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1.0 Introduction

1.1 Purpose

This Machinery and Machine Guarding Program establishes minimum safety requirements for machinery and machine guarding at Emory. This policy is intended to assure that equipment or machines are operated safely and meet the machine guarding requirements established by the Occupational Safety and Health Administration (OSHA). While some entities and/or divisions of Emory may have additional or more stringent guidelines, the guidelines outlined in this document will serve as the minimum requirements for all.

1.2 Scope

This program covers employee use of all Emory machine shops, including but not limited to, carpentry; heating, ventilation, and air conditioning; plumbing; printing; art; theater; and museum. Employees include healthcare, faculty, staff, and student employees. Use of shops by students is covered under the Student Machine Shop Safety Guideline.

1.3 Definitions

Adjustable guard. A guard that allows flexibility in being able to adjust according to the thickness of the stock.

Dadoing. A groove or rectangular section for receiving the end of a board.

Featherboard. A safety device with parallel fingers or “feathers” that flex in the direction of travel, preventing the piece from being dragged backwards by blade friction and preventing fingers from slipping into the saw blade.

Fixed Guard. A guard that is a permanent part of the machine.

Grooving. A long, narrow cut or indentation in a surface, as the cut in a board to receive the tongue of another board

Interlocked guard. A type of guard that when opened or removed, the tripping mechanism and /or power is automatically shut off. The machine cannot start until the guard is replaced.

Jointing. A connection between pieces of wood, metal, or the like, often reinforced with nails, screws, or glue.

Lockout/Tagout. Procedures for servicing and maintenance of machines or equipment in which the unexpected energization or startup of the machines or equipment, or release of stored energy, could harm employees.

Machinery. Includes but is not limited to, lathes; table saws; milling machines; abrasive wheel machinery; band saws; drill presses, etc.

Moulding. A frame on which something may be constructed.

Nip point. A point of convergence between two rolling parts, or a rolling part and a

stationary part, where all or part of the human body could become trapped and injured.

Point of operation. The point where material is positioned, inserted, or manipulated, or where work such as cutting, shaping, boring, or forming is performed on the stock.

Power transmission apparatus. All components of the mechanical system which transmit energy to part of the machine performing work. These components include flywheels, pulleys, belts, connecting rods, couplings, cams, spindles, chains, cranks, and gears.

Rabbeting. A deep notch formed in or near one edge of a board, framing timber, etc., so that something else can be fitted into it or so that a door can be closed against it.

Ring test. Process used to detect damage in a grinding wheel before it is mounted. The grinding wheel is tapped gently with a light nonmetallic implement, such as the handle of a screwdriver for light wheel, or a wooden mallet for a heavier wheel. Wheels that emit a clear ringing sound rather than a dull sound are likely undamaged.

Self-adjusting guards. This guard protects the operator by placing a barrier between the danger area and the operator. An example of self-adjusting guard would be a guard on a circular saw.

1.4 Responsibilities

Environmental Health and Safety Office (EHSO) and applicable Hospital and Clinic Safety Management

As the administrative department for the Machinery and Machine Guarding Program, EHSO and applicable hospital and clinic safety management groups are responsible for the following in their areas:

- Providing safety information, training, and consultation to employees as needed;
- Inspecting machines for appropriate guarding during safety inspections or as requested;
- Reporting any questionable or hazardous conditions that are discovered to the responsible department; and
- Evaluating and updating the Machinery and Machine Guarding Program.

Directors, Supervisors, and Managers/Principle Investigators (PIs)

Directors, managers, and supervisors have primary responsibility for the management and enforcement of this program in their areas. They must:

- Provide adequate resources for maintenance, repairs, and safe guarding of equipment;
- Enforce the Machinery and Machine Guarding Program in their areas;
- Ensure all newly acquired machines are properly guarded prior to being put into service;
- Restrict access to machines and equipment to prevent unauthorized use or unnecessary exposure;
- Prevent employees and shop operators from removing manufacturer provided guards from equipment;

- Ensure that damaged or improperly guarded equipment is removed from service;
- Ensure employees are properly trained on any machine they are expected to operate; and
- Ensure those employees who need to modify/disable any protective guards complete lockout/tagout training.

Employees

Employees are responsible for complying with the rules set forth by this program. Employees must:

- Complete all required Machine Guarding Training and obtain authorization prior to operating machines;
- Operate and maintain machinery and machine guards in a safe manner;
- Do not operate machines without safeguards in place;
- Report all damaged or malfunctioning tools/equipment to their supervisor and remove or tag such tools/equipment "out of service";
- Report unauthorized or unsafe use of machines and equipment to a supervisor; and
- Follow Emory's Lockout/Tagout Program when servicing, repairing, or cleaning equipment.

1.5 Training Requirements

- EHSO is responsible for ensuring Machine Guarding Awareness training is provided to all Emory University employees who work with (or in close proximity to) machinery. This training will be given upon initial assignment and every three years thereafter.
- EHSO will provide training to Emory University employees in the following:
- OSHA Machine Guarding Requirements
- Purpose and Function of Machine Controls
- How to use emergency buttons and other measures, when needed;
- Personal Protective Equipment
- Accident/Incident Reporting
- EHSO will maintain documentation of attendance for training provided by EHSO which will include the employee's name, department, and date of training.
- Department leaders are responsible for ensuring machine-specific training is provided to personnel upon initial assignment to an area and whenever new or altered safeguards are introduced into a work area.
- The equipment operating manual, explaining an equipment's operation and maintenance, must be provided by the manufacturer and should be accessible to all machine operators.

1.6 Recordkeeping Requirements

- Any entity or division that provides Machinery and Machine Guarding training is responsible for maintaining records of their training.
- Any entity or division that conducts Machine Guarding assessments is responsible for maintaining records of the assessments.

1.7 Program Evaluation

The Machinery and Machine Guarding Program will be re-evaluated annually and revised if necessary.

2.0 General Requirements

2.1 Personal Protective Equipment (PPE)

Any employee operating machinery, which exposes them to any hazard (i.e., falling, flying, abrasive, and splashing objects, harmful dusts, fumes, mists, vapors, or gases) must be provided appropriate PPE necessary to protect them from the hazard. Refer to the Emory University PPE Guideline for additional PPE requirements. The following are required when working in machine areas:

- Wear eye protection when working with or around machinery. Use a face shield in addition to safety glasses or goggles to provide protection to the face.
- Utilize hearing protection for tasks where employees are exposed to an 8-hour time weighted average of 85 decibels on an A-weighted scale (dBA) or higher. Refer to the Emory Hearing Conservation Program.
- Wear closed-toe shoes in machine shop areas. Equipment operators must wear safety shoes with a reinforced toe to assist in eliminating injuries caused by a dropped tool or stock.
- Do not wear loose fitting clothing, neckties, gloves, or jewelry while operating shop equipment.
- Restrain long hair to prevent poor visibility and to prevent it from being caught in rotating machinery.
- Respirators, protecting against dust and fumes, may be necessary if a hazardous atmosphere is created while working with the machine and material. Refer to the Respiratory Protection Program for respirator requirements.
- Additional PPE that is needed is worn in accordance with the Emory University PPE Guideline.

2.2 Electric Power/Controls

- Install all machinery in accordance with the National Electric Code (NEC) and the manufacturer's requirements;
- Provide an appropriate electrical ground system on all machines that have exposed non-current carrying metal components;
- Locate control switches within easy reach of the operator at his/her operating position;
- Ensure controls are easily identifiable, allowing the operator to turn "OFF" the power at the point of operation; and
- Ensure a trip device is provided on machinery where injury might result if the motor were to restart after a power failure. This prevents the machine from automatically restarting when electrical power is restored.
- A positive means should be provided for rendering such controls or devices inoperative while repairs or adjustments are being made to the machines they control.

2.3 Housekeeping

- Keep floors and aisles in good repair and free from potential hazards.
- Clean metal pieces, sawdust, and other debris from the machine using a brush or compressed air.
    - If compressed air is used, the nozzle pressure at the discharge end of the airline cannot exceed 30 psi.
    - Do not use compressed air to blow chips or other debris from an employee's body or clothing.
- Allow machinery to come to a complete stop before cleaning.
- If available, utilize a dust collection system.
- ***Keep metal filings and wood dust separate at all times.*** Combining wood dust and metal filings can create a fire hazard.

2.4 Operation

- Do not exceed the manufacturer's rated capacity for the machine.
- Do not leave machines unattended with the control switch in the "ON" position.
- Before mounting blades, cutter heads, and collars ensure they are accurately sized.
- Do not use blades that are dull, badly set, improperly filed, or improperly tensioned.
- Only qualified employees may sharpen or tension saw blades or cutters.
- All knives and cutting heads of woodworking machines should be kept sharp, properly adjusted, and firmly secured. When two or knives are used in one head, they should be properly balanced.
- Inspect equipment before each use. Items that are cracked, warped, or otherwise damaged must immediately be removed from service.
- Ensure preventative maintenance is conducted periodically to keep equipment maintained and lubricated. All drip cups and pans should be securely fastened.

3.0 Machine Installation and Guarding Requirements

3.1 Anchoring Fixed Machinery

- Securely anchor all machines designed for a fixed location to prevent walking or movement of the machine.
- Secure smaller bench top machines to benches, tables, or stands of adequate strength and design.
- Consider the weight limitation of the floor prior to installing all machinery.

3.2 Machine Guarding

Appropriate guards must be provided to protect the operator and others in the area from hazards created by the point of operation, power transmission apparatus (including gears, sprockets, pulleys, fly-wheels, knives, belts, drive shafts, drive couplings, and chains that are located seven (7) feet or less above a floor or platform), other moving parts, flying chips, and sparks. For specific requirements on various types of machinery found at Emory, see the machine-specific safety rules provided by the manufacturer.

- Affix guards to the machine where possible and secure elsewhere if for any reason attachment to the machine is not possible, to prevent access to the

hazard from all accessible directions including front, top, bottom, and back. Types of machine guards include fixed guards, interlocked guards, adjustable guards, and self-adjusting guards.

- Ensure starting and stopping controls are within easy reach of the operator.
- Prevent objects from falling into moving/rotating parts by installing appropriate guards. A small tool dropped into a cycling machine could easily become a projectile that could strike and injure someone.
- Ensure guards prevent hands, arms, and any other part of an operator's body from making contact with dangerous moving parts.
- Ensure guards and safety devices are made of a durable material that will withstand the conditions of normal use.
- Ensure guards cannot be easily removed by personnel.
- Guards cannot create additional hazards, such as a shear point, a jagged edge, or an unfinished surface that could cause a laceration. Bolt the edges of guards in such a way that sharp edges are eliminated.
- Ensure guards are constructed and installed in such a way as to allow for the safe lubrication of equipment without removal of the guard. Drip cups and pans must be securely fastened.
- Operate machines with guards in place except when a guard is designed to be removed for cutting device changes, to make small cuts, or has to be removed for lockout/tagout procedures. Replace guards before the machine is placed back into service.
- Feeder attachments should have the feed rolls or other moving parts covered or guarded as to protect the operator from hazardous points.
- Provide special hand feeding tools, such as push sticks or push blocks, for placing and removing material and that permit easy handling of material without the operator placing a hand in the danger zone. Such tools cannot be used in lieu of the machine guarding required by this policy.

3.3 Saws

- Do not use automatic cutoff saws that stroke continuously without the operator being able to control each stroke.
- Ensure that all belts, pulleys, gears, shafts, and moving parts are guarded.
- Provide combs (featherboards) or suitable jigs for use when a standard guard cannot be used, as in dadoing, grooving, jointing, moulding, and rabbeting.
- Provide non-kickback fingers or dogs to prevent the saw from picking up the material or throwing it back toward the operator. They should be designed to provide adequate holding power for all the thicknesses of materials being cut. They should be located in front of the saw and arranged so as to be in continual contact with the wood being fed.
- Push blocks and push sticks should be provided at the work space in the several sizes and types suitable for the work to be done.
- Circular saws:
    - Circular saws with a portion of the saw either beneath or behind the table must have that portion of the saw covered with an exhaust hood. If no exhaust system is required, guard the saw blade to prevent accidental contact.
    - Guard hand-fed circular ripsaws with a hood that completely encloses

the portion of the saw above the table and the portion of the saw above the material being cut. Arrange the hood so that it will automatically adjust itself to the thickness of and remain in contact with the material being cut.
    - Furnish hand-fed circular ripsaws with a spreader to prevent material from squeezing the saw or being thrown back on the operator.
    - Guard each circular resaw with a metal hood or shield above the saw to protect against flying splinters or broken saw teeth.
    - Provide each circular resaw (other than self-feed saws with a roller or wheel at back of the saw) with a spreader fastened securely behind the saw.
    - Arbors of all circular saws should be free from play.
- Radial Saws:
    - Ensure that the upper hood completely encloses the upper portion of the blade down to a point that will include the end of the saw arbor.
    - Guard the sides of the lower exposed portion of the blade to the full diameter of the blade with a device that will automatically adjust itself to the thickness of the stock.
    - In repetitive operations, provide an adjustable stop to prevent the forward travel of the blade beyond the position necessary to complete the cut.
    - Install radial saws so that the front end of the unit is slightly higher than the rear, to cause the cutting head to return gently to the starting position when released by the operator.
    - Ensure that ripping and ploughing is only done against the direction in which the saw turns. Clearly mark the direction of the saw rotation on the hood. In addition, affix a permanent label (at least 1 1/2 inches by 3/4 inch) to the rear of the guard at approximately the level of the arbor, reading as follows: "Danger: Do Not Rip or Plough From This End".
    - Swing cutoff saws should be provided with a hood that completed encloses the upper half of the saw, the arbor end, and the point of operation at all positions of the saw. They should also be provided with an effective device to return the saw automatically to the back of the table when release at any point of its travel.
    - Limit chains or other equally effective devices should be provided to prevent a swing cutoff saw from swinging beyond the front or back edges of the table.
    - Inverted swing cutoff saws should be provided with a hood that will cover the part of the saw that protrudes above the top of the table or above the material being cut.
- Bandsaws and Resaws:
    - Enclose or guard all portions of the saw blade, except for the working portion of the blade between the bottom of the guide rolls and the table.
    - Each bandsaw machine should be provided with a tension control device to indicate a proper tension for the standard saws used on the machine.
    - Fully encase bandsaw wheels. The front and back of the band wheels must be either enclosed by solid material or by wire mesh or perforated metal that is at least 0.037 inch (U.S. Gage No. 20), with openings no

larger than three-eighths inch.
  - Ensure the portion of the blade between the sliding guide and the upper-saw-wheel guard is guarded. This portion of the guard must be self-adjusting to raise and lower with the guide.

3.4 Jointers

- A hand-fed jointer with horizontal head should be equipped with a cylindrical cutting head and the knife projection cannot exceed one-eighth inch beyond the cylindrical body of the head.
- The clearance between the edge of the rear table and the cutter head shall be no more than one-eighth inch.
- A hand-fed jointer with horizontal head should have an automatic guard that will cover all the section of the head on the working side of the gage. It should also have a guard that will cover the section of the head on the back of the gage.
- A wood jointer with vertical head should have either an exhaust hood or other guard so arranged as to enclose the revolving head completely.

3.5 Lathes

- Cover the cutting heads of profile and swing-head lathes with a metal guard.
- Cover the cutting heads on wood-turning lathes, whether rotating or not, as completely as possible with hoods or shields.
- Automatic wood-turning lathes of the rotating knife type must be equipped with hoods enclosing the cutter blades completely except at the contact points while the stock is being cut.
- Lathes used for turning long pieces of wood stock held only between the two centers must be equipped with long curved guards extending over the tops of the lathes in order to prevent the work pieces from being thrown out of the machines if they should become loose.
- Where an exhaust system is used, the guard should form part of all of the exhaust hood.

3.6 Woodworking Machines

- Tenoning Machines:
  - Feed chains and sprockets of all double end tenoning machines should be completely enclosed, except for the portion of the chain used for conveying the stock.
  - At the rear ends of frames over which feed conveyors run, sprockets and chains should be guarded at the sides by plates projecting beyond the periphery of sprockets at the ends of lugs.
  - Cutting heads, and saws if used, should be covered by metal guards.
  - When an exhaust system is used, the guard should form part or all of the exhaust hood.
- Boring and Mortising Machines:
  - Ensure safety-bit chucks with no projecting set screws are used.
  - Boring bits should be provided with a guard that will enclose all portions of the bit and check above the material being worked.
  - The top of the cutting chain and driving mechanism should be enclosed with a guard.

  - Universal joints on spindles of boring machines should be completely enclosed.
  - Operating treadles should be covered by an inverted U-shaped metal guard, fastened to the floor, and of adequate size.
- Wood Shapers:
  - The cutting heads of wood shapers, hand-fed panel raisers, or other similar machine not automatically fed, should be covered by a metal guard.
  - Where an exhaust system is used, the guards should form part or all of the exhaust hood.
  - Feed rolls should be guarded by a hood or suitable guard. The guard should be fastened to the frame carrying the rolls so as to remain in adjustment for any thickness of stock.
  - Surfacers or planers used in thicknessing multiple pieces of material simultaneously should be provided with sectional infeed rolls that have sufficient yield in the construction of the sections. Suitable section kickback finger devices should be provided at the infeed end.

3.7 Sanding Machines

- Protect feed rolls of self-feed sanding machines with a semi-cylindrical guard to prevent the hands of the operator from coming in contact with the in-running rolls at any point. The bottom of the guard should come down to within three-eighths inch of a plane formed by the bottom or contact face of the feed roll where it touches the stock.
- The revolving drum of drum sanding machines must have an exhaust hood, or other guard if no exhaust system is required, enclosing the revolving drum, except for that portion of the drum above the table.
- The revolving disk of disk sanding machines must have an exhaust hood, or other guard if no exhaust system is required, enclosing the revolving disk, except for the portion of the disk above the table.
- Provide belt sanding machines with guards at each nip point where the sanding belt runs on to a pulley. Guard the unused run of the sanding belt against accidental contact.

3.8 Veneer Cutters and Wringers

- Veneer slicer knives should be guarded at both front and rear.
- Veneer clippers should have automatic feed or should be provided with a guard that would make it impossible to place a finger under the knife while feeding or removing the stock.
- Sprockets on chain or slat-belt conveyors should be enclosed.
- Where practical, hand and foot-powered guillotine veneer cutters should be provided with rods or plates or other satisfactory means on the feeding side.

3.9 Abrasive Wheel Machinery

- Ensure floor and bench abrasive wheel machinery is securely mounted to the floor or bench surface;
- Ensure grinding wheels are dressed to prevent a ridge from forming;
- Ring test and visually inspect all new abrasive wheels before mounting to

ensure the wheel is not cracked. Do not use if a dull sound is noted.

- Ensure safety guards cover the spindle end, nut, and flange projections and 75% of the wheel diameter;
- **NOTE: Safety guards on all operations where the work provides a suitable measure of protection to the operator, may be so constructed that the spindle end, nut, and outer flange are exposed; and where the nature of the work is such as to entirely cover the side of the wheel, the side covers of the guard may be omitted**
- Adjust the work rest to within 1/8 inch of the abrasive wheel;
- Adjust the tongue guards to within 1/4 inch of the abrasive wheel;
- Ensure the maximum revolutions per minute (RPM) rating of each abrasive wheel is compatible with the RPM rating of the grinder motor.

3.10 Exposure of Blades

- When the periphery of the fan blades is less than seven feet above the floor or working level, the blades must be guarded to prevent contact.
- Ensure that openings on fan blade guards are no larger than one-half inch.

3.11 Guarding by Location

- Equipment that is guarded by location or distance does not require further safeguarding as long as all moving parts are positioned so that he hazardous areas are not accessible and do not present a hazard during normal operation. Examples include:
  - Positioning equipment a minimum of 7 feet above the work platform; or
  - Locating equipment behind a wall, barrier, or fence.

3.12 Power Transmission Apparatus

Power transmission apparatus are all components of the mechanical system which transmit energy from the motor to the location and part of the machine performing the work. These components include flywheels, pulleys, connecting rods, couplings, cams, spindles, chains, cranks, and gears.

- Flywheels should be guarded with an enclosure of perforated or expanded metal sheet or woven wire. Guard rails should be placed no less than fifteen inches nor more than twenty inches from the rim.
- Shaft couplings should be constructed as to present no hazard from bolts, nuts, setscrews, or revolving surfaces.
- All sprocket wheels and chains should be enclosed unless they are more than seven feet above the floor or platform.
- Gears should be guarded by a complete enclosure; a standard guard at seven feet high extending six inches above the mesh point of the gears; or by a band guard covering the face of the gear and having flanges extended inward beyond the root of the teeth on the exposed side(s).
- When frequent oiling is required, openings with hinged or sliding self-closing covers should be provided. Oil feed tubes should be added if lubrication is needed while machinery is in motion.
- Clutches, cutoff couplings, or clutch pulleys having projecting parts should be enclosed by a stationary guard.
- All metal should be free from burrs and sharp edges.

- These requirements do not apply to safeguarding belts, pulleys, or shafting located in basements, towers or room used exclusively for power transmission equipment if the space is locked against unauthorized entrance, the vertical clearance in passageways is at least five feet six inches, and the intensity of illumination conforms to the requirements of ANSI A11.1-1962 (R-1970).
- These requirements apply to all machinery except horizontal overhead belts, cables, or chain guards more than seven feet above the floor or platform.

4.0 References

- OSHA Machinery and Machine Guarding – 29 CFR 1910 Subpart O
- Emory University Energy Control Program – Lockout/Tagout
- Georgia Institute of Technology Machine Guarding Guidelines
- University of California, Berkeley Machine Guarding Guidelines

5.0 List of Associated Documents

- Band Saw Safety Rules
- Belt Disc Sander Safety Rules
- Circular Saw Safety Rules
- Drill Press Safety Rules
- Miter Saw Safety Rules
- Router Safety Rules
- Saber Saw Safety Rules
- Table Saw Safety Rules