**B: Facilities and Operations Guidelines**

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

**This document provides guidelines for the establishment and ongoing administration of a fabrication facility such as a makerspace or workshop in a K12 environment.**

1. **Administration and Supervision of Workshops and Fabrication Spaces**

1.1 Facility Managers and supervisors

Designate a Facility Manager for each workshop or fabrication space, with overall authority and responsibility for that location. Facility Managers may further designate one or more Supervisors or Monitors to assist with day-to-day operations, provide user oversight and supervision, and offer training on certain tools and equipment in their space. Supervisors have significant experience with shop tools and understand the safe operation of tools. Monitors may be less-skilled, but are aware of hazardous situations and can be in charge of general safety and training on lower level tools and machines. As determined by the institution, students can serve in these positions and be positive role models.

The Training and Supervision document establishes a framework supervisory authority designations based on user training and competencies.

1.2 Tool classification and zoning

A classification system for machines, tools, and equipment appears in the Tool Classification document. This system uses a potential hazard rating scale ranging from 1 to 4, with 4 representing the highest tool hazard level. Understanding that some tools may be difficult to categorize and require additional professional assessment, the system provides descriptions of the size and power of each tool class, common examples, and requirements for access control, supervisory oversight, training, and authorization.

**1.3 Access to tools and machines**

Zones may be created to limit access to tools requiring a higher level of training. This can be accomplished with locked walls/doors or cage-type barriers. Alternatively, tools and equipment can be locked-out and rendered inoperable and harmless with power cutoffs and other locks on the individual machines.

**1.4 Tool selection, installation, and safeguarding**

Tools and equipment should be selected based upon good design with adequate functionality and reliability appropriate for the expected use level. It should also meet the institutions requirement for environmental and physical safety.

Electric tools shall be double insulated or provided with grounded three-prong plugs to help prevent electric shock.

Unless they are powered by cord and plug, tools and equipment shall be installed with a disconnect switch that can be locked in the off position during servicing and repair.

Power equipment and large manual tools shall be leveled and adequately secured to the floor or workbench, as appropriate, to prevent/minimize movement, tip-over, walking, and vibration.

Manufacturer’s operating manuals for all tools and equipment shall kept and made available in the shop or fabrication space.

Tools, equipment, and other machines shall meet or exceed applicable regulatory and advisory safety and safeguarding standards (also see References). These vary by tool type and agency, with specific prescriptive OSHA requirements for many wood- and metal-working tools. Note that even many newly-manufactured machines do not always meet these standards. Machine safeguarding can be a complex and difficult process, especially for older equipment and unique or unusual machine configurations.

Basic machine safeguarding generally includes one or more of the following features depending upon the specific type of tool and materials processed:

1. Shields or covers for protection from the point-of-operation where the tool actually performs work and any flying chips or objects;
2. Guards or enclosures to prevent inadvertent contact or access to dangerous rotating parts and motions elsewhere on the machine;
3. E-stops or other rapid and readily-accessible means to shut the machine off in the event of an accident or emergency;
4. Anti-restart protection where unanticipated restart after an electrical outage could result in injuries; and
5. Methods to control, capture, filter, or exhaust dusts, vapors, mists, or gases generated during machine and tool use.

A general guide to machine hazards and safeguarding appears in the document Guidelines for the safe use of tools and equipment.

**1.5 Emergency stop devices**.

All powered tools and machines (except those with momentary or trigger pressure switches) shall be equipped with a means to safely shut power off during normal operations and in the event of an emergency or accident. For Class 2 and higher machines and tools, this mechanism is generally in the form of one or more factory-installed or aftermarket emergency power stops (“E-stops”). These may include red-colored mushroom-style buttons, paddles or large format toggle switches, trip wires, and other readily-identifiable and readily-accessible means to effectively shut the machine off by a single motion. Light curtains, foot brakes, and step-off pads may also fulfill this requirement in certain circumstances. All emergency controls must be prominently marked and red in color; new E-stops must also have a yellow background.

**2. Room and Infrastructure**

**2.1 General requirements**

In addition to basic room-level infrastructure requirements established by the institution, at a minimum shops and fabrication spaces shall:

1. Physically limit or restrict access to authorized users only;
2. Have a working landline telephone with posted emergency contact information;
3. Contain at least one portable fire extinguisher;
4. Post basic safety rules, and have specific equipment and tool operating manuals and other information available;
5. Make appropriate personal protective equipment available to users free-of-charge;
6. Provide other supplies and equipment appropriate to operations in the space, including special waste collection containers, spill supplies, and a plumbed eyewash station (if corrosive chemicals are used).

**2.2 Ventilation.**

Equipment that emits dusts, fumes, vapors, or gases may require local exhaust ventilation or other contaminant control devices. Some common examples include outdoor exhaust connections for laser cutters, dust collection systems for sanders, and spray booths for certain painting and coating activities. These systems must be carefully designed, installed, and periodically inspected to ensure safe effective operations.

**3. Inspection, Maintenance, and Repair**

**3.1 Inspections.**

Facility Managers and their designees shall regularly inspect their spaces, tools, and equipment for safety, housekeeping, and general condition. This includes a general overview of the space and its contents each day, periodic formal documented inspections as determined by the institution, and tool-specific inspections following manufacturer’s instructions.

Inspections shall also be performed after any accident, injury, or report of unsafe conditions.

A sample self-check shop and tool inspection outline is available in the Self-Inspection Checklist document

**3.2 Damage reports**

Authorized users shall inspect their work area and tools prior to each use, and report any damages, off-normal conditions, or problems encountered during use to their Facility Manager, Supervisor, or Monitor. In particular:

1. Where required, mechanical guards or shields shall be present, properly adjusted, and in good condition.
2. Damaged tools and equipment shall be immediately removed from service and rendered inaccessible or inoperable until repaired or replaced.

4. Relevant Standards

OSHA – 29 CFR 1910.212 – General Requirements for All Machinery

OSHA – 29 CFR 1910.213 – Wood Working Machinery requirements

OSHA – 29 CFR 1910.219 – Mechanical Power Transmission Guarding

OSHA Publication 3067 – Concepts and Techniques of Machine Safe Guarding

ASME B107 Hand Tools

ANSI Standards:

B11.1 Construction, Care and Use of Mechanical Power Presses

B11.4 Construction, Care and Use of Shears

B11.6 Construction, Care and Use of Lathes

B11.8 Construction, Care and Use of Drilling, Milling and Boring Machines

B11.9 Construction, Care and Use of Grinding Machines

B11.10 Construction Care and Use of Metal Sawing Machines

B15.1 Mechanical Power Transmission Apparatus

01.1 Woodworking Machinery – Safety Requirements