adjustable tongue guard within 1/4" distance of grinding wheel.
- As the grinding wheel wears down, readjust the tool rest and tongue guard. When you can no longer adjust them, replace the wheel.
- Ensure the grinding wheel manufacturer's recommended speed, as posted on the wheel, is compatible with the RPM rating of the grinder motor.
- Visually inspect new grinding wheels for imperfections before installing. Do not install a wheel with visible irregularities.
- Ensure the outer wheel guard is securely in place.
- Ensure the power transmission cover is securely in place.

7.2 MACHINE GUARDING

Machine guarding is required by OSHA under 29 CFR 1910.211. A guard is a barrier that prevents the entry of the operator's hands or fingers into any part of a machine or piece of equipment where they may be cut or caught between moving parts, between moving and stationary parts, or between the material and moving parts of the machine.

Guarding is required of machine tools. Hand-held, portable power tools or manual tools are not required to be guarded.

Machine guarding provided by the manufacturer should never be removed from the machine.

8.0 HAND AND PORTABLE POWER TOOLS

When using hand tools, keep the following safety procedures:

- Safety glasses should be worn whenever working with tools.
- Wear protective gloves when appropriate.
- Clean grease and oil from hands and tools to prevent slipping.
- Only use tools that are in good condition.
- Only use tools for their designated purpose.
- Use the correct size tool for the job.
- Always cut away from your hands and body.
- All power tools must be turned off and completely stopped before they are set down by the operator.

9.0 TOXIC AND HAZARDOUS SUBSTANCES

Refer to the Chemical Hygiene Plan, Biosafety Manual, and Hazard Communication Plan for policies and procedures associated with the use of toxic and hazardous substances.

APPENDIX A

The following is a list of machines currently in use in Wyss Institute Light Machine Shops:

CLSB 528A

Mitre table saw

Scroll saw

Drill press

Belt sanders (2)

Handheld circular saw

Bench grinder

Tumbler

Manual milling machine

Mini milling machine

CLSB 531

Haas Super Mini Mill 2

Microlution 5100 Micro-milling Center

Haas lathe

Band saw

3D Prototyping Sites

Haas OM2A milling machine

Manual milling machine

Manual/CNC lathe

Hardened steel grinder

Carbide (diamond) grinder

Horizontal band saw

Vertical band saw