**F: Guidelines for Safe Operation of**

**K12 Makerspace Tools, Machines, and Equipment**

**For All Tools, Machines, and Equipment:**

* Develop a binder or file of manufacturer’s operating and maintenance manuals for on-going reference.
* Post key safety requirements for the shop in general and each tool in particular.
* Secure tools to the bench top or, for larger pedestal-style self-standing machines, the floor to prevent tipping, movement, or excessive vibration. Installing a heavy, wide base may be an acceptable alternative.
* Install and use all required guards and shields. If removed for service, repair, or other authorized temporary reasons, reinstall them before returning the tool to standard operating use.
	+ - Be aware that processing toxic or reactive materials is hazardous and generally requires specials controls, including local exhaust ventilation and possible fire protection or inert atmospheres.
* Sanders and most woodworking tools generate significant quantities of particulate matter and dust. Wood dust exposure has been associated with a variety of adverse health effects including dermatitis, skin and respiratory sensitization as well as (nasal) cancer. The use of local ventilation is the primary engineering control. Exhaust hoods should be installed as close as possible to the emission source.
* “Kickback” can occur with many tools, most frequently woodworking tools, when a saw blade or cutting head seizes the stockpiece and accelerates it in the direction of rotation, generally back at the operator. It occurs more often when cutting parallel to the grain (ripping) than when crosscutting. Kickback can occur when the stock twists and binds, if the blade or other cutter is not sharp or set an incorrect height, wet or poor quality lumber (knots or nails). These hazards can be reduced by using safeguards such as spreaders or splitters, anti-kickback fingers, power feeders, and gauge or rip fences. Hand and body positions relative to the workpiece are also very important.
	+ - Physically deactivate, unplug, or otherwise disconnect power to tools and machines before replacing blades or performing other service and maintenance work where accidental starting could cause injury.

**Drill Press Safety Rules:**

* Always secure the work in a vise or clamp to the drill table. Never hand-hold a workpiece.
* Operate the drill at the optimum RPM for the diameter of the drill bit and material (check mfg.’s instructions).
* Use the proper size and type of drill; ensure it is sharp and not cracked.
* Use the proper cutting fluid for the material being drilled
* Support material on parallels or backing board when drilling completely through
* If the drill binds, stop the machine and turn the spindle carefully backwards by hand to release the bit
* When drilling a deep hole, withdraw the bit frequently to clear the chips.
* Seek advice and training for drilling Plexiglas (and other brittle materials) if not experienced and approved.
* Wear safety glasses with side shields or machinist’s goggles as a minimum. Consider face shields.

**Lathe Safety Rules:**

* Ensure the chuck, drive plate, or faceplate is securely tightened onto the lathe spindle.
* Do not use machine power to install the chuck, drive plate or faceplate.
* Ensure the tool bit is sharp and is clamped as secure (short) as possible in the tool holder to minimize the risk of breakage or chatter.
* Remove turnings or chips with a hook or appropriate tool while the machine is switched OFF and not running. *Never with an unprotected hand.*
* Remove the chuck key from the chuck immediately after tightening or loosening.
* Wear safety glasses with side shields or machinist’s goggles as a minimum. Consider face shields. Heavy duty or safety shoes are required unless it can be shown that the potential hazards of the task are non-existent or minimal.
* Chip shields/chuck guards and lead screw covers shall be used.

**Milling Machine Safety Rules:**

* Ensure work is clamped securely in a vise and the vise clamped securely to the worktable.
* Ensure cutter is rotating in the proper direction and spindle is clear before cutting material.
* Use the proper cutting speed and cutting fluid.
* Ensure cutters are sharp and ensure power is off prior to changing.
* Remove tightening wrench immediately after using
* Use safety glasses with side shields or machinist’s goggles as a minimum. Consider face shields.

**Grinder Safety Rules:**

* Ensure guards are in place and operable. The bench tool rest clearance must be less than 1/8 inch. Grinders shall be secured to bench top (or if pedestal) to floor to prevent movement.
* Ensure local ventilation (if required) is in place and operable.
* Ensure grindings wheels are not defective, unbalanced or cracked. Such damage may not be obvious. Stand to one side upon starting.
* Keep the wheel dressed with small amounts frequently.
* For a surface grinder, ensure the magnetic chuck is securely placed.
* Do not grind aluminum due to potential hazards. Check with supervision for safety requirements.
* Use safety glasses with side shields or machinist’s goggles as a minimum. Consider face shields.

**Band Saw Safety Rules:**

* Ensure the upper guide and guard is set close to the work (¼”)
* Use the proper pitch blade depending on the material thickness. There should be at least 2 teeth in aluminum material and 3 teeth when cutting steel.
* Ensure the blade is not defective or cracked prior to installation and is covered by a blade guard.
* Do not run the saw at a higher speed than recommended for the material being cut.
* If the motor/saw stalls or breaks, shut off the power immediately and keep clear until the machine has stopped.
* Use safety glasses with side shields or machinist’s goggles as a minimum. Consider face shields.

**Disc and Belt Safety Rules:**

* + - Ensure the guards are in place prior to use.
		- Do not operate machines with worn, ripped or torn belts or discs.
		- Place the work against the rest on the disc and belt sanders as firmly as possible.
		- For disc sanders, always use the downward motion side of the disc. Using the upward motion can throw the parts outward with force.
		- For horizontal belt sanders, always use the motion of the sanding belt that is away from the body.
		- Even for common materials, sanding operations generate significant amounts of dust and require control. For infrequent use local bag filters or filtered shop vacuum cleaners are generally sufficient, but high use units and those involved with more hazardous materials will require true local exhaust ventilation for contaminant control. Consult the MIT EHS Office for technical assistance.
* Use safety glasses with side shields or machinist’s goggles as a minimum. Consider face shields.

**Table Saw Safety Rules:**

* Consider presence-sensing emergency stop technology such as the SawStop® for new purchases and the replacement of existing tablesaws. While this safety feature can be overridden, and it does not prevent workpiece kickback, it can significantly lessen the risk of serious lacerations and amputations when used appropriately.
* Ensure the guards are in place prior to use.
	+ - Use the proper blade for the material being cut. Set it 1/8” above the work.
* Inspect the blade prior to use. Ensure it is sharp and free of defects
* Use a push stick or block to rip narrow pieces of stock. Never place fingers near the blade
* User infeed and outfeed supports for large material, especially full-size sheet goods. If such supports are unavailable or impractical, obtain assistance from the Facility Manager, Supervisor, or Monitor. Alternatively, use a panel saw to dimension and rough cut large workpieces.
	+ Prevent the accumulation of scraps and sawdust by routinely cleaning the area and discarding waste materials appropriately.
	+ Provide dust collection under the blade slot. For infrequently used equipment, a fabric dust bag or filtered shop vacuum is generally sufficient. For higher use equipment, true local exhaust ventilation and a dust collector are necessary. Dust collection hoods integrated with an over-the-blade guard are also available.
	+ Use safety glasses with side shields or machinist’s goggles as a minimum. Consider face shields.
* Under certain specific circumstances, guards or shields may impede actions such as bevel cuts, tenoning, slotting and dadoing. Under these kinds of conditions only, alternative safeguarding must be implemented. These should be discussed first with the Facility Manager, Supervisor, or Monitor, and may include the adoption of special jigs, “sleds”, templates, fixtures, or other means that effectively control hazards.

**Jig Saw Safety Rules:**

* + Ensure the guard is in place prior to use.
* Use a threshold rest (slotted foot) to hold the stock.
* Ensure blade is properly attached and secured.
* Make turns slowly, no sharp turns with a wide blade.
* Use safety glasses with side shields or machinist’s goggles as a minimum. Consider face shields.