



Machine Guarding and Shop Safety Procedure

1. Purpose

The purpose of this procedure is to minimize the risks associated with the operation of machinery and equipment by providing requirements for the protection of machine operators, shop users including students, and others who work or traverse an area with machining hazards. The purpose is also to ensure regular maintenance of machining equipment is conducted.

This procedure is in compliance with 29 CFR 1910 Subpart O, "Machinery and Machine Guarding" and Subpart P, "Hand and Portable Powered Tools and Other Hand-Held Equipment". It is developed in accordance with other University of Notre Dame procedures including Lock, Tag and Try, Hot Work, Hearing Conservation, and Hazard Communication.

2. Scope

This procedure applies to faculty, staff and students whose work duties or studies require them to utilize equipment in machine shops or require them to work with portable power tools. It includes all University departments and shop areas that have machinery and equipment capable of causing injury. Shop areas include those used for the purpose of teaching as well as performing other work related tasks.

Areas with only a few pieces of machinery or temporary construction sites with machinery are not considered "shops", but the safeguarding requirements still apply. It is recognized that in certain situations, a guard may impact the work on an oversized part, e.g., complicated laboratory glassware. In situations such as these, contact RMS for risk mitigation techniques.

All hand and powered tools and other hand-held equipment utilized at ND for construction, alteration, repair, demolition, electrical, plumbing, vehicle maintenance and general purposes are covered by this program.

3. Responsibilities

- 3.1. Department Chair / Unit Director / Area Manager shall provide the resources necessary to ensure those areas under their supervision meet the expectations of this procedure.
- 3.2. Risk Management and Safety (RMS) shall:
 - 3.2.1. Maintain this written procedure to meet regulatory requirements and periodically review the program to assure it is current.

- 3.2.2. Provide technical assistance to ensure this program is successfully implemented.
 - 3.2.3. Conduct routine inspections of machine shops to verify that the requirements of this procedure are being met and provide oversight to ensure any findings are addressed.
- 3.3. Shop or Machine Area Manager / Supervisor or Designee shall:
- 3.3.1. Have overall responsibility for the shop, including equipment maintenance, training, controlling access to hazardous machinery, implementing safety guidelines and approving authorized operators.
 - 3.3.2. Be capable of identifying existing and predictable hazards in the shop which include unsanitary, hazardous, or dangerous conditions in the area and has the authorization to take prompt corrective measures to eliminate them.
 - 3.3.3. Be familiar with the safe operation of all shop machines, equipment and tools.
 - 3.3.4. Ensure this procedure is enforced within their areas of responsibility.
 - 3.3.5. Ensure that all machine safeguards are in place and operational.
 - 3.3.6. Ensure employees follow machine safety operating procedures, including, but not limited to, not bypassing, removing or defeating machine safeguards.
 - 3.3.7. Maintain the owner's manuals or instructions for each piece of equipment.
 - 3.3.8. Ensure shop and/or machine specific training is provided and documented for shop personnel or machine operators as required by Section 14 of this procedure.
 - 3.3.9. Complete a personal protective equipment (PPE) hazard assessment for the shop.
 - 3.3.10. Ensure that equipment in need of repair or service is taken out of service and that repairs and service are made only by authorized personnel.
 - 3.3.11. Maintain records such as training, shop safety inspections, and maintenance and repair records.
 - 3.3.12. Ensure only trained and authorized personnel are permitted to work in the shop.
- 3.4. Machine Operators, Shop and Equipment Users shall:
- 3.4.1. Follow the requirements of this program.
 - 3.4.2. Operate machines and equipment with all safeguards in place.

- 3.4.3. Conduct visual pre-operation inspections of machines and equipment to ensure guards are in proper operating condition.
- 3.4.4. Not bypass, remove or defeat safeguards.
- 3.4.5. Maintain proper housekeeping of work area.
- 3.4.6. Report all missing or damaged safeguards to the Area Manager/Supervisor or designee immediately and not operate any machine or equipment with a missing or defective safeguard.
- 3.4.7. Participate in required training.
- 3.4.8. Not operate a machine until properly trained.

4. Definitions

- 4.1. Emergency Stop – A hardwired stop that is generally accessible to employees in their work area and is designed to cut off power to the machine or process when activated.
- 4.2. Ground Fault Circuit Interrupter (GFCI) – A fast-acting circuit breaker designed to shut off electric power in the event of a ground-fault within as little as 1/40 of a second. It works by comparing the amount of current going to and returning from equipment along the circuit conductors.
- 4.3. Hazards – Mechanical, electrical and/or physical conditions that could cause harm to employees or other personnel in the vicinity of machinery or equipment. Mechanical Hazards include rotational motion, nip points, and cutting, shearing, punching and forming mechanisms.
- 4.4. Hot Work Activity – Any use of open flames such as welding, torch use or soldering. In addition this includes any activity which creates sparks such as grinding. Refer to [ND's Hot Work Procedure, Safe-09](#).
- 4.5. Interlock – An arrangement in which the operation of one part or mechanism automatically brings about or prevents the operation of another. Interlocks shall be durable, not easily bypassed, and shall stop all hazardous motion before employee interaction.
- 4.6. Machine Guards – Physical structures or electrical systems used to prevent access during machinery or equipment operation. This includes barrier guards, two-hand trip mechanisms and electronic safety devices.

- 4.7. Nip Point – An in-running machine or equipment part, in which two in-running parts rotate towards each other, or where one part rotates toward a stationary object.
- 4.8. Point of Operation – The point at which cutting, shaping or forming is accomplished upon the stock, including the hazards associated with inserting and manipulating the stock.
- 4.9. Safeguard – Term for a number of measures that provide workers with effective protection from harmful contact with moving parts or other harmful conditions. Safeguards include barrier guards, safety devices, shields, awareness barriers, warning signs, or other appropriate means, used singly or in combination.
- 4.10. Safeguarding Device – Devices used as alternatives to barrier guards, such as interlocked movable barrier guards, two-hand controls, and electronic presence-sensing devices such as light curtains and pressure-sensitive mats. These solutions are more complex and technical but are designed to provide protection during normal operation.

5. General Machine Shop Requirements

- 5.1. Only trained and competent personnel are permitted to utilize machine shop equipment and tools. See Section 14 – Training.
- 5.2. When students are present within a shop, the course instructor or supervisor shall be present at all times to ensure all tools and equipment are used properly.
- 5.3. Machine shops shall be secured when the shop supervisor or designee is not in the shop.
- 5.4. It is recommended that there are a minimum of 2 (two) personnel present in machine shops when equipment is in use.
- 5.5. Appropriate personal protective equipment (PPE) shall be worn while working in machine shops or when using hand/portable power tools that may be hazardous to the operator. See Section 12 – PPE.
- 5.6. Damaged or broken equipment/tools shall be removed from service and tagged “DO NOT USE” or similar. Repairs shall be made prior placing equipment back into service.

- 5.7. When guarding or other engineering controls are not feasible or are not fully capable of protecting the operator, consult with RMS for potential administrative or personal protective equipment controls.
 - 5.8. Machines designed for a fixed location shall be securely anchored to prevent walking or moving.
 - 5.9. Spring loaded chuck keys shall be used with all drill presses and lathes.
 - 5.10. Safeguards removed during repair or preventative maintenance shall be replaced before equipment is returned to service. Equipment with removed safeguards shall be locked and tagged in accordance with the University's [Lock, Tag, Try Program, \(Safe 014\)](#).
 - 5.11. All machines equipped with emergency stop (e-stop) buttons shall have the e-stops located in close proximity (within the operator's reach) to the machine operator and be red in color with a yellow background.
 - 5.12. The use of compressed air to clean equipment shall utilize air nozzles that upon dead-ending the exit orifice, the static pressure is reduced to less than 30 psi. Use of compressed air for cleaning is only permitted when there are chip guards and when PPE is used by the operator and other personnel in the area. Compressed air shall never be used for cleaning personnel or their clothing.
- 6. General Machine Guarding Requirements**
- 6.1. One or more methods of guarding shall be provided to protect operators and other personnel in the area from machine hazards.
 - 6.1.1. Hazard examples include those created by point of operation, nip points, rotating parts, flying chips and sparks.
 - 6.1.2. Examples of guarding methods include fixed guards, barrier guards, two-hand tripping devices, electronic safety devices, etc.
 - 6.2. Routine Machine Guarding Checks
 - 6.2.1. Machinery and equipment shall be visually checked before each operation to verify that the guards are in place and that sensing devices and interlocks, if available, are functioning properly and have not been bypassed, removed or otherwise not functional.



- 6.2.2. Missing guards or defective safeguards shall be corrected immediately or the machines taken out of service until corrections are completed.
 - 6.3. Machine guards shall meet the following requirements:
 - 6.3.1. Prevent operator contact with the hazard by enclosing it or otherwise preventing access to the hazard by reaching over, under, around or through a guard.
 - 6.3.2. Firmly attached to equipment or secured elsewhere by use of fasteners that requires a tool to remove. If the guards cannot be affixed to the machine, consult RMS.
 - 6.3.3. Constructed of durable material that will withstand normal conditions of use.
 - 6.3.4. Protect objects from falling into the machine's moving parts.
 - 6.3.5. Not introduce any new hazards or create unintended machine operations.
 - 6.3.6. Allow for safe lubrication and maintenance of equipment.
 - 6.4. Point of operation guarding
 - 6.4.1. The point of operation of the machine shall be guarded. The guard shall be designed and constructed to prevent the operator from having any body part in the danger zone during the operating cycle.
 - 6.4.2. Special hand tools for placing and removing material should be used. If used, the tools shall permit easy handling of material without the operator placing a hand in the danger zone. Such tools shall only be used to supplement a guard.
 - 6.5. All foot operated switches shall be guarded to prevent accidental activation by personnel or falling objects.
 - 6.6. When the periphery blades of a fan are less than seven (7) feet above the floor or working level, the blades shall be guarded.
- 7. Welding / Cutting / Brazing – Hot Work Activities**
- 7.1. Areas where hot work is performed shall be evaluated as to whether a Hot Work Permit is required. Areas where hot work is performed may be considered a Designated Hot Work Area. Refer to the University's [Hot Work Procedure – Safe 09](#). Contact NDFD or RMS for support.

8. Hand and Power Tools

- 8.1. Exposed moving parts of power tools shall be safeguarded. This includes belts, gears, shafts, pulleys, sprockets, spindles, drums, flywheels, chains or other moving parts.
- 8.2. Safeguards shall never be removed when a tool is being used.
- 8.3. Bench, pedestal and portable grinders:
 - 8.3.1. Bench and pedestal grinders shall have a work rest adjusted no greater than $\frac{1}{8}$ inch away from the grinding wheel. Tongue guards shall be no greater than $\frac{1}{4}$ inch from the grinding wheel.
 - 8.3.2. Wheels mounted on abrasive wheel tools shall be inspected prior to mounting. This includes conducting a ring test on bench and pedestal grinder wheels. Instructions can be found at the following link: [ring test](#).
 - 8.3.3. When mounting a wheel, always ensure that the grinder speed does not exceed the maximum operating speed marked on the wheel.
- 8.4. Electric power tools are to be effectively grounded or be double insulated.
- 8.5. Hand and power tools shall be in good operating condition free from defects or broken parts.
- 8.6. Power tools shall be unplugged before performing service such as blade replacement, grinding wheel replacement, etc.
- 8.7. Ground Fault Circuit Interrupter (GFCI) shall be used for electric power tools that could potentially be used in a wet environment.
- 8.8. Extension cords are not allowed to be used as permanent fixtures.
 - 8.8.1. There is a 90 day limit for the use of an extension cord.
 - 8.8.2. Extension cords shall be inspected prior to use.
 - 8.8.3. Ground Fault Circuit Interrupter (GFCI) shall be used with all extension cords servicing hand tools.

9. Other Requirements

- 9.1. Shop layout and machinery placement shall not interfere with clear access to emergency exits or emergency equipment such as fire extinguishers or electrical disconnects. Machinery shall be positioned so that a clear and safe operating area is maintained for each machine.

- 9.2. Housekeeping
 - 9.2.1. Areas shall be maintained in a clean and orderly manner.
 - 9.2.2. Sawdust, metal chips, and other debris shall be routinely cleaned (e.g., at end of work shift or class) from surfaces such as machinery, bench tops, and floors.
- 9.3. Food and drink are prohibited inside a shop areas and any other area where food and beverages may be contaminated by dust, debris, paint, or chemicals.
- 9.4. Wet surfaces or slippery floors shall be cleaned or addressed immediately.
- 9.5. Materials shall be stored in a manner that prevents objects from falling. Shelves or cabinets shall be used as appropriate to store materials and storage of items shall not exceed the capacity of the shelves or cabinets.

10. Hazard Communication and Chemical Waste Handling / Storage

- 10.1. The purpose of the Hazard Communication Program is to ensure employees are aware of hazardous chemicals in the workplace and are provided information regarding the potential hazards associated with exposure to these chemicals. Chemicals shall be evaluated for hazards; this information shall be provided to employees. The program also covers container labeling, safety data sheets, employee training and emergency procedures. The University of Notre Dame's [Hazard Communication Program \(Safe 02\)](#) is designed to comply with the OSHA Hazard Communication Program or "Employee Right-to-Know" Act. Some elements of the program include:
 - Chemicals shall be properly stored for example, in cabinets approved for that use such as flammable or corrosive cabinets. Review the [Laboratory Flammable/Combustible & Compressed Gas Handling/Storage Procedure \(Safe 03\)](#).
 - Work areas and shops shall maintain a chemical inventory and have a method of providing Safety Data Sheets for each chemical.
 - Personnel shall be trained on the hazards of the chemicals they will be working with prior to their work assignment.
- 10.2. Hazardous waste shall be handled per the requirements of the [Hazardous Waste Procedure \(Env 02\)](#).

10.3. Teaching Shops – Teaching shops shall follow additional instructions as listed in Appendix A.

11. Emergency Response

11.1. Emergency response equipment and procedures that shop users shall receive once are noted below. This training shall be conducted by the Shop Manager or designee and be documented.

- Building evacuation assembly point and the building severe weather shelter area.
- Campus phone in order to report an emergency
- First aid kit location
- Fire extinguisher location
- Emergency eye wash location and function
- Emergency stop button for each piece of equipment being used and other means of disabling power to machinery

11.2. All accidents and injuries shall be reported immediately to the Shop Manager. The Shop Manager shall then adhere to [the University of Notre Dame's Incident Reporting and Investigation Procedure \(Safe 016\)](#).

11.3. Emergency stops not located on equipment shall be clearly labeled with the name of the equipment it stops.

12. Personal Protective Equipment (PPE) and Work Area Attire

12.1. The minimum PPE required for shop areas includes long pants, closed toe shoes, t-shirt equivalent shirt and safety glasses meeting ANSI Z87 requirements. Face shields may be necessary for tasks that produce flying debris or sparks.

12.2. All areas shall have a completed [PPE Hazard Assessment](#). For non-shop areas, units shall adhere to the requirements set forth by the area's PPE Hazard Assessment.

12.3. Personnel shall wear hearing protection when noise exposure exceeds the action level (85 dBA) and shall participate in the [University Hearing Conservation Program \(Occ 02\)](#). Contact RMS for additional guidance or for a noise survey.

12.4. Loose shirt material such as long sleeves or shirrtails shall be tucked in, rolled up, or otherwise secured to prevent contact with moving parts. Other material such as neckties, scarves, hood strings shall not be worn when in machine/shop areas or around moving and rotating machine parts.

- 12.5. Hair below the collar shall be tied back or covered by a hat. Long beards shall also be secured or covered when working around machinery.
- 12.6. Jewelry that can get caught in moving parts shall be removed. This may include rings, bracelets, necklaces, etc.
- 12.7. Gloves shall not be worn near rotating equipment. Gloves may be necessary for material handling tasks that could cause splinters or when conducting welding or grinding operations or when working with hot materials such as when forming glass.

13. Visitors and Contractors

- 13.1. Contractors shall not use University owned equipment with the exception of contracted maintenance trades who maintain trade shops.
- 13.2. Contractors who are performing repairs or servicing University owned equipment may have to operate the equipment for troubleshooting or verifying repairs.
- 13.3. Visitors including visiting faculty are not permitted to utilize machine shop tools or equipment unless special provisions have been made. Contact Risk Management and Safety for support.

14. Training

- 14.1. The Supervisor, Shop Manager or Designee shall complete a [Training Needs Assessment](#). This shall include the personnel operating equipment in the shop.
- 14.2. The Shop Area Manager / Supervisor or Designee shall ensure all personnel utilizing the machine shop are trained prior to granting permission to use the shop machines or tools. General Shop and Machine Guarding training is included in [complyND](#).
- 14.3. The Shop Manager or Designee shall conduct equipment specific training for personnel operating machinery and equipment. The trainee shall complete the General Shop and Machine Guarding Training prior to attending equipment specific training. The training shall be documented and include the date the training occurred and the person conducting the instruction. The training shall include, at a minimum, the following:

- Description and identification of the hazards associated with the particular machinery or equipment.
- Purpose and function of the safeguards, how they provide protection, and the hazards for which they are intended.
- How to use the safeguards and under what circumstances can they be removed and by whom.
- What to do if safeguard is damaged, missing or unable to provide protection.
- Shop specific rules.

14.4. Refresher Training for the General Shop and Machine Guarding Training ([complyND](#)) shall be conducted once every three (3) years.

15. Machine Guarding Safety Assessments

- 15.1. Prior to using a machine or tool, the User or the Shop Manager or Designee shall visually ensure each machine guard, e-stop (if so equipped) and other safety devices are present and functioning properly. If these safety devices are missing or not working, the tool or machine shall be immediately taken out of service and not used until proper repairs have been made.
- 15.2. Machine guarding safety reviews shall be conducted routinely by the Shop Manager or Designee. These are to evaluate machine and equipment safeguarding. Each review should include the following:
- 15.2.1. Confirmation that machine guards and safety devices currently in use are sufficient to protect the operator from hazards.
- 15.2.2. If necessary, the development of an action list identifying safeguarding needs by machine, actions planned to address the needs, a timetable for resolution and person(s) responsible.
- 15.3. RMS shall conduct an annual machine shop assessment of each shop. [Machine Shop Assessment Tool](#) is available on the Risk Management and Safety (RMS) web page.

16. Record Retention

- 16.1. Shop or machine specific training records and safety assessments shall be maintained per the [University Record Management and Archive Policy](#).



16.2. These records may be retained electronically or in hard copy format.

17. References

- 17.1. 29 CFR 1910 Subpart O, "Machinery and Machine Guarding"
- 17.2. 29 CFR 1910 Subpart P, "Hand and Portable Powered Tools and Other Hand-Held Equipment"
- 17.3. University of Notre Dame Lock, Tag and Try – Zero Energy Procedure (Safe 014)
- 17.4. University of Notre Dame Hot Work (Safe 09)
- 17.5. University of Notre Dame Hazard Communication Program (Safe 02)
- 17.6. University of Notre Dame Hearing Conservation Program (Occ 002)
- 17.7. American National Standards Institute applicable standards



REVISION TABLE

History	Effective Date
October 2018	Procedure Revised



APPENDIX A

Teaching Shop Instructions

1. Prior to using any shop machines/equipment, users shall be trained by Shop Manager or Designee.
2. ANSI Approved safety glasses shall be worn at all times in the workshop.
3. Loose clothing and accessories are not permitted; remove all dangling jewelry.
4. Always wear closed-toe shoes; open toe shoes, sandals and or slippers are prohibited.
5. Long hair shall be tied back or otherwise restrained.
6. Working alone is NOT permitted in the workshop.
7. Identify the location of the emergency stop buttons on the machines.
8. Do not leave running machinery unattended.
9. Do not remove or alter machine guards.
10. Keep hands away from moving/rotating machinery. Use hand tools carefully, keeping both hands behind the cutting edge.
11. Eating and drinking are not permitted in the workshop.
12. Keep work areas as tidy as possible and clean-up after yourself.
13. Know where the first aid kit and fire extinguisher are located.
14. Immediately report any injury to the Shop Manager.
15. Immediately report any damage to machines or equipment to Shop Manager.