

CHAPTER 11 - MACHINERY, MACHINE GUARDING, AND HAND AND PORTABLE POWERED TOOLS

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CHAPTER 11 - MACHINERY, MACHINE GUARDING, AND HAND AND PORTABLE POWERED TOOLS

A. INTRODUCTION

1. This Chapter applies to Smithsonian Institution (SI) employees engaged in the use of machinery, powered hand tools, and manual hand tools. This Chapter also provides SI employees requirements for the safe handling and use of:
 - a. Machinery (also known as Industrial equipment)
 - b. Power tools
 - (1) Electric tools;
 - (2) Pneumatic tools;
 - (3) Liquid fuel tools;
 - (4) Powder-actuated tools; and
 - (5) Hydraulic power tools.
 - c. Hand tools
2. Some industrial equipment examples include abrasive wheel equipment (bench) grinder, drill presses, lathes, mills, vertical and horizontal band saws, table saws, radial arm saws, planers, and joiners.
3. Industrial equipment and powered hand tools shall be used in accordance with the [Occupational Safety and Health Administration \(OSHA\) 29 Code of Federal Regulations \(CFR\) 1910 Subpart P](#); the National Electric Code (NEC), published by the National Fire Protection Association (NFPA); and the applicable American National Standards Institute (ANSI standard(s)). The references at the end of this Chapter contain detailed powered industrial equipment and powered hand tool safety information.
4. This Chapter does **not** cover material handling equipment. Material handling equipment (e.g., forklifts, hoists, hydraulic lift truck, hand truck, powered industrial trucks, etc.) safety procedures are located in [Chapter 13, "Materials Handling and Equipment"](#), of this *Manual*.
5. This Chapter does not include all safety and health precautions, requirements, and hazard possibilities for all industrial equipment, power tools, and hand tools in SI's inventory.

B. CHAPTER-SPECIFIC ROLES AND RESPONSIBILITIES

1. Supervisors shall

- a. Accomplish employee's initial and refresher training. ([See Section C.6. of this document for additional information.](#))
- b. Monitor work procedures to ensure employees are performing their duties in a safe manner.
- c. Ensure industrial equipment, powered hand tools, and manual hand tools are used only for their intended purpose.
- d. Ensure that the industrial equipment and tools used by employees (whether SI owned or employee owned) are in safe working condition.
- e. Ensure unsafe industrial equipment and tools are taken out of service. See [Chapter 9, "General Workplace Safety"](#), of this *Manual*.

2. Employees shall

- a. Be attentive and focused while operating powered equipment / machines / tools.
- b. Inspect the work station or job site for potential hazards and ensure that all equipment, machines and tools are in a safe operating condition before use. Employees shall not use unsafe or damaged tools. See [Chapter 9, "General Workplace Safety"](#), of this *Manual*.
- c. Attend job-specific safety training to become knowledgeable about the hazards associated with equipment and tools used to perform work.
- d. Use the specified PPE required for the hazards for the task and/or work area.
- e. Maintain the engineering controls (guards, shut-off switches, anchoring devices, etc.). Employees are prohibited from removing or disabling any of these safety devices without first getting permission from their supervisor.
- f. Not wear loose fitting clothing, jewelry, or other apparel that may become entangled in moving machinery.
- g. Not Operate powered industrial equipment or powered hand tools unless trained, qualified, and authorized.
- h. Only use powered equipment / machines / tools for the intended purpose in accordance with the manufacturer's instructions.

C. COMPONENTS

1. Hazard Identification

- a. **Industrial Equipment.** Hazards associated with industrial equipment may include, but not limited to, electrical components, pneumatic components, hydraulic components, points of operation, power transmissions, and auxiliary equipment.
- b. **Power Tools.** Improper use and/or maintenance of power tools may result in injuries such as lacerations, serious cuts, crushing injuries, or electric shock. Employees may also be struck by flying debris/chips/sparks, or caught in nip points or rotating parts.
 - (1) Electric Tools. The most serious hazards from an improper electric tool can range from electrical burns to shocks to heart failure. An electric shock can also cause other consequences such as causing the user to fall off a ladder or other elevated work surface.
 - (2) Pneumatic Tools. Pneumatic tools are powered by compressed air and include chippers, drills, hammers, and sanders. The biggest hazard associated with the use of pneumatic tools is the danger of getting hit by one of the tool's attachments or by some kind of fastener the worker is using with the tool. Noise is another hazard associated with pneumatic tools.
 - (3) Liquid Fuel Tools. Fuel-powered tools are usually operated with gasoline. The most serious hazard associated with the use of fuel-powered tools comes from fuel vapors that can burn or explode and also give off dangerous exhaust fumes.
 - (4) Powder-Actuated Tools. Powder-actuated tools operate like a loaded gun and must be treated with extreme caution. These tools are highly hazardous and so they must be operated only by specially trained employees.
 - (5) Hydraulic Power Tools. The hazards associated with hydraulic equipment include exposure to pressurized hydraulic fluid in the event of a hose, valve, pips, filter, or other fitting failure.
- c. **Hand Tools.** Hand tools are tools that are powered manually. Hand tools include anything from axes to razor blade knives to wrenches. The greatest hazards posed by hand tools result from misuse, lack of pre-use inspections, and improper maintenance (e.g., If a chisel is used as a screwdriver, the tip of the chisel may break and fly off; If impact tools such as chisels, wedges, or drift pins have mushroomed heads, the heads might shatter on impact). The most common hand tool accidents are caused by the following:
 - (1) Failure to use the right tool.
 - (2) Failure to use a tool correctly.

- (3) Failure to keep edged tools sharp.
- (4) Failure to replace or repair a defective tool.
- (5) Failure to store tools safely.

IMPORTANT: Use the right tool to complete a job safely, quickly, and efficiently.

2. Hazard Control

a. General Requirements

- (1) Hot work protocols shall be implemented for those tools that produce heat such as sparks (e.g., grinders). Refer to [Chapter 14, "Hot Work Management and Permit System"](#), of this *Manual*.
- (2) Machine noise shall be reduced to the lowest possible achievable level through engineering, administrative, and work practice controls. When sound pressure levels at the operator's position cannot be controlled below 85 decibels (dBA) time weighted average (TWA), refer to [Chapter 41, "Occupational Noise"](#), of this *Manual*, for additional information.
- (3) Local Exhaust Ventilation. Industrial machines that develop dust and fumes shall be equipped with effective exhaust hoods that are connected to an effective exhaust system. Refer to [Chapter 27, "Ventilation for Health-Hazard Control"](#), of this *Manual*, for additional information.
- (4) Lock-out Procedures. Lock-out procedures shall be strictly enforced where accidental operation of a machine or device during maintenance, repairs, or adjustments could cause injury. Failure to properly lock-out machinery or equipment may result in serious injury. Refer to [Chapter 12, "Lock-out/Tag-out Program"](#), of this *Manual*, for additional information.
- (5) Out of Service Procedures. Out of service procedures shall be used in circumstances such as when equipment and/or a tool are unsafe or when the equipment or tool is not needed. Refer to See [Chapter 9, "General Workplace Safety"](#), of this *Manual*.
- (6) Chuck Keys. Chuck keys used on lathes must be spring-loaded so that they (chuck keys) self-eject from the chuck when pressure is released. When feasible, the use of spring-loaded chuck keys is highly encouraged on other types of equipment.
- (7) Chuck Shield. Lathes are required to have a hinged chuck shield.
- (8) Razor Blade Knives. Supervisors should identify tasks that require the use of razor blade knives. These identified tasks should be evaluated for the possible use of safety cutters (i.e. finger safe blades, automatic retractable blades, etc.).

"Used razor blades" shall be placed in a dedicated, labeled container located for ease of use by SI personnel. Used razor blades shall **not** be put into waste baskets.

b. Power Controls

- (1) Industrial equipment shall be equipped with an individual disconnect switch that can only be locked in the "off" position.
- (2) Install anti-restart (magnetic) devices on industrial equipment where injury to employees might result if motors were to restart after a power failure.

c. Machine Guards. Many accidents are caused by machinery that are improperly guarded or not guarded at all. An important factor that must be kept in mind relative to machinery guarding is that no mechanical motion that threatens a SI employee's safety should be left without a safeguard.

- (1) When a point-of-operation guard cannot be used because of unusual shapes or cuts, jigs or fixtures that provide equal safety for the operator will be used. Upon completion of the unusual operation, the guard will be immediately replaced. Lock-out/Tag-out is required to remove the guard and to re-install the guard after the unusual shape or cut is accomplished.
- (2) Whenever a guard is removed for other than an operational requirement, the machine will be shut down and the power control(s) locked and tagged in the "Off" position. See [Chapter 12, "Lock-out/Tag-out Program"](#), of this *Manual*, for additional information.

d. Maintenance

- (1) Supervisors shall be responsible for assigning competent personnel to perform preventative maintenance, adjustments, and repairs of industrial equipment. The competent person(s) shall follow the manufacturer's recommendations (i.e. operation and/or maintenance manuals), if available, which establish guidelines for use and care of machines. If the manufacturer's recommendations (i.e. operation and/or maintenance manuals) are not available, the supervisor and competent person should develop guidelines by using best engineering practices.
- (2) Maintenance Area. The area around the machine shall be kept clear of all personnel not directly involved in the maintenance operation.
- (3) See Section "E" below for "Records and Reports" requirements.

3. Specific Tool Requirements

a. Industrial Equipment

(1) Abrasive Wheel Machinery (i.e. Bench Grinder)

- (a) Operate and inspect the abrasive wheel machinery in accordance with the manufacturer's instructions.
- (b) An abrasive wheel may disintegrate or explode during start-up. Allow the tool to come up to operating speed prior to grinding/cutting.
- (c) Do not stand in the plane of rotation of the wheel as it accelerates to full operating speed.
- (d) Use the pedestal/bench abrasive wheel equipment grinder checklist located on [the OSHA web site](#).

b. Power Tools

(1) Electric Tools

- (a) Operate and inspect the electric tool in accordance with the manufacturer's instructions.
- (b) To protect the user from shock and burns, electric tools must have a three-wire cord with a ground and be plugged into a grounded receptacle; be double insulated; or be powered by a low-voltage isolation transformer. Double-insulated tools must be labeled.
- (c) Do not use electric tools in damp or wet locations unless they are approved for that purpose.
- (d) Workplace floors shall be kept as clean and dry as possible to prevent accidental slips.
- (e) Manufacturer's safety devices (i.e. guards and safety switches) shall remain in place when the electric tool is in use.
- (f) To prevent hazards associated with the use of power tools, SI employees should observe the following general precautions:
 - i. Never carry a tool by the cord or hose.
 - ii. Never yank the cord or the hose to disconnect it from the receptacle.
 - iii. Keep cords and hoses away from heat, oil, and sharp edges.
 - iv. Disconnect tools when not using them, before servicing and cleaning them, and when changing accessories such as blades, bits, and cutters. See [Chapter 12, "Lock-out/Tag-out Program"](#), of this *Manual*, for "cord and plug" procedures.

- v. Keep all people not involved with the work at a safe distance from the work area.
- vi. Secure the work with clamps or a vise, when feasible, to free both hands to operate the tool.
- vii. Do not hold fingers on the switch button while carrying a plugged-in tool to avoid accidental starting.
- viii. Maintain tools with care; keep them sharp and clean for best performance.
- ix. Be sure to keep good footing and maintain proper balance when operating power tools.

(2) Pneumatic Tools

- (a) Operate and inspect the pneumatic tools in accordance with the manufacturer's instructions.
- (b) Pneumatic tools shall be inspected to ensure the tools are fastened securely to the air hose. A short wire or positive locking device attaching the air hose to the tool shall also be used as an added safeguard.
- (c) If an air hose is more than 1/2-inch in diameter, a safety excess flow valve shall be installed at the source of the air supply to reduce pressure in the event of hose failure.
- (d) When using pneumatic tools, a safety clip or retainer shall be installed to prevent attachments such as chisels on a chipping hammer from being ejected during tool operation.
- (e) Pneumatic tools that shoot nails, rivets, staples, or similar fasteners and operate at pressures more than 100 pounds per square inch (6,890 kPa), shall be equipped with a special device to keep fasteners from being ejected, unless the muzzle is pressed against the work surface.
- (f) Airless spray guns that atomize paints and fluids at pressures of 1,000 pounds or more psi (6,890 kPa) shall be equipped with automatic or visible manual safety devices that will prevent pulling the trigger until the safety device is manually released.
- (g) Eye protection is required, and head and face protection is recommended for employees working with pneumatic tools.
- (h) Screens shall be set up to protect nearby workers from being struck by flying fragments around chippers, riveting guns, staplers, or air drills.
- (i) Working with noisy tools such as jackhammers requires proper, effective use of hearing protection. See [Chapter 41](#).

[Occupational Noise](#)", of this *Manual*.

(3) Liquid Fuel Tools

- (a) SI employees shall handle, transport, and store gas or fuel only in approved flammable liquid containers, according to the procedures for flammable liquids. Refer to [Chapter 36, "Fire Protection"](#), of this *Manual* for additional flammable liquid handling, transport, and storage information.
- (b) Before refilling a fuel-powered tool tank, the user shall shut down the engine and allow it to cool to prevent accidental ignition of hazardous vapors.
- (c) Never re-fuel tools inside a building or a closed area.
- (d) Fire extinguishers rated 2A:40BC shall be available in the fuel refilling area.

(4) Powder-Actuated Tools

- (a) Only individuals who have been trained may operate, repair, service, and handle powder actuated tools.
- (b) Operate and inspect the powder-actuated tools in accordance with the manufacturer's instructions.
- (c) Do not use a tool in an explosive or flammable atmosphere.
- (d) See [29 CFR 1910.243 for General Industry](#) and [29 CFR 1926.302](#) for additional information.

(5) Hydraulic power tools

- (a) Operate and inspect the powder-actuated tools in accordance with the manufacturer's instructions.
- (b) The manufacturer's recommended safe operating pressure for hoses, valves, pipes, filters, and other fittings must not be exceeded.

c. Hand Tools

- (1) Supervisors shall not issue or permit the use of unsafe hand tools.
- (2) Employees shall be trained in the proper use and handling of tools.
- (3) When using saw blades, knives, or other tools, direct the tools away from aisle areas and other employees working in close proximity.
- (4) Knives and scissors must be sharp.
- (5) Cracked saw blades must be removed from service.

- (6) Wrenches shall not be used when jaws are sprung to the point that slippage occurs.
- (7) Impact tools such as drift pins, wedges, and chisels shall be kept free of mushroomed heads.
- (8) The wooden handles of tools shall not be splintered.
- (9) Iron or steel hand tools may produce sparks that can be an ignition source around flammable substances. Where this hazard exists, spark-resistant tools made of non-ferrous materials shall be used where flammable gases, highly volatile liquids, and other explosive substances are stored or used.

4. Employee Exposure Monitoring.

Exposure monitoring for elevated noise levels is required for operating certain tools. Tools that have not been checked, or are suspected to exceed 85 db TWA sound pressure levels require exposure monitoring and other controls as described in [Chapter 41, "Occupational Noise"](#), of this *Manual*.

5. Personal Protective Equipment (PPE)

- a. Protective equipment shall be used that is required by the task being performed and in accordance with requirements indicated in each Job Hazard Analysis (JHA).
- b. Wear proper work clothing for the task. Do not wear loose fitting clothing, jewelry, or other apparel that may become entangled in moving machinery. Loose, long hair, ties, and dangling hood and pants strings may become caught in moving parts.
- c. Additional information can be found in [Chapter 17, "Personal Protective Equipment"](#), of this *Manual*.

6. Training – Industrial Equipment, Power Tools, and Hand Tools

- a. Supervisors shall provide and document initial and refresher training.
- b. All employees whose work assignments are or may be in an area where industrial equipment or tools could present a hazard to other than the user, will be instructed to an awareness level commensurate with the hazard(s).
- c. All employees shall receive job-specific safety training prior to operating any industrial equipment, power tool, or hand tool.
- d. Supervisors shall provide adequate supervision to reinforce safe practices. Supervisors shall provide documented refresher training to employees whose work performance is not accordance with established procedures.
- e. Refresher safety training will be provided at least every three (3)

years.

- f. Supervisors shall train and document employee training upon the introduction of new machinery and/or new procedures.
- g. Training should include the following topics such as:
 - (1) All hazards in the work area, including machine-specific hazards;
 - (2) Machine operating procedures, lock-out/tag-out procedures, out of service procedures, and safe work practices;
 - (3) The purpose and proper use of machine safeguards; and
 - (4) All procedures for responding to safeguarding problems such as immediately reporting unsafe conditions such as missing or damaged guards and violations of safe operating practices to supervisors.

D. REQUIRED INSPECTIONS AND ASSESSMENTS

1. Inspection General Requirements

- a. Visual inspections
 - (1) “First use” of equipment and/or tool on each shift by an operator.
 - (2) “First use” after a tool/machine has been serviced or repaired.
- b. Supervisors shall document each machine’s preventative maintenance inspection schedule based on:
 - (1) The manufacturer’s recommendations;
 - (2) Best engineering practices (if manufacturer’s recommendations are not known or available);
 - (3) The amount of use (e.g., tools/machines used daily require more frequent inspections);
 - (4) The type of environment (e.g., tools/machines used in dusty conditions or under temperature extremes require more frequent inspections);
 - (5) The hazard of the tool/machine (e.g., powder-actuated tools, chain saws, etc., require more frequent inspections);
 - (6) If a tool/machine has been subjected to an abnormal load or shock, it shall be inspected prior to use; and
- c. Supervisors shall be responsible for assigning competent personnel to perform preventative maintenance inspections. (See C.2.d. above for additional information.)

2. **Assessments General Requirements**

- a. Supervisor shall be required to verify safety procedures and practices are being followed, including (but not limited to):
 - (1) PPE is available and worn;
 - (2) Guards are being used; and
 - (3) Safe work practices as outlined in the JHA are being followed.

E. RECORDS AND REPORTS

1. **Inspection and Maintenance Records and Reports** shall be:
 - a. Maintained for all industrial equipment for a minimum of five (5) years.
 - b. Logged and stored with the equipment, or in the office of the supervisor responsible for the equipment.
 - c. Available for review at any time, and at a minimum identify:
 - (1) Equipment (equipment name, manufacturer's model # & serial # and/or by SI asset #);
 - (2) Date of the inspection/maintenance;
 - (3) Procedure performed; and
 - (4) Name of the competent person and/or contractor.

F. REFERENCES

1. 29 CFR [1910 Subpart O - Machinery and Machine Guarding](#)
2. 29 CFR [1910 Subpart P - Hand and Portable Powered Tools and Other Hand-Held Equipment](#)
3. NFPA 70, National Electric Code (NEC) <http://www.nfpa.org>
4. American National Standards Institute (ANSI) B Series <http://ansi.org>
5. NIOSH Publication "Easy Ergonomics: A Guide to Selecting Non-Powered Hand Tools" <http://www.cdc.gov/niosh/docs/2004-164/pdfs/2004-164.pdf>
6. OSHA Publication "Hand and Power Tools" <http://www.osha.gov/Publications/osha3080.pdf>
7. NIOSH Publication "Engine and Turret Lathe Safety Guide" http://ofeo.si.edu/safety_health/docs/lathe_niosh.pdf