BS 7044 : Part 1 : 1990

British Standard

Artificial sports surfaces

Part 1. Classification and general introduction

Surfaces de sport artificielles
Partie 1. Classification et introduction générale

Künstliche Sportflächen
Teil 1. Einteilung und Einführung

British Standards Institution

Foreword

This Part of BS 7044 has been prepared under the direction of the Textiles and Clothing Standards Policy Committee and forms Part 1 of a comprehensive British Standard on artificial sports surfaces.

It is based on Part 1 of the Sports Council Specification for Artificial Sports Surfaces, but has been significantly re-arranged and revised. In particular, all test methods and requirements for surfaces have been omitted and will be included in subsequent Parts of BS 7044.

Many sports were developed on and are still played on natural surfaces, notably turf. However, it has always been necessary to use artificial surfaces for sports played indoors and this increasingly includes indoor versions of sports normally played outdoors. Economic and climatic factors have also made it desirable in many cases for artificial surfaces to be used in place of natural surfaces outdoors, for example where the maintenance is prohibitive or where more intensive use is required than can be sustained by natural turf.

A large variety of artificial surfaces has been developed and found to satisfy the economic and convenience criteria demanded by particular sports and also to provide satisfactory, or in some cases superior, playing characteristics. However, the variety of surfaces available and the lack of standardization of performance data has made the choice of a surface by a potential purchaser for a particular application very difficult. This is especially so as regards the playing performance of the surface.

BS 7044 has been developed with the cooperation of the equipment manufacturers and governing bodies of sport to standardize test methods, to specify requirements for durability, playing performance and safety and to give guidance on the characteristics of artificial surfaces.

BS 7044 is primarily intended to be of interest to local and education authorities, universities, schools and sports clubs to guide them when purchasing a sports surface. The performance requirements given in BS 7044 reflect mainly recreational, educational and club standard needs but may also be satisfactory for top level competition.

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

Contents

Classification

1 Scope

This Part of BS 7044 gives a classification of artificial sports surfaces for the purpose of setting performance requirements. Walls, loose particulate surfaces and surfaces designed for motor sports use are not covered in this standard.

NOTE 1. Background information and guidance are given in appendices which cover the characteristics of the various types of artificial surface, considerations in selecting a surface and the parameters which require measurement.

NOTE 2. The titles of publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purposes of this Part of BS 7044, the following definitions apply.

2.1 natural sports surface. A sports surface formed by the preparation of an area of land including surfaces formed with vegetation or solely of loose particulate mineral layers, ice or snow.

2.2 artificial sports surface. A sports surface formed by a layer or layers of processed and formed material laid so as to produce an essentially continuous and bound-together surface. The surface may also include loose particulate material essentially retained by the formed material.

NOTE 1. It is not possible to make an absolute distinction between what is a natural and what is an artificial surface. It is obvious that turf and water are natural and that polyurethane sheet is synthetic but to classify such materials as cinders or wood is more difficult. An essentially continuous surface produced by a manufacturing process from a natural material (for example wood boards) is considered artificial.

NOTE 2. The term 'synthetic surface' is sometimes used to describe a surface manufactured from a material such as a plastic to distinguish it from a surface constructed from a natural material such as wood.

2.3 polymeric surface. A sports surface formed of plastics, rubber and textile materials collectively.

2.4 substrate. The layer or layers of material below the top playing layer, which may be an essential component of the surface, and may considerably affect its performance.

2.4 resilience. The ratio of energy returned after impact to the energy put in.

NOTE 1. For example, the rebound height of a ball divided by the height from which it was dropped.

NOTE 2. Resilience has no particular connection with stiffness.

2.6 stiffness. The ratio of applied force to deflection, that is often called softness or hardness.

NOTE. Stiffness is not a constant but may vary with the rate of application of the force and the magnitude of the force.

3 Classification of sports surfaces

In this standard, surfaces are classified by intended use and performance characteristics and not by material or construction.

NOTE 1. A guide to the principal types of material and construction used is given in appendix A.

Two classes of principal intended use are described as follows:

(a) surfaces for general (multi-sport) use;

(b) surfaces for individual sports.

Each of these classes is further classified into the following:

(1) surfaces for outdoor use;

(2) surfaces for indoor use.

The surfaces for general use are also further classified into the following:

(i) medium duty;

(ii) heavy duty;

(iii) spike resistant.

The surfaces for individual sports may be further classified into intended level of use, for example international, national, county, club or recreational.

The designations of these classifications are given in table 1.

Additionally, it is necessary for the purchaser to specify, in the case of outdoor surfaces, whether the playing layer (and the substrate) is to be permeable or non-permeable, if this requirement is not specified in the relevant Part of BS 7044.

Table 1. Classification of surfaces

Surface	Designation
General use, medium duty, outdoors	MD/O
General use, medium duty, indoors	MD/I
General use, heavy duty, outdoors	HD/O
General use, heavy duty, indoors	HD/I
General use, spike resistant, outdoors	SR/O
General use, spike resistant, indoors	SR/I
Individual sport, outdoors	*
Individual sport, indoors	*

*Examples are Cricket/O/county and club, Cricket/I/school.

Ideally, all sports activities should have the surface individually specified but economic pressures dictate that in many installations a number of sports have to be played in the same space and often on the same surface. For this reason, general classes have been defined in this standard.

In selecting a surface to be used for a number of sports, it should be recognized that no surface meeting the requirements of any of the general classes can be equally

satisfactory for all the sports which could be played on it.

Even if a surface appears satisfactory for a given sport as regards playing characteristics, it may not be satisfactory in terms of safety.

Where more than one sport has to be played on a single surface, there has inevitably to be a compromise which purchasers will have to make in the light of their objectives for the use of the space in which the surface is to be laid.

NOTE 2. Guidance on selecting a surface is given in appendix B.

4 Substrates

The top layers will be laid onto some form of substrate or basework and this substrate will influence, sometimes to a large degree, the performance of the surface. This is the case, for instance, when considering the resilience of a thin, soft surface.

Where it may affect the result, it is essential that performance tests to assess compliance with the requirements for any of the classes defined in this standard are carried out with the top layers backed by the substrate to be used in the final installation.

NOTE. Requirements for substrates will be given in another Part of BS 7044.

5 Performance parameters

Performance requirements for the classes of surface defined in clause 3 will be given in BS 7044 : Part 4 for surfaces for general (multi-sport) use and in subsequent Parts BS 7044 for surfaces for individual sports.

NOTE. The relevance of many of the performance parameters is discussed in appendix C.

Appendices

Appendix A. Types of artificial sports surfaces

A.1 General

Artificial surfaces can be divided into those for outdoor and those for indoor installations (see clause **3**). The main distinction is that outdoor surfaces have to be very resistant to weathering and the top layers have to be designed in conjunction with the substrate on which they are laid to give adequate drainage. This distinction between outdoor and indoor installations is maintained in the classification of surfaces used in this standard.

A most important distinction for outdoor surfaces can be made between those which are permeable and those which are non-permeable. A permeable top layer on a suitably permeable substrate does not have to be laid to falls to ensure drainage. However, some fall may have to be allowed for because of the decrease in permeability due to clogging of pores. Furthermore, with a permeable construction, there will be less tendency for water to be retained between the blades of artificial grass or in the hollows of any surface pattern. This needs to be specified when purchasing a surface.

A division can also be made between permanent and temporary installations. Most installations are intended to be permanent and the substrate has to be chosen accordingly. Certain types of surface can be used as temporary installations but no distinction is made in this standard as regards performance between permanent and temporary use.

The performance requirements for surfaces, to be given in subsequent Parts of BS 7044, will not in most cases classify surfaces by the material or the method of construction used. It is, however, advantageous to appreciate the general characteristics of the various types of surface which are available and these are given for guidance in **A.2** to **A.7**. Any of these materials may be used in combination as a multi-layer surface construction.

If a rigid surface is mounted in such a manner that a fairly heavy impact will cause a large area of the floor to deflect, then this type of surface is a sprung floor. Springing may result from wood joists themselves, rubber or foam pads or underlayers, or actual springs. It is apparent that, depending on the construction, a variety of sprung or semi-sprung floors can be constructed with different characteristics. Springing is advantageous in certain circumstances because the shock of impact is reduced and the apparent resilience is increased. The term 'area elastic' is sometimes applied to this type of surface.

The term 'point elastic' is sometimes applied to surfaces, such as the polymeric surfaces, which on impact only deform appreciably at and immediately surrounding the point of impact. More rigid materials, such as concrete, deform very little on impact. By a combination of materials, a floor can have the characteristics of being point elastic to a ball dropped on it, whilst being area elastic to the greater energy of a falling athlete.

A.2 Concrete surfaces

Concrete forms a very hard, durable and water resistant surface which has high resilience and good slip resistance. It is not recommended for sports involving much bodily contact because of the risk of injury through jarring and abrasion. Permeable and non-permeable constructions are available.

A.3 Coated macadam surfaces

Coated macadam surfaces include bitumen, asphalt, tar macadam and those surfaces modified by polymeric additives. They are generally slightly less hard than concrete, durable, water resistant, and have good slip resistance and fairly high resilience. Additives can appreciably lower stiffness and at the same time reduce the tendencies to soften and be prone to permanent indentation at high temperatures. Permeable and non-permeable constructions are available.

Colour coatings may be applied to these surfaces which may affect the frictional properties.

A.4 Timber surfaces

Timber surfaces include those made of timber as well as those made of composite boards, e.g. chipboard. Timber floors may be supported by joists or battens, with or without pads, or laid in the form of blocks directly on to concrete. Timber is less hard than concrete and is durable but not water resistant. Resilience varies with the type of timber but is generally high when laid directly on concrete. When laid on joists or battens with pads, there will generally be a degree of springing, and apparent stiffness and resilience will vary considerably with energy of impact. Friction is generally lower than for concrete or asphalt but is normally sufficient to prevent slipping. Friction will, however, be modified by any surface treatment used, e.g. sealant.

A.5 Composition surfaces

The materials used to form composition surfaces include cement, wood granules, fillers and binders and they can be formed into a seamless floor on site or produced in the form of blocks and tiles which are usually bonded to a substrate. They are harder than timber but have better stability, are water resistant and their properties are likely to be more uniform over a large area. Slip resistance will depend on the surface treatment used.

A.6 Textile surfaces

There is a wide variety of textile surfaces available, ranging from heavy woven fabrics through felts and fine pile carpets to coarse plastics pile simulating grass. (This last type could be classified with the polymeric surfaces.) The characteristics of textile surfaces vary considerably depending on material and construction; durability, water resistance, porosity and friction can range from high to low. Generally, textile surfaces are all softer than concrete, asphalt, composition materials or timber and, in the main, have lower resilience, although the resilience will be influenced by any backing. Some require fixing but many can be laid and removed relatively quickly and easily. Some artificial grasses have the spaces between the pile filled with a particulate material such as sand.

A.7 Polymeric surfaces

A very large number of different surfaces composed of polymeric materials are available, some consisting of more than one layer and including both solid and foamed constructions. A considerable range of stiffness is covered but they are generally softer than concrete, asphalt, composition materials or timber. Depending on material type, a large range of resilience, durability and friction levels is possible. Most are water resistant and some are permeable. They may be prefabricated as sheet or tile materials and then loose laid or bonded to the substrate, manufactured in situ from raw materials, or poured as a liquid and cast in situ.

Appendix B. Selecting a surface

For a particular sport, a surface should be chosen which conforms with the relevant individual Part of BS 7044, with due regard to the level of play intended. As a practical compromise, where more than one sport is to be played either a surface complying with one of the general classes (see BS 7044 : Part 4) or one which complies with the requirements for a number of individual sports should be chosen.

No surface will be satisfactory for all sports and no surface meeting the requirements for any of the general classes can be equally satisfactory for all the sports which could be played on it. Even if playing characteristics are acceptable, the surface may not be satisfactory in terms of safety. However, many surfaces are satisfactory for a considerable number of sports.

There has to be a compromise when choosing a surface for multi-sport use, selection first becomes a matter of noting the main sports for which the surface is required and ensuring that the most important parameters (see appendix C) for these sports are at a satisfactory level.

Indications of the usual type of surface and important performance parameters for a wide range of sports are given in table 2. This table may be helpful when selecting a surface, particularly when it is intended to be used for a number of sports.

Commonly played sports, such as association football, athletics, hockey, basketball, badminton, handball, five-a-side football, netball, volley ball, movement and dance and table tennis, can be played satisfactorily on most but not all multi-sport surfaces of the appropriate class.

Bicycle polo, roller skating and roller hockey, trampolining and weightlifting are examples of sports which can be played on some multi-sport surfaces but impose particular requirements for stiffness and resistance to damage.

Similarly, tennis and cricket are examples of sports which can be played on some multi-sport surfaces but which impose particular requirements for ball bounce and spin.

Boxing, darts, gymnastics, wrestling and the martial arts (except karate and kendo) usually require the addition of mats or podia when played on multi-sport surfaces and this can also be a suitable solution for indoor bowls, cricket and fencing.

The lists of sports given are by no means exhaustive and there are many more sports which can be played satisfactorily on many multi-sport surfaces.

It should be noted that the requirements for such general activities as trade and technical exhibitions may not be compatible with, and may be opposed to, the performance requirements for sports activities.

Table 2. Types of artificial sports surface and performance parameters

Sport		Performance parameters								Type of surface						Remarks
		Heavy duty	Spike resistant	Stiffness	Energy absorption, person/surface	Resilience, ball/surface	Rolling resistance	Spin	Friction	Concrete	Coated macadam	Timber	Composition materials	Textiles	Polymerics	
Archery	Indoor											P	P	S	P	
	Outdoor										S					
Association football	Indoor	E														
	Outdoor	E		E	I	E	E	I	E					P	S	
Athletics	Indoor	E	I	E	I				E			S			P	
	Outdoor	E	E	E	I				E						P	
Badminton	Indoor				I				I			P	S		P	
	Outdoor				I											
Baseball	Outdoor	I			I				I					S		
Basketball	Indoor			I	I	E			E			P	S	S	P	
	Outdoor			I	I	E			E		S				P	
Bicycle polo	Outdoor	E		I			E		E					S		Friction and rolling resistance important for bicycle wheel
Billiards and snooker	Indoor												S	P	S	Special floor requirements
Bowls	Indoor						E							P		Roll up mats may be used
	Outdoor						E							P		
Boxing	Indoor			E	E				E			S		P	S	Special ring needed
Cricket	Indoor	I		E		E		E	E					P	P	Roll up mats often used
	Outdoor	I	I	E		E		E	E					P	P	
Croquet	Outdoor						E									Confined to natural turf

Table 2. *(continued)*

Sport		Performance parameters								Type of surface						Remarks
		Heavy duty	Spike resistant	Stiffness	Energy absorption, person/surface	Resilience, ball/surface	Rolling resistance	Spin	Friction	Concrete	Coated macadam	Timber	Composition materials	Textiles	Polymerics	
Cycling	Indoor	E		I H			E L		E	S	S	P			S	Special track. Friction and rolling resistance important for bicycle wheel
	Outdoor	E		I H			E L		E	P	P	S				
Fencing	Indoor			I					E			S	S	S	P	Often performed on mats
Five-a-side football	Indoor	E		I	I	E	I		I			P	P	P	P	
	Outdoor	E		I	I	E	I		I		S			P	P	
Football training	Indoor	E		I	I	E	I		I			S	P	S	S	
	Outdoor	E		I	I	E	I		I	S	S			S	P	
Golf	Outdoor		I			I	E	I						S	S	Primarily played on grass
Golf practice	Indoor													P		
Gymnastics	Indoor			E	E H				E			S	S	S	P	Usually with mats added
Handball	Indoor				I	E	I		I			P	P	S	P	
	Outdoor				I	E	I		I					S	S	
Hockey	Indoor	E		I		I	E		I			S	S	P	P	
	Outdoor	E		I		I	E		I					P		
Ice sports	Indoor			E H					E L						S	Special rink
Irish handball	Indoor											P			S	Special court
Lacrosse	Indoor	E			I				E			P	S	S	P	
	Outdoor	E			I				E							
Lawn tennis	Indoor					E		E	E			S	S	S	P	
	Outdoor					E		E	E		S			S	P	

Table 2. *(continued)*

Sport		Performance parameters								Type of surface						Remarks
		Heavy duty	Spike resistant	Stiffness	Energy absorption, person/surface	Resilience, ball/surface	Rolling resistance	Spin	Friction	Concrete	Coated macadam	Timber	Composition materials	Textiles	Polymerics	
Martial arts	Indoor			I	E				E			P		P	P	Mats often used
Movement and dance	Indoor			I	I				E			P	S	P	P	
Netball	Indoor					E			E			P	P	P	P	
	Outdoor					E			E	S	P				S	
Pelota	Indoor											S			S	Special court
Rackets	Indoor				I	E		I	I			P		S	S	Special court
Raquetball	Indoor				I	E		I				P		S	S	Special court
Real tennis	Indoor				I	E		I				P				Special court
Rugby fives	Indoor				I	E			I						P	Special court
Riding and equestrian	Indoor	E		E	E				E						S	
	Outdoor	E		E	E				E							
Roller skating Roller hockey	Indoor	E		E H			E L					P	S		S	
	Outdoor	E		E H			E L				P					
Rounders	Outdoor								I	P	P			P	P	
Rugby football (League and Union)	Outdoor	E		E	E				E					S	S	
Skiing	Indoor								E						P	Special surfaces
	Outdoor								E						P	
Squash	Indoor				I	I		I	E			I P	S		S	Special court
Table tennis	Indoor								I	S		P	P	S	P	

Table 2. *(concluded)*

Sport		Performance parameters								Type of surface						Remarks
		Heavy duty	Spike resistant	Stiffness	Energy absorption, person/surface	Resilience, ball/surface	Rolling resistance	Spin	Friction	Concrete	Coated macadam	Timber	Composition materials	Textiles	Polymerics	
Tenpin bowling	Indoor			E			E	I				P				Special rinks
Trampolining	Indoor									P		P	P		P	Special floor requirements
Tug of war	Indoor								E			S	S	P	P	Mats can be used
	Outdoor								E					P	P	
Volleyball	Indoor			I	I				E			P	P	S	P	
Weight lifting	Indoor								I			S	P	S	S	Special floor requirements
Weight training	Indoor												S	P	P	
Wrestling	Indoor			E	E				E			S		P	S	Special ring

NOTE 1.

E = essential requirement;
I = important requirement;
H = high level;
L = low level;
P = primary or commonly used surface;
S = also used.

NOTE 2. The levels of any property which will be satisfactory should be found by reference to the relevant Part of BS 7044 or be advised by the governing body of the sport in question.

NOTE 3. Where no recommendation is indicated in table 2, a wide range of property levels should be satisfactory.

Appendix C. Performance parameters

C.1 General

There are many parameters to consider when selecting a surface for a particular application but in general these can be classified into the following:

(a) dimensional;

(b) safety;

(c) playing performance;

(d) durability.

A test to measure a specific property (see BS 7044 : Part 2) may be relevant to more than one of these areas. For example, the property of stiffness may be important in terms of safety and playing performance.

C.2 Comparison with natural surfaces

When the performance of artificial sports surfaces is considered, comparison may be made with the natural surface on which some sports may have originally been played. No artificial surface has yet been produced that has all the desirable properties of good natural turf. In BS 7044, the limits specified for performance parameters are intended to produce surfaces which maintain as nearly as possible the traditional or ideal playing characteristics, although other less important characteristics may be quite different.

C.3 Dimensional

The area of surface needs to be adequate for playing the sport in question and generally this will be indicated by the rules of that sport, but safety margins should be considered if not specified. For some sports, there may be particular restraints on surface geometry. For example, a pronounced surface pattern could be unacceptable for cricket.

All surfaces, when laid in accordance with the manufacturer's instructions, should form an essentially continuous surface, i.e. joints in the material should not significantly affect the playing performance.

C.4 Safety

There are many aspects to safety including fire resistance, toxicity, e.g. by skin contact or release of vapour or dust and the possibility of the surface causing physical injuries. It is not feasible to define for individual sports a complete safety specification and it is incumbent on the owners or operators of a sports facility to satisfy themselves as to the suitability of the surface from a safety aspect for the sports to be played.

The types of injury associated with sports surfaces can be listed as follows:

(a) abrasion from sliding contact;

(b) friction burns from sliding contact;

(c) bone fracture and other injury from severe impact;

(d) muscle strain and other injury from repeated impacts, e.g. the foot when running;

(e) twisting of joints.

The likelihood of injury is a complex function of the physical properties of the surface and the nature of the sport to be played. Hence, for a multi-sports surface, it is not possible to specify absolute limits for each property which would be applicable to all sports.

Abrasion from sliding contact is influenced by surface roughness and stiffness. It is not advisable to play sports likely to involve sliding contact on a rough rigid surface. Friction burns from sliding contact are influenced by the friction and thermal properties of the surface. Although, in general, the higher the coefficient of friction the higher are the chances of friction burns in sports with the likelihood of person/surface sliding contact, this cannot be taken as a rule because the material and structure of the surface may significantly affect the temperature reached in sliding.

The chance of injury from impact may to some extent be influenced by friction in that low friction enhances the possibility of a fall. If a severe person/surface impact occurs, the likelihood of bone fracture or other injury is influenced by the stiffness and damping characteristics of the surface.

Repeated, less severe impacts are experienced in the course of running, and can result in injury if the activity is continued long enough. As a general guide, the risk is least with a surface of moderate stiffness and moderate damping. Injury to joints through twisting can occur under any conditions but is probably most likely on soft, highly damped surfaces.

For multi-sports use, the most desirable surface characteristics from the safety aspect are moderate levels of friction, stiffness and damping, although such a combination of properties may not be ideal from the performance point of view for any given sport. Where much body contact is envisaged, very stiff surfaces should be avoided and surfaces with high damping are to be preferred.

C.5 Physical injury

Physical injury to the player may occur through impact or other interaction between the player and the surface, which may result in abrasions, bruises, friction burns, muscle fatigue, bone fracture, etc. The likelihood of injury is a complex function of the surface stiffness, roughness, energy absorption and friction and the optimum requirements will vary from sport to sport. The specification limits given in subsequent Parts of BS 7044 for these properties are intended to provide a reasonable compromise between the best conditions to reduce each type of injury and the optimum conditions for high performance.

C.6 Durability

To be economic, the surface has to have a long life. Wear can occur through abrasion, tearing, the impact of equipment and from the penetration of spikes, and the level of resistance necessary will vary from sport to sport. Surfaces used out of doors are exposed to rain, extremes of temperature and solar radiation and to give a long life have to be adequately resistant to degradation.

C.7 Rebound resilience

This property is only relevant when the sport involves the bouncing and rolling of a ball on the surface. Resilience is the property which governs the height of rebound of the ball and also the speed at which the ball returns from the surface. Resilience is not a constant but may vary with the construction, size and energy of the ball. To characterize a surface fully, it is therefore necessary to test over the range of energy (speed and height) which is likely to occur in play with the actual ball which will be used.

C.8 Rolling resistance

When the sport involves a ball or wheel rolling on the surface, the rolling resistance should not be so great or so small as to alter substantially the accepted characteristics of the sport.

C.9 Spin

Spin is only relevant when the sport involves the bouncing and rolling of the ball on the surface. It is of special importance in sports such as tennis and cricket where spin is one of the essential subtleties of the game. Spin is determined by the friction between the ball and the surface together with the surface stiffness.

C.10 Friction

For most sports, a high enough level of friction is necessary to give traction and to prevent accidental slipping, although too high a level will restrict foot movement in such sports as tennis. In certain cases such as skiing and ice skating, a particularly low level of friction is needed. Where there is any likelihood of person/surface sliding contact, friction should be low enough to prevent friction burns, and the surface should be smooth enough to prevent severe abrasion of the skin. Friction can be very much altered by the presence of water.

C.11 Stiffness and energy absorption

The dynamic interaction between person and surface is very complex and involves the properties of stiffness, energy absorbed and the forces realized, which are very dependent on the conditions under which contact takes place.

High stiffness is generally necessary for such sports as roller skating and cycling, although strictly it is rolling resistance which is the critical parameter.

For most sports, a moderate level of stiffness is desirable; in normal running a very soft surface tends to slow the athlete, whereas a very hard surface may jar the athlete and possibly cause injury. A surface with very high energy absorption is also undesirable because it is tiring and reduces performance.

When a player falls onto the surface, the energy absorbed is not the first consideration because to prevent injury it does not matter how far he or she bounces back as long as the peak forces between the person and surface are low. Hence, for sports involving bodily contact with the surface, low stiffness is desirable.

In practice, a compromise on stiffness is generally necessary between the ideal for safety and that acceptable for playing characteristics. Also, whereas a thin, relatively soft surface may be satisfactory for running and low level impacts, it may appear stiff and generate high contact forces due to 'bottoming out' under high level impacts.

C.12 Other considerations

C.12.1 Permeability

The advantages of a permeable system for surfaces outdoors have been mentioned in **A.1.**

C.12.2 Colour

The colour (hue, lightness and 'strength' of colour) of the surface should not be considered in isolation but in conjunction with related surfaces (e.g. wall and ceiling), the natural or artificial lighting to be used and the specific requirements for the sports for which the area is intended.

The difference in hue, lightness or 'strength' of colour between floor and walls should not be too wide as sudden contrasts increase the difficulty in following a fast moving object, but there should be sufficient contrast to give spatial definition.

The surface should be sufficiently matt (low gloss) to avoid glare or specular reflection which may cause confusion or difficulty in sighting balls, etc.

Outdoor surfaces have traditionally been green or red-brown, approximately matching the colours of the natural grass and shale they replace. Such colours give good contrast with the ball, etc. but artificial surfaces are available in other colours which may be more suited to the particular surroundings.

Particularly for indoor surfaces, the lightness of the colour should be such as to give light reflectance values which will contribute to high, even illumination levels over the playing area but the surface should also provide a background which will contrast in hue and/or lightness with the ball, shuttlecock, line marking, etc., which need to be clearly visible. Formerly, a reflectance value of 20 % was suggested

for sports hall floors but good lighting design has led to the use of lighter floors with reflectance values up to 40 % and this is the value now recommended for indoor multi-sports surfaces (The Sports Council, Standardized Approach to Sports Hall Design Guide 1, 1986).

C.12.3 Sound absorption

For particular sports or installations, there may be a need to take into consideration the sound absorbancy of the surface.

C.12.4 Local forces

The continued application of a local force to the surface can result in permanent deformation. This is particularly undesirable when a smooth surface is necessary and may need to be considered where there will be repeated impacts on the same spot or where heavy equipment is used. Heavy wheeled or static equipment including seating or stands may cause damage to the surface.

C.12.5 Line markings

Where line markings are required, consideration needs to be given to the methods which can be used with the surface. Although inlaid lines are the most permanent, this permanency may itself be inconvenient where more than one sport is played. Self adhesive tapes can usually be easily removed but are likely to lift under heavy usage. Carefully chosen paint may sometimes be a good compromise.

C.12.6 Cleaning

Proper cleaning of a surface is necessary if the various performance parameters are to be retained. This is particularly true of friction which, in many cases, may be drastically reduced by the presence of dust. Any routine maintenance should not increase the gloss of the surface to an unreasonable level. The use of inappropriate cleaning materials or equipment may damage the surface, particularly those made from polymeric materials.

Publications referred to

BS 7044 Artificial sports surfaces
Part 2 Methods of test
Part 4 Specification for surfaces for multi-sports use

*†Specification for Artificial Sports Surfaces 1984.
Part 1 General principles and classification

†The Sports Council, Standardized Approach to Sports Hall Design Guide 1, 1986

*Referred to in the foreword only.
†Available from the Sports Council, 16 Upper Woburn Place, London WC1H 0QP.

This British Standard, having been prepared under the direction of the Textiles and Clothing Standards Policy Committee, was published under the authority of the Board of BSI and comes into effect on 28 February 1990

ISBN 0 580 17844 7

The following BSI references relate to the work on this standard:
Committee reference TCM/14 Draft for comment 88/38753 DC

British Standards Institution. Incorporated by Royal Charter, BSI is the independent national body for the preparation of British Standards. It is the UK member of the International Organization for Standardization and UK sponsor of the British National Committee of the International Electrotechnical Commission.

In addition to the preparation and promulgation of standards, BSI offers specialist services including the provision of information through the BSI Library and Standardline Database; Technical Help to Exporters; and other services. Advice can be obtained from the Enquiry Section, BSI, Milton Keynes MK14 6LE, telephone 0908 221166, telex 825777.

Contract requirements. A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Revision of British Standards. British Standards are revised, when necessary, by the issue either of amendments or of revised editions. **It is important that users of British Standards should ascertain that they are in possession of the latest amendments or editions.**

Automatic updating service. BSI provides an economic, individual and automatic standards updating service called **PLUS**. Details are available from BSI Enquiry Section at Milton Keynes, telephone 0908 221166, telex 825777.

Information on all BSI publications is in the *BSI Catalogue*, supplemented each month by *BSI News* which is available to subscribing members of BSI and gives details of new publications, revisions, amendments and withdrawn standards. Any person who, when making use of a British Standard, encounters an inaccuracy or ambiguity, is requested to notify BSI without delay in order that the matter may be investigated and appropriate action taken.

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
Consumer Policy Committee of BSI
Department of Education and Science
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 bodies were also represented in the drafting of the standard, through subcommittees and panels:

Association of District Councils
British Floor Covering Manufacturers' Association
British Plastics Federation
Institute of Leisure & Amenity Management
RAPRA Technology Ltd.
Sports Turf Research Institute
Textile Institute
Textile Research Council

Amendments issued since publication

Amd. No.	Date of issue	Text affected