



EEC166 & EEC171 Design and Prototyping Lab
Operation and Safety Handbook

Handbook & General Guidelines

While this manual covers specific issues related to the School of Engineering (SOE) Design and Prototyping Lab, the University of Alabama at Birmingham policies and procedures must always be followed.

All users of the School of Engineering (SOE) Project Labs and facilities are required to follow the health and safety guidelines outlined in this manual at all times.

Report any safety issues IMMEDIATELY to your instructor(s), staff member, or the school's Safety Officer.

Use of the Design and Prototyping lab requires completion of the UAB Environmental Health and Safety [Shop Safety Course](#), the [OSHA Hazard Communication Awareness Training](#) (logon with your BlazerID) and the School of Engineering Operation and Safety Training. Details of the required training are explained here, including instruction for uploading the certificates of completion (<https://www.uab.edu/engineering/home/students/design-and-prototyping-lab>). Upon completion of the training, students will receive a sticker for their BlazerID indicating that the training has been completed. Training/certification is required annually for all users of the Design and Prototyping Lab.

Introduction

The Design and Prototyping Lab is available to engineering students to work on projects as part of their engineering coursework, student organizations and other project-based activities. Use of the Design and Prototyping Labs requires completion of safety training (<https://www.uab.edu/engineering/home/students/design-and-prototyping-lab>) and supervision when required. EEC166 is designated as low-fidelity prototyping. Students have access to EEC 166 when the EEC building is open to students (7:00 a.m. to 10:00 p.m.) once they have completed annual safety training. Because students can work in EEC 166 without direct faculty or staff supervision, work is limited to activities that are not 'inherently dangerous' (for example cutting with an X-ACTO knife or utility knife or using a soldering iron). Similarly, students can use the filament and SLA 3D printers (FlashForge and Elegoo) without supervision (see the section on 3D printers below for additional information).

The School of Engineering also provides a variety of hand tools and power tools and some machining tools available to students for project work. Use of hand tools and power tools requires additional tool-specific training and can only be used under direct supervision of a faculty member or staff person (usually the course instructor or faculty mentor). Training and use should be arranged with the appropriate faculty/staff member well in advance of the anticipated need for the tool(s). Training and supervision is also required for use of personal tools in the Design and Prototyping Lab. The faculty mentor, the SOE Safety Officer and Dr. Wick must be notified and approve of use of personal tools in the Design and Prototyping Lab *before* any outside tools are brought into the lab.

Do not ever use a tool or try to do something that you are not comfortable with. If you do not feel safe using a tool, even if you have been trained, ask for help.

The SOE has specific health and safety guidelines for all students, staff, and faculty members using their facilities. Though this handbook will outline many of the correct health and safety procedures, should a problem arise, please identify who the appropriate contact is and contact that person with questions. It is the responsibility of each student and faculty member to be familiar with and follow these procedures when they are on the UAB campus. Each member of the SOE community needs to follow these practices to keep the working and teaching environment safe for everyone. While this manual covers specific issues related to the SOE, all UAB policies and procedures must also be followed.

In Case of Emergency

Call 911 or 205-934-3535 if there is an emergency. When contacting let them know your location and the type of emergency. Also, give them your building name and room number if applicable. You should also report all accidents/emergencies to the School of Engineering Safety Officer (Jerry Turner 205-440-5556, jlt13@uab.edu).

Incident Reporting

In the event, a UAB student is injured. An immediate assessment should be made to determine the severity of injuries and the proper response required. **The following guidelines should be followed.**

- If a student is unresponsive and not breathing, contact UAB dispatch immediately at 934-3535 or 911 from the UAB phone. A qualified person should start Cardiopulmonary Resuscitation (CPR), attach an Automatic External Defibrillator if one is available. If severely injured the same process should be used in notifying UAB dispatch at (205) 934-3535 or 911 from a UAB phone. Dispatch will then send the appropriate response needed.
- If a student has minor injuries and emergency response is not needed, then the student should be directed to the Student Health and Wellness Center. It will be up to the student whether to seek medical attention or not. UAB faculty cannot force a student to seek medical attention.
- The following form at the link provided below should be filled out and sent to UAB On-the-Job Injury (OJI). **(Use this form regardless of student status, employee or not. For campus student injuries please use the OJI Incident report tab on the following webpage.)** <https://www.uab.edu/humanresources/home/relations/oji>
- At no point should notification to dispatch or transport be delayed obtaining the proper paperwork.
 - **The Incident must be reported to UAB OJI, the UAB Faculty/Staff Member that is responsible for the student, Chair of that Department, and to the Schools Safety officer per the School of Engineering's Dean's office.**
 - **(Jerry Turner 205-440-5556, 6-5091 or jlt13@uab.edu)**

Emergency Action Plans

Most high-risk buildings on the UAB campus have a dedicated Emergency Action Plan (EAP). These plans cover a wide variety of topics for occupant safety such as Bomb threats, loss of power, severe weather, fire safety, active shooter, injuries, and others. The EAP for the School of Engineering is housed on the school's intranet page. It is located under the safety issues and procedures tab. <https://uab365.sharepoint.com/sites/Engineering/Safety/Pages/default.aspx>

Fire Extinguishers

The School of Engineering (SOE) follows all UAB fire safety codes enforced on campus. Marked fire extinguishers can be found throughout all campus buildings, labs, and classrooms. Only use fire extinguishers rated for the type of fire being extinguished. Report all fires by calling UAB Police Dispatch at 911 or (205) 934-3535 from a cell phone. Also, report any use of an extinguisher to Campus Maintenance so it may be inspected and replaced.

A report describing the incident must be produced for the SOE Safety Officer including what happened, why the extinguisher was used, and what equipment or materials were damaged.

First Aid

First Aid kits are found in most lab areas. Identify where the first aid kit is located in the lab you are working. Notify your instructor if supplies are low.

Environmental Health & Safety <https://www.uab.edu/ehs/> (205)934-2487

The UAB Department of Environmental Health & Safety's mission is to ensure that EH&S customers have a safe workplace by providing them with the services and knowledge necessary to protect themselves, the UAB community, and the environment. UAB's Office of Environmental Health & Safety is a federally regulated organization that deals with campus concerns regarding health and safety. It governs all health and safety on campus. EH&S works as a liaison between the university and many governmental agencies and departments. The Hazardous Materials Management division of EH&S manages and picks up the hazardous waste from all the SOE satellite accumulation areas. EH&S ensures compliance of the SOE with federal laws and protects the safety of personnel and student.

Training

Training is required of all students enrolled in classes and who are going to be working in a lab or shop setting. You must have proof of completion submitted to the Deans' office for the following training before gaining access to the project lab.

- Shop Safety – [Shop Safety Training Link](#)
- OSHA Hazard Communication Awareness Training – [HAZCOM Training Link](#) (logon with you BlazerID)
- General Lab Safety – Read this Lab Safety Operation and Safety Handbook and sign and date the last page.
- Upload the two completion certifications (Shop Safety and HAZCOM Training) and the signed safety manual attestation (the last page only) using the proscribed file naming convention

Training to be offered in person each fall, for first-time students, and a refresher to be completed annually for those who have already completed the in-person training.

Safety Data Sheets

Safety Data Sheets (SDS) are available for each chemical used in School of Engineering Labs. SDS information for all materials used in SOE labs is accessible online at [Chemwatch](#). The Chemwatch website lists important information including the name of the chemical, company information, and safe handling procedures. SDS information is invaluable so that everyone can know what chemicals and products are being used in the labs. Access to Chemwatch should be provided to emergency responders or a printout of specific chemical used should be taken to the

emergency room with the victim if exposure or accident occurs where materials may be involved. Sheets can be downloaded online from manufacturer and supplier websites. If there is an accident such as a spill, accidental ingestion, or medical problem, the sheets will supply the emergency responders with all the chemical information. It is the responsibility of the instructor to make sure that the inventory on Chemwatch is up to date.

Basic Student Shop Rules

Rules are subject to review and revision. It is incumbent on the individual user to make certain that they have the most current rule revisions.

Entering the Facility

- You must receive and read a copy of the Design and Prototyping Lab Operation and Safety Handbook, complete all required training, and have a signed permission form before receiving approval for Design and Prototyping Lab privileges and access. Access is a privilege, not a right. The procedures for requesting extra-curricular access are posted. The ability to gain access does NOT automatically grant permission.
- Any attempt to obscure, evade, or circumvent any safety feature or program implemented for your protection will be considered as a reckless disregard for your safety and the safety of fellow users.
- Use of the facility or any equipment, tools, or supplies therein, while impaired in ANY manner (Alcohol, medications, lack of sleep, etc.) is expressly forbidden.
- All UAB students are issued a ONE card, and must have it visible with the appropriate identifier issued by the Deans' office. Any unauthorized or inappropriate use of access cards is a serious offense. Students should not allow access to the lab for any other students. Report lost cards immediately.
- The facility is monitored by Closed Circuit TV, recorded to validate compliance and document infractions. No guarantee of personal protection is implied.

Inside the Facility

- Safety glasses (ANSI Standard Z87.1) must be worn at all times.
- Wear any other personal protective equipment (PPE) required for the task at hand.
- Report any injury, breakage, incident, or potential safety violation immediately. Failure to report a violation is itself a violation
- Read, understand and follow all valid safety instructions, written or verbal
- Do not wear loose clothing, hair, or jewelry in the facility. Long hair must be appropriately secured. No short pants, long sleeves, or open shoes. Never wear gloves around machines in operation.
- Clothing, accessories, or activities that may obscure the view of security cameras are prohibited.
- UAB ONE cards are to be visible at all times.
- No horseplay or other distractions.
- Keep work areas clean and free of clutter.

HAND TOOL SAFETY GUIDELINES

PURPOSE

The purpose of this guidance document is to promote the safe use of and to reduce the likelihood of injuries involving hand or power tools.

SCOPE

These requirements apply to all University departments and their employees where the use of hand or power tools is in use or will be used. This will most notably apply to students involved in lab and shop areas.

RESPONSIBILITIES

Environmental Health and Safety: EHS is responsible for reviewing hazards associated with hand and portable power tools during annual shop inspections. The tools will be reviewed to make sure they are in good working order, suitable for the jobs they are used for and do not pose a hazard to the operator. EHS is responsible for reviewing and updating the Hand & Portable Power Tools Guidelines. EHS and instructors can also work jointly in the development of project analysis for hand tools that present a unique hazard to the employee.

- **Select the Right Tool for the Job:** Examples of unsafe practices are Striking hardened faces of hand tools together (such as using a carpenter's hammer to strike another hammer, hatchet, or metal chisel), using a file for a pry, a wrench for a hammer, using a 'cheater', and pliers instead of the proper wrench.
- **Keep Tools in Good Working Condition:** Wrenches with cracked work jaws, screwdrivers with broken points or broken handles, hammers with loose heads, dull saws, and extension cords or electric tools with frayed cord or broken plugs, improper or removed grounding prongs, or split insulation are examples of tools in poor conditions. Tools that have deteriorated in this manner must be taken out of service.
- **Use Tools the Right Way:** Screwdrivers applied to objects held in the hand, knives pulled toward the body, and failure to ground electrical equipment are common causes of accidents.
- **Place/Keep/Store Tools in a Safe & Secure Place:** Many accidents have been caused by tools falling from overhead and by knives, chisels, and other sharp tools carried in pockets or left in toolboxes with cutting edges exposed. Tools should be kept away from workbench edges.

The following procedures are excellent shop practices for students to follow to promote a safe working environment where hand and portable power tools are used:

- Establish regular tool inspection procedures and provide good repair facilities to ensure that tools will be maintained in a safe condition.

- Establish a procedure for control of tools such as a check-out system at tool cribs.
- Provide proper storage facilities in the tool room and on the job.
- The SOE is responsible for the safe condition of tools and equipment used by students, but students have the responsibility for properly using and maintaining tools.

**Failure to observe safe work practices when using hand and portable power tools accounts for most hand and power tool accidents.

Each instructor/professor is to make a complete check of his/her operations to determine the need for special tools that will do the work more safely than ordinary tools. This can be completed by, developing a Job Safety Analysis can be used to identify the hazards associated with the job and the appropriate tools that should be used.

Special tools should be kept readily available in a centralized tool room if possible.

The instructor/professor should be qualified through training and experience to pass judgment on the condition of tools for further use. Dull or damaged tools shall not be returned to stock.

Students should not continue the use of damaged tools during a job if it is noticed during the job that the tool is damaged.

Proper maintenance and repair of tools requires adequate facilities, workbenches, vises, a forge or furnace for hardening and tempering, tempering baths, safety goggles, repair tools, grinders, and good lighting. Faculty/Staff specifically trained in the care of tools should oversee these facilities. If this service is not available, tools should be sent out for repairs.

School of Engineering 3D Printing Policies

All 3D printing activities in the Design and Prototyping labs must be conducted in accordance with the School of Engineering 3D printing guidelines and completion of mandatory annual safety training (<https://www.uab.edu/engineering/home/students/design-and-prototyping-lab>). The following are examples of objects that cannot be 3D printed at UAB:

- Prohibited by law or illegal.
- Unsafe, harmful, dangerous or threatening to the well-being of others.
- Obscene or otherwise inappropriate.
- Knowingly violate another's intellectual property or privacy rights.
- Intended for direct sale, retail, or immediate commercial use.
- Used in human research or human clinical settings other than for educational purposes.
- Used in animal laboratory settings without first obtaining approval from the Institutional Animal Care and Use Committee (IACUC).

3D Printer User Information

The primary 3D printers available for student use are three Flash Forge Adventure 3 Lite FDM (fused deposition modeling) and three Elegoo Mars 2 SLA (Stereolithography) with Elegoo UV curing machines.



FlashForge Adventurer 3 Lite 3D Printer



Elegoo Mars 2



Elegoo UV Curing Machine

- The difference between FDM and SLA printers is explained here: <https://formlabs.com/blog/fdm-vs-sla-compare-types-of-3d-printers/>.
- Product information for the FlashForge FDM printers is here: https://flashforge-usa.com/products/flashforge-adventurer-3-lite-3d-printer?_pos=2&_sid=15b7491fe&_ss=r
- Product information for the Elegoo Mars 2 printer is here: https://www.elegoo.com/products/elegoo-mars-2-mono-lcd-3d-printer?gclid=Cj0KCQjwspKUBhCvARIsAB2IYutNX3-d0M6dVv8ok2uDwH3Lu5bFF33ZmGdmyjnTqCMwARW0uG1_cVMaArrIEALw_wcB
- Product information for the Elegoo Mercury UV Curing Machine is here: https://www.elegoo.com/products/elegoo-mercury-curing-machine?_pos=3&_sid=b21db03e3&_ss=r
- Download the FlashPrint software compatible with your computer's operating device: <https://flashforge-usa.com/pages/download>.
- Operating details for the Mars 2 printer is here: <https://www.elegoo.com/pages/3d-printing-user-support>
- *Only PLA (Poly Lactic Acid) filament can be used in the FlashForge printers.* If you need to use another material or a different printer, contact your professor, student organization faculty mentor or Dr. Wick to arrange printing.
- If a print running unattended, you must place a note with your name, a contact phone number and the name of the class, organization, or professor on or in front of the printer.
- Unless a print has obviously failed, or the filament reservoir is exhausted under no circumstances are you to stop a print file in progress. If the print has failed, carefully remove and place the remnants of the print on the user's contact card.
- 3D printers are available on a first come, first served basis. It is incumbent on the student to keep track of project deadlines and due dates. A printer cannot be reserved for a specific project or class. Any one project team can only use one printer at a time.

(*Note, external references (links) are provided for your convenience and were active on the date of publication listed on the title page. The School of Engineering does not maintain these websites and is not responsible for their content or inaccessibility. If you need additional information about 3D printing or anything else covered in this manual you can access a number of credible web-based resources and tutorials or ask your instructor/mentor.

PERSONAL PROTECTIVE EQUIPMENT

Appropriate personal protective equipment (i.e.: safety glasses, face shield, safety goggles, gloves, etc.) should be worn to protect from hazards that may be encountered while using portable power tools and hand tools.

Students that use hand and power tools and are exposed to the hazards of falling, flying, abrasive and splashing materials, or exposed to harmful dust, fumes, vapors, or gases shall be provided with the specified personal protective equipment necessary to protect them from the hazard.

Safety glasses or safety goggles must be worn at all times in EEC171 whether you are using tools or not. Project planning, design and other activities can be done in EEC166 or the EEC common area without safety glasses.



USE OF HAND TOOLS

The School of Engineering provides students access to hand tools and power tools for project work. Their use requires tool-specific training (beyond the basin lab safety training requirements explained above) and direct supervision by a UAB employee (usually your class, organization of project instructor or professor).

Hand tools are non-powered, which includes saws, axes, wrenches, screwdrivers, hammers, etc. The greatest hazards posed by hand tools result from misuse and improper maintenance. Employee instruction/training programs shall provide detailed training in the proper use of hand tools for the specific area of operations in which they will be working. Attention will be given to tool selection, tool use, and proper personal protective equipment that are required to be used when operating the specific tool as outlined in the following sections:

Metal-Cutting Hand Tools

Chisels

- Factors determining the selection of cold chisels are the materials to be cut, the size and shape of the tool, and the depth of the cut to be made.

- The chisel should be made heavy enough so that it will not buckle or spring when struck.
- A chisel no larger than the material should be selected so that the blade is used rather than the point or corner. Also, a hammer heavy enough to do the job should be used.
- Students are required to wear safety goggles when using a chisel and should set up a shield or screen to prevent injury to other employees from flying chips. If a shield does not give protection to all exposed employees, then all employees in the work area are required to wear glasses with side protection.

Tap and Die Work

- Tap and die work should be firmly mounted in a vise.
- Only a T-handle wrench or adjustable tap wrench should be used.
- When threads are being cut with a hand die, hands and arms should be kept clear of the sharp threads coming through the die, and metal cuttings should be cleared away with a brush.



Hack Saws

- Hacksaws should be adjusted in the frame to prevent buckling and breaking but should not be tight enough to break off the pins that support the blade.
- Install blade with teeth pointing forward.
- Pressure should be applied on the forward stroke, not on the backstroke.
- If the blade is twisted or too much pressure is applied, the blade may break and cause injury to the hands or arms of the user.



Files

- Selection of the right kind of file for the job will prevent injuries and lengthen the life of the file.
- The file should never be cleaned by being struck against a vise or other metal object due to file chips becoming possible flying debris.
- A file-cleaning card or brush should be used.
- A file is not to be hammered or used as a pry. Use of a file in this manner frequently results in the file chipping or breaking causing injury to the user.
- A file should not be made into a center punch, chisel, or any other type of tool because the hardened steel may fracture in use.
- A file is never to be used without a smooth, crack-free handle; if the file were to get hung up, the tang may puncture the palm, the wrist, or other parts of the body.
- Under some conditions, a clamp-on raised offset handle may be useful to give extra clearance for the hands.
- Files are not to be used on lathe stock turning at high speed (faster than three turns per file stroke) because the end of the file may strike the chuck, dog, or faceplate and throw the file (or metal chip) back at the operator hard enough to inflict serious injury.



Tin/Sheet Metal Snips

- Tin snips should be heavy enough to cut the material so easily that the employee needs only one hand on the snips and can use the other to hold the material.
- The material is to be well supported before the last cut is made so that cut edges do not press against the hands.
- Jaws of snips are to be kept tight and well lubricated.
- Students are required to wear safety goggles when trimming corners or slivers of metal because small particles often fly with considerable force.
- Students are also required to wear gloves when making cuts.



Cutters

- Cutters used on wire, reinforcing rods, or bolts should have ample capacity for the stock; otherwise, the jaws may be sprung or spread.
- Chips may fly from the cutting edge and injure the user.
- Frequently lubricate cutters.
- To keep cutting edges from becoming nicked or chipped, cutters are not to be used as nail pullers or pry bars.
- Cutter jaws should have the hardness specified by the manufacturer for the particular kind of material to be cut.
- When the blade cannot be guarded, it is safer to carry the ax at one's side.
- The blade on a single-edged ax shall be pointed down. Hatchets
- Hatchets shall not be used for striking hard metal surfaces since the tempered head may injure the user or others by flying chips.
- When using a hatchet in a crowded area, a student shall take special care to prevent injury to themselves and other students.
- Using a hatchet to drive nails is prohibited.



Miscellaneous Cutting Hand Tools

Scrapers, Knives, Scalpels/X-acto Knives, & Box Cutters

- These tools are to be kept sharp and in good condition.
- The principal hazard in the use of knives is that hands may slip from the handle onto the blade or that the knife may strike the body or the freehand.
- A handle guard or a finger ring (and swivel) on the handle eliminates these hazards and is required to be used.



- Never carry a sheathed knife on the front part of a belt, but carry it over the right or left hip, toward the back. This will prevent severing a leg artery or vein in case of a fall.
- Knives should be stored safely and must never be left lying on benches or in other places such as being hidden under a product, under scrap paper or wiping rags, or among other tools in workboxes or drawers where they may cause hand injuries. Safe placing and storing of knives is one of the most important keys to knife safety.
- Instructors must make certain that students who handle knives have ample room in which to work so they are not in danger of being bumped by other employees.
- Knives are to be kept separate from other tools to protect the cutting edge of the knife as well as to protect the employee.
- Horseplay such as throwing knives, "fencing", trying to cut objects into smaller and smaller pieces, and similar practices are prohibited around any knife operations.
- Instructor shall assure that nothing is cut that requires excessive pressure on the knife.
- Knives shall not be used as a substitute for can openers, screwdrivers, or ice picks.



Torsion Tools

Open-End or Box Wrenches

- Open-end or box wrenches shall be inspected to make sure that they fit properly and that the jaws are not sprung or cracked.
- When defective, the wrench is required to be taken out of service until repaired.



Socket Wrenches

- Socket wrenches are safer to use than adjustable or open-ended wrenches.
- Socket wrenches give great flexibility in hard-to-reach places. The use of special types shall be encouraged where there is a danger of injury.



Adjustable Wrenches

- Adjustable wrenches are used for many purposes but are not intended to take the place of standard open-end, box, or socket wrenches.



- They are used mainly for nuts and bolts that do not fit a standard wrench.
- Pressure is always applied to the fixed jaw.

Pipe Wrenches

- Pipe wrenches, both straight and chain tong, shall have sharp jaws and be kept clean to prevent slipping.
- The adjusting nut of the wrench is to be inspected frequently and taken out of service if cracked. A cracked nut may break under strain.
- A piece of pipe (also called a 'cheater') slipped over the handle shall not be used to give added leverage because this can strain a pipe wrench to the breaking point.
- The handle of every wrench is designed to be long enough for the maximum allowable safe pressure.
- A pipe wrench should never be used on nuts or bolts, the corners of which will break the teeth of the wrench, making it unsafe to use on pipe and fittings, and it also damages the nuts/bolts.
- A pipe wrench shall not be used on valves, struck with a hammer, nor used as a hammer.



Pliers

- Side-cutting pliers sometimes cause injuries when short ends of wires are cut.
- A guard over the cutting edge and the use of safety glasses will help prevent eye injuries.
- The handles of electricians' pliers are to be insulated. In addition, employees shall wear the proper electrical-rated gloves if they are to work on energized lines.
- Pliers shall not be used as a substitute for a wrench.



Screwdrivers

- The practice of using screwdrivers for punches, wedges, pinch bars, or pry bars shall not be allowed.
- Cross-slot (Phillips's head) screwdrivers are safer than the



square bit type because they have fewer tendencies to slip. The tip must be kept clean and sharp, however, to permit a good grip on the head of the screw.

- (For use on metal surfaces) The part to be worked upon must never be held in the hands; it should be laid on a bench or flat surface or held in a vise.
- No screwdriver used for electrical work shall have the blade or rivet extending through the handle. Both blade and handle shall be insulated except at the tip.

Shock Tools

Hammers

- A hammer is to have a securely wedged handle suited to the type of head used. The handle shall be smooth, without cracks or splinters, free of oil, shaped to fit the hand, and of the specified size and length. Employees shall be warned against using a steel hammer on hardened steel surfaces. Instead, a soft-head hammer or one with a plastic, wood, rubber, or rawhide head should be used. Safety goggles or safety glasses shall be worn to protect against flying chips, nails, or scale.

Riveting Hammers

- Riveting hammers, often used by sheet metal workers, must have the same kind of use and care as ball pen hammers and should be watched closely for cracked or chipped faces.



Carpenter's or Claw Hammers

- The faces shall be kept well-dressed at all times to reduce the hazard of flying nails while they are being started into a piece of wood.
- A checker-faced head is sometimes used to reduce this hazard.

****When nailing is being conducted in a work area, eye protection is advised to be used by all students nailing and all students working in the same area.**



Spark-Resistant Hand Tools

Around flammable substances, sparks produced by iron and steel hand tools can be a dangerous ignition source. Where this hazard exists, spark-resistant tools made from brass, plastic, aluminum, or wood will provide for safety.



POWER TOOL PRECAUTIONS (OSHA 1926.302)

Power tools can be hazardous when improperly used. There are several types of power tools, based on the power source they use: electric, pneumatic, liquid fuel, hydraulic, and powder actuated.

The following general precautions should be observed by power tool users:

- Never carry a tool by the cord or hose.
- Never yank the cord or the hose to disconnect it from the receptacle.
- Keep cords and hoses away from heat, oil, and sharp edges.
- Cords are required to be free of frays/cuts. If the cord is damaged, the equipment shall be removed from service immediately.
- Disconnect tools when not in use, before servicing, and when changing accessories such as blades, bits and cutters.
- All observers should be kept at a safe distance away from the work area.
- Secure work with clamps or a vise, freeing both hands to operate the tool.
- Avoid accidental starting. The employee should not hold a finger on the switch button while carrying a plugged-in tool.
- Tools should be maintained with care. They should be kept sharp and clean for the best performance. Follow instructions in the user's manual for lubricating and changing accessories.
- Be sure to keep good footing and maintain good balance.
- The proper apparel should be worn. Loose clothing, ties, or jewelry can become caught in moving parts.

All portable electric tools that are damaged shall be removed from use and tagged "Do Not Use".

GUARDS (OSHA 1910.243)

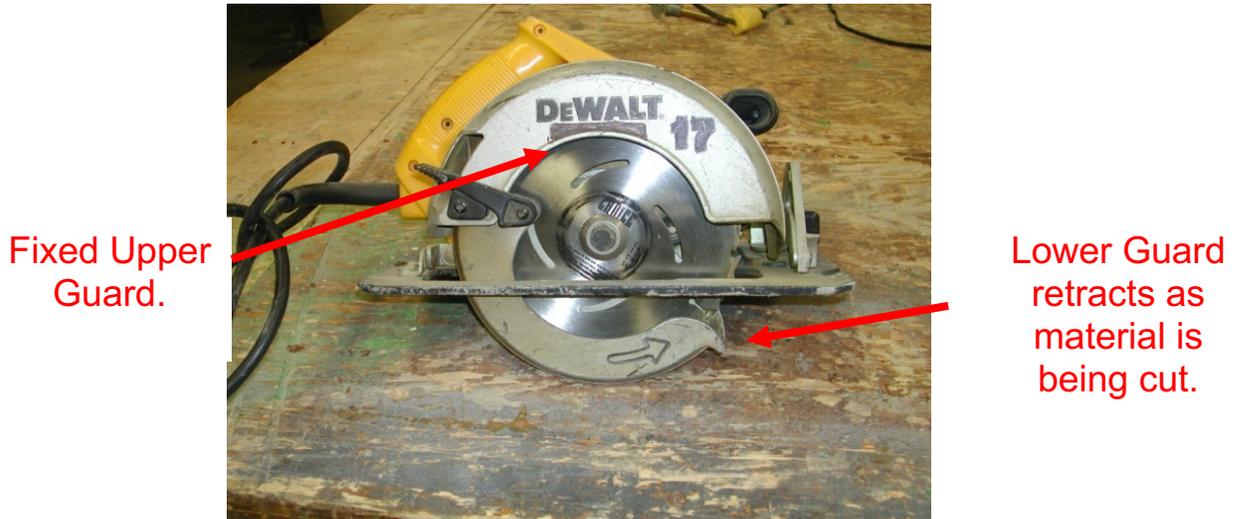
Hazardous moving parts of a power tool need to be safeguarded. For example, belts, gears, shafts, pulleys, sprockets, spindles, drums, fly wheels, chains, or other reciprocating, rotating, or moving parts of equipment must be guarded if such parts are exposed to contact by employees. Guards, as necessary, should be provided to protect the operator and others from the following:

- point of operation,
- in-running nip points,
- rotating parts, and
- flying chips and sparks.

Safety guards shall never be removed when a tool is being used.

***See Machine Guarding section in the Engineering Safety Manual for further machine guarding information.**

Example with pictures to illustrate: A portable circular saws must be equipped with guards. An upper guard must cover the entire blade of the saw. A retractable lower guard must cover the teeth of the saw, except when it makes contact with the work material. The lower guard must automatically return to the covering position when the tool is withdrawn from the work.



Safety Switches

The following tools are required to be equipped with a constant pressure switch or control that will shut off the power when the pressure is released if they do not have a positive accessory holding means:

- All hand-held powered circular saws having a blade diameter greater than 2 inches.
- Electric, hydraulic or pneumatic chain saws.
- Percussion tools.

**All hand-held gasoline powered chain saws shall be equipped with a constant pressure throttle control that will shut off the power to the saw chain when the pressure is released. The following tools are required to be equipped with a constant pressure switch or control, and may have a lock-on control provided that turnoff can be accomplished by a single motion of the same finger or fingers that turn it on:

- All hand-held powered drills.
- Tappers.
- Fastener drivers.
- Horizontal, vertical, and angle grinders with wheels greater than 2 inches in diameter.
- Disc sanders with discs greater than 2 inches in diameter.
- Belt sanders, reciprocating saws, saber, scroll, and jig saws with blade shanks greater than a nominal one-fourth inch (1/4").
- Other similarly operating powered tools shall be similarly equipped.
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Other hand-held powered tools such as circular saws having a blade diameter greater than 2 inches, chain saws, and percussion tools without positive accessory holding means must be equipped with a constant pressure switch that will shut off the power when the pressure is released.

ELECTRIC TOOLS

Employees using electric tools must be aware of several dangers. The most serious of these dangers is the possibility of electrocution.

Among the chief hazards of electric-powered tools are burns and slight shocks which can lead to serious injuries or even heart failure. Under certain conditions, even a small amount of current can result in fibrillation of the heart and eventual death. A shock also can cause the user to fall off a ladder or other elevated work surface.

To protect the user from shock, tools must have a three-wire cord with a ground prong and be grounded, double insulated, or powered by a low-voltage isolation transformer.

Three-wire cords: These cords contain two current-carrying conductors and a grounding conductor. One end of the grounding conductor connects to the tool's metal housing. The other end is grounded through a prong on the plug. Anytime an adapter is used to accommodate a two-hole receptacle, the adapter wire must be attached to a known ground. The third prong should never be removed from the plug.

Double insulation: This is a more convenient method. The user and the tools are protected in two ways: by normal insulation on the wires inside, and by a housing that cannot conduct electricity to the operator in the event of a malfunction.

The following general practices should be followed when using electric tools:

- Electric tools should be operated within their design limitations.
- Gloves and safety footwear are recommended during use of electric tools.
- When not in use, tools should be stored in a dry place.
- Electric tools should not be used in damp or wet locations.
- Work areas should be well lighted.
- Frayed cords are required to be taken out of service and replaced.
- Electric cords shall be inspected periodically and kept in good condition. Heavy-duty
- plugs that clamp to the cord should be used to prevent strain on the current-carrying parts,
- if the cord is accidentally pulled.
- Although no guards are available for drill bits, some protection is afforded if drill bits are carefully chosen for the work to be done, such as being no longer than necessary to do the work.
- Where the operator must guide the drill by hand, the drill is required to be equipped with a sleeve that fits over the drill bit. Oversized bits shall not be ground down to fit small



- electric drills; instead, an adapter should be used that will fit the large bit and provide
- extra power through a speed reduction gear; however this again is an indication of
- improper drill size. When drills are used, the pieces of work are to be clamped or
- anchored to prevent whipping.
- Electric saws are usually well guarded by the manufacturer, but employees must be
- trained to use the guard as intended. The guard should be checked frequently to be sure
- that it operates freely and encloses the teeth completely when it is cutting.
- Circular saws shall not be jammed or crowded into the work. The saw is to be started
- and stopped outside the work.

POWERED ABRASIVE WHEEL TOOLS

Powered abrasive grinding, cutting, polishing, and wire buffing wheels create special safety problems because they may throw off flying fragments.

Before an abrasive wheel is mounted, it should be inspected closely and sound- or ring-tested to be sure that it is free from cracks or defects. To test, wheels should be tapped gently with a light non-metallic instrument. If they sound cracked or dead, they could fly apart in operation and so must not be used. A sound and undamaged wheel will give a clear metallic tone or "ring."

To prevent the wheel from cracking, the user should be sure it fits freely on the spindle. The spindle nut must be tightened enough to hold the wheel in place, without distorting the flange. Follow the manufacturer's recommendations. Care must be taken to assure that the spindle wheel will not exceed the abrasive wheel specifications.

Due to the possibility of a wheel disintegrating (exploding) during start-up, the employee should never stand directly in front of the wheel as it accelerates to full operating speed.

Portable grinding tools need to be equipped with safety guards to protect employees not only from the moving wheel surface, but also from flying fragments in case of breakage.

In addition, when using a powered grinder:

- Always use eye protection.
- Turn off the power when not in use.
- Never clamp a hand-held grinder in a vise.

ABRASIVE WHEEL USE:

- Floor stand and bench mounted abrasive wheels, used for external grinding shall be provided with safety guards (protection hoods). The maximum regular exposure of the grinding wheel periphery and sides shall be not more than 90 degrees except that, when work requires contact with the wheel below the horizontal plane of the spindle, the angular exposure shall not exceed 125 degrees.

****Safety guards shall be strong enough to withstand the effect of a bursting wheel.**

- Floor and bench-mounted grinders shall be provided with work rests which are rigidly supported and readily adjustable. Such work rests shall be kept at a distance not to exceed one-eighth inch (1/8") from the surface of the wheel.
- The top of the guard that covers the abrasive wheel should be no more than one-quarter inch (1/4") from the abrasive wheel.
- Cup type wheels used for external grinding shall be protected by either a revolving cup guard or a band type guard. All other portable abrasive wheels used for external grinding shall be provided with safety guards (protection hoods), except as follows:
 - When the work location makes it impossible, a wheel equipped with safety flanges shall be used.
 - When wheels 2 inches or less in diameter which are securely mounted on the end of a steel mandrel are used.
- Portable abrasive wheels used for internal grinding shall be provided with safety flanges (protection flanges) except as follows:
 - When wheels 2 inches or less in diameter which are securely mounted on the end of a steel mandrel are used.
 - If the wheel is entirely within the work being ground while in use.
- When safety guards are required, they shall be so mounted as to maintain proper alignment with the wheel, and the guard and its fastenings shall be of sufficient strength to retain fragments of the wheel in case of accidental breakage.
- The maximum angular exposure of the grinding wheel periphery and sides shall not exceed 180°.
- When safety flanges are required, they shall be used only with wheels designed to fit the flanges. Only safety flanges, of a type and design and properly assembled so as to ensure that the pieces of the wheel will be retained in case of accidental breakage, shall be used.
- All abrasive wheels shall be closely inspected and ring-tested before mounting to ensure that they are free from cracks and defects.
- Grinding wheels shall fit freely on the spindle and shall not be forced on. The spindle nut shall be tightened only enough to hold the wheel in place.
- All employees using abrasive wheels shall wear Personal Protective Equipment specified below:
 - Dust-type safety goggles or plastic face shields should be worn. If dust is created, a respirator the National Institute for Occupational Safety & Health (NIOSH) maybe required.

FUEL POWERED TOOLS

- All fuel powered tools shall be stopped while being refueled, serviced, or maintained, and fuel shall be transported, handled, and stored in approved safety cans.

- Leakage or spillage of flammable or combustible liquids shall be disposed of promptly and safely.
- When fuel powered tools are used in enclosed spaces, the applicable requirement for concentrations of toxic gases and use of personal protective equipment shall apply.

PNEUMATIC TOOLS

Pneumatic tools are powered by compressed air and include chippers, drills, nail/staple/screw 'guns', hammers, and sanders.

There are several dangers encountered in the use of pneumatic tools. The main one is the danger of getting hit by one of the tool's attachments or by some kind of fastener the employee is using with the tool.

Eye protection is required and face protection (i.e.: Face Shield) is recommended for employees working with pneumatic tools.

Noise is another hazard. Working with noisy tools such as jackhammers requires proper, effective use of hearing protection.

When using pneumatic tools, employees must check to see that they are fastened securely to the hose to prevent them from becoming disconnected. A short wire or positive locking device attaching the air hose to the tool will serve as an added safeguard.

A safety clip or retainer must be installed to prevent attachments, such as chisels on a chipping hammer, from being unintentionally shot from the barrel.

Screens must be set up to protect nearby employees from being struck by flying fragments around chippers, riveting guns, staplers, or air drills.

Compressed air guns should never be pointed toward anyone. Users should never "dead-end" it against themselves or anyone else.

- The operating trigger on portable hand-operated utilization equipment shall be so located
- as to minimize the possibility of its accidental operation and shall be arranged to close the
- air inlet valve automatically when the pressure of the operator's hand is removed.

- All pneumatically driven nailers, staplers, and other similar equipment provided with
- automatic fastener feed, which operate at more than 100 psi. pressure at the tool shall have a safety device on the muzzle to prevent the tool from ejecting fasteners, unless the muzzle is in contact with the work surface.

- Compressed air shall not be used for cleaning purposes except with an air blow gun
- limited to 30 psi static pressure at the outlet nozzle and then only with effective chip
- guard and personal protective equipment.

- The manufacturer's safe operating pressure for hoses, pipes, valves, filters, and other fitting shall not be exceeded.
- The use of hoses for hoisting or lowering tools shall not be permitted.
- All hoses exceeding 1/2-inch inside diameter shall have a safety device at the source of supply or branch line to reduce pressure in case of hose failure.
- Airless spray guns of the type which atomize paints and fluids at high pressures (1,000 pounds or more per square inch) shall be equipped with automatic or visible manual safety devices which will prevent pulling of the trigger to prevent release of the paint or fluid until the safety device is manually released.
- In lieu of the above, a diffuser net which will prevent high pressure, high velocity release, while the nozzle tip is removed, plus a nozzle tip guard which will prevent the tip from contacting the operator, or other equivalent protection shall be provided.

Appendix A

EEC166/171/172 DESIGN AND PROTOTYPING LAB ACCESS FORM

Engineering students are not automatically given access to project spaces (Room EEC166 & EEC171). Access is given by the SOE Dean's Office, only after completing all requirements contained within the Project Lab Operation and Safety Handbook and completion of this form. This access is only given for the project space(s) (Rooms 166 or 171), as required by approved students for their specific courses, projects, or other limited purposes.

The purposes of this policy are to ensure the safety and protection of both the students and the facilities, the orderly and productive use of the facilities by all who need them, and the development of professional conduct and procedures by engineering students.

Students are not given access to any facility until they have completed and understand all

requirements covered in the Design and Prototyping Lab Operations and Safety Handbook, read the rules listed below, and have signed the accompanying form acknowledging their commitment to observe these rules and have returned the signed form along with required training certificates (Shop Safety and Lab Safety) to the SOE Deans Office. Either failure to comply with these rules personally or behavior that interferes with another authorized student's effective use of the facilities is grounds for revoking the offending student's access to the SOE Design and Prototyping Labs. Some courses or facilities may have additional requirements disseminated through individual courses.

1. I will not give lab access to other persons.
2. I will not have food or drink in the lab.
3. I will not prop the door open or disable the lock in any way.
4. I will only use the equipment for the purposes for which I have been given access to the lab.
5. I will adhere to all rules/procedures covered in the Design and Prototyping Lab operation and safety handbook.
6. I will not be involved in behavior that lessens the full access and use of the lab by other authorized students.
7. I will use all tools in a safe manner and wear appropriate personal protection equipment (PPE) for the task being performed.
8. I will report any unsafe practices in regards to the lab or its equipment.

Having read and fully understood the above rules, also all rules/procedures covered in the project lab operation and safety handbook and having completed all required training, I promise to abide by all

date

signature

legibly print name

email

