

# Yale University Student Shop Safety Policies and Practices

September 2, 2011

Yale's Student Shop Safety Policies and Practices constitute a comprehensive program for student shop safety developed by a Provostial Committee of senior faculty members with experience in the wide range of student shops at Yale. These Policies and Practices cover the sciences, medicine, theater, fine arts, engineering, and hobby shops. The Committee worked closely with Yale's Department of Environmental Health & Safety, and benefited from consultation with outside experts for advice on industry best practices and current legal standards for machine tool guarding and operations.

Yale's Student Shop Safety Policies and Practices cover all aspects of physical plant and operations that contribute to safety, including supervision and monitoring, training pre-requisites, protective equipment, hours of operation, ingress and egress, tool guarding, warnings and advisories, facilities infrastructure, and safety inspections. The program is designed to ensure that Yale's student shops meet industry-level safety practices, tailored for a university environment.

## Guiding Principles

Shop and fabrication activities play an important role in the education of many Yale students in the arts, sciences and engineering. Safety is a shared responsibility that involves the institution, the user, and staff. Comprehensive safety emerges only when all aspects are considered: the tools and environment, the individuals, as well as the devices and materials being used and fabricated. Collectively and individually, our focus must be on establishing, supporting and maintaining a University-wide culture of safety. This policy is oriented towards work in student shops but the principles apply as well to fabrication work that occurs outside of formal shops (e.g., to construction of marching band floats and sets for dramatic productions).

## Shop Safety Audits

Yale Environmental Health and Safety (EHS) conducts periodic detailed safety audits of each of the many shops on campus and follows up by ensuring that any necessary remediation work is accomplished. The audit consists of a physical review of the shop room infrastructure, verifying that it meets the elements in the University's Shop Infrastructure Guidelines. It includes verification of signage and postings ([Appendix I](#)), requisite safety supplies and personal protective equipment, and housekeeping and waste management. Training histories for professional staff and students are also reviewed, as are the room and tool access policies. The audit also includes verification of tool condition and safeguarding. The reference document, Yale Practices for Tool Guarding and Controls, is used to assist in this evaluation. The audit concludes with a discussion about any observed deficiencies or problems, and development of a plan in writing for follow-up.

## Shop Hazard Categories

[Appendix II](#) presents a classification system designed on a scale of 1 to 5, with 5 being the highest hazard level, for tools and equipment, based on their potential hazards. The classification system prescribes the training, supervision, personal protective equipment and access controls required for each hazard level.

The hazard category of a shop is defined to be the highest hazard category of any tool in the shop that is not disabled by a secure lock-out. Obviously, no hazards matrix can capture all the safety nuances of every possible situation, and common sense must be applied. Individual shop supervisors therefore are authorized to apply rules and make decisions that are *more* restrictive than those indicated in [Appendix II](#). The shop supervisor community is encouraged to communicate with each other and with EHS on best practices and implementation difficulties so that Yale's policies and rules can be updated as needed.

Key aspects of the tools and equipment classification system as they pertain to student access are summarized below:

### Graduate Students

For Categories 3-5, graduate students may not work alone and must use the buddy system. Both buddies must have the appropriate shop training and qualifications for the type of work being performed and tools being used. They must be within immediate sight and sound of each other and familiar with emergency shut-off of the equipment.

### Undergraduates

For Category 2, undergraduates may not work alone and must use the buddy system. Both buddies must have the appropriate shop training and qualifications for the type of work being performed and tools being used. They must be within immediate sight and sound of each other and familiar with emergency shut-off of the equipment.

For Categories 3-4, undergraduates are required to have a trained and qualified monitor or professional supervisor present. For Category 5, undergraduates are required to have a professional supervisor present.

## **Definition, Roles and Authority of Monitors, Supervisors and EHS**

A *monitor* is an experienced graduate student, postdoctoral associate or fellow, or staff member who has appropriate tool experience (and for category 4, documented extensive tool experience) and who has been certified by EHS after completing the EHS monitor/supervisor training course and CPR/first-aid training. Monitors have full authority over shop operations and must be recommended to EHS by shop supervisors. Monitors are expected to exercise their authority to halt unsafe operations at any time and to restrict shop access to anyone who violates the rules. Undergraduates are not eligible to be shop monitors. Any problems should be reported to the shop supervisor, EHS and/or the Office of the Provost as appropriate.

A *supervisor* is a staff or faculty member who has documented professional-level experience and who has been certified by EHS after completing the EHS monitor/supervisor training course and CPR/first-aid training. Professional staff members who are the primary shop supervisor have full authority over all shop operations and use, including use by faculty members. Supervisors are expected to exercise their authority to halt unsafe operations at any time and to restrict shop access to anyone who violates the rules.

Monitors and supervisors will enforce these Policies and Practices, including the rules on hours, practices, pre-training/experience requirements, use of personal protective equipment, use of tool and equipment guards, appropriate clothing, and never working alone. They will model best practices and educate students to promote a general culture of safety in all shop and fabrication work. Any enforcement problems or problems with equipment needing repair, not working properly, or having broken or missing guards are to be reported to EHS, the Department or School, and/or the Office of the Provost as appropriate.

EHS has final authority over all safety issues and may halt operations or practices it considers unsafe any time at its discretion. EHS will periodically inspect all shops, and the shop supervisor and the Department or School are responsible for resolving any issues that arise.

A brief overview of the material covered in the EHS shop/supervisor training course is presented in [Appendix III](#), Outline of Monitor and Supervisor Training.

### **Shop Access**

Shop access requires a signed agreement accepting the code of conduct and defining the tools which the student is authorized to use.

All student shops will have means for restricting tool access, either by room-level electronic access control systems or electronic or mechanical controls on individual tools. Where room-level electronic control is used, the system will be standardized on the University's ID card access control system. Shop supervisors and monitors will use a control reader which toggles the door open when they swipe in and locks the door when they swipe out. Students with access via the buddy system must swipe in separately, via the second reader. Both badge reads will be recorded and held in access control records indefinitely.

Undergraduates will not have electronic access to Category 3-5 shops; a shop supervisor (for Category 3-5) or monitor (for Category 3-4) must be present to let them in. For Category 3-5 shops, the second reader allows buddy-system access to graduate students, post-doctoral students and other authorized non-undergraduates during normal operating hours when a monitor or supervisor is not present. A system is being developed to communicate to Security what level of entry authorization individuals have to each shop.

Fatigue is a significant source of risk and no work may be performed in shop Categories 2-5 by anyone after midnight.

At the discretion of shop supervisors, shop access and use may be monitored by video cameras. A standard placard indicating that video monitoring is in use will be posted at each entrance to the shop. The shop use agreement, will inform the user that video monitoring may be in use at any time.

### **Project Safety Review**

The hazards associated with a student project involve multiple aspects, including the level of student training, the tools and materials being used, and potential hazards associated with the device being fabricated and its use (e.g., the project may be to build a device with electrical or engine power). Each student project involving Category 2 and above must therefore undergo a formal safety review with a shop supervisor (and where applicable) with the faculty advisor. This is an important educational opportunity for the student and should be treated as such. The shop supervisor and faculty advisor should communicate with each other and with the student to note potential hazards and require changes where appropriate. In the course of the project, monitors/supervisors will track progress and the quality of work to verify that the student has the requisite skills to safely perform the work. After completion of the work, a final safety check by a supervisor and the faculty advisor is required prior to activation/use of the device. Some devices may require a monitor or supervisor to be present every time they are tested or used. In case of doubt about any safety issue which arises in the review, EHS and (as appropriate) the University Safety Committee are to be consulted.

A uniform process for these safety reviews is being developed in collaboration with shop supervisors, faculty, and the Yale College Dean's office.

### **Promoting a Culture of Safety**

Promoting and maintaining a culture of safety depends on the individual behavior of everyone: students, staff, monitors, supervisors and faculty. We must look out for each other, teach each other, and when appropriate, caution each other. As part of a general effort to promote a culture of safety we have established a campus-wide user group of shop supervisors and instructors. This group will meet regularly to exchange ideas and discuss best practices. There will also be periodic visits to different shops, demonstrations by guest experts, industry new equipment demonstrations, additional training and tool-specific professional development.

### **Standardized Safety Reporting System**

Because we are dealing with very low-probability events with potentially severe consequences, it is important to have a robust system for reporting, tracking and analyzing all safety issues, including cases where accidents occurred, and equally importantly, where accidents were avoided. Without this information it is difficult to reliably assess and refine best practices. It is important that the process not be onerous and it is likewise important that a culture be established which makes people at all levels feel encouraged and comfortable to report mistakes. To this end, we have developed formal online reporting system which is available at this URL: <http://www.yale.edu/finance/controller/riskman/documents/IncidentForm5-2011.pdf>. Monitors

and supervisors are responsible for reporting all safety issues, incidents, and accidents. Any shop user who wishes to report unsafe conditions anonymously may do so using the Yale Hotline 1-877-360-YALE (1-877-360-9253).

### **Principles for Tool Purchases**

Excessive variability amongst shops, and machines within shops, is itself a potential hazard. Increasing consistency will simplify training, but more importantly simplify the correct operator responses needed in emergencies. We are therefore coordinating the purchase of uniform replacement tool sets for several of the student shops.

### **Evolving Safety Program**

This safety program is an evolving work that will continue to be updated and refined as we gain further experience with these new policies and procedures. Further, this document, its appendices and references do not represent the entirety of Yale's shop safety program. We welcome feedback, advice and suggestions from the user community as we all work together to promote a culture of shop safety.

These policies and procedures were developed by the Provost's ad hoc committee on student shop safety in consultation with EHS, shop supervisors and faculty. Going forward, the responsibility for these matters will move from the ad hoc committee to the standing University Safety Committee.

### **References**

- Shop Infrastructure Guidelines
- Yale Practices for Tool Guarding and Controls
- Yale University Shop/Tool Use Safety Agreement
- Yale Undergraduate Project Safety Review
- Personal Protective Equipment (PPE) Assessment for Shops

### **Contact Information**

Peter A. Reinhardt, Director  
Environmental Health & Safety  
[peter.reinhardt@yale.edu](mailto:peter.reinhardt@yale.edu)

Robert C. Klein, Deputy Director  
Environmental Health & Safety  
[rob.klein@yale.edu](mailto:rob.klein@yale.edu)

Steven M. Girvin  
Deputy Provost for Science and Technology  
[steven.girvin@yale.edu](mailto:steven.girvin@yale.edu)

Yale University Student Shop Safety Policies and Practices

*The Appendices which follow are key components of the Policies and Practices, providing much of the working guidance and requirements for their implementation.*

*The three Appendices are*

**[Appendix I](#): Student Shop Safety Poster**

**[Appendix II](#): Tool Classification Matrix**

**[Appendix III](#): Outline of Monitor and Supervisor Training**

**Appendix I**

**Student Shop Safety Poster**





HOURS OF OPERATION:

# SHOP RULES

**Never work alone** – and a Supervisor or Monitor must be present at all times for undergraduates.

**Safety glasses** must be worn at all times in the shop. Some operations and equipment may require additional personal protective equipment.

**No loose clothing** may be worn in the shop, including ties, scarves, and loose sleeves. Open-toed shoes, short pants, or skirts are also prohibited.

**Remove jewelry** before beginning work, including rings, necklaces, bracelets, and watches.

**Long hair** must be pulled back and secured and contained; long beards must also be contained.

**Aisles, exits, and access to emergency equipment** must be kept clear at all times.

**Cell phones, mp3 players, and other personal electronic devices** must not be used when working at any machine. Loud music is prohibited.

**Food and drinks** are permitted in designated areas only.

**Approval** to operate power equipment must be obtained prior to use. Undergraduates must check in with Monitor/Supervisor upon arrival.

**All guards and shields** must be secured and in place prior to operating equipment.

**Compressed air** must not be used to clean skin or clothing.

**Damaged equipment**, or equipment that does not appear to be operating normally, must not be used. Tag it as out of service and report the issue to the Supervisor or Monitor.

**Immediately report** all problems or concerns to the Supervisor or Monitor.

**Supervisors and Monitors** have full authority over the shop and its safe use, including the responsibility, authority, and obligation to prohibit shop or tool access for the safety of an individual, others in the shop, or the equipment.

## EMERGENCY CONTACTS:

911  
203-785-3555  
203-432-0123

MEDICAL, POLICE, FIRE  
YALE EHS – HAZARDOUS MATERIALS  
YALE HEALTH – MINOR MEDICAL

Yale University Student Shop Safety Policies and Practices

**Appendix II**

**Tool Classification Matrix**

Yale University Student Shop Safety Policies and Practices

## Classification System for Student Access Shops

Revised July 28, 2011

Device Class	1	2	3	4	5
<b>Power</b>	<b>Low power hand / small bench tools</b> (2 - 4 amp @ 120 VAC, < 9V cordless)	<b>Medium power tools</b> (¼ to ½ hp) (< 10 amp @ 120 VAC, 14-18V cordless); specialized enclosed NC-computer tools	<b>Powerful portable and small benchtop tools</b> (> ½ hp) (10-15 amps @ 120 V AC, 24V-36V portable, pneumatics, hydraulics)	<b>Light industrial tools</b> (typically benchtop, < ½ hp, pneumatics, hydraulics)	<b>Large industrial tools</b> (manual and NC-controlled) (some of these tools may be off-limits to any student use) <b>Highest hazard tools in bold</b>
<b>Common Examples</b>	<ul style="list-style-type: none"> <li>• Dremel tool</li> <li>• Cordless drills under 18V</li> <li>• Palm sanders</li> <li>• Soldering irons and guns</li> <li>• Heat guns</li> <li>• Hot melt glue guns</li> <li>• Sewing machines</li> <li>• 3d printers</li> </ul>	<ul style="list-style-type: none"> <li>• Jig saw</li> <li>• 3/8" hand drill</li> <li>• Corded devices &lt; 1/3 hp</li> <li>• 18V-24V cordless drill</li> <li>• Laser cutters / engravers</li> <li>• Thermal foam cutters</li> </ul>	<ul style="list-style-type: none"> <li>• Circular saw</li> <li>• Belt sander</li> <li>• Framing nailer</li> <li>• ½ hp geared drill</li> <li>• Reciprocating saw</li> <li>• &gt; 18V cordless tools</li> <li>• Chop / miter saws</li> <li>• Routers</li> <li>• Mini-lathe</li> <li>• Angle grinders</li> <li>• Printing presses</li> </ul>	<ul style="list-style-type: none"> <li>• Small bandsaw</li> <li>• Small drill press</li> <li>• Small/benchtop milling machines</li> <li>• Small/benchtop lathes</li> <li>• Belt/disc sander</li> <li>• Horizontal saw</li> <li>• Scroll saw</li> <li>• Planer, jointer</li> <li>• Bench grinder</li> <li>• SawStop-style tablesaw</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Full sized milling machine</b></li> <li>• <b>Full sized metal lathe</b></li> <li>• <b>Table saw (non-SawStop)</b></li> <li>• Radial arm saw</li> <li>• Large drill press</li> <li>• Large band saw</li> <li>• Surface grinder</li> <li>• Large jointer/planer</li> <li>• Shaper/moulder</li> <li>• Power shear</li> </ul>
<b>Shop Access Control</b>	By permission of Shop Supervisor and/or Monitor	By permission of Shop Supervisor and/or Monitor	All student shops – ID Card	All student shops – ID Card	All student shops – ID Card
<b>Tool Use Restrictions and Oversight</b>	<ul style="list-style-type: none"> <li>• Performed in shops or designated approved locations, i.e. theater</li> </ul>	<ul style="list-style-type: none"> <li>• Undergrads - buddy system</li> </ul>	<ul style="list-style-type: none"> <li>• Undergrads – monitored</li> <li>• Grads – buddy system</li> </ul>	<ul style="list-style-type: none"> <li>• Undergrads – monitored<sup>i</sup></li> <li>• Grads – buddy system</li> </ul>	<ul style="list-style-type: none"> <li>• Undergrads – only under professional supervision<sup>ii</sup> after extensive training</li> <li>• Grads – buddy system</li> <li>• Emergency self-alert devices for low occupancy shops / times</li> </ul>
<b>User Training</b>	<ul style="list-style-type: none"> <li>• Introduction to shop safety and individual tools by shop supervisor / manager</li> <li>• Directions in manual or on wall postings</li> </ul>	<ul style="list-style-type: none"> <li>• Introduction to shop safety and individual tools by shop supervisor / manager</li> <li>• Signed agreement</li> </ul>	<ul style="list-style-type: none"> <li>• Basic shop safety orientation by shop supervisor / manager</li> <li>• Individual tool instruction</li> <li>• Demonstrate proficiency</li> </ul>	<ul style="list-style-type: none"> <li>• Basic shop safety orientation by shop supervisor / manager</li> <li>• Individual tool instruction</li> <li>• Hands-on use training and</li> </ul>	<ul style="list-style-type: none"> <li>• Basic shop safety orientation by shop supervisor / manager</li> <li>• Individual tool instruction</li> <li>• Extended hands-on use</li> </ul>

Yale University Student Shop Safety Policies and Practices

Device Class	1	2	3	4	5
<b>Power</b>	<b>Low power hand / small bench tools</b> (2 - 4 amp @ 120 VAC, < 9V cordless)	<b>Medium power tools</b> (¼ to ½ hp) (< 10 amp @ 120 VAC, 14-18V cordless); specialized enclosed NC-computer tools	<b>Powerful portable and small benchtop tools</b> (> ½ hp) (10-15 amps @ 120 V AC, 24V-36V portable, pneumatics, hydraulics)	<b>Light industrial tools</b> (typically benchtop, < ½ hp, pneumatics, hydraulics)	<b>Large industrial tools</b> (manual and NC-controlled) (some of these tools may be off-limits to any student use) <b>Highest hazard tools in bold</b>
	<ul style="list-style-type: none"> <li>• Required to read operator manual</li> <li>•</li> <li>•</li> </ul>	regarding code of conduct and list of tools approved for use	by performing certain operations to specified accuracy <ul style="list-style-type: none"> <li>• Signed agreement regarding code of conduct and list of tools approved for use</li> </ul>	experience <ul style="list-style-type: none"> <li>• Demonstrate proficiency by performing certain operations to specified accuracy</li> <li>• Signed agreement regarding code of conduct and list of tools approved for use</li> </ul>	training and experience <ul style="list-style-type: none"> <li>• Demonstrate proficiency by performing certain operations to specified accuracy</li> <li>• Signed agreement regarding code of conduct and list of tools approved for use</li> </ul>
<b>Monitor / Supervisor Training</b>	<ul style="list-style-type: none"> <li>• Tool experience</li> </ul>	<ul style="list-style-type: none"> <li>• Tool experience</li> </ul>	<ul style="list-style-type: none"> <li>• Tool experience</li> <li>• Yale EHS shop safety training class for monitors and supervisors</li> <li>• First aid / CPR</li> </ul>	<ul style="list-style-type: none"> <li>• Extensive tool experience-documented</li> <li>• Yale EHS shop safety training class for monitors and supervisors</li> <li>• First aid / CPR</li> </ul>	<ul style="list-style-type: none"> <li>• Professional-level experience-documented</li> <li>• Yale EHS shop safety training class for monitors and supervisors</li> <li>• First aid / CPR</li> </ul>
<b>Tool Access Controls</b>	Locked cabinet (Tool key / code lockout for 3d printers)	Locked cabinet (Tool key / code lockout for laser or thermal foam cutters)	Locked cabinet	Tool power lockout (for tiered access shops)	Tool power lockout (for tiered access shops)
<b>Remote Monitoring (Future Enhancement)</b>	As desired	As desired	(Cameras in shop)	(Cameras in shop)	(Cameras in shop)

<sup>i</sup> “Monitors” are experienced graduate students or higher with full authority over shop use and control who have been recommended by the Shop Supervisor and completed required safety training.

<sup>ii</sup> “Supervisors” are staff or faculty with professional-level training and experience in applicable tool set-up, use, and maintenance

## **Appendix III**

### **Outline of Monitor and Supervisor Training**





## **Proposed Safety Training Outline for Shop Instructors, Supervisors, and Monitors**

### **Background and Purpose**

- 2-tiered training / qualifications process
- This serves as baseline mandatory shop safety training – TMS tracking
- This course alone does not automatically qualify individuals to access shops or tools
- Your safety training requirements:
  - This course
  - First Aid / CPR/ AED (via EHS and refreshers)

### **Authority and Responsibilities of Shop Instructors, Supervisors, and Monitors**

- Daily shop inspections and proposed work reviews
- Complete work start / stop authority
- Enforcement of basic shop rules, including authorized access, attire, PPE
- Removal of damaged / malfunctioning equipment
- Authority to restrict or remove equipment privileges
- Emergency response and reporting

### **Shop Classification and Control**

- Shop classes (1 – 5)
- Access restrictions and supervision / oversight / authority
- Means to restrict access to higher hazard tools and to derate remainder of shop

### **Standard Shop Postings**

- University basic shop rules and hours of operation
- Shop-specific rules and postings

### **Emergency Response Procedures**

- Landline phone, 911 sticker, contacts
- Fire, medical, police
- First aid supplies
- Emergency eyewash
- 

### **Personal Protective Equipment**

- PPE assessment table
- Types
- Locations
- Use, storage, and maintenance

### **Accident / Incident Reporting**

### **Fire Prevention**

- Oily rags / combustible materials
- Housekeeping
- Dust control
- Hot work (as applicable)

### **Chemical Safety**

- Chemical hazards – Hazard communication
- MSDS and labeling
- Storage and use
- Disposal

### **Inspections of Shops**

- Key criteria
- Self-inspections
- Periodic EHS inspections

### **Power Tools and Equipment**

- EHS tool inventory, maintenance records
- Types of tools and tool classification matrix
- When to remove equipment from service
  - Damaged, malfunctioning
  - After an accident
- Equipment removal process (out-of-service / remove from service process)
- 
- Machine guarding requirements
- Sources for service and maintenance

### **User Training**

**Optional: Fire Extinguisher Live Use Practicals**

**Open Forum and Questions / Comments**