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**NORTHERN COLORADO**

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**Environmental Health and Safety**

## **Machine Shop Program**

May 2019



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**Environmental Health and Safety**

**Machine Shop Program**  
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## Environmental Health and Safety

### Machine Shop Program

#### I. Purpose

The purpose of this program is to outline the operation, maintenance, training, and safety for the University of Northern Colorado (UNC) machine shops and their associated equipment. This program is intended to establish guidelines for safety within the machine shops and applies to some related tasks performed outside of the machine shops as well.

This program has been developed in compliance with the following regulations and standards:

- 29 CFR 1910 Subpart I, “Personal Protective Equipment”
- 29 CFR 1910 Subpart O, “Machinery and Machine Guarding”
- 29 CFR 1910 Subpart P, “Hand and Portable Powered Tools and Other Hand-Held Equipment”

#### II. Scope and Application

This program outlines the safe use of all University machine shops and includes guidelines for basic safety, maintenance, training, and emergency response procedures to minimize risks within the machine shops. This program applies to rooms that either use or store machine shop equipment that are utilized by faculty, staff, employees and students of UNC.

#### III. Responsibilities

In order for this program to be effective, individuals working within UNC machine shops in any capacity shall understand and take an active role in meeting these responsibilities.

A. Environmental Health and Safety (EHS) Department:

- Provide program oversight and assist personnel in implementing this program
- Periodically conduct audits of the machine shops
- Investigate injuries and incidents involving shop equipment
- Update this program

B. Supervisors (Machine Shop):

- Read the contents of this program and understand how it relates to their roles and responsibilities
- Ensure that the requirements within this plan are implemented and practiced in the machine shop
- Maintain records in accordance with this document

C. Machine Shop User (Employees and Students):

- Comply with the contents of this program, including the use of personal protective equipment (PPE) and machine guarding
- Complete trainings for this program
- Report any injuries, incidents, and concerns related to shop equipment or shop safety issues to a supervisor/faculty member immediately

#### IV. Definitions

The following terms used in this program are defined to allow for a better understanding and application:

- Employee: Works for UNC in a faculty, staff, or other waged payroll capacity
- Graduate Teaching Assistant (GTA) or Teaching Assistant (TA): A student (graduate or undergraduate) who works for UNC and is compensated
- Machine Shop: Any workshop or workspace where materials are cut, shaped or otherwise manipulated using hand and/or power tools and equipment.
- Equipment: All fixed machinery and portable hand/power tools that are typically used in a shop environment.
- Monitor: An individual who has been designated to observe others working in a machine shop to ensure a safe work environment is maintained
- Student: An individual enrolled at UNC
- Supervisor: A UNC employee who oversees a machine shop. This individual has full authority regarding equipment use.

- Visitor: Any individual who is not an employee, faculty, or student. Visitors are prohibited from using machine shop equipment.

## V. Training

The shop supervisor is responsible for conducting the following training for all individuals who utilize student and employee shops.

- General Shop Information (Appendix A)
  - Provides basic information to those using the shop. It must be reviewed by all shop users and be easily accessible in the shop.
- General Shop Safety (Appendix B)
  - Must be conducted for each employee or student using the shop and in every shop in which the individual utilizes.
- Equipment Specific Training (If necessary)
  - This training will be conducted at the supervisor's discretion for more complex or hazardous equipment.

First aid training is highly recommended for shop monitors and supervisors.

Refresher training will be provided to employees and students under the following circumstances:

- Changes in the workplace render previous training obsolete
- Changes in the type of shop equipment or PPE used render previous training obsolete
- An individual has been observed operating equipment in an unsafe manner
- An individual has been involved in an accident or near miss

## VI. Machine Shop Safety Guidelines

- **Housekeeping:**
  - Floors, equipment, and other surfaces must be kept free of dirt, wood, metal chips, sawdust, oil, grease, and other debris
  - Surfaces that become wet or slippery during work activities will be protected with a non-slip coating or covering
  - Cease operation of a machine before cleaning or performing maintenance
  - Use a brush to remove chips and a cloth to clean oily surfaces
  - Return stock and unused material to a storage rack after cutting
  - Never use compressed air to clean off skin or clothing
  - Materials shall be stored in such a manner to prevent falling, slipping, or rolling

- **Egress**
  - Materials shall not be stored on the floor or in any area in which it will impede egress from the area
  - All exits shall be properly identified with signage
  - Equipment will be positioned in such a way that allows for a clear and safe operating space for each machine
  
- **Procedures**
  - Emergency contact numbers and other means for summoning help will be readily available
  - Safety glasses shall always be worn when equipment is in operation, some tasks and equipment may require additional PPE.
  - Loose clothing should not be worn when operating equipment. Open toed shoes or shorts are prohibited. Legs should always be covered.
  - Jewelry that may impede or cause a hazard during operation of a machine must not be worn. Long hair must be tied back to keep it away from equipment in operation.
  - Sufficient ventilation should be provided for welding and cutting areas. Refer to other UNC procedures for hot work processes.
  - Shop areas should maintain adequate lighting to perform the tasks in a safe manner.
  - Only those who have received training consistent with this program will access shop areas.

## **VII. Inspections and Maintenance**

Machinery and equipment should be inspected and maintained according to the manufacturer's recommendations. This information and other safety-related guidelines are located in the operator's manual. If a manual is not available, one will be made available by contacting the manufacturer or using an online source. Inspections should be performed as follows:

- Supervisor Inspections (Quarterly):
  - The shop supervisor may complete an inspection of each shop in quarterly intervals.
  - Remove equipment from service that is unsafe or not operating in conformance with the manufacturer's guidelines.
  - See the Machine Shop Inspection Checklist (Appendix C)
  
- User Inspections (Pre-Use):
  - Visually inspect all machinery and equipment before use to ensure that they are in a safe and operational condition.

- Any damaged or defective equipment must be reported to the shop supervisor immediately.

## **VIII. Monitoring**

Monitoring of machine shop activities should be performed in order to reduce the risk of injury to individuals using the equipment. Monitors must be capable of identifying existing and foreseeable hazards within the machine shop and have the authority to take immediate action to eliminate them.

Shop supervisors may act as monitors and carry out the roles and responsibilities associated with the position. Other faculty, staff, teaching assistants, and graduate teaching assistants may act as shop monitors if previous education, training, or professional experience demonstrates their competency to do so. Undergraduate students may not serve as monitors unless specific approval is obtained from the department.

UNC employees may operate equipment without a monitor present.

## **IX. Machine Guarding**

Each piece of equipment must be outfitted with the proper guards and shields as per manufacturer's requirements. Proper guarding is necessary to help prevent injuries and ensure the safe operation of all equipment.

Guards must not pose any additional hazards to the user; at no time should a guard be removed or changed in any way.

See the "Machine Guarding Reference Guide" (Appendix D) for basic guidelines on guarding common shop equipment. For any questions on proper guarding for a piece of equipment, contact the supervisor.

## **X. Recordkeeping**

Each supervisor will maintain the following records of their respective shop(s) for each individual student or employee as long as they are affiliated with UNC:

- General shop safety training
- Any equipment specific training

Supervisors will complete and maintain inspection records for a period of seven years.

(Appendix A)  
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**General Shop Information**

**Shop Personnel:**

1. The shop supervisor is: \_\_\_\_\_
2. Supervisor Contact Information: \_\_\_\_\_

**Emergencies:**

1. Dial 911
2. Location of the shop telephone (if available): \_\_\_\_\_

**Injuries:**

In the event of an injury, ask the shop supervisor for assistance in completing an incident report.

In case of life-threatening emergencies (amputation, head injury, uncontrolled bleeding, large cuts) **dial 911**.

**Non-Life threatening**

- Students: Notify the shop supervisor (instructor) immediately.
- Employees: Notify your supervisor immediately.

**Location of Emergency Equipment (If not in shop, please write "None"):**

- Fire Extinguishers:
- First Aid Kit:
- Emergency Shutoff:
- Emergency Eyewash / Shower:

(Appendix B)  
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**General Shop Safety Training**

These guidelines must be reviewed by all individuals who utilize any UNC shop

- All machines and equipment shall be operated with the required guards and shields in place as per the manufacturer's requirements.
- Safety glasses must be worn at all times. Additional PPE may be required by the shop supervisor or equipment being used. Wear the required PPE when necessary.
- Closed-toed shoes must be worn at all times. All clothing and jewelry should be worn in such a way to avoid entanglement or obstruction of a machines normal function.
- Neck ties, jewelry, loose clothing, and gloves are prohibited around moving machinery. Hair should be tied back to keep it away from equipment in operation.
- Perform a brief inspection of a piece of equipment before using it to ensure it is in working condition and free from noticeable hazards.
- Machines must be turned off when cleaning or performing maintenance.
- Machines shall be serviced by shop supervisors or other faculty/employees.
- Do not use compressed air to clean clothing or aim at another person.
- Food and drink should not be kept in working areas, it is only allowed in designated areas within the shops.
- Horseplay within the shops is forbidden.
- Keep your fingers and other body parts away from the point of operation. Always use devices to manipulate materials that are at the point of operation.
- Keep floors and aisles clear of materials and equipment at all times.
- Do not attempt to remove foreign objects from the body or eye. Seek immediate medical attention. If chemicals are splashed into the eyes, utilize the eyewash system for 15 minutes while seeking medical attention.
- In case of injury, no matter how minor, you must report it to the shop supervisor immediately.
- Additional requirements may be added if necessary at the discretion of the supervisor.
- **If you are unsure about any of the above guidelines, the operation of a piece of equipment, or have any other safety concerns, do not hesitate to ask your supervisor for assistance.**

<u>Name of Trainee (Print):</u>	<u>Signature of Trainee:</u>	<u>Date:</u>
<u>Name of Supervisor (Print):</u>	<u>Signature of Supervisor:</u>	<u>Date:</u>

(Appendix C)  
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**Machine Shop Inspection Checklist**

Date:		Inspection (Name):			
Building/Room:		Department:			
			Yes	No	N/A
<b>A. Housekeeping</b>					
1. Shop is maintained in a clean and orderly manner					
2. Shop is free from slip/trip/fall hazards					
3. All walkways and exits are free from obstruction					
<b>B. Chemical Safety</b>					
1. Chemical containers and cylinders are clearly labeled					
2. Chemical containers are in good condition					
3. Chemical containers are properly stored and separated					
<b>C. Personal Protective Equipment</b>					
1. PPE is available and used where necessary					
2. Eye protection					
3. Hand protection					
4. Hearing protection					
5. Foot protection					
6. Respiratory protection					
7. Eyewash/shower stations are labeled, accessible and regularly tested					
<b>D. Fire Protection</b>					
1. Exits are clearly marked					
2. Fire extinguishers are labeled and accessible					
3. Fire extinguishers are properly mounted					
4. Fire extinguishers serviced in the last 12 months					
5. All emergency pull stations are easily accessible					
6. Fire sprinklers have at least 18 inches of clearance					
7. Oily rags and combustible wastes are stored properly					
8. Flammable liquids are properly stored					
<b>E. Electrical Safety</b>					
1. Equipment is free from frayed or exposed wiring					
2. At least 3 feet of clearance in front of electrical panels					
3. All electrical openings are covered					
4. All switches and outlets equipped with tight fitting covers					
5. All extension cords are equipped with grounding connectors					
6. Portable tool wires are grounded or double-insulated					

	Yes	No	N/A
<b>F. Equipment/Machinery</b>			
1. All equipment, machinery, and tools have the proper guarding in place as per manufacturers requirements			
2. Machine guarding is in proper working order			
3. Emergency stop mechanisms are adequately identified and working			
4. Equipment controls are clearly labeled			
5. Warning stickers are legible			
6. Equipment is arranged to prevent unsafe access during operation			
7. Compressed air used for cleaning is at less than 30 psi			
8. Equipment is capable of being locked out for service			
9. All hands tools are in proper working condition			
<b>G. Material Storage and Handling</b>			
1. Materials are stored in a safe manner			
2. Compressed gas cylinders are properly secured			
3. Cylinders not in use are stored with protective caps			
4. Means for lifting heavy materials are present			
5. Protection from falling stored materials is in place			
<b>H. Occupational Health</b>			
1. Adequate ventilation exists for the work being conducted			
2. Exhaust ducts are in good condition			
3. Noise levels are maintained at a safe level			
4. Lighting is adequate for safe operation			
5. First aid supplies are maintained and stocked			
<b>I. Hazardous Waste</b>			
1. Waste materials are placed in appropriate containers			
2. Waste is removed routinely			
3. Waste containers are correctly labeled			
4. Spill cleanup supplies are available			

Name of Inspector (Print):	Signature of Inspector:	Date:

Note any other inspection items:

(Appendix D)

**Machine Guarding Reference Guide**

- The following are general guidelines regarding machine guarding. In many cases there is more than one way to achieve proper machine guarding.
- This is not intended to be an all-inclusive list of shop equipment.
- Consult with EHS and/or the equipment manufacturer for additional machine guarding information.

**Guarding Requirements for All Shop Equipment**

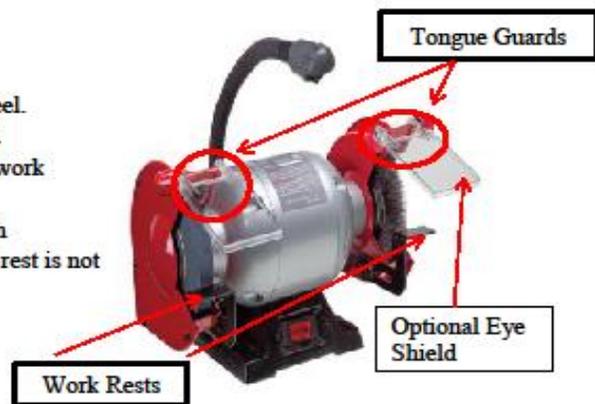
The following points must be adequately guarded on all types of shop equipment:

- Point of operation:
  - Area where the machine performs work. (An example would be where a saw blade meets the material being cut).
- Power transmission devices:
  - Elements of the mechanical system that transmits energy. (Examples would include flywheels, belt, chains and pulleys).
- Other moving parts:
  - Other parts of the machine that move when the machine is in cycle.



**Bench Grinder**

- Guarding Requirements
  - Adjustable tongue guard 1/4" from wheel.
  - Adjustable work rest 1/8" from wheel.
  - Bench grinder needs to be secured to work surface.
  - The required guarding for a wire brush attachment is a tongue guard. (A tool rest is not recommended in this situation).



- Safe Work Practices

- Grinding wheel must be dressed to prevent a ridge from forming.
- Perform a ring test before mounting an abrasive wheel.
  - The abrasive wheel must not be used if a dull sound is noted.
- If the grinding wheel is cracked, do not use it because it could shatter.



Grinder Dresser Tool

### Band Saw

- Guarding Requirements
  - Adjustable guard. Set the guard as close as possible to the stock.



Blade guard

### Milling Machine

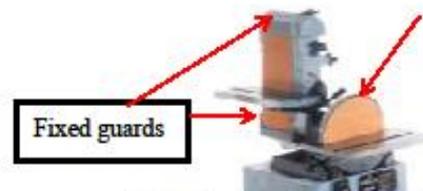
- Guarding Requirements
  - Point of operation guard.



Point of operation guard

### Belt/Disc Sander

- Guarding Requirements
  - Fixed guards at pinch and nip points.



Fixed guards



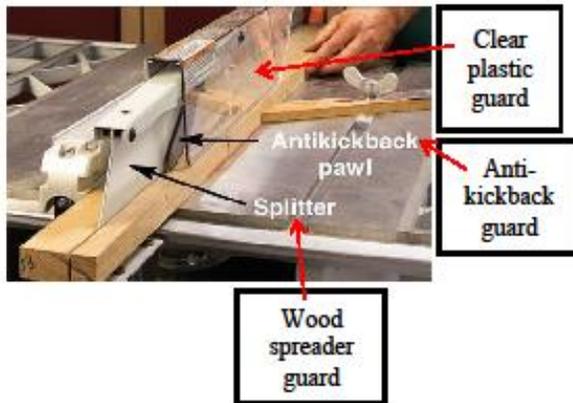
### Angle Grinders

- Guarding requirements
  - A fixed guard must be on the grinding wheel enclosing one-half or 180° of the grinding wheel.



### Table Saw

- Guarding Requirements
  - There are three guards needed on a table saw: a wood spreading guard, anti-kickback guard and a self-adjusting guard over the blade.
- Safe Work Practices
  - A push stick must be used when the stock being cut is small.
  - The top of the teeth of the table saw blade shall not extend ¼" above the material being cut.



### Saw Stop – Table Saw

- Guarding Requirements
  - The guarding requirements for a "Saw Stop" table saw are the same as those for a standard table saw.

Saw Stop Table Saw



## Radial Arm Saw

- Guarding Requirements
  - A self-adjusting guard below the blade
- Safe Work Practices
  - The radial arm saw must be returned to the original position after a cut is finished.
  - Saw should only be used for cross cutting. A table saw is a better tool for ripping.

Self-adjusting guard



## Jointer (manual)

- Guarding Requirements
  - Self-adjusting blade guard.
- Safe Work Practices
  - If the wood stock is small, use a push stick to feed the stock.

Self-adjusting blade guard



## Planer/Moulder (Automatic)

- Guarding Requirements
  - Cutter heads must be completely enclosed, except for the opening needed to feed the stock into the tool.

Completely enclosed



## Circular Saw

- Guarding Requirements
  - Self-adjusting blade guard.
- Safe Work Practices
  - If the saw cut is stopped before the cut is finished, the saw must be turned off before being removed. If the saw is pulled out before stopping, kickback could occur.

Self-adjusting blade guard



## Routers

- Guarding Requirements
  - Self-adjusting guard above cutting bit on bench version. Fixed guard on hand held version.



## Welding and Brazing

- PPE
  - Fire resistance clothing
    - Coat
    - Pants
  - Welding helmet or tinted face shield
    - Tinted number depends on what type of welding or torch being used.
    - If face shield is used, safety glasses are required.
  - Leather gloves
    - Heat resistant
  - Respiratory Protection (site specific)
- Safe Work Practices
  - Oxygen and acetylene cylinders must be secured to a cart by using chain or webbing strap.
  - If a cylinder does not have a regulator attached, it must be capped.
  - Inspect work area for any combustibles. (Follow PSU Hot Work Permit Program)

Oxygen Acetylene Torch



Stick Welding

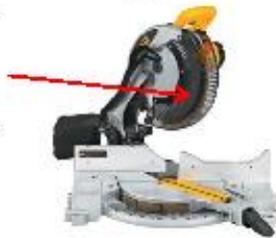
### Chop/Miter saws

- Guarding Requirements
  - Both saws must have self-adjusting blade guards.
- Safe Work Practices
  - Only use the recommended blade based on size and revolutions per minute (RPM).

Chop Saw – self adjusting guard



Miter Saw – Self adjusting guard



### Reciprocating Saw

- Guarding Requirements
  - Must be equipped with hand/finger guard.



Hand/finger guard

### Jig Saw

- Guarding Requirements
  - Upper portion of the blade, above the tool rest, must be guarded.

Blade guard



### Scroll Saw

- Guarding Requirements
  - Blade guard



Blade guard

## Power Press Brake

- Guarding Requirements

- Note: There are many different methods which can be used to effectively guard this equipment. They are listed below. The best means of guarding will depend on how the press brake is used.
  - Moveable barrier guards
  - Fixed guards
  - Presence-sensing devices
  - Pull back devices
  - Restraint devices
  - Two-hand trip devices

This press is equipped with a properly designed two-hand control



## Power Shear

- Guarding Requirements

- Adjustable guard

Adjustable guard



## Power Press (Mechanical and Hydraulic) (Part Revolution and Full Revolution)

- Guarding Requirements

- Note: Depending on the size and type of power press a variety of guarding methods are available. The following are examples of such methods. Contact EHS or the equipment manufacturer for consultation.
  - Point of operation guard
  - Pull back device
  - Restraint device
  - Gate type guards (A and B types)
  - Two-hand trip
  - Two-hand control
  - Presence-sensing device

Mechanical Power Press



Hydraulic Power Press



### Drill Press

- Guarding Requirements
  - Chuck guard
- Safe Work Practices
  - Small material being cut shall be clamped to prevent any spinning.
  - The drill press machine must be secured so it will not “walk”.



### Milling Machine

- Guarding Requirements
  - ♦ Adjustable or permanent chip/coolant shield
- Safe Work Practices
  - ♦ Tie back hair and no loose clothing so it doesn't get caught on the spinning chuck.
  - ♦ Do not allow large quantities of chips to accumulate around the work piece or machine table.



### Compressed Air Tools

- Guarding requirements
  - Safety tips must be installed to relieve air pressure in the event the nozzle is “dead-ended”.
  - Air pressure must be less than 30 PSI when using compressed air for cleaning.
- Safe Work Practices
  - Compressed air tools shall never be used to remove dirt from clothing or skin.

