



Introduction to Safety – Unit Six: Tool Safety

Chapter Reading

Tool Safety

Unit 6





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LEARNING OBJECTIVES:

- **Describe the operation of the following types of handtools and explain the guidelines and precautionary measures that should be taken with them.**
 - Knives
 - Screwdrivers
 - Hammers
 - Pliers
 - Woodsaws
 - Wrenches
 - Socket wrenches
 - Files
 - Clamps
- **Describe the operation of the following types of power tools and explain the guidelines and precautionary measures that should be taken with them.**
 - Electric portable power tools
 - Electric stationary power tools
 - Hydraulic tools
 - Pneumatic tools
 - Powder-actuated tools
- **Explain the function of momentary switches and interlocks**
- **Describe how tool guards prevent harm from flying sparks, particles, and rotating parts that come loose or when they break.**

ALLOTTED LEARNING TIME:

7 days



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Orientation

In the manufacturing environment where products are assembled, they require fasteners of various types to hold things together. These fasteners include nails, screws, bolts and nuts. Each type of fastener requires various hand tools during the assembly. Some of these products that are assembled inside cabinets made of wood, plastic or metal as storage containers, or enclosures that protect the components inside from environmental conditions. Hand tools are required to fasten the cabinets together or to bend, cut and shape them.

Tools are designed to perform various functions and are also designed to be safe if used properly. However, if used in the wrong way, they can injure the person using them, and can cause damage to parts and equipment they come in contact with. Therefore, individuals who work with tools should receive training on their proper usage and applications. In the workforce, these individuals include production workers and maintenance personnel who troubleshoot and make repairs. The types of tools they use include those which are manipulated by hand, and those which are powered by electricity, pneumatics and hydraulics.

Introduction

Proper training on tool usage should be provided by employers for their workers when they begin employment, and also on an ongoing basis. Improper usage can result in having accidents that cause harm ranging from minor to serious injuries. Minor injuries include scrapes, lacerations, cuts, or bruises. Serious injuries include fractures, head trauma, crushes hands, severed fingers, and blindness.

In this unit, information about tool safety will be provided on both hand tools and power tools. This information will include how to inspect tools before they are used; how to keep them in good condition and what the technician should do if he or she suspects that a tool is unsafe for use; using the right tool for a particular job and using the tool properly; wearing the required personal protection equipment when applicable; and knowing the parameters for specific tools and what is considered safe and unsafe. This knowledge of tool safety will save lives, decrease lost work-hours, and save the company money. Knowing the proper use of tools is every production technician's responsibility.

The topics that will be covered in this unit include:

1. The operation of manual hand tool safety guidelines
2. The operation of electrical power tools and safety guidelines
3. The operation of hydraulic power tools and safety guidelines
4. The operation of pneumatic power tools and safety guidelines
5. The operation of powder-actuated power tools and safety guidelines



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1. Hand Tools

Any tool that is manually powered is considered a hand tool. Hand tools are a familiar part of our lives and are present in nearly every type of industry. Without these tools, many of the tasks when working would be difficult or even impossible. However, misuse and improper maintenance of tools can cause loss of work days, severe injury, or death. Most manufacturers of tools build them with adequate safety measures, which should never be altered, disabled or ignored.

The Consumer Product Safety Commission (CPSC) estimates that emergency treatments of injuries due to the misuse of hand tools number around 150,000 each year. There are approximately 30,000 injuries from hammers alone. Many of these injuries are preventable when people apply a little common sense and use hand tools properly.

1.1 Common Handtools

In this section of the chapter, the most common types of tools will be covered and their proper uses will be identified. Let us examine a few of the hand tools the production technician uses along with related safety issues. Although the rules of tool usage seem obvious or simple, they are often violated, which is why it is important to provide information about on how to use them properly and safely

Knives

The primary function of a knife is to cut through a material soft enough to allow the blade to penetrate through it. All knives have a handle that enables the worker to grab onto when making the cut. When the blade is sharp, less pressure is needed to go through the material, and has less of chance of getting hung up and slipping. Because more pressure is needed when the blade is dull, they are more dangerous than sharp blades.

There are a few rules and guidelines that should be followed when using this tool.

- Always move the blade away from you as you make the cut.
- Never use knives as prying tools because the blade may break, and an injury can occur if the broken part flies up and strikes the user at an unprotected area of the body.
- Never use the blade as a punch because it can easily damage the blade.
- Never use a knife as a screwdriver, an awl or a can opener as these unintended operations can dull the blade.

Screwdrivers

Screwdrivers are meant to turn screws, such as those with flat, Phillips, hex heads, and screws with specialty heads. Each type of screwdriver tip is designed to be used for the particular head of the screw being turned. There are also various



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screw head sizes which is usually influenced by the diameter of the threaded portion of the screw. As a result, each type of screwdriver, such as a phillips type for example, have tips that are of different sizes. If the screwdriver tip does not fit the head of the screw, it will be necessary to apply more force to turn the screw. However, in the process, the screwdriver can easily slip and cut or puncture a body part, the square edge of the tip may become dull, or the slots of the screw head may become rounded.

There are a few rules and guidelines that should be followed when using this tool.

- For better control, use screwdrivers with shorter shafts.
- To apply more torque with less effort to turn the screwdriver, use one with thicker handles.
- Redress the tips of flat head screwdrivers to keep them sharp and square edged.
- Do not use screwdrivers for prying, as can openers, punches, chisels, wedges, etc., because they can cause chipped, rounded heads, dull tips, bent shafts, or the handles can become split or broken.

Hammers

Hammers and other striking tools are widely used and often abused. Hammers are made for specific purposes in various types and sizes, and with striking heads of varying shapes and hardnesses. For example, hammers are used for general carpentry, framing, for pulling nails, cabinet making, assembling furniture, upholstering, wood finishing, riveting, bending or shaping metal, and striking masonry. Commonly used hammers include the claw hammer, ball peen hammer, machine hammer, dead blow, and the sledge hammer. Hammers are designed according to the intended purpose, therefore the following rules and guidelines should be followed:

- Select a hammer that is comfortable for use and that is the proper size and weight for the job. Misuse can cause the striking face or surface that is struck to chip, possibly causing a serious injury.
- Choose a hammer with a striking face diameter approximately 12 mm (0.5 inch) larger than the face of the tool head (e.g., chisels, punches, wedges, etc.) being struck.



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Hammers

- Select correct hammer for the job
- Striking face diameter
- Firmly attached hammer head
- Replace damaged handles
- Strike properly
- Wear PPE



- Inspect before use to ensure the head of the hammer is firmly attached to the handle.
- Replace loose, cracked, or splintered handles. The head of the tool can easily fly off and hit someone.
- Discard any hammer with a mushroomed or chipped face, or those with cracks in the claw or eye sections.
- **When using a hammer, always wear safety glasses or a face shield.**
- Strike a hammer blow squarely with the striking face parallel to the surface being struck. Avoid glancing blows and over and under strikes. Hammers with beveled faces are less likely to chip or spall.

Question: Why must a hammer handle be properly fitted into the hammer head?

Answer: If not fitted properly, the hammer head may fly off and hit someone or even you in the face or head.

Pliers

Pliers are designed to clamp on to a material to make it easier for bending, twisting, or pulling whatever is being worked on. The pliers is a type of lever with a



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mechanical advantage which applies a large gripping force by its teeth when squeezing the handles with a hand.

There are a few rules and guidelines that should be followed when using this tool.

- Do not substitute a pliers for a wrench because the gripping surface could be damaged, or the bolt or nut can be ruined because the pliers can easily slip off.

Wood Saws

There are different types of saws designed for specific applications. The difference between them is based on the way the teeth are designed. The teeth of cross-cut saws are designed to cut across the grain of wood, whereas the teeth of a ripping saw is designed to cut with the grain. There are a few rules and guidelines that should be followed when using saws:

- Use a saw with course teeth for sawing green wood, thick lumber or making course cuts.
- Use fine-toothed saw when making fine cuts with dry wood.
- After use, wipe the saw with a lightly oiled rags to keep the teeth clean.
- Prevent the saw from getting bent during storage by laying it flat and by not placing something heavy on top.

Wrench types

Wrenches are handtools designed to tighten or loosen hardware that are mated with threads. Wrenches come in various shapes and sizes and are used for gripping, fastening, turning, tightening and loosening at least one of the mating parts. The particular shape of a wrench is designed for fitting with a certain kind of hardware, such as pipes, pipe fittings, nuts, and bolts. Therefore, there are several types of wrenches, each used for particular applications. However, wrenches can be put into two different categories, **pipe wrenches** and **general use wrenches**. *Pipe wrenches* are used in plumbing and have jaws with teeth for gripping round (cylindrical) objects. *General use wrenches* are used on nuts and bolts, and have flat, parallel surfaces (for example, square or hexagonal). General use wrenches may be fixed or adjustable, and can include sub-categories, such as Allen wrenches and Torx wrenches.



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Types of Wrenches

- **Pipe Wrench**
 - Fits around plumbing and electrical piping and fittings (round objects)
- **General Use Wrench**
 - Nuts & bolts with flat parallel surface
- **Adjustable**
 - Monkey wrench, Crescent™



Socket wrenches

A socket wrench, **also known as a ratchet wrench**, is a type of wrench, or tightening/loosening tool that has separate, removable sockets to fit many different sizes of hardware fittings and fasteners, most commonly nuts and bolts. Most often the sockets are attached to a handle that is a lever with a ratcheting mechanism which allows the nut or bolt to be tightened or loosened with a continuous motion, rather than requiring that the wrench be removed and refitted after each turn.

Socket Wrenches

- Use correct socket for the job
- Ensure that wrench fits socket properly
- Remember: a socket is a wrench, not a hammer





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There are a few rules and guidelines that should be followed when using wrenches:

- Choose a wrench that fits the fastener you want to turn.
- Use the correct size – use metric for metric nuts and bolts and English or SAE for standard nuts and bolts.
- Never use a wrench as a hammer.
- Never hammer on the wrench to loosen bolts or nuts.
- Never use a wrench with damaged or sprung jaws because it can slip off a bolt or nut, causing the worker to scrape a knuckle, fall from an elevated worksite, or fly out of the hand and strike someone.



Files

Files are shaping tools made of hardened steel that smooth wood, fiberglass, or metal, removing burrs, sharp edges or rough spots. They can finish off or enlarge holes, and allow wood to be pared and shaved in places where planes and chisels just won't reach. Using a rasp or a file is often the first step in finishing a project, or prepping a material for the next step after cutting a material.

Files are handtools designed to shape material by cutting. A file consists of a hardened steel bar, mostly covered with a series of sharp, parallel ridges or teeth. Most files have a narrow, pointed tang at one end to which a wooden handle can be fitted. Similar to a [file](#), another tool called a [rasp](#) has [generally larger and has raised, pointed teeth on its surface rather than straight ridges](#). Rasps generally cut more coarsely than files and is designed for the rapid removal of wood or a



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similarly soft material. A **file card** is a brush with metal bristles used to clean the cutting grooves in a file.

There are a few rules and guidelines that should be followed when using files:

- The filing action should be repetitive forward strokes, angling the tool slightly to the workpiece.
- Select the correct file for the job.
- When using a file, wear proper personal protective equipment (PPE), such as gloves and safety glasses.
- Do not use a file as a chisel or scraper. Files are brittle and will shatter on impact.
- Sharpen the file when the finish goes bad.

Files

 A **file** (or **hand-file**) is a hand tool used to shape material by cutting. A file typically takes the form of a hardened steel bar, mostly covered with a series of sharp, parallel ridges or *teeth*. Most files have a narrow, pointed tang at one end to which a handle can be fitted.

 The **rasp** is a related tool which is generally larger and has raised, pointed teeth on its surface rather than straight ridges.

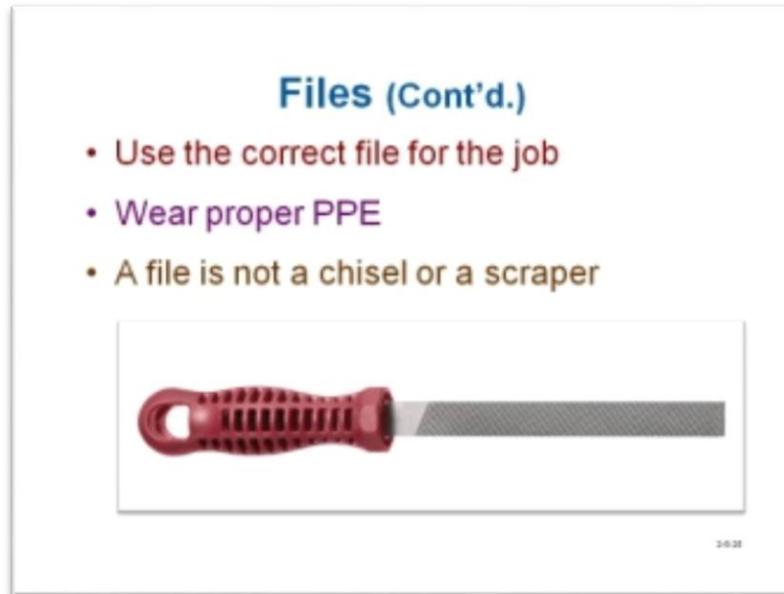
 A **File card** is a brush with metal bristles, used to clean the cutting grooves in a file.

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Question: What are files used for?

Answer: To smooth out rough edges on metal surfaces.

Clamps – Clamps are versatile devices used to temporarily hold workpieces securely in place. They are used for many assembly applications including carpentry, woodworking, furniture making, welding, construction and metalworking.

There are several styles of clamps, each of which are designed for various objects of different shapes and sizes. These clamps include C-clamps, bar clamps, pipe clamps, and hand screws. Bar clamps have adjustable arms that are easily widened or narrowed to fit the work piece, and require fewer turns of the screw spindle, compared to a C-clamp, to hold the piece tightly in place. When working with clamps, the proper clamp style and size should be selected to accommodate the specific requirements of the job with the following clamp considerations and features:

- strength and weight (e.g., consider rail size and nominal clamping pressure),
- opening (length of reach),
- throat depth (depth of reach),
- ease of adjustment,



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- clamping surfaces (material used and size),

Clamps

Never:

- Tighten the clamp with a section of pipe
- Use a clamp for hoisting materials
- Over-tighten clamp



There are a few rules and guidelines that should be followed when using clamps:

- Never tighten the clamp with a section of pipe to extend grip and gain more leverage
- **Never use a clamp for hoisting materials** (picking up work)
- Never over-tightening clamp, thus bending frame and twisting handle threads

1.2 Hand Tool General Guidelines

As a production or maintenance technician who uses tools in the workplace, one of their responsibilities is to inspect them before usage to ensure there is no damage. **It is important to follow some general guidelines regarding tools. Otherwise they could be damaged or the** important safety features they have may be rendered useless. These guidelines include:

- **Do not take short cuts** – Use the right tool for the job. Often the reason for injuries from improper use of tools is that people do not want to take



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the time to get the proper one and therefore take shortcuts by using other types of tools instead. This situation often occurs when maintenance is being performed in the field, where there is a rush to get production equipment which broke down running again. So an alternative tool is used because it would be inconvenient or time-consuming to get the proper tool.

- **Complacency** – Over time, employees can often become complacent and therefore fail to recognize hazards because they are so familiar with the area in which they are working, or the equipment on which they are working.
- **Inspection** – All tools should be inspected daily, if not before every use.

Recognizing Tool Hazards

- No short cuts – right tool for right job
- Difficult to spot hazards due to familiarity
- Inspect the tools daily



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- Do not leave tools lying unattended. Keep the workplace clean and orderly to avoid clutter that may cause slip, trip, and fall-related accidents.
- When there is a risk of flying particles from tool use, it is imperative to wear safety glasses and/or face shields.
- Tools in use near aisle ways can project particles at people walking by.



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- When working around flammable materials, precautions must be taken prior to using tools that generate heat, sparks, etc.
- Always be aware of your surroundings and the people around you. Materials that are not adequately secured could become airborne and strike people in the work area.

Safety Factors

- General housekeeping
- Use PPE
- Use protection around flammables
- Do not use tools near aisleways
- Unsecured materials can become airborne
- Be aware of surroundings



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Review Questions

1. Always move the blade of a knife _____ you when cutting.
 - A. away from
 - B. towards
2. When using a phillips screwdriver that is too large for the head of the screw, the _____ will become stripped or rounded.
 - A. Screw head
 - B. Screwdriver tip
 - C. Both A and B
3. A _____ wrench is used for SEA nut and bolts.
 - A. metric
 - B. English
 - C. Both A and B
4. A hammer's striking surface should be _____ the face of a tool being struck.
 - A. 0.5 inches larger than
 - B. 0.5 inches smaller than
 - C. the same size as
 - D. There is no rule
5. What type of PPE should be worn when using a hammer?
 - A. safety glasses
 - B. face shield
 - C. A or B
 - D. gloves
6. What type of PPE should be worn when using a file?
 - A. gloves
 - B. safety glasses
 - C. Both A and B
 - D. None are required
7. A file card is a _____.
 - A. knife
 - B. brush
 - C. small fire
 - D. abrasive cloth



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8. Clamps are versatile tools that serve to _____ hold work securely in place.
- A. temporarily
 - B. permanently
 - C. A or B
 - D. There is no recommendation
9. Pipe wrenches are designed to be used on nuts or bolts. True or False





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2. Power Tools

Various types of tools are available to the production and maintenance technician that are run by some power source other than the human operating them. This power creates the force that provides the mechanical action of the tool. The specific movement and operation of the tool is usually manipulated and controlled by the technician's hands. Power tools can operate at very high speeds and are especially dangerous if they have sharp or abrasive edges. Each type of power tool has a unique hazard, but for most there are similar precautions that should be observed. Knowing what types of hazards to look for and how to safely use these tools is vital to an individual's safety and to the safety of others. The employer should provide training to their employees who use power tools prior to operating them for the first time.

Energy Sources – Power tools get their energy from a variety of sources, and therefore are classified accordingly. These power sources include:

Electric – powered by electricity.

- Alternating current (AC), such as wall plug.
- Direct current (DC), such as a battery.

Pneumatic – powered by compressed air, which is produced by electric or gasoline compressors.

Hydraulic – powered by fluid pressure using oil. The fluid power is usually produced by electric pumps.

Powder-actuated – powered by gunpowder cartridges called boosters.



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Power Tool Energy Sources

- **Electric** – Powered by electricity

- Alternating current (AC), a wall plug
- Direct current (DC), such as a battery



- **Hydraulic** – Powered by fluid pressure

- Manual or electric pumps
- Used to produce fluid pressure



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Power Tool Energy Sources (Cont'd.)

- **Pneumatic** – Powered by air

- Compressors produce the air pressure



- **Powder-actuated** – Powered by gunpowder cartridge called boosters

- OSHA requires that all operators be qualified and certified by the manufacturer before use



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NOTE: OSHA requires that before use of power tools, all operators must be qualified and certified by the manufacturer.



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2.1 Electric Powered Tools – Most common power tools is run by electricity. These tools are very safe, but if used improperly because of not following manufacturer’s guidelines, an electric powered tool can result in serious injury. Among the **chief hazards** of electric power tools are **shocks** that can lead to **burns** or even **cardiac arrest**, and **eye** injuries. Specific training should be provided on their usage and also electrical safety before an employee is given the assignment to operate these devices.

There are **portable** electric power tools and **stationary** electric tools.

Portable Electric Tools

There are several types of portable electric tools, which include:

2.1.1 Saws – The most common portable saw is the circular type that has a blade with teeth which turns at a very high RPM. These saws are relatively heavy, and therefore have a handle to grab onto to make it easier to carry or manipulate during its operation. Most often these saws are used to cut wood. Portable circular saws should be equipped with an upper guard that covers the entire blade of the saw. A retractable lower guard must cover the teeth of the saw except where it makes contact with the work material. This lower guard must also automatically return to the position where it covers the blade when the tool is withdrawn from the material it is cutting.

Another type of saw commonly used is a saber saw, it is used for smaller woodcutting jobs and for making curved cuts.

There are a few rules and guidelines that should be followed when using saws:

- Wear PPE devices such as ear plugs to protect hearing because they are loud.
- Wear goggles or safety glasses and an eye shield to protect from flying debris or sawdust.
- Turn the saw off before unplugging it.
- Don’t set the saw down until the blade comes to a complete stop.
- Do not use dull blades, make sure the correct type is used for the job, and don’t overload the motor by pushing too hard or cutting a material that is too dense or large.
- Saw blades should be directed away from aisle areas and other people working in close proximity.



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- Be sure the hand that is not use to hold the saw will not get in the way of the cut.
- Be sure to have firm footing and balance to prevent falling when making the cut.

2.1.2 Drills – A hand tool commonly used is the drill. They are used for several operations such as boring holes, turning screws, grinding, and buffing. Drills can be fixed speed or variable speed.

There are a few rules and guidelines that should be followed when Using drills:

- Select the correct drill bit for the job to be performed, and make sure they are sharp.
- Tighten the chuck securely and make sure the key is removed before starting the drill.
- Make sure that the material being worked on is secured or clamped firmly.
- Hold the drill firmly and at the correct angle, and don't apply too much force.
- Always remove the bit when finished with the drilling operation.

2.1.3 Abrasive Wheels and Tools – Abrasive tools are one type of electric powered tool commonly used in the workplace. These tools have electrical motors that turn a mechanism to perform a variety of operations. They include grinding, cutting, polishing, and wire buffing wheels, all of which create special safety problems because they may throw off flying fragments. A sander is another type of abrasive tool. Sanders either have an orbital disk, or have a belt that rotates in a linear fashion. When using this type of tool, the following safety guidelines and precautions must be considered:

- **Arrange** the power cord so that it won't be damaged by coming in contact with the abrasive element of the tool.
- **Before** use, inspect the tool to ensure it is in good condition and the wheel is properly secured.
- **After** a cutting or grinding operation is finished, do not set the tool aside until the wheel comes to complete stop.



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- **Always** use eye protection, preferably including a full-face shield with safety glasses underneath.
- **When** holding an electric power tool that has a high speed motor, both hands should be used to keep it secure because of the high torque it creates.
- **Since** powered wheel tools can pull you off balance, ensure that you have firm footing during use.
- **Ensure** that all safety guards are in place.
- **Never** clamp a hand-held grinder in a vise because it can shake loose and injure the operator.



- **When** changing wheels, disconnect the electric power source to avoid inadvertent start-up.



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Powered Abrasive Wheel Tools

- Always use eye protection
- Use both hands to hold tool
- Make sure you have firm footing
- Make sure all guards are in place
- Never clamp a hand-held tool in a vise
- Disconnect electric source when changing wheels



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Question: What are the safety hazards associated with placing a hand held grinder in a vise?

Answer: The grinder will vibrate the vise and fall out. A person's natural instinct is to try to catch it, which will result in cuts and abrasions or worse.

2.1.4 Power Tool Momentary Switches – Electric hand tools are commonly equipped with a constant-pressure on-off switch (also referred to as a momentary switch) that is similar to the trigger of a handgun. When the trigger is pulled, the switch is on and the tool is activated.

When the trigger mechanism is released the tool is off.

Some momentary switches have an additional feature that is a lock-on control. This control is activated by a simple movement of the forefinger, where the trigger becomes locked on when a button is pressed. By locking the switch, the operator can grip the handle more firmly with the forefinger not holding the trigger in place. The “lock-on” switch is simply disengaged with a simple movement of the forefinger on the trigger device itself.

Examples of tools that might have momentary switches include:

- electric drills,
- electric screwdrivers,
- fastener drivers,



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- horizontal, vertical and angle grinders,
- disc and belt sanders, and
- reciprocating saws
- saber saws.

Note: For some applications that require a firm hold of the tool, older tools that do not have lock-on switches should not be used.

Note: To avoid accidental starting, do not hold onto the power switch while carrying an energized tool.

Question: What is a momentary switch?

Answer: It is an “on-off” switch that allows the equipment to work only when the trigger is engaged.

2.1.5 Interlocks – An **interlock** is a device used to help **prevent** a **machine** from **harming** its operator or damaging itself by **stopping** the **machine** when **tripped**. An example of a household interlock at work is a microwave oven. When the door is opened, the interlock trips and it stops running. Another example is a washing machine that interrupts the spin cycle when the lid is opened.

Interlocks

- **Interlocking** is a method of preventing undesired states in a machine, which in a general sense can include any electrical, electronic, or mechanical device or system.
- **Interlocks** also serve as important safety devices in industrial settings, by protecting employees from devices such as robots, presses, and hammers.

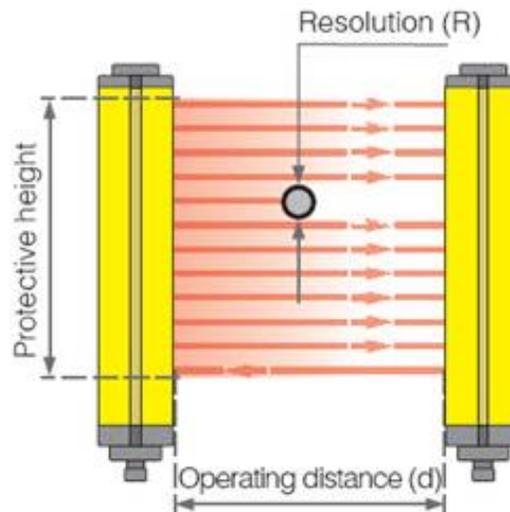
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In industrial applications, interlocks protect workers from various types of equipment such as robots, presses, and hammers. They may be as sophisticated as safety curtains that use a roll of optical sensors, or as simple as a switch.



Optical Safety Curtain

2.1.6 Electric Hand tool Guidelines - Following some simple rules will reduce potential hazards and help to ensure the safe operation of portable electric hand tools, such as,

- Ensure that the tool is properly grounded by using a three-prong plug, or a ground-fault circuit interrupter when OSHA regulations are required.
- The tool should not be carried by the cord.
- The cord should not be yanked out of the receptacle, which can result in loose wires, causing shock or fire hazards.
- The tools should be disconnected when changing attachments, or when not in use, to prevent accidental start-up.
- Use PPE as required including glasses, gloves, face shields, boots, and protective clothing, such as leather or rubber aprons.



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- Operate the equipment within its design limitations.
- Do not use electrically powered tools in wet or damp locations.
- Do not use electrically powered tools around combustible materials.

Electrically Powered Tool Safety

- Use PPE as required
- Operate within design limitations
- Do not use in wet or damp locations
- Do not use around combustible materials
- Work areas should be well lighted
- When not in use, store tools in a dry location

- Keep work areas well lit.
- When not in use, store electrically powered tools in a dry location. Moisture can affect the electrical circuit in the tool, leading to a possible shock hazard and reducing the useful life of the tool.
- The cords must not be strung through water.

Power Tool Precautions

- Never carry a tool by the cord
- Never pull the cord to unplug it
- Keep cords out of water
- Disconnect tools when changing attachments or when not in use
- Keep tools maintained properly
- Do not wear loose clothing or jewelry





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Question: What are the hazards of working with a tool that has loose wires?

Answer: Electric shock or fire.

Stationary Electric Tools

There are several types of stationary electrical tools, which means they are used in a fixed position, often because they are heavy to move. They include:

2.1.7 Table Saws – This tool has a horizontal table made of a polished metal top to make it easy to slide a material into the blade. The cutting blade protrudes out of the table surface, and the amount it rises above the table is adjustable so that it is capable of cutting various thicknesses of the material being cut. The blade can also be adjusted from a vertical position to a slanted position to make angle cuts of wood or other materials.

When using this type of saw, the following safety guidelines and precautions must be considered:

- Never reach over the saw to push stock.
- Use a fine cross-cut saw to cut across the grain of wood.
- Use a ripping saw to cut wood along the grain.
- Do not cut pieces of stock that are too small to be secured.
- Remove any loose knots, nails or other metal hardware from the stock before making a cut.

- Make sure the saw is at full speed before starting the cutting operation.
- Stand slightly to one side instead of in line with the saw blade to avoid getting hit if the material is thrown back (called “kickback”)
- Use a splitter guard
- Never use a dull blade
- Try not to cut freehand, but push the stock through the stock with a stick if possible.

2.1.8 Radial-Arm Saws - This multipurpose saw is mounted on a moveable head, and slides in tracks or along a track as it cuts through the stock.

When using this type of saw, the following safety guidelines and precautions must be considered:



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- Return the saw to the rear of the table against the column after each cut is made.
- Never remove the safety built-in safety devices, such as blade guards, anti-kick pawls, and blade brakes.

2.1.9 Drill Presses – The drill press is a stationary tool that is large and more powerful than a portable drill. Therefore, it is capable of drilling through materials that are too thick or too dense for the smaller hand drill.

When using this type of drill, the **following safety guidelines** and **precautions** must be **considered**:

- Make sure any attachments are fastened tightly.
- Clamp and secure the material being drilled.

2.1.10 Power Sanders – This tool has a horizontal table made of a polished metal top to make it easy to slide a material into the abrasive element, which is either a orbital disk or a belt. When using this type of tool, the **following safety guidelines** and **precautions** must be **considered**:

- Move the stock around to avoid heating and burning a portion of the disk, belt, or material being sanded.
- Use a dust collector to avoid making amess, and to minimize inhaling the small particles.



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Review Questions

10. Drills are used for _____.
- A. buffing
 - B. boring holes
 - C. turning screws
 - D. All of the above
11. If a hand-held grinder needs to be in a solid fixed position, it is recommended that it be tightly secured in a vise. True or False
12. Some momentary switched used for hand tools have a “lock-on” switch.
13. An example of an interlock is a _____.
- A. boat canel
 - B. microwave oven
 - C. keyless entry
 - D. keyed paddlock
14. When wearing protective gloves, the best way to remove the male connector from a female socket is to grab the power cord and pull. True or False
15. A _____ saw should be used to cut wood across the grain.
- A. ripping
 - B. cross-cut
16. When finished making a cut with a radial saw, return the saw to the rear of the table against the column. True or False
17. Which is not a rule that needs to be followed for powered handtools?
- A. Don't carry the tool by the cord
 - B. Don't allow the cord to be in contact with water
 - C. Disconnect tools when not in use
 - D. Clean before every use



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2.2 Hydraulic Tools – Hydraulic tools are powered by a liquid, which is a special type of oil. This oil is forced through pipes and hoses under a pressure created by a pump. The oil used in hydraulic powered tools must be an approved fire-resistant fluid and must be engineered to retain its operating characteristic at the most extreme temperatures to which it will be exposed. The oil also acts as a lubricant for moving parts in a hydraulic system. The manufacturer's recommended safe operating pressure for hoses, valves, pipes, filters, and other fittings used in the hydraulic system must not be exceeded.

One of the most common types of hydraulic tools that the production technician will use is the hydraulic jack that moves or lifts objects too heavy for a human to do by hand.



The proper maintenance of hydraulic jacks is essential for safety. It is highly recommended that these jacks are inspected before each use and lubricated on a regular basis. All hydraulic jacks are designed with a device that stops them from jacking up too high. Also, the manufacturer of the jack is required to have its load limit permanently marked in a prominent place on the jack, so it should never be exceeded by the user.

There are several important factors to consider and safety guidelines to follow when using these hydraulic jacks, which include:

- Set up the jack so that its base rests on a firm, level surface. If the jack cannot be placed on a level surface, move the object being lifted to a level surface prior to using the jack.



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- Keep the **object** being lifted by the jack **centered** to prevent tipping.
- Ensure that the **jack head** is **against** a **level surface** of the **object being lifted**. If the object slips from the jack head, it is possible that the object that is being lifted will fall.
- During the actual “jacking” operation of the object, **keep your body clear** of the **jacking mechanism**.
- Be certain that the **lift force** is applied **evenly**.
- A **jack** should **never** be used to **support** a **load for a prolonged period of time**. If the load will be held up in this situation it should be blocked up with jack stands.
- Properly maintain the jacks by keeping them lubricated, using them at least once every six months to prevent the seals from drying up, and keeping an adequate amount and proper type of antifreeze (based on the manufacturer’s recommendations) in them when exposed to freezing temperatures.

Hydraulic Jack Safety

- Set up a jack so that the base rests on a firm, level surface
- Ensure that the jack is centered
- Ensure that the jack head is against a level surface
- Be certain the lift force is applied evenly
- Know load restrictions



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If a **pin hole** forms in one of the **hydraulic hoses** and is spraying oil, **DO NOT** run your **finger along** the **hose** to find out where it is coming from. The pressure of the fluid leaving the hose could be at a pressure high enough where it could



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sever the **finger**. Also, if a hose becomes disconnected from a fitting or a seal breaks, the oil can spray from the opening if the pump is on. This oil is under pressure and may be hot, so it is important not to allow yourself to be located in the direction at which the oil is straying.

Question: Should you trust a hydraulic jack to hold the load after you lifted it to the desired height?

Answer: **DO NOT** trust the hydraulic jack alone. Use jack stands

Question: What is the number one safety hazard to be aware of when using a hydraulic powered tool?

Answer: Not to run your finger along a hose that has a pin hole, or take evasive action if there is a blown hose or a seal that breaks because the operator could be sprayed with oil that is highly pressurized or hot.

2.3 Pneumatic Tools – Pneumatic tools are powered by air that is compressed and then stored in a sealed tank. This pressurized air is then released from the tank when it passes through hoses and then flows out into the atmosphere as it goes through the tool. The force from the air, as it passes through the tool, turns some type of mechanism, which gives the tool its power to do its particular job. The types of pneumatic tools include chippers, drills, wrenches (also impact wrenches), nailing guns, hammers, riveters, and sanders. There are several important factors to consider and safety guidelines to follow when using these air tools, including:

- **Injury** can occur because of improper use of PPE or **not wearing PPE correctly**. **Pressurized air** can **break** the **skin**, enabling dust, grit and even small metal shavings to become embedded and eventually cause infection.
- Failure to wear **ear protection** can **impact hearing**. The air from outlets at hoses, tubes, and pneumatic tools create noise when the pressure is released; therefore, operators are either encouraged or required to wear hearing protection when working with pneumatic tools.
- When using **pneumatic tools**, the **quick bursts** of **air** that occur can create forces that can **break damaged fasteners**, causing them to become **airborne** and **strike** someone in their path.



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- Do not **ignore** or **exceed** the **recommended** operating air **pressure** for the various types of **pneumatic tools** or **systems**. Pneumatic systems have air regulators that allow the operator to adjust the air pressure while monitoring the level on a gauge. Going above the required pressure setting could cause something to explode and the flying debris could cause injury to someone in its path.
- Always make sure the tools are securely fastened to the attachment at the end of the hose.
- Precautions should be taken with the hose to keep it from being damaged, or avoiding it being placed where someone can rip over it. Never drag a hose across a walkway.



- If a tool breaks free of an attachment at the end of a pressurized air hose, the hose will begin to whip around. **Stay clear of whipping air hoses** because it may cause injury especially when a metal fastener attached at the end of the hose strikes someone. – It is recommended that **whip checks** are used at each connection. **Whip checks are restraining devices**, such as cables, that attach to the end of hoses.

Before a technician works with pneumatic tools, it is important that they receive training to ensure their safety and that of co-workers. Some other precautions when working with pneumatics include:



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- Keep your body stance balanced,
- Keep body parts away from the working end of the tool,
- Use accessories specifically made for pneumatic tools, and
- When using an impact wrench, use impact sockets made specifically for these pneumatic wrenches,
- Avoid pointing compressed air guns toward anyone.

Question: What dangers exist when using pneumatic tools?

Answer: Air supply hoses can come loose and whip back and forth, which may cause injury to the user or a bystander.

2.4 Powder-Actuated Tools – A powder-actuated tool is a [nail gun](#) that shoots fasteners that attach one material to another, usually to join a softer object to a harder substrate such as steel and concrete. The fastener is shot into the hard substrate. Known as "direct fastening", this tool relies on a controlled explosion created by small [chemical propellant](#) charge, similar to the process that discharges a [firearm](#). Since their operation is similar to a regular handgun, they should be treated with the same respect and precautions. In fact, they are so dangerous that there is a requirement that they must be operated only by specially trained personnel.





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There are certain guidelines and precautions that should be observed to ensure the safe operation of these tools, which include:

- **Inspect** the tool thoroughly **before each use** to determine that it is **clean**, that all **moving parts operate freely** and that the **barrel** is free from **obstructions**.
- **Load** the tool with the cartridge **only** when it is **going to be used**.
- **Never leave** a **loaded power-actuated** tool **unattended**.
- **Keep** all **body parts** and **co-workers away** from the **path of fire** to avoid serious injury by being hit with the projectile.
- **Never hold** your **hand behind** the **material** at which the projectile will be fired.
- **Wear appropriate PPE** (e.g., safety glasses, face shields, and hard hats) when using powder-actuated types of tools.
- **Do not fire** the **tool in** an **explosive** or **flammable atmosphere**.
- **Before firing** the **tool**, **keep hands clear** of the barrel end and **keep the tool pointed** in a **safe direction**.
- **Do not** try to **pry** the **cartridge** from the **actuated tool**.
- **Before each use**, keep the tool oiled properly by **adding a few drops** of **oil** to the air inlet.
- **Fasteners** shall **not** be **driven into** very **hard** or **brittle materials** such as cast iron, glazed tile, surface hardened steel, glass block, live rock, face brick or hollow tile.
- **Fasteners** shall **not** be **driven into soft materials** unless such materials are backed by a substance that will prevent the pin or fastener from passing completely through and creating a flying missile hazard on the opposite side.



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Chapter Reading

Question: What is a “powder-actuated” tool?

Answer: It is a tool powered by an explosive charge.

2.5 Tool Guards – With various types of power tools, there are exposed moving parts that turn at a high speed. If one of the parts becomes loose or breaks, it may fly off and strike someone. Also, whatever material is being worked on, the high speed tool can create flying sparks or fragments that can also cause injury. To stop any particles or parts from flying, safeguards are placed between the workpiece and individuals close by.

Belts, gears, shafts, pulleys, sprockets, spindles, drums, flywheels, chains, or other reciprocating, rotating, or moving parts of equipment must be guarded. Guards provide the operator protection from the following flying hazards:

2.5.1 Sparks – Flying sparks can cause a fire or burn the operator, especially the eyes. The guard surrounds the “point of operation,” which is the location where the tool actually performs the work, such as where there is saw blade or grinding wheel operations. Flying chips and sparks that come off the materials being worked on can cause serious bodily harm.

Tool Guards

- Guards provide operators protection from the following hazards:
 - Flying sparks
 - Nip points
 - Rotating parts
 - Flying chips



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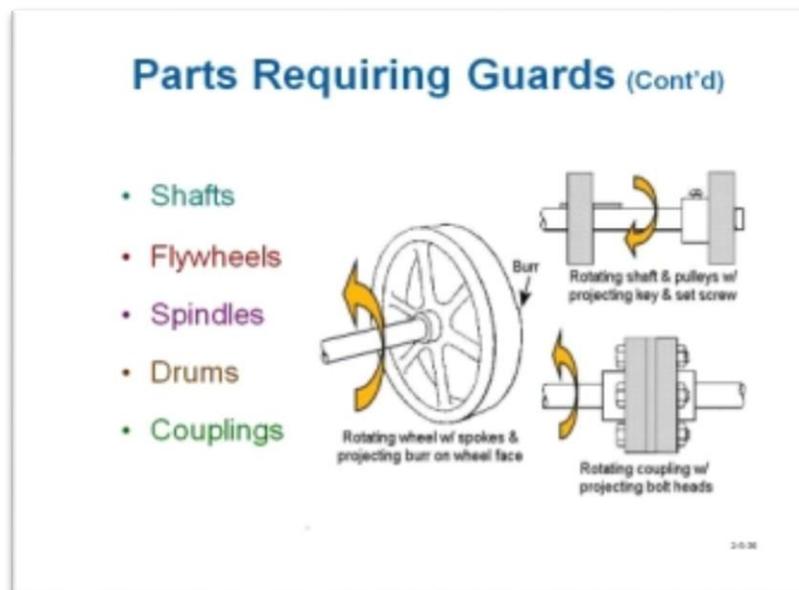
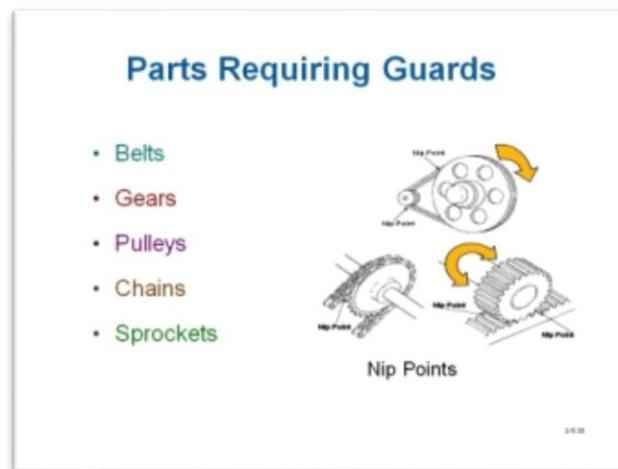
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Chapter Reading

2.5.2 Rotating parts – As a machine runs, there are many moving parts that can cause injury if someone makes physical contact. Machine guards are used to prevent making contact.

Here are examples of machine parts that require guards:

- belts,
- gears,
- pulleys,
- chains,
- sprockets,
- shafts,
- flywheels,
- spindles,
- drums, and
- couplings.





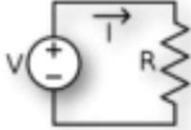
Introduction to Safety – Unit Six: Tool Safety

Chapter Reading

2.6 Five Basic Rules of Hand and Power Tool Safety

The Five Basic Rules for Hand and Power Tool Safety

- Regularly maintain all tools
- Use the right tool for the job
- Examine each tool before use for damage
- Operate tools according to manufacturer instructions
- Proper personal protective equipment must be used



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PPE devices are the last line of protection. Additional precautions include:

- Tie back or confine long hair and loose sleeves.
- Avoid wearing loose clothing, jewelry, or non-protective shoes.
- Remove the power source before making any changes of accessories or when making adjustments.



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Chapter Reading

Review Questions

18. A hydraulic jack is designed to support a load while as it is in an elevated position.
True or False
19. Hydraulic fluids _____.
A. provide lubrication for moving parts
B. transmit power
C. operate at extreme temperatures
D. All of the above
20. The most effective and recommended way in which to find a pin-hole leak in a hydraulic hose is the running a finger along the hose until the hydraulic fluid is felt coming out. True or False
21. Whip checks are used with _____ hoses
A. hydraulic hoses
B. pneumatic hoses
C. to secure hydraulic jacks in place
22. Fasteners are propelled to penetrate hard materials, such as cast iron.
True or False
23. To prevent being caught and pulled by moving machines, which precaution should be observed?
A. Never wear loose-fitting clothes
B. Never wear jewelry
C. Long hair should be tied back
D. All of the above
24. Tool and machine guards protect operators from _____.
A. flying sparks and chips
B. rotating equipment
C. Nip points
D. All of the above
25. Pneumatic tools are powered by _____.
A. electricity
B. pressurized oil
C. compressed air
D. gasoline



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Chapter Reading

Summary

In this unit,

Summary

- We discussed the following:
 - Basic principles of electricity
 - Electrical hazards and safety precautions
 - Training methods for preventing hazards on the production floor



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Summary (Cont'd.)

- We also discussed:
 - What tools to use for what jobs
 - What not to use some tools for
 - How to select the necessary tools to complete a job
 - The function and possible hazards of tools commonly used on the production floor
 - Methods of training to use hand and portable power tools



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Chapter Reading

Module 6 Chapter/Quiz Questions

1. A flat-head screwdriver _____.
 - a. is designed to have multiple uses, such as prying or acting as a wedge
 - b. is still safe if it doesn't fit the screw head
 - c. can be damaged if it isn't used properly
 - d. should have a metal handle because it has the highest torque
2. Pliers can easily slip off a nut or bolt _____.
 - a. if the gripping force is not great enough
 - b. if it isn't kept properly oiled
 - c. if its teeth are worn
 - d. when you try to use it as a wrench
3. A _____ wrench is also known as a ratchet wrench.
 - a. hex
 - b. torx
 - c. pipe
 - d. socket
4. Another name for a file is a *rasp*.
 - a. True
 - b. False
5. One advantage of a clamp is that it can be adjusted to securely attach to an object that is hoisted.
 - a. True
 - b. False
6. For better control, use screwdrivers with _____.
 - a. handles with smaller diameters
 - b. shorter shafts
 - c. longer shafts
 - d. metal handles
7. _____ wrenches are designed to be used for round cylindrical objects.
 - a. Socket
 - b. Pipe
 - c. Adjustable
 - d. Open-ended



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8. Wear _____ when using a hammer.
 - a. safety glasses
 - b. a face shield
 - c. a facemask
 - d. Both a and b

9. Power handtools should be disconnected when not in use _____.
 - a. because they may short and start a fire
 - b. because flammable dust will collect on them
 - c. because they may be accidentally started
 - d. because they always draw some electricity

10. To cut wood along the grain, use _____.
 - a. a ripping saw
 - b. a cross-cut saw
 - c. a fine-tooth saw if the wood is green
 - d. any saw as long as the teeth of the blade is sharp

11. When using a variable speed drill, do all of the following except, _____.
 - a. use sharp bits
 - b. be sure the material being drilled is secured in place
 - c. hold the drill at the correct angle
 - d. leave the bit in the drill when done using it

12. One of the primary causes of loose wires that can be a shock or fire hazard is when _____.
 - a. a grinding wheel comes in contact with the power cord
 - b. a saw blade comes in contact with the power cord
 - c. the power cord is repeatedly yanked out of the socket instead of the plug
 - d. the power cord is submerged in water and rapidly deteriorates

13. Disconnect the electric power source to avoid inadvertent start-up when changing the parts of a _____.
 - a. grinder
 - b. drill
 - c. saw
 - d. All of the above



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14. A momentary switch is one that _____.
a. is closed for a prescribed time duration before it automatically turns off
b. enables power equipment to run only when it is momentarily squeezed by a finger
c. Both A and B
d. shuts down for a prescribed time duration before it automatically closes and runs the equipment
15. Hydraulic tools can be safely operated at extremely _____ temperatures.
a. cold
b. hot
c. Both a and b
d. Neither a or b
16. Jack stands are mechanisms that lift a load using a lever and ratchet, similar to an air jack.
a. True
b. False
17. Interlocks cause equipment to _____ to prevent harm to the operator.
a. turn on
b. turn off
c. go into a coasting state
d. destruct
18. A leak from the pressurized air in a pneumatic system may be able to break the skin of an operator.
a. True
b. False
19. A powder-actuated tool is similar to a gun that shoots a bullet.
a. True
b. False
20. Fasteners projected from a powder actuated gun are designed to be driven into _____.
a. very hard and brittle materials
b. very soft materials
c. hard materials that can be penetrated
d. All of the above



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21. Hydraulic fluid _____.
a. is fire-resistant
b. is very combustible
c. cannot be used at extreme temperatures
d. causes extreme burns if it gets on skin
22. One advantage of hydraulic equipment is that it can be trusted to keep a load elevated after being lifted to its desired height.
a. True
b. False
23. Which type of tool is run by pneumatic power?
a. drill
b. chipper
c. grinder
d. All of the above
24. A *whipping hose* _____.
a. is a tool
b. is an operation used to make baking ingredients
c. a condition that occurs when one end of a pressurized hose breaks away from a connection
d. None of the above
25. Machine parts that do not require tool guards are _____.
a. belts
b. gears
c. shafts/couplers
d. None of the above



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Chapter Reading

Review Question Answers

1. A
2. C
3. B
4. A
5. C
6. C
7. B
8. A
9. False
10. D
11. False
12. True
13. B
14. False
15. B
16. True
17. D
18. False
19. D
20. False
21. B
22. False
23. D
24. D
25. B



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