

CHAPTER 7 MACHINE TOOLS

7.1 INTRODUCTION

Power operated machine tools are used in a variety of operations at PPPL. Their safe use is dependent on careful operation and conscientious application of the practices/procedures detailed below.

7.2 SCOPE

This chapter applies to all PPPL personnel engaged in the procurement, installation, use or repair of machine tools.

7.3 DEFINITIONS (RESERVED)

7.4 RESPONSIBILITIES

7.4.1 Department or Division Heads are responsible for ensuring line implementation of this chapter.

7.4.2 Supervisors are responsible for ensuring that machinery is operated and maintained in accordance with this chapter.

7.4.3 Employees operating machinery are responsible to do so in accordance with this chapter.

7.5 REQUIREMENTS

7.5.1 Occupational, Safety, and Health Administration (OSHA) Regulations 29 CFR 1910, Subpart P

7.6 PRACTICES/PROCEDURES

7.6.1 General Requirements

- A. Before turning on a machine, the operator shall make sure that everyone is in the clear and that guards and safety devices are in place and properly adjusted. Operators shall not, under any circumstances, tie down or otherwise block out guards and safety devices, such as two-hand controls.
- B. Do not leave a machine running unattended. When adjustments are necessary, turn off the power and wait until the machine has come to a stand-still. Do not attempt to brake or slow down moving machinery with your hand or some makeshift device. Bleed off residual pressure if machine is pneumatically operated.

- C. Keep the machine clean. If it becomes necessary to remove chips from a moving machine, do it with a brush, vacuum, compressed air (30 psig or less), or clip puller and not with your hands.
- D. Machine operations require that operators wear eye protection that meets the ANSI Z-87 Standard (eye protection is mandated during tasks that involve cutting, grinding, welding, drilling, sanding, machining, crushing, or any activity producing dust, mist, sparks, chemicals, or cryogenic fluids). Do not wear long sleeves, neckties, gloves, watches, rings, or other jewelry when operating machinery. Protect long hair; long hair shall be covered when working around moving machinery.
- E. Guards on machinery and equipment shall always be kept in place during operation. They shall not be removed except for maintenance or adjustment and not without the approval of the supervisor concerned.
- F. No new or unfamiliar machinery will be operated without instructions from the supervisor in charge of such equipment.
- G. PPPL lock-out procedures shall be used in every case when machine maintenance or repair operations are in progress (see PPPL Procedures Manual ESH-016, and Table 2.5.3 in Section 2.0 of ES&H Manual).
- H. Hearing protection shall be worn during operations, which produce excessive noise (see Section 8, Chapter 8).
- I. All machine tools shall be kept in good condition. Operators shall inspect machines at each new set-up and at the start of each shift. Trial runs shall be performed prior to beginning operation and after each new set-up.
- J. All machine tools shall be located in well-lighted areas, but free from glare. When necessary, additional lighting fixtures shall be affixed to machines.

7.6.2 Grinders - Bench and Pedestal

- A. The mounting, trimming, and diamond-dressing of a wheel will be performed only by qualified and authorized employees. Arbor nuts and wheel nuts must be properly guarded.

- B. When replacing wheels see that the motor speed does not exceed the rated speed of the wheel. If the speed rating is illegible, do not use the wheel. See that the paper washers are placed between the wheel and each flange. Tighten just enough to hold; more may crack the wheel.
- C. Stand to one side during a start-up and wait until the maximum speed has been reached before starting work.
- D. Keep the work rest adjusted so that the gap between the wheel and the rest does not exceed 1/8 inch. The upper tongue-guard shall be adjusted so that a clearance of no more than 1/4 inch is maintained.
- E. Use the face of the wheel. Don't grind on the side of the wheel unless it is especially designed to take side pressure.
- F. Do not force work against a cold wheel, but apply it gradually, giving the wheel an opportunity to warm up.
- G. A wheel used in wet grinding shall not be allowed to stand partially immersed in water. Water-soaking a portion of the wheel may put it dangerously out of balance.
- H. Wheels that are badly ruttled or out of balance should be taken out of service and dressed. Wheels that are too worn or out of balance to be balanced by truing or dressing should be taken out of service.

7.6.3 Power Metal Shears

- A. Check shear for proper operation before cutting metal.
- B. All safety guards and devices shall be in place and operable.
- C. Do not exceed the capacity of the machine.
- D. Keep fingers clear of hold-downs. Hold-downs must be guarded.
- E. Never place hands under cutter when motor is running. Shut off the switch and wait for the motor to stop.
- F. Do not start machine until hands and body are completely clear of the cutter.

- G. Do not try to dislodge jammed stock unless the switch is off, the machine has coasted to a stop, and the treadle is locked or otherwise cannot be operated.
- H. Shear blades shall be kept sharp and the correct clearance shall be maintained.
- I. Shear tables shall be kept free of loose tools and materials.

7.6.4 Power Hack Saws

- A. Securely clamp work before starting saw. Never hold work with hand. Do not press down on saw frame while it is in motion as it may break the blade.
- B. Keep hands clear of reciprocating arm.

7.6.5 Drill Presses

- A. Be sure all boring bits and cutters are sharp and in good condition.
- B. Run the drill or tool only at the proper speed; forcing or feeding too fast may result in broken or splintered tools and cause serious injury.
- C. Clamp work securely or use drill vice. Do not hold work with your hands.
- D. If the tool should hang causing the work to start rotating, never attempt to grab the work. Stop the machine.
- E. Tighten the drill in the chuck with the key before starting. Never leave the key in the chuck. Check this item before starting and before leaving the machine. Spring loaded chuck keys are recommended.
- F. Do not remove cuttings from the drill with a hand or a rag. Use a brush or scraper.
- G. Do not change the belt position manually while the machine is running.
- H. Do not place your hand on the chuck to slow it down. All machines will drift to a stop.
- I. Remove the clamps or vise before cleaning the machine.

- J. Never reach around a revolving drill—for example, to get a tool. If tools are kept on a bench where they belong, this will not be necessary. If you must reach around the drill, stop the spindle first.

7.6.6 Punch Presses

- A. Check proper alignment before operating press.
- B. "Test run" the punch press before starting operation.
- C. Worn punches and dies shall be retooled or discarded.
- D. When two or more persons are working on a press, be sure everyone is in the clear before operating the press. Each employee must have a separately interlocked control. Press controls shall be guarded to prevent inadvertent operation.
- E. Provide barrier guards or devices to prevent hands from being caught at any shear, nip-point, or point-of-operation. Operators shall use hand-feeding tools for inserting or removing stock. Do not place hands or body parts between the punch and die at any time.
- F. PPPL's punch presses shall be operated with two-hand controls.
- G. Foot controls or combinations of hand-foot controls shall not be used except under the direct control of a supervisor. Foot controls or combination hand-foot control operation set-ups shall be recorded in a permanent log book and shall be signed off by the supervisor. Punch presses within PPPL shall not be operated in a continuous stroke mode without the approval of the ES&H Division.

7.6.7 Press Brakes

- A. All safety devices must be in place and functioning properly before operating the press.
- B. "Test run" the press before starting operation.
- C. Never place hands, fingers, or any other part of the body between the dies in the press when the motor is running or coasting.

- D. No parts which require fingers to be brought within four-inches of the point-of-operation shall be hand-held. Use soft metal pliers. Hard metal pliers will shatter and pieces will fly if they are caught in the brake.
- E. Stand clear of long parts that are forced up when a bend is being made.
- F. If two or more persons are operating the press brake, be sure others are clear before operation begins. Each operator must have a separately interlocked control. Press controls shall be guarded against inadvertent operation.
- G. Do not attempt to repair defective bends in a press brake.
- H. Never exceed the capacity of the press brake.

7.6.8 Brake - Hand-Powered - make sure no one is near the counterweights when operating the brake. Be sure the counterweights are secured and will not slide down.

7.6.9 Forming Rolls

- A. Never allow your attention to be distracted from your work while feeding metal into a forming roll; your fingers may be caught in the rolls.
- B. Do not wear gloves.
- C. Keep hands at least 6 inches away from rolls.
- D. Each power forming roll (depending on class) shall be equipped with an emergency stop lanyard running the length of the entire face of the roll. The necessary braking devices or zero switch shall be incorporated on forming rolls.

7.6.10 Band Saws

- A. Prior to operating a band saw, the blade shall be inspected for cracks and broken teeth. Defective blades shall be removed from service.
- B. Use a push stick, special jig, or fixture for feeding small parts.
- C. Keep the blade guard adjusted so that not more than 3/8 inch of blade is exposed above the work.

- D. Place scrap in scrap containers. If scrap is too long and sharp edges extend out of the container, saw or shear it to fit the container.
- E. When welding blades on Do-All saws, see that the cover on the welder is in place; wear eye protection. Store blades properly in a cabinet.
- F. Replace all worn and excessively opened well plates. Sawing small parts with excessively worn well plates may result in finger amputations.

7.6.11 Surface Grinders

- A. Before starting the table in motion, make sure that the magnetic chuck is energized, or that work is otherwise secured to the table.
- B. Check clearances of the wheel and the work before operation.
- C. When through, shut off the coolant supply and allow the wheel to run a few minutes in order to rid itself of excess moisture which might create unbalance.

7.6.12 Disc Sanders

- A. Apply work to the down-running half of the disc.
- B. Check guard for proper operation and installation before using sander.
- C. Check sand paper to be sure it is not torn and it adheres to sanding disc.
- D. See that work rest clearance is not more than 1/8 inch.
- E. Dust respirators shall be worn when operating sanding equipment and during clean-up.
- F. When sanding small stock, a jig or holding device shall be used.

7.6.13 Belt Sanders

- A. Before using, inspect belts for tears, frayed edges, excessive wear, and proper adjustment of tension. Torn, frayed, or excessively worn belts shall be replaced.
- B. Stand so you are out of line in event the work is caught and thrown.
- C. Hold the work firmly.
- D. When sanding small stock, a jig or holding device shall be used.
- E. Dust respirators shall be worn when operating sanding equipment and during clean-up.

7.6.14 Lathes

- A. When changing chucks or face plates, start them by hand with the machine power turned off.
- B. Never put your hands on the plate or chuck while the chuck is spinning.
- C. If filing the stock is necessary, use a file with a handle and hold it so that a kickback will not strike you. If filing is necessary near the chuck, use the left hand on the handle and the right hand on the tip. This will avoid arm contact with the revolving face plate.
- D. Be sure the tailstock and tool holder are fastened properly before starting the machine.
- E. Always keep the cutting tools well back out of the way when trying to check dimension.
- F. Make sure the stock is secure before starting up.
- G. Store tools in such a way as to prevent them from falling into rotating parts or to the floor.
- H. When removing a chuck, to keep it from dropping on fingers, put a board under it or run a length of pipe through the headstock. Use a hoist to change heavy chucks, face plates, or steady rests.

- I. Be sure to remove chuck key from lathe chuck after use. Spring-loaded chuck keys are recommended.
- J. Do not touch chips or pull shavings from the work or machine with fingers. Use a hook or brush.
- K. Stock containing checks, splits, cracks, or knots (wood stock only) shall not be used.

7.6.15 Turret Lathes

- A. Guard revolving stock by feeding it through a pipe designed for this purpose.
- B. Move the turret back as far as possible when gauging or changing stock. This will avoid cuts on sharp tools.
- C. Do not rest arm or hand on top of turret.
- D. Keep the machine free of tools and extraneous materials.

7.6.16 Wood Shapers

- A. On start up, turn the machine very slowly to see that the head and tool clear the housing and the work.
- B. Take measures to protect others from flying chips. The chip screen provided affords this protection in addition to improving housekeeping by collecting chips in drums.
- C. Remove the handle of the stroke change screw before starting the shaper.
- D. See that the point-of-operation guard is set no higher than necessary to permit clearance for the work.
- E. When adjusting the table vertically, leave the ram over the table so that you can determine when the table is at the proper level.
- F. When possible, carbide tip or solid carbide cutters that fit over the spindle should be used in place of knives.
- G. When knives are used on shapers, the following criteria shall be met:

1. Knives for shapers must meet the American Society for Testing and Materials (ASTM) rigid specifications for high-speed tool steel.
 2. Knives must be sharpened and installed only by fully qualified personnel.
 3. Knives and the grooves in the collars must fit perfectly and be free of dust.
 4. Knives must balance perfectly and be weighted against each other in a beam balance each time they are set.
 5. Knives that have become so short that the butt end does not extend beyond the middle point of the collar shall be removed from service.
 6. Deep cuts should be avoided. It is safer and more efficient to take two light cuts than one heavy cut.
 7. During start-up, the operator should apply power in a series of short starts and stops to slowly bring the spindle up to operating speed. The operator should listen carefully for chatter and watch for other evidence that knives are out of balance.
- H. When working with stock less than 6 inches (15 cm) in width, a jig must be used.
- I. Shaper work must be held against guide-pins (curved shaping) or a fence (straight-line shaping). Feather-boards should be clamped to the fence and table to hold stock in place.

7.6.17 Vertical and Horizontal Mills

- A. See that the cranks are disengaged and will not spin unexpectedly when power is applied.
- B. When setting up or replacing cutters, be sure that the motor has stopped and that the clutch is not engaged before placing the arbor wrench on the nut. Never stop a revolving arbor with your hands or by applying an arbor wrench. Never attempt to tighten the arbor nut by placing a wrench on the nut, then bracing the wrench against the machine bed and starting the machine.

- C. Be sure that arbors, cutters, vise jaws and fixtures are securely fastened and that the work is properly clamped.
- D. After a milling cut is completed, the vise jaws must be backed away far enough from the revolving cutters for the safe removal or replacement of work.
- E. When deburring parts at the machine, keep a safe distance from the revolving cutters so that your fingers will not be drawn into them.
- F. Use a soft hammer to drive the bar into the spindle.
- G. Never attempt to tighten the tool, caliper or measure the work, lean or reach over the work, feel the edges of the work or cutting tool or the mill while it is in motion.
- H. Use a brush, not fingers, to wipe chips from cutters or clear the area near revolving cutters.

7.7 REFERENCES

OSHA Regulations 29 CFR 1910.

ASTM A 600 (01.05), "Standard Specification for Tool Steel High Speed."

National Safety Council, Accident Prevention Manual for Industrial Operations, ninth edition.