



ENVIRONMENTAL HEALTH & SAFETY

The University of Alabama at Birmingham

Shop Safety Program Manual

2021

PURPOSE_____	3
RESPONSIBILITY_____	4
GENERAL SAFETY RULES_____	5
ANGLE GRINDER_____	6
BANDSAW_____	10
BENCH GRINDER_____	15
CHOP SAW-ABRASIVE WHEEL_____	19
DRILL PRESS_____	22
METAL LATHE_____	25
MILLING MACHINE_____	28
TABLE SAW_____	32
HYDRAULIC TUBING BENDER_____	36
HAND AND PORTABLE POWER TOOLS SAFETY_____	39
TAP AND DYE WORK_____	43
MISC CUTTING HAND TOOLS_____	45
TORSION TOOLS_____	45
SHOCK TOOLS_____	48
ELECTRIC TOOLS_____	52
POWERED ABRASIVE WHEEL HAND TOOLS_____	53
PNEUMATIC TOOLS_____	55
HYDRAULIC TOOLS_____	57

Safety Guidelines

Program Subject: Hand and Power Tool Safety Guidance	Approval Date: .
Next Scheduled Review:	Date Effective: .
Contact Information: Program Owner: Environmental Health and Safety	

I. Purpose, Applicability and Scope Introduction

Machine and shop areas are present in many locations and departments throughout the University. The equipment located within these shops is routinely used by employees and students to complete various tasks that have the potential to result in serious injury. It is the goal of the University of Alabama at Birmingham School of Engineering to provide a safe working environment within all University machine and shop areas.

Purpose

University of Alabama at Birmingham desires to maintain a safe environment for its students, faculty, staff, and visitors. This guideline sets forth operating procedures and practices to operate machines and tools in shops throughout the University in a safe and compliant manner at all times. This document outlines safety guidelines for the use of various machines and tools that are most frequently used in a machine and shop areas within the school.

The information within this document has been developed in accordance with the following regulations and standards:

- 29 CFR 1910 Subpart J, “General Environmental Controls”
- 29 CFR 1910 Subpart O, “Machinery and Machine Guarding”
- 29 CFR 1910 Subpart P, “Hand and Portable Powered Tools and Other Hand-Held Equipment”
- “Safeguarding Equipment and Protecting Employees from Amputations” – OSHA publication 3170-02R
- “A Guide for Protecting Workers from Woodworking Hazards” – OSHA publication 3157
- “Hand and Power Tools” – OSHA publication 3080
- A variety of American National Standards Institute (ANSI) safety standards
- A variety of University of Alabama at Birmingham Environmental Health and safety policies and procedures

Scope

University of Alabama at Birmingham shall provide all faculty, staff, student-employees, students, and volunteers training in safety and use of hand and power tools, equipment, and any other machinery required. The various schools and departments at the University of Alabama at Birmingham will provide personal protective equipment (PPE); the Environmental, Health & Safety (EHS) Department may provide consultation towards selection of proper PPE, as needed or requested.

II. Responsibility: Faculty, Staff and Shop Supervisors

- Be thoroughly informed of the contents of this program and how it relates to their areas of responsibility and authority.
 - Ensure that all provisions of this program are implemented in the shop.
 - Including providing training and maintaining required documentation of training.
- Investigate and report all injuries and incidents including near misses within their shop. **Department of Environmental Health & Safety (EHS)**
- Provide program oversight and assist departments in implementing the provisions of this program.
- Periodically audit machine shops.
- Update this program as needed.

Shop Users

- Comply with all provisions of this program, including the use of protective equipment and machine guarding.
- Attend all training required relative to this program.
- Promptly report any concerns related to shop equipment or shop safety issues to their immediate supervisor/faculty member.

III. Disclaimer

The information provided in this program is designed for educational use only and is not a substitute for specific training or experience.

The University of Alabama at Birmingham and the authors of this program assume no liability for any individual's use of or reliance upon any material contained or referenced herein. The material contained in this program may not be the most current.

This material may be freely distributed for nonprofit educational use. However, if included in publications, written or electronic, attributions must be made to the author. Commercial use of this material is prohibited without express written permission from the author.

General Safety Rules for Machine and Shop Areas

General Safety Rules for Machine and Shop Areas

1. The faculty or staff member in charge of the shop will ensure that all appropriate safety rules are followed. EHS will assist in providing guidelines and recommendations as warranted. EHS will also perform periodic audits of campus shops to ensure compliance with established guidelines.
2. Only trained and approved persons will be permitted to use any piece of powered equipment.
 - a. For shops that are intended to be used by students:
 - I. Training is to be done and documented by the designated shop owner (faculty, staff member). Training should consist of both classroom instruction (including reading the Operator's Manual for each piece of equipment) and hands-on competency training.
 - ii. Training will be documented and record retention will be the responsibility of the department.
3. Shops are to be kept clean and orderly.
4. Shop safety rules are to be posted.
5. Horseplay is forbidden.
6. Machines are to be inspected prior to use.
 1. Machines should NEVER be used if all guards are not in place.
 2. Machines should be placed out of service if:
 - i. Guards are missing or damaged
 - ii. Machine is damaged or not operating properly
 - iii. Power cords are damaged or plug is not properly grounded
7. Use the right tool for the job. Do not force a tool or attachment to do a job for which it was not designed.
8. WEAR PROPER ATTIRE. Do not wear loose fitting, gloves, jewelry, watches, ties, ID badges or anything else dangling that might get caught in a piece of moving equipment. Long hair should be in a protective headcovering such as a hair net.
 - a. Never wear open toe shoes - Use closed-toe shoes in the shop.
9. No student shall operate a powered piece of equipment in a shop alone. A faculty or staff member should be present at all times while work is going on.
10. Shops should have designated and posted operating hours. All work done after normal business hours the "Students After Hours Access Policy" should be followed
11. Never use a powered machine when impaired.
 - a. This includes when you are sick, too tired, stressed or hurried to work carefully or on medication that could make you drowsy.
12. Never be shy about seeking help. Always ask if you're unsure about the safe operation of a tool or any aspect of a job. Have Shop Staff check the tool or work with which you are unfamiliar.
 - I. Exercise common sense and clarify before starting work
 - II. All injuries should be assessed and appropriate medical treatment or first aid administered immediately.
 - III. Never hesitate to activate emergency medical response as time may be critical depending on the injury.
 - IV. All incidents are to be reported to Shop staff and complete a UTK incident reporting

Angle Grinder (Portable Right-Angle Head Grinder)

Angle Grinder (Portable Right-Angle Head Grinder)

Applicable Standards

- 29 CFR 1910.132 {Personal Protection Equipment}
- 29 CFR 1910.147 {Control of hazardous energy}
- 29 CFR 1910.212 {General requirements for all machines}
- 29 CFR 1910.215 {Abrasive wheel machinery}
- 29 CFR 1910.242 {Hand and portable powered tools and equipment, general}
- 29 CFR 1910.243 {Guarding of portable power tools}

Potential Hazards

- The most common causes of injury are lacerations from attachments that break and become projectiles, and lacerations from angle grinder kickbacks.
- Being stuck by the workpiece.
- Working with a grinder near flammable or combustible materials can result in fire and burns to

operators.

- Contact with the rotating grinding disc.
- Being hit, especially in the eyes, by debris flying from point of operation.
- Inhalation of dust and particles.
- Electrical shock.

Key Controls

- Approved and authorized persons **ONLY** can operate equipment.
 - Training to be done and documented by designated competent instructor.
 - Appropriate department supervisor shall ensure unauthorized persons do not have access to machines.
- A visual pre-operation inspection should be done prior to use.
 - Equipment to be operated **ONLY** with required guarding in place.
 - If any guards are damaged or missing, grinder is to be taken out of service.
 - **Closely inspect grinding disc.**
 - **Any grinding disc that has a visible crack, chip, or other damage should be disposed of immediately.**
 - Area clean and free of debris. A grinder should **NEVER** be used in an area where there are flammable liquids or combustible solids.
 - Cord should be checked for cracks or worn areas. Remove from operation if cord is damaged or if plug does not have proper grounding (3-prong).

Angle Grinder (Portable Right-Angle Head Grinder)

- Personal Protective Equipment:

- o Approved safety goggles or safety glasses with side shields (meets ANSI Z87.1) are to be worn while operating angle grinder. It is also highly recommended to wear an ANSI approved face shield to protect the operator's face from flying projectiles.
- o Gloves are to be worn for protection of the hands.
- o Hearing protection is available and its use is highly encouraged (grinding and cutting operations are typically VERY loud). If grinding for extended periods of time, hearing protection may be required. See shop supervisor for more information.

- Instruct operators not to wear loose fitting clothing, or jewelry (including rings and watches).
- Instruct operators with long hair to secure in a cap or hair net.
- PROPER SELECTION of disc is critical.

- o Ensure the disc being used is the correct one for the job (cutting versus grinding).

- o Verify that the correct disc is being used for the class of material to be worked on.

- o Verify that the disc is of the correct speed rating for the grinder being used.

- o Verify that the disc size and arbor size are compatible for the grinder to be used.

- Follow proper lock out procedures (CFR 1910.147).

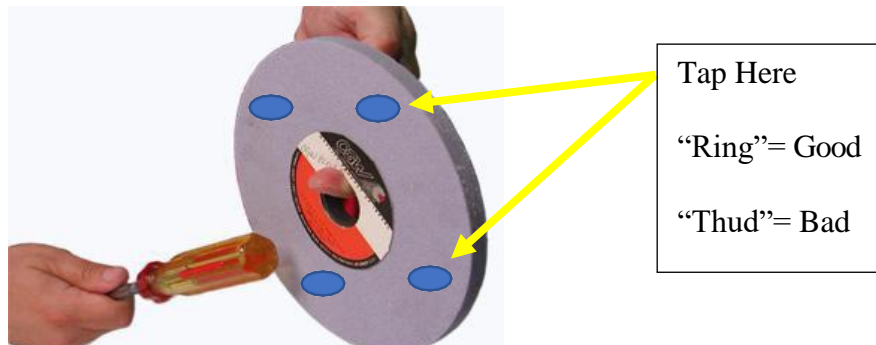
- o NOTE: If device is plug in and plug is under exclusive control of the person performing the work, unplugging the machine will suffice. If person performing the work needs to leave the machine before work is complete, proper LOTO procedures are to be followed.

Ring Test

- Prior to mounting an abrasive wheel, a "Ring Test" should be performed.

- o RING TEST PROCEDURE

- Suspend abrasive disc as shown below:



- o Tap abrasive wheel with a light, non-metallic instrument (such as a screwdriver handle) about 45° from vertical centerline and about 1-2" from edge. Rotate wheel by 45° and repeat, working all the way around the wheel. An undamaged wheel will give a clear metallic ring, where a cracked wheel will sound dull or dead.

- o Any wheel not passing the "Ring Test" (sounds dead) should be disposed of. 6

Angle Grinder (Portable Right-Angle Head Grinder)

Operating Precautions

- Always grasp the grinder firmly with TWO hands.
- When using a cutting disc, use the edge of the disc and not the face.
- When using a grinding disc, use the face of the disc and not the edge.
- Allow grinder to reach full speed before initiating grinding or cutting.
- Do not use excessive pressure as this can cause the disc to break.
- Do not place grinder on ground or bench while disc is still rotating. Do not walk around work

area with a running grinder.

- Do not position your body directly behind the angle grinder as this will limit your ability to move out of the path of the grinder should it kickback.
- Ensure workpiece is appropriately supported and secured.

Guarding Guidelines



Grinder must have a guard for the grinding disc. The maximum exposure angle allowed is 180° and the guard shall be located so as to be between the operator and the wheel during use.

Band Saw - Horizontal

Band Saw - Horizontal

Applicable Standards

- 29 CFR 1910.132 {Personal protection equipment}
- 29 CFR 1910.147 {Control of hazardous energy}
- 29 CFR 1910.212 {General requirements for all machines}
- 29 CFR 1910.213 {Wood working machinery requirements}
- 29 CFR 1910.219 {Mechanical power-transmission apparatus}
- 29 CFR 1926.304 {Wood working tools}

Potential Hazards

- Contact with the blade is the most common injury. Extreme caution is needed because the operator's hands may come close to the saw blade, and a saw blade cannot be completely guarded.
- Getting loose clothes, jewelry, or long hair caught in moving parts.
- Being hit, especially in the eyes, by debris flying from point of operation.
- Contact with moving pulleys and belt.
- Inhalation of dust and particles.
- Dropping objects onto foot.
- Electrical shock.

Key Controls

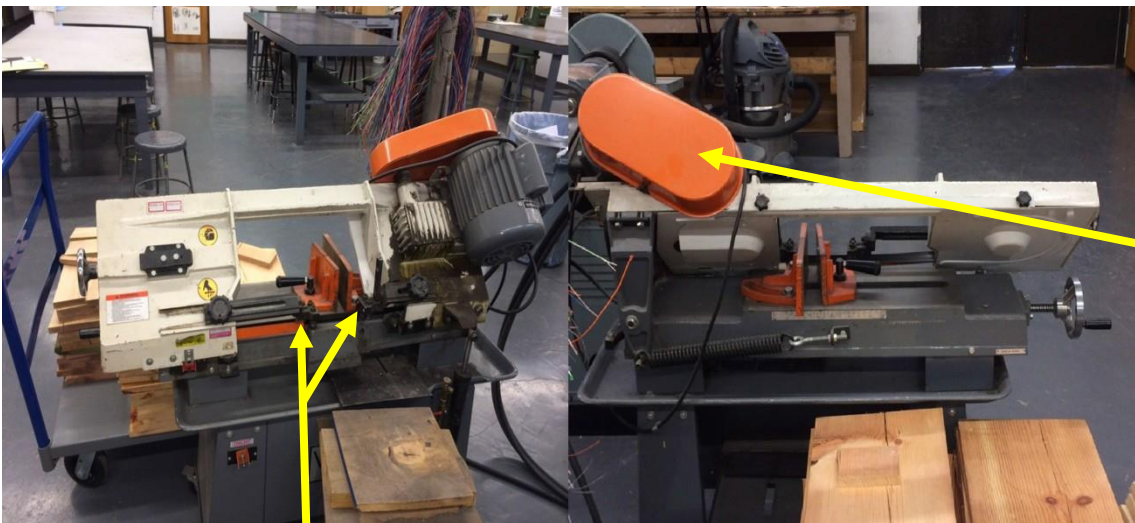
- Approved and authorized persons ONLY can operate equipment.
 - Training to be done and documented by designated competent instructor.
 - Appropriate department supervisor shall ensure unauthorized persons do not have access to machines.
 - Follow all safety warnings and recommended operating procedures given in the machine's Operating Manual.
- A visual pre-operation inspection should be done prior to use. ◦ Equipment to be operated ONLY with required guarding in place.
 - Cord should be checked for cracks or worn areas. Remove from operation if cord is damaged or if plug does not have proper grounding (3-prong).
 - If machine has any visible damage report to shop supervisor immediately and DO NOT use machine.
- Personal Protective Equipment (PPE) shall be worn as detailed in table on page 6.
 - NOTE: Gloves are NOT to be worn when operating a band saw.
- Follow proper lock out procedures (CFR 1910.147).
 - NOTE: If device is plug in and plug is under exclusive control of the person performing the work, unplugging the machine will suffice. If person performing the work needs to leave the machine before work is complete, proper LOTO procedures are to be followed.
- Install awareness devices (signage, barriers, etc.) around saw.
- Instruct operators not to wear loose fitting clothing, jewelry (including rings and watches) or gloves.
- Instruct operators with long hair to secure in a cap or hair net.
- Use vacuum or brush to remove debris. DO NOT USE BARE HANDS.
- When changing saw blade, appropriate gloves are to be worn.

Band Saw - Horizontal

Operating Precautions

- Adjust blade guards to cover unused portions of blade.
- Ensure that blade speed, blade tension and blade tracking are properly adjusted. o A saw with a tension control device to indicate proper tension is desired.
- Use band saw blades that are sharp, properly set and otherwise suitable for the job (e.g., the right tooth pitch; tooth form; blade width).
- Stock should be held firmly in the saws vice. Keep hands away from point of operation.
- If the saw blade binds on a piece of stock, turn the saw off and wait until it comes to a complete stop before attempting to remove the blade from the stock.
- Keep the machine properly oiled and serviced.
- Ensure work area is clean and uncluttered and sufficient space is given to operator using the saw.

Guarding Guidelines



Belts and pulleys to be guarded.

Adjust Guards for saw blade so that unused portion of blade is covered.

Band Saw - Vertical

Band Saw - Vertical

Applicable Standards

- 29 CFR 1910.132 {Personal Protection Equipment}
- 29 CFR 1910.147 {Control of hazardous energy}
- 29 CFR 1910.212 {General requirements for all machines}
- 29 CFR 1910.213 {Wood working machinery requirements}
- 29 CFR 1910.219 {Mechanical power-transmission apparatus}
- 29 CFR 1926.304 {Wood working tools}

Potential Hazards

- Contact with the blade is the most common injury. Extreme caution is needed because the operator's hands may come close to the saw blade, and a saw blade cannot be completely guarded.
- Getting loose clothes, jewelry, or long hair caught in moving parts.
- Being hit, especially in the eyes, by debris flying from point of operation.
- Contact with moving pulleys and belt.
- Inhalation of dust and particles.
- Dropping objects onto foot.
- Electrical shock.

Key Controls

- Approved and authorized persons ONLY can operate equipment. o Training to be done and documented by designated competent instructor.
 - o Appropriate department supervisor shall ensure unauthorized persons do not have access to machines.
 - o Follow all safety warnings and recommended operating procedures given in the machine's Operating Manual.
- A visual pre-operation inspection should be done prior to use. o Equipment to be operated ONLY with required guarding in place.
 - o Cord should be checked for cracks or worn areas. Remove from operation if cord is damaged or if plug does not have proper grounding (3-prong).
 - o If machine has any visible damage report to shop supervisor immediately and DO NOT use machine.
- Personal Protective Equipment (PPE) shall be worn as detailed in table on page 6. o NOTE: Gloves are to be worn when operating a band saw.
- Follow proper lock out procedures (CFR 1910.147). o NOTE: If device is plug in and plug is under exclusive control of the person performing the work, unplugging the machine will suffice. If person performing the work needs to leave the machine before work is complete, proper LOTO procedures are to be followed.
- Install awareness devices (signage, barriers, etc.) around saw.
- Instruct operators not to wear loose fitting clothing (short sleeves preferred), jewelry (including rings and watches) or gloves.
- Instruct operators with long hair to secure in a cap or hair net.
- Use vacuum or brush to remove debris. DO NOT USE BARE HANDS.
- When changing saw blade, appropriate gloves are to be worn.

Operating Precautions

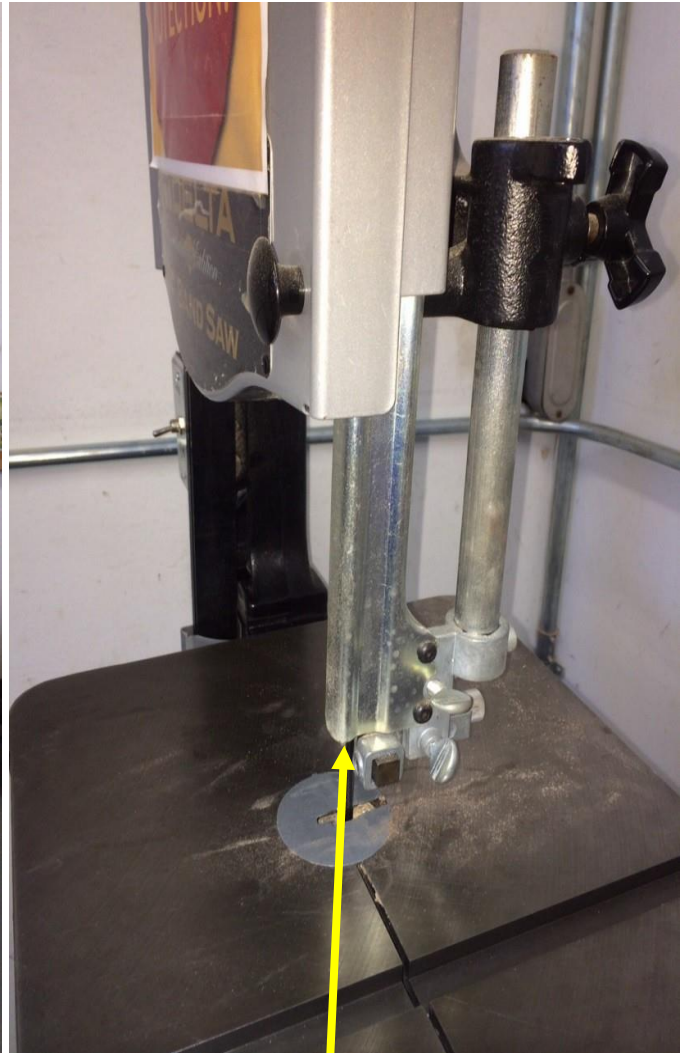
- Adjust blade guard height to about 1/8 inch above the top of the material being cut.
- Ensure the blade is tracking correctly and runs freely in and against the upper and lower guide rollers.
- Ensure the blade is under proper tension. A band saw equipped with automatic tension control is desirable.
- Use band saw blades that are sharp, properly set and otherwise suitable for the job (e.g., the right tooth pitch; tooth form; blade width).
- Hold stock firmly and flat on the table to prevent the stock from turning and drawing your fingers against the blade. Keep hands braced against the table.
- Use a push stick or jig to keep fingers at a safe distance from saw blade (at least 3 inches). Keep your hands on either side of the blade - not in line with the cutting line and the blade.
- Make release (relief) cuts before tight curves when doing intricate scroll-type work. o Plan saw cuts to avoid backing out of curves in the stock.
- If the blade comes out of the guides or breaks, stop the machine immediately by turning off the power. **Do not** open the access door to the machine until the wheels have come to a complete stop. Have the instructor reposition or install a new blade.
- If the saw blade binds on a piece of stock, turn the saw off and wait until it comes to a complete stop before attempting to remove the blade from the stock.
- Keep the machine properly oiled and serviced.
- Ensure work area is clean and uncluttered and sufficient space is given to operator using the saw.

Band Saw - Vertical

Guarding Guidelines



Covers need to be closed and secure before starting.



Adjustable guard should be 1/8" above top of material being cut.

Bench Grinder

Bench Grinder

Applicable Standards

- 29 CFR 1910.132 {Personal Protection Equipment}
- 29 CFR 1910.147 {Control of hazardous energy}
- 29 CFR 1910.212 {General requirements for all machines}
- 29 CFR 1910.215 {Abrasive wheel machinery}
- 29 CFR 1910.219 {Mechanical power-transmission apparatus}

Potential Hazards

- The most serious hazard comes from the potential of an abrasive wheel to explode. Fragments can travel at over 300 mph.
- Contact with the rotating wheel, flange, and spindle end.
- Being caught in the naturally occurring nip point between the wheel and rest plate.
- Being hit, especially in the eyes, by debris flying from point of operation.
- Inhalation of dust and particles.
- Electrical shock.

Key Controls

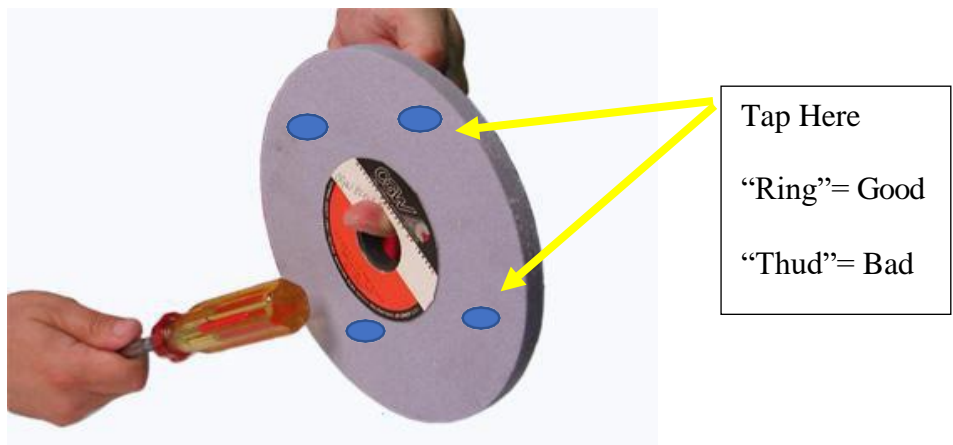
- Approved and authorized persons **ONLY** can operate equipment. o Training to be done and documented by designated competent instructor.
 - o Appropriate department supervisor shall ensure unauthorized persons do not have access to machines.
 - o Follow all safety warnings given in the Machine's Operating Manual.
- A visual pre-operation inspection should be done prior to use. o Equipment to be operated **ONLY** with required guarding in place.
 - o If any guards are damaged or missing, grinder is to be taken out of service.
 - o Make sure the work rest is as close to abrasive wheel as possible (1/8" maximum), and tongue guard is at 1/4" maximum clearance.
 - o **Closely inspect wheel.**
 - **Any wheel that has a visible crack, chip, or other damage should be disposed of immediately.**
 - o Area clean and free of debris.
 - o Cord should be checked for cracks or worn areas. Remove from operation if cord is damaged or if plug does not have proper grounding (3-prong).
- Personal Protective Equipment (PPE) shall be worn as detailed in table on page 6. o NOTE: Gloves should be worn only if using a tool grip of adequate length to keep hands several inches from the face of the stone. Do not wear gloves while holding small pieces or using a wire wheel.
- Machines designed for a fixed location shall be securely anchored to prevent walking or moving.

Bench Grinder

- Follow proper lock out procedures (CFR 1910.147).
 - NOTE: If device is plug in and plug is under exclusive control of the person performing the work, unplugging the machine will suffice. If person performing the work needs to leave the machine before work is complete, proper LOTO procedures are to be followed.
- Install awareness devices (signage, barriers, etc.) around grinder.
- Instruct operators not to wear loose fitting clothing, jewelry (including rings and watches) or gloves.
- Instruct operators with long hair to secure in a cap or hair net.
- Hearing protection is available and its use is encouraged.
- Wear disposable dust masks if needed (optional).

Ring Test

- Prior to mounting an abrasive wheel, a “Ring Test” should be performed.
 - RING TEST PROCEDURE
 - Suspend abrasive wheel as shown below:



- Tap abrasive wheel with a light, non-metallic instrument (such as a screw driver handle) about 45° from vertical centerline and about 1-2” from edge. Rotate wheel by 45° and repeat, working all the way around the wheel. An undamaged wheel will give a clear metallic ring, where a cracked wheel will sound dull or dead.
- Any wheel not passing the “Ring Test” (sounds dead) should be disposed of.
- Any wheel with visible cracks, chips, or other damage should be disposed of.

Bench Grinder

Operating Precautions

- Ensure wheel being mounted is rated for a speed compatible with the grinder. The recommended speed will be given on the side of the wheel.
- Stand to one side when turning on power. Allow grinder to reach full RPM before grinding.
- Keep fingers and hand clear of rotating abrasive wheel.
- When grinding, use the **face** of the abrasive wheel only. Never use the side of the wheel. o Move work back and forth across entire face of wheel to avoid creating grooves.
- When an operator has finished working on the grinder, and before leaving the grinder for any reason, the power must be shut off and the machine must come to a complete stop.
- Keep machine properly oiled and serviced. o **Wheels are to be addressed regularly.** Dressing a grinding wheel is the process by which the abrasive wheel is cleaned of any built up material and is made true across the grinding surface. It is a simple procedure utilizing a dressing tool. See your shop supervisor for specific procedures.

NOTE: Remember to readjust the work bench (less than 1/8" inch) and the tongue guard (less than 1/4") after dressing the grinding wheel.

- Ensure area is clean and uncluttered and sufficient space is given to operator using grinder.
- When an operator observes an unsafe condition on the grinder, or stock that is being worked on, they must report it immediately to the Supervisor. o Do not use a grinder whose wheel is vibrating.

Bench Grinder

Guarding Guidelines



Tongue Guard must be adjusted to a **maximum** ¼" to the abrasive wheel

Bench rest must be adjusted to a **maximum** 1/8" to the abrasive wheel

The opening of the wheel guard must not exceed 90° total , and the exposure shall begin at a point not more than 65° above the horizontal plane of the wheel spindle

Chop Saw– Abrasive Wheel (Metal Cutting)

Chop Saw– Abrasive Wheel (Metal Cutting)

Applicable Standards

- 29 CFR 1910.132 { Personal protection equipment }
- 29 CFR 1910.147 { Control of hazardous energy }
- 29 CFR 1910.212 { General requirements for all machines }
- 29 CFR 1910.215 { Abrasive wheel machinery }
- 29 CFR 1910.219 { Mechanical power-transmission apparatus }

Potential Hazards

- Hands and fingers can be severely cut or amputated if contact is made with the rotating cutting blade.
- The abrasive wheel has the potential to crack, and then fly apart during use.
- Lacerations from sharp metal burrs.
- Burns from the workpiece.
- Getting loose clothes, jewelry, or long hair caught in moving parts.
- Being hit, especially in the eyes, by debris flying from point of operation.
- Dropping objects onto foot.
- Electrical shock.

Key Controls

- Approved and authorized persons ONLY can operate equipment.
 - Training to be done and documented by designated competent instructor.
 - Appropriate department supervisor shall ensure unauthorized persons do not have access to machines.
 - Follow all safety warnings given in the Machine's Operating Manual.
- A visual pre-operation inspection should be done prior to use. ◦ Equipment to be operated ONLY with required guarding in place.
 - If any guards are damaged or missing, saw is to be taken out of service.
 - Ensure the correct abrasive wheel or blade is being used and that it is free from cracks or any other damage.
 - Area clean and free of debris. Key and any other tools removed from area of operation.
 - Cord should be checked for cracks or worn areas. Remove from operation if cord is damaged or if plug does not have proper grounding (3-prong).
- Personal Protective Equipment (PPE) shall be worn as detailed in table on page 6.
 - NOTE: The workpiece will become very hot when cut with an abrasive wheel chop saw.
DO NOT handle workpiece by hand. Use leather work gloves to handle hot metal.
- Machines designed for a fixed location shall be securely anchored to prevent walking or moving.

Chop Saw– Abrasive Wheel (Metal Cutting)

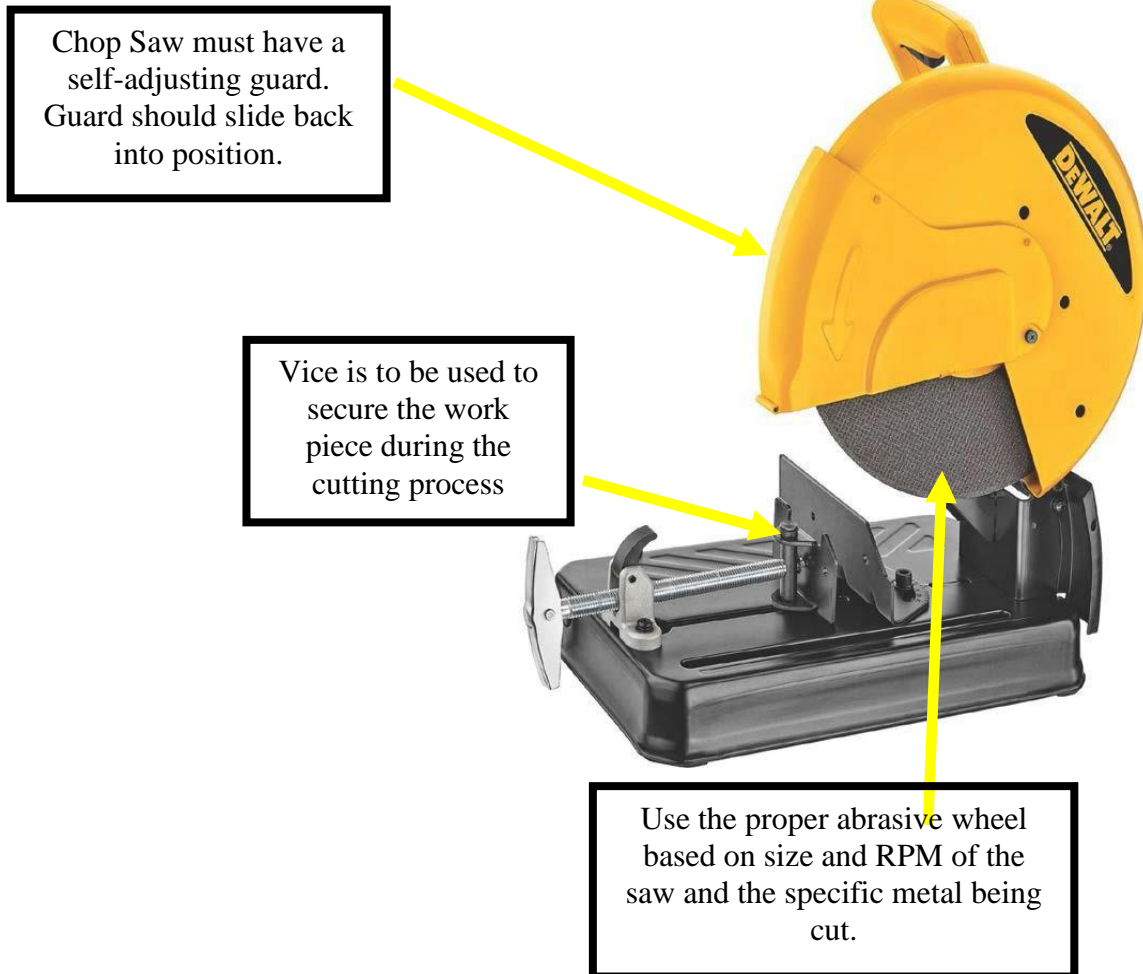
- Follow proper Lock out procedures (CFR 1910.147). o NOTE: If device is plug in and plug is under exclusive control of the person performing the work, unplugging the machine will suffice. If person performing the work needs to leave the machine before work is complete, proper LOTO procedures are to be followed.
- Install awareness devices (signage, barriers, etc.) around drill.
- Instruct operators not to wear loose fitting clothing, or jewelry (including rings and watches).
- Instruct operators with long hair to secure in a cap or hair net.

Operating Precautions

- **DO NOT** use an abrasive wheel chop saw for wood or wood products.
- Be sure to use the proper abrasive wheel for the saw you are using and the metal you are cutting.
- A cracked abrasive wheel has the potential to fly apart during use. Inspect saw blade and remove if there is any indication of a crack or other damage. When starting the machine, stand off to one side.
- Ease the abrasive disc into the workpiece. Do not use excessive force and this may cause the blade to crack and fail. Light pressure is all that is needed to get a good cut.
- Be careful to avoid coasting blades. Do not reach into cut area until blade has come to a complete stop.
- The workpiece will become extremely hot during the cutting process. Do not handle work piece with bare hands. Use leather work gloves to handle hot metal.
- Keep hands and fingers out of the line of fire.
- **ALWAYS USE THE VICE TO CLAMP THE WORKPIECE AND PROPERLY SUPPORT OVER-HANGING PORTION OF WORKPIECE LEVEL WITH THE BASE OF THE MACHINE.**
- Keep machine properly oiled and serviced.
- Ensure area is clean and uncluttered and sufficient space is given to operator using saw.

Chop Saw– Abrasive Wheel (Metal Cutting)

Guarding Guideline



Drill Press

Drill Press

Applicable Standards

- 29 CFR 1910.132 { Personal Protection Equipment }
- 29 CFR 1910.147 { Control of hazardous energy }
- 29 CFR 1910.212 { General requirements for all machines }
- 29 CFR 1910.213 { Wood working machinery requirements }
- 29 CFR 1910.219 { Mechanical power-transmission apparatus }
- 29 CFR 1926.304 { Wood working tools }

Potential Hazards

- Entanglement with rotating drill bit.
- Contact with a rotating drill bit at point of operation. Drilling one's own finger.
- Being hit, especially in the eyes, by debris flying from point of operation.
- Being hit by key left in drill chuck.
- Being hit by a piece of wood that is caught by the drill bit and begins to spin at same rate as the drill bit.
- Inhalation of dust and particles.
- Dropping objects on foot.
- Electrical shock.

Key Controls

- Approved and authorized persons ONLY can operate equipment.
 - Training to be done and documented by designated competent instructor.
 - Appropriate department supervisor shall ensure unauthorized persons do not have access to machines.
- A visual pre-operation inspection should be done prior to use.
 - Equipment to be operated ONLY with required guarding in place.
 - If any guards are damaged or missing, drill is to be taken out of service.
 - Area clean and free of debris. Key and any other tools removed from area of operation.
 - Cord should be checked for cracks or worn areas. Remove from operation if cord is damaged or if plug does not have proper grounding (3-prong).
- Personal Protective Equipment (PPE) shall be worn as detailed in table on page 6. ◦ NOTE: Gloves are not to be worn when operating a drill press.
- Machines designed for a fixed location shall be securely anchored to prevent walking or moving.
 - Follow proper Lock out procedures (CFR 1910.147).
 - NOTE: If device is plug in and plug is under exclusive control of the person performing the work, unplugging the machine will suffice. If person performing the work needs to leave the machine before the work is complete, proper LOTO procedure are to be followed.
- _Install awareness devices (signage, barriers, etc.) around drill.
- _Instruct operators not to wear loose fitting clothing, jewelry (including rings and watches) or gloves.
- _Instruct operators with long hair to secure in a cap or hair net.

Drill Press

Operating Precautions

- Do not make adjustments to the drill press (setting depth for example), secure material to the drill press bed or reposition material while drill bit is still rotating.
- Keep hands and fingers away from the point of operation.
- Material to be drilled should be secured to drill press bed using vise, clamps, or other appropriate device suitable for the piece being worked on. o If material slips in the vise or clamp, do not attempt to hold by hand. Shut down drill then retighten.
- Know the location of start and stop switches or buttons and keep the drill press table free of tools and other materials.
- Use only properly sharpened drill bits, sockets and chucks in good condition. Remove dull drill bits, battered tangs or sockets from service.
- Do not remove by hand metal or wood chips from the table or stock. Use brushes or other tools to properly remove chips.
- Use the correct speed and drill for the type of stock being drilled.
- The drill bit should be mounted the full depth and in the center of the chuck.
- Feed the bit smoothly into the work. If the hole being drilled is deep, withdraw the bit frequently to remove shaving on the bit.
- When an operator has finished working on the drill press, and before leaving the drill press for any reason, the power must be shut off and the machine must come to a complete stop.
- Keep machine properly oiled and serviced.
- Ensure area is clean and uncluttered and sufficient space is given to operator using drill.
- When an operator observes an unsafe condition on the drill press, or stock that is being worked on, they must report it immediately to the Supervisor and the press will be taken out of service until the problem has been corrected.

Drill Press

Guarding Guidelines

Guards for power transmission **MUST** be in place before use.

An adjustable guard to cover unused portion of chuck and drill bit can be installed to protect against flying debris and rotating parts.



Metal Lathe

Metal Lathe

Applicable Standards

- 29 CFR 1910.132 {Personal Protection Equipment}
- 29 CFR 1910.147 {Control of hazardous energy}
- 29 CFR 1910.212 {General requirements for all machines}
- 29 CFR 1910.219 {Mechanical power-transmission apparatus}
- ANSI B11.6-2001 {Safety Requirements for Manual Turning Machines with or without Automatic Control}

Key Hazards

- Contact with moving parts, such as drive gears, chucks, lead and feed screws, and the workpiece.
- Getting loose clothes, jewelry, or long hair caught in rotating parts.
 - **Entanglement is a serious hazard on a lathe.** Loose clothes or long hair can become entangled around the rotating parts of the lathe pulling the operator into the cutter or rotating stock resulting in significant injury or death.
- Being hit by loose objects on the lathe, such as chuck keys, tools or turnings.
- Being struck by a workpiece that has not been adequately secured in the lathe or is oversized.
- Dropping objects on foot.
- Electrical shock.

Key Controls

- Approved and authorized persons **ONLY** can operate equipment.
 - Training to be done and documented by designated competent instructor.
 - Appropriate department supervisor shall ensure unauthorized persons do not have access to machines.
 - Follow all safety warnings given in the Machine's Operating Manual.
- A visual pre-operation inspection should be done prior to use.
 - Equipment to be operated **ONLY** with required guarding in place.
 - Remove chuck keys, adjusting wrenches and knockout bars. Form a habit of checking for these before returning on the lathe.
 - Cord should be checked for cracks or worn areas. Remove from operation if cord is damaged or if plug does not have proper grounding (3-prong).
- Personal Protective Equipment (PPE) shall be worn as detailed in below table on page 6.
 - NOTE: Gloves are not to be worn while operating a lathe.
- Machines designed for a fixed location shall be securely anchored to prevent walking or moving.
- Follow proper Lock out procedures (CFR 1910.147).
 - NOTE: If device is plug in and plug is under exclusive control of the person performing the work, unplugging the machine will suffice. If person performing the work needs to leave the machine before work is complete, proper LOTO procedures are to be followed.
- Install awareness devices (signage, barriers, etc.) around saw.
- Instruct operators not to wear loose fitting clothing (short sleeves preferred), jewelry (including rings and watches) or gloves.
- Instruct operators with long hair to secure in a cap or hair net.

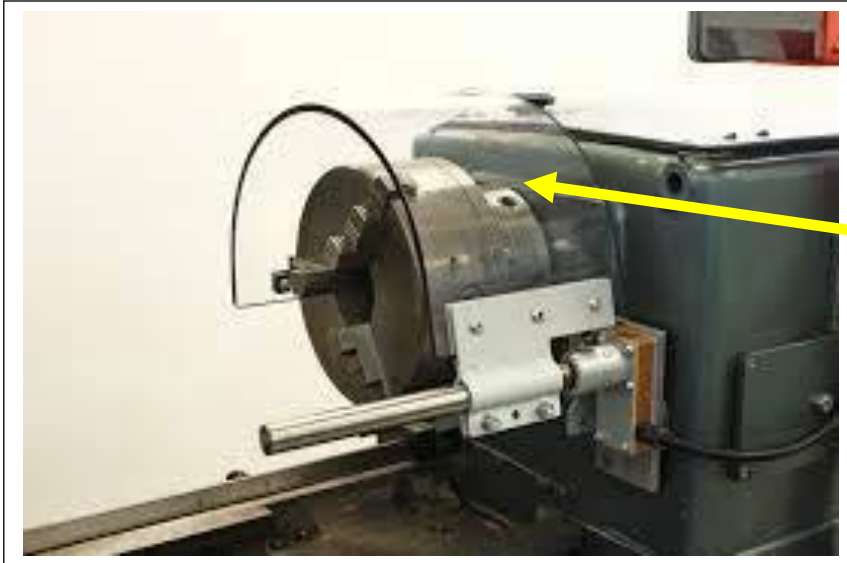
Metal Lathe

Operating Precautions

- Pay close attention to work pieces that have keyway slots or other surface profiles that may increase the risk of entanglement.
- Assess the need to manually polish (e.g., emery cloth) rotating material. If necessary, consider milling keyways or other profiles after polishing or use emery cloth with the aid of a tool or backingboards.
- Always use a brush or tool to remove chips. **DO NOT USE BEAR HANDS.**
- Make sure all work pieces and work-holding devices are secure and free from defects.
- Keep metal lathe cutting tools sharp. Do not use damaged or broken metal lathe cutting tools.
- Remove the chuck key from the chuck after securing the material.
 - A good rule is to never take your hand off the chuck key until you set it back onto a table. Consider using a spring-loaded or self-ejecting chuck key.
- Inspect tools prior to use and ensure worn or damaged tools are removed and not used.
- Turn the chuck or faceplate by hand to be sure there is no binding or danger of the work striking any part of the lathe.
- Don't run the machine faster than the proper cutting speed (consult speed and feed table to determine the best speed).
- Start lathe slowly and gradually increase rotational speed.
- Don't cut work completely through when turning between centers.
- Stop the machine before taking measurements or making adjustments.
- Remember that the chips are razor sharp. Do not attempt to remove chips with your fingers. Stop the machine and use pliers to remove them.
- Remove all burrs and sharp edges from the piece before removing it from the lathe.

Metal Lathe

Guarding Guidelines



Cover work holding devices (Chucks) with secured fixed or movable guards or shields.

Power transmission needs to be guarded.



NOTE: Guards or shields used to protect lathe operators from projected parts must either be From the manufacturer or if fabricated in-house, meet or exceed the same impact-resistance Specifications as the original manufacturer part. Various materials (such as polycarbonates) may possess different and less effective impact-resistance characteristics than the original materials used by the manufacturer.

Milling Machine

Milling Machine

Applicable Standards

- 29 CFR 1910.132 {Personal Protection Equipment}
- 29 CFR 1910.147 {Control of hazardous energy}
- 29 CFR 1910.212 {General requirements for all machines}
- 29 CFR 1910.219 {Mechanical power-transmission apparatus}
- ANSI B11.6-2001 {Safety Requirements for Manual Turning Machines with or without Automatic Control}

Potential Hazards

- Contact with rotating cutter while:
 - o Loading/unloading parts or calipering while cutter is rotating
 - o Operating machine with guarding not in place
 - o Performing servicing and maintenance such as:
 - Changing and lubricating parts
 - Clearing jams
 - Removing excess oil, chips turnings
- Contact with the gears while machine is in motion while performing:
 - o Inspection of gearbox by removing gearbox cover
- Getting loose clothing or long hair caught in rotating cutter
- Being struck by a flying object coming off mill
- Electrical shock
- Dropping objects onto foot

Key Controls

- Approved and authorized persons **ONLY** can operate equipment.
 - o Appropriate department supervisor shall ensure unauthorized persons do not have access to machines.
 - o Follow all safety warnings given in the Machine's Operating Manual.
 - o Training to be done and documented by designated competent instructor.
- A visual pre-operation inspection should be done prior to use.
 - o Equipment to be operated **ONLY** with required guarding in place.
 - o Cord should be checked for cracks or worn areas. Remove from operation if cord is damaged or if plug does not have proper grounding (3-prong).
- Personal Protective Equipment (PPE) shall be worn.
 - o NOTE: Gloves are not to be worn while operating a Milling Machine.
- Machines designed for a fixed location shall be securely anchored to prevent walking or moving.
- Machine should be equipped with an emergency stop control (usually red domed mushroom type head on yellow housing) located in an easily accessible location.
- Follow proper Lock out procedures (CFR 1910.147).
 - o NOTE: If device is plug in and plug is under exclusive control of the person performing the work, unplugging the machine will suffice. If person performing the work needs to leave the machine before work is complete, proper LOTO procedures are to be followed.
- Install awareness devices (signage, barriers, etc.) around saw.
- Instruct operators not to wear loose fitting clothing (short sleeves preferred), jewelry (including rings and watches)

or gloves.

- Instruct operators with long hair to secure in a cap or hair net.

Milling Machine

Operating Precautions

- Always use cutters which are sharp and in good condition.
- Work must be clamped securely in a vise and vise clamped tightly to the table, or, work must be clamped securely to the table.
- Ensure that the cutter is mounted securely before taking a cut.
- Keep working surface clear of scraps, tools and materials.
- Remove the collet tightening wrench immediately after using it.
- Before running machine the spindle should be rotated by hand to make sure it is clear for cutting.
- Never run machine faster than correct speed. See shop instructor if you have any question as to what speed to run cutter.
- Do not take measurements, make adjustments or reach into machine when the cutter is rotating.
- Use a vacuum, brush or rake to remove cuttings only after the cutters have stopped moving. o Do not use bare hands to remove cuttings.

Milling Machine

Guarding Guidelines

Vertical Milling Machines can be very dangerous. Contact or entanglement with rotating parts can result in serious injury. OSHA standard **29 CFR 1910.212(a)(iv)(e)** specifically references the point of operation of a milling machine as something that must be guarded.

Note: Older Bridgeport Milling Machines did not come equipped with point of operation guarding. There are many aftermarket types of guards that can be installed to protect the operator. Contact EH&S if assistance is needed.

Each of the guards shown will protect the operator from contacting the point of operation, entanglement and from flying metal.



Table Saw

Table Saw

Applicable Standards

- 29 CFR 1910.132 {Personal Protection Equipment}
- 29 CFR 1910.147 {Control of hazardous energy}
- 29 CFR 1910.212 {General requirements for all machines}
- 29 CFR 1910.213 {Wood working machinery requirements}
- 29 CFR 1910.219 {Mechanical power-transmission apparatus}
- 29 CFR 1926.304 {Woodworking tools}

Potential Hazards

- Contact with the blade is the most significant and dangerous hazard. **Hands and fingers can be amputated if they come into contact with moving blade.**
- Getting loose clothes, jewelry, or long hair caught in moving parts.
- Being hit, especially in the eyes, by debris flying from point of operation.
- Kick-backs – Stock is caught by the blade and thrown back at the operator.
- Inhalation of dust and particles.
- Dropping objects on foot.
- Electrical shock.

Key Controls

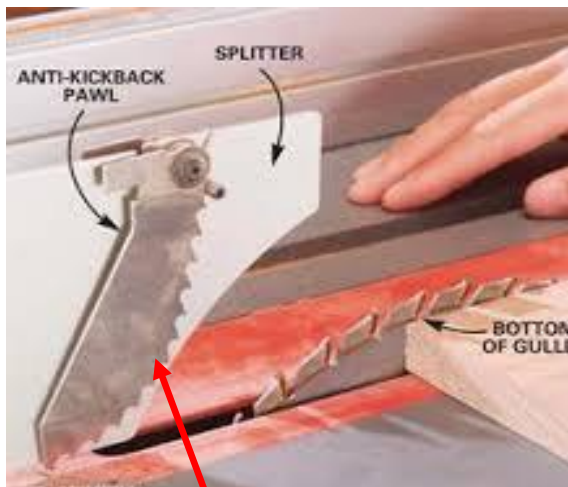
- Approved and authorized persons ONLY can operate equipment.
 - Training to be done and documented by designated competent instructor.
 - Appropriate department supervisor shall ensure unauthorized persons do not have access to machines.
 - Follow all safety warnings given in the Machine's Operating Manual.
- A visual pre-operation inspection should be done prior to use.
 - Equipment to be operated **ONLY** with required guarding in place. This includes spreader (if performing a rip cut) and anti-kickback fingers.
 - The self-adjusting guard should adjust to the height of the wood and remain in contact with it. If it does not, remove saw from service and repair/replace guard.
 - Ensure blade is tight and sharp.
 - Cord should be checked for cracks or worn areas. Remove from operation if cord is damaged or if plug does not have proper grounding (3-prong).
- Personal Protective Equipment (PPE) shall be worn.
 - NOTE: Gloves are not to be worn while operating a table saw.
- Machines designed for a fixed location shall be securely anchored to prevent walking or moving
- Follow proper Lock out procedures (CFR 1910.147). ◦ NOTE: If device is plug in and plug is under exclusive control of the person performing the work, unplugging the machine will suffice. If person performing the work needs to leave the machine before work is complete, proper LOTO procedures are to be followed.
- Install awareness devices (signage, barriers, etc.) around saw.
- Instruct operators not to wear loose fitting clothing (short sleeves preferred), jewelry (including rings and watches) or gloves.

- Instruct operators with long hair to secure in a cap or hair net.

Table Saw

Operating Precautions

- Use a push stick for small pieces.
- Be careful to avoid coasting blades. Do not reach into cut area until blade has come to a complete stop.
- Blade height should be set so that the top of the teeth extend no more than 1/8 inch above the wood.
- Ensure proper blade is on the saw and that the blade is sharp, undamaged, and that the arbor nut is tight.
- Do not saw freehand. Always hold the stock firmly against the miter gauge or a rip fence to position and guide the cut.
- To reduce risk of kick-backs:
 - o Avoid use of poor quality lumber.
 - o Use proper blade for cut being performed.
 - o Ensure blade height is correctly set.
 - o Operate saw at speed recommended by MACHINE'S.
 - o Maintain and sharpen blade.
 - o Guide stock parallel to the rip fence.
 - o For rip cuts, use a spreader to prevent material from squeezing the saw or kicking back during ripping.
 - o Use anti-kickback fingers to hold the stock down in the event that the saw kicks back the material.
- Stand to side of blade in case a kick-back does occur.
- Ensure work area is clean and uncluttered and sufficient space is given to operator using the saw.
- Keep the machine properly oiled and serviced.



**Anti-Kickback
Device**



Push Sticks



Table Saw

Table Saw Guards and Operating Parts



Hydraulic Tubing Bender

Hydraulic Tubing Bender

Applicable Standards

- 29 CFR 1910.132 {Personal Protection Equipment}
- 29 CFR 1910.147 {Control of hazardous energy}
- 29 CFR 1910.212 {General requirements for all machines}

Potential Hazards

- Moving and rotating parts
- Movement of the work piece
- Rupture and /or leakage from over pressurization of hoses or fittings.
- Pinch points
- Possibility of entanglement from loose clothing, jewelry, or body parts.

Key Controls

- Check the pipe bender thoroughly. Check for any damage or defect. Make sure to do this check every time while using the pipe.
- Make sure that the roller shafts are properly pinned, prior to using the pipe. Also, ensure that the bending die is properly seated, so that there is no mishap.
- The pipe should be cleaned regularly, so that its performance is not lowered.
- Use the hydraulic pipe bender only for the purpose it is meant for, and not for any other purpose.
- You should only use hydraulic oil. Avoid using brake fluid.
- Ensure the work area is clear of other persons before using the bender.
- Ensure pipe bender ram is disengaged before fitting the appropriate former.
- You should never exceed the rated capacity of the hydraulic units.

Operating Precautions

- Read and understand all instructions. Failure to follow all instructions may result in serious injury or property damage.
- The warnings, cautions, and instructions in this manual cannot cover all possible conditions or situations that could occur. Exercise common sense and caution when using this tool. Always be aware of the environment and ensure that the tool is used in a safe and responsible manner.
- Do not allow persons to operate or assemble the product until they have read this manual and have developed a thorough understanding of how it works.
- Do not modify this product in any way. Unauthorized modification may impair the function and/or safety and could affect the life of the product. There are specific applications for which the product was designed.
- Use the right tool for the job. DO NOT attempt to force small equipment to do the work of larger industrial equipment. There are certain applications for which this equipment was designed. It will do the job better and more safely at the capacity for which it was intended. DO NOT use this equipment for a purpose for which it was not intended.
- Industrial or commercial applications must follow OSHA requirements.

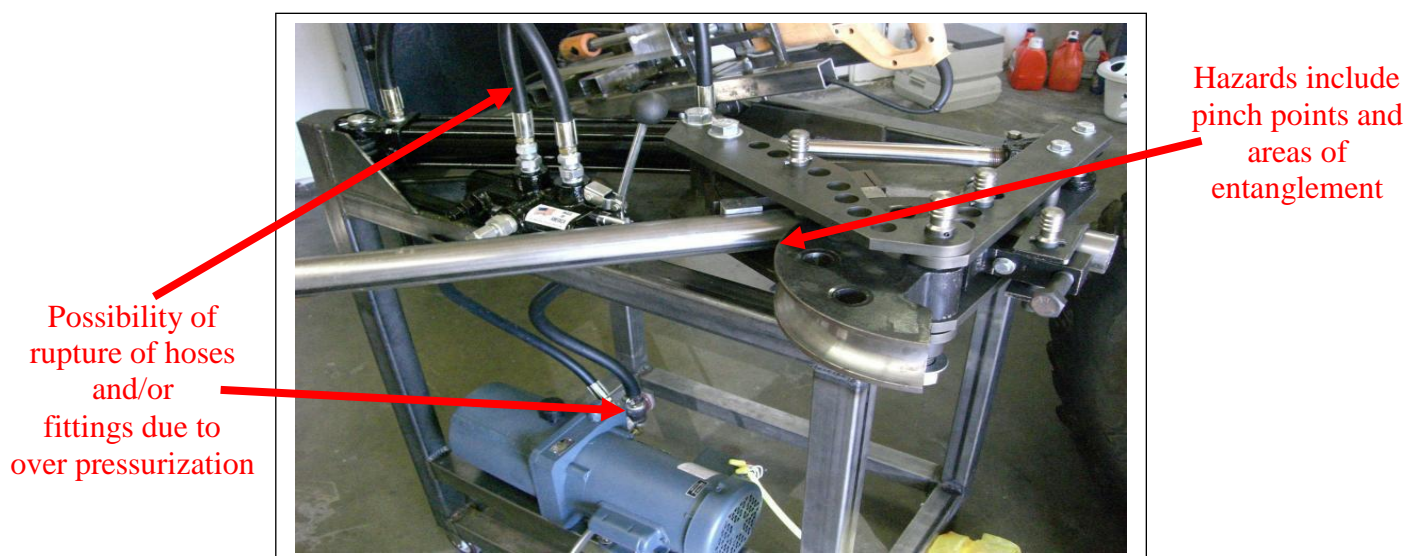
Hydraulic Tubing Bender

WORK AREA SAFETY

- Inspect the work area before each use. Keep work area clean, dry, free of clutter, and well lit. Cluttered, wet, or dark work areas can result in injury. Using the tool in confined work areas may put you dangerously close to other cutting tools and rotating parts.
- Do not allow the product to come into contact with an electrical source. The tool is not insulated and contact will cause electrical shock.
- Keep bystanders away from the work area while operating the tool.
- Be aware of all power lines, electrical circuits, water pipes, and other mechanical hazards in your work area. Some of these hazards may be hidden from your view and may cause personal injury and/or property damage if contacted.

PERSONAL SAFETY

- Stay alert, watch what you are doing, and use common sense when operating the tool. Do not use the tool while you are tired or under the influence of drugs, alcohol, or medication. A moment of inattention while operating the tool may result in serious personal injury.
- Dress properly. Do not wear loose clothing, dangling objects, or jewelry. Keep your hair, clothing and gloves away from moving parts. Loose clothes, jewelry, or long hair can be caught in moving parts. Air vents on the tool often cover moving parts and should be avoided.
- Wear the proper personal protective equipment when necessary. Use ANSI Z87.1 compliant safety goggles (not safety glasses) with side shields, or when needed, a face shield. Use a dust mask in dusty work conditions. Also use non-skid safety shoes, hardhat, gloves, dust collection systems, and hearing protection when appropriate. This applies to all persons in the work area.
- Do not overreach. Keep proper footing and balance at all times.
- Do not use the tool when tired or under the influence of drugs, alcohol or medication.
- Secure the work with clamps or a vise instead of your hand when practical. This safety precaution allows for proper tool operation using both hands.



Operating Precautions

- All operators shall be trained on the relevant safe work procedures, emergency procedures, and measures to eliminate or control the health and safety risks that are identified via the risk assessment process.
- Before commencing operation, functionality checks shall be performed for all safety devices on the power press and the material feeder. Examples of such safety devices include machine guards, presence-sensing device, two-hand operation devices, interlocking devices and emergency stop pushbuttons.
- Care should be taken when handling materials with sharp edges. Cut resistant gloves should be used.
- Ensure that the machine is at a complete stop before any work piece is loaded onto the die set.
- Ensure that no hands or any other part of the body is within the operational zone before activating the machine.
- Care should be taken when handling materials with sharp edges.



ENVIRONMENTAL HEALTH & SAFETY

The University of Alabama at Birmingham

Hand and Portable Power Tool Safety

HAND AND PORTABLE POWER 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 are in use or will be used. This will most notably apply to employees involved in industrial, maintenance, construction and manual labor trade 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 supervisors can also work jointly in the development of Job Safety Analysis for hand tools that present a unique hazard to the employee.

Supervisor and Employee: Supervisor led training is required upon employment for employees who operate hand and portable power tools.

- **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, screw drivers with broken points or broken handles, hammers with loose heads, dull saws, and extension cords or electric tools with 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:** Screw drivers 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 tool boxes with cutting edges exposed. Tools should be kept away from work bench edges.

The following procedures are excellent shop practices for supervisors and employees to follow in order 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 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 employer is responsible for the safe condition of tools and equipment used by employees, but the employees 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 supervisor 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 which 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 tool room attendant or craft supervisor 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.

Employees shall not continue 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, work benches, vises, a forge or furnace for hardening and tempering, tempering baths, safety goggles, repair tools, grinders, and good lighting. Employees specifically trained in the care of tools should be in charge of these facilities. If this service is not available, tools should be sent out for repairs.

CARRYING TOOLS

Employees are prohibited from carrying tools, which in any way could interfere with using both hands freely on a ladder or while climbing on a structure. A strong bag, bucket, or similar container is to be used to hoist tools from the ground to the job. Tools are to be returned in the same manner. Employees should never bring tools down by hand, carry in pant/shirt pockets, or dropped tools to the ground.

Loose tools and tools laid inappropriately cause a substantial portion of hand tool injuries. Tools should not be left above where employees are moving or walking. This presents a falling object hazard.

Chisels, screwdrivers, and pointed tools shall never be carried in an employee's pocket. They are to be carried in a tool box/cart, a carrying belt (sharp/pointed end down) like those used by electricians and steel employees, a pocket tool pouch, or in the hand with points and cutting edges pointed away from the body.

Employees carrying tools on their shoulders should pay close attention to clearances when turning around. Tools should also be handled so that they will not strike other employees or pedestrians.

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.

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



USE OF HAND TOOLS

Hand tools are non-powered, which includes axes, wrenches, screw drivers, hammers, etc. The greatest hazards posed by hand tools results 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 in. 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.
- Employees 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 back stroke.
- 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 of the hand, the wrist, or other part 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 face plate 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.
- Employees are required to wear safety goggles when trimming corners or slivers of metal because small particles often fly with considerable force.
- Employees 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 axe at one's side.



- The blade on a single-edged axe 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, employee shall take special care to prevent injury to themselves and other employees.
- 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 free hand.
- A handle guard or a finger ring (and swivel) on the handle eliminates these hazards and is required to be used.
- Employees who must carry knives with them on the job shall keep them in sheaths or holders.
- 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 work boxes or drawers where they may cause hand injuries. Safe placing and storing of knives is one of the most important keys to knife safety.
- Supervisors must make certain that employees 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.



- Supervisors 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 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.



Special Cutters for Banding, Wire & Strap

- Special cutters include those for cutting Banding, wire and strap. Claw hammers and pry bars shall not be used to snap metal banding material.



- Employees must neither stand nor jump on the tongs nor place extensions on the handles to obtain more leverage. Larger tongs should be used if an employee encounters either scenario.

Screwdrivers

- The practice of using screwdrivers for punches, wedges, pinch bars, or pry-bars shall not be allowed.
- Cross-slot (Phillips 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, 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 employees, 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 employees nailing and all employees 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](#))

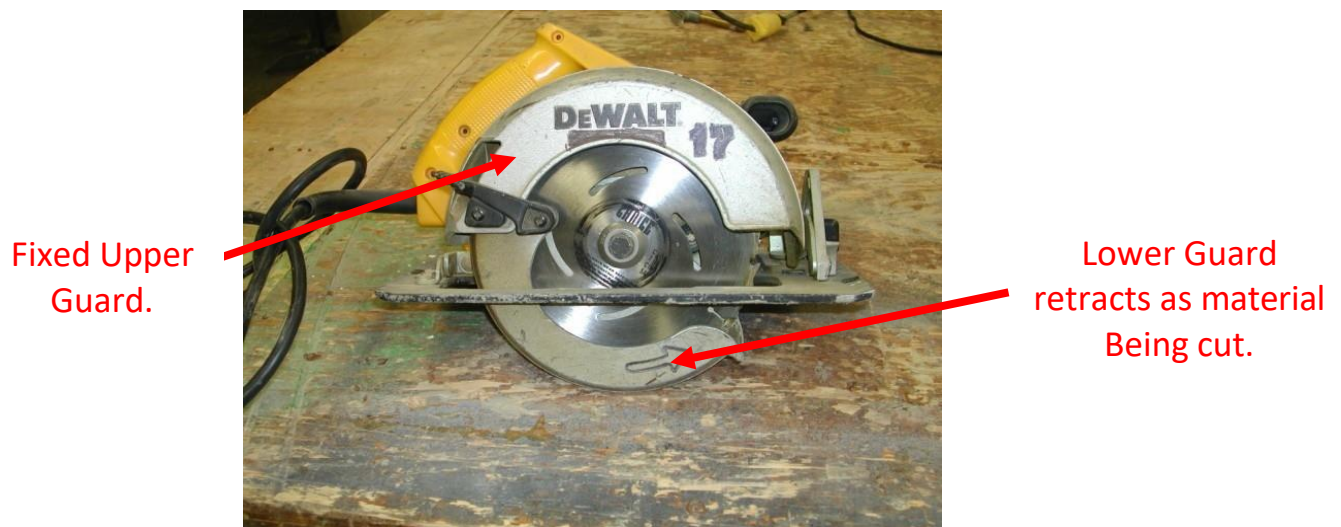
Hazardous moving parts of a power tool need to be safeguarded. For example, belts, gears, shafts, pulleys, sprockets, spindles, drums, fly wheels, chains, or other reciprocating, rotating, or moving parts of equipment must be guarded if such parts are exposed to contact by employees. Guards, as necessary,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

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:

- o When the work location makes it impossible, a wheel equipped with safety flanges shall be used.

- o 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:

- o When wheels 2 inches or less in diameter which are securely mounted on the end of a steel mandrel are used.

- o 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:

- o 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) may be required

SANDERS

- o If a sander is used steadily, it should be dismantled periodically, as well as thoroughly cleaned every day by being blown out with low-pressure air. If compressed air is used the operator shall wear safety goggles or work with a transparent chip guard between his body and the air blast.
 - o Because wood dust presents a fire and explosion hazard, keep dust to a minimum; sanders can be equipped with a dust collection or vacuum bag. Electrical equipment shall be designed to minimize the explosion hazard. Fire extinguishers approved for Class C (electrical) fires should be available.

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 coming in contact with the operator, or other equivalent protection shall be provided.

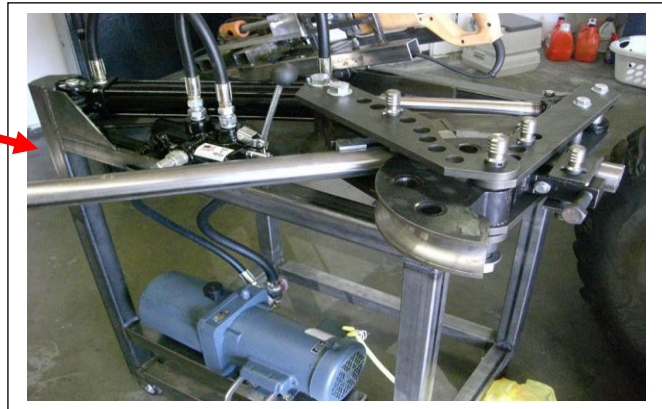
FUEL POWERED TOOLS

- 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.

HYDRAULIC POWER TOOLS

- The fluid used in hydraulic powered tools shall be fire-resistant and shall retain its operating characteristics at the most extreme temperatures to which it will be exposed.
- The manufacturer's safe operating pressures for hoses, valves, pipes, filters, and other fittings shall not be exceeded.

Hydraulic Tubing Bender



JACKS

All jacks - lever and ratchet jacks, screw jacks, and hydraulic jacks - must have a device that stops them from jacking up too high. Also, the manufacturer's load limit must be permanently marked in a prominent place on the jack and should not be exceeded.

A jack should never be used to support a lifted load. Once the load has been lifted, it must immediately be blocked up. Use wooden blocking under the base if necessary to make the jack level and secure. If the lift surface is metal, place a 1-inch-thick hardwood block or equivalent between it and the metal jack head to reduce the danger of slippage.

To set up a jack, make certain of the following:

- The base rests on a firm level surface.
- The jack is correctly centered.
- The jack head bears against a level surface.
- The lift force is applied evenly.



Proper maintenance of jacks is essential for safety. All jacks must be inspected before each use and lubricated regularly. If a jack is subjected to an abnormal load or shock, it should be thoroughly examined to make sure it has not been damaged. Hydraulic jacks exposed to freezing temperatures must be filled with adequate antifreeze liquid.