



Designation: **F2413 – 17 F2413 – 18**

Standard Specification for 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

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 (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 hazard protection (EH), to protect the wearer when accidental contact is by stepping on live electric wires; (6) static dissipative properties (SD) to reduce hazards due to excessively low footwear electrical resistance that may exist where SD footwear is required; and (7) puncture resistance (PR) footwear devices.

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1. Scope

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.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

¹ This specification is under the jurisdiction of ASTM Committee F13 on Pedestrian/Walkway Safety and Footwear and is the direct responsibility of Subcommittee F13.30 on Footwear.

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1.8 This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

2. Referenced Documents

2.1 ASTM Standards:²

B117 Practice for Operating Salt Spray (Fog) Apparatus

F1646 Terminology Relating to Walkway Safety and Footwear

F2412 Test Methods for Foot Protection

2.2 Federal Standards:³

29 CFR Part 1910.132 Personal Protective Equipment—General Requirements

29 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 *certification (recertification)*, *n*—testing of product as required by this standard using the most recently published methods of test and obtain a Certificate of Conformance (see Section 7).

3.1.2 *footbed (removable)*, *n*—also known as ‘insock,’ a component typically made of a foam material with a leather or fabric cover/sockliner and often shaped or contoured covering the entire insole board which can be inserted between the foot and insole board.

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

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

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

3.1.6 *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 *product category*, *n*—description for a type of footwear designed and group of similar footwear items manufactured for a specific hazard or hazards and that:

- Have same protective toe cap, protective insole or metguard materials.
- Have the same supplier for each of those components.
- Have the same thickness (within a ± 12.5 % range) of upper, lining, and insole.
- Are manufactured using the same method of construction; cemented, welted, etc.
- Are manufactured in the same factory.
- Are manufactured using the same last.

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

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

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

3.1.11 *puncture resistant device*, *n*—component designed to provide penetration protection to the bottom of the foot – the device shall be an integral and permanent part of the footwear.

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

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

3.1.14 *soling material*, *n*—exterior bottom platform of the footwear; the bottom surface that is exposed to wear.

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

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.

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, (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-to protect the wearer when accidentally stepping on live wire, (EH);~~ electric wires (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, that result from a build up of static charge where there is an underlying risk of accidental contact with live electrical circuits (SD), and~~

4.1.7 Puncture resistance footwear ~~devices;~~ devices (PR).

4.2 Any changes to the original components of the safety toe footwear such as replacing or adding aftermarket 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 the outsole or midsole, including its hardness.

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

4.2.6 Change in material or supplier of protective insole.

4.2.7 Change in material or supplier of the metatarsal guard.

5. Performance Requirements for Foot Protection

5.1 *Impact (I) and Compression (C) Resistant Footwear:*

5.1.1 ~~Impact and compression resistant footwear shall also Footwear shall meet the requirements of both 5.2 for impact resistance and 5.3 compression resistant footwear for compression resistance. Any specimen that does not meet the minimum impact or compression performance resistance requirement constitutes a non-compliance for the product category.~~

5.1.2 Footwear shall be constructed and manufactured so that a protective toe cap is an integral and permanent part of the footwear. The toecaps shall be free from corrosion, sharp edges, burrs and defects that may affect safety performance. 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. Protective metallic toe caps shall have an open bottom. If a flange is present on a metallic toe cap, the width of the flange, when measured from the inside edge, shall be no greater than 0.394 in. (10 mm); 10 mm (0.394 in.).

5.1.2.1 ~~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 cannot be marked with ASTM F2413 designation.~~

5.1.3 ~~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 cannot be marked with the ASTM Specification F2413 designation.~~

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

5.1.5 ~~Care and Use—Impact 75 shall be determined by evaluating three specimens in accordance with Test Methods—If there is evidence of physical damage to F2412. The requirement for impact resistance represents the minimum force required that results in the toe area of the footwear having a minimum the protective toecap or evidence of significant physical damage to the toe area, or both, replace the footwear at once. (Warning—If an aftermarket insert or insole is added to this footwear, that device may reduce the impact or compression clearance, or both, in the toe area.~~ 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 as follows:

(1) Impact 75 product 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) 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 ~~Care and Use—If there is evidence of physical damage to the protective toecap or evidence of significant physical damage to the toe area, or both, replace the footwear at once. (Warning—If an aftermarket insert or insole is added to this footwear, that device may reduce the impact or compression clearance, or both, in the toe area.)~~

5.2 *Impact Resistant Footwear (I):*

5.2.1 Impact resistance shall be determined by evaluating three specimens in accordance with Test Methods **F2412**. The requirement for impact resistance is that the toe area of the footwear provides 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 when subjected to an impact force of 101.7 J (75 lbf).

5.2.1.1 Impact resistance of footwear shall be as follows:

(1) Impact resistant product 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 lbf).

(2) Impact resistant 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 lbf).

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

~~5.3 *Compression Resistant Footwear (C)—(C):* Compression 75 shall be determined by evaluating three specimens in accordance with Test Methods **F2412**. The 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.~~

~~5.3.1 Compression resistance of footwear shall be as follows: shall be determined by evaluating three specimens in accordance with Test Methods **F2412**. The requirement for compression resistance is that the toe area of the footwear provides 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 when subjected to a compressive force of 11 121 N (2500 lbf).~~

~~5.3.1.1 Compression 75 product 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): resistance of footwear shall be as follows:~~

~~(1) Compression resistant product 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) Compression resistant 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).~~

~~5.2.1.2 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).~~

~~5.3.2 Any specimen that does not meet the minimum impact and compression performance resistance requirement for Compression 75—compression resistance performance requirement constitutes a non-compliance for the product category.~~

5.4 *Metatarsal Protective Footwear (Mt):*

5.4.1 Metatarsal protective footwear shall first meet the requirements of **5.1** for impact resistant footwear and **5-25.3** for compression resistant footwear.

5.4.2 Footwear shall be 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.

5.4.3 Mt 75 shall be determined by evaluating three specimens in accordance with Test Methods **F2412**.

5.4.3.1 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):lbf.

5.4.3.2 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):lbf.

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

5.4.3.4 *Care and Use*—Keep external guards properly laced into the footwear. Dispose of the footwear after an impact to the metatarsal guard has occurred or if the exterior covering becomes torn exposing the metatarsal guard.

5.5 *Conductive Protective Footwear (Cd):*

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

5.5.1 Conductive footwear shall also meet the requirements of **5-15.2** for impact resistant footwear and **5-25.3** for compression resistant footwear.

5.5.2 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.

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

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