



Wisconsin Contractors Institute

Hand and Power Tool Safety

2 Continuing Education Hours

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What is the Purpose of this Course?

This course is designed to present workers with the basic safety procedures and safeguards associated with hand and portable power tools.

The following sections identify various types of hand and power tools and their potential hazards. They also identify ways to prevent worker injury through proper use of the tools and through the use of appropriate personal protective equipment.

Please note: *Material in this course is based on the standards of the Occupational Safety and Health Administration (OSHA). This course should not be considered as a substitute for the full safety and health standards for general industry, or for the construction industry. These texts are available at www.osha.gov.*

The Danger of Hand and Portable Power Tools

Tools are such a common part of our lives that it is difficult to remember that they may pose hazards. A serious incident can occur before steps are taken to identify and avoid, or eliminate tool-related hazards.

The following measures should always be taken:

- Workers who use hand and power tools must be provided with the appropriate personal protective equipment.
- All electrical connections for these tools must be suitable for the type of tool and the working conditions (wet, dusty, flammable vapors).
- When a temporary power source is used for construction, a ground-fault circuit interrupter should be used.
- Workers should be trained in the proper use of all tools.
- Workers should be able to recognize the hazards associated with the different types of tools and the safety precautions necessary.

Here are five basic safety rules that can help prevent hazards associated with the use of hand and power tools:

- Keep all tools in good condition with regular maintenance.
- Use the right tool for the job.
- Examine each tool for damage before use and do not use damaged tools.
- Operate tools according to the manufacturers' instructions.
- Provide and use properly the right personal protective equipment.

Employees and employers should work together to establish safe working procedures. If a hazardous situation is encountered, it should be brought to the attention of the proper individual for hazard abatement immediately.

Exam Questions:

1. Which of the following measures should be taken when working with hand and/or power tools?
 - a. Workers should be provided with the appropriate personal protective equipment
 - b. Workers should be trained in the proper use of all tools.
 - c. All electrical connections must be suitable for the type of working conditions
 - d. All of the above

2. When should a hazardous situation be reported?
 - a. Within 2-3 days
 - b. Immediately
 - c. At the beginning of the month
 - d. During staff meetings

The Hazards of Hand Tools

What are hand tools?

Hand tools are tools that are powered manually. Hand tools include anything from axes to wrenches. The greatest hazards posed by hand tools result from misuse and improper maintenance.

Some examples of misuse include the following:

- If a chisel is used as a screwdriver, the tip of the chisel may break and fly off, hitting the user or other workers.
- If a wooden handle on a tool, such as a hammer or an axe, is loose, splintered, or cracked, the head of the tool may fly off and strike the user or other workers.
- If the jaws of a wrench are sprung, the wrench might slip.
- If impact tools such as chisels, wedges, or drift pins have mushroomed heads, the heads might shatter on impact, sending sharp fragments flying toward the user or other workers.

The employer is responsible for the safe condition of tools and equipment used by employees. Employers shall not issue or permit the use of unsafe hand tools. Employees should be trained in the proper use and handling of tools and equipment.

When using saw blades, knives, or other tools, workers should direct the tools away from aisle areas and away from others working in close proximity. Knives and scissors must be sharp; dull tools can cause more hazards than sharp ones. Cracked saw blades must be removed from service.

Wrenches must not be used when jaws are sprung to the point that slippage occurs. Impact tools such as drift pins, wedges, and chisels must be kept free of mushroomed heads. The wooden handles of tools must not be splintered.

Iron or steel hand tools may produce sparks that can be an ignition source around flammable substances. Where this hazard exists, spark-resistant tools made of non-ferrous materials should be used where flammable gases, highly volatile liquids, and other explosive substances are stored or used.

Appropriate personal protective equipment such as safety

goggles and gloves must be worn to protect against hazards that may be encountered while using hand tools.

Workplace floors shall be kept as clean and dry as possible to prevent accidental slips with or around dangerous hand tools.

Exam Questions:

3. What are hand tools?
 - a. Tools that are powered manually
 - b. Tools that are powered electrically
 - c. Tools that are powered pneumatically
 - d. Tools that are powered hydraulically

4. What do the greatest hazards from hand tool result from?
 - a. Misuse
 - b. Improper maintenance
 - c. Both a and b
 - d. None of the above

5. True or false? Sharp tools can cause more hazards than dull ones.
 - a. True
 - b. False

6. When should spark-resistant tools made of non-ferrous materials be used?
 - a. Around flammable gases
 - b. Around highly volatile liquids
 - c. Around explosive substances
 - d. All of the above

The Dangers of Power Tools

The types of power tools are determined by their power source: electric, pneumatic, liquid fuel, hydraulic, and powder-actuated.

Power tools must be fitted with guards and safety switches; they are extremely hazardous when used improperly.

To prevent hazards associated with the use of power tools, workers should observe the following general precautions:

- Never carry a tool by the cord or hose.
- Never yank the cord or the hose to disconnect it from the receptacle.
- Keep cords and hoses away from heat, oil, and sharp edges.
- Disconnect tools when not using them, before servicing and cleaning them, and when changing accessories such as blades, bits, and cutters.
- Keep all people not involved with the work at a safe distance from the work area.
- Secure work with clamps or a vise, freeing both hands to operate the tool.
- Avoid accidental starting. Do not hold fingers on the switch button while carrying a plugged-in tool.
- Maintain tools with care; keep them sharp and clean for best performance.
- Follow instructions in the user's manual for lubricating and changing accessories.
- Be sure to keep good footing and maintain good balance when operating power tools.
- Wear proper apparel for the task. Loose clothing, ties, or jewelry can become caught in moving parts.
- Remove all damaged portable electric tools from use and tag them: "Do Not Use."

Exam Questions:

7. Which of the following are types of power tools?
 - a. Manual
 - b. Liquid fuel
 - c. Hydraulic
 - d. Both b and c

8. What should all power tools be fitted with?
 - a. Guards
 - b. Safety switches
 - c. Both a and b
 - d. Batteries

9. True or false? The best method for disconnecting a cord from the receptacle is to yank it.
 - a. True
 - b. False

Guards

The exposed moving parts of power tools need to be safeguarded. Belts, gears, shafts, pulleys, sprockets, spindles, drums, flywheels, chains, or other reciprocating, rotating, or moving parts of equipment must be guarded.

Machine guards, as appropriate, must be provided to protect the operator and others from the following:

- Point of operation.
- In-running nip points.
- Rotating parts.
- Flying chips and sparks.

Safety guards must never be removed when a tool is being used.

Portable circular saws having a blade greater than 2 inches in diameter must be equipped at all times with guards. An upper guard must cover 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. The lower guard must automatically return to the covering position when the tool is withdrawn from the work material.

Exam Questions:

10. Portable circular saws having a blade greater than _____ inches in diameter must be equipped at all times with guards.
- 2 inches
 - ½ inch
 - ¾ inch
 - 1 ½ inches
11. True or false? Safety guards must never be removed when a tool is being used.
- True
 - False

Operating Controls and Switches

The following hand-held power tools must be equipped with a constant-pressure switch or control that shuts off the power when pressure is released:

- drills
- tappers
- fastener drivers;
- horizontal, vertical, and angle grinders with wheels more than 2 inches in diameter
- disc sanders with discs greater than 2 inches
- belt sanders
- reciprocating saws
- saber saws, scroll saws, and jigsaws with blade shanks greater than 1/4-inch wide
- other similar tools

These tools also may be equipped with a “lock-on” control, if it allows the worker to also shut off the control in a single motion using the same finger or fingers.

The following hand-held power tools must be equipped with either a positive “on-off” control switch, a constant pressure switch, or a “lock-on” control:

- disc sanders with discs 2 inches or less in diameter
- grinders with wheels 2 inches or less in diameter
- platen sanders, routers, planers, laminate trimmers, nibblers, shears, and scroll saws
- jigsaws, saber and scroll saws with blade shanks a nominal 1/4-inch or less in diameter

It is recommended that the constant-pressure control switch be regarded as the preferred device.

Other hand-held power tools such as circular saws having a blade diameter greater than 2 inches, chain saws, and percussion tools with no means of holding accessories securely must be equipped with a constant-pressure switch.

Exam Questions:

12. A reciprocating saw must be equipped with which of the following?
 - a. A positive “on-off” control switch
 - b. A “lock-on” control
 - c. A constant-pressure switch or control that shuts off the power when pressure is released
 - d. None of the above
13. A jigsaw must be equipped with which of the following?
 - a. A positive “on-off” control switch
 - b. A “lock-on” control
 - c. A constant-pressure switch or control that shuts off the power when pressure is released
 - d. Either a or b

Electric Tools

Employees using electric tools must be aware of several dangers.

Among the most serious hazards are electrical burns and shocks.

Electrical shocks, which can lead to injuries such as heart failure and burns, are among the major hazards associated with electric-powered tools. Under certain conditions, even a small amount of electric current can result in fibrillation of the heart and death. An electric shock also can cause the user to fall off a ladder or other elevated work surface and be injured due to the fall.

To protect the user from shock and burns, electric tools must have a three-wire cord with a ground and be plugged into a grounded receptacle, be double insulated, or be powered by a low-voltage isolation transformer. Three-wire cords contain two current-carrying conductors and a grounding conductor. Any time an adapter is used to accommodate a two-hole receptacle, the adapter wire must be attached to a known ground. The third prong must never be removed from the plug.

Double-insulated tools are available that provide protection against electrical shock without third-wire grounding. On double-insulated tools, an internal layer of protective insulation completely isolates the external housing of the tool.

The following general practices should be followed when using electric tools:

- Operate electric tools within their design limitations.
- Use gloves and appropriate safety footwear when using electric tools.
- Store electric tools in a dry place when not in use.
- Do not use electric tools in damp or wet locations unless they are approved for that purpose.
- Keep work areas well lit when operating electric tools.
- Ensure that cords from electric tools do not present a tripping hazard.

In the construction industry, workers who use electric tools must be protected by ground-fault circuit interrupters or an assured equipment-grounding conductor program.

Exam Questions:

14. What are some of the most serious hazards associated with electric tools?
- Electrical burns and shocks
 - Severed limbs
 - Paralysis from falls
 - There are no risks when using electric tools
15. Where should electric tools be stored when not in use?
- A place below 70 degrees Fahrenheit
 - A place that is well lighted
 - A dry place
 - A damp or wet location

Portable Abrasive Wheel Tools

Portable abrasive grinding, cutting, polishing, and wire buffing wheels create special safety problems because they may throw off flying fragments. Abrasive wheel tools must be equipped with guards that:

- cover the spindle end, nut, and flange projections
- maintain proper alignment with the wheel
- do not exceed the strength of the fastenings

Before an abrasive wheel is mounted, it must be inspected closely for damage and should be sound, or ring, tested to ensure that it is free from cracks or defects. To be tested, wheels should be tapped gently with a light, non-metallic instrument. If the wheels sound cracked or dead, they must not be used because they could fly apart in operation. A stable and undamaged wheel, when tapped, will give a clear metallic tone or “ring.”

To prevent an abrasive wheel from cracking, it must fit freely on the spindle. The spindle nut must be tightened enough to hold the wheel in place without distorting the flange. Always follow the manufacturer's recommendations. Take care to ensure that the spindle speed of the machine will not exceed the maximum operating speed marked on the wheel.

An abrasive wheel may disintegrate or explode during start-up. Allow the tool to come up to operating speed prior to grinding or cutting. The employee should never stand in the plane of rotation of the wheel as it accelerates to full operating speed. Portable grinding tools need to be equipped with safety guards to protect workers not only from the moving wheel surface, but also from flying fragments in case of wheel breakage.

When using a powered grinder:

- Always use eye or face protection.
- Turn off the power when not in use.
- Never clamp a hand-held grinder in a vise.

Exam Questions:

16. When tapped, a stable and undamaged wheel will make what kind of sound?
 - a. A cracked or dead sound
 - b. A clear metallic tone or "ring"
 - c. A soft humming sound
 - d. A loud bang

17. What safety measures should be taken when using a powered grinder?
 - a. Eye or face protection
 - b. Turn the power off when not in use
 - c. Never clamp a hand-held grinder in a vise
 - d. All of the above

Pneumatic Tools

Pneumatic tools are powered by compressed air and include:

- chippers
- drills
- hammers
- sanders

There are several dangers associated with the use of pneumatic tools. First and foremost is the danger of getting hit by one of the tool's attachments or by some kind of fastener the worker is using with the tool.

Pneumatic tools must be checked to see that the tools are fastened securely to the air hose to prevent them from becoming disconnected. A short wire or positive locking device attaching the air hose to the tool must also be used and will serve as an added safeguard.

If an air hose is more than $\frac{1}{2}$ -inch in diameter, a safety excess flow valve must be installed at the source of the air supply to reduce pressure in case of hose failure.

In general, the same precautions should be taken with an air hose that are recommended for electric cords, because the hose is subject to the same kind of damage or accidental striking, and because it also presents tripping hazards.

When using pneumatic tools, a safety clip or retainer must be installed to prevent attachments such as chisels on a chipping hammer from being ejected during tool operation.

Pneumatic tools that shoot nails, rivets, staples, or similar fasteners and operate at pressures more than 100 pounds per square inch, must be equipped with a special device to keep fasteners from being ejected, unless the muzzle is pressed against the work surface.

Airless spray guns that atomize paints and fluids at pressures of 1,000 pounds or more per square inch, must be equipped with automatic or visible manual safety devices that will prevent pulling the trigger until the safety device is manually released.

Eye protection is required, and head and face protection is recommended for employees working with pneumatic tools.

Screens must also be set up to protect nearby workers from

being struck by flying fragments around chippers, riveting guns, staplers, or air drills.

Compressed air guns should never be pointed toward anyone. Workers should never “dead-end” them against themselves or anyone else. A chip guard must be used when compressed air is used for cleaning.

Use of heavy jackhammers can cause fatigue and strains. Heavy rubber grips reduce these effects by providing a secure handhold. Workers operating a jackhammer must wear safety glasses and safety shoes that protect them against injury if the jackhammer slips or falls. A face shield also should be used.

Noise is another hazard associated with pneumatic tools. Working with noisy tools such as jackhammers requires proper, effective use of appropriate hearing protection.

Liquid Fuel Tools

Fuel-powered tools are usually operated with gasoline. The most serious hazard associated with the use of fuel-powered tools comes from fuel vapors that can burn or explode and also give off dangerous exhaust fumes. The worker must be careful to handle, transport, and store gas or fuel only in approved flammable liquid containers, according to proper procedures for flammable liquids.

Before refilling a fuel-powered tool tank, the user must shut down the engine and allow it to cool to prevent accidental ignition of hazardous vapors. When a fuel-powered tool is used inside a closed area, effective ventilation and/or proper respirators such as atmosphere-supplying respirators must be utilized to avoid breathing carbon monoxide. Fire extinguishers must also be available in the area.

Exam Questions:

18. What are pneumatic tools powered with?
 - a. Compressed air
 - b. Liquid fuel
 - c. Electricity
 - d. Pressurized water

19. True or false? A liquid fueled tool should always be “on” when refilling with gasoline.
 - a. True
 - b. False

Power-Actuated Tools

Powder-actuated tools operate like a loaded gun and must be treated with extreme caution. In fact, they are so dangerous that they must be operated only by specially trained workers.

When using powder-actuated tools, a worker must wear suitable ear, eye, and face protection. The user must select a powder level—high or low velocity—that is appropriate for the powder-actuated tool and necessary to do the work without excessive force.

The muzzle end of the tool must have a protective shield or guard centered perpendicular to and concentric with the barrel to confine any fragments or particles that are projected when the tool is fired. A tool containing a high-velocity load must be designed not to fire unless it has this kind of safety device.

To prevent the tool from firing accidentally, two separate motions are required for firing. The first motion is to bring the tool into the firing position, and the second motion is to pull the trigger. The tool must not be able to operate until it is pressed against the work surface with a force of at least 5 pounds greater than the total weight of the tool.

Safety precautions that must be followed when using powder-actuated tools include the following:

- Do not use a tool in an explosive or flammable atmosphere.
- Inspect the tool before using it to determine that it is clean, that all moving parts operate freely, and that the barrel is free from obstructions and has the proper shield, guard, and attachments recommended by the manufacturer.
- Do not load the tool unless it is to be used immediately.
- Do not leave a loaded tool unattended, especially where it would be available to unauthorized persons.
- Keep hands clear of the barrel end.
- Never point the tool at anyone.

When using powder-actuated tools to apply fasteners, several additional procedures must be followed:

- Do not fire fasteners into material that would allow the fasteners to pass through to the other side.
- Do not drive fasteners into very hard or brittle material that might chip or splatter or make the fasteners ricochet.
- Always use an alignment guide when shooting fasteners into existing holes.
- When using a high-velocity tool, do not drive fasteners more than 3 inches from an unsupported edge or corner of material such as brick or concrete.
- When using a high velocity tool, do not place fasteners in steel any closer than $\frac{1}{2}$ -inch from an unsupported corner edge unless a special guard, fixture, or jig is used.

Hydraulic Power Tools

The fluid used in hydraulic power tools must be an approved fire-resistant fluid and must retain its operating characteristics at the most extreme temperatures to which it will be exposed. The exception to fire-resistant fluid involves all hydraulic fluids used for the insulated sections of derrick trucks, aerial lifts, and hydraulic tools that are used on or around energized lines. This hydraulic fluid shall be of the insulating type.

The manufacturer's recommended safe operating pressure for hoses, valves, pipes, filters, and other fittings must not be exceeded.

All jacks—including lever and ratchet jacks, screw jacks, and hydraulic jacks—must have a stop indicator, and the stop limit must not be exceeded. Also, the manufacturer’s load limit must be permanently marked in a prominent place on the jack, and the load limit must not be exceeded.

A jack should never be used to support a lifted load. Once the load has been lifted, it must immediately be blocked up. Put a block under the base of the jack when the foundation is not firm, and place a block between the jack cap and load if the cap might slip.

To set up a jack, make certain of the following:

- The base of the jack rests on a firm, level surface;
- The jack is correctly centered;
- The jack head bears against a level surface; and
- The lift force is applied evenly.

Proper maintenance of jacks is essential for safety. All jacks must be lubricated regularly. In addition, each jack must be inspected according to the following schedule: (1) for jacks used continuously or intermittently at one site—inspected at least once every 6 months, (2) for jacks sent out of the shop for special work—inspected when sent out and inspected when returned, and (3) for jacks subjected to abnormal loads or shock—inspected before use and immediately thereafter.

Exam Question:

20. How often should jacks used continuously at one site be inspected?
- a. Immediately before and after use
 - b. When sent out of the shop for work
 - c. At least once every 6 months
 - d. At least once every year