

Personal Protective Equipment

Personal protective equipment is designed to protect workers from serious workplace injuries or illnesses resulting from contact with chemical, radiological, physical, electrical, mechanical, or other workplace hazards. Besides face shields, safety glasses, hard hats and safety shoes, protective equipment includes a variety of devices and garments such as goggles, coveralls, gloves, vests, earplugs, and respirators.

- Use protective equipment properly
- Be aware of when personal protective equipment is necessary
- Know what kind of personal protective equipment is protecting workers from injury
- Understand the limitations of personal protective equipment
- Maintain protective equipment properly

Selecting PPE

All PPE and equipment should be of safe design and construction, and should be maintained in a clean and reliable fashion. PPE that fits well and is comfortable to wear is the right choice of PPE. Most protective devices are available in multiple sizes and care should be taken to select the proper size. If several different types of PPE are worn together, make sure they are compatible. If PPE does not fit properly, it can make the difference between being safely covered or dangerously exposed.

Protection from Foot and Leg Injuries

In addition to foot guards and safety shoes, leggings (e.g., leather, aluminized rayon, or other appropriate material) can help prevent injuries by protecting workers from hazards such as falling or rolling objects, sharp objects, wet and slippery surfaces, molten metal's, hot surfaces and electrical hazards.

Protection from Eye and Leg Injuries

Besides spectacles and goggles, personal protective equipment such as special helmets or shields, spectacles with side shields, and face shields can protect workers from the hazards of flying fragments, large chips, hot sparks, optical radiation, splashes from molten metal's, as well as objects, particles, sand, dirt, mists, dusts, and glare.

Protection from Hearing Loss

Wearing earplugs or earmuffs can help prevent damage to hearing. Exposure to high noise levels can cause irreversible hearing loss or impairment as well as physical and psychological stress. Earplugs made from foam, waxed cotton, or fiberglass wool are self-forming and usually fit well. A professional should fit your workers individually for molded or preformed earplugs. Clean earplugs regularly, and replace those you cannot clean.

Protection from Hand Injuries

Workers exposed to harmful substances through skin absorption, severe cuts or lacerations, severe abrasions, chemical burns, thermal burns, and harmful temperature extremes will benefit from hand protection.

Protection from Body Injury

In some cases workers must shield most or all of their bodies against hazards in the workplace, such as exposure to heat and radiation as well as hot metals, scalding liquids, body fluids, hazardous materials or waste, and other hazards. In addition to fire-retardant wool and fire retardant cotton, materials used in whole-body personal protective equipment include rubber, leather synthetics, and plastic. Optical radiation, splashes from molten metal's, as well as objects, particles, sand, dirt, mists, dusts, and glare.

Eye Safety

Each day about 2000 U.S. workers have job-related eye injury that requires medical treatment. About one third of the injuries are treated in hospital emergency departments and more than half 100 of these injuries result in one or more days of lost work. **The majority of these injuries result from small particles or objects striking or abrading the eye. Examples include metal silvers, wood chips, dust, and cement chips that are ejected by tools, windblown or falling above a worker.** Some of these objects, such as nails, staples, or slivers of wood or metal penetrate the eyeball and result in a permanent loss of vision. Large objects may also strike the eye/face, or a worker may run into an object causing blunt force trauma to the eyeball or eye socket. Chemical burns to one or both eyes from splashes of industrial chemicals or cleaning products are common. Thermal burns to the eye may occur as well. Among welders, their assistants, and nearby workers, **UV radiation burns (welders flash) routinely damage workers eyes and surrounding tissue.**

Personal protective eyewear, such as goggles, face shields, safety glasses, or full face respirators must also be used when an eye hazard exists. The eye protection chosen for specific work situations depends upon the nature and extent of the hazard, the circumstances of exposure, other protective equipment used, and personal vision needs. Eye protection should be fit to the individual or adjustable to provide appropriate coverage. It should be comfortable and allow for sufficient peripheral vision. Selection of protective eyewear appropriate for a given task should be made based on a hazard assessment of each activity.

Eye Protection for Exposed Workers

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, sawyers, welders, laborers, chemical process operators and handlers, and timber cutting and logging workers. Employers of workers in other job categories should decide whether there is a need for eye and face PPE through a hazard assessment. Examples of potential eye or face injuries include:

- Dust, dirt, metal or wood chips entering the eye from activities such as chipping, grinding, sawing, hammering, or use of power tools or even strong wind forces
- Chemical splashes from corrosive substances, hot liquids, solvents, or other hazardous solutions
- Objects swinging into the eye or face, such as tree limbs, chains, tools or ropes
- Radiant energy from welding, harmful rays from the use of lasers or other radiant light (as well as heat, glare, sparks, splash and flying particles)

Welding Operations

The intense light associated with welding operations can cause serious and sometimes permanent eye damage if operators do not wear proper eye protection. The intensity of light or radiant energy produced by welding, cutting or brazing operations varies according to a number of factors including the task producing light, the electrode size and the arc current. The following table shows the minimum protective shades for a variety of welding, cutting and brazing operations in general industry and in the shipbuilding industry.

Filter Lenses for Protection against Radiant Energy

Operations	Minimum* Protective Shade
Shielded Metal Arc	10
Gas Metal Arc Welding and Flux Arc Welding	10
Gas Tungsten Arc	10
Air Carbon (Light)	10
Arc Cutting (Heavy)	11
Plasma Arc Welding	11
Plasma Arc Cutting (Light)	8
Plasma Arc Cutting (Medium)	9
Torch Soldering	2
Carbon Arc Welding	14

Filter Lenses for Protection against Radiant Energy

Operations	Minimum* Protective Shade
Gas Welding (Light)	4
Gas Welding (Medium)	5
Gas Welding (Heavy)	6
Oxygen cutting (Light)	3
Oxygen cutting (Medium)	4
Oxygen Cutting (Heavy)	5

Foot and Leg Protection

People who face possible foot or leg injuries from falling or rolling objects or from crushing or penetrating materials should wear protective footwear. Also, people whose work involves exposure to hot substances or corrosive or poisonous materials must have protective gear to cover exposed body parts, including legs and feet. If an employee's feet may be exposed to electrical hazards, non-conductive footwear should be worn. On the other hand, workplace exposure to static electricity may necessitate the use of conductive footwear. Examples of situations in which an individual should wear foot and/or leg protection include:

- When heavy objects such as barrels or tools might roll onto or fall on the person's 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 on feet or legs
- Working on or around hot, wet, or slippery surfaces
- Working when electrical hazards are present

Foot and Leg Protection Choices Include the Following:

- Leggings protect the lower legs and feet from heat hazards such as molten metal or welding sparks. Safety snaps allow leggings to be removed quickly.
- Metatarsal guards protect the instep area from impact and compression. Made of aluminum, steel, fiber or plastic, these guards may be strapped on the outside of shoes.
- Toe Guards fit over the toes of regular shoes to protect the toes from impact and compression hazards. They may be made of steel, aluminum or plastic.

Combination of foot and shin guards protect the lower legs and feet, and may be used in combination with toe guards when greater protection is needed. Safety shoes have impact-resistant toes and heat-resistant soles that protect the feet against hot work surfaces common in roofing, paving and hot metal industries. The metal insoles of some safety shoes protect against puncture wounds. Safety shoes may also be designed to be electrically conductive to prevent the build-up of static electricity in areas with the potential for explosive atmospheres or nonconductive to protect workers from workplace electrical hazards.

What are the Hazards of Hand Tools?

Hand 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 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 other employees.

When using saw blades, knives, or other tools, you should direct the tools away from aisle areas and away from other people. Knives and scissors may be dull; 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 mushroom heads. The wooden handles of tools must not be splintered. Iron or steel 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 for use.

What are the Dangers of Power Tools?

Appropriate PPE 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. Power tools must also be fitted with guards and safety switches; they are extremely hazardous when used improperly. The types of power tools are determined by their power source: electrical, pneumatic, liquid fuel, hydraulic, and power-actuated. 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 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 fold 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 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

Guards

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

Portable circular saws having a blade greater than 2 inches (5.08 centimeters) 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.

Electric Tools

People 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 can also cause the user to fall of 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 3-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. Anytime 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 thirds-wire grounding. 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 lighted when operating electric tools
- Ensure that cords from electric tools do not present a tripping hazard
- In the industry, people who use electric tools must be protected by ground-fault circuit interrupters

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:

- (1) Cover the spindle end, nut, and flange projections
- (2) Maintain proper alignment with the wheel
- (3) 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 test, 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 in 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 and face protection
- Turn off the power when not in use
- Never clamp a hand-held grinder in a vise

Pneumatic Tools

Pneumatic tools are powered by compressed air and include chippers, drills, hammers, and 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 ½-inch (12.7 millimeters) 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 take 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 prevents 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.