CANADIAN STANDARDS ASSOCIATION

Z195-09

Protective footwear

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Protective footwear

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Contents

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Preface

This is the sixth edition of CSA Z195, *Protective footwear*, covering design and performance requirements for protective footwear, including toe protection, sole puncture protection, metatarsal protection, electric-shock-resistant soles, slip-resisting soles, and other requirements relating to the general stability of footwear. It supersedes the previous editions, published in 2002, 1992, 1984, and 1981, and the first edition, entitled *Safety Footwear*, published in 1970.

This edition incorporates several amendments made to the 2002 edition, including modifications to protective sole coverage criteria, modification of the chainsaw cut test procedure, and the addition of blue and grey labels designating footwear offering toe protection only. New to this edition are performance requirements and test procedures for metatarsal guards and test procedures and labelling requirements for slip-resisting footwear. A clarification has also been made to the difference between electrically conductive footwear as specified in this Standard and other types of conductive footwear used by professional electricians for live electrical work.

Selection, care, and use guidelines for footwear users are specified in a companion document, CSA Z195.1, *Guideline on Selection, Care, and Use of Protective Footwear.*

This Standard is considered suitable for use for conformity assessment within the stated scope of the Standard.

This Standard was prepared by the Technical Committee on Protective Footwear, under the jurisdiction of the Strategic Steering Committee on Occupational Health and Safety, and has been formally approved by the Technical Committee.

November 2009

Notes:

(1) *Use of the singular does not exclude the plural (and vice versa) when the sense allows.*

(2) *Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.*

(3) *This publication was developed by consensus, which is defined by* CSA Policy governing standardization — Code of good practice for standardization *as "substantial agreement. Consensus implies much more than a simple majority, but not necessarily unanimity". It is consistent with this definition that a member may be included in the Technical Committee list and yet not be in full agreement with all clauses of this publication.*

(4) *CSA Standards are subject to periodic review, and suggestions for their improvement will be referred to the appropriate committee.*

(5) *All enquiries regarding this Standard, including requests for interpretation, should be addressed to Canadian Standards Association, 5060 Spectrum Way, Suite 100, Mississauga, Ontario, Canada L4W 5N6.*

Requests for interpretation should

(a) define the problem, making reference to the specific clause, and, where appropriate, include an illustrative sketch;

(b) provide an explanation of circumstances surrounding the actual field condition; and

(c) be phrased where possible to permit a specific "yes" or "no" answer.

Committee interpretations are processed in accordance with the CSA Directives and guidelines governing standardization *and are published in CSA's periodical* Info Update*, which is available on the CSA Web site at www.csa.ca.*

Z195-09
Protective footwear

1 Scope

1.1
This Standard deals with new protective footwear and includes requirements for two grades of toe impact resistance, as well as special requirements for sole plate performance, metatarsal protection, electric-shock protection, sole flex durability, conductivity, and chainsaw protection. (See Figures 1 and 2 for footwear and foot nomenclature used in this Standard.)

1.2
This Standard also provides requirements for static-dissipative footwear, with or without toe impact resistance.

1.3
This Standard also provides requirements for slip-resisting footwear, with or without other protective features.

1.4
Electrical flash and flame protection, ankle protection, firefighter's footwear, spiked climber's footwear, and riot boots are not specifically addressed in this Standard. While the specific protection required by these applications is not covered, impact, puncture, and static-dissipative criteria may be applied to other types of footwear as appropriate.

1.5
In CSA Standards, "shall" is used to express a requirement, i.e., a provision that the user is obliged to satisfy in order to comply with the standard; "should" is used to express a recommendation or that which is advised but not required; "may" is used to express an option or that which is permissible within the limits of the standard; and "can" is used to express possibility or capability. Notes accompanying clauses do not include requirements or alternative requirements; the purpose of a note accompanying a clause is to separate from the text explanatory or informative material. Notes to tables and figures are considered part of the table or figure and may be written as requirements. Annexes are designated normative (mandatory) or informative (non-mandatory) to define their application.

1.6
The values given in SI units are the units of record for the purposes of this Standard. The values given in parentheses are for information and comparison only.

2 Reference publications
This Standard refers to the following publications, and where such reference is made, it shall be to the edition listed below, including all amendments published thereto.

CSA (Canadian Standards Association)
Z195.1-02
Guideline on selection, care, and use of protective footwear

ASTM International (American Society for Testing and Materials)
B117-07a
Standard Practice for Operating Salt Spray (Fog) Apparatus

ISO (International Organization for Standardization)
11393-1:1998
Protective clothing for users of hand-held chain-saws — Part 1: Test rig driven by a flywheel for testing resistance to cutting by a chain-saw

11393-3:1999
Protective clothing for users of hand-held chain-saws — Part 3: Test methods for footwear

13287:2006
Personal protective equipment — Footwear — Test method for slip resistance

ULC (Underwriters Laboratories of Canada)
CAN/ULC-60895-09
Live Working — Conductive Clothing For Use at Nominal Voltage Up to 800 kV A.C. and ± 600 kV D.C.

3 Definitions

The following definitions shall apply in this Standard:

Certification organization — an organization that provides conformity assessment services.
Note: *In Canada, certification organizations are accredited by the Standards Council of Canada.*

Chainsaw-protective footwear — boots that are designed to prevent a chainsaw from cutting into the shin, ankle, foot, and toes.

Conductive footwear — a boot or shoe designed to continuously electrically ground the foot and thereby prevent an electrical discharge that might ignite volatile, flammable materials in close proximity to the wearer.

Disruptive discharge — a phenomenon associated with the failure of insulation under electrical stress, in which the discharge completely bridges the insulation under test, reducing the voltage between the electrodes to zero or nearly zero (i.e., less than 10% of the applied voltage).

Electric-shock-resistant sole — a sole and heel design and method of attachment to the footwear that, at the point of manufacturing, has electrical-insulating properties.

Feather edge — the edge of the last.

Insole — the inner part of footwear upon which the foot rests and that conforms to the bottom of the last.

Last — a solid form in the general shape of a foot and around which footwear is constructed.

Metatarsal protection — an integrated component that protects the complete dorsum (top side) of the foot.

Outsole — the bottom surface of footwear, which is exposed to wear.

Permanently marked — given a marking that is intended to remain in the applied position and remain legible for the lifetime of the footwear under normal wear conditions.

Protective footwear — a boot or shoe that provides the wearer with a degree of protection against injury as specified in this Standard.

Protective sole plate — an integrated component (metallic or nonmetallic) that provides puncture protection to the sole of the foot.

Protective toecap — a component that, when incorporated into a boot or shoe, provides protection against impact at the toe of the boot.

Room temperature — a temperature of 20 ± 2 °C.

Slip resistance — a property of slip-resisting footwear that reduces slipping on specific surfaces (see Annex A).

Static-dissipative footwear — a boot or shoe designed to continuously dissipate electrostatic charges.

4 Design requirements

4.1 General

4.1.1
All protective footwear covered by this Standard shall provide toe protection and may provide sole, metatarsal, chainsaw, and conductive protection, with the exception of static-dissipative footwear and slip-resisting footwear, which need not provide toe protection.

4.1.2
Where a protective sole plate is incorporated in a shoe or boot, no part of the shoe or boot shall be constructed in such a way as to overhang the sole in the area of the toe and ball of the foot, as this would expose the wearer's foot to possible puncture from beneath the shoe or boot.

4.2 Protective toecap

4.2.1
Where required, the protective toecap shall be incorporated into footwear during construction and shall be an integrated part of the footwear. The protective toecap shall be made of material that, when built into the footwear, meets the requirements for impact resistance specified in this Standard.

4.2.2
All surfaces of the protective toecap shall be smoothly finished and all edges and corners shall be rounded in the finished product to help prevent possible injury to the wearer.

4.3 Protective sole
The protective sole, where incorporated into the footwear, shall cover the sole, including the heel area, and shall be an integrated part of the footwear. The outer edge of the protective sole plate shall be not more than 8 mm from the feather edge of the last all around the sole from the toe to not less than 10 mm beyond the breast of the heel, and shall be within 13 mm of the edge around the heel area (see Figure 3). For footwear not incorporating a defined heel, the outer edge of the protective sole plate shall be not more than 8 mm from the feather edge all around the last.

4.4 Metatarsal protector

4.4.1
The metatarsal protector, where incorporated in the footwear, shall be of sufficient width and height to cover the complete dorsum of the foot.

4.4.2
The metatarsal protector shall be an integrated part of the footwear.

4.4.3
The metatarsal protector shall be attached to the footwear in such a manner that the footwear can be laced and unlaced, where laces are employed.

4.4.4
The metatarsal protector shall be attached to the footwear in such a manner that the front edge of the metatarsal protector overlaps and rests on the protective toecap.

4.5 Heel

4.5.1
Heel height, as measured from the ground up to the top of the sole at the breast of the heel, shall not exceed 60 mm.

4.5.2
Construction of the shoe or boot shall be such that the heel of the foot is not lower than the ball of the foot when the footwear is on a level surface.

4.6 Electric-shock-resistant footwear
Electric-shock-resistant footwear, as originally manufactured, shall have a sole and heel with an outer surface that is not penetrated by conductive or potentially conductive material (e.g., screws, nails, staples, sewing threads, and fibres). Under dry conditions, this footwear shall meet the test requirements for voltage and current flow limitations specified in Clause 5.4.

Notes:

(1) *This footwear should have a sole and heel of sufficient thickness to ensure that the wearer is not exposed to conductive or potentially conductive material during normal use and wear.*

(2) *Under wet conditions, it is possible that the footwear will not meet the test requirements.*

4.7 Static-dissipative footwear
Static-dissipative footwear shall be constructed to meet the test requirements for static dissipation as specified in Clause 5.5.

4.8 Conductive footwear
Conductive footwear shall be constructed to meet the test requirements for electrical conductivity as specified in Clause 5.6.

4.9 Chainsaw-protective footwear
Chainsaw-protective footwear shall incorporate either a steel protective toecap having a thickness not less than 1.6 mm or shall be constructed to meet the test requirements for chainsaw-protective toecaps specified in Clause 5.7. In addition, chainsaw-protective footwear shall meet the requirements of Clause 5.1 for Grade 1 toe protection and Clause 5.2 for a protective sole.

5 Performance requirements

5.1 Protective toecap

5.1.1
When struck in accordance with Clause 6.2.1 with the energy and velocity specified in Table 1, the internal toe clearance shall be not less than that specified in Table 2 and the protective toecap shall not fracture through the thickness.

5.1.2
Metallic protective toecaps shall not be adversely affected by corrosion (e.g., as indicated by surface pitting or the presence of orange-red rust in iron-based materials) after being exposed to a 5% salt solution for 24 h in accordance with ASTM B117.

5.1.3
Tables 1 and 2 indicate the required performance for Grade 1 and Grade 2 footwear. Table 1 provides the required strike velocity and resulting energy to be applied to the protective toecap being tested. Table 2 lists the minimum clearance (as indicated by the compression of the plasticine forms) for a wide range of footwear sizes.

5.2 Protective sole

5.2.1
The protective sole insert (plate), as a separate item, shall withstand a force of not less than 1200 N when tested in accordance with Clause 6.3.1.

5.2.2
Metallic protective sole plates shall not be adversely affected by corrosion (e.g., as indicated by surface pitting or the presence of orange-red rust in iron-based materials) after being exposed to a 5% salt solution for 24 h in accordance with ASTM B117.

5.2.3
When tested in accordance with the method specified in Clause 6.3.2, the protective sole insert (plate) shall show no visible signs of cracking after it has been subjected to 1.5 million (1.5×10^6) flexes. When conducting this test, there shall be no failures.

5.3 Metatarsal protector

5.3.1
Metatarsal protectors, where incorporated in the footwear, shall comply with the performance requirements specified in Clauses 5.3.2 and 5.3.3. For the purposes of the impact resistance test specified in Clause 6.4, men's size 9 and women's size 8 footwear shall be selected.

5.3.2
When impacted in accordance with Clause 6.4.2 at an energy level of 101.7 J and an impact velocity of 2.99 ± 0.06 m/s, the metatarsal protector clearance shall be not less than 24.4 mm for men's footwear, and not less than 21.4 mm for women's footwear. In addition, the metatarsal protector shall not fracture through its thickness.

5.3.3
Metallic metatarsal protectors shall not be adversely affected by corrosion (as indicated by the presence of orange-red rust) after being exposed to a 5% salt solution for 24 h in accordance with ASTM B117.

5.4 Electric-shock-resistant footwear
Under dry conditions, each test specimen shall withstand a test potential of 18 kV 60 Hz for a period of 1 min without disruptive discharge to ground. The leakage current shall not exceed 1 mA when tested in accordance with Clause 6.5.2.

5.5 Static-dissipative footwear
When tested in accordance with Clause 6.6.2, each test specimen shall fall within a range of 10^6 to 10^8 Ω for a period of 5 s.

5.6 Conductive footwear
When tested in accordance with Clause 6.7.2, each test specimen shall fall within a range of 0 to 500 000 Ω for a period of 5 s.

Note: *Conductive footwear, as specified in this Standard, is intended to prevent an electrical discharge that might ignite volatile, flammable materials in close proximity to the wearer. This type of footwear is not intended to be used as part of an electrically conductive clothing ensemble (specified under CAN/ULC-60895) used for live electrical work.*

5.7 Chainsaw-protective footwear
Chainsaw-protective footwear shall prevent a running chainsaw from cutting all the way through the boot upper when tested in accordance with Clause 6.8.2. Protective toecaps that are not constructed of steel at least 1.6 mm thick shall also prevent a running chainsaw from cutting all the way through the cap when tested in accordance with Clause 6.8.2.

5.8 Slip-resisting footwear
If protective footwear is identified as being slip resisting (slip resistant) or as offering slip-resisting soles, the soles shall be tested in accordance with Clause 6.9 and the results made available as specified in Clause 7.8. For the purposes of this performance test, men's size 10 and women's size 8 footwear shall be selected.

Notes:

(1) *Most manufacturers and distributors of footwear will provide advice on appropriate application of slip-resisting footwear.*

(2) *Manufacturers may apply these slip resistance criteria to both protective footwear and non-protective footwear (i.e., footwear not having other protective features).*

6 Test methods

6.1 General

6.1.1
Test specimens shall be finished unworn protective footwear selected at random from stock that is at least 14 d old. Samples covering the full range of sizes available, or as otherwise specified, shall be tested.

6.1.2
For the purposes of these tests, all test specimens shall be conditioned for not less than 40 h at room temperature before being tested at room temperature. A controlled relative humidity of 50 ± 5% shall be used in cases where the certification organization deems that relative humidity accounts for variations in test results yielded at different testing facilities (e.g., when testing for slip resistance).

6.1.3
For the purpose of the low-temperature impact test only, protective toecap specimens shall be conditioned for a minimum of 12 h at –18° ± 2 °C. Test specimens shall then be removed from the conditioning area and tested within 2 min at room temperature for impact resistance.

6.2 Protective toecap

6.2.1 Toecap impact resistance
Note: *See Figure 4.*

6.2.1.1 Drop test equipment

6.2.1.1.1
The striker shall have a mass of 22.7 kg. The nose of the striker shall be a steel cylinder 25.0 ± 0.5 mm in diameter and at least 50 mm, but not more than 75 mm, in length (see Figure 5).

6.2.1.1.2
The striking surface shall be a portion of a sphere, with a radius of 25.0 ± 0.5 mm. The whole surface shall be smoothly machined and finished.

6.2.1.1.3
The striker can fall in a guide tube or on guide rails; the effect of friction shall be minimized. Provision shall be made for a mechanism to catch the striker after the initial impact so that the test specimen is struck only once.

6.2.1.1.4
A velocity meter shall be used to verify the velocity of the striker to within 2% at the point of impact.
Note: *The impact energy, E, in joules, is determined by the equation*

$E = (1/2)mv^2$

where
m = *mass of the striker*
= 22.7 kg
v = *impact velocity of the striker, m/s (see Table 1)*

6.2.1.1.5
The sample shall be supported on a heavy rigid base having a thickness of at least 19 mm.

6.2.1.2 Sample preparation

6.2.1.2.1
A minimum of 25 mm of material shall be retained behind the rear corners of the protective toecap (see Figure 7).

6.2.1.2.2
A tack (small penetrator) shall be inserted at the centre-axis edge of the toe box to mark the approximate centre of the toe box on the plasticine cylinder.

6.2.1.3 Test procedure

6.2.1.3.1
All samples shall be impact tested at room temperature. However, a minimum of 50% of the samples shall be impact tested at room temperature after conditioning at –18° ± 2 °C as specified in Clause 6.1.3.

6.2.1.3.2
The specimen shall be placed on the base of the test apparatus in such a way that the central point of impact will be the approximate centre of the protective toecap, 13 mm in front of its rear edge. In all cases, the central point of impact shall be at least 25 mm back from the inside front of the protective toecap (see Figure 7). The specimen shall be held by means of a clamp in accordance with Figure 6. The bolt of the hold-down clamp shall be tightened to a torque of 2.0 ± 0.5 N•m when the bolt in relation to the slot is nearest to the impact point and 4.0 ± 0.5 N•m when the bolt in relation to the slot is farthest from the impact point. The torque shall be interpolated between these two limits when the bolt in relation to the slot is located between these two extreme positions.

6.2.1.3.3
Plasticine, kept at room temperature and formed approximately as a vertical cylinder, shall be placed under the protective toecap, protruding slightly past the rear edge of the cap (see Figure 7). The plasticine shall be shaped by fingers to make contact with the dome, the back edge of the protective toecap, and the insole. When in place, the nominal base diameter of the plasticine cylinder shall be 25 mm nominal.

6.2.1.3.4
After impact, the plasticine insert shall be carefully removed and its minimum height shall be measured. This dimension shall be recorded as the internal toe clearance (see Table 2).
Note: *A small piece of waxed paper or equivalent non-stick material placed on the ends of the cylinder will prevent the plasticine from adhering to the insole or lining.*

6.2.2 Specifications for plasticine test quality

6.2.2.1
Plasticine used for the test form inserts shall be tested in accordance with Clauses 6.2.2.2 to 6.2.2.4. The plasticine quality test shall be performed at least once every 6 months.

6.2.2.2
Plasticine formed as a cylinder of 35 ± 2 mm in diameter and weighing 50 ± 2 g shall be conditioned for a minimum of 24 h at room temperature.

6.2.2.3
The plasticine cylinder shall be placed, with its longitudinal axis oriented vertically, at the centre point of the base of the toe impact test apparatus (see Figure 7). A wooden block of approximately 75 mm × 75 mm × 44 mm, with a hole in the centre of 25 mm in diameter and 25 mm in depth, shall be placed over the test apparatus striker nose (see Figure 8). The test apparatus striker shall be carefully lowered until the bottom of the wooden block contacts the top of the plasticine cylinder. The striker shall be released, allowing it to compress the plasticine cylinder for a period of 10 s. The striker shall then be raised and the plasticine form measured so as to determine its mean height. This residual mean height shall be recorded as the compressed thickness.

6.2.2.4
The compressed thickness of the plasticine cylinder shall be 15 ± 2 mm. Compression of the cylindrical form to within this range indicates that the plasticine is of acceptable firmness and consistency for use in impact tests.

6.2.2.5
When not in use, the plasticine forms should be stored in a sealed container.

6.3 Protective sole

6.3.1 Protective sole penetration test

6.3.1.1 Test equipment

6.3.1.1.1 General
The test assembly shall consist of a pin, a pin support, a support base, and a movable crosshead (see Figure 9(a)).

6.3.1.1.2 Steel test pin
The steel test pin shall be manufactured to the dimensions shown in Figure 9(b) and shall be AISI-SAE 01 tool steel, having a hardness in the range 52 to 56 RHC. Each pin shall be limited to a maximum of 200 tests.

6.3.1.1.3 Support base
The support base shall
(a) be rigid steel plate;
(b) have a machined surface upon which the test specimen is placed;
(c) be perpendicular to the travel of the pin; and
(d) have a 15 mm diameter hole concentric to the pin.

6.3.1.1.4 Instrumentation
The instrumentation used to measure force shall have, at minimum, an accuracy of ±1%.

6.3.1.2 Test procedure

6.3.1.2.1
A minimum of three tests on the protective sole shall be conducted. The points of penetration shall be at least 25 mm from the edge of the sample and at least 25 mm apart. For small protective soles that are too narrow to allow 25 mm clearance from both edges, the points of penetration shall be centred between the edges of the sample.

6.3.1.2.2
The crosshead rate of travel for the penetration test shall be 10 ± 1 mm/min.

6.3.1.2.3
The reading taken shall be the peak of force when the pin penetrates the test specimen.

6.3.2 Protective sole flexing test

6.3.2.1 Test equipment
Flexing apparatus shall comprise a reciprocating guide bar, to move the free end of the insert through a specified distance at a defined rate, and a clamping device consisting of two elastic interlayers 4 mm thick, of a Shore A hardness of 75 ± 5, with two metal clamping plates at least 130 mm wide. The clamping plates shall be clamped on either side with two standard 6 mm (1/4 in) No. 20 bolts with a nut and lock-washer combination. The clamping plate bolts shall be torqued to 2.5 to 3.0 N•m or equivalent clamping pressure.

In the zero position, the guide bar shall act at a distance of 70 ± 1 mm from the clamping plates (see Figure 10(a)). In order to accommodate all sizes of protective sole inserts, the flexing line may be shifted by a maximum of 10 mm in the direction of the heel (see the shaded region in Figure 10(b)).

6.3.2.2 Procedure

6.3.2.2.1 Determination of the flexing line

The insert shall be laid with its inner edge against a plane surface so that the edge of the insert contacts the surface at the joint and heel regions. From the point of tangency at the joint area, a perpendicular line shall be drawn across the surface of the protective sole. This line is the flexing line along which the protective sole shall be clamped (see Figure 10(b)).

6.3.2.2.2 Preparation of test specimen

The heel part of the insert shall be cut off at a distance of 90 mm from the flexing line, as determined in Clause 6.3.2.2.1.

6.3.2.2.3 Test procedure

The test specimen shall be flexed at a rate of 16 ± 1 cycles per second by moving the guide bar to a height of 33 mm measured vertically above the zero position. A guide shall be used to ensure that the test specimen returns to the zero position after every deflection. In the case of formed soles, the guide rail shall be adjusted to suit the form angle.

After 1.5 million (1.5×10^6) flexes, an unaided visual observation shall determine whether the specimen has failed. Fifty percent of the lot tested shall consist of sole plates oriented for use in right-foot specimens and the other 50% shall consist of sole plates oriented for use in left-foot specimens.

6.4 Metatarsal protector impact resistance

6.4.1 Drop test equipment

6.4.1.1

The striker shall have a mass of 22.7 kg. The striking surface shall be a cylindrical bar measuring 25.4 ± 5 mm in diameter and 152 ± 3 mm in length. The striking bar shall be oriented horizontally (see Figure 11).

6.4.1.2

The striker shall fall in a guide tube or on guide rails; the effect of friction shall be minimized. Provision shall be made for a mechanism to catch the striker after the initial impact so that the test specimen is struck only once.

6.4.1.3

A velocity meter shall be used to verify the velocity of the striker to within 2% at the point of impact.
Note: *The impact energy, E, in joules, is determined by the equation*

$E = (1/2)mv^2$

where
m = *mass of the striker*
= 22.7 kg
v = *impact velocity of the striker*
= 2.99 m/s

6.4.1.4

The sample shall be supported on a heavy rigid base having a thickness of at least 19 mm.

6.4.2 Test procedure

6.4.2.1
Polyurethane-injected foot forms shall be used in this test procedure to represent the strength and resilience of the human foot. The design and dimensions of these surrogate foot forms are specified in Figure 12.

Note: *The precise dimensions of these foot forms and the foot forms themselves are available from*
Swenco Limited
Conestogo Road
Waterloo, Ontario N2L 4E3
E-mail: info@swencolimited.com

6.4.2.2
The men's foot form shall have a completed weight of 172 ± 3 g. The women's foot form shall have a completed weight of 164 ± 3 g. Both foot forms shall have a mean density of 0.45 ± 0.05 g/cm^3.

6.4.2.3
A plasticine bar that is 25 mm × 25 mm × (50 mm ± 2 mm), and weighs 62 ± 3 g shall be inserted into the centre part of the cutaway area of the foot form, approximately equidistant from the edges. The foot form shall be fully inserted into the specimen.

6.4.2.4
A leg form of the dimensions specified in Figure 13 shall be inserted behind the foot form in such a manner as to completely fill the cavity between the form and the shoe (heel) counter. The footwear shall be oriented for testing in the manner in which it is normally worn.

6.4.2.5
The specimen shall be placed on the base of the test apparatus such that the central point of impact is the approximate centre of the foot form cavity (or, more specifically, directly over the plasticine bar). The specimen shall be held in place at the heel to prevent backward movement (see Figure 11).

6.4.2.6
After impact, the foot form shall be carefully removed to protect the plasticine insert.

The minimum height of the polyurethane and the plasticine combined, as measured at the lowest point along the centre scribe of the foot form, shall be recorded as the internal metatarsal clearance.

6.4.2.7
In order to maintain consistent quality, all foot forms used for testing shall be destroyed and replaced every two years. No foot form should be older than five years from its date of manufacture. Foot forms should be stored in a dry environment at room temperature and away from direct sunlight.

6.4.3 Specification for plasticine
Plasticine used for the test form inserts shall be tested and maintained in accordance with Clause 6.2.2.

6.5 Electric-shock-resistant footwear

6.5.1 Test equipment

6.5.1.1
The inner boot electrode shall consist of solid metal (electrically conductive) spheres of 3 mm in diameter (e.g., BB shot), placed inside the footwear to be tested and covering the entire inner sole surface of the footwear to a depth of not less than 30 mm.

6.5.1.2
The outer electrode shall consist of a metal mesh (fire screen) mounted under moderate tension by spring-loading so as to support the weight of the footwear when the footwear contains the metal spheres (see Figure 14).

6.5.1.3
The voltage shall be measured using a method that yields accurate effective values of the voltage actually applied to the test specimen (e.g., a voltmeter used in conjunction with a calibrated instrument-potential transformer connected directly across the high-voltage circuit).

6.5.1.4
The current shall be measured with an ac ammeter, or an equivalent non-inductive shunt and a voltmeter, connected in series with the specimen.

6.5.2 Test procedure

6.5.2.1
The inner electrode shall be maintained at ground potential. The test voltage shall be applied to the outer electrode at a low level (approximately 0 V) and steadily increased at a maximum rate of 1 kV/s until the prescribed test voltage is reached. This voltage shall be maintained for 1 min.

6.5.2.2
The current shall be recorded at the beginning and at the end of the test period.

6.6 Static-dissipative footwear

6.6.1 Test equipment
The test equipment shall consist of
(a) a megohmmeter designed to read in the range of 10^5 to 10^9 Ω with two leads and an impression voltage of 500 V dc;
(b) a metal tray of approximately 200 mm × 380 mm × 13 mm attached to a metal baseplate of approximately 380 mm × 380 mm that is mounted on a wooden base of 460 mm × 460 mm;
(c) a 30 mm depth of electrically conductive metal spheres that are 3 mm in diameter (e.g., BB shot); and
(d) the footwear to be tested.

6.6.2 Test procedure
The test procedure for static-dissipative footwear shall be as follows:
(a) One lead from the megohmmeter shall be connected to the metal base to which the metal tray is attached.
(b) The inside of the metal tray shall be covered with 3 mm of water.
(c) The footwear to be tested shall be set in the water of the metal tray.
(d) The metal spheres shall be placed inside the footwear to a depth of approximately 30 mm.
(e) The second megohmmeter lead shall be inserted into the conductive metal spheres inside the footwear.
(f) The reading observed on the megohmmeter shall be recorded.

6.7 Conductive footwear

6.7.1 Test equipment

The test equipment shall consist of

(a) a megohmmeter designed to read in the range of 0 to 10^6 Ω with two leads and an impression voltage of 500 V dc;
(b) a metal tray of approximately 200 mm × 380 mm × 13 mm attached to a metal baseplate of approximately 380 mm × 380 mm that is mounted on a wooden base of 460 mm × 460 mm;
(c) a 30 mm depth of electrically conductive metal spheres that are 3 mm in diameter (e.g., BB shot); and
(d) the footwear to be tested.

6.7.2 Test procedure

The test procedure for conductive footwear shall be as follows:

(a) One lead from the megohmmeter shall be connected to the metal base to which the metal tray is attached.
(b) The inside of the metal tray shall be covered with 3 mm of water.
(c) The footwear to be tested shall be set in the water of the metal tray.
(d) The metal spheres shall be placed inside the footwear to a depth of approximately 30 mm.
(e) The second megohmmeter lead shall be inserted into the conductive metal spheres inside the footwear.
(f) The reading observed on the megohmmeter shall be recorded.

6.8 Chainsaw-protective footwear

6.8.1 Test equipment

The test equipment shall consist of

(a) a power unit and a connecting device that transfers rotational energy to the saw unit;
(b) a saw unit (including shaft, flywheel, sprocket, chain, and bar) with a defined moment of inertia;
(c) a fixture for the saw unit;
(d) test piece mounts for samples; and
(e) instrumentation.

Each of these components shall comply with the requirements of Section 5 of ISO 11393-1. The general arrangement of the chainsaw test equipment shall be as shown in Figure 15.

6.8.2 Test procedure

6.8.2.1 Calibration and positioning of samples

The test rig shall be calibrated as specified in Section 7 of ISO 11393-1. Test samples shall be positioned relative to the test rig in accordance with Clause 6.2 of ISO 11393-3.

6.8.2.2 Chainsaw cut test

With an applied load of 30 ± 0.5 N, a chain speed of 28 ± 1 m/s, and a contact point 300 ± 2 mm from the centre of the sprocket, test cuts shall be performed on both right and left footwear at the following positions (see Figure 16):

(a) on the left side of the vamp (Figure 16, position 1);
(b) at the throat (Figure 16, position 2);
(c) at the leg front (Figure 16, position 3); and
(d) on the protective toecap (Figure 16, position 4).

A cut test on the protective toecap is not required where the cap is constructed of steel at least 1.6 mm thick (see Clause 4.9).

Note: *Where possible, cutting into any fastenings that are fitted to the footwear should be avoided, as this could yield anomalous results.*

6.9 Slip-resisting footwear

Footwear identified as being slip resisting (slip resistant) or as offering slip-resisting soles and heels shall be tested in accordance with ISO 13287 using distilled water on the following test surfaces:

(a) stainless steel; and

(b) quarry tile.

In addition, the footwear shall be tested in accordance with ISO 13287 on dry quarry tile.

Notes:

(1) *The ISO 13287 test method, using SATRA slip-testing apparatus or other apparatus, may also be used to test slip performance on other test surfaces and with other slipping agents (e.g., oils, greases, detergents, etc.). Such additional tests may be conducted in order to meet user demands.*

(2) *One source of quarry tile is the SATRA Technology Centre (Wyndham Way, Telford Way, Kettering, Northamptonshire, NN16 8SD, UK).*

7 Marking and labelling

7.1 Manufacturer's identification

At least one shoe or boot of each pair shall have the following information permanently marked in a conspicuous location:

(a) either

(i) the manufacturer's or listee's name or trademark; or

(ii) the manufacturer's trade name and the certification organization's identification number (if certified); and

(b) the month and year of manufacture (a date code may be used).

7.2 Grade 1 footwear

7.2.1

Grade 1 protective footwear with protective soles (with or without integrated metatarsal guards) shall have a green equilateral triangle with sides measuring not less than 20 mm sewn or otherwise permanently attached to the right boot or shoe upper or tongue, at a conspicuous location, as a means of indicating that sole protection and Grade 1 toe protection are provided (see Figure 17). The green patch shall be permanent in nature and of a material compatible with the footwear involved. If compliance with this Standard has been certified by a certification organization, the green patch shall be permanently marked with the registered identifying logo or mark of the certification organization.

7.2.2

Footwear offering Grade 1 toe protection only (without sole protection) shall be marked with a blue rectangular patch, measuring approximately 15 mm × 12 mm, sewn, embossed, or otherwise permanently attached to the right boot or shoe upper or tongue at a conspicuous location (see Figure 17). If compliance with this Standard has been certified by a certification organization, the blue patch shall be permanently marked with the registered identifying logo or mark of the certification organization.

7.3 Grade 2 footwear

7.3.1

Grade 2 protective footwear with protective soles (with or without integrated metatarsal guards) shall have a yellow equilateral triangle with sides measuring not less than 20 mm sewn or otherwise permanently attached to the right boot or shoe upper or tongue, at a conspicuous location, as a means of indicating that sole protection and Grade 2 toe protection are provided (see Figure 17). The yellow patch shall be permanent in nature and of a material compatible with the footwear involved. If compliance with this Standard has been certified by a certification organization, the yellow patch shall be permanently marked with the registered identifying logo or mark of the certification organization.

7.3.2

Footwear offering Grade 2 toe protection only (without sole protection) shall be marked with a grey rectangular patch, measuring approximately 15 mm × 12 mm, sewn, embossed, or otherwise permanently attached to the right boot or shoe upper or tongue at a conspicuous location (see Figure 17). If compliance with this Standard has been certified by a certification organization, the grey patch shall be permanently marked with the registered identifying logo or mark of the certification organization.

7.4 Electric-shock-resistant footwear

Footwear incorporating electric-shock-resistant soles shall be marked

(a) with a rectangular patch sewn, embossed, or otherwise permanently attached to the right boot or shoe. The patch shall be white and shall measure approximately 16 mm × 25 mm. The patch shall be permanently marked with the Greek letter omega (Ω) and, if compliance with this Standard has been certified by a certification organization, the registered logo or mark of the certification organization, both in orange (see Figure 17); and

(b) with a printed label or tag attached to the footwear clearly warning that electric-shock-resistant performance deteriorates in a wet environment and with wear.
Note: *The following wording may be used for this purpose: "WARNING: Electric shock resistance deteriorates rapidly in a wet environment and with wear" and «AVERTISSEMENT : La résistance aux chocs électriques se détériore rapidement en milieu humide et avec l'usure».*

7.5 Static-dissipative footwear

Footwear incorporating static-dissipative soles shall be marked

(a) with a rectangular patch sewn, embossed, or otherwise permanently attached to the right boot or shoe. The patch shall have a fluorescent yellow background and shall measure approximately 16 mm × 25 mm. The patch shall be permanently marked with a prominent green "SD" notation. Below the "SD" notation the patch shall show an electrical grounding symbol and, if compliance with this Standard has been certified by a certification organization, the registered logo or mark of the certification organization, both in green (see Figure 17); and

(b) with a printed label or tag attached to the footwear clearly warning against the use of static-dissipative footwear in areas where there is hazard of electric discharge.
Note: *The following wording may be used for this purpose: "WARNING: This footwear should not be used in areas where there is hazard of electric discharge" and «AVERTISSEMENT : Cette chaussure ne doit pas être portée dans des endroits où il y a risque de décharge électrique».*

7.6 Conductive footwear

Footwear incorporating electrically conductive soles shall be marked

(a) with a rectangular patch sewn, embossed, or otherwise permanently attached to the right boot or shoe. The patch shall be red and shall measure approximately 16 mm × 25 mm. The patch shall be permanently marked with a black "C", an electrical grounding symbol, and, if compliance with this Standard has been certified by a certification organization, the registered logo or mark of the certification organization (see Figure 17); and

(b) with a printed label or tag attached to the footwear clearly warning against the use of conductive footwear in areas where there is hazard of electric discharge.
Note: *The following wording may be used for this purpose: "WARNING: This footwear should not be used in areas where there is hazard of electric discharge" and «AVERTISSEMENT : Cette chaussure ne doit pas être portée dans des endroits où il y a risque de décharge électrique».*

7.7 Chainsaw-protective footwear

Chainsaw-protective footwear shall be marked with a square patch sewn, embossed, or otherwise permanently attached to the right boot or shoe. The patch shall be white and shall measure approximately 16 mm × 25 mm. The patch shall be permanently marked with a green fir tree symbol and, if compliance with this Standard has been certified by a certification organization, marked with the registered identifying logo or mark of the certification organization (see Figure 17).

Note: *See Clause 4.9 for requirements pertaining to the toe protection and protective sole of chainsaw-protective footwear.*

7.8 Slip-resisting footwear

Footwear identified as slip resisting (slip resistant) shall have the six mean coefficients of friction attained during testing (in accordance with Clause 6.9) specified either on the packaging or on a label affixed to the footwear.

The six mean coefficients of friction attained during testing should be specified on a product information sheet included with each pair of footwear. The data may also be displayed on box/container labels. These six values represent the coefficients of friction attained for the heel and flat of the sole on the two primary test slipping surfaces: stainless steel and quarry tile.

The following is a suggested format for the statement of slip resistance performance:

"This footwear has been tested in accordance with the slip resisting requirements of CSA Z195. The following average coefficients of friction (CoFs) were attained under the specified test conditions:

Wet stainless steel ____ Heel CoF ____ Flat CoF
Wet quarry tile ____ Heel CoF ____ Flat CoF
Dry quarry tile ____ Heel CoF ____ Flat CoF"

In addition, a statement directing the user to "seek the advice of the footwear manufacturer or distributor regarding appropriate application based on test results" shall be included on the footwear hang-tag, the packaging, or a product information sheet provided with each pair of footwear.

Table 1
Toe impact test
(See Clauses 5.1.1, 5.1.3, and 6.2.1.1.4.)

Grade	Toe impact energy, J	Impact velocity, m/s
1	125	3.32
2	90	2.82

Table 2
Minimum internal toe clearances upon impact
(See Clauses 5.1.1, 5.1.3, and 6.2.1.3.4.)

Clearance, mm	Men's sizes	Women's sizes
10.7	—	3
11.2	1-1/2–3	3-1/2–5
11.7	3-1/2–5	5-1/2–7
12.2	5-1/2–7	7-1/2–9
12.7	7-1/2–9	9-1/2–11
13.2	9-1/2–11	≥ 11-1/2
13.7	11-1/2–13-1/2	—
14.2	≥ 14	—

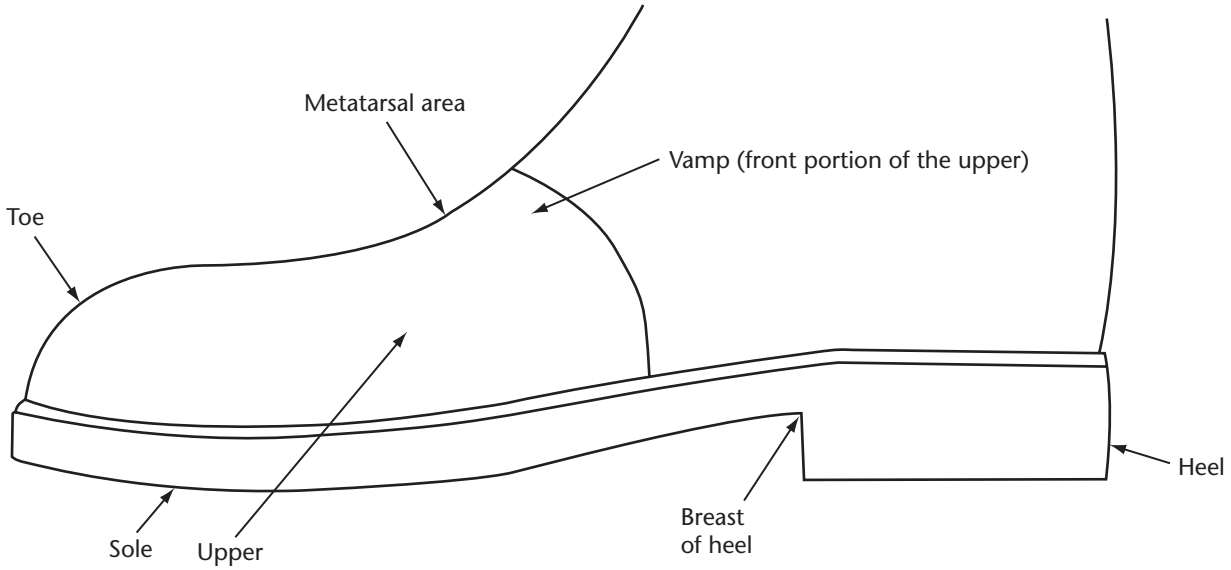


Figure 1
Footwear nomenclature
(See Clause 1.1.)

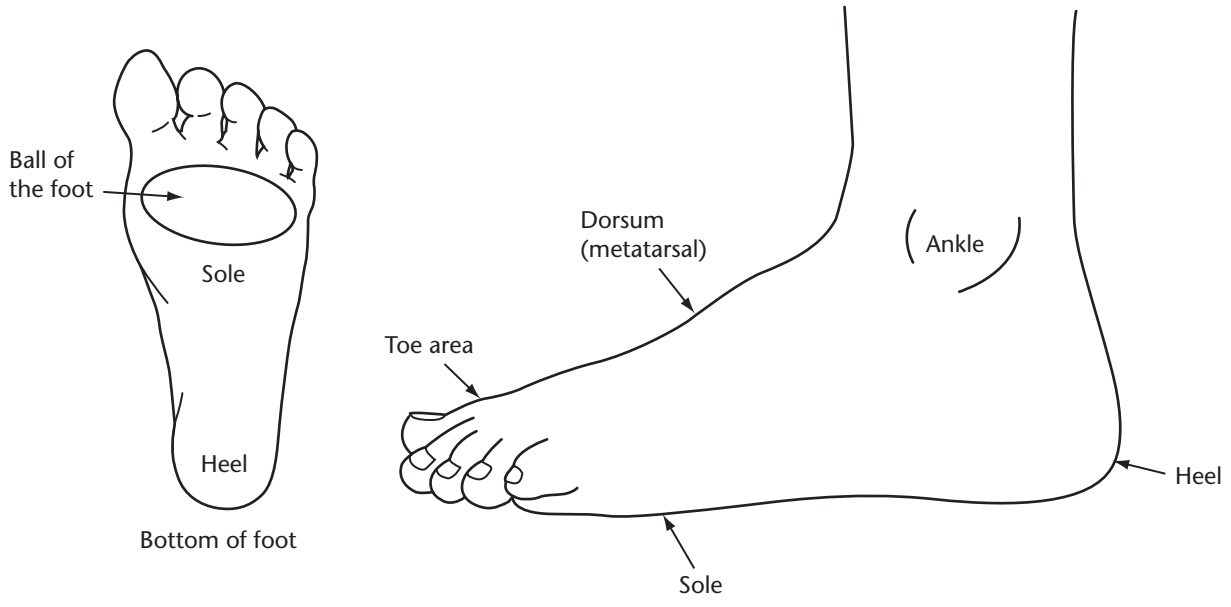


Figure 2
Foot nomenclature
(See Clause 1.1.)

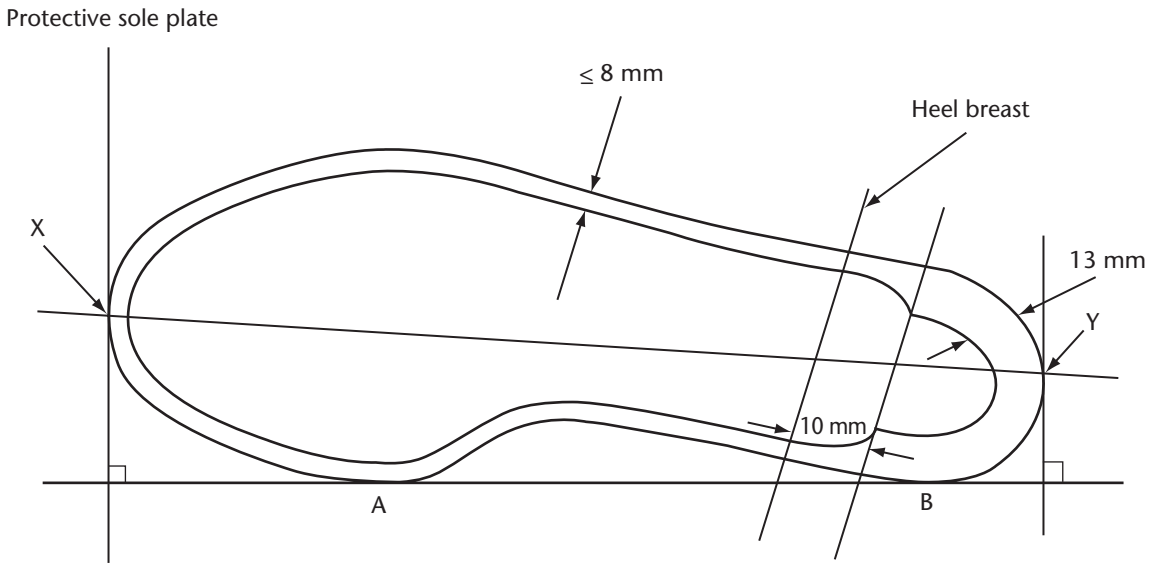


Figure 3
Protective sole coverage
(See Clause 4.3.)

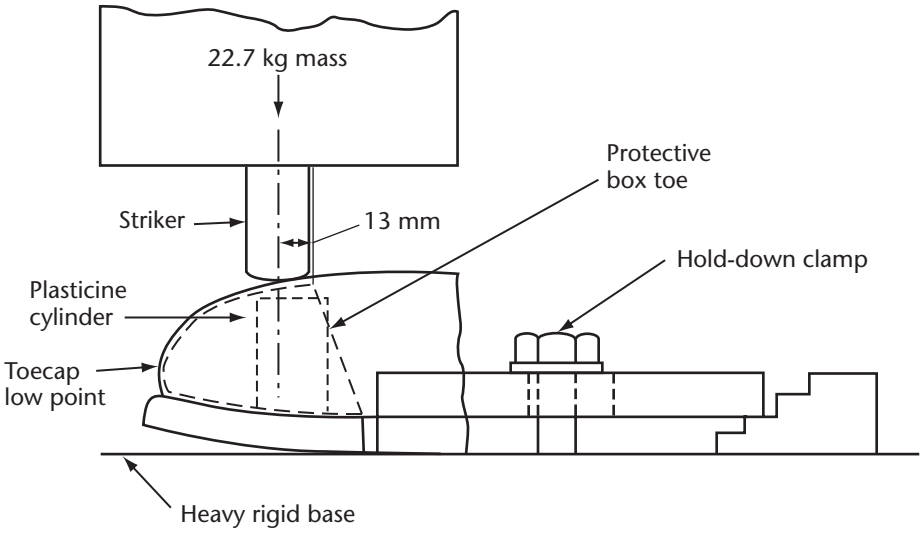


Figure 4
Apparatus for impact test
(See Clause 6.2.1.)

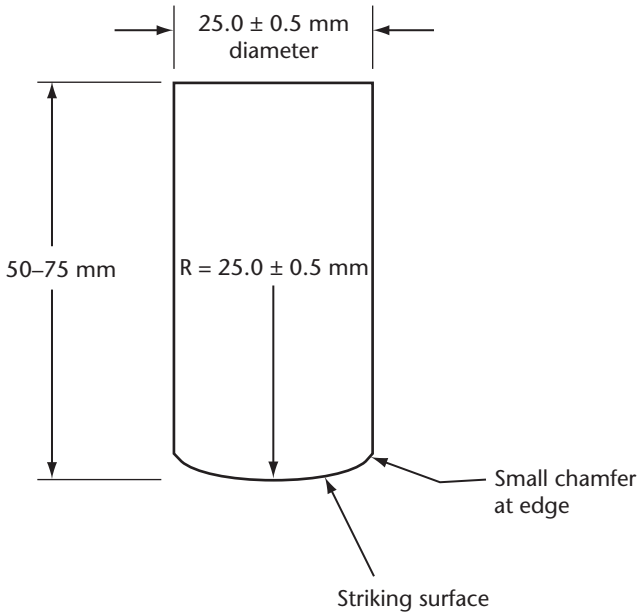


Figure 5
Striker nose
(See Clause 6.2.1.1.1.)

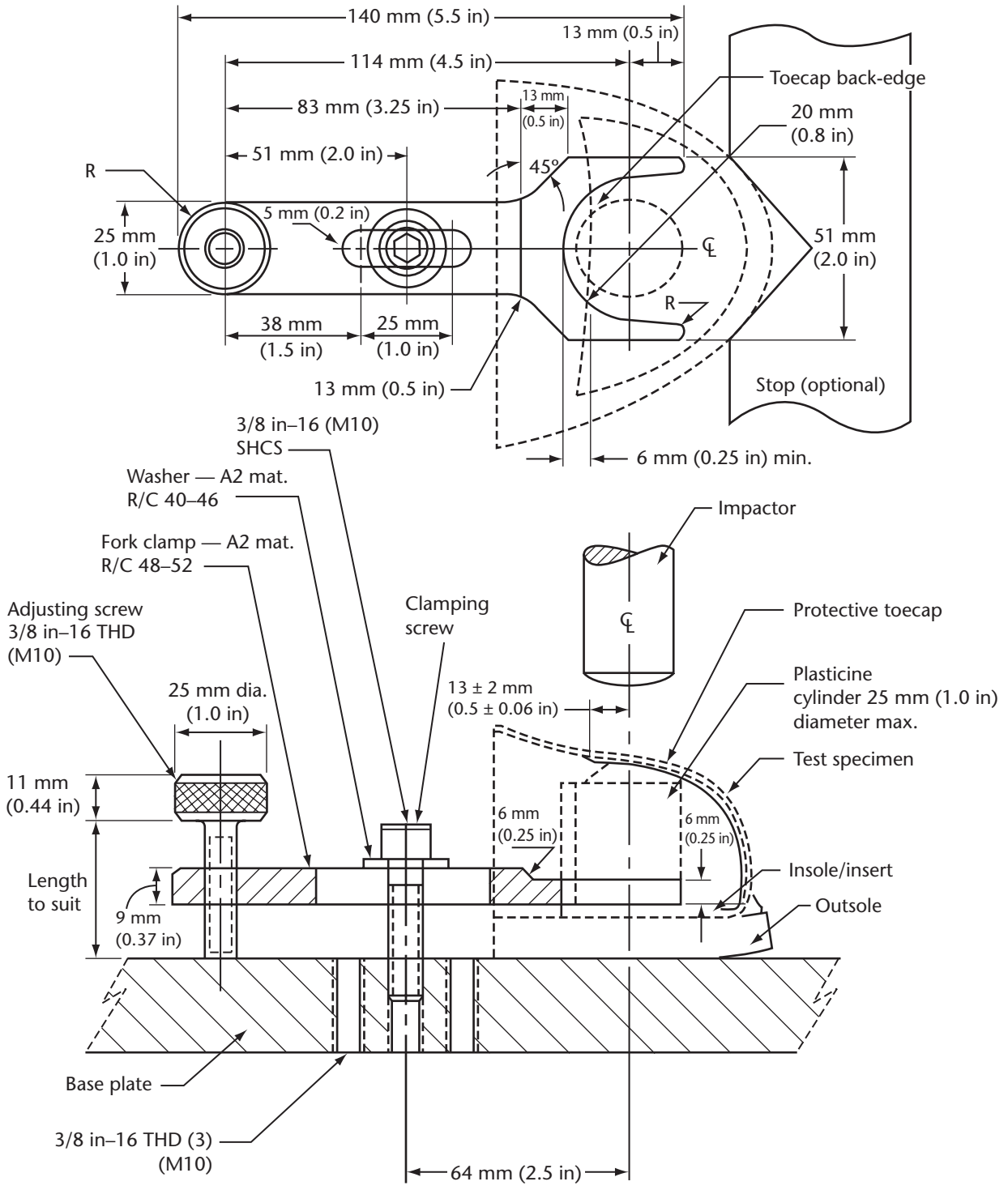


Figure 6
Toecap clamping device
(See Clause 6.2.1.3.2.)

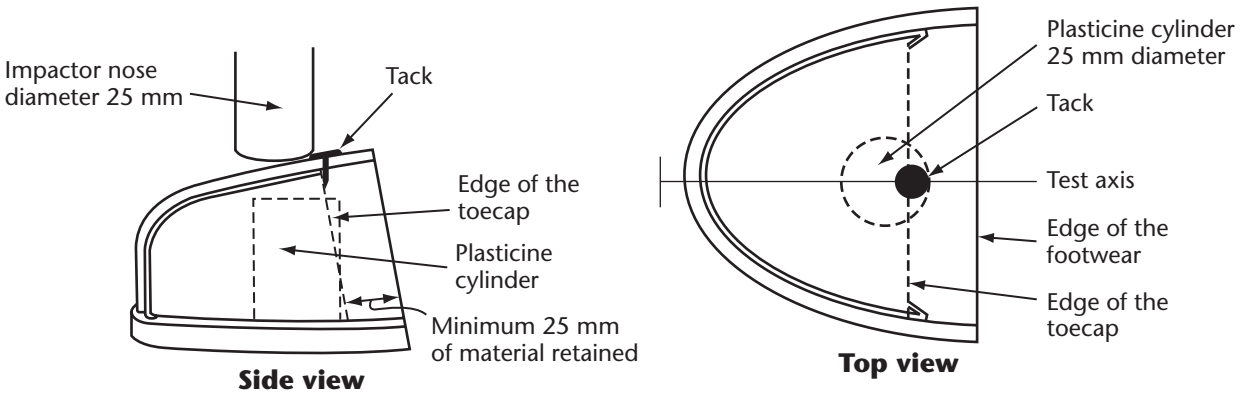


Figure 7
Placement of plasticine form
(See Clauses 6.2.1.2.1, 6.2.1.3.2, 6.2.1.3.3, and 6.2.2.3.)

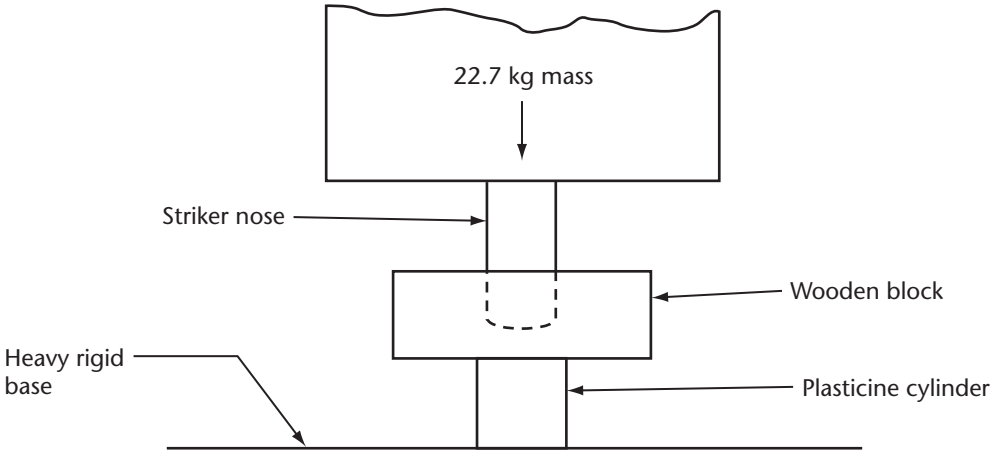
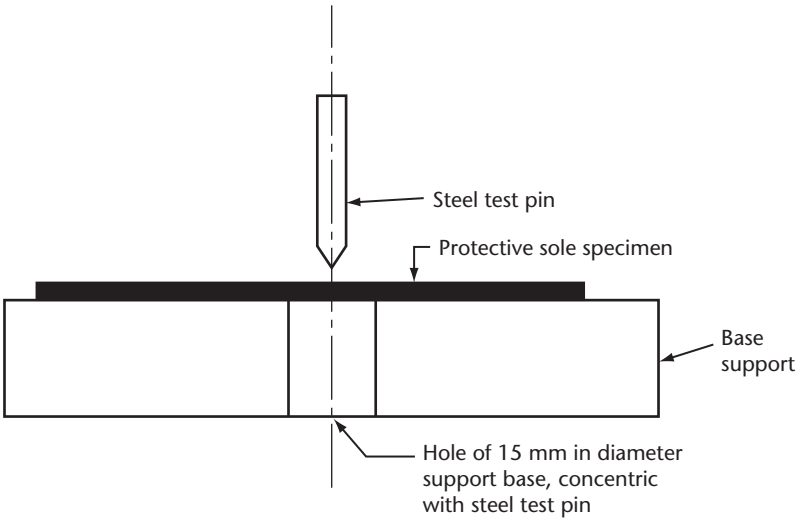
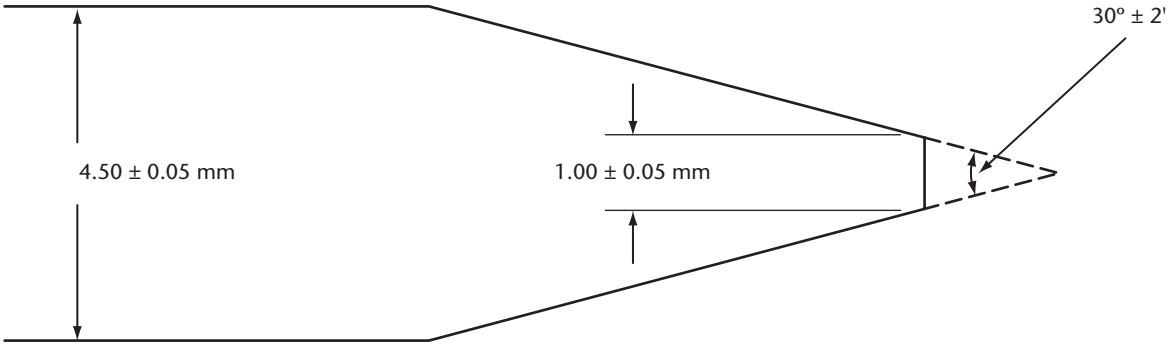


Figure 8
Apparatus for plasticine quality test
(See Clause 6.2.2.3.)



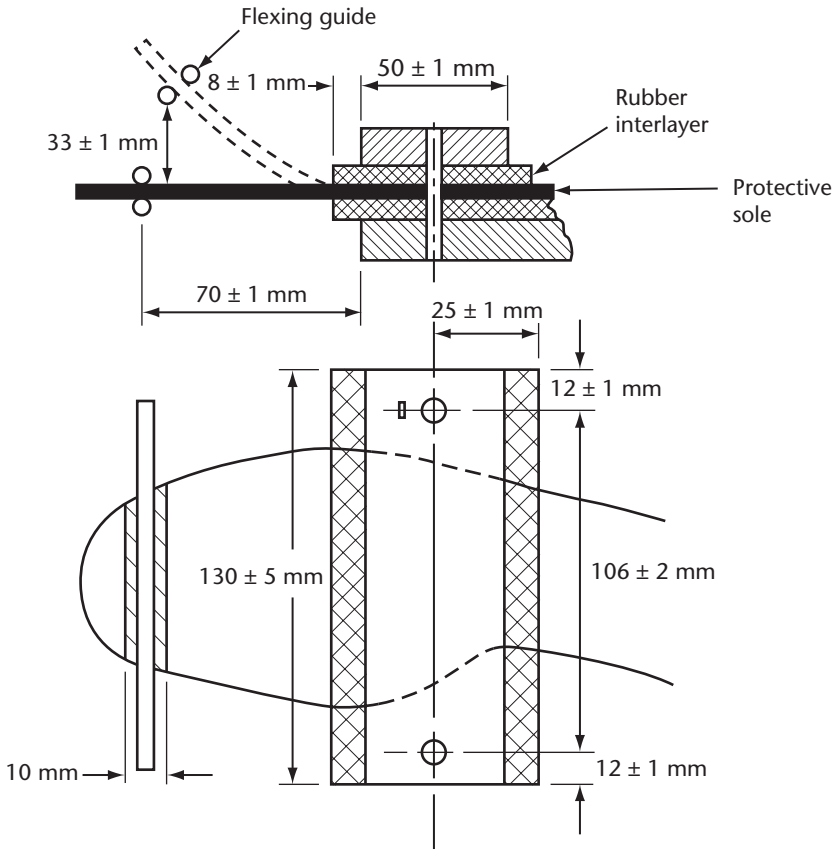
(a) Test assembly



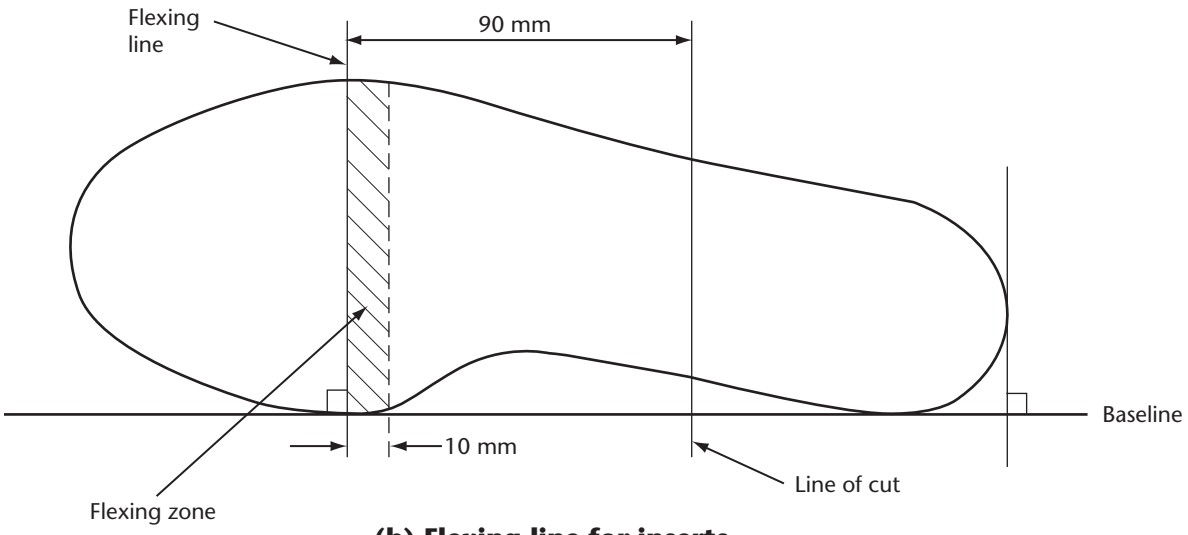
(b) Test pin

Note: *Steel test pin* 45.0 ± 0.05 mm *in diameter, with a conical truncated tip* 1.00 ± 0.005 mm *in diameter and an angle of* 30° ± 2′ *at its tip.*

Figure 9
Penetration test set-up
(See Clauses 6.3.1.1.1 and 6.3.1.1.2.)



(a) Flexing apparatus for penetration-resistance inserts



(b) Flexing line for inserts

Figure 10
Protective sole flexing test
(See Clauses 6.3.2.1 and 6.3.2.2.1.)

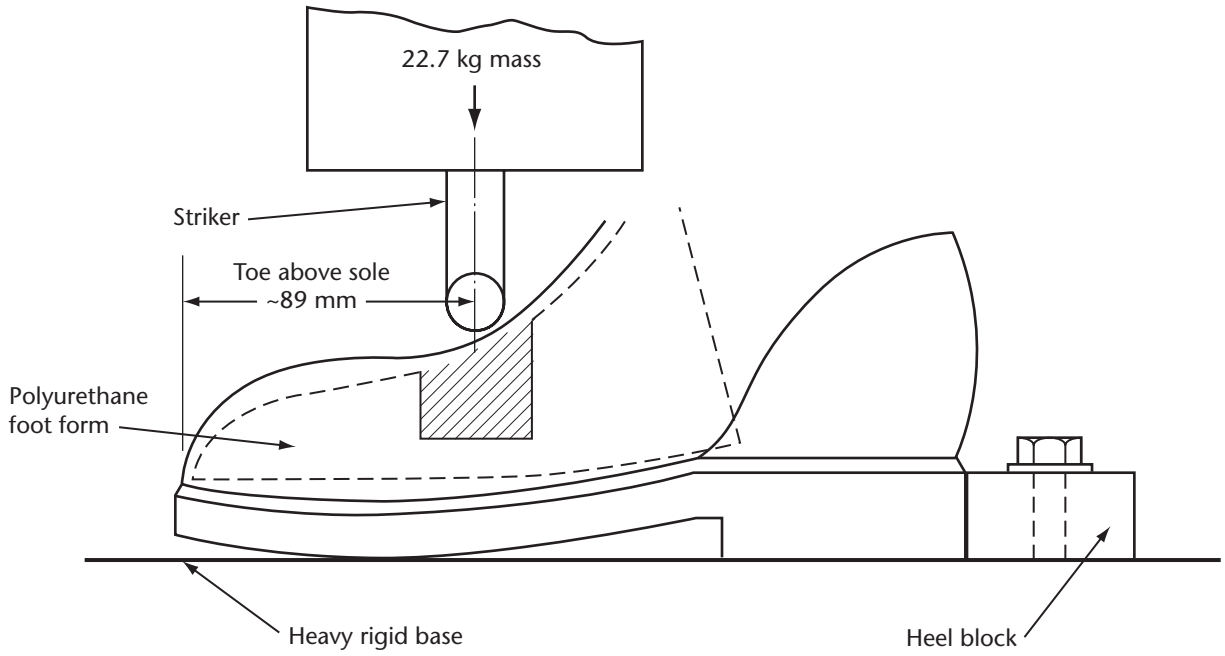


Figure 11
Metatarsal impact test apparatus set-up
(See Clauses 6.4.1.1 and 6.4.2.5.)

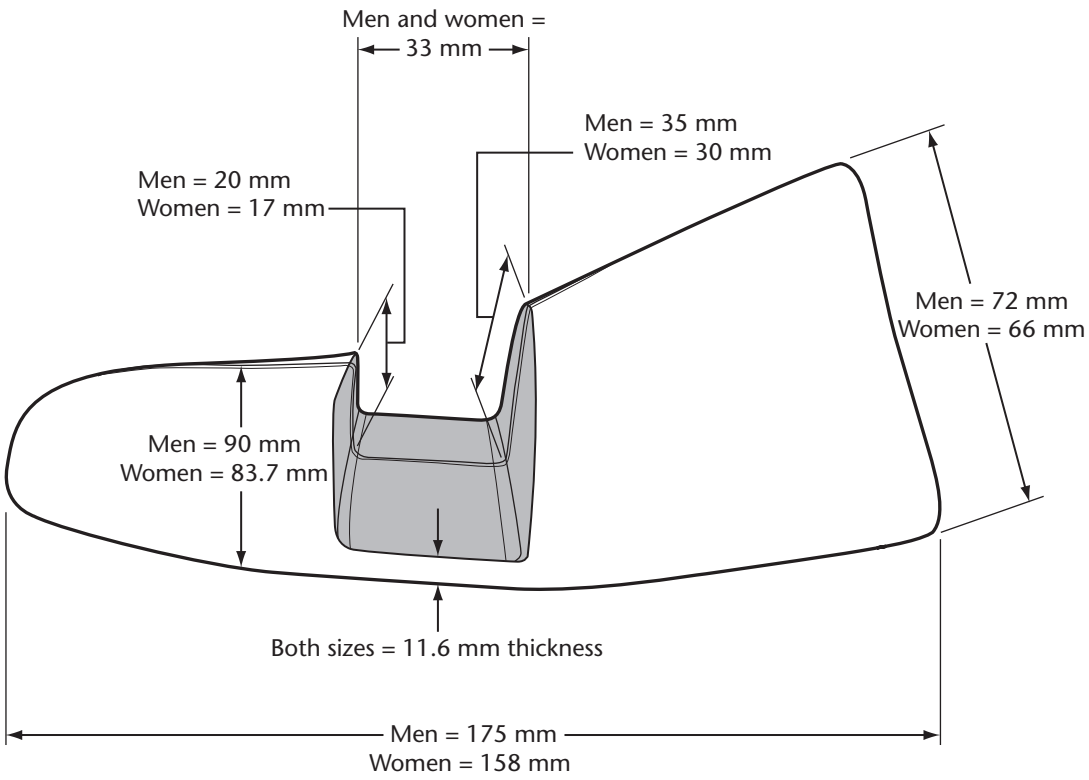


Figure 12
Metatarsal impact test on polyurethane foot form
(See Clause 6.4.2.1.)

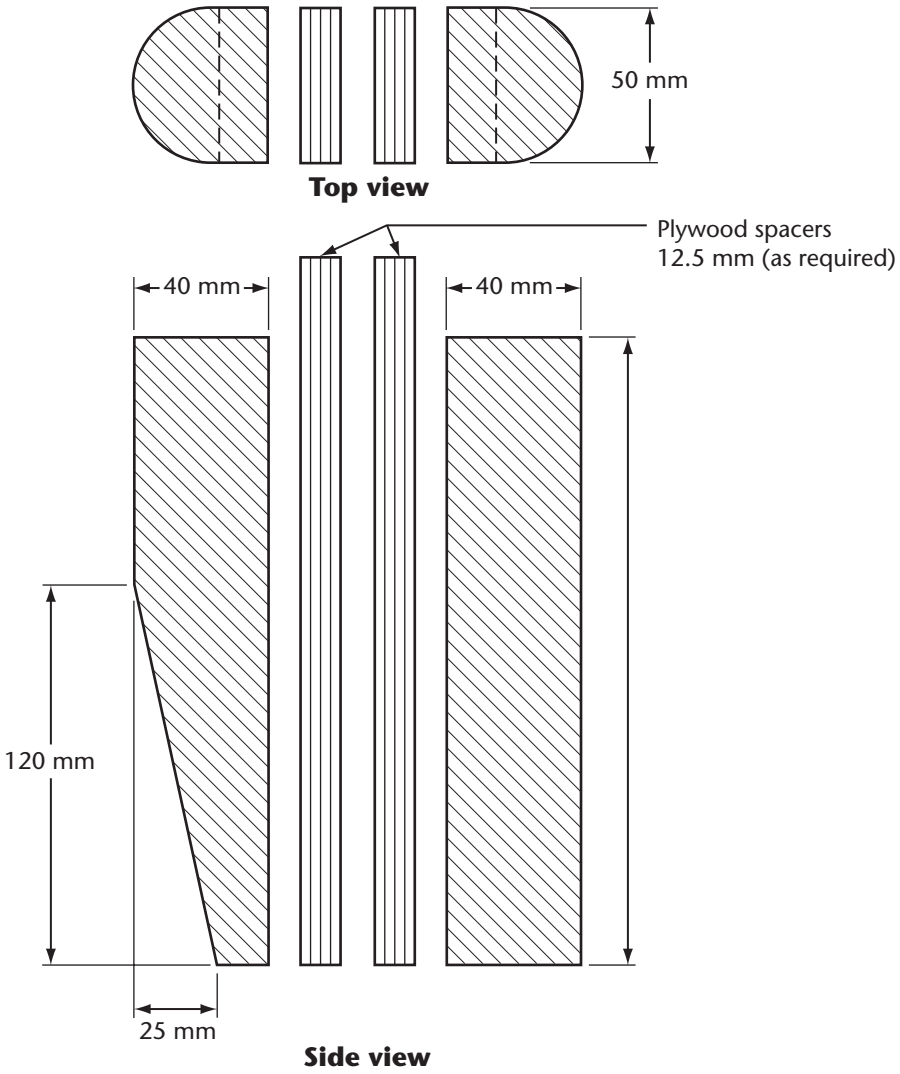
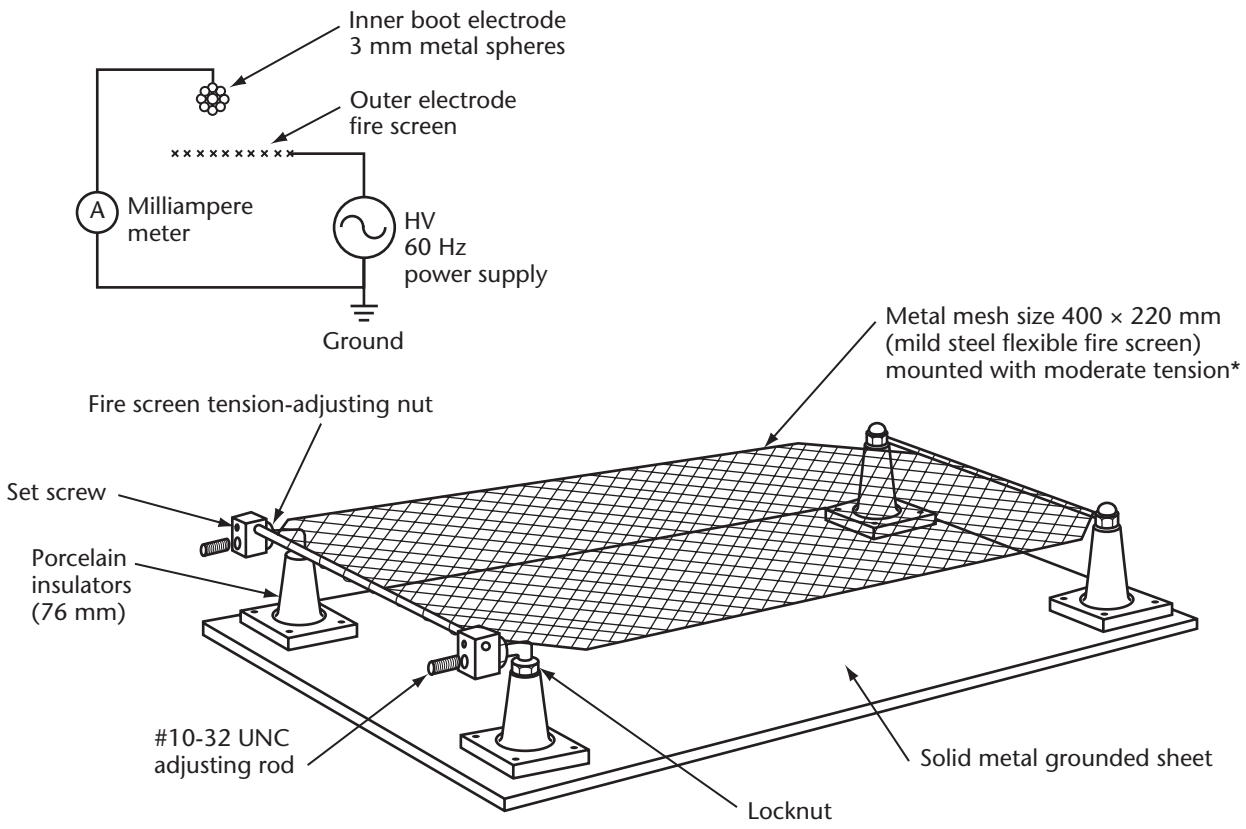
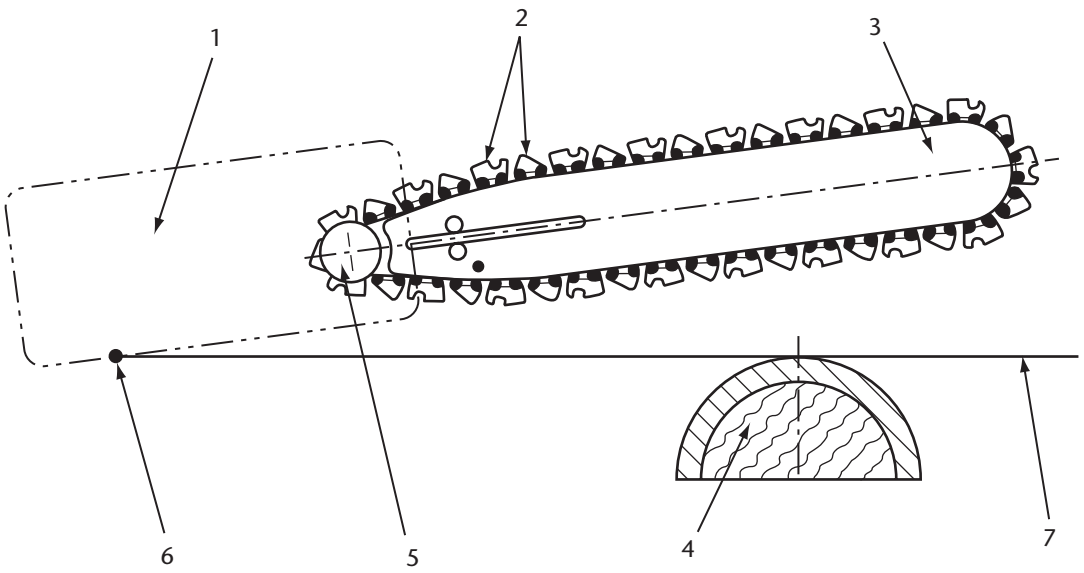


Figure 13
Metatarsal impact on test on leg form
(See Clause 6.4.2.4.)



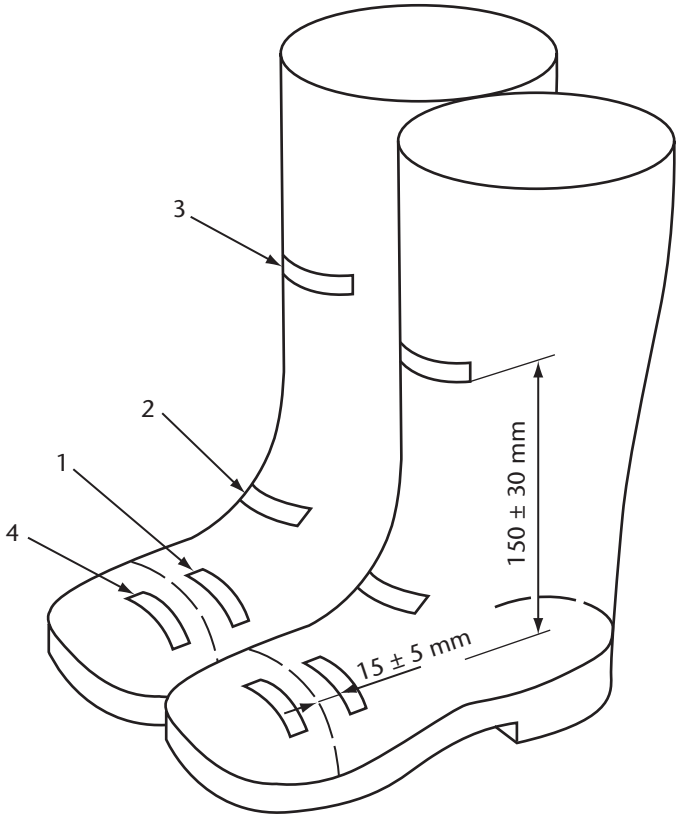
**Moderate tension is achieved when there is a* 15 ± 2.5 mm *deflection at the centre of the fine screen when a* 1 kg *mass is placed on an aluminum plate of* 100 mm in *diameter positioned at the centre of the screen.*

Figure 14
Typical footwear electrical test platform
(See Clause 6.5.1.2.)



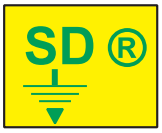
Legend:
1 = Mounting for sprocket
2 = Chain
3 = Guide bar
4 = Sample mount
5 = Sprocket
6 = Pivot
7 = Horizontal plane

Figure 15
Chainsaw test apparatus
(See Clause 6.8.1.)



Note: *Numerals 1–4 show positions for test cuts.*

Figure 16
Test cut positions
(See Clause 6.8.2.2.)

Outside labels	Location	Criteria	Intended application
	The label shall appear at ankle height or on the tongue of the right shoe.	Green triangle indicates sole puncture protection with a Grade 1 protective toe to withstand impacts less than or equal to 125 J.	For heavy industrial environments, especially that of construction, where sharp objects (e.g., nails) are present.
	The label shall appear at ankle height or on the tongue of the right shoe.	Yellow triangle indicates sole puncture protection with a Grade 2 protective toe to withstand impacts less than or equal to 90 J.	For light industrial work environments requiring puncture protection as well as toe protection.
	The label shall appear at ankle height or on the tongue of the right shoe.	White rectangle with orange Greek letter omega indicates that soles provide resistance to electric shock.	For any industrial environment where accidental contact with live electrical conductors can occur. **Warning:** *Electric shock resistance deteriorates rapidly in a wet environment and with wear.*
	The label shall appear at ankle height or on the tongue of the right shoe.	Yellow rectangle with green "SD" and grounding symbol indicates that soles are static dissipative.	For any industrial environment where a static discharge can generate a hazard for workers or equipment.
	The label shall appear at ankle height or on the tongue of the right shoe.	Red rectangle with black "C" and grounding symbol indicates that soles are electrically conductive.	For any industrial environment where low-power electrical charges can generate a hazard for workers or equipment.
	The label shall appear at ankle height or on the tongue of the right shoe.	White label with green fir tree symbol indicates chainsaw-protective footwear.	For forestry workers and others exposed to hand-held chainsaws or other cutting tools.
	The label shall appear on the right shoe upper or tongue.	Blue rectangle indicates a Grade 1 protective toe with no protective sole.	For industrial work environments not requiring puncture protection.
	The label shall appear on the right shoe upper or tongue.	Grey rectangle indicates a Grade 2 protective toe with no protective sole.	For institutional and non-industrial work environments not requiring puncture protection.

Note: *The ® symbol represents the preferred positioning for the registered identifying logo or mark of the certification organization.*

Figure 17
Protective footwear markings chart
(See Clauses 7.2, 7.3, 7.4, 7.5, 7.6, and 7.7.)

Annex A (informative)
Sole slip resistance

Note: *This Annex is not a mandatory part of this Standard.*

A.1 General
The following information is provided as a guide for selecting sole material that will minimize the hazard of slipping. It is impossible to make specific recommendations regarding the most effective sole material or design for all walking and flooring conditions. It is possible that a sole material effective for one type of flooring material will not be as effective in a different work environment.

A.2 Markings
Footwear users should look for indications that the footwear sole has been tested in accordance with the slip resistance test method specified in this Standard (see Clause 6.9). They should look also for a statement of the average coefficients of friction attained under the specified test conditions either on a product information sheet or a hang-tag attached to the footwear (see Clause 7.8).

A.3 Manufacturer's advice regarding selection
Most manufacturers and distributors of slip-resisting footwear provide advice regarding the appropriate application of various types of footwear. Users should seek the manufacturer's or supplier's advice regarding the selection of footwear that will best meet the needs of their work environment.

A.4 Design factors to be considered
Aside from the basic sole material, aspects of sole design that affect slip resistance include
(a) the shape of the sole;
(b) the tread design;
(c) the shape of the heel; and
(d) the softness/hardness of the sole.

Treads in the sole allow liquid on the floor to be dispersed so that the sole can make contact with the floor surface. The shape of the heel may be bevelled so that on initial contact there is a greater heel surface area contacting the ground, which can minimize the chances of slipping. In some instances, soft sole materials can provide better slip resistance.

A.5 Work environment factors to be considered
Work environment factors that can affect slip resistance include
(a) the type of flooring material;
(b) the surface smoothness of flooring;
(c) a dry, wet, or contaminated surface;
(d) the type of liquid on a wet surface;
(e) the temperature of the floor; and
(f) the temperature of the air.

Smooth or wet flooring surfaces are usually more slippery. Lower temperatures can affect the sole material by making it harder and less slip resisting.

Proposition de modification

N'hésitez pas à nous faire part de vos suggestions et de vos commentaires. Au moment de soumettre des propositions de modification aux normes CSA et autres publications CSA prière de fournir les renseignements demandés ci-dessous et de formuler les propositions sur une feuille volante. Il est recommandé d'inclure

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- le numéro de l'article, du tableau ou de la figure visé
- la formulation proposée
- la raison de cette modification.

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