GAA Performance and Construction Standards for Synthetic Turf Pitches

April 2009

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Whilst every effort has been made to ensure the accuracy of the information contained in this publication any party who makes use of any part of this document in the development of a synthetic turf pitch shall indemnify the Gaelic Athletic Association, its servants, consultants or agents against all claims, proceedings, actions, damages, costs, expenses and any other liabilities for loss or damage to any property, or injury or death to any person that may be made against or incurred by the Gaelic Athletic Association arising out of or in connection with such use.

There are many ways of constructing a synthetic turf pitch. These guidelines do not constitute any form of approval from the GAA on a particular form of surfacing or construction but are intended to provide information to potential consumers to allow them to make informed choices when designing and selecting surfaces, contractors, etc.

1 Introduction

The development of synthetic turf surfaces that replicate the playing qualities of natural turf but sustain much higher levels of use has led to their increasing use for Gaelic sports. To ensure these new forms of surface provide a satisfactory playing environment that will not increase the risk of injury to players and are of adequate durability the National Infrastructural and Safety Committee of the GAA has prepared these performance and construction standards for synthetic turf pitches

The standard is based on European Standard IS EN 15330-1: *Surfaces for Sports Areas: Specification for Synthetic Turf and Needle-punched surface: Part 1 – Specification for synthetic turf surfaces* [1], modified for the specific requirements of Gaelic Football and Hurling and takes into account the results of a comprehensive study by the Sport Turf Research Institute into the performance of natural turf pitches during the summer of 2007(2) and research undertaken by Labosport on natural and synthetic turf pitches in 2008 (3).

Readers will note that the Head Injury Criteria (HIC) specified is higher than those required by other field sports. In setting this standard the GAA consulted with a number of industry experts on HIC and the importance of maintaining a consistently high value during the useful life of the playing surface. It is our view that our games have the potential for high falls associated with high ball catch and that the frequency of this skill, necessitates that we adopt a standard that is in keeping with the manner in which our games are played and the wide age group distribution of individuals who will be using our facilities.

To ensure only synthetic turf pitches that satisfy this Standard are used for Gaelic games the GAA has adopted a three stage process of pitch certification as follows:

Stage 1 - product type approval - the synthetic turf surface is subjected to a comprehensive series of laboratory tests that assesses its performance, durability and material qualities. Only synthetic turf surfaces that have been tested and shown to comply with the laboratory requirements of this Standard should be considered for possible selection when designing a synthetic turf pitch.

Stage 2 – initial facility testing and certification - following installation the pitch is tested to verify the synthetic turf surface has been installed correctly and is providing the anticipated levels of performance. **The GAA require all synthetic turf pitches that are to be used for competitive play or training to be tested and the results notifed to the GAA within three months of construction.**

Stage 3 – pitch recertification - the pitch is **re-tested every three years** throughout its life to demonstrate it is still providing a satisfactory and safe playing environment.

Following the testing of a pitch a GAA Synthetic Turf Field Test Report (see Appendix A) should be submitted to:

Secretary to NISC
Gaelic Athletic Association
Croke Park
Dublin 3
Ireland

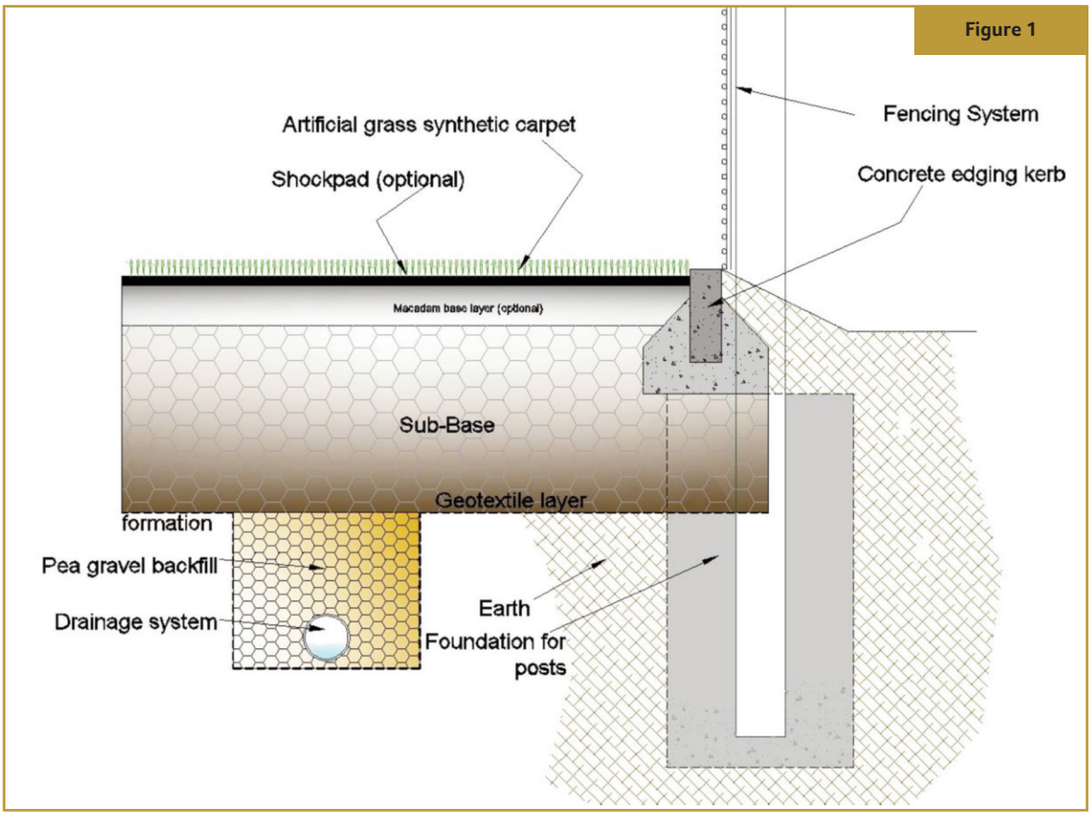
2 What is a synthetic turf pitch?

The basic components of a synthetic turf pitch are shown in Figure 1. They comprise:

- the formation; this is the prepared natural ground on which the pitch is built. A geotextile is normally laid between the formation and pitch construction to prevent contamination of the sub-base by clay migration, settlement, etc;

- a sub-pitch drainage system. The pitch should have a drainage system that is designed to remove surface water from the playing surface at a sufficient rate to prevent flooding and to ensure that excess water is not allowed to build-up within the sub-base causing a reduction in its structural integrity. The drainage system will typically consist of a series of lateral drains laid beneath the pitch at between 5m and 15m centres, depending on site conditions. The lateral drains will connect into collector drains located on the outside of the perimeter edgings that will discharge into a suitable outlet.

Figure 1



- the sub-base; carefully graded aggregates that are laid to provide load bearing and stability for the playing surface and to protect, as far as possible, the formation from the effects of rain and frost.

  The most commonly used forms of sub-base are constructed from unbound graded aggregates that are designed to provide an inert, stable and free draining structure for the synthetic turf surface to be laid on.

  Occasionally the unbound base is constructed from carefully selected aggregates that are loose-laid to aid the dynamic properties of the playing surface. The correct selection and installation of the aggregates is critical if these objectives are to be achieved.

- macadam base (optional); designed to provide structural stability to the pitch, ensuring good surface regularity and ease of resurfacing. Macadam bases may be formed in either one or two layers. Two-layer constructions were originally introduced to sports pitches to ensure that constructions complied with the tolerances for surface regularity. Nowadays the use of laser-controlled paving machines (on full size pitches) to install the top layer of the sub-base and the macadam means that the tolerances can now be achieved with a single (typically 40mm thick) layer of macadam, although the structural benefits of two layers are still worthy of consideration for difficult sites.

- shockpad (optional); whilst the dynamic playing and safety characteristics of the playing surface may be provided solely by the synthetic turf infill the demanding HIC requirements of Gaelic games will make the incorporation of a shockpad a more common design solution.

  Shockpads take many forms including polyurethane bound rubber mixes that are mixed and laid with a paving machine (often described as in situ laid shockpads) or factory produced panels or rolls that are manufactured from a range of materials including rubber granules, polyurethane foam, expanded polyethylene beads and recycled polyurethane foam.

  Whilst laying a shockpad will significantly increase construction costs it will help ensure the pitch retains the required playing and safety characteristics throughout the life of the carpet.

- synthetic turf playing surface; this is made up of the synthetic turf carpet and the infill materials, all of which will have been carefully selected to provide the appropriate levels of performance and durability. Figure 2 shows a typical construction.

  The pile of the carpet is one of the most important components of the synthetic turf surface as it influences the playing characteristics, durability and visual appearance of a pitch. Nowadays most synthetic turf carpets have piles manufactured from polyethylene yarn as this provides a resilient and durable surface, whilst not being too abrasive to players when they fall or slide on it. Some surfaces also include secondary yarns to help provide and retain the desired playing characteristics; these are often polypropylene or nylon.

  The pile yarn is formed into the tufts of the playing surface by one of two manufacturing processes. Fibrillated yarns are manufactured from thin sheets of plastic that are slit and twisted to form thicker filaments that form the pile. Experience has shown, however, that the abrasive effects of play can cause the pile yarn to split into increasing fine fibrils making it increasingly hard for the surface to provide the required playing characteristics – particularly restricting the speed of a football as it rolls across the surface. Fibrillated yarns do provide good stabilisation of the rubber infill, preventing excessive rubber splash and dispersion.

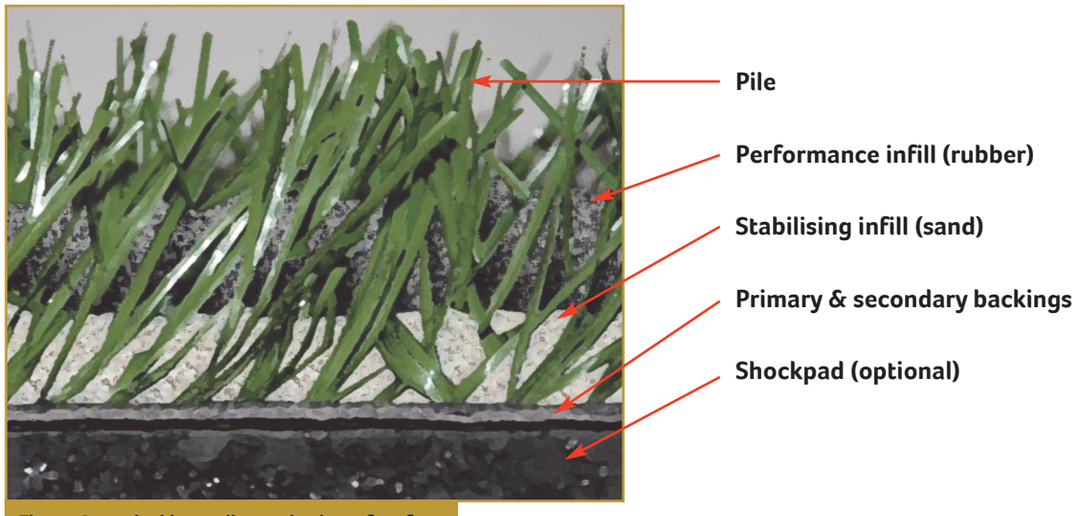


Figure 2- typical long pile synthetic turf surface

Monofilament yarns are manufactured as individual strands that are plied together to form the individual tufts. The number of plies can vary and is normally specified as the number of ends per tuft; the higher the number the denser each tuft. This type of yarn is increasingly being used because of their enhanced durability and resilience. Binding the individual monofilament strands into a carpet's backing can be a source of weakness in some forms of carpet and it is important that the carpet manufacturer can demonstrate adequate tuft bind.

As monofilament pile yarns are manufactured in their finished state manufacturers are able to engineer an increasingly complex range of profiles in an attempt to increase the resilience of the fibre so that the tendency for the pile to flatten is reduced. Whilst most pile yarns are straight it is also possible to texturise the yarn during manufacturing so it develops a degree of curl. This can aid infill stability and enhance the playing characteristics.

Factors that will influence the performance of the carpet include:

- Pile length - normally expressed as the height of the pile above the backing of the carpet, although it is also sometimes expressed as the total length of the yarn forming the tuft (the two sides of the tuft). Pile heights range from 70mm down to 35mm depending on whether all of the dynamic properties of the surface are provided by the infill within the carpet or whether a shockpad is incorporated into the system; meaning less infill is required. Experience suggests that a free pile height (the height of fibre above the infill) of around 20mm is normally required to provide the desired playing characteristics.

- Stitch rate – normally expressed as the number of stitches per square metre. The stitch rate is a combination of the number of stitches per unit length (e.g. 20 per 100mm) and the spacing (gauge) of the rows of stitches (e.g. 5/8"). Experience suggests carpets with higher (denser) stitch rates are more suited to Gaelic games; particularly hurling.

- Pile dtex - the ratio of mass of the pile yarn to its length which is expressed in units of dtex (1 dtex = 1g per 10,000m). Thicker or wider yarns will have higher dtex values than thinner or narrower yarns of the same length.

- Pile weight – the combination of the number of stitches and the profile, length and width of the pile yarn from which the stitches are formed. Higher quality surfaces will normally have higher pile weights than cheaper alternatives, the actual values depending on the pile length.

- Carpet infill - the majority of synthetic turf surfaces are filled with particulate materials. Normally laid in two layers the upper (performance infill) layer is normally either granulated rubber or mixes of rubber and sand; whilst the lower (stabilising) layer is normally sand. Some companies are now starting to also offer organic infills and non-filled systems.

  The infill materials are used to support the pile of the carpet, to help it remain vertical, to contribute to the playing and cushioning qualities of the surface and to provide weight to ensure the carpet is held in place. The grading, composition and depth of the infill materials are therefore carefully selected by the manufacturer to ensure the combination of the carpet pile and infill materials gives the performance required from the surface.

  An increasing number of rubber polymers are being used as infill materials although the most common is styrene-butadiene rubber (SBR as it is more commonly referred to). The granules are black in colour and produced from recycled tyres. If an alternative colour is required a polyurethane coating may be applied to encapsulate the SBR granules. The granules may be produced using ambient or cryogenic production processes; ambient granulating involves passing the rubber through a series of rotating knives until it is cut to the required size, whilst cryogenic granulate is produced by freezing and shattering the rubber to produce granules of the required size. Both forms of production have been shown to produce infills with good performance.

As the development of synthetic turf surfaces progresses, manufacturers are engineering infill materials and profiles to enhance performance. A range of materials including vulcanised and non-vulcanised thermoplastic polymers (TPE and TPV) and Ethylene Propylene Terpolymer (EPDM) granules are now being used. As they are specifically manufactured from virgin stock material they may be granulated, extruded or moulded to the required shape, size and colour. The use of these materials has increased after questions were raised about the potential toxicological and environmental impact of filling synthetic turf surfaces with recycled tyres. Subsequent international studies and literature reviews of published research, have, however, concluded that the research does not substantiate the claims.

One major advantage of the new infill material is that they can have flame retardant additives incorporated in their formulations to reduce their flammability; an important consideration for certain sites and in particular when surfaces are being laid indoors.

3 GAA Performance and Construction Standards for Synthetic Turf Pitches

3.1 Introduction

The *GAA Performance and Construction Standard for Synthetic Turf Pitches* details the requirements for synthetic turf surfaces used for Gaelic sports (training and competition). The Standard comprises two parts and for a pitch to meet the Standard it must comply with both. Part 1 comprises a series of laboratory tests that are designed to assess the ability of a synthetic turf surface to provide the required levels of ball/surface and player/surface interaction, together with tests that assess the durability and quality of materials used to form the surface.

Part 1 also includes a series of product identification tests that are undertaken to ensure that materials subsequently installed on site are of the same quality and specification to those offered for the original laboratory test.

Part 2 of the Standard details the requirements for pitch tests. These tests are undertaken following construction of a pitch to ensure it has been constructed correctly and is achieving the required levels of performance and periodically through the life of the pitch to ensure it is retaining acceptable playing characteristics.

This Standard incorporates dated or undated reference provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications will apply to this Standard only when incorporated into it by amendment or revision. For undated references, the latest edition of the publication referred to applies.

3.2 Test laboratories

Laboratory and pitch tests shall only be undertaken by laboratories operating a quality system accredited to ISO 17025 for principal sports performance tests. A list of suitable laboratories may be obtained from the GAA. The laboratory appointed to undertake a pitch test shall not have been involved in the design, specification or procurement of the pitch.

3.3 Definitions

A synthetic turf surface comprises the synthetic turf carpet and infill plus shockpad and any supporting layers that are designed to influence the sports performance or biomechanical response of the surface. Tests shall be made on all elements of the construction that influence the sports performance or biomechanical response of the surface.

The designation IS used to reference test procedures in this Standard refers to 'Irish Standard'. Irish Standards are published by the National Standards Authority of Ireland (www.nsai.ie).

The designation BS used to reference test procedures in this Standard refers to 'British Standard'. British Standards are published by the British Standards Institution (www.bsi-global.com).

3.4 Test balls

Ball tests for Hurling shall be made using a sliothar that when tested in accordance with IS EN 12235 from a drop height of 2.0 $\pm$ 0.01m has a rebound on concrete of 0.65 $\pm$ 0.03m.

Ball tests for Gaelic Football shall be made using an O'Neills All Ireland Official match ball. When inflated to the manufacturer's specified pressure range and tested in accordance with IS EN 12235 from a drop height of 2.0 $\pm$ 0.01m the rebound on concrete shall be 1.10 $\pm$ 0.03m.

3.5 Laboratory test specimens

Test specimens shall be prepared strictly in accordance with the manufacturer's instructions and IS EN 12229. If required this may include additional consolidation of the infill by means of a conditioning roller or other means (up to a maximum of 250 passes by the roller). The same conditioning procedure shall be used on all test specimens being prepared for ball / surface and player / surfaces tests.

3.6 Laboratory test bases

Unless a synthetic turf surface is laid on a base that is designed to contribute to the dynamic performance of the surface, laboratory tests shall be carried out on test specimens laid on a rigid flat floor.

If a synthetic turf surface is laid on a base that is designed to contribute to the dynamic performance of the surface the measurements of ball rebound, angle ball rebound, shock absorption, HIC and vertical deformation shall be made on a test specimen comprising the synthetic turf surface and the base, laid to the depth specified by the manufacturer or supplier.

3.7 Laboratory test conditions

Laboratory tests shall be made at an ambient laboratory temperature of 23 ± 2° C.

Test specimens shall be conditioned for a minimum of 3 hours at the laboratory temperature prior to test.

3.8 Laboratory test specimen conditioning

3.8.1 Wet test specimens

Laboratory tests shall be made on dry and wet test specimens as specified in the appropriate test procedure.

Wet specimens shall be prepared by evenly applying to the test piece a volume of water that thoroughly soaks the specimen (if in doubt this is should be equal to the volume of the test specimen). Care shall be taken when applying the water to ensure it does not disturb the infill within the carpet; the use of a fine hose spray or fine rose on a watering can is recommended.

Following wetting the test specimen shall be allowed to drain for 15 minutes and the test carried out immediately thereafter.

3.8.2 Resistance to simulated use

Test specimens shall be conditioned in general accordance with IS EN 15306 with transverse movement of the test specimen. The number of conditioning cycles shall be **20,200 cycles** and dispersed infill shall be reapplied to the test specimen every 2,500 cycles.

3.8.3 Water ageing

Test specimens shall be conditioned in accordance with IS EN 13744.

3.8.4 Air ageing

Test specimens shall be conditioned in accordance with IS EN 13817.

3.8.5 Resistance to artificial weathering

Test specimens shall be conditioned in accordance with IS EN 14836.

3.9 H.I.C. tests

H.I.C tests shall be made in accordance with IS EN 1177 (2008). In order to assess the effects of compaction of any infill materials, surfaces shall be tested as loose particulate materials and three repeat tests be made at each drop height on the same location and the highest H.I.C. value. A minimum of five drop heights shall be used with at least two giving H.I.C. values in excess of 1000.

3.10 Requirements

3.10.1 Laboratory tests

The synthetic turf system shall satisfy the Laboratory Test Requirements of Table 1 and Table 2.

3.10.2 Pitch tests

For a pitch to comply with the *GAA's Performance and Construction Standard for Synthetic Turf Pitches* it shall be surfaced with a synthetic turf that meets the laboratory test requirements of the Standard and meets the Field Test Requirements detailed in Table 1.

In recognition that the performance of a surface may deteriorate as a result of high intensity use the ranges of acceptable performance for some properties are wider for retests than for an initial test. If for any reason a pitch is required to be retested before the initial three year period has passed the *Initial Pitch Test Requirements* shall apply if the pitch has been used for less than 12 months.

Tests on site shall be made in the seven positions shown on Figure 1. Tests may be made in additional positions if their performance is of concern.

Tests shall be made under the prevailing meteorological conditions, but with the surface temperature above +5°C.

The surface and ambient temperatures and the ambient relative humidity at the time of test shall be recorded and reported.

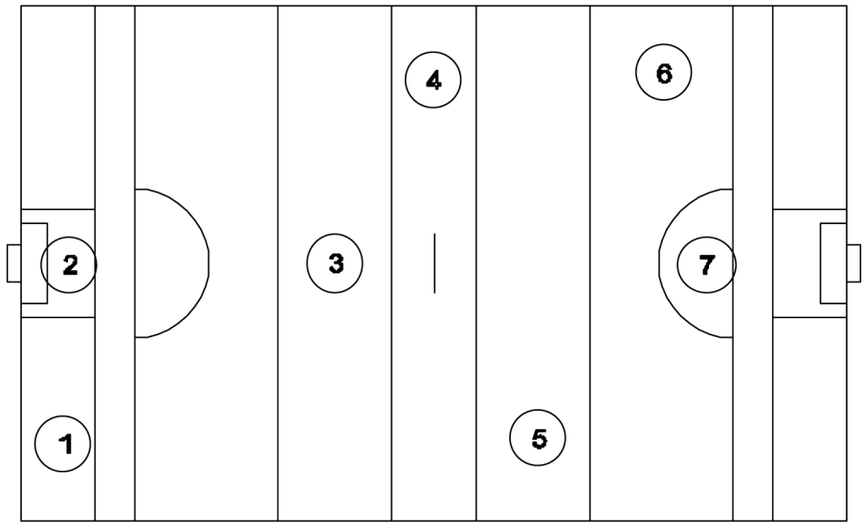


Figure 1- pitch test positions

Ball roll tests (unless the test area is screened from the wind) shall be made when the prevailing wind speed is less than 5 m/s. The wind speed at the time of test shall be recorded and reported.

The results of all pitch tests shall be detailed on a GAA Synthetic Turf Pitch Test Report (see Appendix A), a copy of which shall be submitted within three weeks of a pitch test to:

Secretary to NISC
Gaelic Athletic Association
Croke Park
Dublin 3
Ireland

3.10.3 Product identification

As part of the laboratory test programme, each element forming the synthetic turf surface shall be characterised using the test methods specified in Table 3 and the results of the tests shall be within the tolerances specified in Table 3 when compared to the manufacturer's declared values for each property. The manufacturer's declared values shall be reported in the laboratory test report.

In order to ensure the components of the synthetic turf surface installed on a pitch are the same as those previously tested in the laboratory the initial pitch test shall also include the identification tests detailed in Table 3. The maximum variation between the installed materials and the manufacturer's declared values shall be as specified in Table 3.

Table 1 - laboratory and pitch test requirements

Property	Test Method	Laboratory tests		Field tests	
		Test Condition	Requirement	Initial test requirement	Re-test requirement
Gaelic Football Rebound	IS EN 12335	Dry Wet After simulated use	0.65m – 0.80m	0.65m – 0.80m	0.65m – 0.80m
Gaelic Football ball roll	IS EN 12334	Dry Wet	4.5 – 7.0m	4.5 – 7.0m	4.5 – 10.0m
Sliothar ball roll	GAA 02	Dry Wet	5m – 9m	5m – 9m	5m – 12m
Head Injury Criterion	IS EN 1177 (1)	Dry Wet	≥ 1.4m	≥ 1.4m	**≥ 1.0m HIC must not fall below 1.0m during the life time of the pitch**
Shock Absorption	IS EN 14808	Dry Wet	55% - 65%.	55% - 65%	**≥ 50% Shock absorption must not fall below 50% during the life of the pitch**
		After simulated use After air ageing	≥ 50%		
Vertical Deformation	IS EN 14809	Dry Wet After simulated use	4.0mm - 7. 0mm	4.0mm - 7. 0mm	4.0mm - 7. 0mm
Rotational Resistance - studded sole	IS EN 15301-1 football stud sole	Dry Wet After simulated use	35Nm - 55Nm	35Nm - 55Nm	35Nm - 55Nm
Rotational Resistance - dimpled rubber sole	IS EN 15301-1 dimpled rubber sole	Dry Wet After simulated use	25Nm - 55Nm	25Nm - 55Nm	25Nm - 55Nm
Water	IS EN 12228	After simulated use	> 300mm/h	> 300mm/h	> 300mm/h

Table 2 - laboratory specific test requirements

Property		Test Method	Laboratory tests		
			Test Condition		Requirement
Gaelic Football Angle Ball Rebound		GAA 01	Dry Wet		50% - 80%
Skin Friction		GAA 03	Dry		≤ 0.75μ
Skin Abrasion		GAA 03	Dry		≤ 30%
Joint Strength - stitched joints		IS EN 12616 Method A	Unaged After water ageing		≥ 1200/100mm
Joint Strength - Bonded joints		IS EN 12616 Method B	Unaged After water ageing		75N/100mm
Resistance to tuft withdrawl		IS ISO 4919	Unaged After water ageing		≥ 40N
Tensile strength of carpet		IS ISO 13934-1	Unaged After water ageing		≥ 20N
Tensile strength of pile yarn		IS EN 13864	Fibrilated yarns Mono-filament yarns	Unaged Unaged	≥ 30N ≥ 8N per strand
Tensile strength of shockpads		IS EN 12230	Unaged After water ageing		≥ 0.15 MPa
Infill splash		GAA 04	Unaged		≤ Category 3
Pile Compression		GAA 05	Unaged		≤ 10mm or 50% of free pile height, which-ever is the lesser value
Resistance to artificial weathering	Pile yarns				
	Change in tensile strength	IS EN 13864	After UV exposure		≤ 50%
	Colour change	IS EN ISO 20105-A02	After UV exposure		> Grey scale 3
	Polymeric infills				
	Colour change	IS EN ISO 20105-A02	After UV exposure		> Grey scale 3
	Composition	Visual assessment	After UV exposure		No change

Table 3 - Product identification tests

Component	Property	Test Method	Maximum variation Field sample / Laboratory sample / Manufacturer's declaration
Artificial Grass	Mass per unit area	IS ISO 8543	≤ 10%
	Tufts per unit area	IS ISO 1763	≤ 10%
	Tuft withdrawal force	IS ISO 4919	> 90% of lab sample result
	Pile length	IS ISO 2549	≤ 5%
	Pile weight	IS ISO 8543	≤ 10%
	Gauge	IS ISO 1763	Same gauge
	Pile yarn characterisation	IS ISO 11357-3	Same polymer
Shockpad or e-layer	Force Reduction	IS EN 14808	± 5% (FR) of lab sample
	Thickness	IS EN 1969	≥ 90% of lab sample result
	Particle grading	IS EN 933 - Part 1	Same particle range (+ 10%)
Performance infill	Particle shape	IS EN 14955	Similar shape
	Bulk density	IS ISO 1097-3	< 15%
	Thermo-gravimetric analysis	%organic /%inorganic	Not applicable
	Particle grading	IS EN 933 – 1	Same particle range (+ 10%)
Stabilising infill	Particle shape	IS EN 14955	Similar shape
	Bulk density	IS ISO 1097-3	< 15%

3.11 Pitch construction requirements and tolerances

Pitches should be designed and built to the following requirements.

3.11.1 Surface regularity

When assessed with a 3m straightedge and graduated wedge in accordance with IS EN 13036-7 the maximum undulation shall be 10mm. Up to 20 deviations (for full size pitches pro–rata for smaller areas) are considered permissible providing no deviation is greater than 15mm and does not form a potential hazard to players or detract from the playing experience. Any undulations greater than 1m in length shall be considered multiple deviations of 1m intervals.

3.11.2 Gradients

The gradient of a pitch shall be no more than 1.0% in any direction.

3.11.3 Formation

In the absence of any site specific geotechnical requirements the prepared formation shall be trimmed to a tolerance of ±25mm and have a minimum California Bearing Ratio (CBR) of 10%. If required this requirement shall be achieved by the use of geotextiles, or stabilisation methods as considered appropriate by the designer.

The formation shall be graded to have a surface tolerance of + 10mm relative to the design levels.

The area of the works shall be stripped of all vegetation and topsoil and the ground trimmed and levelled using cut and fill techniques as required. Any filling should be carried out in layers not exceeding 150mm thickness, and each layer should be compacted before the next is spread.

The formation shall be free from mud or slurry and will have no areas of freestanding water. Any loose, fragmented or soft materials or any soft spots shall be excavated and replaced with imported crushed rock, free from detritus material.

The prepared formation shall be treated with a total weed-killer selected to minimise the risk of future weed growth within the construction and applied strictly in accordance with the manufacturer's specified application rate.

A geotextile membrane shall be laid over the formation. Joints shall overlap by at least 300mm. The membrane shall be a non-woven type and have a minimum tensile strength of 20kN/m when tested in accordance with IS EN ISO 10319 and a static puncture strength of at least 2.0KN when tested in accordance with IS EN ISO 12236.

3.11.4 Drainage

The drainage system shall be designed and installed to:

(i) Ensure that all surface water is removed from the pitch at a rate greater than 100mm/h and to ensure that no surface flooding will occur during heavy storms, or the facility will not be lost either through rain at the highest intensity which may be expected to occur once every five years or through continuous rainfall of 50mm over a 24 hour period.

(ii) Protect the installation from the effects of ground or surface water from the areas surrounding the pitch.

(iii) Ensure no water remains present in the construction so that it may result in a reduction of the load bearing capacity of the formation or damage to the construction from the actions of frost.

The drainage system shall comprise a perimeter drain (minimum 160mm diameter) tied to lateral drains installed at (minimum 80mm diameter), which shall be fully connected via 'T' piece connectors.

Drainage trenches shall be a minimum of 450mm deep by 300mm wide and be back filled with clean graded round/sub-rounded gravel. Perforated drainage pipe shall comply with BS 4962 and be laid to a minimum fall of 0.5%. Pipe bedding materials shall be clean, durable 10mm to 20mm single size stone.

Flexible pipes shall be laid on a bed of 75mm (minimum depth) of compacted granular materials and the trench filled with similar granular materials above the barrel of the pipe. Pipe jointing shall be carried out strictly in accordance with the manufacturer's instructions. All pipes shall be tested for effectiveness before haunchings or backfilling.

Rodding eyes or catch-pits, with covers, shall be installed at each corner of the pitch. Pre-cast concrete manholes shall be circular and comply with BS 5911-3. Units that bed onto bases shall be manufactured so that the full wall thickness is in contact with the base.

Pre-cast soak-aways shall be perforated with rows of 50mm diameter holes at nominal 450mm horizontal and 300mm vertical centres. The lowest row shall not be less than 150mm above the base of the soak-away.

Existing drains cut through during the construction of the pitch shall be re-connected into the new drainage system.

3.11.5 Perimeter Edgings

Edgings shall be minimum 150mm x 150mm/125mm precast concrete kerbs or other approved edgings, well haunched in concrete with movement joints at appropriate spacings. The maximum gap between the outer kerb face and any adjacent perimeter fencing shall be 10mm. Kerbs shall be laid to a true line and level with adequate up-stand for the subsequent fitting of the artificial grass surfacing system.

3.11.6 Sub-base

The sub-base shall be designed and constructed to:

(i) Resist the effects of frost or drought that may be expected to occur in a return cycle of once every 50 years

(ii) Provide adequate stability that it does not move outside the tolerances for surface regularity over a period of 8 years

(iii) Have an in situ density of not less than 95% of the maximum dry density when tested in accordance with BS 1377 Part 4 (2.5kg method).

The sub-base shall be laid to a tolerance of + 10mm of the design profile for this phase of construction.

The installed sub-base shall have a compacted density of 95% of the maximum dry density when tested in accordance with BS 5835 and have a CBR of 30% when tested using a BS 1377 plate test.

The depth of the sub-base shall be determined to satisfy the specified design criteria and taking into account the findings of the ground investigation survey. In all cases the depth shall be equal to or greater than the minimum requirements of UK Sport and Play Construction Association's Code of Practice for the Construction and Maintenance of Artificial Grass Sports Pitches.

Sub-base aggregates shall be a frost resistant reduced fines grade of crushed rock aggregates.

If the construction incorporates an unbound sub-base it shall be laid to satisfy the surface regularity requirements of clause 3.11.1 of this Standard.

3.11.7 Macadam base

If the pitch construction incorporates a macadam base it shall be produced and laid in accordance with the UK Sport and Play Construction Association's Code of Practice for the Construction and Maintenance of Artificial Grass Sports Pitches.

The surfacing course shall be laid to satisfy the surface regularity requirements of clause 3.11.1 of this Standard.

3.11.8 Synthetic grass surfacing system

3.11.8.1 Shockpads *(when incorporated into surfacing system)*

If the pitch construction incorporates an in situ shockpad it shall be laid to the manufacturer's specified depth as detailed in the laboratory test report demonstrating the performance of the surfacing system. If the construction incorporates a prefabricated shockpad it shall be adequately dimensionally stable to ensure rucking, creasing or movement does not occur. Prefabricated rolls shall either be inter-locking; ribbon bonded to the base or seamed alongside / head joints.

The shockpad shall be laid to satisfy the surface regularity requirements of clause 3.11.1 of this Standard.

At any location on the pitch thickness of the shockpad shall be no less than 90% of the manufacturer's specified thickness.
No shockpad bay joint should vary in level by more than 2mm.

The tensile strength of the installed shockpad, when tested in accordance with IS EN 12330, shall be ≥ 0.15 MPa.

3.11.8.2 Synthetic turf

The synthetic turf surface shall be laid in full widths across the pitch, other than where longitudinal rolls are laid to include tufted sideline markings. The method of jointing / seaming, including all in-laid line markings, shall be such that no ridge, groove or crease shall be wider than 3mm apparent. No seam shall be within 300mm of any permanent inlaid line. Bonded joints shall be formed using jointing tape of not less than 400mm wide and glue applied evenly to either side of the tape to a minimum total of 300mm.

There shall be no loops in the tufts, random long tufts, loose tufts, tears, holes or melted areas, undulations, pile height variations or any other visual or manufacturing defects.

3.11.8.3 Line Marking

Line markings shall be in accordance with the GAA Official Guide Part 2. All lines shall be 90mm + 13mm wide. All straight line marking shall be within +100mm of a tensioned string line joining its ends. No line shall exhibit any sudden irregularity or deviation greater than 50mm over a distance of 1 metre.

3.12 Quality monitoring

Throughout installation of the synthetic turf surfacing system, the contractor shall take samples of all materials as detailed in Schedule 1 and arrange for them to be sent to a GAA approved independent test house for testing. All samples shall be coded and the areas of installed materials from which they came recorded so any defective materials can be identified and removed.

Schedule 1 - samples required for testing – artificial grass surfacing materials

Component	Sampling	Tests / test methods	
Shockpad	Pre-fabricated - three 300mm x 300mm samples plus one additional sample for every for every 1000m2 area In situ mixed – three 300mm x 300mm samples per day of installation	Thickness Tensile strength Shock absorption	IS EN 1969 IS EN 12230 IS EN 14808
Synthetic turf carpet joint	One 1m x 500mm wide joint sample for each day of seaming	Joint strength	IS EN 12228

Sampling should be scheduled to ensure samples are fully representative of those installed over the whole pitch. In situ laid shockpad and joint sample should be left for at least 48 hours on site exposed to the elements so they experience the same climatic conditions as the installed materials

In addition, the contractor shall arrange for a 1m x 1m sample of the installed synthetic turf carpet plus 5kg of the installed performance infill and 5kg of the installed stabilising infill to be available for collection from site when the initial pitch test is undertaken to allow the product identification tests forming part of the pitch testing procedures to be undertaken.

4 Synthetic turf pitch procurement

Having selected the appropriate playing surface it is essential that it is laid on a well-engineered sub-base and drainage system capable of withstanding the different stresses and climatic conditions that it will be exposed to throughout its life. It cannot be over emphasised that failure to give full consideration to all elements of the pitch's design is likely to result in a pitch that fails to achieve and retain the appropriate levels of performance, resulting in expensive remedial works at the time of the surfaces replacement.

Experience shows the design, specification and project/construction management of the pitch is best undertaken by people with specialist expertise. A typical project team is likely to include:

- Design consultant
- Geo-technical engineer
- Project manager / quantity surveyor
- Floodlighting engineer

Project team members should be appropriately qualified in their respective disciplines, be independent of suppliers and manufactures and have adequate professional indemnity insurance cover. Each specialist should be carefully selected and should provide references from previous relevant engagements.

The appointment of a project team is likely to incur professional fees, some of which may have to be paid early in a project and possibly before any external funding awards have been secured. Adequate budget allowance for professional services should therefore be made at an early stage of a project. The complexity and size of a project will ultimately dictate the level of external professional advice and services required. As a budget guide, professional services may be expected to typically cost between 5% and 10% of the actual cost of constructing the pitch depending on the complexity of the scheme.

There are various forms of specification that can be used when inviting contractors to bid for the construction of a synthetic turf pitch. Most synthetic turf pitches are, however, designed and procured using a design and build approach where a number of contractors are invited to submit their proposals for the design and construction of the facility. In this type of contract the customer needs to prepare a design brief (or Employer's Requirements document) that adequately describes what is required

Due to the demands that will be placed on the synthetic turf pitch it is essential that proper quality assurance procedures are applied throughout the construction process. Site inspections and material sampling should be undertaken throughout construction with particular attention being paid to the completion of each key stage.

5 Synthetic turf pitch maintenance

The maintenance of the synthetic turf surface is of vital importance if the pitch is to retain acceptable performance and be long lasting. The surfaces guarantee will also usually be conditional on the recommended maintenance requirements being carried out with reasonable diligence. It is essential that this vital aspect of the pitch's management is not over looked.

Prior to selecting a surface the manufacturers advice must be sought on the maintenance equipment to be used in conjunction with the synthetic turf pitch and how regularly the maintenance works should be carried out given the programme of use; if you cannot follow the recommendations you should not select the surface. Many installers offer a periodic (quarterly) inspection service as part of their after-sales. This should be welcomed and encouraged so any shortcomings in maintenance are identified before they have a detrimental effect on the playing surface.

Three types of maintenance are normally required:

Routine regular maintenance

- Drag matting / brushing to redistribute infill
- Brushing to lift the pile that will flatten through the actions of play. Failure to do so will result in a faster surface and more fibrillation and matting of the carpet's pile with a deterioration in performance
- The localised topping up of fill materials to ensure consistent ball and foot responses from the surface and to provide support to the carpet's pile
- The removal of litter, leaves and other debris from the surface

The frequency of such maintenance will vary and needs to be adjusted to reflect the hours of use but is likely to be at least weekly. Such maintenance is undertaken using specialist plant and is likely to take around two hours per session for a full size pitch.

Routine periodic maintenance

- Relieving compaction of the particulate infill to ensure consistent ball and foot response.
- Removal of any moss or weeds that germinate within the surface, particularly around the edges of the pitch where it is harder to get mechanical brushes into.

The relieving of compaction will require specialist equipment and is likely to be required between one and four times per year, depending on usage – small training areas with intensive use having the greatest demand. Where a pitch operator has a number of pitches they may wish to purchase the necessary equipment, whereas an operator with only one facility may find it more cost effective to enter a maintenance contract with a specialist company.

Rejuvenation

Even with good levels of maintenance dirt and fibre debris (resulting from the wearing of the carpet pile) will eventually become trapped within the fill material. At some stage during the surfaces life it will probably be necessary to remove the contaminated fill and replace with new material before serious problems of compaction (leading to a harder playing surface) and a reduction in porosity (eventually causing flooding on the surface in wet periods) start to occur.

References

1 IS EN 15330-1: Surfaces for Sports Areas: Specification for Synthetic Turf and Needle-punched surface: Part 1 – Specification for synthetic turf surfaces

2 Baker S, Spring C, Hayden R (2007), The Performance of Gaelic Athletic Association Pitches

3 Cox A (2009), Development of a Performance Standard for Synthetic Turf Pitches for Gaelic Football and Hurling

Appendix A - GAA Synthetic Turf Pitch Test Report

GAA Synthetic Turf Pitch Test Report

1 Site details

Type of test	**Initial**	❑	**Retest**	❑
Club (if applicable)				
Pitch location				
Site contact				
Tel.				
Email				
Synthetic turf surface name				
Surface manufacturer				
Installation contractor				
Date of pitch construction				

2 Test laboratory

Test laboratory	
Laboratory address	
Test laboratory project reference	
Laboratory email address	

3 Test conditions

Date of test				
Surface condition (dry or wet)				
Surface temperature (°C)	Min.		Max.	
Humidity (%RH)	Min.		Max.	
Maximum wind speed (m/s)	Ball rebound tests		Ball roll tests	

4 Conclusions

Pitch passed	❑	**Pitch failed**	❑
Criteria that failed (if any)			
Laboratory Director			
Date			

Section 3: Detailed result

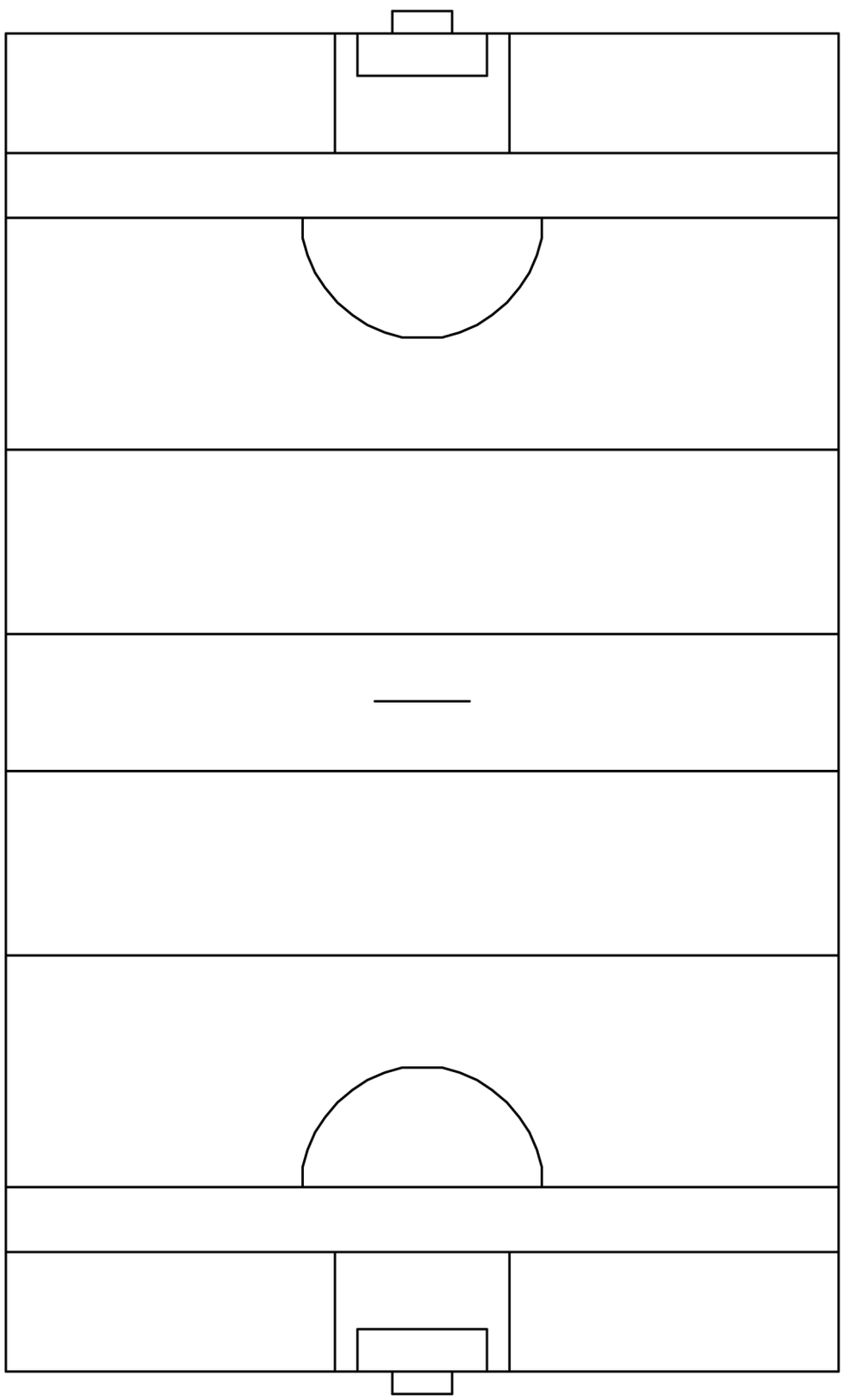
Property	Specified Range		Test Position							Pass / Fail
	Initial Test	Re-test	1	2	3	4	5	6	7	
Gaelic Football Rebound	0.65 – 0.80m	0.65 – 0.80m								
Gaelic Football Ball Roll	4.5 – 7.0m	4.5 – 10.0m								
Sliothar Ball Roll	5m – 9m	5m – 12m								
Head Injury Criterion	> 1.4m	> 1.0m								
Shock Absorption	55% - 65%.	>50%								
Vertical Deformation	4mm- 7mm	4mm- 7mm								
Rotational Resistance – studded sole	35 – 55Nm	35 – 55Nm								
Rotational Resistance - dimpled rubber sole	25 – 50 Nm	25 – 50 Nm								
Water Permeability	> 300mm/h	> 300mm/h								

Product identification (initial pitch tests only)

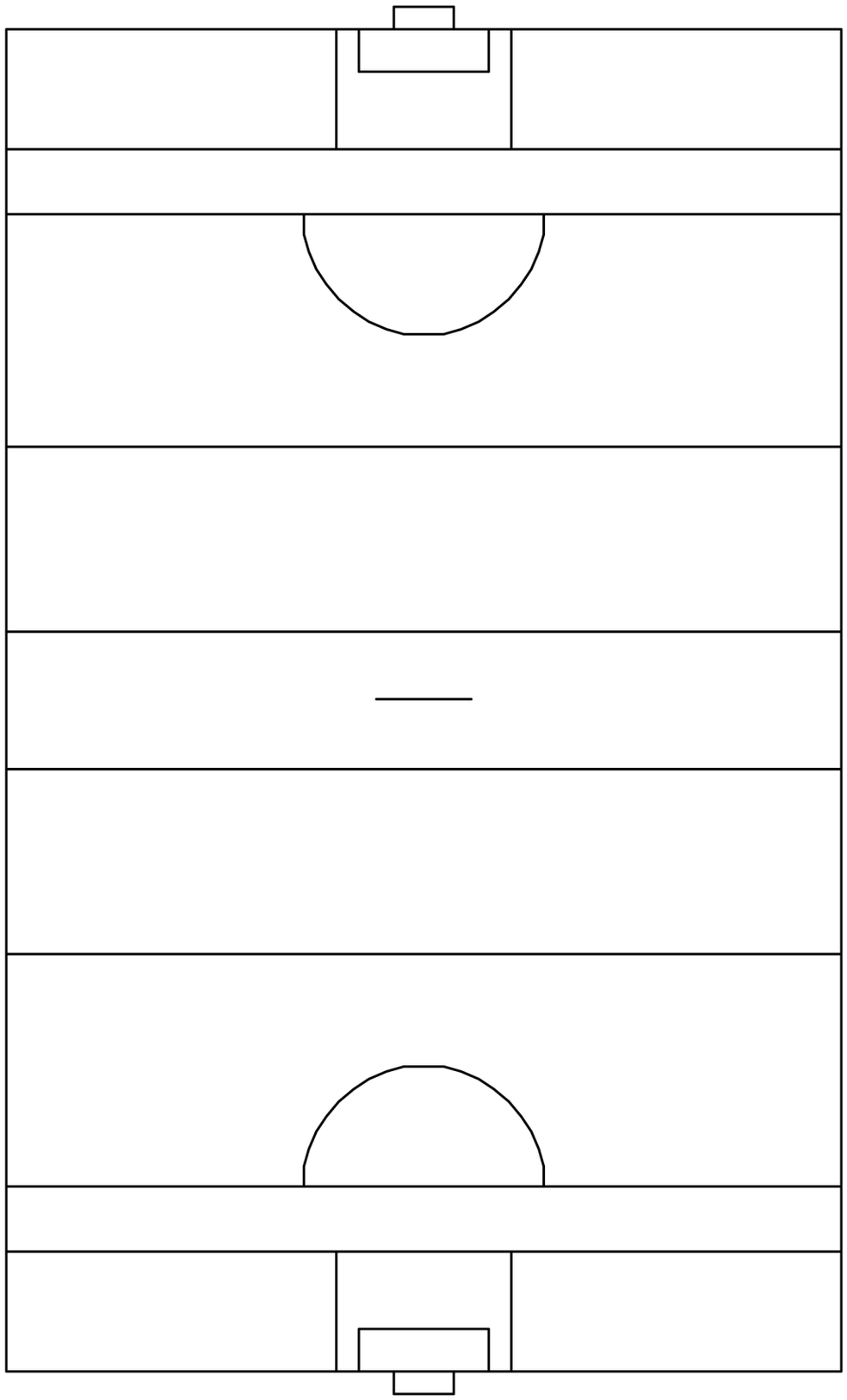
Component	Property	Site sample	Manufacturer's declaration (*)	Variation	Tolerance	Pass / Fail
Artificial turf	Mass per unit area				< + 10%	
	Tufts per unit area				< + 10%	
	Tuft withdrawal				>90% of reference	
	Pile length above backing				< + 5%	
	Total Pile weight				< ± 10%	
	Dtex				< ± 10%	
	Yarn characterisation				Same polymer	
Performance infill	Particle size				< + 20%	
	Particle shape				Similar shape	
	Bulk density				< ± 15%	
Stabilising infill	Particle size				< + 20%	
	Particle shape				Similar shape	
	Bulk density				< ± 15%	

* As detailed in product laboratory report (test laboratory and report reference)

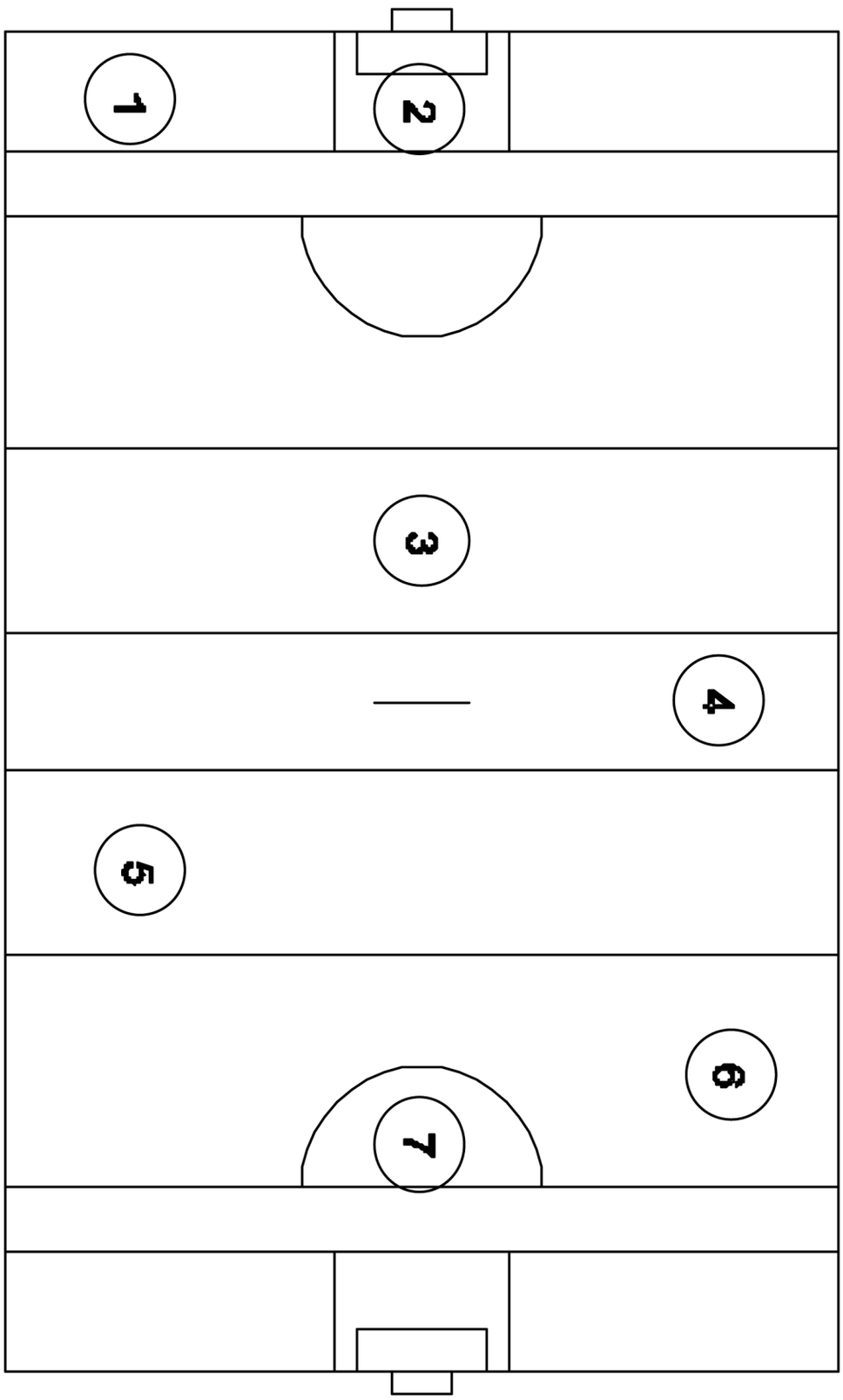
Plan showing surface undulations exceeding 10mm – detail location, size and magnitude



Plan showing principal gradients



Field test position – mark orientation on drawing



Appendix B – GAA test methods

Test Method GAA 01 - Gaelic Football Angle Ball Rebound

Test apparatus

The test apparatus comprises:

- Pneumatic cannon capable of projecting the ball onto the surface at the specified angle and velocity.
- Radar gun capable of determining the horizontal speed of the ball before and after its impact with the test specimen to an accuracy of ±0.1 km/h.
- O'Neill's All Ireland Official Match Ball

Test procedure

Validate the vertical rebound of the ball on concrete immediately before the testing.

Adjust the pneumatic cannon so that the ball departs at an angle of 15 ±2° to the horizontal and has a velocity of 50 ±5 km/h just prior to impacting the surface.

Project the ball onto the surface and record the velocity of the ball immediately before and immediately after impact with the surface.

Repeat the procedure five times, ensuring that ball does not strike the same position twice.

Calculation and expression of results

Calculate the angle ball rebound using the formula:

Angle ball rebound (%) = (S2 / S1). 100

Where:
S2 = velocity after rebound in km/h
S1 = velocity before rebound in km/h

Report the angle ball rebound as a percentage to the nearest whole number e.g. 50%.

Calculate the mean value of angle ball rebound from the five tests for each test location.

Test Method GAA 02 - Sliothar ball roll

Test apparatus

Test apparatus comprising:

- Electronic timing gates as described in IS EN 12334.
- Pendulum or other means of imparting an initial impact force so the sliothar has a mean velocity of 4.0 ± 0.05m/s when measured over a distance of 1000 ± 5mm, the first timing gate being positioned 1000 ± 5mm from the leading edge of the sliothar prior to impact. The calibration floor shall be smooth concrete having a slip resistance of 65 ±3 when tested in accordance with IS EN 13036– 4.
- Means of measuring the distance the ball rolls to an accuracy of ±0.01m.
  Sliothar

Test procedure
Place the sliothar on the surface. Strike the sliothar with the initial impact force and allow the resulting roll to end. Measure the roll distance.

Laboratory tests
From one end of the test specimen determine the Sliothar Ball Roll in five positions, each at least 100mm from the sides of the test specimen.

Repeat the test from the opposite end of the test specimen to assess the influence of factors such as turf pile pattern, etc.

Undertake tests under dry and wet conditions, as appropriate.

Calculate the mean value of Ball Roll from the 5 tests in each direction.

Calculate the mean of the two test directions.

Field tests
At each test location make five individual measurements, each at least 100mm apart.

Undertake the tests in at least four directions (0º, 90º, 180º and 270º) to determine if the result is influenced by factors such as slope or turf direction.

For each test position/direction calculate the mean value of ball roll from the five tests.

Calculate the mean value of ball roll from all tests at each test position.

Test Method GAA 03 - Skin / Surface Friction and Skin Abrasion

Determination of Skin Friction & Skin Abrasion

Test apparatus

The test apparatus comprises:
- Securisport ® Sports Surface Tester by Wassing Messtecknik GmbH
- Silicon Skin L7350 supplied by Maag Technic AG
- Polished steel test plate (0.2µm < Ra < 0.4µm).

Skin preparation

Wash three silicon skin specimens each measuring 15cm by 8cm in water and allow to air dry for 24 hours.

Clean the metal test plate with acetone and allow it to evaporate for at least 5 minutes.

Attach a test skin to the test foot (glossy side exposed) using double sided adhesive tape and the clamping screws. Ensure the smooth surface of the silicon skin is the test face; the grooved side being attached to the test foot.

Attach the draw strings to the mounting screws on the test foot and place the test foot (with silicon skin) onto the test plate and add additional weights to obtain a total mass of 1,700 ± 50g;

Ensuring the test foot remains stable on the test plate, measure the force required to pull the test foot along the metal plate over a distance of 100mm at a speed of 500 ± 10mm/min.

Repeat the force measurement at least ten times and determine the average force over a sliding distance of 40mm and 80mm.

Calculate the average force ($F_{new\ skin}$) of the ten measurements.

Repeat on two further samples of silicon skin.

Measurement of skin/surface friction

Fix the test specimen to the laboratory floor to prevent movement during the test.
Attach a calibrated skin to the test foot of the Securisport Sports Surface Tester using double sided adhesive tape and mount onto the apparatus. Adjust the test foot so it is positioned just above the test specimen.

Position the Securisport Sports Surface Tester over test specimen and adjust to level. Apply a vertical force to the test foot of 100N + 10 N and start the rotation of the test foot. Allow the test foot to make five complete revolutions at a speed of 40 + 1 rev/min; sampling at a frequency of 40 Hz. Ignoring any peak value occurring as the test foot starts to rotate, recording the mean coefficient of friction as displayed on the Securisport.

Repeat the test three times, changing the synthetic skin and replacing any infill between tests.

Calculate the mean Coefficient of Friction of the three tests

Determination of skin abrasion

Carefully remove the test foot from the Securisport without touching the test skin. Remove any detritus from the test skin using compressed air.

Place the test foot (with silicon skin) onto the clean metal plate and add an additional mass to obtain a total mass of 1,700 ± 50g.

Measure the force required to pull the silicon skin along the metal plate over a sliding distance of 100mm at a speed of 500 ± 10mm/min. Repeat the force measurement at least ten times.

Determine the average force over a sliding distance of 40mm and 80mm.

Calculate the skin abrasion using the following formula:

Skin abrasion = $100 \times [F_{new\ skin} - A_{braded\ skin}] / F_{new\ skin}$)

where:

$F_{(new\ skin)}$ = the mean average force of the second to fourth tests prior to the Skin Friction test

$F_{(abraded\ skin)}$ = the mean average force of the second to fourth tests after the Skin Friction test

Report the result to the nearest 1% e.g. 25%

Repeat the test three times.

Test Method GAA 04 – Infill Splash

Test apparatus

The test apparatus comprises:

- A release mechanism that allows the ball to fall vertically from 2.00 +0.01m (measured from the bottom of ball) without imparting any impulse or spin.
- Vertical scale to allow the drop height of the ball to be established.
- Video or other means of recording the balls impact with the surface and resulting infill dispersion, that allows frame by frame analysis and a permanent record of the maximum infill dispersion to be recorded
- Gaelic Football.

Test procedure

Validate the vertical rebound of the ball on concrete immediately before testing.

Release the ball from 2.00 ±0.01 m and photographically record its impact with the surface capturing the degree of infill dispersion that occurs.

Select the image showing the maximum infill dispersion resulting from the ball's impact and assess the degree of dispersion against the following scale:

Infill Splash grading scale

Category 1
No infill splash

Category 2
Low infill splash

Category 3
Medium infill splash

Category 4
High infill splash

Test Method GAA 05 – Pile compression

Test apparatus

- Graduated gauge capable of measuring pile height / ball diameter to an accuracy of + 1mm
- Sliothar

Test procedure

Align the sliothar so the seams are horizontal and measure the diameter of the sliothar (Z) to an accuracy of + 1mm.

Prepare the test specimen of synthetic turf (minimum dimension 400mm x 400mm) in accordance with the manufacturer's instruction and IS EN 12229. Brush the carpet pile as required to lift the pile.

Condition the test specimen for 30 + 10 minutes under standard laboratory conditions.

Determine the free pile height using the graduated gauge as shown in Figure GAA 05/1.

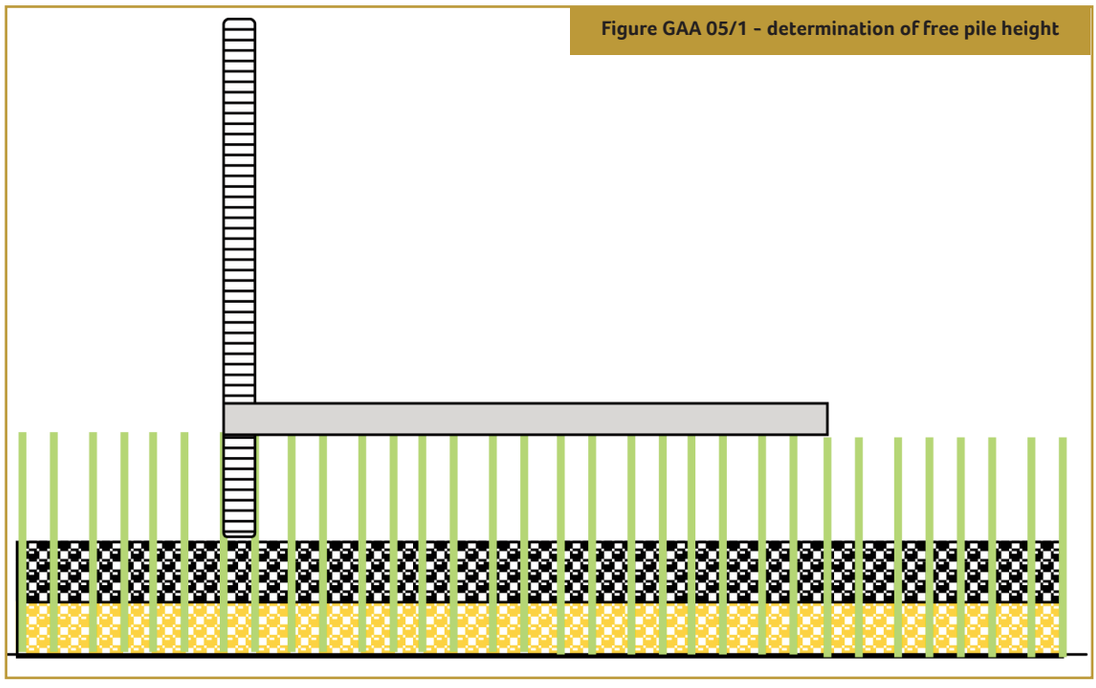


Figure GAA 05/1 - determination of free pile height

Note placing a thin sheet of rigid plastic film on the pile has been found to aid the measurement. Ensure the film does not compress the pile and adjust the Free Pile height value to take into account the thickness of the plastic film.

Repeat the procedure five times and calculate the mean Free Pile Height (X).

Align the sliothar so the seams are horizontal and place it on the test specimen.

Determine the distance between the top of the infill and top of the sliothar as shown in Figure GAA 05/2, ensuring the gauge does not place pressure on the sliothar.

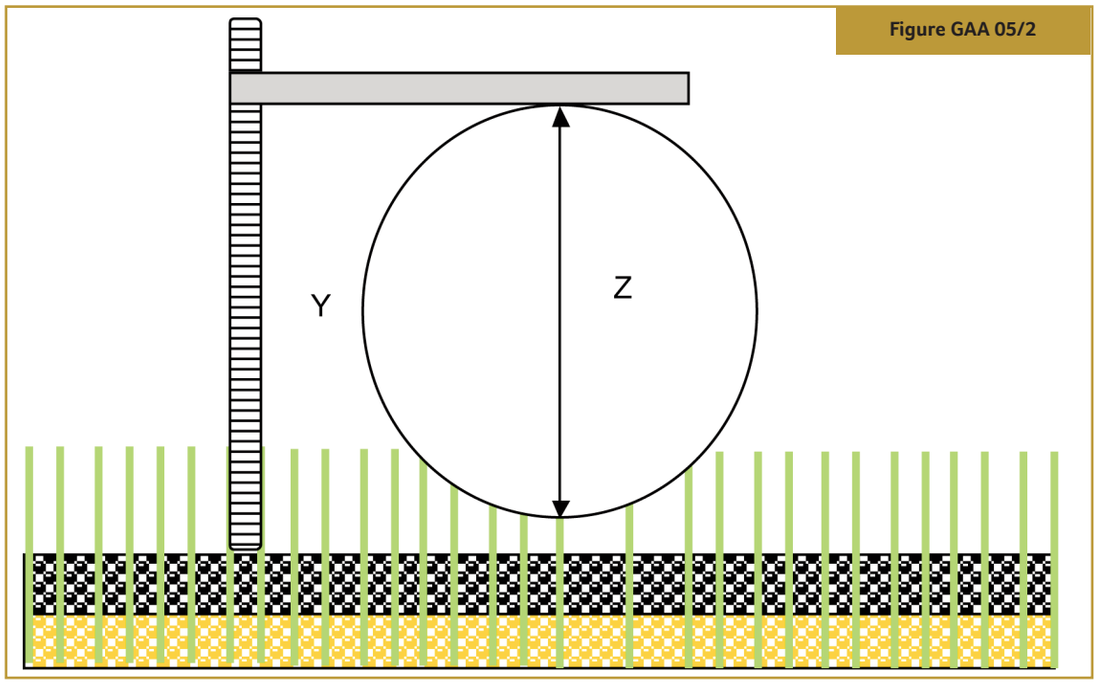


Figure GAA 05/2

Repeat the procedure five times and calculate the mean height (Y).

Calculation and expression of results

Calculate the Pile Compression using the formula:

Mean Free Pile Height $^{(X)}$ - (mean Infill Sliothar Height $^{(Y)}$ – Sliothar diameter $^{(Z)}$)

Report the Free Pile Height and Pile Compression values.