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Standard Specification for Performance Requirements for Foot Protection Performance Requirements for Protective (Safety) Toe Cap Footwear¹

This standard is issued under the fixed designation F2413; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

INTRODUCTION

For more than sixty years, the predecessor to this specification, ANSI Z41, established the performance criteria for a wide range of footwear to protect from hazards that affect the personal safety of workers.

The value of these standards was recognized early in the history of Occupational Safety and Health Administration (OSHA) and incorporated as a reference standard in the Code of Federal Regulations (CFR) 1910.

The value of these standards was recognized early in the history of Occupational Safety and Health Administration (OSHA) and incorporated as a reference standard in the Code of Federal Regulations (29 CFR Part 1910.132 and 29 CFR Part 1910.136).

The principal purpose of this standard is the certification of protective footwear. Certification must be performed by independent third party laboratories in order for footwear to bear the ASTM marking.

The specification contains performance requirements for footwear to protect workers' feet from the following hazards by providing: (1) impact resistance (I) for the toe area of footwear; (2) compression resistance (C) for the toe area of the footwear; (3) metatarsal impact protection (Mt) that reduces the chance of injury to the metatarsal bones at the top of the foot; (4) conductive properties (Cd) 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, hazard protection (EH), to protect the wearer when accidental contact is made with by stepping on live electric wires; (6) static dissipative (SD) properties (SD) to reduce hazards due to excessively low footwear electrical resistance that may exist where SD footwear is required; and (7) puncture resistance of footwear bottoms; (8) chain saw cut resistance; and (9) dielectric insulation.) puncture resistance (PR) footwear devices.

1. Scope

1.1 This specification covers minimum requirements for the design, performance, testing, and classification of footwear designed to provide protection against a variety of workplace hazards that can potentially result in injury.

1.2 The objective of this specification is to prescribe fit, function, and performance criteria for footwear that is intended to be worn to reduce injuries.

1.3 This specification is not intended to serve as a detailed manufacturing or purchasing specification, but can be referenced in purchase contracts to ensure that minimum performance requirements are met.

1.4 Controlled laboratory tests used to determine compliance with the performance requirements of this specification shall not be deemed as establishing performance levels for all situations to which individuals may be exposed.

1.5 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.6

1.1 This specification covers minimum requirements for the performance of footwear to provide protection against a variety of workplace hazards that can potentially result in injury.

1.2 This specification is not intended to serve as a detailed manufacturing or purchasing specification, but can be referenced in purchase contracts to ensure that minimum performance requirements are met.

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1.3 Controlled laboratory tests used to determine compliance with the performance requirements of this specification shall not be deemed as establishing performance levels for all situations to which individuals may be exposed.

1.4 Any changes to the original components of safety toe footwear such as replacing or adding after market footbeds/inserts could cause failure to any or all parts of this standard rendering the ASTM marking invalid.

1.5 This specification is not applicable to overshoes with safety toe caps or strap on devices with safety toes.

1.6 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.7 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. Referenced Documents

2.1 ASTM Standards:²

B117 Practice for Operating Salt Spray (Fog) Apparatus F1116 Test Method for Determining Dielectric Strength of Dielectric Footwear

F1117 Specification for Dielectric Footwear

F1818 Specification for Foot Protection for Chain Saw Users

F1646 Terminology Relating to Safety and Traction for Footwear

F2412 Test Methods for Foot Protection

2.2 Federal Standards:³

CFR 1910.13229 CFR Part 1910.132 Personal Protective Equipment—General Requirements

CFR 1910.13629 CFR Part 1910.136 Personal Protective Equipment—Occupational Foot Protection

2.3 Canadian Standards Association Standard:⁴

CAN/CSA Z195 Protective Footwear

3. Terminology

3.1 Definitions:

3.1.1 *footwear insert/footbed/sockliner* (all removable), *n*—wearing apparel for the feet (such as shoes, boots, slippers, or overshoes) excluding hosiery.

3.1.1.1 *Discussion*—This term can refer to either left foot or right foot units or pairs.

3.1.2 *insert*, *n*—footbed normally made of a foam product with leather or fabric cover shaped to cover the entire insole which can be inserted between the foot and insole board.

3.1.3

3.1.2 *insole*, *n*—foundation of the shoe; the inner sole of the shoe which is next to the foot, under the sock liner or the insert, onto which the upper is lasted.

3.1.4

3.1.3 *last*, *n*—solid hinged form, in the general shape of a foot, around which footwear is constructed.

3.1.5

3.1.4 *lasting*, *v*—building of footwear around a specific foot form last.

3.1.6 3.1.5 *lining*, *n*—term used to describe all components that can be used to construct the interior of the upper part of the footwear.

3.1.7 *outsole and heel*

3.1.6 *soling material*, *n*—exterior bottom platform of the footwear; the bottom surface.

3.1.8

3.1.7 *product category*, *n*—description for a type of footwear designed and manufactured for a specific hazard or hazards.

3.1.9 *product classification*, *n*—footwear manufactured to meet a minimum performance requirement for a specific hazard or hazards.

3.1.10

3.1.8 *protective footwear*, *n*—footwear that is designed, constructed, and classified to protect the wearer from a potential hazard or hazards.

3.1.11

3.1.9 *protective toe cap*, *n*—component designed to provide toe protection that is an integral and permanent part of the footwear.

3.1.12

3.1.10 *quarter*, *n*—entire back portion of the footwear upper.

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401.

⁴ Available from Canadian Standards Association (CSA), 178 Rexdale Blvd., Toronto, ON Canada M9W1R3.

3.1.13 *shall*, *v*—mandatory action.

3.1.14 *should*, *v*—advisory comment.

3.1.15

3.1.11 *size*, *n*—length and breadth measurements of footwear determined by using a specific grading; the American system of footwear grading.

3.1.16 *socklining*

3.1.12 *socklining (non-removable)*, *n*—material placed over the insole which is imprinted with a brand name or other designation.

3.1.17—*material placed over the insole, footbed, or insert that may be imprinted with a brand name or other designation.*

3.1.13 *upper*, *n*—parts of a shoe or boot that are above the sole-bottom of the foot.

4. Significance and Use

4.1 This specification contains requirements to evaluate the performance of footwear for the following:

4.1.1 Impact resistance for the toe area of footwear;

4.1.2 Compression resistance for the toe area of footwear;

4.1.3 Metatarsal protection that reduces the chance of injury to the metatarsal bones at the top of the foot;

4.1.4 Conductive properties which reduce hazards that may result from static electricity buildup, and reduce the possibility of ignition of explosives and volatile chemicals;

4.1.5 Electric shock resistance;

4.1.6 Static dissipative (SD) properties to reduce hazards due to excessively low footwear resistance that may exist where SD footwear is required;

4.1.7 Puncture resistance of footwear bottoms;

4.1.8 Chain saw cut resistance; and

4.1.9 Dielectric insulation.

4.1.1 Impact resistance for the toe area of footwear, (I),

4.1.2 Compression resistance for the toe area of footwear, (C),

4.1.3 Metatarsal protection that reduces the chance of injury to the metatarsal bones at the top of the foot, (Mt),

4.1.4 Conductive properties which reduce hazards that may result from static electricity buildup, and reduce the possibility of ignition of explosives and volatile chemicals, (Cd),

4.1.5 Electric hazard by stepping on live wire, (EH),

4.1.6 Static dissipative (SD) properties to reduce hazards due to excessively low footwear electrical resistance that may exist where SD footwear is required, and

4.1.7 Puncture resistance footwear devices, (PR).

4.2 Any changes to the original components of the safety toe footwear such as replacing or adding after market footbeds/inserts could cause failure to any or all parts of this standard rendering the ASTM MARKING INVALID. Protective toe footwear specimens or samples shall be retested for any of the following changes:

4.2.1 Change in material used to make protective toe cap, change in protective cap manufacturer, change in the design of the toe cap.

4.2.2 Change in construction method used to make footwear or change in factory in which footwear is produced.

4.2.3 Change in the upper or insole material thickness greater than 25 %, change to the soling system, or a change in the hardness of the outsole.

4.2.4 Change in shape of last used in the manufacturing of footwear.

4.2.5 Change in material or supplier of protective insole.

4.2.6 Change in material or supplier of the metguard.

5. Performance Requirements and Workmanship Performance Requirements for Foot Protection

5.1 *Impact Resistant Footwear (I)*:

5.1.1 Impact resistant footwear shall also meet the requirements of 5.2 for compression resistant footwear.

5.1.2 Footwear shall be designed, constructed, and manufactured so that a protective toe cap is an integral and permanent part of the footwear.

5.1.2 Footwear shall be constructed and manufactured so that a protective toe cap is an integral and permanent part of the footwear. This type of footwear is to be worn over the foot only. Overshoes and overboots, including strap on devices with protective toe caps that are meant to be worn over footwear, do not comply with the requirements of this standard. Therefore they can not be marked with ASTM F2413 designation.

5.1.3 The workmanship in the production and assembly of the footwear shall ensure that the footwear provides functionality to the wearer.

5.1.4 Classification 5.1.4 Impact 75 shall be determined by evaluating three specimens in accordance with Test Methods F2412. The product classification requirement for impact resistance represents the minimum force required for each classification that

results in the toe area of the footwear having a minimum interior height clearance of 12.7 mm (0.50 in.) in men's footwear and 11.9 mm (0.468 in.) in women's footwear.

5.1.4.1 Impact resistance of footwear shall be classified as follows:

(1) Class Impact 75 product classification for men's footwear shall demonstrate a minimum interior height clearance of 12.7 mm (0.50 in.) during exposure to impact energy of 101.7 J (75 ft-lbf).

(2) Class 75 product classification women's footwear shall demonstrate a minimum interior height clearance of 11.9 mm (0.468 in.) during exposure to impact energy of 101.7 J (75 ft-lbf).

(3) Class 50 product classification men's footwear shall demonstrate a minimum interior height clearance of 12.7 mm (0.50 in.) during exposure to impact energy of 67.8 J (50 ft-lbf).

(4) Class 50 product classification women's footwear shall demonstrate a minimum interior height clearance of 11.9 mm (0.468 in.) during exposure to impact energy of 67.8 J (50 ft-lbf).

5.1.4.2 Any specimen that does not meet the minimum impact performance requirements for the product classification constitutes failure for the product category.

5.1.4.3 Protective toe footwear specimens or samples shall be retested for classification for any of the following changes:

(1) Change in material used to make protective toe cap, change in protective cap manufacturer, or changes in the design of the toe cap.

(2) Change in construction method used to make footwear.

(3) Change in the upper or insole material thickness greater than 25%, change to the soling system, or a change in the hardness of the outsole.

(4) Shape of last used in the manufacturing of footwear. Impact 75 product for women's footwear shall demonstrate a minimum interior height clearance of 11.9 mm (0.468 in.) during exposure to impact energy of 101.7 J (75 ft-lbf).

5.1.4.2 Each protective toe cap shall bear the manufacturer's name or trademark or logo. Cap number or identification, and toe cap size and R (right) or L (left) shall be permanently stamped or marked in a conspicuous location.

5.1.4.3 Any specimen that does not meet the minimum impact performance requirements for Impact 75 constitutes non-compliance for the product category.

5.2 *Compression Resistant Footwear (C):*

5.2.1 Compression resistant footwear shall also meet the requirements of 5.1 for impact resistant footwear.

5.2.2 Footwear shall be designed, constructed, and manufactured so that a protective toe cap is an integral and permanent part of the footwear.

5.2.2 Footwear shall be constructed and manufactured so that a protective toe cap is an integral and permanent part of the footwear. This type of footwear is to be worn over the foot only. Overshoes and overboots, including strap on devices with protective toe caps that are meant to be worn over footwear, do not comply with the requirements of this standard. Therefore they can not be marked with the ASTM F2413 designation.

5.2.3 The workmanship in the production and assembly of the footwear shall ensure that the footwear provides functionality to the wearer.

5.2.4 Classification 5.2.4 Compression 75 shall be determined by evaluating three specimens in accordance with Test Methods F2412. The product classification requirement for compression resistance represents the minimum force required that results in the toe area of the footwear having a minimum interior height clearance of 12.7 mm (0.50 in.) in men's footwear and 11.9 mm (0.468 in.) in women's footwear.

5.2.4.1 Compression resistance of footwear shall be classified as follows:

(1) Class Compression 75 product classification for men's footwear shall demonstrate a minimum interior height clearance of 12.7 mm (0.50 in.) during exposure to a compressive force of 11 121 N (2500 lbf).

(2) Class 75 product classification women's footwear shall demonstrate a minimum interior height clearance of 11.9 mm (0.468 in.) during exposure to a compressive force of 11 121 N (2500 lbf).

(3) Class 50 product classification men's footwear shall demonstrate a minimum interior height clearance of 12.7 mm (0.50 in.) during exposure to a compressive force of 7784 N (1750 lbf).

(4) Class 50 product classification women's footwear shall demonstrate a minimum interior height clearance of 11.9 mm (0.468 in.) during exposure to a compressive force of 7784 N (1750 lbf).

5.2.4.2 Any specimen that does not meet the minimum compression resistance requirements for the product classification constitutes a failure for the product category.

5.2.4.3 Compression resistant footwear shall be retested for classification for any of the following changes:

(1) Change in material to make protective toe cap, change in protective toe cap manufacturer, or changes in the design of the toe cap.

(2) Change in construction method used to make footwear.

(3) Change in the upper or insole material thickness greater than 25%, change to the soling system, or a change in the hardness of the outsole.

(4) Shape of last used in manufacturing of footwear.

5.2.4.4 Classifications—Protective footwear shall be classified in accordance with the tables below for its ability to meet

compression resistance and impact resistance. The proper classification shall be determined by the test results of three specimens for each requirement.

5.2.4.5 The lowest recorded compression or impact resistance of the three test specimens will determine the footwear classification. If the product fails to meet the class for which it is intended, you must retest. For example, if a product test results meet Class 50 for compression resistance and Class 75 for impact resistance, the rating of the footwear will be I50/C50.

Classification Table Impact I/75=75 ft-lbs (101.7 J) I/50=50 ft-lbs
(67.8 J)
Classification Table Compression C/75=2500 lb (11121 N) C/=1750
lb (7784 N)
Minimum Clearance (all classifications) Men=0.500 in. (12.7 mm)
Women=0.468 in. (11.9 mm)

Compression 75 product for women's footwear shall demonstrate a minimum interior height clearance of 11.9 mm (0.468 in.) during exposure to a compressive force of 11 121 N (2500 lbf).

5.2.4.2 Each protective toe cap shall bear the manufacture's name or trademark or logo. Cap number or identification and toe cap size and R (right) or L (left) shall be permanently stamped or marked in a conspicuous location.

5.2.4.3 Any specimen that does not meet the minimum compression performance resistance requirement for Compression 75 constitutes a non-compliance for the product category.

5.3 Metatarsal Protective Footwear (Mt):

5.3.1 Metatarsal protective footwear shall first meet the requirements of 5.1 for impact resistant footwear and 5.2 for compression resistant footwear.

5.3.2 Footwear shall be ~~designed, constructed,~~ constructed and manufactured so that a metatarsal impact guard is positioned partially over the protective toe cap and extended to cover the metatarsal bone area. The metatarsal protection shall be an integral and permanent part of the footwear.

5.3.3 The workmanship in the production and assembly of the footwear shall ensure that the footwear provides functionality to the wearer.

5.3.4 Classification 5.3.3 Mt 75 shall be determined by evaluating three specimens in accordance with Test Methods F2412. The product classification for metatarsal protection shall be made after the footwear has been classified for impact resistance and compression resistance.

5.3.4.1 Class 75 product classification metatarsal protective footwear for men shall first meet the performance requirements for Class 75 Impact Resistant and Class 75 Compression Resistant footwear. Subsequent to meeting these performance requirements, the height of the wax form used to measure metatarsal protection shall be a minimum of 25.4 mm (1.0 in.) after exposure of impact energy of 101.7 J (75 ft-lbf).

5.3.4.2 Class 75 product classification metatarsal protective footwear for women shall first meet the performance requirements for Class 75 Impact Resistant and Class 75 Compression Resistant footwear. Subsequent to meeting these performance requirements, the height of the wax form used to measure metatarsal protection shall be a minimum of 23.8 mm (0.937 in.) after exposure of impact energy of 101.7 J (75 ft-lbf).

5.3.4.3 Class 50 product classification metatarsal protective footwear for men shall first meet the performance requirements for Class 50 Impact Resistant and Class 50 Compression Resistant footwear. Subsequent to meeting these performance requirements, the height of the wax form used to measure metatarsal protection shall be a minimum of 25.4 mm (1.0 in.) after exposure of impact energy of 67.8 J (50 ft-lbf).

5.3.4.4 Class 50 product classification metatarsal protective footwear for women shall first meet the performance requirements for Class 50 Impact Resistant and Class 50 Compression Resistant footwear. Subsequent to meeting these performance requirements, the height of the wax form used to measure metatarsal protection shall be a minimum of 23.8 mm (0.937 in.) after exposure of impact energy of 67.8 J (50 ft-lbf).

5.3.4.5 Any specimen that does not meet the metatarsal impact resistance performance requirement constitutes a failure for the product category.

5.3.4.6 Metatarsal impact resistance protection shall be retested for classification for any of the following changes:

(1) Change in material used to produce the metatarsal impact resistant protection device, change in manufacturer, or design of the product, or a combination thereof.

(2) Change in construction method used to make footwear.

(3) Change in the upper or insole material thickness greater than 25%, a change to the soling system, or a change in the hardness of the outsole.

(4) Shape of last used in manufacturing of footwear.

5.3.3.1 Mt 75 metatarsal protective footwear for men shall first meet the performance requirements for Impact 75 Resistant and Compression 75 Resistant footwear. Subsequent to meeting these performance requirements, the height of the wax form used to measure metatarsal protection shall be a minimum of 25.4 mm (1.0 in.) after exposure of impact energy of 101.7 J (75 ft-lbf).

5.3.3.2 Mt 75 metatarsal protective footwear for women shall first meet the performance requirements for Impact 75 Resistant and Compression 75 Resistant footwear. Subsequent to meeting these performance requirements, the height of the wax form used to measure metatarsal protection shall be a minimum of 23.8 mm (0.937 in.) after exposure of impact energy of 101.7 J (75 ft-lbf).

5.3.3.3 Each metatarsal device shall bear the manufacturer name or trademark or logo and device number or identification and

should be stamped or marked in a conspicuous location.

5.3.3.4 Any specimen that does not meet the metatarsal impact resistance performance requirement constitutes a non-compliance for the product category.

5.4 Conductive Protective Footwear (Cd):

NOTE 1—Conductive footwear is not intended to be worn by personnel working near open electrical circuits.

5.4.1 Conductive footwear shall also meet the requirements of 5.1 for impact resistant footwear and 5.2 for compression resistant footwear.

~~5.4.2 Footwear shall be designed, constructed, and manufactured to provide protection for the wearer against hazards that may result from static electricity buildup and to reduce the possibility of ignition of explosives or volatile chemicals.~~

5.4.2 Conductive protective Footwear shall be constructed, and manufactured to provide protection through conductance with a maximum 500 000 Ω resistance for the wearer against hazards that may result from static electricity buildup and to reduce the possibility of ignition of explosives such as munitions manufacturer.

5.4.2.1 Footwear shall dissipate static electricity from the body to reduce the possibility of ignition of volatile compounds.

~~5.4.2.2 Footwear shall be of a construction that facilitates a stable electrically conductive path. All external components shall be made of nonferrous materials.~~

~~5.4.2.3 Conductive footwear is not designed to be worn by personnel working near open electrical circuits.~~

5.4.3 The workmanship in the production and assembly of the footwear shall ensure that the footwear provides functionality to the wearer:

5.4.3.1 The uppers shall be made of materials that facilitate the dissipation of static electricity.

5.4.3.2 The insoles, linings, outsoles, and heels of the footwear shall be made of any combination of materials and compounds which will facilitate electrical conductivity and the transfer of static electricity build up from the body to the ground.

5.4.3.3 The recommended design of the outsole and heel is a single unit. Where the outsole and heel are separate components, the following practices shall be used:

(1) Heel shall be attached to outsole to ensure no disruption in electrical conductivity.

(2) Non-ferrous heel nails shall be used to attach the heels when heel nails are used. These nails shall be recessed within the tread surface and then covered with conductive material. These nails shall not be either exposed or visible.

5.4.4 Electrical resistance shall be determined by evaluating the minimum number of specimens per lot size in accordance with Test Methods

~~5.4.2.2 Footwear shall be of a construction that facilitates a stable electrically conductive path. All external components shall be made of non-metallic materials.~~

~~5.4.3 Conductive protective footwear shall be determined by evaluating three specimens in accordance with Test Methods F2412.~~

~~5.4.4.1 The 5.4.4 The specimens shall demonstrate resistance between 0 to and 500 000 ohms- Ω .~~

~~5.4.4.2 Any 5.4.5 Any specimen or sample of conductive footwear that does not meet the performance requirement constitutes a failure non-compliance for the lot-product category.~~

5.5 Electric Shock Resistant Footwear (EH):

~~5.5.1 Electric shock resistant footwear shall also meet the requirements of~~

NOTE 2—Electrical hazard protection is severely deteriorated in the following conditions : excessive wear on the soling material or exposure to wet and humid environments or both. Work footwear can become contaminated with conductive materials. For example, soles can pick up metal shavings, etc., which may reduce the effectiveness of the protection. In step potential environments, dielectric overshoes should be used.

5.5.1 Electric hazard resistant footwear shall also meet the requirements of 5.1 for impact resistant footwear and 5.2 for compression resistant footwear.

~~5.5.2 Electric shock resistant footwear shall be designed, constructed, and manufactured with non-conductive electric shock resistant soles and heels so that the footwear outsole can provide a secondary source of electric shock resistance protection to the wearer against the hazards from an incidental contact with live electrical circuits, electrically energized conductors, parts, or apparatus.~~

~~5.5.3 Footwear shall have an electrical shock resistant outsole and heel with an outer surface which is not penetrated by electrically conductive components, parts, or conductive materials.~~

~~5.5.4 Footwear outsole shall provide a secondary source of protection against incidental contact with live electrical circuits, electrically energized conductors, parts, or apparatus under dry conditions.~~

~~5.5.5 Electrical hazard protection is severely deteriorated in the following conditions: excessive wear on the outsole and heel or exposure to wet and humid environments, or both.~~

~~5.5.6 The workmanship in the production and assembly of the footwear shall ensure that the footwear provides functionality to the wearer.~~

~~5.5.7 The outsoles and heels shall be made of materials designed to offer electrical insulative properties to provide electric shock resistance.~~