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Standard Test Methods for Foot Protection[1]

This standard is issued under the fixed designation F2412; 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 these test methods, ANSI Z41, established the performance criteria for a wide range of footwear to protect from the hazards that affect the personal safety of workers. The value of these standards was recognized early in the history of the Occupational Safety and Health Administration (OSHA) and incorporated as a reference standard in the Code of Federal Regulation (CFR) Section 1910.

These test methods contains test protocols developed in conjunction with ANSI Z41 as well as other ASTM standards that are used to evaluate the performance of footwear when exposed to a variety of hazards: *(1)* impact resistance (I) for the toe area of footwear; *(2)* compression resistance (C) for the toe area of 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) that ~~reducees~~reduce hazards that may result from static electricity buildup and reduce the possibility of ignition of explosives and volatile chemicals; *(5)* ~~electric shock resistant non-conductive;~~ *electric hazard resistant (EH) non-conductive; (6) static dissipative (SD) properties to reduce hazards due to excessively low footwear electrical resistance that may exist where SD footwear is required; and (7)* ~~*puncture resistance of foot bottoms; (8) chain saw cut resistance hazards; and (9) dielectric hazard.*~~ *puncture resistance (PR) of foot devices.*

1. Scope

1.1 These test methods measure the resistance of footwear to a variety of hazards that can potentially result in injury.

1.2 These test methods may be used to test for compliance to minimum performance requirements in established safety standards.

1.2.1 By agreement between the purchaser and the supplier, or as required by established safety standards, these test methods can be used to determine any one, or all of the following: *(1)* ~~impact resistance,~~ *impact resistance (I), (2)* ~~*compression resistance,*~~ *compression resistance (C), (3)* ~~*metatarsal impact resistance,*~~ *metatarsal impact resistance (Mt), (4)* ~~*resistance to electrical conductivity,*~~ *resistance to electrical conductivity (Cd), (5)* ~~*resistance to electric shock,*~~ *resistance to electric hazard (EH), (6)* ~~*static dissipative performance,*~~ *static dissipative performance (SD), and (7)* ~~*puncture resistance of outsoles, (8) chain saw cut resistance, and (9) dielectric insulation.*~~

~~1.3The values stated in SI units are to be regarded as standard. The values given in parentheses are for information only.~~ puncture resistance (PR).

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

1.4 *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~~

[1] These test methods are under the jurisdiction of ASTM Committee F13 on Pedestrian/Walkway Safety and Footwear and are the direct responsibility of Subcommittee F13.30 on Footwear.

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[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.

F1116Test Method for Determining Dielectric Strength of Dielectric Footwear
F1458Test Method for Measurement of Cut Resistance to Chain Saw of Foot Protective Devices Practice for Operating Salt Spray (Fog) Apparatus

2.2 *CSA Standard:*[3]
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 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.

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 portion of the footwear.

3.1.7

3.1.6 *outsole and heel*, *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

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

3.1.10

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

3.1.11

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

3.1.12

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

3.1.13

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

3.1.14*socklining*

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

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

3.1.14 *specimen, for protective footwear*, *n*—footwear units evaluated for various hazards.

3.1.15.1

3.1.14.1 *Discussion*—Footwear units may be a left foot, a right foot, or a matched pair. The exact number and type of footwear units is indicated by test method.

3.1.16

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

4. Significance and Use

4.1The purpose of these test methods is to provide measurable criteria for various hazards.

4.2The protection that can be demonstrated by evaluation of footwear includes the following:

4.2.1The effectiveness of impact resistant footwear to eliminate or diminish the severity of injury to the toe area of the foot when subjected to a falling object.

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

~~4.2.2The effectiveness of compression resistant footwear to eliminate or diminish the severity of injury to the toe area of the foot when subjected to a compressive force.~~

~~4.2.3The effectiveness of metatarsal protective footwear to eliminate or diminish the severity of injury to the metatarsal area adjacent to where the toes and the bones of the upper foot intersect.~~

~~4.2.4The effectiveness of conductive footwear to safely reduce the buildup of static electricity from wearer to ground so as to reduce the possibility of ignition of explosives and volatile chemicals.~~

~~4.2.5The effectiveness of electric shock resistant footwear to provide resistance to electric shock when accidental contact is made with live wires.~~

~~4.2.6The effectiveness of static dissipative footwear to reduce the hazards due to excessively low footwear electrical resistance that may exist where SD footwear is required.~~

~~4.2.7The effectiveness of puncture resistant footwear to reduce the possibility of puncture injury to the bottom of the human foot.~~

~~4.2.8The effectiveness of chain saw cut resistant footwear to reduce the chance of injury when exposed to a running power chain saw.~~

~~4.2.9The effectiveness of dielectric insulative footwear to reduce the possibility of injury when exposed to a high voltage charge.~~

4.1 These test methods contain requirements to evaluate the performance of footwear for the following:

4.1.1 Impact resistance for the toe area of footwear (I/75),

4.1.2 Compression resistance for the toe area of footwear (C/75),

4.1.3 Metatarsal protection that reduces the chance of injury to the metatarsal bones at the top of the foot (Mt/75),

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 safety toe footwear such as replacing or adding after market footbeds/inserts could cause non compliance to any or all parts of this standard rendering the ASTM label 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 met guard.

5. ~~Impact Resistance~~ Protective Toe Impact Resistance (I)

5.1 *Summary of Method*:

~~5.1.1Footwear with a protective toe cap is impacted with a specified force.~~

~~5.1.2After impact, the height of the clay cylinder is measured.~~

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

5.1.2 Footwear with a protective toe cap is impacted with a specified force.

5.1.3 After impact, the height of the modeling clay cylinder is measured.

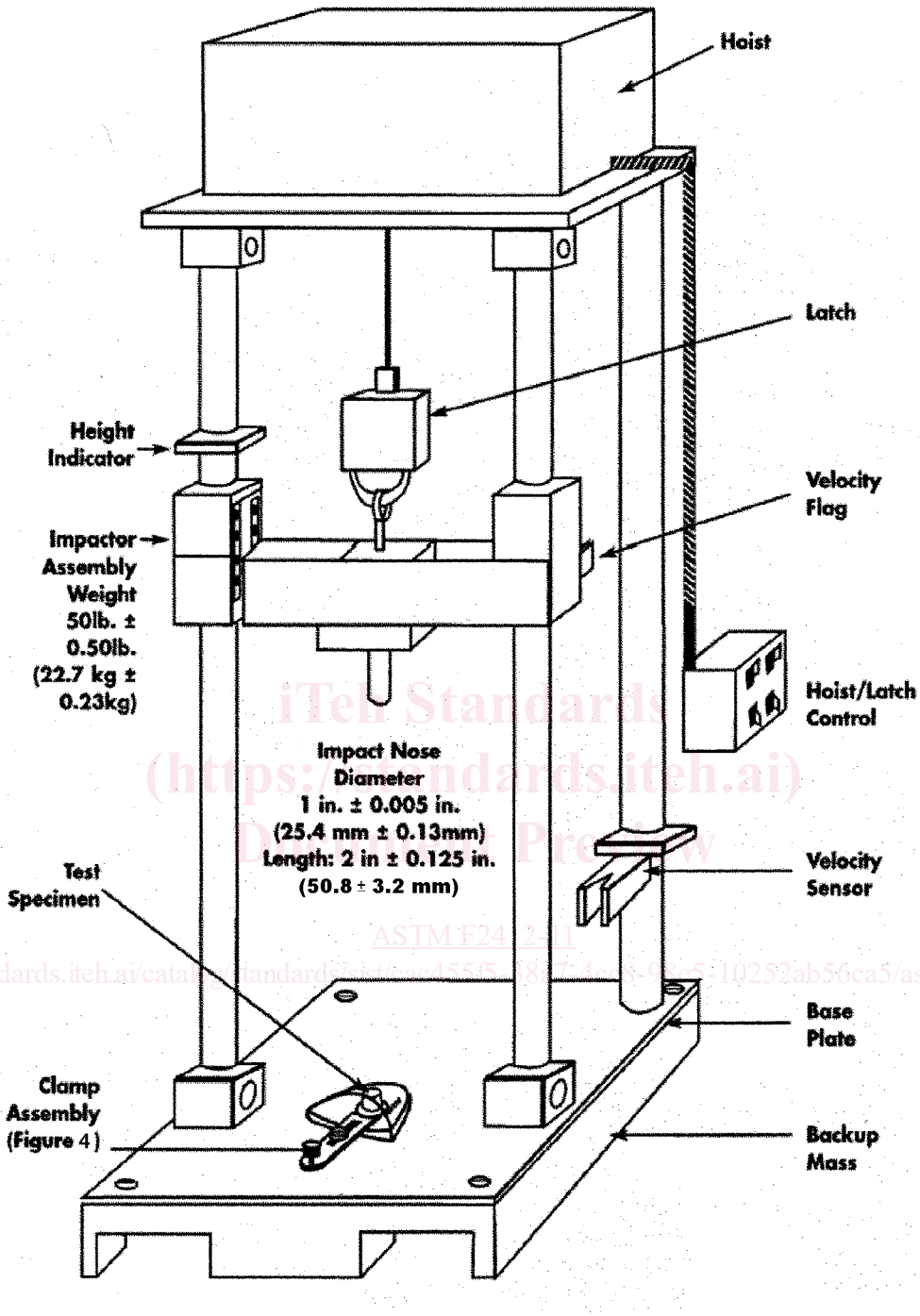
5.2 *Apparatus*:

5.2.1 The apparatus as shown in Fig. 1 consists of a frame structure that permits the impactor to be constrained to fall along a known and repeatable path.

5.2.1.1 The impactor consists of a steel weight having a mass of 22.7 ± 0.23 kg (50 ± 0.5 lb). The nose of the impactor is a steel cylinder having a diameter of 25.4 ± 0.8 mm (1 ± 0.03 in.) and length of 50.8 mm (2.0 in.). The impact side of the cylinder has a smooth spherical surface with a radius of 25.4 ± 0.127 mm (1.00 ± 0.005 in.). The longitudinal centerline of the cylinder is parallel and coincident with 3.175 mm (0.125 in.) to the symmetry of its vertical axis.

5.2.1.2 Apparatus incorporates a means of measuring the velocity at impact with a tolerance of ±2 %. The use of a velocity metering system allows for determining the time required for a 25.4-mm (1-in.) wide blade to pass completely through a beam of light prior to the impactor striking the specimen. The result, referred to as gate time, is measured in milliseconds (ms). The speed in in./s can be calculated using the following formula:

$$V = \frac{1000}{t_g} \tag{1}$$



NOTE—Dimensions are in inches (millimetres).

FIG. 1 Footwear Impact Test Apparatus

where:

V = velocity in in./s, and

t_g = gate time in ms.

5.2.2 The base of the apparatus consists of a steel plate with a minimum area 0.3 m^2 (1 ft^2) and minimum thickness of 25.4 mm (1 in.). The base is anchored to a structure having a minimum mass of 909.1 kg (2000 lb) to provide sufficient stability to the apparatus before, during, and after testing.

5.3 *Sampling*:

5.3.1 ~~T~~Randomly select three half-pair test ~~specimens shall include~~ specimens, including both left and right footwear, of each product category ~~are prepared~~ from ~~new~~unworn manufactured ~~footwear randomly selected from stock inventory.~~ footwear.

5.3.1.1 Men's footwear specimens ~~are prepared~~ shall be obtained from size ~~9D, medium width.~~ 9.

5.3.1.2 Women's footwear specimens ~~are prepared~~ shall be obtained from size ~~8B, medium width.~~ 8.

5.3.2 The specimens shall be obtained by completely removing the toe portion of the footwear. This is done by cutting across the width of the footwear 25.4 ± 3.2 mm (1 ± 0.125 in.) behind the back edge of the protective toe cap and cutting the upper material back to the edge of the protective toe cap as shown in Fig. 2.

~~5.4~~

5.4 Prior to impact testing, modeling clay, kept at room temperature and formed approximately as a vertical cylinder, shall be placed under the protective toe cap to back rear edge of the cap positioned inside the specimens directly under the point of impact (see Fig. 3).

5.4.1 Modeling clay for the test forms shall be tested in accordance with 5.4.2-5.4.9. Test frequency shall be no less than once every month. It is recommended that this quality test be conducted on a specimen just prior to its use during an impact test (see Fig. 4).

5.4.2 Weigh out a 50 ± 2 g sample of modeling clay.

5.4.3 Form material into a 35 ± 2 mm (1.375 ± 0.075 in.) cylinder and allow material to sit at room temperature for 24 h.

5.4.4 The modeling clay cylinder shall be placed horizontally on the base plate at the center point of the impact tester.

5.4.5 A block having dimensions of 75 by 75 by 44 mm (3 by 3 by 1.75 in.), with a hole drilled in the center of the block that is 25 mm (1 in.) in diameter and 25 mm (1 in.) deep, is slipped onto the impact nose.

5.4.6 The block/impactor assembly is carefully lowered until the wooden block makes contact with the modeling clay cylinder.

5.4.7 The impactor assembly is released allowing full weight to compress the cylinder for 10 s.

5.4.8 Immediately afterwards, the impactor assembly is raised and the modeling clay cylinder cut in half to measure.

5.4.9 A modeling clay cylinder having a compressed thickness of 15 ± 2 mm is acceptable to use in impact resistance.

5.5 *Specimen Mounting*:

5.4~~5~~.1 Specimens are to be placed on the test apparatus base plate so that the sole is parallel with the base.

5.4~~5~~.1.1 The specimen is positioned so that the longitudinal center of the nose of the impactor strikes the approximate center of the protective toe cap at a point that is 12.7 ± 1.6 mm (0.50 ± 0.0625 in.) toward the front as measured from the back edge of the protective toe cap (see Fig. 3).

~~5.4.2The~~5.5.2 The specimen is held in position during test by use of a clamping device as shown in Fig. 4~~5~~.

5.4~~5~~.2.1 The stabilizing fork clamp device rests on the insert and can be adjusted by means of a screw.

5.4~~5~~.2.2 The adjustment secures the specimen parallel to the base plate and prevents movement when the impactor strikes the specimen.

5.4~~5~~.2.3 Clamping screw shall be tightened using a force less than 28 Nm (25 in. lbs).

~~5.5~~5.6 *Procedure*:

~~5.5.1Prior to impact testing, a lump of modeling clay formed as a vertical cylinder is positioned inside the specimens directly under the point of impact (see Fig. 3).~~

~~5.5.1.1The clay shall be shaped so that the cylinder simultaneously makes contact with the insole/sock of the footwear and the dome of the protective toe cap.~~

5.6.1 When in place, the modeling clay cylinder shall be shaped having a base diameter of approximately 25 mm (1 in.) nominal and positioned so that the cylinder simultaneously makes contact with the insert/sock liner/footbed of the footwear and the dome of the protective toe cap. (See Note 1.)

~~NOTE1—A small piece of wax paper or cellophane can be placed on either the bottom side or top side of the cylinder to prevent the clay from adhering to either the insert/sock liner or dome.~~

~~5.5.1.2The diameter of the cylinder shall not exceed 25.4 mm (1 in.).~~

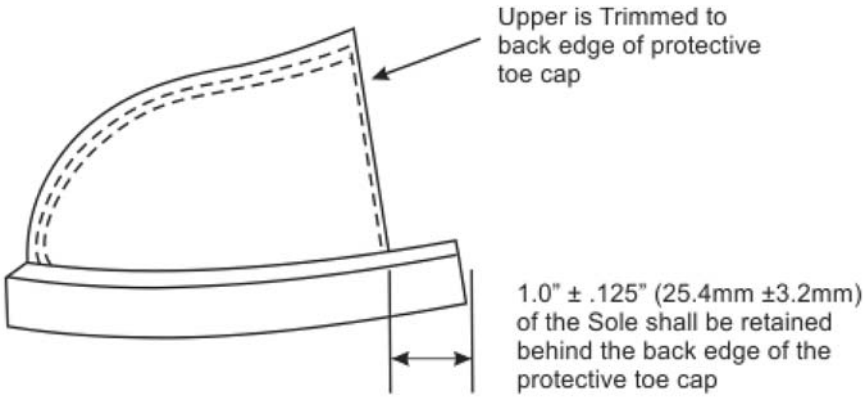


FIG. 2 Specimen Prepared for Impact and Compression Testing

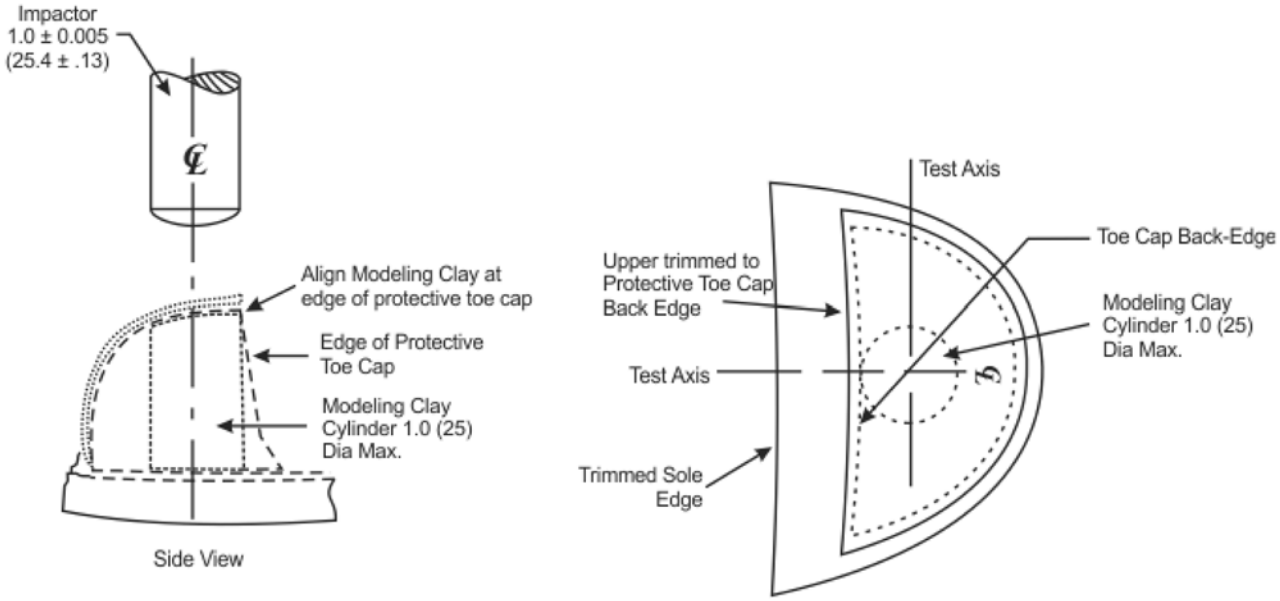


FIG. 3 Specimen Prepared for Impact and Compression Testing

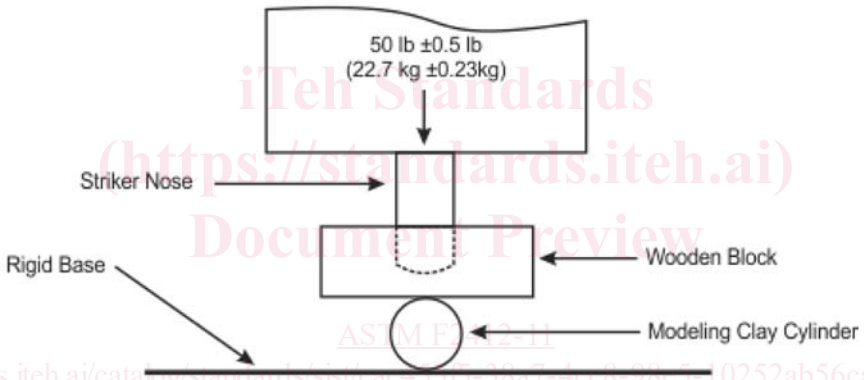


FIG. 4 Apparatus for Modeling Clay Quality Test

~~5.5.2After impact, carefully remove the clay cylinder from inside the specimen and measure the height of the cylinder at its lowest point using a measuring device capable of measuring to the nearest 0.1 mm (0.004 in.).~~

~~5.5.2.1This value is reported as the impact minimum interior height clearance for the specimen.~~

~~5.5.3To measure Class 75 product classification footwear, the impactor is dropped from a height that results in an impact velocity of 2995 ± 61 mm/s (117.9 ± 2.4 in./s), creating a force of 101.75 J (75 ft-lbf).~~ 1—A small piece of release paper such as wax paper or cellophane can be placed on either the bottom side or top side of the cylinder to prevent the modeling clay from adhering to either the insert/sock liner or dome.

5.6.2 To measure Impact 75 product footwear, the impactor is dropped from a height that results in an impact velocity of 2995 ± 61 mm/s (117.9 ± 2.4 in./s), creating an energy of 101.75 J (75 ft-lbf).

NOTE 2—In a vacuum, the distance would be 457 mm (18 in.). Due to friction and air resistance, the height used for the test is somewhat greater.

~~5.5.4To measure Class 50 Product Classification footwear, the impactor is dropped from a height that results in an impact velocity of 2438 ± 48.3 mm/s (96 ± 1.9 in./s), creating a force of 67.8 J (50 ft-lbf).~~

~~NOTE3—In a vacuum, the distance would be 305 mm (12 in.). Due to friction and air resistance, the height used for the test is somewhat greater.~~

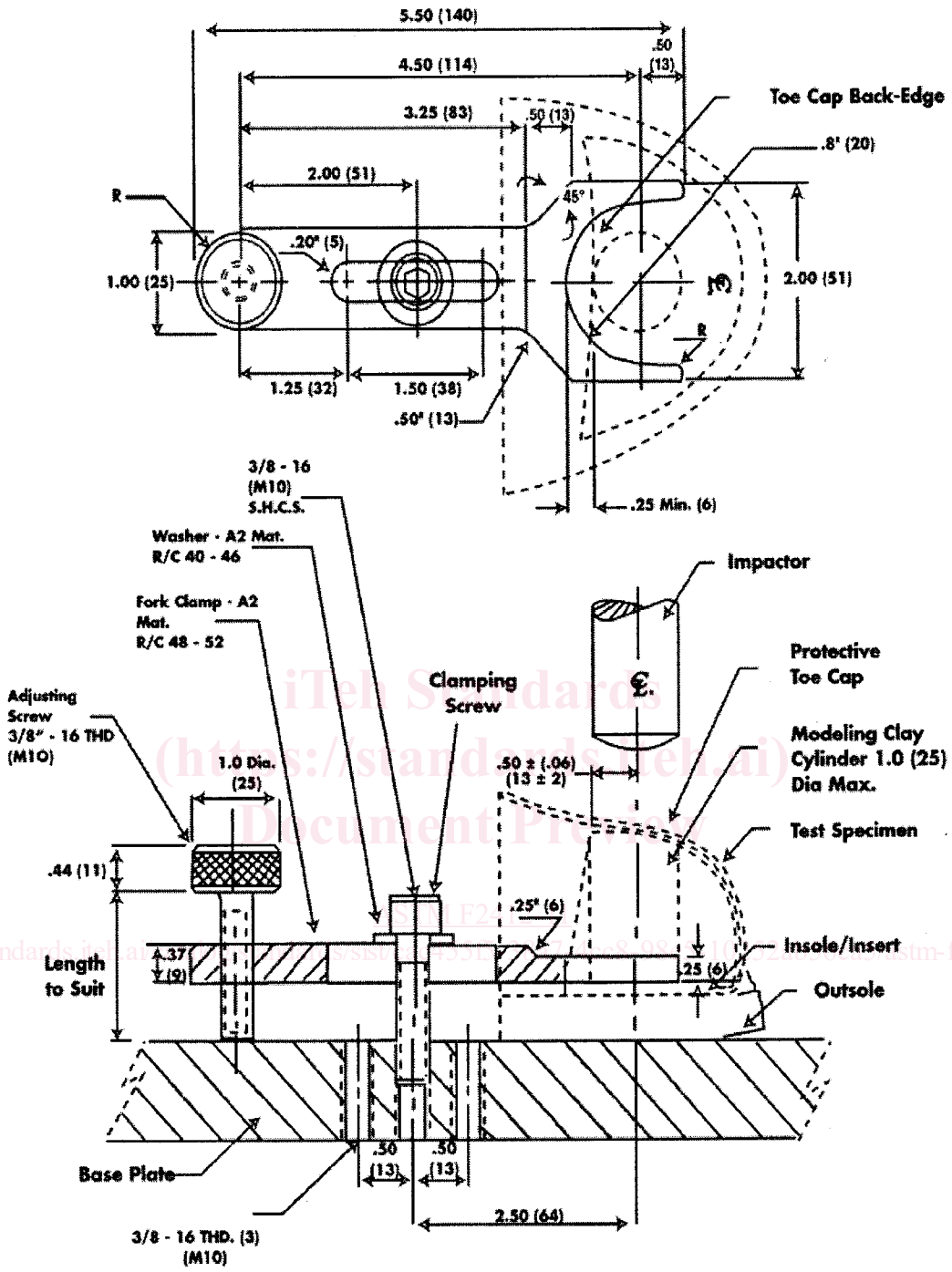
~~5.6~~

5.6.3 Release the impactor.

5.6.4 After impact raise and secure the impactor on test apparatus, carefully remove the clay cylinder from inside the specimen and measure the height of the modeling clay cylinder at its lowest point using a measuring device capable of measuring to the nearest 0.1 mm (0.004 in.).

5.6.5 This value is reported as the impact minimum interior height clearance for the specimen.

5.7 *Test Report*—Report the minimum height of the modeling clay cylinder, without rounding up, to the nearest 0.1 mm (0.004



NOTE—Dimensions are in inches (millimetres).

FIG. 4 5 Position/Clamping/Impact Arrangement

in.) as the clearance result for the product category for all three specimens.

6. ~~Compression Resistance~~ Protective Toe Compression Resistance (C)

6.1 *Summary of Method*:

~~6.1.1Footwear with a protective toe cap is exposed to a compressive force.~~

~~6.1.2During application of the compressive force, the interior space of the toe cap is measured using a clay cylinder.~~

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

6.1.2 Footwear with a protective toe cap is exposed to a compressive force.

6.1.3 During application of the compressive force, the interior space of the toe cap is measured using a modeling clay cylinder.

6.2 *Apparatus*:

6.2.1 Compression testing equipment that is equipped with smooth steel compression test surfaces.

6.2.1.1 Test surfaces must remain parallel during application of force up to 44 482 N (10 000 lbf).

6.2.1.2 Pressure head has a minimum diameter of 76.2 mm (3 in.) and a bed plate with a minimum width of 152.4 mm (6 in.).

6.2.1.3 Equipment must be graduated in increments so as to measure compressive force between 222.4 N (50 lbf) to 44 482 N (10 000 lbf).

6.3 *Sampling*:

~~6.3.1*A total of three half pair specimens*, which shall include both left and right footwear of each product category, are prepared from new manufactured footwear randomly selected from stock inventory.~~

~~6.3.1.1Men's footwear specimens are prepared from size 9D, medium width.~~

~~6.3.1.2Women's footwear specimens are prepared from size 8B, medium width.~~

~~6.3.2The specimens shall be prepared by completely removing the toe portion of the footwear. This is done by cutting across the width of the footwear 25.4 ± 3.2 mm (1 ± 0.125 in.) behind the back edge of the protective toe cap as shown in~~

6.3.1 Randomly select three half-pair test specimens, including both left and right footwear, of each product category from unworn manufactured footwear.

6.3.1.1 Men's footwear specimens shall be obtained from size 9.

6.3.1.2 Women's footwear specimens shall be obtained from size 8.

6.3.2 The specimens shall be prepared by completely removing the toe portion of the footwear. This is done by cutting across the width of the footwear 25.4 ± 3.2 mm (1 ± 0.125 in.) behind the back edge of the protective toe cap and cutting the upper material back to the edge of the protective toe cap as shown in Fig. 2.

~~6.4~~

6.4 Prior to compression testing, modeling clay, kept at room temperature and formed approximately as a 1 in. diameter vertical cylinder, shall be placed under the protective toe cap positioned inside the specimens directly under the point of impact (see Fig. 3) with the edge of the clay cylinder aligned with the back edge of the toe cap.

6.4.1 Modeling clay for the test forms shall be tested in accordance with 6.4.2-6.4.9. Test frequency shall be no less than once every 6 months. It is recommended that this quality test be conducted on a specimen just prior to its use during an impact test (see Fig. 4).

6.4.2 Weigh out a 50 ± 2 g sample of modeling clay.

6.4.3 Form material into a 35 ± 2 mm (1.375 ± 0.075 in.) cylinder and allow material to sit at room temperature for 24 h.

6.4.4 The modeling clay cylinder shall be placed horizontally on the base plate at the center point of the impact tester.

6.4.5 A block having dimensions of 75 by 75 by 44 mm (3 by 3 by 1.75 in.), with a hole drilled in the center of the block that is 25 mm (1 in.) in diameter and 25 mm (1 in.) deep, is slipped onto the impact nose.

6.4.6 The block/impactor assembly is carefully lowered until the block makes contact with the modeling clay cylinder.

6.4.7 The impactor assembly is released allowing full weight to compress the modeling clay cylinder for 10 s.

6.4.8 Immediately afterwards, the impactor assembly is raised and the modeling clay cylinder cut in half to measure.

6.4.9 A modeling clay cylinder having a compressed thickness of 15 ± 2 mm is acceptable to use in impact resistance.

6.5 *Specimen Mounting*:

~~6.4.1The~~6.5.1 The specimen is positioned on the bed plate of the test apparatus so that the highest point of the protective toe cap is perpendicular to the direction of force.

~~6.4.2The~~6.5.2 The stabilizing fork clamp device rests on the insert and can be adjusted by means of a screw (see Fig. ~~4~~5).

6.~~4~~5.2.1 This adjustment secures the specimen parallel to the bed plate and prevents movement.

6.~~4~~5.2.2 Clamping screw shall be tightened using a force less than 28 Nm (25 in. lbs).

~~6.5~~6.6 *Procedure*:

~~6.5.1Prior to compression testing, a lump or modeling clay as a vertical cylinder is positioned inside the specimen directly under the center of the protective cap (see Fig. 3).~~

~~6.5.2The clay shall be shaped so that the cylinder simultaneously makes contact with the insert/sock liner of the footwear and the dome of the protective cap (see~~

6.6.1 When in place, the modeling clay cylinder shall be shaped having a base diameter of approximately 25 mm (1 in.) nominal and positioned so that the cylinder simultaneously makes contact with the insert/sock liner/footbed of the footwear and the dome of the protective toe cap. (See Note 1 ~~).~~

~~6.5.3The diameter of the cylinder shall not exceed 25.4 mm (1 in.).~~ and Fig. 3.)

~~6.5.4A~~6.6.2 A compressive force is applied to the specimen at an approximate rate of 222.4 N/s (50 lbf/s) until it reaches 11 121 N (2500 lb) for Compression 75.

~~6.5.5After~~6.6.3 After compression testing, carefully remove the modeling clay cylinder from the specimen and, using a measuring device capable of measuring to the nearest 0.1 mm (0.004 in.) measure the height of the modeling clay cylinder at its lowest point, without rounding up.

~~6.6~~6.7 *Test Report*—~~Report the minimum interior height clearance for the specimen to the nearest 0.1 mm (0.004 in.), without~~

~~rounding up for each of three specimens as the compression resistance and classification for the product category.~~ —Report the minimum height of the modeling clay cylinder without rounding up to the nearest 0.1 mm (0.004 in.) the clearance result for the product category for all three specimens.

7. Metatarsal Impact Resistance (Mt)

7.1 *Summary of Method*:

~~7.1.1Footwear with a protective toe cap and metatarsal guard is impacted with the appropriate force.~~

~~7.1.2After impact, the height of the wax form is measured.~~

7.1.1 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.

7.1.2 Footwear with a protective toe cap and metatarsal guard is impacted with the appropriate force.

7.1.3 After impact, carefully remove the wax form from inside the footwear and measure.

7.2 *Apparatus*:

7.2.1 The same apparatus as used in 5.2 (Fig. 1) for impact testing of protective footwear, with certain modifications, is used for metatarsal impact testing. The modifications to the apparatus are shown in ~~Fig. 5~~Fig. 6 and ~~Fig. 6~~Fig. 7.

7.2.1.1 The striking surface that impacts the metatarsal protection is a horizontal bar that is perpendicular to the vertical traverse of the test apparatus. The bar of polished steel has a diameter of 25.4 ± 0.5 mm (1 ± 0.02 in.) and a length of 152.4 ± 3.2 mm (6 ± 0.125 in.).

7.2.1.2 The striking bar is positioned so that the impact is perpendicular to the longitudinal plane of the heel/toe axis at the appropriate impact point for men's and women's footwear (see Fig. ~~7~~8).

7.3 *Sampling*:

~~7.3.1A total of three half-pair test specimens (shall include both left and right footwear) of each product category are prepared from new manufactured footwear randomly selected from stock inventory.~~

~~7.3.1.1Men's footwear specimens are prepared from size 9D, medium width.~~

~~7.3.1.2Women's footwear specimens are prepared from size 8B, medium width.~~

7.3.1 Randomly select three half-pair test specimens, including both left and right footwear, of each product category from unworn manufactured footwear.

7.3.1.1 Men's footwear specimens shall be obtained from size 9.

7.3.1.2 Women's footwear specimens shall be obtained from size 8.

7.4 *Specimen Mounting*:

7.4.1 Mount specimen in a device, as shown in ~~Fig. 6~~Fig. 7, that retains footwear in place during testing.

7.4.2 Mount specimen so that outsole is resting on base of apparatus and positioned so that the point of contact for the striking bar is appropriate for the specimen as shown in ~~Fig. 7~~Fig. 8.

7.4.2.1 Men's footwear requires that the point of contact for the striking bar is 89 mm (3.5 in.) when measured backwards from the front point of the toe toward the heel.

7.4.2.2 Women's footwear requires that the point of contact for the striking bar is 86 mm (3.375 in.) when measured backwards from the front part of the toe toward the heel.

7.5 *Procedure*:

7.5.1 Insert a wax form, as described in Annex A1, into the specimen. The insert/sock lining/footbed of the footwear shall remain in the footwear during testing.

7.5.1.1 The wax form shall completely fill the protective footwear cavity and extend toward the quarter of the footwear approximately 76.2 mm (3 in.) beyond the back edge of the protective toe cap. (See Fig. 8.)

7.5.1.2 The use of a heel block is used to secure the wax form in place and also to fill the cavity between the back edge of the wax form and the quarter.

~~7.5.2Position the impactor on test apparatus to the proper height for product classification of footwear (see 5.5.3 and 5.5.4).~~

7.5.2 To measure Metatarsal Impact 75 product footwear, the impactor is dropped from velocity of 2995 ± 61 mm/s (117.9 ± 2.4 in./s), creating an energy of 101.75 J (75 ft-lbf). a height that results in an impact see Note 3.

NOTE 3—In a vacuum, the distance would be 457 mm (18 in.). Due to friction and air resistance, the height used for the test is somewhat greater.

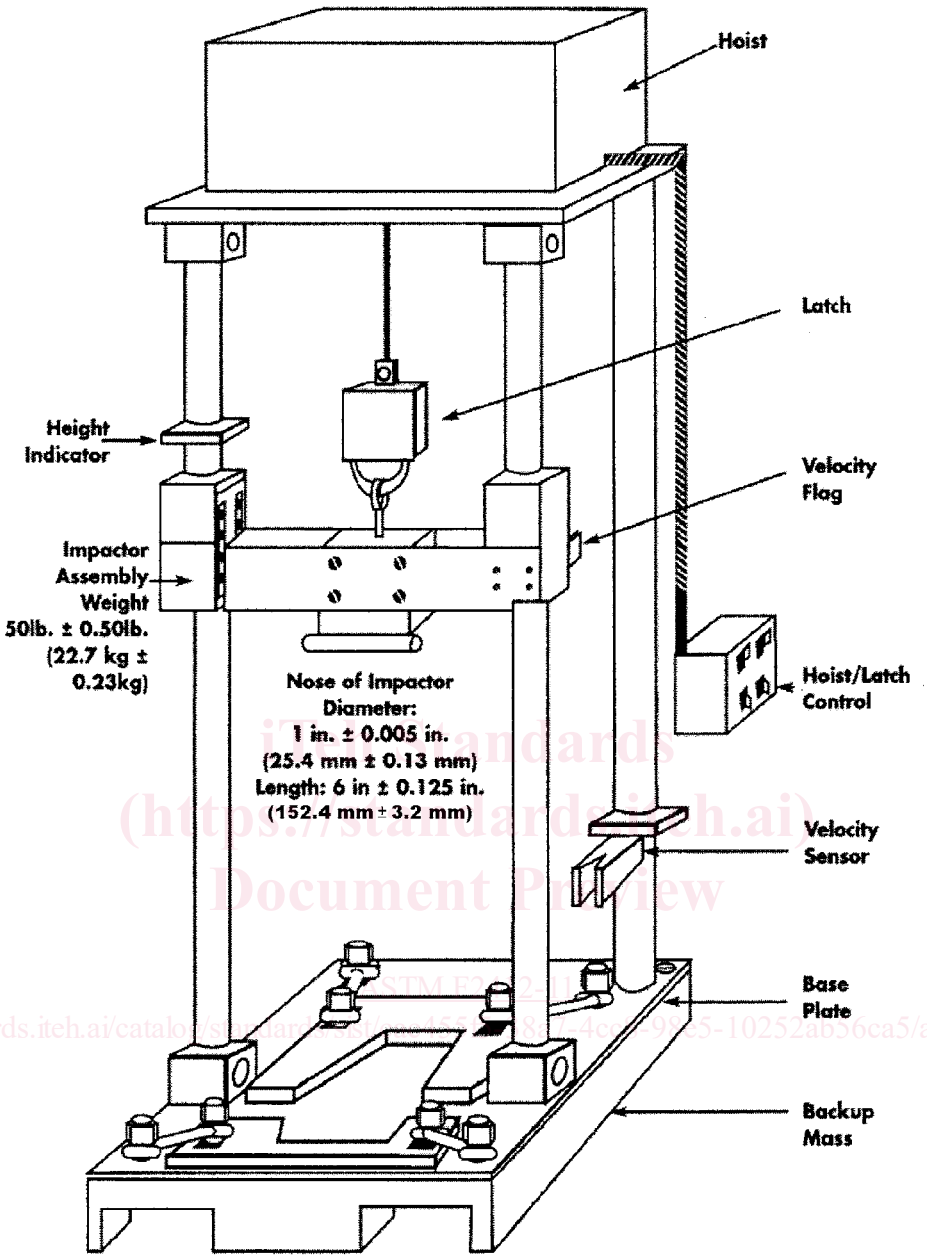
7.5.2.1 Release the impactor,

~~7.5.3Reposition~~7.5.3 After impact raise and secure the impactor on test apparatus, and carefully remove the wax form from the specimen.

7.5.4 *Test Report*—Measure the distance from the lowest point of the impression made in the wax form to the bottom surface of the form as shown in ~~Fig. 7~~ Fig. 8 and report the results to the nearest 0.1 mm (0.004 in.) for all three test specimens without rounding up.

8. Conductive Protective Footwear (Cd)

8.1 *Summary of Method*:



NOTE—Dimensions are in inches (millimetres).

FIG. ~~5~~ 6 Metatarsal Footwear Impact Test Apparatus

8.1.1 The footwear is placed on a base electrode plate and the second electrode is embedded in a layer of metal spheres which fill the inside of the footwear.

8.1.2 Electrical resistance is measured after applying the specified voltage for a prescribed time.

8.2 *Apparatus*:

8.2.1 The apparatus as shown in ~~Fig. 8~~Fig. 9 requires that it be as follows:

8.2.1.1 500 V regulated dc power supply with a current rating of 5 mA or greater.

8.2.1.2 100 000 ~~σ~~Ω resistor with accuracy ±10 % rated at 2.5 W and 500 V or greater.

8.2.1.3 0 to 5 mA ammeter with accuracy of ±5 % in one or more ranges.

8.2.1.4 Voltmeter of 0 to 500 V with minimum accuracy of ±5 % in one or more ranges with a nominal internal resistance of 10 Megohm or greater.

~~8.2.1.5A stainless steel base electrode plate 228.6 by 330.2 mm (9 by 13 in.) that can accommodate the complete outsole and heel of the footwear. The second electrode consists of 3 mm (0.117 in.) solid metal spheres, such as BB shot, which is placed inside~~