

PERSONAL PROTECTIVE EQUIPMENT (PPE) – FOOT PROTECTION AND CHECKLIST

Introduction

Protective footwear is necessary when there is risk of injury due to:

- A heavy object falling or large animal stepping on the foot
- A heavy object rolling over the foot
- A sharp object penetrating the sole of the foot or cutting through the top
- Ignition of flammable or explosive vapors or dusts from static electricity discharged between the foot and walking surface
- Accidental contact with low voltage (AC > 50V < 600 V) live electrical systems
- Contact with high voltage systems
- Chainsaw usage (or similar cut hazard)
- Contact with chemicals, potentially infectious human body fluids, or human pathogens
- Molten metals splashing on the foot
- Slips or falls due to wet or slippery surfaces, or rough terrain
- Environmental conditions (e.g., extreme heat/cold, bites from venomous snakes, etc.)

Performance Standards

For most foot hazards, protective footwear must be constructed in accordance with ASTM Standards F-2412 and F-2413, Standard Methods for Foot Protection and Standard Specification for Performance Requirements for Protective Footwear, respectively. These standards replaced American National Standards Institute (ANSI) Standard Z41-1999, American National Standard for Personal Protection- Foot Protection. These standards contain minimum requirements for: (1) impact resistance to the toe area; (2) compression

resistance for the toe area; (3) metatarsal impact protection that reduces the chance of injury to the metatarsal bones at the top of the foot; (4) conductive properties which reduce hazards that may result from static electricity buildup; and reduce the possibility of ignition of explosives and volatile chemicals; (5) electric shock resistance to protect the wearer when accidental contact is made with live electric wires; (6) static dissipative (SD) properties to reduce hazards due to excessively low footwear resistance that may exist where SD footwear is required; (7) puncture resistance of footwear bottoms; and (8) dielectric insulation. Chain saw cut resistance is addressed in ASTM Standard F-1818.

ASTM footwear standards do not address some foot hazards, such as slip resistance, thermal insulation capability, resistance to chemical permeability and biological agents, and ankle support. Protective footwear for these types of hazards must be selected with good judgment and consideration given to specific site and use conditions.

Special footwear features may be available such as specially designed comfort soles and heels for people standing for prolonged periods, temperature insulation and coatings over the outer upper of the shoe to increase shoe life or keep the feet dry. These features are considered comfort factors and not safety factors.

ASTM Foot Protection Performance Standards

Toe Impact Rating (I): Safety shoes or boots with impact protection are required when carrying or handling heavy materials/objects such as packages, parts or heavy tools, which could be dropped or fall onto the feet and cause serious injury. The standard for impact resistance specifies protection against exposure to impact energy of 101.7 J (75 ft-lbf), which is approximately the force created by an object dropped directly on the toe weighing 50 lb. and dropped from a height of 18 inches.

Toe Compression Rating (C): Safety shoes or boots with compression protection are required for work where a heavy object or item may roll over or a heavy animal may step on the toe (e.g., operating skid trucks and pallet jacks, working around bulk paper rolls or heavy pipes, etc.). In accordance with ASTM performance standards, compression resistant footwear must also meet impact resistance requirements. The standard for compression resistance specifies protection against exposure to a compressive force of 2500 lbf.



Metatarsal Protection (Mt): Safety shoes with metatarsal protection protect the bones of the upper foot from compression and impact. In accordance with ASTM performance standards, they must also meet minimum requirements for toe impact and compression.

Puncture/Penetration of Footwear Bottoms (PR): Safety shoes or boots with puncture protection are required when there is risk of sharp objects such as nails, wire, tacks, screws, large staples, scrap metal, etc., penetrating the sole of the shoe. Protection is gained by the addition of a built-in, puncture resistant plate that is positioned between the insole and outsole.

Chainsaw Use: This type of footwear provides cut resistance to the feet in addition to the puncture resistant sole while operating a chainsaw (or device with similar hazard). This higher boot style is designed to protect the feet between the toe and lower leg.

Electric Shock (EH): This type of footwear is constructed with non-conductive electric shock resistant soles and heels so that the outsole provides a **secondary** source of electric shock resistance protection to the wearer. In accordance with ASTM Standards, conductive protective footwear must also meet the impact and compression standards. The insulation protection may be compromised if the soles become wet, the soles are worn through, metal particles become embedded in the sole or heel, or employees touch conductive items that are grounded.

Electrical Conduction (EC): Safety shoes with electrical conduction rating are intended to provide protection against the buildup of static electricity between the shoe and walking surface in areas where such static could serve as an ignition source for explosive or flammable vapors or dust. In accordance with ASTM Standards, conductive protective footwear must also meet the impact and compression standards. Conductive protective footwear must **not** be worn by personnel working near open electrical circuits. Foot powder should not be used with protective conductive footwear because foot powder provides insulation and reduces the conductive ability of the shoes. Silk, wool, and nylon socks can produce static electricity and should not be worn with conductive footwear. Conductive shoes must be removed when the task requiring their use is completed.

Static Dissipation (SD): This type of shoe is often used when working on or constructing sensitive electrical equipment. They are designed to prevent the buildup of static electricity which can damage electrical components, but also to provide a level of shock protection to the wearer should they inadvertently come in contact with a live electrical system.



Dielectric Insulation (DI): This type of footwear is commonly found as an overshoe and is designed to provide the wearer with additional insulation if accidental contact is made with energized electrical conductors, apparatus or circuits, usually in a wet environment.

Performance Standard Markings

Protective footwear must contain a permanent marking that identifies those performance standards that the footwear meets or exceeds. This is displayed in a four-line format.

- Line one identifies that the footwear complies to an ASTM standard with a specific year of issuance.
- Line two identifies the gender of the user and the classifications for impact resistance, compression resistance, and metatarsal impact resistance.
- Lines three and four indicate that the footwear is made to offer protection from specific types of hazards (puncture resistant, etc.). Line four is used only when more than three sections of the ASTM specifications apply to any one pair of protective footwear.
 - SD- Identifies footwear designed to reduce the accumulation of excess static electricity.
 - PR- Identifies footwear designed to be puncture resistant.
 - Mt- Identifies footwear designed to be impact resistant to the top of the foot.
 - DI- Identifies footwear which provides dielectric insulation.

ASTM F2413-18

M/I/C

PR

In the above example, the footwear meets or exceeds the minimum performance requirements of ASTM Standard F2413, as issued in 2018. This footwear was tested for a male worker and has an impact resistance and compression resistance. It is puncture resistant.

Footwear that is determined to be chain saw cut resistant will be marked: This product has been certified to comply with ASTM F-1818 [year].

Other Considerations

Following are considerations that are beyond the scope of the ASTM performance standards.

Slip Resistance: The following work environment factors may affect slip resistance: type of surface material; smoothness of the walking surface; wet or dry surface; type of liquid on the surface; temperature of the surface and the surrounding air. In general, smooth and/or wet surfaces are more slippery. Cold temperatures can also reduce the amount of traction if the sole material becomes harder and less slip resistant. Treads in the sole may allow liquid to disperse. The shape of the heel may be beveled so initially the heel makes more contact with the surface. Softer soles may also allow for more traction. Proper selection requires judgment with consideration given to specific site/use condition factors.

Ankle Protection: Lace-up boots that cover the ankle and provide support are recommended when the user will be navigating rough/uneven terrain, or riding horses, ATVs, or motorcycles. Boot style also provides protection to the ankle and calf (depending on boot height) if animal bites or contact with poisonous plants or animals is a recognized hazard.

Chemical Permeability: In general, disposable shoe covers or impermeable boots will be necessary to protect against hazardous chemicals. The manufacturer will provide permeability data based on the material of construction. The selected shoe cover/boot must be resistant to the chemical(s) of interest.

Biological Agents: Disposable shoe covers or rubber-like boots may be used when there is risk of contact with biological agents. For example, caretakers of animals that have been challenged with human pathogens may be required to put on protective shoe covers or boots that are easily disinfected. The material of construction must be compatible with specified disinfectants.

Inspections and Regular Maintenance

Safety footwear should be inspected prior to each use. They should be checked for wear and tear and replaced as needed. Look for cracks or holes, separation of materials, broken buckles or laces. Check the soles for pieces of metal or other embedded items that could present electrical or tripping hazards. Follow manufacturers' recommendations for cleaning and maintenance.

Payment for Protective Footwear

In general, employers are required to purchase and provide employees with necessary personal protective equipment (PPE), including protective footwear. However, there are a few exceptions. Employees should consult their supervisors regarding department-specific policies. Some departments elect to provide and pay for PPE even if not required to do so in accordance with OSHA standards. Employers are not required to pay for the following, but may require their use:

- Non-specialty safety-toe footwear (e.g., leather work boots with steel toes) if the employee is allowed to wear it off the job site.
- Ordinary clothing, including insulated winter boots, that the employee would normally have to protect themselves from the elements.
- Replacement PPE when the employee has lost or intentionally damaged the PPE. However, the employer must provide replacement PPE at a reasonable interval.
- PPE, including footwear that the employee already owns and requests to use instead of the PPE that the employer provides at no cost to employees.
- Upgraded PPE that the employee wants to buy and use rather than the PPE that employer normally provides (if allowed by the employer).

Other FAQs

Steel toe vs. Titanium or Composite Toe: All may be rated the same for protection, but a composite toe is non-metallic and non-magnetic.

Add-on Protective Devices: Protective toe caps must be an integral and permanent part of the footwear per the ANSI and ASTM standards. Metatarsal guards may be of an add-on type only if they are supplied with the footwear by the manufacturer and the manufacturer provides data showing them to provide protection equivalent to the ANSI/ASTM requirement.

Men's vs. Women's Shoe Styles: Safety footwear is tested to different minimum interior height clearances for each sex. Men should not wear women's safety footwear as the interior height allowance is less when subjected to an impact or compression test. Women may wear men's styles as their feet are still properly protected at the minimum heights.

Inserts or Insoles: If added after the purchase of protective footwear, they could reduce or eliminate the effectiveness of the footwear.



Footwear Hazard Assessment

Following is a form that may be used to perform and document a hazard assessment for a worker, based on their assigned job tasks.

Footwear Hazard Assessment

Employee's Name		Date	
Sex		NU ID	
Department		Supervisor	

Tasks expected to be performed while on the job:

	Mandatory	Recommended	NA
Toe Impact (I) and Compression (C) Rating			
Metatarsal Protection (Mt)			
Puncture Resistant (PR)			
Slip Resistant			
Electrical Shock (EH)			
Electrical Conduction (CD)			
Static Dissipation (SD)			
Dielectric Insulation (DI)			
Chain Saw Cutting (ASTM F-1818)			
Ankle protection			
Water resistant			
Chemical resistant (specify chemical):			
Thermally insulated (cold)			



Sample print label inside the footwear for the employee to look for:

Line 1 ASTM F2413-xx

Line 2 __ / __ / __ / __ / __ / __ / __

Line 3 _____

Line 4 _____

Chain-saw cut resistance. Yes No:

This product has been certified to comply with ASTM F-1818 [year].