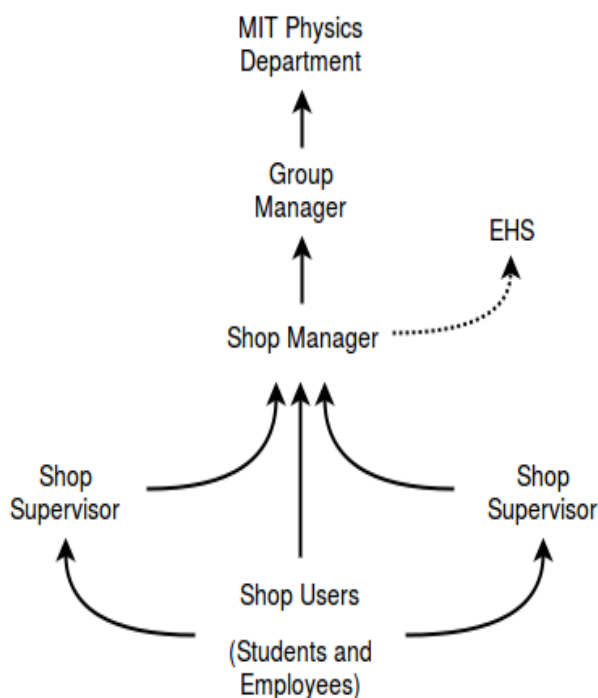


Shops Structure and Safety Policy

The MIT Physics Student Shops follow the institute-wide shop rules, the EHS Standard Operating Guidelines (SOG) on shop use, and the EHS policies and procedures on Hazardous Waste management, as well as the following policy on working alone, which is in line with other similar policies across the institute. In order to make sure these procedures and guidelines are followed, the shops will have a shop manager who is responsible for tracking and supervising shop use, as well as ensuring proper maintenance of shop equipment and installed safety measures. The shop manager will, in turn, train and monitor shop supervisors, who can be other physics departments employees, or highly competent and trustworthy students who have shown skill and attention to safety with machine tools and the shop environment.

There are various roles and access rights related to the MIT Physics Student Shop:



Group Manager: This person, who will probably be the supervisor for the Technical Services Group or the upper division lab courses, is in charge of purchases for the Physics Faculty and Student Shops. This person also manages the Shop Manager position.

Shop Manager: This person is responsible for the logs of shop access, providing and documenting shop and tool use training, and ensuring appropriately supervised access and usage, including key card access. This person is also responsible for ensuring proper shop maintenance: making sure the physics shops remain clean and appropriately stocked, identifying needed repairs and upgrades to equipment (and implementing those repairs when easily achievable). They are the EHS representative for the shops and as such, are responsible for doing weekly inspections of chemical storage and waste in compliance with EHS rules and guidelines.

Shop Supervisors: These people have substantial experience working with the machine shop tools in the Physics Student Shops and have knowledge of the Shop Rules and MIT Emergency Procedure, as well as hazardous waste management. Shop supervisors are permitted by the shop manager to supervise the student shops for general use when they demonstrate sufficient competency and responsibility. Shop Managers and Shop Supervisors also work together to provide training for new shop users. The term supervisor, as used in this document, bridges the EHS Shop SOG definitions of Facility Supervisors and Facility Monitors.¹

Shop Users: A member of the MIT Physics Department Community who wishes to use the physics shops for educational purposes, either to learn to use certain tools or to create items of educational value. Shop users must know and understand the posted shop rules and be responsible for cleaning up

¹ SOG can be found at <https://ehs.mit.edu/site/shop-and-makerspace-safety>, specifically: https://ehs.mit.edu/site/system/files/secure/sog_0076_0.pdf

workspace and arranging storage of their work, and follow shop safety and use related directions from a shop manager or supervisor.

Shop Access:

Anyone using or present in the MIT Physics Student Shops must abide by institute and physics student shop safety rules at all times, and if found to be in violation of these, may be asked to complete more training (in most cases), or lose shop use privileges in the Physics Shops (generally only for multiple violations, or exceptional violations). Shop safety rules are posted and available online at <http://physshop.mit.edu/shop-safety>

MIT Physics Shop policy on supervised work is:

- **Absolutely no one shall use powered or cutting tools while alone!**
- Shop use will be logged and reported to the shop manager, who will keep a record.
- Shop Managers and Shop Supervisors may be alone in shops for the purpose of cleaning and basic shop maintenance (routine tasks not including repair), or during “open shop” times when they are not using tools except when other people are present in the shop.
- Shop managers and supervisors may use machines with another person present so long as that person is aware of basic shop safety procedure.
- If a shop manager or supervisor is present, a person with appropriate shop safety training (e.g. Edgerton course) and familiarity with a piece of equipment may use shop tools without direct supervision (the shop manager or supervisor must be present, but can work on other things or with other people).
- If a person has not completed a comprehensive safety training, or is unfamiliar with a piece of equipment, they should work directly under supervision from a shop manager or supervisor. If the manager or supervisor feels uncomfortable with this work, they can request that a person receive more training before working with them.
- A shop manager or supervisor may provide key-card access for a handful of trusted individuals who have completed a safety training course and are familiar with the tools they will be using and procedures for medical emergencies and cutting oil storage and disposal.
- Shop tools may be used between 8 AM and 10 PM with appropriate supervision, and not outside of those hours, regardless of supervision.

The adjacent MIT Physics Shops are available to qualified MIT Staff and Faculty for the development and maintenance of educational apparatus and materials.

Types of shop access:

- **Orientations and Tours** are for the purposes of viewing the shop and introducing potential users to its tools and their organization. The individuals at the orientation are presumed to have no safety training, and are accompanied by a shop manager or supervisor. No work should be done during orientations to minimize any potential hazards. The group size shall be limited to ten people, with a preference for fewer than six.
- **Open shop hours** are open to all shop users, regardless of training. A shop supervisor or manager must be present to supervise shop usage. Experienced users may use tools on which they are trained without direct supervision, and novice users can work directly with a shop supervisor or may observe the work of their experienced peers. Proposed open shop hours for the fall 2018 semester are Tuesdays and Thursdays, 4:30-7:00. The total number of shop users may be limited at the discretion of the manager or supervisor on duty.

- **Trainings** are available to all shop users. They constitute the only case in which novice users will operate tools, albeit under direct supervision and direction of the instructor. Attendance will be limited to no more than six trainees.
- **Individual use** is limited to trained and experienced users with a buddy, or novice users working directly with a shop supervisor or manager. The buddy system applies for all users; no one shall use powered or cutting tools alone in the physics shop. A shop buddy for a sufficiently experienced user (e.g. a shop supervisor) does not have to be trained in shop use, but must be present and aware, and must know the location of the E-stop on the machines being used.

Types of tools available:

Class 1 (low power hand and benchtop tools): Generally considered the safest tools, these include non-cutting tools such as screwdrivers, hammers, and layout/measuring tools. Additionally, tools such as soldering irons, Dremels, or benchtop 3D printers are considered Class 1. These tools can cause minor injury fairly easily but do not have incidental concerns such as the ability to catch and pull loose items without warning. Shop users with a brief introduction to these tools can work without direct supervision in most cases (this does not negate the working alone policy). Layout and measurement tools specifically may be loaned out or brought in without specific shop manager clearance (though the loan-out should be recorded, and labeling of outside tools is recommended).

Class 2 (medium power hand and benchtop tools): This classification includes small powered tools such as hand drills, jig saws, and small benchtop drill presses. Stand-alone manual sheet metal tools, such as shears, brakes, and rollers, are also included in this category, with the understanding that large units are inherently more hazardous than hand tools.

Class 3 (medium power construction-scale tools): Tools like metal grinders or disk sanders have hazards such as serious abrasion, the ability to throw unsecured parts, and the ability to catch loose hair and clothing. Tools that have a higher likelihood of throwing unsecured parts especially should be used only by those with experience or direct supervision. Stand-alone band saws and drill presses are also included in this category.

Class 4 (industrial machine tools): These tools, such as saws, drills, and lathes, have the highest potential for hazard, but can be used safely with training and safeguards. Machine tool training should be reasonably extensive, and shop supervisors should exercise discretion if they feel a machine is being used in a way that might be unsafe and ask that a process be directly supervised or stopped until better safety precautions are taken.

Tiered Training:

Tier Zero: All Shop Users, regardless of experience

The MIT Physics Student Shop is open to Physics Department students and employees who have:

- Reviewed and understood the shop safety rules
- Taken and passed the physics shop safety quiz (the link to which will be posted on the physics shop website physshop.mit.edu)
- Received an in-person shop hazard orientation, and
- Signed the physics shops usage form stating that they have read and understood the shop rules as posted, that they agree to follow them or either be denied access or go through retraining, and that they understand that a shop environment has certain inherent risks

The purpose of this initial process is to introduce new users to the shop, its tools, and its hazards. It ensures that everyone is familiar with shop safety practices and that the shop keeps records of users.

Tier One: Proficiency assessment per tool

In order to work with anyone other than a Shop Supervisor or Manager, Shop Users must pass a basic in-person proficiency assessment for each tool they plan to use. The purpose of this assessment is to ensure that any user working with a tool Class 2 and above has adequate knowledge to operate the tool in a way that is safe to the user, to the other shop users, and to the tool itself, including so-called consumables like drill bits.

A competent operator at this level will be able to:

- Identify parts of the tool/machine and describe their functions
- Identify and describe hazards associated with each machine/tool, and choose appropriate personal protective equipment (PPE) for their work
- Identify allowed materials and materials that may be hazardous or not appropriate (e.g. aluminum for a grinding wheel)
- Examine the tool prior to use and determine that it is in good operating condition
- Select an appropriate cutting tool for a given operation and justify that selection
- Use appropriate fixturing to hold stock or odd shaped workpieces to minimize vibration and other potential issues
- Select an appropriate cutting speed for a given operation and describe considerations taken into account when selecting a speed
- Identify common symptoms of problems with a given machining process related to speed, feed, material, or fixturing
- Change cutting speeds and cutting tools with ease
- Perform several operations with the tool (e.g. drilling and facing, or drilling multiple holes) in a safe and controlled manner
- Leave the workspace in a clean and safe condition for other shop users

Any shop user can schedule a time for an in-person assessment with the Shop Manager, but it is expected that Shop Users have completed a shop training course, either at MIT or elsewhere.

The educational shop will offer tool-specific basic training for novice shop users with little or no experience, which should prepare students sufficiently to pass the proficiency assessment. The shop will also offer in-person tool refreshers for those who have experience working with machine tools but are out of practice, and may be unfamiliar with the specific tools in the physics shop. No user's training will be taken at face value; no one can work without direct supervision by a manager or supervisor until they have demonstrated their competence on the tools. The flowchart on the following page outlines potential paths for new users.

Tier Two: Shop supervisor qualification

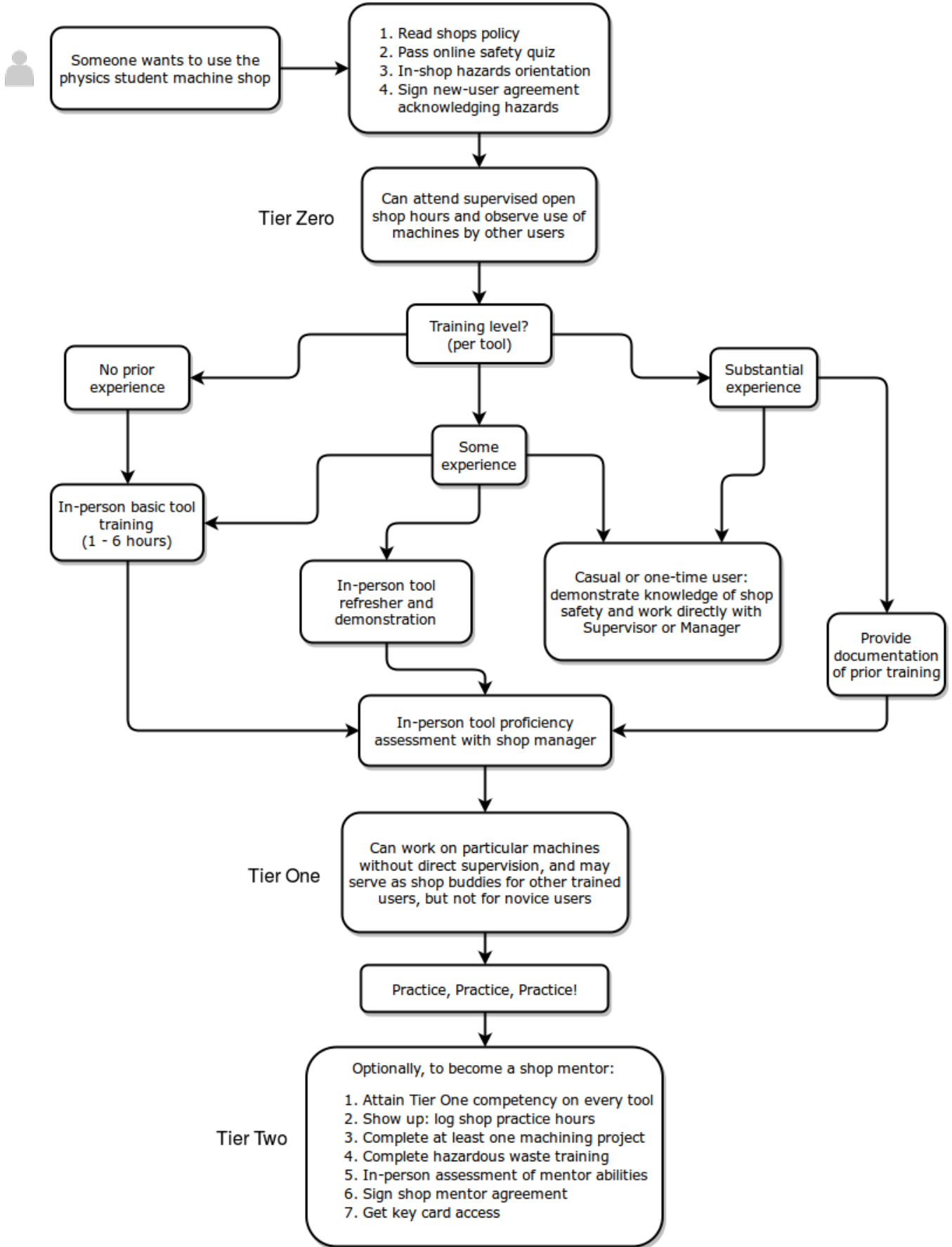
To become a Shop Supervisor, or to be granted card access, a user must:

- complete a Tier One exam for all the tools in the shop
- practiced significantly on all the powered cutting tools, and must complete at least one project
- have Hazardous Waste management training, and possibly emergency response training
- be able to enforce shop policy, to identify and correct bad practice by users through direct communication

- be willing and able to record, note, and communicate any maintenance or repair needs to the shop manager
- be familiar with incident reporting guidelines, and willing to report any injuries in the shop

In addition to being competent in machining, a shop supervisor must be able to monitor shop use. This entails a willingness to engage with shop users and to intervene if a user is acting in an unsafe or foolish way, and a willingness to directly address problems with users. Finally, anyone who has key-card access to the shop space must be a trusted and responsible individual. These qualities will be assessed by the shop manager when working with shop users who wish to be granted key-card access.

Training Records: Training records will be kept through Mobius user records, and a digital record of shop users and training levels may additionally be maintained by the shop manager. A physical record may be kept at the discretion of the shop manager.



Someone wants to use the physics student machine shop

1. Read shops policy
2. Pass online safety quiz
3. In-shop hazards orientation
4. Sign new-user agreement acknowledging hazards

Tier Zero

Can attend supervised open shop hours and observe use of machines by other users

Training level?
(per tool)

No prior experience

Substantial experience

Some experience

In-person basic tool training
(1 - 6 hours)

In-person tool refresher and demonstration

Casual or one-time user:
demonstrate knowledge of shop safety and work directly with Supervisor or Manager

Provide documentation of prior training

In-person tool proficiency assessment with shop manager

Tier One

Can work on particular machines without direct supervision, and may serve as shop buddies for other trained users, but not for novice users

Practice, Practice, Practice!

Tier Two

- Optionally, to become a shop mentor:
1. Attain Tier One competency on every tool
 2. Show up: log shop practice hours
 3. Complete at least one machining project
 4. Complete hazardous waste training
 5. In-person assessment of mentor abilities
 6. Sign shop mentor agreement
 7. Get key card access

Chemical Safety and Hygiene:

Training and general usage: The Physics Student Shops use various chemicals which need to have correct packaging/labeling, tracking, and disposal. Specifically, machine oils and cutting oils are listed as hazardous materials by the State of Massachusetts, and these products and contaminated materials should be disposed of through appropriate channels involving EHS. Additionally many glues, paints, wood stains, and finishes have hazardous properties and need to be used in appropriately ventilated locations, and be safely stored and have appropriate disposal. To this end, the shop managers should be up to date on EHS Chemical Hygiene training as long as they fill the roll, and should inform others new to the shops on chemical use, storage, and disposal (including for contaminated materials like shavings or oil soaked rags) as appropriate, and may request that shop supervisors complete this training as well. As shops are EHS inspected space, the shop manager will also be responsible for weekly inspections related to storage and disposal of regulated chemicals.

Secondary Containers for solvents, paints, glues and oils: All secondary containers (a container, often used to disperse a chemical, that is not manufacturer packaging) should be immediately and clearly labeled with the contents of that container as the container is first used, and then either refilled only with the same product, or put into the appropriate EHS waste stream. Original packaging and/or other chemical safety information (such as MSDS sheets) should be immediately available for any product in a secondary container.

Shop Chemical Supply: While manufacturing materials should be purchased by shop users (or come from a "scrap" supply in the shops), the physics shops will supply manufacturing components including a reasonable variety of chemicals such as cutting oils, and marking paint. Shop users wishing to use chemicals such as oils, solvents, paints, and glues should ask the shop for availability and be restricted from bringing these products into the shop without express permission of a shop manager, and must bring these items in while still in manufacturer packaging. Manufacturing materials other than standard aluminum, iron/nickel/steel, copper and bronze alloys, and common plastics should only be used if a shop manager has researched the material and verified that it is safe to machine or work in the desired manner.

Oil Soaked Metal Chips and Rags: Metal debris and cleaning rags which are soaked in cutting or other oil will be disposed of in black 5 gallon buckets as provided by EHS. If it is reasonable to reclaim and reuse cutting oil then the shop manager or supervisors may do so and place recycled oil back in appropriately marked containers. If cutting oil needs to be disposed of, then it should be stored and disposed of as liquid waste through MIT EHS procedures. Other chemicals such as finishes and glues should be stored and disposed of according to the appropriate MIT EHS guidelines.

Chemical disposal: The physics shops follow MIT EHS chemical disposal guidelines, and a shop manager will be expected to maintain up-to-date chemical hygiene training through EHS.

Equipment Maintenance and Lockout-Tagout

Routine Maintenance: The Shop Manager should ensure that equipment is cleaned, oiled and operating correctly at least fortnightly while shops are in use. Equipment that needs maintenance beyond oiling should be secured using lockout-tagout procedures, and maintenance should be arranged.

Lockout-Tagout: Any equipment that is in need of maintenance or not intended for use should be secured using lockout-tagout procedures by a shop supervisor (if trained) or the shop manager. If a shop supervisor discovers an equipment malfunction and does not have lockout-tagout training, then the machine should be clearly labeled and the shop manager notified as soon as possible (within 12 hours).

Emergency Procedure:

In the event of a shop related injury or emergency, the person supervising work (supervisor or work partner) should shut off power to all involved tools (either through individual machine e-stops or through the shop e-stop button that shuts off power supplied to all machines and outlets). For incidents resulting in injury beyond abrasions and minor cuts or cases where there may still be danger of further injury after machine shutoff, the supervisor or work partner should immediately dial 100 for campus emergency services, then offer medical aid if she or he is qualified and willing to do so. For all incidents, including non-emergency shop related injuries, the event should be documented and reported to the shop manager as soon as possible within 12 hours and logged for department records.

For major chemical spills (<https://ehs.mit.edu/site/content/chemical-spills>), EHS or emergency services should be contacted at x23477 or by dialing 100, and the shop manager should be notified as soon as possible, within 12 hours. For chemical spills classified as minor spills the chemicals should promptly be cleaned up appropriately, and a note of the incident should be made in the shop records so that new supplies can be purchased. In cases where there is a question, EHS should be contacted for further information.