BS 6366:2011

BSI Standards Publication

# Specification for studs for rugby football boots

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## Publishing and copyright information



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# Contents



**Summary of pages**

This document comprises a front cover, an inside front cover, pages i to ii, pages 1 to 20, an inside back cover and a back cover.

# Foreword

## Publishing information

This British Standard is published by BSI to come into effect on 1 April 2012. It was prepared by Subcommittee PH/3/11, *Protective clothing and equipment for sports*, under the authority of Technical Committee PH/3, *Protective equipment for sports players*. A list of organizations represented on this committee can be obtained on request to its secretary.

## Supersession

This British Standard supersedes BS 6366:1983+A2:2001, which is to be withdrawn on 31 March 2012.

## Information about this document

The initial drafting of this British Standard was produced in association with BIS as part of their on-going programme of support for standardization.

This is a full revision of the standard, and introduces the following principal changes:

- the scope has been widened to encompass a wider range of stud design;
- the skin simulant has been discontinued so the test material used for this has been updated;
- test procedures have been clarified;
- new tests for stamping have been included.

## Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall".

*Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.*

## Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

**Compliance with a British Standard cannot confer immunity from legal obligations.**

# 1 Scope

This British Standard specifies design, dimensions, construction, performance and marking requirements for studs for use in rugby football boots.

# 2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 3643-1:2007, *ISO metric screw threads – Part 1: Principles and basic data*

BS 3643-2:2007, *ISO metric screw threads – Part 2: Specification for selected limits of size*

ISO 6344 (all parts), *Coated abrasives – Grain size analysis*

# 3 Materials

Materials used in the studs shall be such that they do not give rise to hazards as a result of actions such as abrasion or impacts through wear or through any other form of damage or deterioration (see Clause **5**).

*NOTE Nylon should not be used; it has been found previously not to be a suitable material due to its propensity for burring.*

Materials used in the studs shall be such that the studs conform to the performance requirements in Clause **5**.

# 4 Construction and design

## 4.1 General

The shape and dimensions of any stud design shall be such that they present no greater risk of injury to another player than the comparator stud (see Figure 1).

There shall not be a single stud at the toe of the boot.

The edge profile of the sole unit itself shall be rounded with no sharp edges.

When fitted to the shoe, the stud shall have no external projections on its surface except where the stud has been marked in accordance with Clause **7**. In such cases, the embossment details shall be no more than 0.3 mm proud of the surrounding material of the stud.

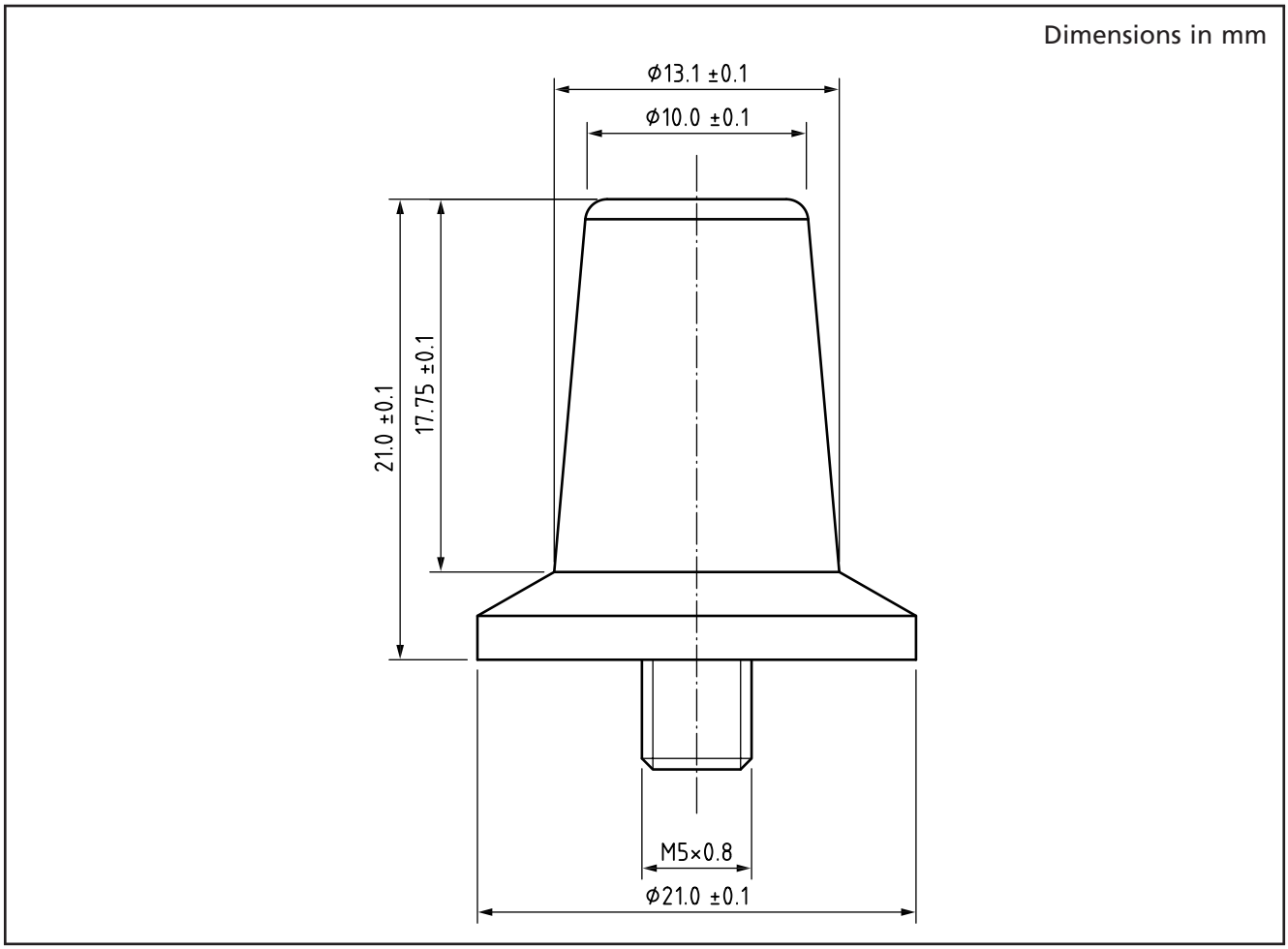
The studs and any attachment shall be capable of withstanding the mechanical demands of service in accordance with Clause **5**, including impact and abrasive wear.

No stud shall be greater than 21 mm in length, measured from the base of the stud to its tip.

*NOTE Studs might be different lengths on the forepart (shorter) and heel (longer) of a boot.*

All edges of studs or cleats shall be filleted with a radius of not less than 1.5 mm with a smooth finish.

Figure 1 **The comparator stud**




## 4.2 Replaceable studs

Replaceable studs shall be designed in such a way that they can be fitted by a method that does not damage the stud and thereby introduce a cutting hazard or any other hazard. In the case of studs incorporating a spigot or similar, the following shall apply.

a) When the attachment spigot is of a different material from the stud, a clearly visible warning mark shall become evident when the stud has worn down to a length that gives a minimum of 2 mm cover to the end of the spigot.

b) Studs shall be designed so that the fixing tool, supplied by the manufacturer, acts only through recesses or flutes on the flanks of the studs or on flats on the integral washer at the base.

   If the attachment spigot is made of metal, the thread shall be either M5 or M7 in accordance with BS 3643-1:2007 and BS 3643-2:2007.

   *NOTE If the attachment spigot is not made of metal, a method of fitting other than by an M5 or M7 thread may be used.*

   If the method of attachment is other than by the use of an attachment spigot with an M5 or M7 thread, marking shall include the information specified in Clause **7**.

c) Any flutes or other recesses for the fixing tool, shall not extend nearer to the tip of the stud than the clearly visible warning mark.

### 4.3 Comparator stud

A stud manufactured from Aluminium 6082 in accordance with the dimensions given in Figure 1 shall be used as a comparator stud that performs acceptably in the tests referred to in **5.1.1**, **5.1.2** and **5.2.3**.

## 5 Performance

### 5.1 Skin damage assessment

#### 5.1.1 Skin damage assessment caused by glancing or raking (abrasion and cutting)

When tested in accordance with Annex A, each stud shall cause no more damage than that caused by the comparator stud (see **4.3**).

#### 5.1.2 Skin damage assessment caused through stamping actions

When tested in accordance with Annex B, each stud shall cause no more damage than that caused by the comparator stud (see **4.3**).

### 5.2 Stud damage assessment

#### 5.2.1 Stud damage assessment caused by impact loads

When tested in accordance with Annex C, with impact energy up to and including 8 J, each of the three studs tested shall:

a) remain secured to the attachment spigot;

b) not disintegrate or completely split;

c) not show a fracture in the attachment spigot.

If the impact of 8 J causes fine hairline splits or cracks, the test shall be continued in increasing energy steps of 0.5 J. The stud shall remain secured to the attachment spigot and not disintegrate or completely split at impacts of up to 12 J.

#### 5.2.2 Stud damage assessment caused by tightening and loosening

After testing in accordance with Annex D, studs shall be assessed visibly for any signs of damage or wear, which might cause an increased risk of injury to other players, caused by repeated tightening and loosening. Where any such damage occurs, studs shall be tested in accordance with Annex A and Annex B to meet the performance requirements in **5.1.1** and **5.1.2**.

#### 5.2.3 Stud damage assessment caused by wear simulation

After testing in accordance with Annex E, studs shall be assessed visibly for any signs of damage or wear, which might cause an increased risk of injury to other players, caused by the replication of roughening processes expected to be experienced in normal usage. Where any such damage occurs, studs shall be tested in accordance with Annex A and Annex B to meet the performance requirements in **5.1.1** and **5.1.2**.

## 6 Test report

A report containing the following information shall be recorded:

a) identification of the studs, including source, date of receipt and general description;

b) the method used by reference to this standard;

c) a statement indicating conformity or nonconformity to this standard;

d) a breakdown of the mechanical testing results as follows;

   1) the result of glancing or raking testing as described in **A.5**;

   2) the result of stamping testing as described in **B.5**;

   3) the result of impact testing as described in **C.5**;

   4) a description of any damage to studs caused by tightening and loosening as described in **D.6** and any affect it had on the resulting test;

   5) a description of any damage to studs caused by wear generation as described in **E.2.3**, **E.3.1.5** or **E.3.2.5** and any affect it had on the resulting test;

e) if relevant, any deviations from the method specified in this standard;

f) any unusual features observed during these tests;

g) date of testing;

h) identification of the laboratory or test house carrying out these tests.

# 7 Marking

The immediate packaging for the studs shall be marked with the following information:

a) the name, trademark or other means of identification of the manufacturer;

b) the number and date of this standard (i.e. BS 6366:2011) [1)];

c) the words "Use only the tool supplied to fit or remove studs";

d) an explanation of the method used to operate the visible warning mark if applicable;

e) if the method of attachment is other than by the use of an attachment spigot with an M5 or M7 thread (as specified in BS 3643-1 and BS 3643-2), a description of the type and method of attachment.

If a stud is to be marked with an indication of conformity to BS 6366:2011, then it shall be in accordance with **4.1**.

[1)] Marking BS 6366:2011 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is solely the claimant's responsibility. Such a declaration is not to be confused with third-party certification of conformity.

# Annex A (normative) Method of test for risk of causing injury by glancing or raking (abrasion and cutting)

## A.1 Principle

The test assesses the risk that a stud might cause injury due to a glancing/raking action. A test material is subjected to a glancing swing from a stud mounted on a pendulum. Any damage to the test material is noted and compared with the performance of the comparator stud.

## A.2 Apparatus

**A.2.1** *A pendulum type skid tester,* such as a tyre skid tester, with the following features:

a) a graduated scale to determine swing through the test stud;

b) a spring loaded mechanism to achieve the correct swing distance;

c) a height adjustment system to allow stud swing length to be set to the correct length.

**A.2.2** *One test stud* (new), of each stud length.

**A.2.3** *A comparator stud* (conforming to **4.3**).

**A.2.4** *A flat surface,* on which to stand the skid tester (**A.2.1**).

**A.2.5** *Test material*, constituting either two gelatine slabs, conforming to **F.3**, or a composite of synthetic chamois (**F.1**) on top of Foam A (**F.2.1**) mounted together securely on the flat surface.

*NOTE Double-sided tape has been shown to be a suitable adhesive to secure the test material to the flat surface or the composite parts at the edges to restrict movement on impact.*

**A.2.6** *A means of attaching the studs (representative of how they are to be used, i.e. with a boot)*, with a part of the sole with mounting fixture, to the underside of the pendulum.

*NOTE This can be done with small screws or bolts that do not interfere with the swing. Other means of attachment can be used dependent on the equipment being used.*

**A.2.7** *A device that can be attached to the underside of the pendulum*, to simulate the stud being swung in the opposite direction, see Figure A.1 a) and b).

## A.3 Conditioning

Condition the studs, all test materials and apparatus for at least 48 h in an atmosphere having a temperature of (20 ±5) °C and a relative humidity of (65 ±25)%.

## A.4 Procedure

### A.4.1 Calibration

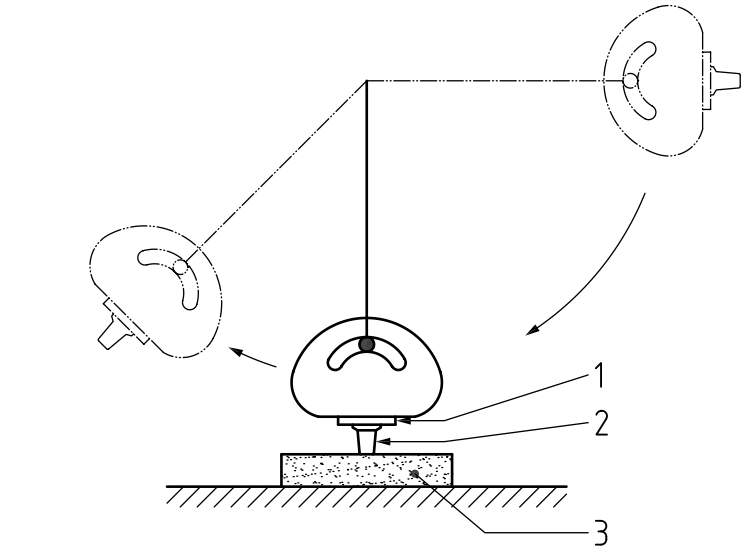
**A.4.1.1** Set up the skid tester on the level surface.

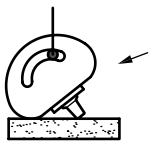
**A.4.1.2** Attach a stud to the underside of the pendulum.

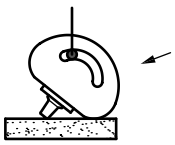
**A.4.1.3** Perform a swing test without the test material underneath. If scale reading is not zero, adjust.

**A.4.1.4** Repeat this calibration procedure for each stud just prior to testing.

Figure A.1 **Example of skin glancing or raking test**





a) Raking test mode

b) Glancing test mode

**Key**

1 Part of shoe sole incorporating stud mounting fixture
2 Stud
3 Test material

### A.4.2 Testing

**A.4.2.1** Place the test material under the skid tester. Set the height adjustment system so that the stud is in contact with the gelatine slab for 126 mm during the swing.

**A.4.2.2** Raise the pendulum to the horizontal start position, press the release button and allow the pendulum to swing. Catch it before it swings back and travels across the gelatine again.

**A.4.2.3** Record the swing through scale reading.

**A.4.2.4** Repeat steps **A.4.2.1**, **A.4.2.2** and **A 4.2.3** for a further four swings each time, ensuring that the swing is done on a new section of the same test material.

*NOTE Two swings should be done on one of the slabs and three swings on the other.*

**A.4.2.5** Repeat steps **A.4.2.1**, **A.4.2.2** and **A.4.2.4** for the comparator stud, ensuring five swings are undertaken.

**A.4.2.6** Test the test studs and comparator studs in both the glancing and raking modes as different damage can be caused by the different orientation of the stud.

*NOTE Asymmetrical studs might be positioned in different directions in the forepart and heel of a boot so should be mounted on the underside of the pendulum appropriately to give the correct glancing and raking modes.*

**A.4.2.7** Visually compare the damage of the test stud on the test material with that of the comparator stud. Compare glancing mode tests to each other and raking mode tests to each other. If the damage caused by the test stud is worse than the comparator, it does not pass.

### A.5 Expression of results

**A.5.1** State the test materials used.

**A.5.2** Pass or fail for each stud in the two test modes: glancing and raking.

## Annex B (normative) Method of test for risk of causing injury by stamping

### B.1 Principle

The test assesses the risk that a stud might cause injury due to a stamping action. A test material is subjected to an impact from a stud mounted on a drop weight. The severity of the impact (see **B.4.1**) and any indication of additional damage (see **B.4.2**) is noted and compared with the performance of the comparator stud.

### B.2 Apparatus

**B.2.1** *A dropping apparatus*, such that a mass can be released in order to drop along a guided vertical path onto the test material placed on a flat anvil (see Figure B.1), conforming to the following criteria with a:

a) total mass of (8.5 ±0.1) kg, which consists of six 1 kg masses (that can be removed individually) and a linear bearing;

b) mass raised to a height of 50 mm above the simulated skin surface;

c) securely screw the stud onto the striking face of the drop weight with a torque of 1.5 Nm or if the stud has another fixing mechanism, fix the stud onto the striking face according to the manufacturer's instructions;

d) device to measure the maximum (dynamic) and final (static) penetration;

e) device to measure the deceleration of the stud within the test material;

f) chart recorder to display the penetration and deceleration values.

**B.2.2** *An anvil*, flat surface rigidly attached to a mass of at least 100 kg.

**B.2.3** *One test stud* (new), of each stud length.

*NOTE The test can also be carried out in pairs of studs, such as a heel pair or a toe pair. These should be tested against equivalent pairs of comparator studs to give meaningful results. Pairs of studs do not penetrate as deeply into the test foam or test material as single studs do, but multiple stud penetration is more likely to happen in play.*

**B.2.4** *A comparator stud* (as defined by **4.3**).

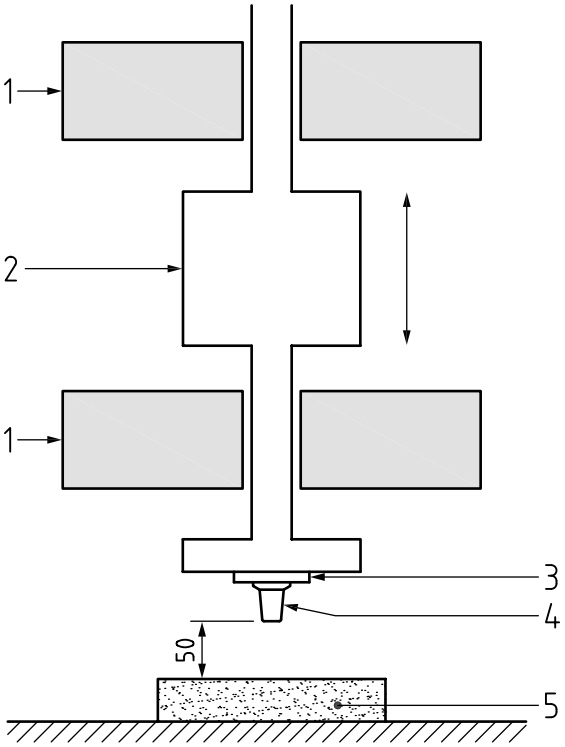
**B.2.5** *A test material*, consisting of either a composite of synthetic chamois (**F.1**) on top of Foam A (**F.2.1**), or a single layer of Foam B (**F.2.2**) with no synthetic chamois top layer, used for stud penetration in **B.4.1**.

**B.2.6** *A test material*, consisting of either a composite of synthetic chamois (**F.1**) on top of two gelatine slabs, conforming to **F.3**, or a composite of synthetic chamois (**F.1**) on top of Foam A (**F.2.1**), mounted together securely on the flat surface, used for damage caused by stamping in **B.4.2**.

*NOTE Double-sided tape has been shown to be a suitable adhesive to secure the test material to the flat surface or the composite parts at the edges to restrict movement on impact.*

Figure B.1 **Example of skin stamping test**

Dimensions in mm




**Key**

| | | | |
|---|---|---|---|
| 1 | Linear bearing | 4 | Stud |
| 2 | 8.5 kg mass, including shaft | 5 | Test material |
| 3 | Part of shoe sole incorporating stud mount fixture | | |

## B.3 Conditioning

Condition the studs, all test materials and apparatus for at least 48 h in an atmosphere having a temperature of (20 ±5) °C and a relative humidity of (65 ±25)%.

## B.4 Procedure

### B.4.1 Determination of stud penetration by stamping

**B.4.1.1** Mount the comparator stud into the bottom of the linear bearing.

**B.4.1.2** Set the drop mass to 4.5 kg by removing four of the 1 kg masses.

*NOTE 1 This only allows for partial penetration by any test stud including the comparator stud. The amount of penetration is influenced by the cross-sectional area/shape of the stud as it penetrates the test foam.*

*NOTE 2 For penetration tests 8.5 kg should not be used for the drop mass as all studs penetrate to a depth greater than their total length. The test stud comes to rest at the portion of sole (see Figure B.1, key 3) used to attach the stud to the linear bearing. This does not take into account the effect of cross-sectional area/shape of the stud on its penetration into the test material. Also, it gives the deceleration value for the test material and not that of the stud.*

**B.4.1.3** Secure the selected test material (see **B.2.5**) onto the anvil. Ensure the linear bearing is well above the test material so that it does not become damaged when setting the drop height.

*NOTE Foam is used as part of the test material as the area tested remains indented permanently and this can easily be seen and therefore no repeat tests are carried out in the same area again.*

**B.4.1.4** Adjust the linear bearing until the end of the stud is 50 mm above surface of the test material.

**B.4.1.5** Release the linear bearing and allow it to come to rest in the test material. Measure the depth of maximum and static penetration into the test material from the graph produced by the chart recorder.

*NOTE 1 The deceleration for that test can also be determined from the graph.*

*NOTE 2 Deceleration is inversely proportional to the penetration, i.e. a greater penetration gives a lower deceleration.*

**B.4.1.6** Repeat a further four times for the comparator stud, each time with a fresh area of test material. Each time set the drop height to 50 mm.

**B.4.1.7** Repeat steps **B.4.1.1** to **B.4.1.6** for the test stud.

**B.4.1.8** Compare with the depth of penetration caused by the comparator stud. If the average penetration from five tests for the test stud is greater than the average penetration from five tests of the comparator stud, then the stud fails.

### B.4.2 Possible damage caused to player by stamping

**B.4.2.1** Mount the comparator stud into the bottom of the linear bearing.

**B.4.2.2** Set the drop mass to 8.5 kg by reattaching the four 1 kg masses.

**B.4.2.3** Secure the selected test material (see **B.2.6**) onto the anvil. Ensure that the linear bearing is well above the test material so that it does not become damaged when setting the drop height.

**B.4.2.4** Adjust the linear bearing until the end of the stud is 50 mm above the test material.

**B.4.2.5** Release the linear bearing and allow it to come to rest in the test material. Examine the test material to check that there are no signs of tearing or ripping, removing the top layer if necessary.

**B.4.2.6** Repeat a further four times for the comparator stud, each time on a fresh area of the test material. Each time set the drop height to 50 mm.

**B.4.2.7** Repeat steps **B.4.2.1** to **B.4.2.6** for the test stud.

**B.4.2.8** Visually compare test material where the test stud and comparator stud tests have been carried out, removing the top layer if necessary.

*NOTE The damage from the test stud should be no worse than that from the comparator stud.*

## B.5 Expression of results

**B.5.1** State the test materials used.

**B.5.2** Depth of penetration from each test, including the comparator stud, determined in **B.4.1**.

**B.5.3** Pass or fail for each stud based upon penetration depth, determined in **B.4.1**.

**B.5.4** Any damage caused to the test material if greater than that caused by the comparator stud, determined in **B.4.2**.

# Annex C (normative) Method of test for impact resistance

## C.1 Principle

A stud, mounted vertically with the tip uppermost, is subjected to a series of measured blows to its side horizontally from the striker of a ballistic pendulum. The energy of the blows is increased in steps until either the stud fails or a specified energy level is reached without damage occurring.

## C.2 Apparatus

**C.2.1** *A pendulum type ballistic tester*, conforming to the following:

a) circular steel bob of (108 ±0.5) mm and thickness (48 ±1) mm, which is fixed by a circular steel shaft of (25 ±0.5) mm on a bearing axle with a diameter of (75 ±0.5) mm;

b) moment required to hold the pendulum in a horizontal position of (17.3 ±0.2) Nm;

c) distance between axis of rotation and tip of the striker as (432 ±1) mm;

d) tip of striker (89 ±1) mm from the neutral axis of the pendulum;

e) striker consisting of a metal strip (6 ±0.5) mm wide and (35 ±0.5) mm long with the striking edge rounded to a radius of (3 ±0.5) mm; the striker is angled in such a way that its tip is aligned with the arc of motion;

f) energy scale for the pendulum calibrated in increments of 0.5 J up to 12 J; a marker attached to the pendulum moves over this scale and enables the pendulum to be set to the required energy for each blow;

g) base clamp to hold the stud under test and to enable it to be adjusted vertically and horizontally to achieve the correct test position relative to the striker head.

*NOTE 1 The base clamp should be able to clamp part of the sole incorporating the stud mounting fixture.*

*NOTE 2 A suitable form of apparatus is shown in Figure C.1.*

*NOTE 3 One suitable pendulum for this test is used in BS 5131-5.6 (for rigid shoe bottoms). Apparatus normally used for this test can be adapted to test studs by the addition of a suitable base clamp.*

**C.2.2** *Three studs* (new) of each stud length.

*NOTE More studs might need to be tested as each type of stud might need to be hit from more than one angle dependent on its design and shape.*

## C.3 Conditioning and testing atmosphere

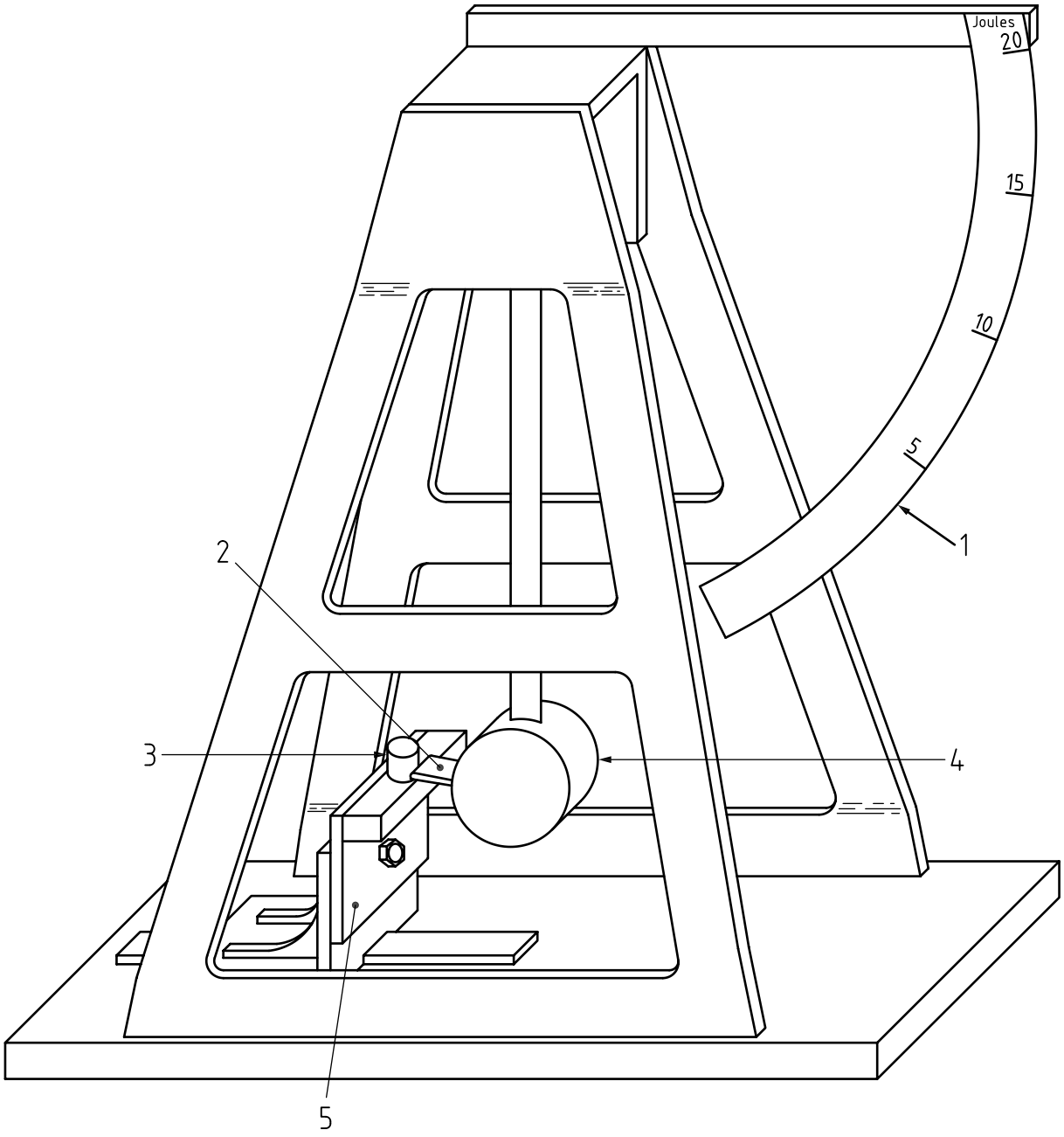
Condition the studs and all test apparatus for at least 48 h in an atmosphere having a temperature of (20 ±5) °C and a relative humidity of (60 ±25)%, and carry out the test in this atmosphere.

## C.4 Procedure

**C.4.1** Fix the pendulum ballistic tester firmly to a rigid base.

**C.4.2** Clamp a section of the sole, incorporating the mounting fixture and stud, on to the base clamp. If the stud has a screw thread, apply a torque of 1.5 Nm to the fixing tool provided to tighten it. If the stud has another fixing mechanism, fix the stud in its mounting, according to the manufacturer's instructions, using the fixing relevant tools.

Figure C.1 **Single pendulum ballistic tester**




**Key**

| | | | |
|---|---|---|---|
| 1 | Energy scale | 4 | Pendulum bob |
| 2 | Striker head | 5 | Base clamp |
| 3 | Stud | | |

**C.4.3** If the stud is conical in shape, adjust the horizontal and vertical position of the base clamp so that the centre of the striker edge just touches the side of the stud 10 mm below the tip of the stud (see Figure C.2). Lock the base clamp firmly in this position.

*NOTE For other shapes of stud the impact point from the tip might need to be altered and then all alterations of impact point need to be recorded in the final report.*

**C.4.4** Lift the pendulum to the 0.5 J mark on the energy scale and release it so that the striker hits the stud. Catch the pendulum on its rebound to prevent a second blow. Repeat this procedure, increasing the impact energy in steps of

0.5 J. When damage to the stud is observed record the energy of the blow that produced it and the type of damage that has occurred. The main types of damage that are likely to occur are:

a) separation between the main body of the stud and the attachment spigot;

b) disintegration or complete splitting of the stud;

c) fracture of the attachment spigot;

d) indentation of the stud by the striker tip;

e) bending of the attachment spigot.

**C.4.5** Stop the test, either when damage of one of a), b) or c) is observed prior to the 8 J blow or after the 8 J blow except if this produces slight splitting of the stud.

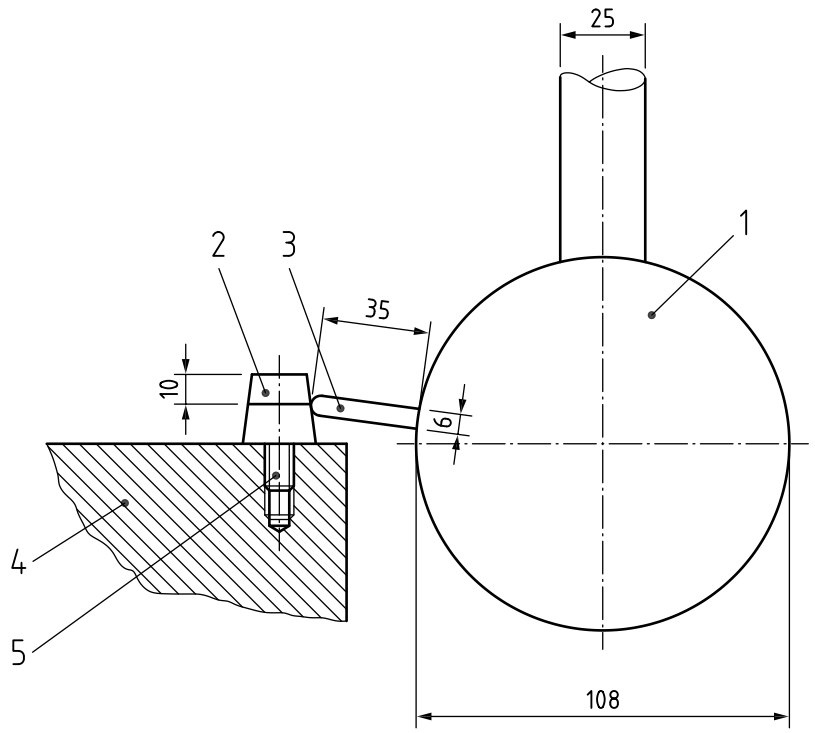
**C.4.6** If slight splitting of the stud is observed at the 8 J blow, continue the test either until a more severe type of damage of types a) or b) occurs or until the 12 J blow is reached, whichever occurs first.

**C.4.7** Repeat the procedure for a further two studs of each stud length.

*NOTE Studs with push in fixing might become dislodged from their fixing mounts before the 8 J is reached. As long as there is no risk of injury from the fixing mounting, the stud can be passed.*

Figure C.2 **Striker/stud contact**

Dimensions in mm




**Key**

| | | | |
|---|---|---|---|
| 1 | Pendulum bob | 4 | Part of base clamp |
| 2 | Stud | 5 | Threaded hole for stud |
| 3 | Striker head | | |

## C.5 Expression of results

Express the result for each of the three studs of each length as either:

a) the energy of the blow at which the test was stopped and the type of damage produced; or

b) the damage (if any) after the 8 J blow, and, where appropriate, the energy of the blow above 8 J that produced further damage, together with its type.

# Annex D (normative) Method for preparation of replaceable studs for assessment of damage caused by tightening and loosening

## D.1 Principle

Studs are subjected to repeated tightening and loosening. The studs are then visually inspected to determine whether any damage has occurred to the stud that might increase the risk of injury to a player, and if required are then tested in accordance with Annex A and Annex B.

## D.2 Apparatus

**D.2.1** *A fixing tool*, provided by the stud manufacturer for fitting the specific type of stud under test.

**D.2.2** *A screw socket (or sole)*, with fixing mount appropriate for the stud under test.

**D.2.3** *Three studs* (new), of each stud length.

## D.3 Conditioning

Condition the studs and all apparatus for at least 48 h in an atmosphere having a temperature of (20 ±5) °C and a relative humidity of (65 ±25)%.

## D.4 Procedure

For screw fitted studs, using the supplied fixing tool, tighten the stud to a torque of 1.5 Nm in the screw socket and loosen the stud two full turns. Repeat these actions a further nine times. Then repeat the procedure with a further two studs.

For studs with alternative fixing mounts, insert and remove a stud from the appropriate fixing mount, according to the manufacturer's instructions, using the supplied fixing tool a total of 10 times. Repeat the procedure for a further two studs.

## D.5 Assessment of damage

Inspect the studs for any sign of damage that could be deemed to increase the risk of causing injury through wear, e.g. sharp burrs or notches or a large decrease in contact area. Where such damage is deemed to occur, test the stud concerned in accordance with Annex A and Annex B.

## D.6 Expression of results

Express the result for each of the three studs as a description of the damage incurred, if any, and whether the stud was deemed to require further testing in accordance with Annex A and Annex B.

# Annex E (normative) Methods for preparation of studs for assessment of wear damage

## E.1 Principle

Studs are subjected to a process to introduce wear in a manner that might be representative of typical actions during use, for instance walking short distances on tarmac (see **E.2**). Alternatively, studs are given a combined impact/abrasion treatment, where they are fixed to the striking head of a mechanical hammer and subjected to a series of blows against a moving coarse, abrasive cloth, supported on an anvil (see **E.3.1**). A further alternative method is given in **E.3.2** for a biomechanical machine that can simulate walking on tarmac. The studs are then visually inspected to determine whether any damage to the stud has occurred that might increase the risk of injury to a player, and if required are tested in accordance with Annex A and Annex B.

## E.2 Method for assessing wear damage through walking/jogging

### E.2.1 Procedure

A person weighing (80 ±10) kg, wearing suitable footwear to hold the appropriate number of studs required for each boot, with studs tightened using the appropriate tool and method, walks/jogs for approximately 200 m [approximately 250 walking steps (125 steps per foot)] across an abrasive man-made surface, e.g. tarmac. Remove the worn studs and visually inspect them. Visually compare wear to comparator studs that have been marked in accordance with Clause **7** and have already undergone this test procedure.

*NOTE This method gives results that are more likely to be experienced in wear than those from the pivoted hammer and anvil method (see **E.3.1**).*

### E.2.2 Assessment of damage

Inspect studs for any signs of damage through wear that could be deemed to increase the risk of injury to another player, e.g. sharp burrs or notches. Where such damage is deemed to occur, test the stud concerned in accordance with Annex A and Annex B.

### E.2.3 Expression of results

Express the result for each stud as a description of the damage incurred, if any; which method was used to generate wear and whether the stud was deemed to require further testing in accordance with Annex A and Annex B.

## E.3 Alternative wear methods

### E.3.1 Alternative method A

#### E.3.1.1 Apparatus

**E.3.1.1.1** *A pivoted mechanical hammer,* of dimensions and mass such that when held horizontally its moment is (26.5 ±1) Nm and its centre of percussion is (54 ±1) cm from the pivot. The underside of the head of the hammer is drilled and tapped to accept the attachment spigots of studs. The axis of the stud when fixed to the hammer passes through the centre of percussion of the hammer.

**E.3.1.1.2** *A driving means and cam for the hammer*, that enable the latter to be raised and lowered at a frequency of 1 Hz and that allow the stud to fall freely through a distance of (75 ±2) mm. The cam is designed so that (0.30 ±0.07) s after release it begins the lifting stage of the cycle. The position of the cam relative to the pivot is such that the hammer is horizontal approximately halfway through its fall.

**E.3.1.1.3** *An anvil*, arranged so that the edge of the stud tip furthest from the hammer pivot strikes the top surface on impact when the hammer falls. The angle on impact between the stud axis and top surface is (83 ±1)°. The anvil is capable of vertical adjustment to take account of the variation in stud height.

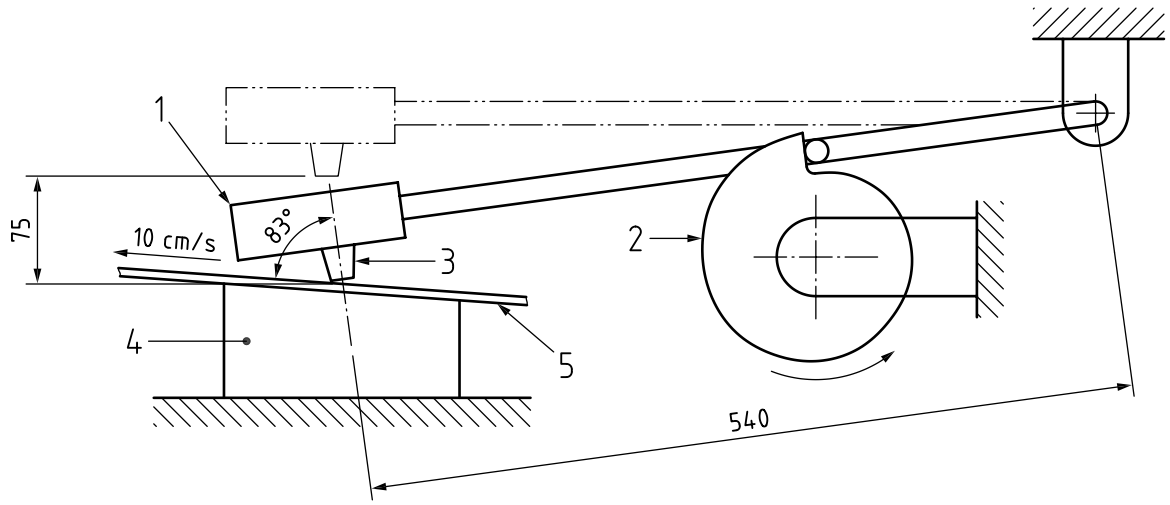
*NOTE To prevent multiple impacts and reduce peak forces, connection of the anvil to the machine frame could be via a spring and damper system, provided that the vertical movement of the anvil during the test is less than 5 mm.*

**E.3.1.1.4** *Abrasive cloth*, laid over the anvil to form the striking surface. The cloth has grade P36 in accordance with ISO 6344 (all parts).

**E.3.1.1.5** *Forwarding means*, for the abrasive cloth to provide a speed of (10 ±1) cm/s in a direction away from the pivot.

*NOTE A suitable form of apparatus is shown in Figure E.1.*

Figure E.1 **Impact/abrasion test apparatus**




**Key**

| | | | |
|---|---|---|---|
| 1 | Hammer | 4 | Anvil |
| 2 | Lifting cam | 5 | Abrasive cloth |
| 3 | Stud | | |

### E.3.1.2 Conditioning and testing atmosphere

Condition the studs and all apparatus for at least 48 h in an atmosphere having a temperature of (20 ±5) °C and a relative humidity of (65 ±25)%, and carry out the test in this atmosphere.

### E.3.1.3 Procedure

**E.3.1.3.1** Screw the stud firmly into position on the underside of the hammer or if the stud has another fixing mechanism, fix the stud into position according to the manufacturer's instructions.

**E.3.1.3.2** Fix the abrasive cloth over the anvil and to the forwarding means.

**E.3.1.3.3** Turn the cam drive by hand until the hammer is at its highest position.

**E.3.1.3.4** Adjust the height of the anvil until the vertical distance between the tip of the stud and the abrasive cloth on the anvil at the point where the stud strikes it is (75 ±2) mm.

**E.3.1.3.5** Set the hammer and abrasive cloth in motion and continue the test for 1 200 impact cycles.

**E.3.1.3.6** Repeat the procedure for two further studs.

#### E.3.1.4 Assessment of damage

Assess studs with regard of their risk of injury and test in accordance with Annex A and Annex B.

*NOTE This method produces greater wear damage to the stud when compared with the damage experienced by the studs that have been worn by a wearer (see **E.2**).*

#### E.3.1.5 Expression of results

Express the result for each stud as a description of the damage incurred, if any; which method was used to generate wear and whether the stud was deemed to require further testing in accordance with Annex A and Annex B.

### E.3.2 Alternative method B

#### E.3.2.1 Apparatus

**E.3.2.1.1** *A prosthetic foot*.

**E.3.2.1.2** *Boot*, to be worn on the prosthetic foot (**E.3.2.1.1**).

**E.3.2.1.3** *Biomechanical walking tester*, which simulates walking.

*NOTE This is used to replicate the biomechanics of gait such that it reproduces the correct contact angles and loads between the boot and ground that occur in wear.*

#### E.3.2.2 Conditioning and testing atmosphere

Condition the studs and all apparatus for at least 48 h in an atmosphere having a temperature of (20 ±5) °C and a relative humidity of (65 ±25)%, and carry out the test in this atmosphere.

#### E.3.2.3 Procedure

Start the test cycle (see Figure E.2) with the heel striking the test floor at a predetermined angle. Increase the vertical load as the "leg" rolls forward over the shoe–ground contact point and finally toe off.

*NOTE 1 The vertical load achieved during the test cycle should be at least 120% bodyweight (for a 75 kg person).*

*NOTE 2 The floor used should replicate an abrasive man-made surface such as tarmac that would be expected to be found around rugby pitches or in clubhouses.*

*NOTE 3 The test machine can be operated for 125 steps (see **E.2.1**).*

When the test is complete, remove the boot and check the studs for signs of damage and compare with comparator studs that have been marked in accordance with Clause **7** and have been tested to this method.

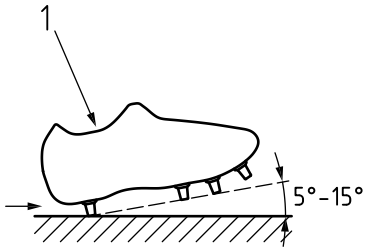
#### E.3.2.4 Assessment of damage

If any such damage is deemed to increase the risk of injury, test further in accordance with Annex A and Annex B.

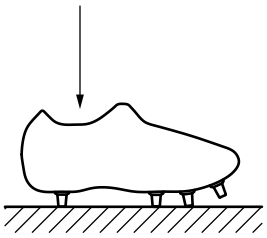
#### E.3.2.5 Expression of results

Express the result for each stud as a description of the damage incurred, if any; which method was used to generate wear and whether the stud was deemed to require further testing in accordance with Annex A and Annex B.

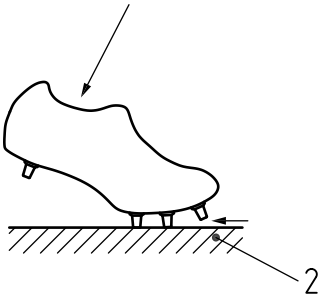
Figure E.2 **Method B test cycle**




a) Heel strike (forward abrasive motion)



b) Flat




c) Toe off (backward abrasive motion)

**Key**

1 Minimum load: 120% body weight

2 Abrasive surface (i.e. concrete)

**Annex F (normative)**

# Test materials

*COMMENTARY ON Annex F*

*This annex specifies requirements for the layer(s) that comprise the test material used to simulate the response of a human limb (e.g. the thigh) during testing. One or more of these layers is to be used as described in Annex A and Annex B.*

*Testing performed on different test materials might not produce comparable damage in each different test material, however, the purpose of the tests are to compare the damage caused to each test material using the comparator stud with the test stud. The various versions of the test materials given in this annex have been found to be suitable for this purpose.*

## F.1 Synthetic chamois

The synthetic chamois shall consist of a single 1.3 mm layer, which is made up of a blend of polyvinyl-alcohol and viscose fibres, coagulated with polyurethane.

*NOTE When used as part of a composite test material, the synthetic chamois comprises the top layer to simulate skin tissue.*

## F.2 Test foam

*COMMENTARY ON **F.2***

*When used as part of a composite test material, the foam comprises the bottom layer to simulate soft tissue layers.*

### F.2.1 Foam A

Foam A shall consist of a single 30 mm expanded closed cell polyethylene foam with a density of 33 $km^{-3}$.

### F.2.2 Foam B

Foam B shall consist of a high density 9.5 pcf (152.2 kg/$m^3$) closed-cell polyethylene foam with a depth of 50 mm.

## F.3 Gelatine slab

### F.3.1 General

The gelatine slabs shall have a length of 295 mm, a width of 195 mm and a depth of 20 mm and shall consist of:

- gelatine powder (528 g);
- glycerol (990 g);
- water (132 mL).

The gelatine slabs shall be prepared in accordance with **F.3.2**.

### F.3.2 Preparation of the gelatine slab

**F.3.2.1** Pour 132 mL of water and 990 g of glycerol into a 3 L beaker and mix the solution with a palette knife until it is homogeneous.

**F.3.2.2** Gradually add the gelatine powder into the beaker while continually stirring the mixture to ensure that the consistency and colour is homogeneous.

**F.3.2.3** Cover the beaker with foil or plastic wrap and leave for not less than 16 h to allow the gelatine to absorb the water and glycerol solution and bind together.

**F.3.2.4** Place the beaker in the oven at not less than 60 °C and no more than 80 °C to allow the gelatine mixture to melt. Do not stir the gelatine mixture at all during this melting process as air might be introduced into the mixture and it can take longer for the bubbles to rise to the mixture's surface.

**F.3.2.5** After not less than 24 h and no more than 30 h in the oven, pour the gelatine mixture into a tray (295 mm × 195 mm × 20 mm). Firstly check that the mixture is dark brown in colour throughout. Secondly, if there is a layer of air bubbles on the top surface of the mixture, carefully remove these with a spoon or ladle before pouring.

**F.3.2.6** Pour the melted gelatine mixture into the tray up to the brim. Then leave the gelatine mixture to set for not less than 24 h before removing the gelatine slab from the tray.

**F.3.2.7** Use within 48 h and retain in a sealed bag or container when not in use.

# Bibliography

**Standards publications**

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 5131-5.6, *Methods of test for footwear and footwear materials – Part 5: Testing of complete footwear – Section 5.6: Impact test for rigid units and shoe bottoms*

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