

Hazard Analysis of the Craftsman Drill Press

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Abstract: A hazard analysis of an industrial drill press is presented. The analysis included a discussion of prior injury data, a preliminary hazard analysis (PHA), a fault tree analysis (FTA), and a failure mode and effects analysis {FMEA} of a Craftsman drill press (include model number), with attention given to pre-operational safety, operational safety, and housekeeping concerns. Based on these various analyses, the most common and the most severe injuries were identified, as well as the causes of these accidents. The results show that the accidents with drill presses are consistent with the hazards identified by the OSHA website. Most of the injuries are amputations, with the second most frequent being fractures. Electrical shock injuries were also a concern. The preliminary hazard analysis reveals that the hazard controls for both amputations and fractures were similar: Drill users must avoid wearing loose clothing or jewelry that may become caught on the spinning drill. In general, amputations are among the most severe and disabling workplace injuries that often result in permanent disability. In terms of strategies to prevent re- occurrences of these accident scenarios, the most useful would appear to be adequate training towards improving the use of drill press, with attention to clothing and jewelry worn by the operator. The second important hazard control is verifying that all manufacturer-supplied guards are in place before use. Because users may not receive the drill press in a “new” condition, familiarity with OSHA machine guarding publications such as OSHA 3170 can cue a user to guards which may have been removed and not replaced. Pre-operational checks should also verify that no wiring has come loose to reduce the electric shock hazard. The Fault Tree Analysis revealed another basic cause of injuries and amputations. In addition to concerns about loose clothing and jewelry, improper securing of the workpiece can cause operator injuries as well, so verifying that the workpiece is secured before drilling is also a necessary precaution. The Failure Modes and Effects Analysis identified issues with the belt cover, the guarding of the spindle, and the securing of the drill press to the floor.

Keywords: Product safety, Hazard analysis, System safety

1. Introduction

A drill press is a wood cutting machine that uses a multiple-cutting-edged rotating tool to remove wood and produce a hole in the stock. Normally, drilling machines are vertically arranged with the tools having variable speeds and feeds. They may also have multiple spindles for gang drilling [5]. The most used drilling machine is a single- spindle, floor-mounted, belt-driven machine for non-production drilling. Nowadays, the drill press comes in a floor or bench mounted model. It has a motor driven head that has a chuck that accepts bits and cutters. It also has an adjustable table on which the work is mounted. The drill press is operated by pulling a rotary lever which lowers the drill bit/cutter into the work material.

2. Accident History Discussion

Accidents are possible with the type of hazard analysis of the craftsman drilling press, there are several hazard specification and safety warnings for a reason. Personal protective equipment (PPE) must be worn, and safety precaution must be taken in consideration to avoid injury [1]. The results show that the accidents with drill presses are consistent with the hazard identifications given by the OSHA website. Most of the injuries are amputations; the first two sections are the recognizing and controlling amputation hazards, look at sources of amputations, and how to safeguard machinery and control employee exposure to hazardous energy (lockout/ tagout) during machine servicing and maintenance activities. The section on specific machinery hazards and safeguarding methods identifies the hazards and various control methods for machinery associated with workplace amputations, such as: mechanical power presses, press brakes, conveyors, printing presses, roll-forming and roll-bending machines, shears, food slicers, meat grinders, meat-cutting band saws, drill presses, milling

machines, grinding machines, and slitting machines [2]. A description of accident history with drill presses is presented below.

Accident: 99802.015 - Employee Amputates Two Fingers When Operating A Drill Press

Accident: 99802.015 -- Report ID: 0729700 -- Event Date: 10/09/2017						
Inspection	Open Date	SIC	Establishment Name			
1270050.015	10/13/2017		Fca Llc			
At 9:30 a.m. on October 9, 2017, an employee was cleaning out debris from a multiple-head drill press. The employee's gloved hand came into contact with the rotating drill bit and pulled his hand and finger into the drill bit. The employee amputated his right ring and middle fingers from his hand and suffered a laceration to his pinky. The employee was hospitalized as well.						
Keywords: caught in, amputated, drill, finger, laceration, amputation, lockout/tagout, drill press						
Employee #	Inspection	Age	Sex	Degree	Nature	Occupation
1	1270050.015	65	M	Hospitalized injury	Amputation	Machine operators, not specified

Table 1: Shown above is the Employee Amputation two fingers when operating A Drill press [2].

Accident: 202715728 - Drill Press Operator Amputates Ring Finger

Accident: 202715728 -- Report ID: 0950633 -- Event Date: 06/19/2013						
Inspection	Open Date	SIC	Establishment Name			
316212695	07/08/2013	5091	Oreq Corporation			
At about 3:00 p.m. on June 19, 2013, an employee was working for a firm that manufactured pool supplies. He had been working as a regular employee for the employer for 10 years. The employer had 45 employees, and it was nonunionized. At the time of the incident, the employee was operating a Gorton 7-speed drill press, with Serial Number 15780, to make an 0.25-inch (6.35-millimeter) hole in a piece of steel plate. The steel plate had the dimensions 4 inches by 1 inch by 0.0625 inches (102 millimeters by 25.4 millimeters by 1.59 millimeters). The employee was wearing gloves while operating the drill press. The ring finger portion of the glove on his right hand got caught in the spinning drill bit, and the finger was amputated to the first knuckle. The injury was reported to the Division by the employer at 4:15 p.m. on June 19, 2013, and the investigation was initiated at 2:00 p.m. on July 8, 2013.						
Keywords: rotating parts, amputated, finger, glove, machine operator, caught by, elderly, drill press, hand						
Employee #	Inspection	Age	Sex	Degree	Nature	Occupation
1	316212695			Hospitalized injury	Amputation	Helpers, mechanics and repairers

Table 2: Shown above is the Drill Press Operator Amputation Ring Finger [2].

Accident: 202531679 - Employee Gets Middle Finger Amputation From A Drill Press

Accident: 202531679 -- Report ID: 0950664 -- Event Date: 01/15/2013							
Inspection	Open Date	SIC	Establishment Name				
313647190	01/17/2013	1799	California Comfort Systems, Inc.				
On January 15, 2013, Employee #1 of California Comfort Systems was operating a portable drill press and suffered a finger amputation. The employee was drilling holes in a horizontal steel flange at the base of a tank called a beer well. Employee #1 was wearing gloves while using a Milwaukee heavy duty portable drill press with a magnetic base. When he tried to remove the swath (chips, cuttings) from the drill after it was lifted out of the cut, the spinning hole saw attachment on the drill grabbed his glove pulled it into the drill and amputated his finger.							
Keywords: amputated, finger, glove, saw, drill press							
End Use		Proj Type		Proj Cost	Stories	NonBldgHt	Fatality
Manufacturing plant		Alteration or rehabilitation		\$500,000 to \$1,000,000		20	
Employee #	Inspection	Age	Sex	Degree	Nature	Occupation	
1	313647190			Hospitalized injury	Amputation	Plumbers, pipefitters and steamfitters	

Table 3: Shown above is the Employee Gets Middle Finger Amputation from A Drill Press [3].

Accident: 99331.015 - Employee'S Hand Is Injured While Operating Drill Press

Accident: 99331.015 -- Report ID: 0521700 -- Event Date: 09/18/2017						
Inspection	Open Date	SIC	Establishment Name			
1266666.015	09/26/2017		Wiremasters, Incorporated			
At 1:30 p.m. on September 18, 2017, an employee was operating a drill press with a hole saw cutting tool. As the employee loaded a part into the fixture with the drill press running, his right hand contacted the hole saw blade. As a result, the employee's right middle finger was amputated and ring finger lacerated. He was hospitalized for his injuries.						
Keywords: caught in, amputated, drill press						
Employee #	Inspection	Age	Sex	Degree	Nature	Occupation
1	1266666.015	36	F	Hospitalized injury	Amputation	Machine operators, not specified

Table 4: Shown above is the Employee's Hand is injured while Operating Drill press [3].

3. Hazard Analysis of the Craftsman Drilling Press

The drill press should be considered one of the most hazardous tools in the shop. Common injuries on the drill press include broken wrists and fingers, amputated fingers, scalping and eye injuries. Another injury that has a decent amount of frequency on the OSHA website is fractures. An example located in the database is the operator using the drill press had unacceptable PPE to use the machine, and the person's glove got caught in the machinery which lead to a fractured limb. Fingers are easily broken by adjusting the pulleys if the operator accidentally turns on the machine while the speed is being adjusted, as with most drill presses there is no safety switch to stop the machine operation if the cover is open [5]. The manual also has a detailed description and instruction on safety and efficient operation, while space limitation do not make it possible to follow OSHA regulations [5].

4. Safety Analyses

Three different safety analyses techniques were used to review the safe and hazard craftsman drilling press. The first was a preliminary hazard analysis, the second one is the fault tree analysis, and the third one is the failure mode and effect analysis, which is shown below.

4.1 Preliminary Hazard Analysis

See Table 5

Table 5. Preliminary hazard analysis.

HAZARD	CAUSES	EFFECT	CORRECTIVE
The hazard is wearing clothing, jewelry, and long hair could get caught in machine and foreign objects could get into the eyes.	Not wearing proper PPE like safety glasses, full cover shoe [5]	Entanglement leading to personal injury or death [5].	Clothing should be sturdy and snug. Wrap long hair in net. Do not wear rings or jewelry when operating machine. Always wear safety glasses with side shields and full cover shoes [5].
The hazard is spinning parts which can cause injury by the part spinning OR by clothing or body parts being caught by the rotation part.	Drilling incorrectly. (a) Improper operation (b) failure to perform preventive maintenance. (c) Too much preventive maintenance. (d) failure to continuously monitor equipment Bad reliability culture [5]	Machine damage/injury Unchecked machine vibration can accelerate rates of wear (i.e. reduce bearing life) and damage equipment. Vibrating machinery can create noise, cause safety problems and lead to degradation in plant working conditions. Vibration can cause machinery to consume excessive power and may damage product quality [5].	Never start the machine with the drill bit, cutting tool, or sanding drum against the work piece. Use only drill bits, cutting tools, sanding drums or other accessories with a shank size recommended in your instruction manual. Use only drill bits, cutting tools, or sanding drums that are not damaged. Always use recommended speeds for all operations. Use only accessories that are recommended by the manufacturer for model. Accessories that may be suitable for one tool may create a risk of injury when used on another tool. Make sure there are no nails or foreign objects in the part of the work piece to be drilled.
Electrical Safety	Not turning off the drill press and it is important to wait for it to stop before walking away from the machine to avoid	Electricity has long been recognized as a serious workplace hazard, exposing employees to electrical shock;	Inspect/replace damage or worn power cords immediately. Cord replacement should only be done by factory authorized

	overuse and workload of the machine. [5]	which can result electrocution, serious burns, or falls that result in additional injuries or even death; as well as electrical arc-flash and electrical arc-blast. Electric current can produce deep and severe burns in the body due to power dissipation across the body's electrical resistance. Dystonia is the condition where muscles involuntarily contract due to the passage of external electric current through the body. It is important to turn off because it generates bills	technician [5]
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Fault Tree Analysis.

The specific accident scenario selected for the fault tree was amputation or other serious injury [Fig 1].

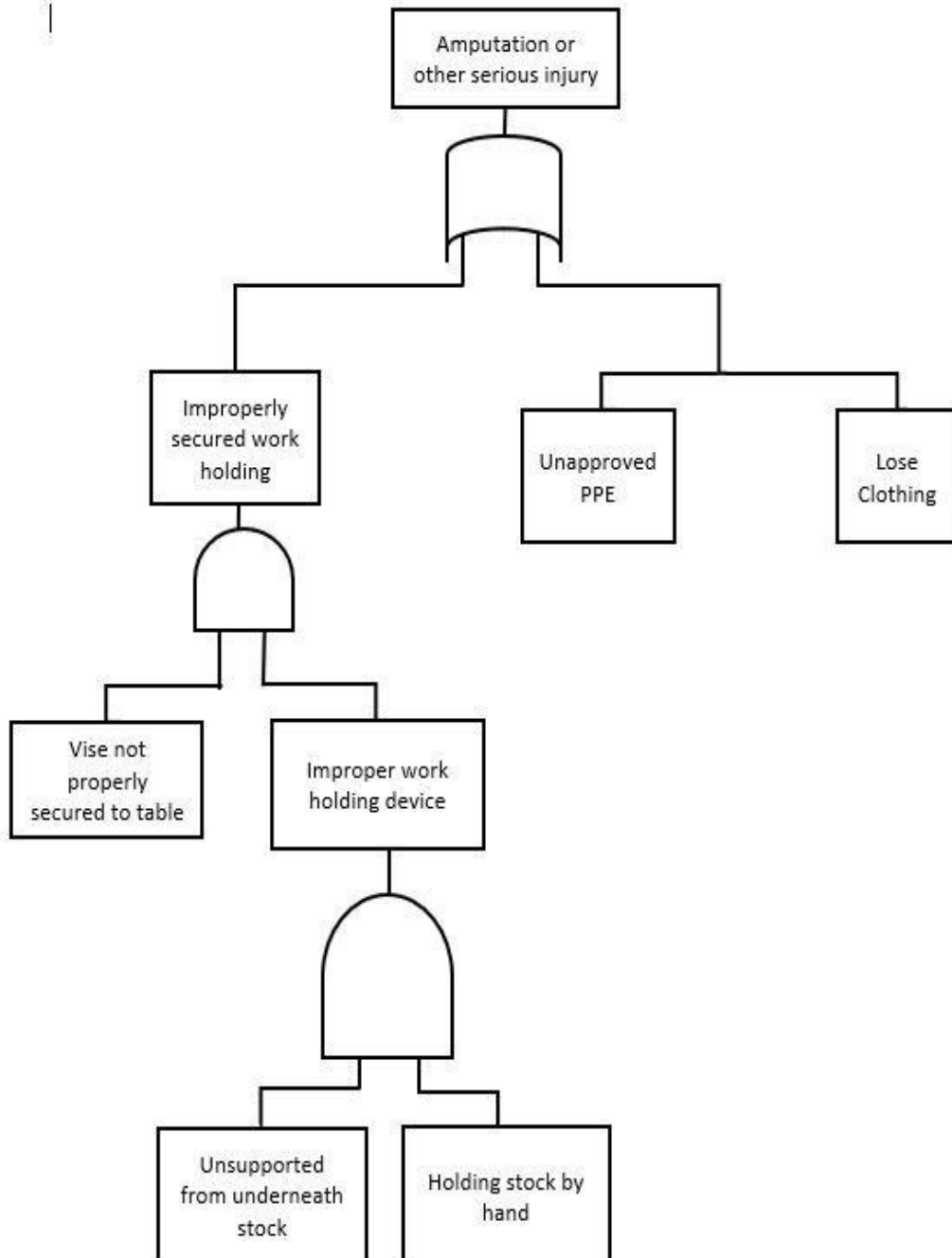


Table 6: Below is the failure mode and effects analysis [FEMA] of craftsman drill press.

Item / Function	Potential Failure Mode(s)	Potential Effect(s) of Failure	Sev	Potential Cause(s)/ Mechanism (s) of Failure	Prob	Current Design Controls	Det	RPN	Recommended Action(s)	Responsibility & Target Completion Date
Belt cover/ Belt guard	Guard is affixed with a spring clip	Fingers or other appendages could get caught in spinning pulleys and belts	2	Human error	4	Simple spring clip	4	32	Design a thumb screw into the mechanism to replace the spring clip	NA
Spindle guarding	Machine guarding	Hot metal cuttings flung into the operator	2	Manufacturer oversight	8	There is no spindle guard on the current model	3	48	Design or buy a better proprietary or universal spindle guard.	NA
Work holding	No standard work holding comes with drill press	Operator may hold work with hands, and work could come loose from operator	5	Manufacturer oversight	8	Standard Drill press table	8	320	Include an entry level work holding tool to keep costs low to customer	NA
Machine mounting	Most drill presses must be mounted to the floor	Drill press could tip during operation	2	Requirements Overlooked	3	Free standing pedestal	3	18	Include anchors for mounting	NA

5. Conclusions

Primary hazard analysis is used to determine what potential hazards of craftsman drilling press may pose to the operator or others standing by. By evaluating the potential hazards, their causes and then taking correct and preventative measures, user exposure to the hazards involved when using craftsman man drilling press is lessened. The fault tree analysis was a useful tool. Using the AND OR logic to produce a sequence of events that pose a potential hazard help clarify those combination of conditions which can result in an accident. The fault tree is a graphical approach to the organization of potential faults and failures that could lead to a larger hazard. The failure mode effects analysis takes specific components of the device, their function, failure mode, and cause, other components the failure could cause failure to, and corrective action that can be used to prevent failures. However, it's important when considering safety, identify equipment failure can save of time in repairing equipment and prevent injuries caused by equipment failure.

The case studies show that conclusions can be drawn concerning with that the drill press is a tool that comes with unforgiving consequences. The primary function of a drill press is to drill holes. However, if some of the simple safeguards are overlooked, a person could be a victim of the rotational inertial of the tool. It is so important that operators observe safety in all aspects of machine operation. The operators should not be wearing loose clothing that could get caught in one of the few spinning objects of the press. Overall, a drill press is a safe tool if the following precautions are followed: wearing safety glasses, avoiding loose clothing, and reading all instructions.

6. References

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