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Module 17: Tools - Hand and Power

Module Description

This module gives you a basic understanding about OSHA's role in the prevention and elimination of work-related illnesses and injuries. Hand and power tools are a part of our everyday lives and help us to perform tasks that otherwise would be difficult or impossible. However, these simple tools can be hazardous and have the potential for causing severe injuries when used or maintained improperly. Special attention to hand and power tool safety is necessary to reduce or eliminate these hazards.

Module Learning Objectives

At the conclusion of this module, students will be able to:

- Discuss OSHA standards and rules associated with hand and power tools
- Explore guarding techniques or principles that apply to hand and power tools
- Identify the precautions that are essential for safe use of hand and power tools

Lesson 1: Safe Use of Hand and Power Tools

Lesson Focus

At the end of this lesson, students will be able to:

- Describe the general requirements for safely using hand and power tools
- Describe the common hazards associated with hand and power tools
- Describe the different kinds of switches and know which is appropriate

Introduction

Hand and power tools help us perform tasks that otherwise would be difficult or impossible. These tasks range from hanging a picture on your living room wall to cutting through slabs of concrete at a construction site. One thing that all tools—from hammers and handheld drills to hydraulic jacks and walk-behind saws—have in common is that they present hazards. Using them improperly or failing to properly maintain them can have dangerous consequences, both for you and for those around you.

Some common hazards employees might encounter when using hand and power tools include falling, flying, abrasive, and splashing objects, as well as harmful dusts, fumes, mists, vapors, or gases. Employees who might encounter these hazards must be provided with the proper personal protective equipment (PPE) to keep them safe.



All employees should receive training on the proper use of any tools they will be using. This training should cover both how to properly use the tools and what safety precautions should be taken while using them.

General Requirements

The following are some basic tool safety rules that all employees should follow:

- Inspect tools before use, perform maintenance regularly, and keep all tools in good working order
- Use the right tool for the job. It should:
  - Fit the workspace available
  - Reduce the force you need to apply
  - Be ergonomic and fit comfortably in your hand
  - Be used in a comfortable work position
- Only use a tool for the task it was designed to perform
- Operate tools according to manufacturers' instructions
- Use the correct guards when necessary and ensure tools are safeguarded when not in use
- Wear/use the correct PPE when necessary
- Keep cutting tools sharp
- Keep the floor and other worksurfaces free of debris or other tripping hazards

If you observe any problems with tools, either during your inspection of the tool or while using it, bring it to the attention of the proper individual(s) immediately.

Working with Tools at Height

According to the Bureau of Labor Statistics (BLS), more than 50,000 occupational injuries occur each year as a result of falling objects—frequently, falling tools. As a result, working with tools at height requires additional precautions.

Tool tethering refers to the practice of securing a tool to a worker or another anchor point in order to prevent it from falling and potentially injuring someone or causing damage below. Anyone working four feet or higher above the ground or above other coworkers should use tethered tools. Tools should also be tethered if they could damage other equipment or materials should they fall.

If employees will be working with tools at height, employers must:

- Secure tools and other materials to prevent them from falling
- Erect barricades where necessary around hazard areas and post warning signs
- Use toe boards and guardrails to prevent tools from falling from scaffolding
- Use nets and canopies to catch or deflect falling objects

Additionally, when working at height, employees must NOT:

- Prop or stand tools against the structure
- Throw tools or objects up or down to other workers

Tool tethers are the lanyards that connect tools to anchor points. If a tool does not already have a place to connect the tether, then a tool attachment should be installed in the field before the tool is used at height. The tool attachment should be positioned on the tool so that it does not interfere with its proper ergonomic use. In other words, ensure the tool functions the same as if the attachment was not there.

Anchor attachments are designed to be field installed on structures, scaffolding, equipment, and even workers. They provide anchor points for the tool tethers. Containers and bags may also be used to safely transport tools to and from heights.

Keep tool tethers as short as possible without impeding your work. This helps prevent tangling or catching the tether on something. Retractable tethers are often a good option. When a tool tether is anchored to a worker's body, try to limit the tool's weight to six pounds. Dropping a heavy tool and having it catch on the tether could throw off your balance and lead to a fall.

Hand Tools

Hand tools are powered manually rather than with electricity or liquid fuel. Examples include hammers, axes, handsaws, wrenches, and screwdrivers. The most significant hazards commonly encountered while using hand tools result from misuse and improper maintenance. For instance:

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

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 and shall ensure employees have the proper training to use the necessary tools.

When using sharp tools like saws, knives, and scissors, employees should direct the tools away from walkways, other workstations, and anywhere other employees might be working. Dull tools cause more injuries than sharp ones, so blades should be kept sharp. Cracked or otherwise damaged blades must be removed from use.

Iron and steel hand tools may produce sparks that can be an ignition source when near flammable substances. If work will be conducted near flammable gasses, highly volatile liquids, or explosive materials, employees should use **spark-resistant tools**, which are made of non-ferrous materials that will not spark when struck.

Personal Protective Equipment (PPE)

Personal protective equipment or PPE refers to clothing and other equipment worn by workers to protect them from hazards. OSHA requires that PPE:

- Is of safe design and construction
- Is maintained in a clean and reliable fashion
- Is selected to account for workers' fit and comfort (this encourages use)
- Meets standards developed by the American National Standards Institute (ANSI)

Employers are responsible for:

- Performing a Job Hazard Analysis (JHA) of the workplace to identify and control physical and health hazards
    - During the JHA, the employer should consider possible dangers arising from impact, penetration, compression, heat or cold, harmful dust, radiation, and chemical and biological sources.
- Identifying and providing appropriate PPE for employees
- Training employees in the use and care of the PPE
- Maintaining the PPE, including replacing it when it becomes worn or damaged
- Periodically reviewing, evaluating, and updating the PPE program

Employees are responsible for:

- Properly wearing and using PPE
- Attending training sessions on PPE
- Caring for, cleaning, and maintaining PPE
- Informing supervisors of the need to repair or replace PPE

Eye and Face Protection

OSHA suggests that eye protection be routinely considered for use by carpenters, electricians, machinists, mechanics, millwrights, plumbers, and pipefitters, sheet metal workers and tinsmiths, assemblers, sanders, grinding machine operators and handlers, and timber cutting and logging workers. In many cases, the hazards that require eye and face protection are caused by using tools. For example, chipping, grinding, sawing, or hammering might send metal or wood chips into your eyes.

The right eye protection should:

- Protect against specific workplace hazards
- Fit properly and be reasonably comfortable to wear
- Provide unrestricted vision and movement
- Be durable and cleanable
- Allow unrestricted functioning of any other required PPE

These are some common types of eye and face protection:

- Safety spectacles have safety frames constructed of metal or plastic and impact-resistant lenses.
- Goggles are tight-fitting eye protection that completely covers the eyes, eye sockets, and facial area immediately surrounding the eyes. They provide protection from impact, dust, and splashes, and sometimes fit over corrective lenses.
- Face shields are transparent sheets of plastic that extend from the eyebrows to below the chin and across the entire width of the head and protect from nuisance dust or splashes but will not provide adequate protection against impact hazards.

Head Protection

Employers must ensure that their employees wear head protection if objects like tools might fall from above, or if they might bump their heads against fixed objects like exposed pipes or beams. Head protection is also required if there is a possibility of head contact with electrical hazards. **Hard hats** are a common type of head protection that is required PPE for anyone working under a scaffold or other raised area where tools are being used. Hard hats should:

- Resist penetration by objects
- Absorb the shock of a blow
- Be water-resistant and slow burning
- Have clear instructions for proper adjustment and replacement of the suspension and headband
- Have a hard outer shell and a shock-absorbing lining
- Allow sufficient ventilation for the wearer's head
- Fit the wearer comfortably
- Be cleaned and inspected daily

Foot and Leg Protection

Employees who face possible foot or leg injuries from falling or rolling objects or from crushing or penetrating materials should wear protective footwear. Examples of such situations include:

- When heavy objects such as barrels or tools might roll onto or fall on your feet
- Working with sharp objects such as nails or spikes that could pierce the soles or uppers of ordinary shoes
- Exposure to molten metal that might splash onto feet or legs
- Working on or around hot, wet, or slippery surfaces
- Working when electrical hazards are present

Hand and Arm Protection

If a workplace Job Hazard Analysis (JHA) reveals that employees face potential injury to hands and arms that cannot be eliminated through engineering and work practice controls, employers must ensure that employees wear appropriate protection. Potential hazards include skin absorption of harmful substances, chemical or thermal burns, electrical dangers, bruises, abrasions, cuts, punctures, fractures, and amputations. Protective equipment includes gloves, finger guards, and arm coverings.

Body Protection

Body protection should prevent or mitigate the effects of temperature extremes, splashes of molten metals or other hot or hazardous liquids, and potential impacts from tools, machinery, and materials. Examples of body protection include laboratory coats, coveralls, vests, jackets, aprons, surgical gowns, and full-body suits. Duck, a closely woven cotton fabric, can protect against cuts and bruises when handling sharp or heavy objects, including certain hand and power tools.

Hearing Protection

Determining whether hearing protection is needed can be challenging. Exposure to excessive noise depends on many factors, including the loudness of the noise as measured in decibels (dB), the duration of each employee's exposure to the noise, whether employees move between work areas with different noise levels, and whether noise is generated from one or multiple sources. Generally, the louder the noise, the shorter the exposure time before hearing protection would be required.

If engineering and work practice controls do not lower employee exposure to workplace noise to acceptable levels, employees must wear appropriate hearing protection. It is important to understand that hearing protectors reduce only the amount of noise that gets through to the ears. The amount of this reduction is referred to as attenuation, which differs according to the type of hearing protection used and how well it fits. Hearing protectors worn by employees must reduce an employee's noise exposure to within the acceptable limits noted in the table below.

Permissible Noise Exposures

Duration per day, in hours	Sound level in dB*
8	90
6	92
4	95
3	97
2	100
1 1/2	102
1	105
1/2	110
1/4 or less	115

*When measured on the A scale of a standard sound level meter at slow response.
Source: 29 CFR 1910.95, Table G-16.

These are some types of hearing protection:

- **Single use earplugs** are made of waxed cotton, foam, silicone rubber, or fiberglass wool. They are self-forming and, when properly inserted, they work as well as most molded earplugs.
- **Pre-formed or molded earplugs** must be individually fitted by a professional and can be disposable or reusable. If reusable, the earplugs should be cleaned after each use.
- **Earmuffs** require a perfect seal around the ear. Glasses, facial hair, long hair, or facial movements such as chewing may reduce the protective value of earmuffs.

Hazards of Hand and Power Tools

Hand Tools

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

Hand tool hazards are often caused by misuse and improper maintenance. Some examples 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 employees.
- 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 employees.
- 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 employees.

Do not use:

- Wrenches when jaws are sprung
- Impact tools (chisels and wedges) when heads have mushroomed
- Tools with loose, cracked, or splintered handles
- A screwdriver as a chisel
- Tools with taped handles (they may be hiding cracks)

Power Tools

In addition to the general rules for tool safety, power tools require some additional consideration. This is because they present additional hazards, such as those related to working with electricity or those arising from the speed and force that power tools can generate. Some important rules for power tool safety include the following:

- Do not lift or carry power tools by the cord
- Keep electric power cords out of the path of the tool
- Keep electric cords and hoses away from heat, oil, and sharp edges
- Do not leave power tools unattended
- Do not stand in water or on wet surfaces when running an electric power tool
- Only use electric power tools with an adequate power supply
- Do not use power tools or extension cords with a missing prong
- Use only **double insulated electrical tools**
- Use **ground fault circuit interrupters (GFCIs)** on all 120-volt, 15- and 20-amp branch circuits
- Do not wear loose clothing, dangling objects or jewelry, or any appendage that could be snagged by a tool
- Keep workplace floors clean and dry to prevent accidental slips
- Keep all people not involved with the work at a safe distance
- Avoid accidental starting; do not hold your fingers on the switch while carrying a plugged-in tool
- Keep good footing and maintain good balance when using power tools
- Remove damaged tools and tag them “do not use”

Power tools must be fitted with guards and safety switches. The exposed moving parts such as belts, gears, shafts, pulleys, sprockets, spindles, drums, flywheels, chains, or other reciprocating, rotating, or moving arts must be guarded. Guards should also protect from flying chips and sparks. Safety guards should never be removed when a tool is in use. Portable circular saws with blades greater than 2 inches in diameter must be fitted with proper upper and lower guards.

Electric Cords

- Don't carry portable tools by the cord
- Don't use electric cords to hoist or lower tools
- Don't yank cord or hose to disconnect it
- Keep cords and hoses away from heat, oil, and sharp edges

Switches

Hand-held power tools must be equipped with one of the following:

- Constant Pressure Switch
- Positive On/Off Switch
- Momentary On/Off Switch

Constant Pressure Switch

Circular saws, chainsaws, and percussion tools without positive accessory holding means must be equipped with a constant pressure switch that will shut off when the pressure is released.

Positive On/Off Switch

This switch is used with many hand-held tools, including powered platen sanders, grinders with wheels two inches in diameter or less, routers, laminate trimmers, nibblers, shears, scroll saws, and jigsaws with blade shanks one-fourth of an inch wide or less.

Momentary On/Off Switch

Hand-held powered drills, tappers, fastener drivers, horizontal, vertical, and angle grinders with wheels greater than two inches in diameter, disc sanders, belt sanders, reciprocating saws, and saber saws must be equipped with a momentary contact "off" switch and may have a lock-on provided that they can be turned off by a single motion of the same finger that turned them on.

Lesson Summary

- The following are some basic tool safety rules that all employees should follow:
  - Inspect tools before use, perform maintenance regularly, and keep all tools in good working order
  - Use the right tool for the job. It should:
    - Fit the workspace available
    - Reduce the force you need to apply
    - Be ergonomic and fit comfortably in your hand
    - Be used in a comfortable work position

  - Only use a tool for the task it was designed to perform
  - Operate tools according to manufacturers' instructions
  - Use the correct guards when necessary and ensure tools are safeguarded when not in use
  - Wear/use the correct PPE when necessary
  - Keep cutting tools sharp
  - Keep the floor and other worksurfaces free of debris or other tripping hazards
- Anyone working four feet or higher above the ground or above other coworkers should use tethered tools. Tools should also be tethered if they could damage other equipment or materials should they fall.
- Hand tools are powered manually rather than with electricity or liquid fuel. Examples include hammers, axes, handsaws, wrenches, and screwdrivers. The most significant hazards commonly encountered while using hand tools result from misuse and improper maintenance.
- In addition to the general rules for tool safety, power tools require some additional consideration. This is because they present additional hazards, such as those related to working with electricity or those arising from the speed and force that power tools can generate.
- Hand-held power tools must be equipped with one of the following:
  - Constant Pressure Switch
  - Positive On/Off Switch
  - Momentary On/Off Switch

Lesson 2: Classification of Tools

Lesson Focus

At the end of this lesson, students will be able to:

- Describe the safety precautions necessary when operating the following kinds of tools:
  - Electric Power Tools
  - Pneumatic Tools
  - Liquid Fuel Tools
  - Powder Actuated Tools
  - Jacks

General Safety Precautions

Employees who use hand and power tools and are exposed to the hazards of falling, flying, abrasive, and/or splashing objects or harmful dusts, fumes, mists, vapors, and/or gases must be provided with the PPE necessary to protect them from those hazards.

All hazards involved in the use of power tools can be prevented by following five basic safety rules:



1. Keep all tools in good condition with regular maintenance
2. Use the right tool for the job
3. Examine each tool for damage before use
4. Operate the tool according to the manufacturer's instructions
5. Provide and use the appropriate PPE.

More Information: Employees and employers have a responsibility to work together to establish safe working procedures. If a hazardous situation is encountered, it should be brought to the attention of the proper individual(s) immediately.

Electric Power Tools

Good practices for the use of electric tools include the following:

- Operate within design limits
- Use gloves and safety shoes (Care must be exercised when using gloves with rotating power tools. In some cases, using gloves can become more dangerous as they may possibly come into contact with the rotating parts, thereby drawing the hand into the tool.)
- Store in a dry place
- Keep work areas well lit
- Ensure that cords don't present a tripping hazard

Circular and Table Saws

Injuries caused by circular and table saws are often severe, requiring stiches, surgery, and even physical therapy for recovery. Be especially careful when working with these types of power tools. Some things to keep in mind include:

- Ensure the blade is appropriate for the saw by checking the size and speed rating.
- Check the power cords for damage before using the saw.
- Do not remove manufacturer's guards! Holding the guard open exposes the spinning blade and greatly increases the chance of injury.
- If using a table saw, adjust the base plate to keep as little of the blade as possible exposed below the material being cut. If using a circular saw, be careful to keep the exposed blade well above and away from hazards.
- Wear the appropriate PPE, including eye protection. If cutting stone, masonry, or other materials that could throw off dangerous fragments, a face shield should be worn.
- Power controls should be within easy reach of the operator.
- Always make sure the material you are cutting is properly secured with clamps or other devices.

Chop Saws

Chop saws are one of the most common power tools encountered in construction. When using, keep the following safety guidelines in mind:

- Use protective guards properly and do not remove when the saw is in use.
- Keep the saw clean of shavings and scraps.
- Bring the blade up to speed before cutting.
- Keep the material firmly against the blade and fence before cutting.
- Do not leave the machine until the blade has come to a complete stop.
- Keep your body and arms at a safe distance from the blade while operating it.
- Use a clamp or vice to keep the saw secured to the work surface.

Chainsaws

Chainsaws are efficient, portable cutting tools, but they can be dangerous if not used correctly and carefully. Before using a chainsaw, always:

- Ensure the area is marked and there are no unauthorized people nearby. If felling a tree, workers should be at least twice as far away as the height of the tree.
- Identify and clear obstacles.
- Identify electrical lines that might become hazards.
- Ensure the chainsaw is the right size and type for the job, and check the controls, chain tension, and all bolts and handles for proper functioning.
- Fuel the saw at least ten feet away from an ignition source.

While using a chainsaw, always:

- Start the saw on the ground or another firm support with the brake engaged.
- Keep both hands on the handles and maintain secure footing.
- Plan the cut; watch for objects under tension and use extreme care to bring objects safely to the ground.
- Be prepared for kickback.
- Never cut directly overhead yourself or others.
- Operate only within your skill level, as accidents often result when operators perform tasks beyond their capabilities.
- Wear proper PPE, including gloves, head protection, hearing protection, and eye and face protection such as safety glasses or goggles. Body protection should include heavy work pants.

Grinders and Abrasive-Wheel Tools

Abrasive wheels and tools may throw off flying fragments. Equip abrasive wheels with guards that:

- Cover the spindle end, nut, and flange projections.
- Maintain proper alignment with the wheel.
- Do not exceed the strength of the fastening.
- Guard so that a minimal amount of the wheel is exposed.

Before mounting, inspect abrasive wheels closely for damage and perform a **sound or ring test** to ensure that the wheel is free from cracks or defects. This test consists of gently tapping the wheel with a light, non-metallic instrument. If the wheel sounds dull or dead, it is likely cracked. DO NOT use it, as it could fly apart. Be sure to suspend rather than directly hold the wheel when performing the test (holding it could alter the sound a produce a false indication of defects).

To prevent an abrasive wheel from cracking, fit it on the spindle freely, then tighten the spindle nut enough to hold the wheel in place *without* distorting the flange. Always let the tool come up to speed prior to grinding or cutting. Do not stand in front of the wheel as it comes up to speed and be sure to always use proper eye and/or face protection.

Be sure to keep work rests not more than 1/8th inch from the abrasive wheel surface, and tongue guards at the top of the wheel not more than 1/4 inch from wheel surface. This prevents jamming the work between the wheel and the rest, which may cause the wheel to break. Do not adjust the wheel while it is rotating.

Guarding

Never remove guards or use a power tool without proper guarding in place. The removal of guards on moving parts may cause severe injury or even death to an employee or other persons near them.
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.

The following information applies to guarding:

- Guard exposed moving parts of power tools
- Guard belts, gears, shafts, pulleys, sprockets, spindles, flywheels, chains, and other moving parts
- Never remove a guard when a tool is in use

Guarding—Point of Operation

The point of operation is where the work is actually performed on the materials. The point of operation must be guarded or otherwise protected. Machine guards must protect the operator and others from:

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

You should never stand in the plane of rotation of the abrasive 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.

Radial Arm Saw Guarding

The lower blade guard on a radial arm saw is designed to prevent the operator from coming into contact with the rotating blade. This guard must automatically return to the covering position when withdrawn from the work.

Guarding Portable Circular Saws

Guard these saws above and below the base plate or shoe. The upper and lower guards must cover the saw to the depth of the teeth. When withdrawn from the work, the lower guard must automatically return to the covering position.

Table Saw Guarding

Use a hood for guarding against contact with the upper blade. Table saws should be equipped with a spreader to prevent material from squeezing the saw or kicking back during ripping. It should also be equipped with anti-kickback fingers (or “dogs”) to hold the stock down in the event that the saw kicks back the material. Properly support all pieces of stock, including the cut and uncut ends, scrap, and finished product. Additionally, use a push stick for small pieces of wood and for pushing stock past the blade.

Pneumatic Tools

Pneumatic tools are powered by compressed air. Like tools powered by fuel or powder, pneumatic tools come with special safety considerations and additional rules. In particular, in a pneumatic tool the power source (the air) may not be delivered to the tool at a constant rate. If the pressure exceeds the manufacturer’s recommendation, the tool could break and injure the user or others nearby. Pneumatic tools can also cause noise hazards (discharged air can be very loud if not muffled) and temperature hazards (the discharged air is sometimes cold enough to cause frostbite on unprotected skin). Additionally, a severed air hose can whip around violently, causing injury.

When using pneumatic power tools, remember the following safety guidelines:

- Hoses should be secured in such a way that they cannot become accidentally disconnected.
- Safety clips should be securely installed and maintained to prevent attachments from accidentally disconnecting.
- Nailers, staplers, and other similar pneumatic equipment with an automatic fastener feed should have a safety device to prevent the tool from ejecting fasteners.
- Compressed air should not be used for cleaning purposes unless reduced to less than 30 pounds per square inch (PSI).
- Do not exceed the **manufacturer's safe operating pressure**.
- Do not use hoses to hoist tools or other materials.
- All hoses more than ½ inch in diameter (interior) should have a safety device installed at the source of the supply line to reduce pressure in case of hose failure.
- Spray guns should have automatic or visible manual safety devices to prevent accidentally pulling the trigger.
- Ensure tool is fastened securely to the air hose to prevent a disconnection. Use a proper wire or positive locking device that attaches the air hose to the tool.

Jacks

Jacks are a type of **hydraulic tool** that uses fluid to create pressure and lift heavy loads. When using a jack, ensure that:

- The base of the jack is on a firm, level surface
- The jack is centered
- The jack head is placed against a level surface
- You apply the lift force evenly to the jack
- The jack is lubricated and inspected regularly

The **manufacturer's rated capacity** must be marked on all jacks and must not be exceeded. All jacks must have a stop indicator that must not be exceeded. Immediately block the load after it is lifted. 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.

Proper maintenance of jacks is essential for safety. All jacks should be lubricated and inspected regularly.

Pneumatic Tool Safety

- All pneumatic driven nail guns, staplers, and other similar equipment with automatic fastener feeds, should have a safety device on the muzzle to prevent

the tool from ejecting fasteners, unless the muzzle is in contact with the work surface.
- The manufacturer's safe operating pressure for hoses, pipes, valves, filters, and other fittings should not be exceeded. Eye protection must be worn while operating pneumatic tools.
- Hearing protection is typically required while operating jackhammers due to the high noise levels generated.
- Compressed air hoses with an inside diameter (ID) greater than one half (1/2) inch must have a safety device in place to reduce pressure in case of hose failure.

Compressed Air Cleaning

Do not use compressed air for cleaning. The only exception allows compressed air to be used for cleaning where it is reduced to less than 30 P.S.I. with effective chip guarding and PPE, and where appropriate controls are in place to prevent injuries and damage.

Liquid Fuel Tools

Like electric power tools, fuel-powered tools present specific additional hazards that workers and employers must consider. Most fuel-powered tools use gasoline and the main hazards arise from fuel vapors and exhaust. As a result, they *should not* be used in enclosed and confined spaces. Use only approved flammable liquid containers to transport fuel, and always shut down the engine and allow it to cool before refilling a fuel-powered tool tank.

When a fuel-powered tool is used inside a closed area, effective ventilation and/or proper respirators must be utilized to avoid breathing carbon monoxide. Fire extinguishers must also be available in the area.

Powder-Actuated Tools

Powder-actuated tools use the expanding air generated by an explosion to drive a fastener into materials like concrete and masonry. This makes them especially hazardous—in many ways, a powder-actuated tool is like a loaded gun and should be treated like one. Here are some rules for using a powder-actuated tool:

- The user must be trained to operate it!
- It must be inspected and tested each day before loading to ensure the safety devices are working properly.
- The user must wear proper ear, eye, and face protection.
- Select a powder level that will do the work without using excessive force.
- Do not use powder-actuated tools in explosive or flammable environments.
- Ensure the tool is clean, its moving parts operate freely, and its barrel is free of obstructions.

- Ensure the tool has the proper shielding and guarding attachments.
- Do not load a tool unless it will be immediately used.
- Do not leave a loaded tool unattended.
- Keep your hands clear of the barrel-end of the tool and never point it at anyone.
- Store unloaded tools in a locked box.

Easily Penetrated Material

Avoid driving into materials easily penetrated unless materials are backed by a substance that will prevent the pin or fastener from passing through. Also, don't drive fasteners into very hard or brittle material that might chip or splatter, or make the fasteners ricochet.

Powder-Actuated Tool Safety Tips

The following safety tips apply to the use of powder-actuated tools:

- Do not use powder-actuated tools in explosive or flammable environments.
- Inspect powder-actuated tools before use to ensure:
  - The tool is clean
  - That moving parts of the tool operate freely
  - The barrel of the tool is free from obstructions and has the proper shield, guard, and attachments
- Do not load the tool unless it will be immediately used.
- Do not leave a loaded tool unattended.
- Keep hands clear of the barrel end of the tool.
- Never point the tool at anyone.
- Store unloaded tools in a secured box.

If a powder-actuated tool misfires, the user must hold the tool in the operating position for at least 30 seconds before trying to fire it again. If it still will not fire, the user must hold the tool in the operating position for another 30 seconds and then carefully remove the load in accordance with the manufacturer's instructions. This procedure will make the faulty cartridge less likely to explode. The bad cartridge should then be put in water immediately after removal.

Case Study

What Happened?
An employee was killed when he was struck in the head by a nail fired from a powder actuated tool. The tool operator was attempting to anchor a plywood form in preparation for pouring a concrete wall.

Description of the incident:
A 22-year-old carpenter's apprentice was killed when he was struck in the head by a nail fired from a powder-actuated nail gun. The nail gun operator fired the gun while

attempting to anchor a plywood concrete form causing the nail to pass through the hollow form. The nail traveled 27 feet before striking the victim. The nail gun operator had never received training on how to use the tool, and none of the employees in the area were wearing PPE.

In another situation, two workers were building a wall while remodeling a house. One of the workers was killed when he was struck by a nail fired from a powder-actuated nail gun. The tool operator who fired the nail was trying to attach a piece of plywood to a wooden stud. But, the nail shot through the plywood and stud, striking the victim.

Below are some OSHA regulations that should have been followed.

- Powder-actuated nail guns should not be used to drive nails into easily penetrated materials unless the material is backed by a substance that will prevent the nail from passing through.
- Employees who operate powder or pressure-actuated tools must be trained to avoid firing into easily penetrated materials (like plywood).
- In areas where workers could be exposed to flying nails, appropriate PPE must be used.

Lesson Summary

- Electric power tools must be double insulated and have a three-wire cord plugged into a grounded receptacle. When using power tools, you should use gloves and safety shoes, keep work areas well lit, and ensure that cords don't present a tripping hazard. Don't use power tools in wet locations unless approved for those conditions.
- Abrasive wheels and tools may throw off flying fragments and should have guards and be inspected before use. Never remove guards or use a power tool without proper guarding in place. The point of operation must be guarded or otherwise protected.
- The lower blade guard on a radial arm saw is designed to prevent the operator from coming into contact with the rotating blade. This guard must automatically return to the covering position when withdrawn from the work.
- Pneumatic tools are powered by compressed air, and they include nail guns, staplers, chippers, drills, and sanders. Hazards include getting hit by a tool attachment or by a fastener that worker is using with the tool. They should have a safety device on the muzzle to prevent the tool from ejecting fasteners, unless the muzzle is in contact with the work surface.
- Powder-actuated tools use the expanding air generated by an explosion to drive a fastener into materials like concrete and masonry. This makes them especially hazardous—in many ways, a powder-actuated tool is like a loaded gun and should be treated like one.
- Avoid driving into materials easily penetrated unless materials are backed by a substance that will prevent the pin or fastener from passing through. Do not use powder-actuated tools in explosive or flammable environments.

- Most fuel-powered tools use gasoline and the main hazards arise from fuel vapors and exhaust. As a result, they *should not* be used in enclosed and confined spaces if it can be avoided. Use only approved flammable liquid containers to transport fuel, and always shut down the engine and allow it to cool before refilling a fuel-powered tool tank.

Module 18: Welding and Cutting

Module Description

Safety is a critical consideration for any welding project. Welding is a safe occupation when proper precautions are taken, but if safety measures are ignored or not in place, welders face an array of hazards that can be potentially dangerous, including electric shock, fumes and gases, fire, explosions, and more.

This module is intended to provide an overview of the hazards associated with welding, cutting, and brazing and the protective measures necessary to assure the work is performed safely. The module is specifically designed to help workers meet OSHA compliance regarding welding, cutting, and brazing.

Module Learning Objectives

At the conclusion of this module, students will be able to:

- Discuss OSHA's general requirements concerning welding, cutting, and brazing
- Identify the general safety requirements for all types of welding
- Describe the general characteristics for various types of welding
- Name the specific safety requirements for oxygen-fuel gas welding and cutting, arc welding and cutting, and resistance welding

Lesson 1: General Requirements

Lesson Focus

At the end of this lesson, students will be able to:

- Describe the necessary fire prevention and protection methods for welding operations
- Explain how to properly protect workers while they perform welding operations
- Describe the necessary health protection measures necessary, including ventilation



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