

Makerspace and Shop Safety Guidelines

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Shop Safety Overview:

With the proper procedures, supervision and precautions, school makerspace and shop classes can be safe places where learning about safety is emphasized. The key to shop safety is awareness of personnel safety, fire protection and loss prevention systems. This can be accomplished with proper installation, inspection, and maintenance of listed or approved safety systems, guards, and protection devices.

Shop Equipment Safety Tips:

- Conduct equipment safety training. School industrial shop classes can be hazardous due to the use of power equipment. Before students are allowed to use any equipment, they should be taught safety procedures and pass a shop safety quiz about the specific equipment and personal protective equipment provided, including such items as safety glasses, gloves and even welding aprons.
- Maintain power equipment on a regular preventive maintenance program with the maintenance documented.
- Register each piece of equipment with the manufacturer to help ensure receipt of recall, service bulletins and other important notices. Periodic review of the manufacturer's websites can help keep abreast of remedial or other safety information.
- Evaluate each piece of equipment for safety. Document the evaluation and maintain the documentation for the life of the equipment.
- Ensure equipment is in good condition, **with all guards in place and functioning.**
- For large equipment, create established work zones, anchor it down, and equip it with an emergency stop button.
- Any power equipment that is permanently installed should be equipped with a magnetic switch that can help prevent accidental start-ups of equipment.
- Install emergency stop buttons on all four walls of the room and clearly label them. These buttons will turn off all the equipment at once in case of an emergency.

- Use smaller hand-held power tools in designated work areas only.

Shop Loss Control/Safety Tips:

- To help protect the shop from fires, install automatic sprinklers in accordance with the most current edition of National Fire Protection Association (NFPA) 13, Standard for the Installation of Sprinkler Systems. Fire extinguishers should be installed in accordance with NFPA 10, Standard for Portable Fire Extinguishers.
- Separate the shop room from the rest of the school by a fire barrier wall or a fire partition wall with at least a two-hour rating. Corridor entrance doors should be self- or automatic-closing and have a one-and-a-half-hour fire rating.
- Train faculty in the proper use of the protective systems installed, such as local exhaust ventilation and equipment safeguards.
- Train students on how to safely handle and store the chemicals they may encounter in the shop, such as flammable or combustible liquids (like laboratory classes). Educate them on where the Safety Data Sheet (SDS) information is located, how to identify the hazards, and how to protect themselves using personal protective equipment and controls provided.
- Train students on what to do in the event of a chemical spill. Note: Rags collected and stored in a safety or oily waste can should be removed and disposed of regularly. Ensure instructors develop emergency procedures, put them in writing and communicate them to the students. The procedures should cover a variety of emergency situations and how to respond to these situations. The procedures should also include what to do if a student is injured. Conducting drills can help reinforce what to do in an emergency to reduce confusion and panic and ensure that everyone reacts quickly and appropriately.
- Have a first-aid kit available in each classroom. Check the kit and restock it as needed.
- Install a plumbed eyewash station in the work area for immediate emergency use as required by ANSI standard Z358.1.

Additional Shop Classroom Safety Guidelines:

- Limit the size of shop classes to comply with state guidelines for the size of the classroom and the amount of power equipment located in the room.
- Keep a copy of the manual with each piece of equipment.
- Install emergency lighting and clearly mark exit signs to:
 - Allow students to exit the room safely in a power outage.
 - Keep exits clear.
 - Allow students to safely de-energize power equipment if the lights go out.
- Allow use of the shop only under supervision of shop teachers.
- Power equipment that generates dust should be equipped with a local exhaust dust collection system. The dust collection system's dust bags or cyclone should be located either on the exterior of the building or in a room cut off by fire barrier walls and explosion relief venting. Firewalls should have a minimum two-hour rating and the door a one-and-a-half hour rating.
- Install a fire damper in the dust collection system to prevent a fire in the dust collection system from coming back into the shop.

- When spray painting, install a spray booth to meet the requirements of the most current edition of NFPA 33, Standard for Spray Application Using Flammable or Combustible Materials. This paint spray booth, ducts and equipment should be maintained routinely and documented.
- Minimize the amount of flammable and combustible liquids kept on hand. Store flammable and combustible paints and liquids in a UL-listed/FM-approved flammable liquids storage cabinet when not in use.
- Conduct an annual inventory of all flammable and combustible liquids and hazardous chemicals and verify the containers are properly marked. Properly dispose of old liquids.
- Clean up the shop daily.

Lock out Tag Out for Equipment and Tools:

Regularly inspect and maintain all equipment, tools, and machinery for signs of damage or wear, ensuring they are in proper working condition before use. If any damage is identified, immediately remove the equipment from service and tag it out for repairs or replacement according to the Lock Out Tag Out (LOTO) procedure.

Lock Out Tag Out Procedure – Example:

The Lock Out Tag Out (LOTO) procedure refers to the process of isolating and securing damaged equipment, tools, or machinery to prevent accidental energization or operation while maintenance, repairs, or inspections are being conducted. Here's a general outline of the LOTO procedure:

1. **Notify Relevant Personnel:** Inform all affected personnel, including shop teachers and students, about the equipment's status and the need for LOTO.
2. **Identify Energy Sources:** Identify all energy sources that power the equipment, such as electricity, hydraulic systems, or compressed air.
3. **Shut Down Equipment:** Turn off or shut down the equipment using the appropriate controls. Follow the manufacturer's guidelines or established procedures for safe shutdown.
4. **Isolate Energy Sources:** Physically disconnect or isolate the energy sources by using lockable switches, valves, or other isolation devices. Ensure that these devices are locked in the off position.
5. **Apply Locks and Tags:** Affix a lock and a tag to each isolation point. The lock prevents the re-energization of the equipment, and the tag provides information about the reason for the lockout and contact information of the person performing the procedure.
6. **Release Stored Energy:** Release any stored energy within the equipment, such as residual pressure or tension, following proper procedures to prevent unexpected movement.
7. **Verify Isolation:** Double-check that all energy sources are effectively isolated by attempting to start the equipment. Ensure that it doesn't start or operate.
8. **Perform Maintenance or Repairs:** Once isolation is confirmed, proceed with the necessary maintenance, repairs, or inspections.
9. **Complete the Work:** After completing the required tasks, ensure that all tools, parts, and personnel are clear of the equipment.
10. **Remove Locks and Tags:** Only after the maintenance work is fully completed and the area is safe, remove the locks and tags from the isolation points.
11. **Notify Personnel:** Inform all affected personnel that the equipment is no longer locked out and can be safely used again.

12. **Document the Procedure:** Keep a record of the LOTO procedure, including the date, equipment involved, personnel involved, steps taken, and any relevant observations.

Please note that the specific steps and procedures may vary depending on the equipment, your organization's safety policies, and local regulations. It's essential to follow established guidelines and ensure that staff involved are properly trained in LOTO procedures.

Safety Recommendations for Makerspaces:

In a makerspace, students can engage with innovative, specialized equipment that goes beyond what is commonly found in a traditional school shop program. Despite the unique and innovative nature of the makerspace environment, it is vital to underscore that all the fundamental shop safety guidelines mentioned earlier remain applicable and form the cornerstone of a safe and successful makerspace.

Safety Program Development:

The staff responsible for the makerspace program should develop a makerspace safety plan. Here are some considerations to assist with developing a safety plan:

- 1) Specialized Equipment Awareness:
 - a) Introduce students, teachers, and staff to the unique equipment found in the makerspace.
 - b) Conduct comprehensive training sessions focused on the proper and safe usage of specific makerspace tools.
 - c) Read all the user manuals of the equipment and tools to ensure that all safety measures are taken into consideration.
 - d) Make a copy of each user manual and hang it close to the equipment or tool.
 - e) Provide all the necessary Personal Protective Equipment (PPE) needed.
 - f) Ensure proper machine guarding for each piece of equipment or tool.
 - g) Work with a professional engineer to install proper ventilation and dust collection system, as needed.
- 2) Material and Equipment Compatibility:
 - a) Educate users about the compatibility of materials with specific machines and tools to prevent accidents caused by inappropriate combinations.
- 3) Prototyping and Testing:
 - a) Emphasize the significance of prototyping and testing designs to identify potential hazards and safety issues before implementing a project.
- 4) Supervision and Access Control:
 - a) Ensure that makerspace activities are conducted under the supervision of trained personnel.
 - b) Implement access control measures to restrict entry to the makerspace without appropriate authorization.
- 5) Age and Skill Level Considerations:
 - a) Assess the complexity of makerspace projects and align them with the age and skill level of students to maintain a safe learning environment.
- 6) Emergency Stop and Shutdown Procedures:

- a) Familiarize all users with emergency stop buttons and shutdown procedures for equipment and machinery, enabling them to respond quickly to unforeseen circumstances.
- 7) Safety Signage and Visual Cues:
 - a) Display clear and visible safety signs throughout the makerspace, highlighting potential hazards and safety protocols.
- 8) Regular Maintenance and Calibration:
 - a) Establish a maintenance schedule for makerspace tools and equipment to keep them in optimal condition and reduce the risk of malfunctions.
- 9) Makerspace Layout and Design:
 - a) Organize the makerspace layout to promote a safe and efficient workflow, minimizing the chances of accidents caused by congestion or confusion.
- 10) Documentation of Projects and Procedures:
 - a) Encourage students and teachers to maintain detailed documentation of their projects and the safety measures employed throughout the creative process.
- 11) Comprehensive Equipment Training:
 - a) Prioritize comprehensive training sessions for all makerspace users, ensuring they are proficient in handling the unique tools and equipment present.
 - b) Encourage regular refresher courses to reinforce safety practices and promote competence.
- 12) Expert Supervision and Certification:
 - a) Designate experienced supervisors or mentors, who have expertise in using specialized equipment, to oversee certain activities.
 - b) Consider a certification process for students who demonstrate a high level of competence and responsibility in using specific advanced tools.
- 13) Emerging Technology Precautions:
 - a) Stay updated on the latest advancements in makerspace technology and assess associated risks before incorporating them into the facility.
 - b) Educate users on any unique safety considerations relevant to emerging technology.
- 14) Designated Work Zones:
 - a) Clearly define and mark specific work zones within the makerspace, each designated for certain activities or equipment.
 - b) Ensure work areas are optimized for safety and efficiency.
- 15) Regular Safety Audits:
 - a) Conduct routine safety audits to identify potential safety gaps and address them promptly.

3D Printer Safety Basics:

Using a 3D printer in a K-12 school can be a fantastic educational tool, but it's essential to prioritize safety to protect students and staff. Here are some safety recommendations for using a 3D printer:

- 1) Supervision and Training:
 - a) Ensure that a responsible adult, such as a teacher or staff member, is present to supervise students while using the 3D printer.

- b) Provide comprehensive training to students on how to operate the 3D printer safely and understand the potential hazards associated with its use.
- 2) Location and Ventilation:
 - a) Place the 3D printer in a well-ventilated area to minimize exposure to fumes emitted by certain printing materials, such as ABS filament.
 - b) Ensure the printer is not placed near high-traffic areas to prevent accidental collisions.
- 3) Material Selection:
 - a) Use only approved and safe printing materials compatible with the 3D printer.
 - b) Avoid using potentially hazardous materials that may release harmful fumes or cause other safety risks.
- 4) Maintenance and Calibration:
 - a) Regularly inspect and maintain the 3D printer to ensure it is in proper working condition.
 - b) Calibrate the printer according to manufacturer guidelines to optimize performance and prevent malfunctions.
- 5) Emergency Shutdown and Fire Safety:
 - a) Instruct students on how to perform an emergency shutdown of the 3D printer in case of any issues.
 - b) Keep a fire extinguisher nearby and ensure all users know how to use it correctly.
- 6) Temperature Monitoring:
 - a) Monitor the temperature of the 3D printer during operation to detect any overheating issues promptly.
- 7) Bed and Nozzle Safety:
 - a) Advise students to avoid touching the heated print bed and nozzle during or immediately after printing, as they can cause burns.
- 8) Remove Finished Prints Carefully:
 - a) Teach students to remove finished prints from the bed carefully to avoid injury.
- 9) Proper Storage of Printing Materials:
 - a) Store 3D printing materials in designated areas, away from heat sources and direct sunlight.
- 10) Age-Appropriate Projects:
 - a) Tailor 3D printing projects to the age and skill level of the students to avoid complex or potentially dangerous designs.
- 11) Fire Safety and Evacuation Procedures:
 - a) Establish clear fire safety and evacuation procedures specific to the makerspace, including 3D printing areas.
- 12) Maintenance Records:
 - a) Keep a log of regular maintenance, calibrations, and safety checks for the 3D printer.
- 13) Safety Signage:
 - a) Display safety signs around the 3D printer area, reminding users of key safety precautions.
- 14) Personal Protective Equipment (PPE):
 - a) Encourage the use of appropriate PPE, such as safety goggles and gloves, when handling printing materials or during maintenance.

15) Documentation of Projects:

- a) Encourage students to document their 3D printing projects, including safety considerations and lessons learned.

3D Printers risk management and safety resource developed by UVM:

<https://www.uvm.edu/riskmanagement/3d-printer-safety>

By integrating these guidelines, the makerspace/shop will not only become a hub of creativity and innovation but also a place where safety takes precedence, enabling students to explore their ideas and projects confidently and responsibly.

If you have any questions or would like someone from Multi-Line's Risk Management staff to review any of the above information including Makerspace/Shop rooms, equipment, or training, give us a call at 802-223-6132.