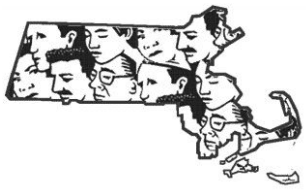
MA FACE
School Shop Injury Report



High School Student Sustains a Partial Fingertip Amputation While Using a Jointer in Wood Shop - Massachusetts

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Massachusetts Department of Public Health
Occupational Health Surveillance Program

SUMMARY

In 2014, a 9th grade student enrolled in a regional comprehensive high school that also offered some shop classes partially amputated a fingertip. The student was operating a wood jointer in shop class when the student's left hand middle finger came in contact with the jointer's cutting head. Immediately after the incident occurred, the student informed the substitute teacher in charge about the injury. The student was brought to the school nurse who placed a call for emergency medical services (EMS). The local police and EMS arrived at the incident location within minutes. The victim was transported to a local hospital where the partially amputated fingertip was reattached and the victim was then released from the hospital.

Contributing factors identified in this investigation included lack of comprehensive standard operating procedures, not having access to the jointer operator's manual, and inexperience. Another contributing factor was the limitations of the jointer's guard.

The Massachusetts Department of Public Health concluded that to prevent similar occurrences in the future, schools with shop classes should:

- **Develop, implement, and enforce standard operating procedures for operating machinery;**
- **Develop guidelines to ensure students have a clear understanding of the task they will be performing; and**
- **Provide shop environments that, at a minimum, meet all relevant Occupational Safety and Health Administration (OSHA) regulations to protect students and school employees from injury.**

In addition, equipment manufacturers should:

- **Perform comprehensive product assessments based on the Prevention through Design (PtD) concept to identify potential hazards and then eliminate these hazards through design changes.**

INTRODUCTION

The Occupational Health Surveillance Program at the Massachusetts Department of Public Health (MDPH) conducted an investigation of an incident where a student was injured while operating a jointer in a comprehensive high school wood shop. No state agency has oversight over Massachusetts comprehensive high school shop classes regarding the safety and health of the students. MDPH investigated this incident as part of a federally funded occupational safety and health injury surveillance and prevention program. Two MDPH representatives visited the school and the incident was discussed with school personnel. The goal of the investigation was to determine the contributing factors that led to the injury and to develop recommended countermeasures to prevent future incidents.

SCHOOL

At the time of the incident, the regional comprehensive high school accepted students from two neighboring municipalities, consisted of grades nine through 12 and had approximately 700 students enrolled. The school building where the incident occurred was scheduled to be demolished after the opening of a new regional high school. The demolition of the old high school took place approximately three months after the incident and the subsequent investigation. The new school did not include a wood shop.

SAFETY INFORMATION

The school provided students with a safety rules guide document and instruction on the use of woodshop machinery. The safety rules guide document contained basic information, including a list of unacceptable behavior in shop, and rules about appropriate shop attire and personal protective equipment (PPE), such as safety glasses. The document also included some basic information about the woodworking machines in the shop. The information on the jointer included: that jointers should primarily be used on a wood piece's edge grain; two push blocks should be used when cutting wood pieces less than four inches wide; wood pieces should be moved from right to left when cutting on a jointer; hands should be kept above the fence line or use a push block; and wood pieces shorter than ten inches long should not be cut on a jointer. There was a basic safety quiz that each student had to pass before they were allowed to operate any of the machines. This quiz was based on the safety rules guide document. The school did not have the manufacturer operator's manual for the jointer.

VICTIM

The student was enrolled in 9th grade and the wood shop where the incident occurred was an introductory class. The wood shop class met for 50 minutes (1:10 p.m. to 2:00 p.m.) and the incident occurred at 1:35 p.m. The previous couple of years the student had taken applied technology and engineering/technology courses. At the time of the incident, the student was wearing safety glasses. It was reported by school personnel that the student said that they were not distracted at the time the incident occurred.

INCIDENT LOCATION

The incident occurred in the wood shop located inside the high school. The wood shop was located on the ground floor and had multiple windows along one wall and was generally in need of updating. The equipment available for students to operate while in wood shop included multiple handheld tools, such as a drill and a palm sander, and larger stationary woodworking machinery. The larger stationary machinery available for students to operate included a jointer, miter saw, router, band saw, and spindle

sander. It was estimated that each student would spend one day using each piece of machinery. The shop also had five emergency stop buttons throughout. The way the system had been designed was that engaging any of the emergency stop buttons resulted in power being cut to all of the shop's machines.

EQUIPMENT

The woodworking machine that the student was operating at the time of the incident was a jointer (Figure 1). The exact date the jointer had been manufactured was unknown, but it was estimated to have been manufactured during the 1960's. Jointers are mainly used to create flat and/or straight surfaces on wood stock. A typical jointer consists of a few main parts: a cutterhead, a fence, and two tables; an infeed table and an outfeed table (Figure 1). The starting location for a wood stock work piece, prior to being cut, would be the infeed table. The adjusted height of the infeed table relative to the cutterhead determines the depth of the cut. Usually the infeed table would be adjusted lower than the outfeed table, but both tables would always be parallel. The outfeed table typically would not be adjusted and should be set to the height of the cutterhead. The cylindrical cutterhead rotates and consists of knives that cut the wood work piece as it is passed over the cutterhead. The fence is an adjustable guide that is positioned parallel with the tables. The fence adjusts crosswise over the tables and the fence's position sets the width of the cut.

The jointer was equipped with a guard from the manufacturer that covered the front side of the cutterhead, from the fence towards the operating area (Figure 1). The guard was equipped with a hinge and an integrated spring. The hinge and spring allow the guard to move with the wood work piece during cutting, keeping the cutterhead covered except at the very beginning and end of the cutting process.

The process of operating a jointer would be to first ensure that the infeed and outfeed tables are parallel to each other, that the fence is perpendicular to these two tables, and that the outfeed table is the same height as the cutterhead. The infeed table would then be adjusted to the desired cutting depth. Next, the fence would be adjusted to the desired width of the cut. The wood work piece would be placed on the infeed table against the fence and with the edge to be cut facing down. The wood piece should be positioned so that the cut will be with the grain of the wood work piece.

Once the jointer is turned on and cutting is in progress, the jointer operator should never grasp the wood work piece at the ends. The operator's left hand is used to hold the wood work piece against the infeed table and fence and the right hand is used to feed the wood work piece towards the cutterhead. The operator's hand should never pass over the cutterhead or come close to the cutterhead. As the cut is being made and the operator's left hand comes closer to the cutterhead, and enough of the wood work piece is on the outfeed table, the operator should transfer their left hand to the section of the wood work piece that is on the outfeed table, away from the cutterhead. The operator should ensure that the wood work piece is secure against the outfeed table and fence with their left hand as their right hand continues to feed the wood work pieces into the cutterhead. As the operator's right hand comes within four inches of the cutterhead, the operator then transfers their right hand from the infeed table to the outfeed table.

Based on an operator's manual for a newer jointer from the same parent company as the manufacturer of the jointer involved in the incident, wood work pieces (Figure 2) to be cut on jointers should be at least 10 inches long, ¾ of an inch wide and ¼ of an inch thick. The depth of the cut should not be

greater than 1/8 of an inch. Push blocks should always be used when surfacing any size wood work piece and when jointing an edge of a work piece that is lower than the fence. Push blocks are tools, typically made of wood and felt, used by the operator to push the work piece while keeping their hands away from the cutterhead. Surfacing is when the larger flat side of the work piece is being cut and placed against the feed table and jointing an edge is when the cut is being made to the narrower side of the work piece (Figure 2).

INVESTIGATION

The wood shop class was scheduled during the last period of the school day. The class had 18 students enrolled and there was one teacher. On the day of the incident, there were about 15 students present in the class. The task the student was performing at the time of the incident was to flatten a piece of wood using the jointer. The wood piece dimensions were 3 ½ feet long x 5 inches wide (Figure 2).

It was reported by school representatives that the student had asked the shop teacher to show them how to use the jointer again. The shop teacher got the other students situated and then started to work with the student who sustained the injury. The shop teacher went over with the student how to use the jointer and watched the student run a wood piece through the jointer. The shop teacher went back to assisting other students and then was subsequently called out of the shop for a meeting and a substitute teacher stepped in to supervise the shop. The amount of technical woodshop knowledge the substitute teacher had was unclear.

While the student was cutting a wood piece, their left hand middle finger came in contact with the jointer's cutterhead, partially amputating the fingertip. During this cut, the cutterhead guard was attached to the jointer and in use. The school reported that the student was not using a push block at the time of the incident and that the student was cutting the wood work piece's edge (Figure 2), which typically does not need the use of a push block. It was unknown if the cut being performed when the injury occurred was the first cut the student made after the teacher stopped observing.

Upon being injured, the student walked over to the teacher and informed the teacher about the injury. The teacher then had another student engage the emergency stop because the machine was still running. The teacher then notified the shop teacher who was out at a meeting. The substitute put pressure on the student's finger and then the student was walked to the school nurse's office. The school nurse called for emergency medical services (EMS) and also notified the student's emergency contact. EMS arrived within minutes and the student was transported to a local hospital. The partially amputated fingertip was reattached with stitches and the student was released from the hospital.

CONTRIBUTING FACTORS

Injuries are often the result of one or more contributing factors or key events in a larger sequence of events that ultimately result in the injury. The Massachusetts Department of Public Health identified the following contributing factors in this incident.

- lack of comprehensive standard operating procedures
- not having access to the jointer's operator's manual
- inexperience
- limitations of the jointer's guard

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Schools with shop classes should develop, implement, and enforce standard operating procedures for operating machinery.

Discussion: Schools can prevent similar situations from occurring by developing, implementing, and enforcing comprehensive standard operating procedures (SOP) for jointers and all other machines students are learning to operate. In this case, the school had developed the safety rules guide that contained some operating procedures for machinery, including the jointer, but the procedures were not comprehensive. When developing SOPs, schools should seek input from professionals and experienced school employees and even other municipal employees about proper operation procedures for the machines and the associated hazards for each machine. During the SOP development, current literature specific to each machine should be reviewed, including the equipment owner's manuals. If the school does not have a copy of the owner's manual, as in this case, then an effort should be made to find and purchase a copy of the manual. A comprehensive SOP for a jointer should clearly outline the proper usage of the jointer including hand placement when cutting a wood piece, when push blocks should be used, and the minimum wood piece size that can be cut on a jointer (see Equipment section for jointer operation). In addition, the SOP should include a section on how to identify and recognize hazards, both common hazards and potential hazards, and how to eliminate or control these hazards.

Once SOPs are developed for each machine, these SOPs should be used when providing students with training on the machines. The SOP will help ensure that the training covers all topics and procedures to ensure proper operation of the machines and hazard recognition. The SOP should also be available for teachers and students as an accessible reference about the machines they are operating. When incidents occur, SOPs should be reviewed and updated to include the lessons learned from these incidents.

In addition, the National Institute for Occupational Safety and Health (NIOSH) has developed a Safety Checklist Program for Schools, which can also be utilized by employers especially when developing SOPs. These checklists were designed to help schools comply with and/or follow federal or state OSHA regulations. The NIOSH Safety Checklist Program for Schools can be found on the NIOSH Web site at www.cdc.gov/niosh/docs/2004-101/default.html.

Recommendation #2: Schools with shop classes should develop guidelines to ensure students have a clear understanding of the task they will be performing.

Discussion: Explaining a task once may not ensure that individuals, including teenagers and less experienced adults, fully comprehend the tasks at hand and feel comfortable enough to safely perform the task. Teenagers typically have limited experience with machinery found in shops and this combined with a desire to demonstrate independence may lead to hesitation to speaking up about their concerns, including asking for a process to be re-explained to them.

In this case, it was reported by the school that the student had asked the instructor to show them again how to use the jointer. After the instructor showed the student how to use the jointer and watched the student run a wood piece through the jointer, the instructor went to assist other students in the shop. It was not clear how the shop teacher assessed the student's competency and comfort with using the machine.

Guidelines should be developed that will help with keeping students safe during machine operation and completing shop tasks. The guidelines should include, but not be limited to, steps to assess student comfort level, competency and comprehension of the machine they are going to use. This should include instructors directly asking students exactly how comfortable they feel with operating the machine and asking them to verbally state the proper machine operating procedures to the instructor. Then, based on these results of the assessment, the instructor can make an informed decision on the level of supervision and/or retraining needed. It is imperative that instructors immediately correct and point out to students when any observed unsafe actions are being performed.

Recommendation #3: Schools with shop classes should provide shop environments that, at a minimum, meet all relevant Occupational Safety and Health Administration (OSHA) regulations to protect students and school employees from injury.

Discussion: Massachusetts Code of Regulations 603 CMR 4.03(3)(d) requires Chapter 74 vocational technical high school shops to comply with the Occupational Safety and Health Administration (OSHA) standards. However, comprehensive high schools that offer shop classes, but are not chartered as vocational high schools under Massachusetts Chapter 74, as in this incident, are not covered by this requirement. To help keep students and employees safe, all schools that offer shop classes, including woodworking, auto body, cosmetology, or health sciences, should provide programs and equipment that at a minimum comply with applicable OSHA standards.

The federal Occupational Safety and Health Act requires private sector employers to provide workplaces that are free from recognized hazards likely to cause death or serious physical harm to employees. OSHA standards outline the minimum requirements for employers to prevent work-related injuries. While private sector employees are covered by federal OSHA, municipal public sector employees in Massachusetts, including those in public schools, are not.

The Massachusetts Department of Labor Standards (DLS), in accordance with Massachusetts General Law Chapter 149 Section 6, is charged with inspecting public sector workplaces, including public schools, in Massachusetts and determining what procedures and practices are required to protect workers from injury and illness. As a matter of policy, DLS references OSHA Standards, in determining whether proper procedures are being followed to protect workers. School shop classes provide students with important opportunities to learn technical skills that they can take with them into the workforce. Complying with OSHA standards in the school setting and teaching students about occupational safety and health is a crucial component of work preparation for these students.

Recommendation #4: Equipment manufacturers should perform comprehensive product assessments based on the Prevention through Design (PtD) concept to identify potential hazards and then eliminate these hazards through design changes.

Discussion: Prevention through Design (PtD), as it would relate to equipment manufacturers, involves addressing occupational safety and health needs during the design process to eliminate or minimize injury. PtD initiates thinking about how the equipment functions in relation to individuals that would come in contact or interact with the equipment in order to identify potential hazards. Once hazards are identified, the equipment can be designed to eliminate or control these hazards.

In this case, the manufacturer equipped the jointer with a spring guard for the cutterhead. This is the style guard that is typically provided by manufacturers for jointers. The guard does completely cover the cutterhead for most of the cutting process. It is during the very beginning and very end of the cutting process when the blades of the rotating cutterhead are partially exposed.

Since jointers are still being manufactured with this same style guard, this machine serves as an excellent example of the potential for eliminating or minimizing injury risks through a comprehensive PtD review of the equipment. Applying PtD to the jointer would clearly identify the worker and equipment interaction that led to the incident, and would highlight the need to redesign and/or incorporate additional engineering controls to guard the cutterhead area.

For example, a redesigned table saw is available where the saw instantly stops as soon as it comes in contact with any part of a body. The blade is charged with a small electrical signal so that when any skin comes in contact with the blade it causes a change in the electrical signal and engages the safety system. Once engaged, a saw brake activates stopping the rotating blade, the blade moves beneath the table, and the power to the motor is shut off, all within 5 milliseconds, minimizing the injury (www.sawstop.com). This example shows that new and creative solutions to hazards that have been routinely thought of as "part of the job" can be eliminated, which is exactly what PtD is about.

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Figure 1 – Jointer involved in the incident

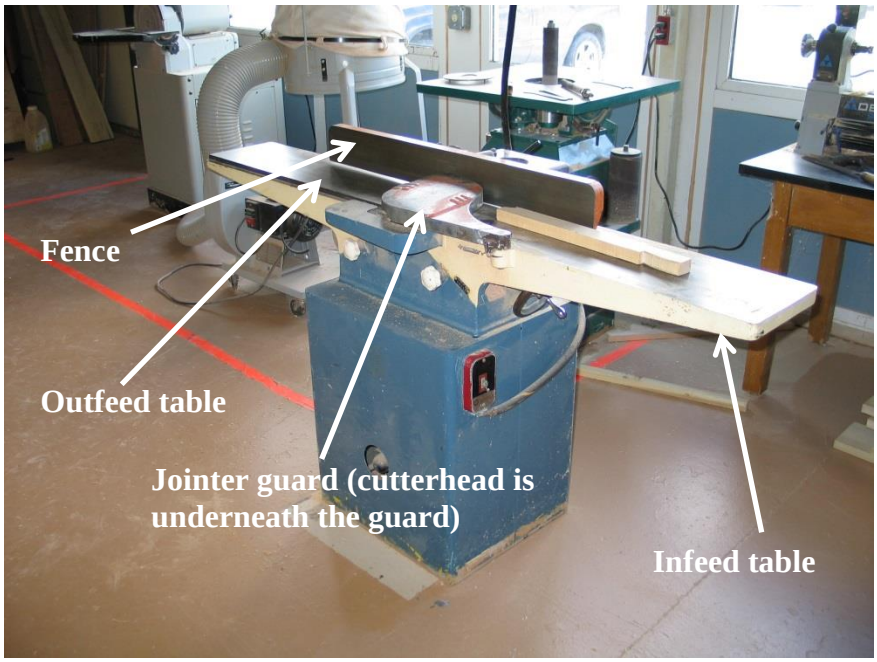

Figure 2 – Similar size wood work piece that was being cut