BS 7044 : Section 2.2 : 1990

British Standard

Artificial sports surfaces

Part 2. Methods of test

Section 2.2 Methods for determination of person/surface interaction

Surfaces de sport artificielles
Partie 2. Méthodes d'essai
Section 2.2 Méthodes de détermination de l'interaction surface/personne

Kunststoffbodenflächen in Sportanlagen
Teil 2. Prüfung
Abschnitt 2.2 Verfahren zur Bestimmung der Wechselwirkung zwischen Mensch und Boden

British Standards Institution

This Section of BS 7044 has been prepared under the direction of the Textiles and Clothing Standards Policy Committee and forms part of a comprehensive British Standard on artificial sports surfaces. A classification and general introduction is given in Part 1.

This Section supersedes BS 7044 : Part 2 : Section 2.2 : 1989 which is withdrawn. This edition introduces an additional method but does not reflect a full review or revision of the standard which will be undertaken in due course.

This Section of BS 7044 describes four methods of test.

Method 1 is based on the method of test for traction described by Canaway and Bell (1986).

Method 2 is based on the method of test for sliding resistance given in the 1985 Sports Council report, 'Artificial Grass Surfaces for Association Football'.

Method 3 is largely based on the method of test for friction given in the Sports Council Specification for Artificial Sports Surfaces, 1984.

In method 4 the apparatus is similar to that given in the Sports Council Specification for Artificial Sports Surfaces, 1984, for measuring severity index but it has been modified to be equivalent to that specified in BS 7188. In the Sports Council Specification, the severity index was measured, i.e. a mathematical integration of the area under a plot of deceleration versus time for the entire impact event. In this standard the peak deceleration is measured because, whereas the concept of severity index is well established as a meaningful assessment of a surface in relation to head injuries, the committee does not consider that such a relationship has been established for the impacts of various parts of the body which may occur in sports.

WARNING NOTE. These methods do not necessarily detail all precautions necessary to meet the requirements of the Health and Safety at Work etc. Act 1974. Attention should be paid to any appropriate safety precautions and the methods should be operated only by trained personnel.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Contents

Methods

1 Scope

This Section of BS 7044 describes methods of test for the determination of traction, sliding distance, slip resistance and peak deceleration of artificial sports surfaces.

NOTE. The titles of the publications referred to in this standard are listed on the inside back cover.

2 Method 1. Determination of traction

2.1 General

This method is suitable for testing all types of artificial sports surfaces, both on test pieces in the laboratory and surfaces installed on site. The result obtained gives a measure of the resistance of movement of the player's foot on the surface.

2.2 Principle

A weighted foot is rotated from a stationary position against a surface and the force required to cause movement is measured.

2.3 Apparatus

2.3.1 *A rigid disc,* of diameter 150 ± 2 mm centrally weighted to give a total mass of 46 ± 2 kg and having a central shaft to which can be attached a torque wrench (see figure 1). To the bottom of the disc is bonded a piece of sports shoe sole material of diameter 150 ± 2 mm.

NOTE. The type and pattern of the sports shoe sole material is not specified but may be agreed between the interested parties.

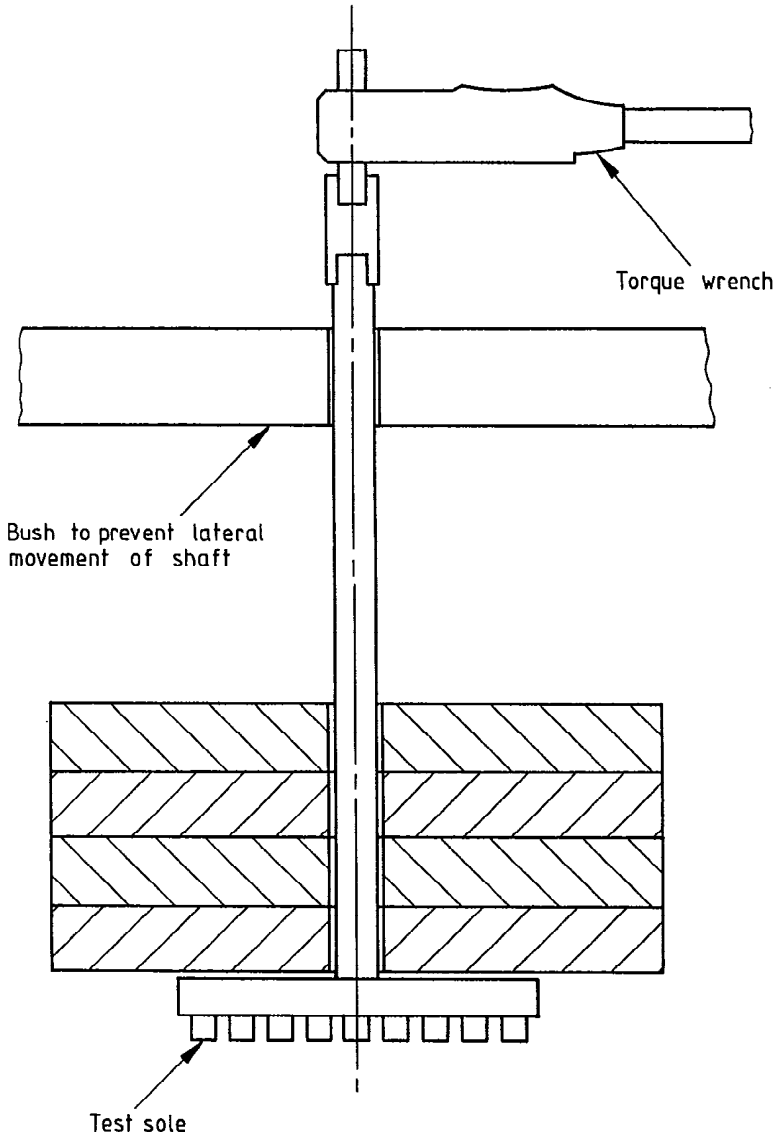


Figure 1. Traction apparatus

2.3.2 *Dial indicating torque wrench,* calibrated in increments of 2.0 N·m with a maximum indicating pointer.

2.4 Test piece

A piece of surface of minimum width 1 m and minimum length 1 m in combination with the substrate to be used in service shall be tested. The surface and the substrate shall be attached using the recommended method of attachment in accordance with the manufacturer's instructions.

NOTE. Loose laid test pieces should be anchored at the edges.

2.5 Conditioning

For tests in the laboratory, condition the test piece for a minimum duration of 3 h at the test temperature of 23 ± 2 °C. Tests on site shall be made at ambient temperature.

2.6 Procedure

Place the weighted disc (**2.3.1**) on the test piece (**2.4**). Gradually apply an increasing force to the torque wrench (**2.3.2**) until the disc starts to slip, ensuring that the disc remains parallel to the surface. Note the torque reading at the point of slipping.

Repeat the test to obtain five readings of torque using a new area of surface for each measurement.

NOTE. Processing aids on new materials may contaminate the sports shoe sole material and affect the results. It is recommended that the sole be cleaned between each test.

2.7 Calculation and expression of results

The median traction coefficient shall be given by the following expression:

$$\text{Median traction coefficient} = \frac{3T}{wD}$$

where

T is the median value of torque (in N·m);

w is the applied force (in N);

D is the diameter of disc (in m).

2.8 Test report

The test report shall include the following particulars:

(a) complete identification of the surface tested including manufacturer's reference, type of substrate and method of attachment and previous history;

(b) a reference to this method, i.e. method 1 of BS 7044 : Section 2.2 : 1990;

(c) identification of the sports shoe sole material used;

(d) the temperature of test and relative humidity, if required;

(e) the condition of the surface at time of test, i.e. wet or dry;

(f) the median traction coefficient;

(g) the individual test results, if required;

(h) details of any deviation from the procedure.

3 Method 2. Determination of sliding distance

3.1 General

This method is suitable for testing all types of artificial sports surfaces, both on test pieces in the laboratory and surfaces installed on site. The result obtained gives a measure of the resistance to the player's foot sliding on the surface.

3.2 Principle

A weighted trolley with a sliding foot in a trailing position travels down a ramp on to the surface and the distance it travels is measured.

3.3 Apparatus

3.3.1 *A trolley,* of total mass 45 ± 2 kg with a foot assembly as shown in figure 2. The foot is a steel plate of nominal length 85 mm and nominal width 60 mm. To the bottom of the foot is bonded a piece of sports shoe sole material of nominal length 75 mm and nominal width 60 mm.

NOTE. The type and pattern of the sports shoe sole material is not specified but may be agreed between the interested parties.

3.3.2 *An inclined plane,* i.e. a ramp, comprising two parallel tracks mounted to a rigid frame together with two horizontal tracks of minimum length 1.5 m (see figure 3).

NOTE. The horizontal track is constructed such that the foot assembly comes into contact with the test piece.

3.4 Test piece

A piece of surface of minimum length 3 m and minimum width 1 m in combination with the substrate to be used in service shall be tested. The surface and the substrate shall be attached using the recommended method of attachment in accordance with the manufacturer's instructions.

NOTE. Loose laid test pieces should be anchored at the edges.

3.5 Conditioning

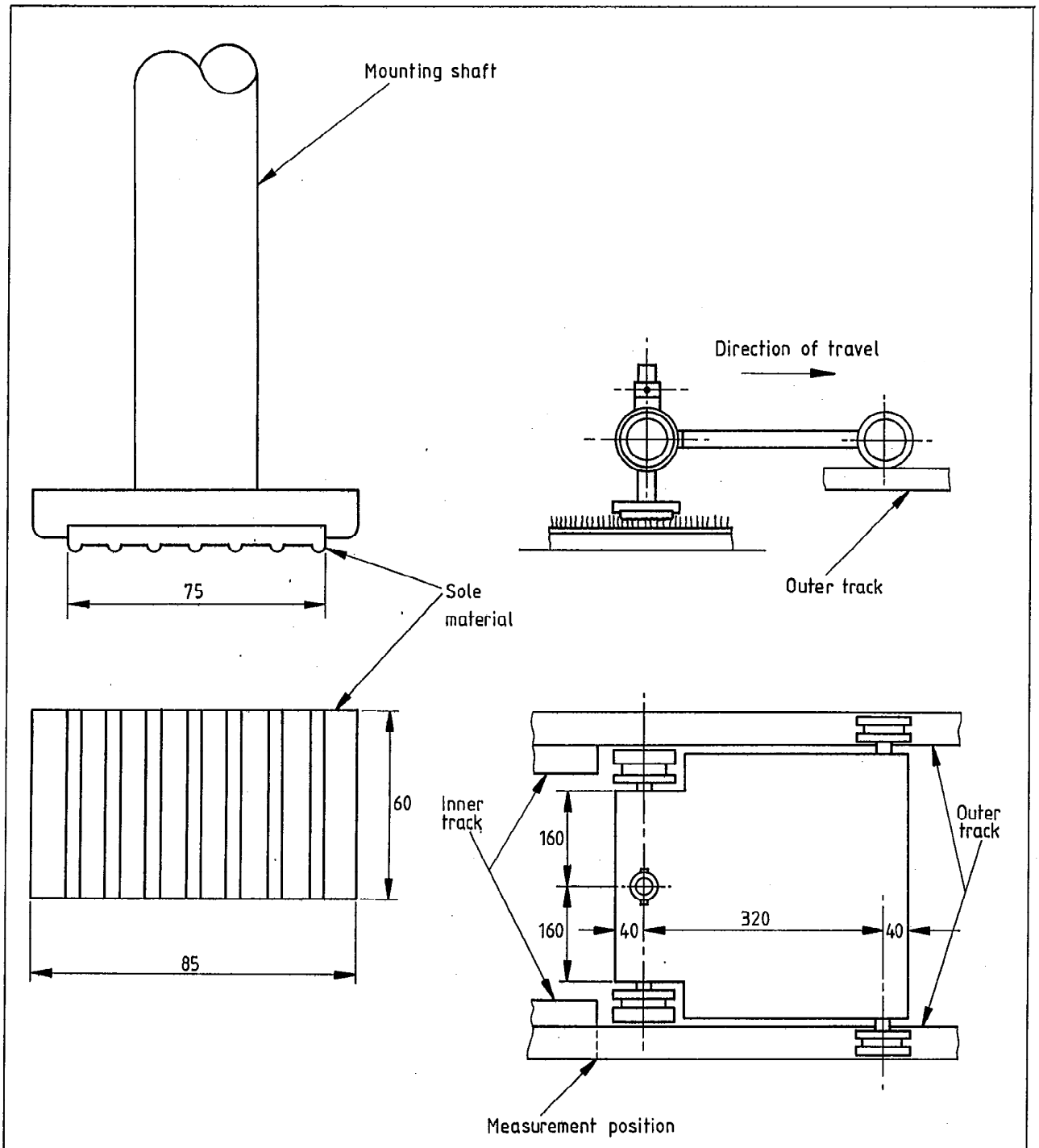
For tests in the laboratory, condition the test piece for a minimum duration of 3 h at the test temperature of 23 ± 2 °C. Tests on site shall be made at ambient temperature.

3.6 Procedure

Place the ramp (**3.3.2**) and horizontal track on the test surface. Place the trolley (**3.3.1**) on the track such that the trailing foot is 5.0 ± 1 mm above the surface under test at a point just before the front wheels of the trolley drop off the inclined section of track. Position the trolley on the ramp such that the average velocity of the trolley, once parallel to the surface and measured across a distance of 100 mm as shown in figure 3, is 2.0 ± 0.02 m/s.

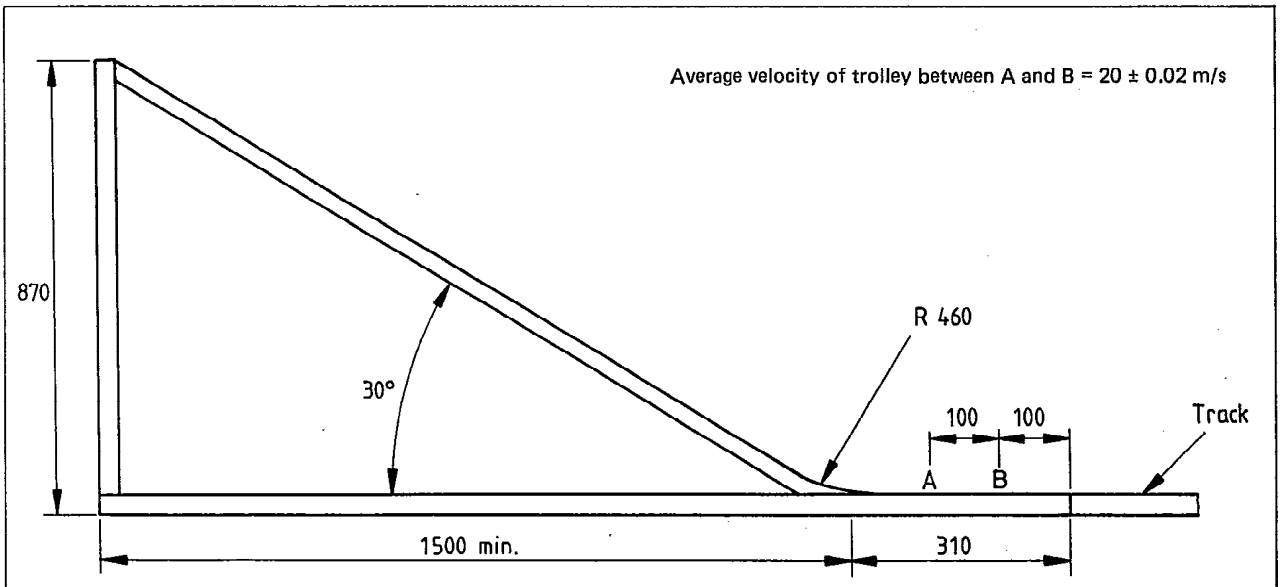
Release the trolley and when it has come to rest measure the distance from the front of the foot assembly to the point where the trolley left the inclined section of track.

Repeat the test to obtain three readings of sliding distance.



All dimensions are in millimetres.

Figure 2. Foot assembly and trolley



All linear dimensions are in millimetres and are nominal unless otherwise specified.

Figure 3. Inclined plane and track

If the surface has any form of directional pattern, for example the lay of the pile in artificial grasses, or is laid with a slope for drainage, repeat the test such that a set of readings is obtained in directions giving maximum and minimum values of sliding distance.

3.7 Calculation and expression of results

Calculate the median measurement (in mm) for a given direction.

3.8 Test report

The test report shall include the following particulars:

(a) complete identification of the surface tested including manufacturer's reference, type of substrate and method of attachment and previous history;

(b) a reference to this method, i.e. method 2 of BS 7044 : Section 2.2 : 1990;

(c) identification of the sports shoe sole material used;

(d) the temperature of test and relative humidity, if required;

(e) the condition of the surface at the time of test, i.e. wet or dry;

(f) the median sliding distances for each direction tested;

(g) the individual test results if required;

(h) details of any deviation from the procedure.

4 Method 3. Determination of slip resistance

4.1 General

This method is suitable for testing all types of artificial sports surfaces both on test pieces in the laboratory and surfaces installed on site. However, it is not recommended for use on non-sand filled grass surfaces because of uncertainty in the length of the contact path.

4.2 Principle

A rubber foot (slider) attached to the arm of a pendulum is allowed to slide over the surface for a set distance and the energy absorbed is measured.

4.3 Apparatus

4.3.1 *Pendulum friction apparatus,* complying with the apparatus described in BS 812 : Part 3 except that the rubber slider* shall comply with table 1.

4.4 Test piece

A piece of surface of minimum length 300 mm and minimum width 300 mm shall be tested.

NOTE. Loose laid test pieces may be bonded to the substrate on which the apparatus rests.

*For information on the availability of a suitable rubber slider, apply to Enquiry Section, BSI, Linford Wood, Milton Keynes, MK14 6LE, enclosing a stamped addressed envelope for reply.

Table 1. Properties of rubber slider				
Property	**Test procedure**	**Physical requirement**		
Resilience	BS 903 : Part A8	21 ± 2 % at 5 °C	24 ± 2 % at 23 °C	28 ± 2 % at 40 °C
Hardness	BS 903 : Part A26	96 ± 2 IRHD at 23 ± 2 °C		

4.5 Conditioning

For tests in the laboratory, condition the test piece for a minimum duration of 3 h at the test temperature of 23 ± 2 °C. Tests on site shall be made at ambient temperature.

4.6 Procedure

NOTE. If the apparatus is placed directly on the test piece, as is necessarily the case for site measurements, there is a need to prevent its feet from sinking into the surface during the test. This arises from the increased downward force on the apparatus' feet caused by the swinging pendulum and gives a false path length.

4.6.1 Adjust the base of the apparatus (**4.3.1**) until it is level in all directions.

Adjust the height of the pendulum mechanism until the slider assembly is in contact with the test piece (**4.4**) over a distance of $125\ ^{+2}_{-1}$ mm.

Execute three conditioning swings of the pendulum but do not record the indicated readings.

Execute a swing of the pendulum and note the slip resistance as indicated by the graduated scale.

4.6.2 Repeat the procedure detailed in **4.6.1** to obtain five readings of slip resistance.

If the surface has any form of directional pattern, for example the lay of the pile in artificial grasses, or is laid with a slope for drainage, repeat the test such that a set of readings is obtained in directions giving maximum and minimum values of friction.

4.7 Calculation and expression of results

For surfaces of uniform pattern calculate the arithmetic mean of the values of friction measured.

For surfaces with directional pattern calculate the arithmetic means of the directions giving maximum and minimum values of friction.

Calculate the percentage variation using the following expression:

$$\Delta = \frac{F_{max} - F_{min}}{F_{max}} \times 100$$

where

Δ is the variation of slip resistance;

F_{max} is the maximum arithmetic mean value;

F_{min} is the minimum arithmetic mean value.

NOTE. There are no precision data currently available.

4.8 Test report

The test report shall include the following particulars:

(a) complete identification of the surface tested including manufacturer's reference, type of substrate and method of attachment and previous history;

(b) a reference to this method, i.e. method 3 of BS 7044 : Section 2.2 : 1990;

(c) the temperature of test and relative humidity, if required;

(d) the condition of the surface at the time of test, i.e. wet or dry;

(e) the arithmetic mean values of slip resistance and, for surfaces with directional pattern, the percentage variation;

(f) the individual test results if required;

(g) details of any deviation from the procedure.

5 Method 4. Determination of peak deceleration

5.1 General

This method is suitable for testing all types of artificial sports surfaces both on test pieces in the laboratory and surfaces installed on site. The result obtained gives a measure of the ability of a surface to absorb the energy of a player falling on to it.

5.2 Principle

A striker is dropped onto the surface and the deceleration during the impact is measured.

5.3 Apparatus

5.3.1 *Severity index apparatus,* in accordance with section two of BS 7188 : 1989, modified (if necessary) to measure the maximum deceleration of the striker during the impact.

5.4 Test piece

A piece of surface of minimum length 1000 mm and minimum width 1000 mm, in combination with the substrate to be used in service, shall be tested. The recommended method of attachment in accordance with the manufacturer's instructions shall be used.

5.5 Conditioning and test temperature

For tests in the laboratory, condition the test piece and the striker for a minimum of 3 h at the test temperature of 23 ± 2 °C. Tests on site shall be made at ambient temperature.

5.6 Procedure

Raise the striker to the required height and lock into position.

Release the striker and allow it to fall vertically onto the test piece.

Record the signal from the accelerometer throughout the impact from a time before the contact of the striker and the test piece until the acceleration of the striker returns to the same level as before the impact.

Digitally process the signal to record the maximum deceleration experienced by the striker during the impact in gravity units ($1g = 9.81\ m{\cdot}s^{-1}$).

If necessary determine the effective drop height in accordance with section two of BS 7188 : 1989.

Repeat the test to obtain five readings of peak g moving the test piece between each drop such that it is not impacted on the same spot twice nor impacted nearer than 100 mm to any edge.

Repeat the procedure at different heights as required.

NOTE. Usually peak g measurements are required at a series of heights such that the height to realize a specified peak g can be obtained from a graph of peak g against drop height.

5.7 Calculation and expression of results

Calculate the mean peak g for each drop height.

5.8 Test report

The test report shall include the following particulars:

(a) complete identification of the surface tested including manufacturer's reference, type of substrate and method of attachment and previous history;

(b) a reference to this method, i.e. method 4 of BS 7044 : Section 2.2 : 1990;

(c) the temperature of test and relative humidity, if required;

(d) the mean peak g for each drop height;

(e) the individual test results if required;

(f) a graph of peak g against drop height and the drop height for a specified peak g if required;

(g) details of any deviation from the procedure.

Publications referred to

BS 812 Testing aggregates
Part 3 Methods for determination of mechanical properties
BS 903 Methods of testing vulcanized rubber
Part A8 Determination of rebound resilience
Part A26 Determination of hardness
BS 7044 Artificial sports surfaces
*Part 1 Classification and general introduction
BS 7188 Methods of test for impact absorbing playground surfaces

*‡Sports Council Specification for Artificial Sports Surfaces, 1984

*‡Sports Council report, Artificial Grass Surfaces for Association Football, 1985

*§ Canaway, P M & Bell, M J (1986). *A method for measuring traction and friction on natural and artificial playing surfaces,* J Sports Turf Res. Inst. 62, 211-214.

*Referred to in the foreword only.
‡Available from The Sports Council, 16 Upper Woburn Place, London WC1H 0QP.
§Available from The Sports Turf Research Institute, Bingley, West Yorkshire BD16 1AU.

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Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Textiles and Clothing Standards Policy Committee (TCM/-) to Technical Committee TCM/14, upon which the following bodies were represented:

Birmingham City
British Amateur Athletic Board
British Amateur Weight Lifters' Association
British Association of Advisers and Lecturers in Physical Education
British Leather Confederation
British Sports and Allied Industries Federation
Central Council of Physical Recreation
City of Glasgow
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Department of the Environment (Building Research Establishment)
Department of Trade and Industry (Consumer Affairs Division)
English Basketball Association
Home Office
Institute of Trading Standards Administration
Ministry of Defence
Physical Education Association of Great Britain and Northern Ireland
Recreation and Leisure Trade Association
Sports Council

The following BSI references relate to the work on this standard: standard, through subcommittees and panels:

Association of District Councils
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