Machine & Woodworking Shop Safety

1. Purpose / Background

Individuals who use hand and powered tools and machine shop equipment may be exposed to cut, abrasion, impact, and inhalation hazards. These hazards can result in injuries to eyes, puncture wounds, cuts to fingers, hands and arms. The safe use and maintenance of the tools and equipment will minimize injuries.

This SOP has been developed to provide guidance for the administration and oversight of woodworking and machine shops. In addition, the SOP includes general foundational guidelines for the safe use of tools and the operation of equipment typically found in shops at MIT. The mosaic of “shops” have a wide range of missions at MIT and as such there may be unique situations and procedures that have been established locally and may not have been addressed by this SOP. Shop managers are considered subject matter experts and should be consulted (in addition to EHS) on shop-level procedures and rules as well as the safe operation of machine tools and other shop equipment.

2. Scope

This document applies to all woodworking and machine shops at MIT. As such, the requirements outlined in this document apply to students, employees and contractors who operate tools and machines in these shops.

3. Prerequisites

None required.

4. Procedures

4.1 Departments, Laboratories and Centers that operate woodworking and machine shops shall develop and implement procedures for shop administration, access control, student and employee training, emergency preparedness, tool/equipment maintenance, repair and recordkeeping.

4.1.1 Requirements- Machine/Woodworking Shop Equipment and Tools: Authorization and Use

4.1.2 Machine/Woodworking Shop equipment and tool operation shall be restricted to individuals trained and authorized by the Department, Laboratory or Center (DLC). In the event of joint ownership of the laboratory space and/or equipment, authorization to work in the shop shall come from both DLC’s.

4.1.3 Only trained and authorized personnel shall be allowed access to woodworking and machine shops. Entry doors shall be secured with locking/combination knobs or card reader access control systems. Contact the MIT Security Office (SEMO) for more information on access control systems.

4.1.4 Anyone using the shop equipment shall receive initial training on the safe use of hand tool and shop equipment before being authorized. The Shop Manager shall determine who is qualified to provide this training if they do not provide it themselves.

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4.1.5 Machine/Woodworking Shop tools and equipment shall not be used during non-scheduled or “off” hours except by permission from the Shop Manager.

4.2 The operation of woodworking and machine shops shall be administered and controlled by a designated representative of the DLC.

4.2.1 Requirements-Woodworking and Machine Shop Administration

4.2.2 The DLC shall designate a Shop Manager. The Shop Manager at MIT generally has overall responsibility for the repair, maintenance, safe operation of tools and equipment, plus any hazardous waste disposal from equipment and tools. Typical wastes include spent cutting, lubricating and quenching oils and turnings/chips in oil. Spent/used oil is a hazardous waste and shall be stored in suitable labeled/tagged containers. Contact the EHS Office for assistance with hazardous waste determination.

4.2.3 Machine/Woodworking Shop Managers may designate an EHS representative. The EHS representative should be familiar with and help enforce the safe operation of all hand tools and equipment. The Shop Manager may act as the EHS Representative.

4.2.4 The Shop Manager or EHS representative shall ensure that employees and students receive training on the safe use of hand tools and equipment prior to initial use and will monitor shop operations while tools are in use.

4.2.5 Shop Hazard Classes, Monitoring, Supervision, Oversight and Working Alone

A shop classification system is presented in Appendix C, Tool Classification System, on a scale of 1 to 3, with 3 being the highest hazard level, for tools and equipment in shops, based on their potential hazards. The classification system describes the power, common examples, access control, and oversight. Also, refer to paragraph 4.1.5.

- **Graduate Students:** For Class 3 shops, graduate students may not work alone and must use the buddy system or have a monitor or supervisor present. 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/or sound of each other and familiar with emergency shut-off of the equipment.

- **Undergraduate Students:** For Class 2 shops, undergraduate students may not work alone and must use the buddy system or have a monitor or supervisor present. 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/or sound of each other and familiar with emergency shut-off of the equipment.

For Class 3 shops, undergraduate students may not work alone and are required to have a trained and qualified monitor or professional supervisor present.
A monitor is an experienced graduate student, postdoctoral associate or fellow, or staff member who has appropriate tool experience (and for category 3, documented extensive tool experience) and who has completed the required training courses. Monitors have full authority over shop operations and must be recommended by shop supervisors.

A supervisor is a staff or faculty member who has documented professional-level experience. Professional staff members who are the primary shop supervisor have full authority over all shop operations and use, including use by faculty members.

- **Employees**: For Class 3 shops, employees, that are not machinists or woodworkers by trade, may not work alone and must use the buddy system or have a monitor or supervisor present. Both buddies must have the appropriate shop training and experience for the type of work being performed and tools being used. They must be within immediate sight and/or sound of each other and familiar with emergency shut-off of the equipment.

For Class 3 shops, employees, that are machinists or woodworkers by trade, can work alone but would require a discussion with their supervisor prior to conducting the work alone and a determination that the risk of working alone is minimal under the specific conditions established by the supervisor for the work.

4.2.6 Manufacturers operating manuals for all woodworking and machine shop and tools and equipment shall be available in the shop.

4.2.7 The Shop Manager shall ensure that the appropriate personal protective equipment (PPE) is available and used in the shop.

4.2.8 Emergency contact information and phone numbers shall be posted in all shops. Injuries shall be reported to the EHS Office as soon as possible.

4.2.9 Wood working and machine shops where chemicals/corrosives are used shall be equipped with eyewash stations. Contact the EHS Office for guidance. Use of an eyewash station for flushing large particulates/chips, (metal, glass, wood, or plastic chips) is not recommended. Seek immediate medical attention. This should be stressed in shop training and posted near the eyewash.

### 4.3 Woodworking and machine shop tools and equipment shall meet certain design and selection criteria.

4.3.1 Hand and machine tool and equipment-requirements

4.3.2 Hand tools should be selected based on good design with adequate strength, good castings and/or forgings, tempered and with anti-vibration characteristics as necessary. Nothing less than “high quality” tools should be purchased for tools that will see continuous use.
4.3 Electric or pneumatic powered tools shall meet nationally recognized design standards.

4.3.4 Electric tools shall be double insulated to prevent electric shock and have a three-prong plug.

4.3.5 Pneumatic tools should have a retainer if there is a potential for tool ejection. All air lines shall be designated for the intended pressure and service. Compressed air stations used for cleaning or blow off shall be set at a value not to exceed 30 psig.

4.3.6 Machine Tool Retrofits: All new machine tools (Class 3) shall be procured with safety guards and chip shields. Older equipment not equipped in this manner shall be evaluated and retrofitted with after-market guards and chip shields. Guards shall be deployed on all rotating parts, as well as at the point of operation. This includes belts, pulley or gears and equipment drive assemblies. Chip shields shall be added at all points of operation.

4.3.7 Machine tools (Class 3 not including those with momentary switches) shall be equipped with motor control E-STOP buttons (red colored/mushroom shaped) and prevented from automatically re-starting after a power failure. Machine shop and woodworking equipment shall be installed with a disconnect switch that can be locked in the off position during servicing and repair, unless they are powered by cord and plug.

4.3.8 All powered equipment (with provisions) shall be leveled and adequately secured to the floor or workbench to prevent/minimize movement, walking, and vibration.

4.4 Woodworking and machine shop tools and equipment shall undergo periodic inspection, maintenance and repair.

4.4.1 Shop Tools and Equipment Inspection and Maintenance: Powered Shop Tools-Requirements

4.4.2 Tools shall be inspected on a routine periodic schedule and manufacturer’s instructions shall be followed.

4.4.3 Electrical wire and connections to be in good condition. Check to ensure that the plug is equipped with a ground prong and that the cord sheathing is not taped, damaged, split or cut.

4.4.4 Mechanical guards shall be present, properly adjusted at the point of operation, e.g. in-running nips, rotating parts, and in the area of flying chips or projectiles. Refer to the Machine Shop Level 2 Inspection Guidance for additional information on guarding.

4.4.5 Some equipment may need to be exhausted to remove fumes and odors that are generated during use by employing specialized local exhaust ventilation (SLEV) or local exhaust ventilation (LEV) systems. It is important that these systems undergo a periodic inspection to ensure they are clean and operating effectively. Exhaust/air velocity at the “source” shall be sufficient to capture vapors, gases, respirable/inhalable particles so as to prevent breathing zone particulate concentrations from exceeding the appropriate threshold limit values (TLVs). Note that special care should be taken when machining plastics. Contact the EHS Office to have SLEV and LEV systems inspected and tested.
4.4.6 It is recommended that proposed designs for new shop construction or alterations and/or equipment installations be reviewed with the EHS Office in conjunction with the Shop Manager.

4.5 **Tool Operation and Use-Guidance**

4.5.1 See Appendix A for specific safety guidance. Users should always consult the tool manufacturer’s manuals and instructions regarding safe use and operation.

4.6 **Shop Safety Rules-all woodworking and machine shops shall post shop specific safety rules. Some common examples include;**

   a. Practice good housekeeping.
      - Prevent slip/trip hazards: wipe up any spills immediately.
      - Practice proper waste disposal of cuttings oils, see Appendix B.
      - Clean the area as needed.
      - Maintain clear aisles and an orderly storage of stock and supplies.
   b. Do not wear loose clothing or jewelry.
   c. Do not wear sandals or open toed shoes. Wear heavy-duty shoes (may include steel-toe shoes where required). Tie-back long hair to prevent it from being caught in rotating parts.
   d. Use the required personal protective equipment and as a minimum wear safety glasses with side shields or goggles.
   e. Keep all tools in good condition with regular maintenance.
   f. Examine each tool for damage before use and take out of service damaged or defective tools.
   g. Operate tools according to manufacturer’s instructions and do not remove or defeat equipment safeguards.
   h. Keep fingers and hands clear of the point of operation by using push sticks, hooks and pliers. Use brushes, hooks or other tools to remove chips and shavings. Never use hands or fingers.
   i. Do not become distracted or distract someone else while operating shop tools.

5. **Roles and Responsibilities**

5.1 **Departments, Laboratories and Centers (DLCs) – have the responsibility to ensure that:**

   - Individuals shall receive initial training for each tool to be used. Only trained and authorized individuals shall use hand and powered tools in shops.
   - Emergency equipment is located nearby, including an eyewash station for dusty environments, a portable fire extinguisher, and a current list of emergency response instructions and telephone numbers.
   - Purchase of new hand and powered tools meet nationally recognized design standards including Underwriters Laboratory (UL,) the American National Standards Institute (ANSI) or the American Society of Mechanical Engineers (ASME.) Most well known manufacturers meet these standards.
   - Routine periodic inspections of hand and portable power tools and machine guards are conducted by qualified personnel.

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See Legal Disclaimer at:  [http://ehs.mit.edu/site/content/legal-disclaimer](http://ehs.mit.edu/site/content/legal-disclaimer)
5.2 MIT EHS Office is responsible for ensuring that:
- Assistance is provided to DLC’s regarding machine shop and tool safety guidelines and requirements.
- Assistance is provided to DLC’s during level 2 inspections of shops.

5.3 Individuals using hand and powered tools have the responsibility for ensuring that:
- They receive training in the selection, safe use, care, and maintenance of hand and powered tools and machine shop equipment.
- Personal protective equipment is worn while using hand/powered tools and shop equipment.

6. Training

6.1 Prior to the use of hand and powered shop tools, users shall attend training and gain hands-on experience to become familiar with the operation of the equipment, as well as the associated hazards and safeguards. The Shop Manager (or other experienced machinist) is the best source for this training.

6.2 Training shall be documented. Training records shall be kept as part of the EHS-MS training system. Names and dates of those receiving 480 Machine Shop Safety training should be sent to the DLC’s EHS Coordinator, or emailed to environment@mit.edu or mailed to the EHS Office at N52-496.

See example roster below:

<p>| Shop Location: ____________________________ |
| Instructor: ______________________________ |
| Course Name: 480 Machine Shop safety      |</p>
<table>
<thead>
<tr>
<th>Date</th>
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6.3 The training shall include:
- The proper selection, use, adjustment and cleaning of the specific powered shop machines and tools.
- The proper inspection procedures required prior to use.
- The use and function of guards and shields.
- Use of personal protective equipment and the operation of emergency stop/motor controls.
- The need to remove from service and report defective or damaged tools.
- Actions to take in the event of an emergency involving shop activities.

7. Monitoring Requirements

N/A

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8. Record Management

8.1 The shop manager or supervisor shall ensure that training records are kept current in the EHS-MS training database as outlined in section 6.2.

8.2 Maintenance of tools and machines shall be recorded by the shop supervisor.

8.3 Inspections of power tools and hand tools should be documented.

9. Reference

9.1 Appendices
Appendix A: Safety Guidance

Appendix B: Best Management Practices for Shop Hazardous Waste
Appendix C: Tool Classification System

9.2 Standards
OSHA – 29 CFR 1910.212 – General Requirements for All Machinery
OSHA Publication 3067 – Concepts and Techniques of Machine Safe Guarding
ASME B107 Hand Tools
ANSI Standards:
   B11.1 – Construction, Care and Use of Mechanical Power Presses
   B11.4 - Construction, Care and Use of Shears
   B11.6 – Construction, Care and Use of Lathes
   B11.8 – Construction, Care and Use of Drilling, Milling and Boring Machines
   B11.9 – Construction, Care and Use of Grinding Machines
   B11.10 – Construction Care and Use of Metal Sawing Machines
   B15.1 – Mechanical Power Transmission Apparatus
   01.1 – Woodworking Machinery – Safety Requirements

9.3 MIT SOPs / SOGs
Personal Protective Equipment
Lock Out Tag Out
Hot Work
Welding Safety
Flammable and Combustible Liquids
Electrical Safety Management for Facility / Operations Work Environment
Electrical Safety Management for Research Work Environment
Hire/Sponsor a High School or Middle Scholl student; Minors Hazard Assessment Guidance
10. Definitions

**Authorized user** – an individual who has received (per 3.2 above,) both general machine/woodworking shop safety training and specific tool training and has been authorized by the DLC to use that equipment.

**Woodworking/ Machine Shop** – a dedicated area/operation where machining, cutting, drilling, grinding, buffing and resurfacing of material (wood, metal, plastic etc.) is conducted using hand and/or machine tools.

To conduct this work, the shop may contain a collection of the following pieces of equipment: circular/crosscut/rip saw, drill press, lathe, band saw, table saw, mill, grinder, buffer, shaper, shear, metal punch, jointer, swing arm saw, radial arm saw, planer, router, borer/mortise, slitter, drum or belt sander etc.
Appendix A
General Shop Safety Guidance for Common Machine Tools

Machine Shop Tools:
As tools are acquired or put into service in the shop:
- Develop a binder containing the manufacturers operating and maintenance manuals for ongoing reference.
- Post key safety requirements for the shop in general and each tool in particular
- Shop managers should be consulted for tool-specific safe operation.

Drill Press Safety Rules:
- Always secure the work in a vise or clamp to the drill table.
- Operate the drill at the optimum RPM for the diameter of the drill bit and material (check mfg.’s instructions).
- Use the proper size and type of drill; ensure it is sharp and not cracked.
- Use the proper cutting fluid for the material being drilled
- Support material on parallels or backing board when drilling completely through
- If the drill binds, stop the machine and turn the spindle carefully backwards by hand to release the bit
- When drilling a deep hole, withdraw the bit frequently to clear the chips.
- Seek advice and training for drilling Plexiglas (and other brittle materials) if not experienced and approved.
- Wear safety glasses with side shields or machinists goggles as a minimum. Consider face shields. Heavy duty or safety shoes are required unless it can be shown that the potential hazards of the task are non-existent or minimal. Chip shields shall be used. Chip shields removed during service and repair work shall be reinstalled prior to operating the equipment.
- Secure to bench top (or if pedestal type) to floor to prevent tipping. Installing a wide base may be an acceptable alternative.

Lathe Safety Rules:
- Ensure the chuck, drive plate, or faceplate is securely tightened onto the lathe spindle
- Do not use machine power to install the chuck, drive plate or faceplate.
- Ensure the tool bit is sharp and is clamped as secure (short) as possible in the tool holder to minimize the risk of breakage or chatter.
- Remove turnings or chips with a hook or appropriate tool while the machine is switched OFF and not running. Never with an unprotected hand.
- Remove the chuck key from the chuck immediately after tightening or loosening.
- Wear safety glasses with side shields or machinists goggles as a minimum. Consider face shields. Heavy duty or safety shoes are required unless it can be shown that the potential hazards of the task are non-existent or minimal.
- Chip shields/chuck guards and lead screw covers shall be used. Guards or shields removed during service or repair work shall be reinstalled prior to operating equipment.

Milling Machine Safety Rules:
- Ensure work is clamped securely in a vise and the vise clamped securely to the worktable.
- Ensure cutter is rotating in the proper direction and spindle is clear before cutting material.
- Use the proper cutting speed and cutting fluid.
- Ensure cutters are sharp and ensure power is off prior to changing.
- Remove tightening wrench immediately after using.
- Use safety glasses with side shields or machinists goggles as a minimum. Consider face shields. Heavy duty or safety shoes are required unless it can be shown that the potential hazards of the task are non-existent or minimal.
- Chip shields and guards shall be used. Guards or shields removed during service or repair work shall be reinstalled prior to operating equipment.

### Grinder Safety Rules:
- Ensure guards are in place and operable. The bench tool rest clearance must be less than 1/8 inch. Grinders shall be secured to bench top (or if pedestal) to floor to prevent movement.
- Ensure local ventilation (if required) is in place and operable.
- Ensure grindings wheels are not defective, unbalanced or cracked. Such damage may not be obvious. Stand to one side upon starting.
- Keep the wheel dressed with small amounts frequently.
- For a surface grinder, ensure the magnetic chuck is securely placed.
- Do not grind aluminum due to potential hazards. Check with supervision for safety requirements.
- Use safety glasses with side shields or machinists goggles as a minimum. Consider face shields. Heavy duty or safety shoes are required unless it can be shown that the potential hazards of the task are non-existent or minimal. Use LEV or SLEV unless it is deemed not necessary.
- Guards or shields removed during service or repair work shall be reinstalled prior to operating equipment.

### Band Saw Safety Rules:
- Ensure the upper guide and guard is set close to the work (¼”)
- Use the proper pitch blade depending on the material thickness. There should be at least 2 teeth in aluminum material and 3 teeth when cutting steel.
- Ensure the blade is not defective or cracked prior to installation and is covered by a blade guard.
- Do not run the saw at a higher speed than recommended for the material being cut.
- If the motor/saw stalls or breaks, shut off the power immediately and keep clear until the machine has stopped.
- Use safety glasses with side shields or machinists goggles as a minimum. Consider face shields. Heavy duty or safety shoes are required unless it can be shown that the potential hazards of the task are non-existent or minimal.
- Guards removed during service or repair work shall be reinstalled prior to operating equipment.

### Disc and Belt Safety Rules:
- Ensure the guards are in place prior to use.
- Do not operate machines with worn, ripped or torn belts or discs. Ensure guards are in place.
- Place the work against the rest on the disc and belt sanders as firmly as possible.
- For disc sanders, always use the downward motion side of the disc. Using the upward motion can throw the parts outward with force.
- For horizontal belt sanders, always use the motion of the sanding belt that is away from the body.
- Do not sand materials that will generate hazardous dust such as asbestos, beryllium or copper / beryllium alloys.
- Use safety glasses with side shields or machinists goggles as a minimum. Consider face shields. Heavy duty or safety shoes are required unless it can be shown that the potential hazards of the task are non-existent or minimal. Use LEV or SLEV unless it is deemed not necessary.
- Guards removed during service or repair work shall be reinstalled prior to operating equipment.

**Woodworking Shop Tools:**
- Kickbacks occur when a saw seizes the stock and hurls it back at the operator. It occurs more often when cutting parallel to the grain (ripping) than when crosscutting. Kickbacks can occur when the stock twists and binds, a blade that is not sharp or set an incorrect height, poor quality lumber (frozen, knots or nails). These hazards can be reduced by using safeguards such as spreaders, anti-kickback fingers and gauge or rip fences. Tools shall be equipped with guards and chip shields.
- Wood dust exposure has been associated with a variety of adverse health effects including dermatitis, skin and respiratory sensitization as well as (nasal) cancer. The use of local ventilation is the primary engineering control. Exhaust hoods (LEVs or SLEV) should be installed as close as possible to the emission source.
- Guards or shields removed during service or repair work shall be reinstalled prior to operating equipment.

**Table Saw Safety Rules:**
- Ensure the guards are in place prior to use. Never remove a guard.
- Use the proper blade for the material being cut. Set it 1/8” above the work.
- Inspect the blade prior to use. Ensure it is sharp and free of defects
- Use a pusher stick to rip narrow pieces of stock. Never place fingers near the blade
- Obtain assistance for supporting large sections of material.
- Ensure scraps and sawdust does not accumulate by routinely cleaning the area and disposing appropriately.
- Consider local exhaust ventilation (LEV) under the blade slot as a minimum. A hood integrated with the guard can also be useful.
- Use safety glasses with side shields or machinists goggles as a minimum. Consider face shields. Heavy duty or safety shoes are required unless it can be shown that the potential hazards of the task are non-existent or minimal.
• Guards or shields removed during service or repair work shall be reinstalled prior to operating equipment.
• Consider “saw-stop” technology for purchase of new table saws.

Jig Saw Safety Rules:
• Ensure the guard is in place prior to use. Never remove a guard.
• Use a threshold rest (slotted foot) to hold the stock
• Ensure blade is properly attached and secured
• Make turns slowly, no sharp turns with a wide blade
• Use safety glasses with side shields or machinists goggles as a minimum. Consider face shields. Heavy duty or safety shoes are required unless it can be shown that the potential hazards of the task are non-existent or minimal.
• Guards or shields removed during service or repair work shall be reinstalled prior to operating equipment.

Jointers Safety Rules:
• Enclose the cutter head with an automatic (spring loaded, self-enclosing) guard that exposes the cutter head only when the stock is being fed.
• Adjust the cutter head to that the knife projects no more than 1/8 inch beyond the head.
• Keep clearances between the table and the head as small as possible.
• Use hold down push blocks when jointing wood narrower than 3 inches.
• Avoid deep cuts to minimize the hazards of kickbacks.
• Never joint material that is less than four times the width of the bed opening.
• Consider Use a local exhaust ventilation hood underneath the machine head.
• Use safety glasses with side shields or machinists goggles as a minimum. Consider face shields. Heavy duty or safety shoes are required unless it can be shown that the potential hazards of the task are non-existent or minimal.
• Guards removed during service or repair work shall be reinstalled prior to operating equipment.

Shaper Safety Rules:
• Enclose the spindle with an adjustable guard or cage. For straight shaping the fence frame should include the guard. Keep the opening as small as possible for the knives. The fence should extend at least 18 inches on either side of the spindle.
• Split adjustable fences are useful for guarding when the entire edge of the stock is to be shaped.
• Mount a ring guard around the cutting bit to reduce the exposure to the bit
• Ensure the knives are precision ground, balanced and fit properly
• Apply the power slowly to bring the spindle to operating speed. Listen for chatter to indicate an out of balance condition.
• Use templates, jigs and fixtures to keep hands from the point of operation
• Cut in the opposite direction of the spindle’s rotation
• Use local exhaust ventilation with a hood located on the table behind each head.
- Use safety glasses with side shields or machinists goggles as a minimum. Consider face shields. Heavy duty or safety shoes, are required unless it can be shown that the potential hazards of the task are non-existent or minimal.
- Guards or shields removed during service or repair work shall be reinstalled prior to operating equipment.

**Router Safety Rules:**
- Enclose the tool with an adjustable tool guard.
- Provide the router with a spindle braking system that gradually engages
- Ensure the tools are properly attached and secured.
- Label the cutting tools and holders with the maximum permissible cutting speed
- Use local exhaust ventilation hoods behind the heads of the router table. Locate an open faced or slot hood at the rear end of the table.
- Use safety glasses with side shields or machinists goggles as a minimum. Consider face shields. Heavy duty or safety shoes are required unless it can be shown that the potential hazards of the task are non-existent or minimal.
- Guards or shields removed during service or repair work shall be reinstalled prior to operating equipment.
Appendix B
Best Management Practices for Shop Hazardous Waste

Machine shop operations generate chemical waste materials, but in different ways than a laboratory. This document provides some general guidance, but additional information may be required for your shop. Contact the EHS Office at environment@mit.edu

- Machine shops that generate hazardous wastes on a routine basis shall store it in a dedicated satellite accumulation area (SAA). These areas must be inspected weekly.
- Personnel generating, handling and storing hazardous waste must attend “Managing Hazardous Waste” training, at least annually.
- The EHS Office encourages machine shop personnel to cleanout stocks of obsolete chemicals on a regular basis to avoid accumulating large quantities of obsolete and/or expired materials. Doing this will free-up valuable storage space.

Cutting Fluids Waste
Machine shops operations typically use and dispose of large quantities of cutting and grinding fluids. These consist of either water-soluble or non-soluble (petroleum) based oils.
*BMP* - Wherever possible use water-soluble cutting fluids. Both types (water-soluble and non-soluble fluids) shall be collected as hazardous waste. Avoid use of chlorinated tapping fluids and take precautions to prevent mixing them with cutting fluids.

Chips and Fines Waste
The primary wastes from metalworking are chips and fines. If saturated with cooling fluids other than water, these materials should be collected as hazardous waste.
*BMP* – To avoid this, EHS encourages machine shops to;
- Completely drain excess cooling fluid from chips prior to recycling using a screen, perforated container, chip wringer, or centrifuge. The drained coolant can then be reused or disposed of as hazardous waste.
- Locate opportunities to recycle chips, fines, and sludge for metal value.
- Segregate by metal type for increased recycling value.

Metal Coatings, Paints, Sealants, Adhesives, Etc.
These materials often are the largest sources of hazardous waste in a shop. They are often flammable or have other characteristics of hazardous waste. If a material is flammable, store it in a flammable storage cabinet.
*BMP* – Misc. waste materials should be disposed of regularly by requesting a shop cleanout.

Degreasers
Degreasing is critical to remove oil, particles, and/or buffing compound contamination. Machine shops typically use mineral spirits as a solvent to remove grease and oil from tools, parts, and equipment. This results in large quantities of hazardous waste being generated during this cleaning process.
*BMP* - Waste degreasers should be disposed of in regular machine shop cleanouts.

Wipes
Rags and wipes which are saturated with a liquid other than water must be collected and managed as a hazardous waste.
*BMP* – Use the minimal amount of cleaner necessary to avoid saturating wipes. Wipes that are not saturated with hazardous liquids can be placed in the regular trash.
# Appendix C
## Tool Classification System

<table>
<thead>
<tr>
<th>Device Class</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Power</strong></td>
<td>Low power hand/small bench tools</td>
<td>Medium power tools</td>
<td>Powerful portable/small bench top tools and industrial tools</td>
</tr>
</tbody>
</table>
| **Examples** | • Dremel tool  
• Cordless drill, <18V  
• Palm sanders  
• Soldering gun  
• Glue gun  
• Sewing machine  
• 3d printer | • Jig saw  
• 3/8 inch hand drill  
• Corded device <1/3 hp  
• Cordless drill, 18 V - 24V  
• Laser cutter  
• Thermal foam cutter | • Circular saw  
• Belt/disc sander  
• Reciprocating saw  
• Chop saw  
• Router  
• Angle grinder  
• Printing press  
• Lathe  
• Band saw  
• Drill press  
• Planer/jointer  
• Bench/surface grinder  
• Table saw  
• Radial arm saw  
• Milling machine  
• Shaper  
• Power shear |
| **Shop Access Control** | By permission of Shop Supervisor 
ID Card/Key | By permission of Shop Supervisor 
ID Card/Key | By permission of Shop Supervisor 
ID Card/Key |
| **Oversight when Shop Supervisor not present** | • Undergrads-none  
• Grads-none  
• Employees (not machinists or woodworkers by trade)-none | • Undergrads-buddy system  
• Grads-none  
• Employees (not machinists or woodworkers by trade)-none | • Undergrads-monitored  
• Grads-buddy system  
• Employees (not machinists or woodworkers by trade)-buddy system |