Rugby Turf Performance Specification

2016 Edition

Turf

Rugby Turf Performance Specification

Technical Manual*

2016 Edition

Contents

* The World Rugby Rugby Turf Performance Specification has, with the kind permission of FIFA, been reproduced in part from the FIFA Turf Manual

Rugby Turf Performance Specification

January 2018

Disclaimer: Whilst every effort has been made to ensure the accuracy of the information contained in this document any party who makes use of any part of this document in the construction of an artificial turf pitch (a "User") does so at its own risk and shall indemnify World Rugby their officers, directors, servants, consultants and 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 World Rugby arising out of or in connection with such User's use of this document.

Compliance with the requirements detailed in this document by a User does not of itself confer on that User immunity from legal obligations. Compliance with the requirements detailed in this document by a User constitutes acceptance of the terms of this disclaimer by that User.

1. Introduction

Rugby Union as a sport was quick to adopt new generation (3G) artificial grass surfaces for the development of the game. What is now referred to as World Rugby Regulation 22 was introduced in 2003 to ensure that 3G surfaces replicate the playing qualities of good quality natural grass. Regulation 22 defines those artificial grass systems specifically designed for the game of rugby union and as such are referred to as Rugby Turf. Climatic conditions, in many countries where the game is played, make it difficult to grow natural turf. In countries where Rugby Union is developing, Rugby Turf offers credible alternatives to those parts of the world where climate or resources make the growing and maintaining of good quality natural grass pitches difficult or impossible to achieve. In future it is hoped that the development of multi-sport artificial turfs, where Rugby Union and Association Football, amongst other sports, can be played, will provide a potential solution to facility operators wishing to maximise the use of their facilities through community use. Rugby Turf fields can be used significantly more intensely than natural turf fields, consequently where resources are limited or space is limited it is a persuasive argument for consideration. Guidelines for natural turf can be found on www.worldrugby.org under Play Rugby or upon request from the World Rugby Technical Services Department.

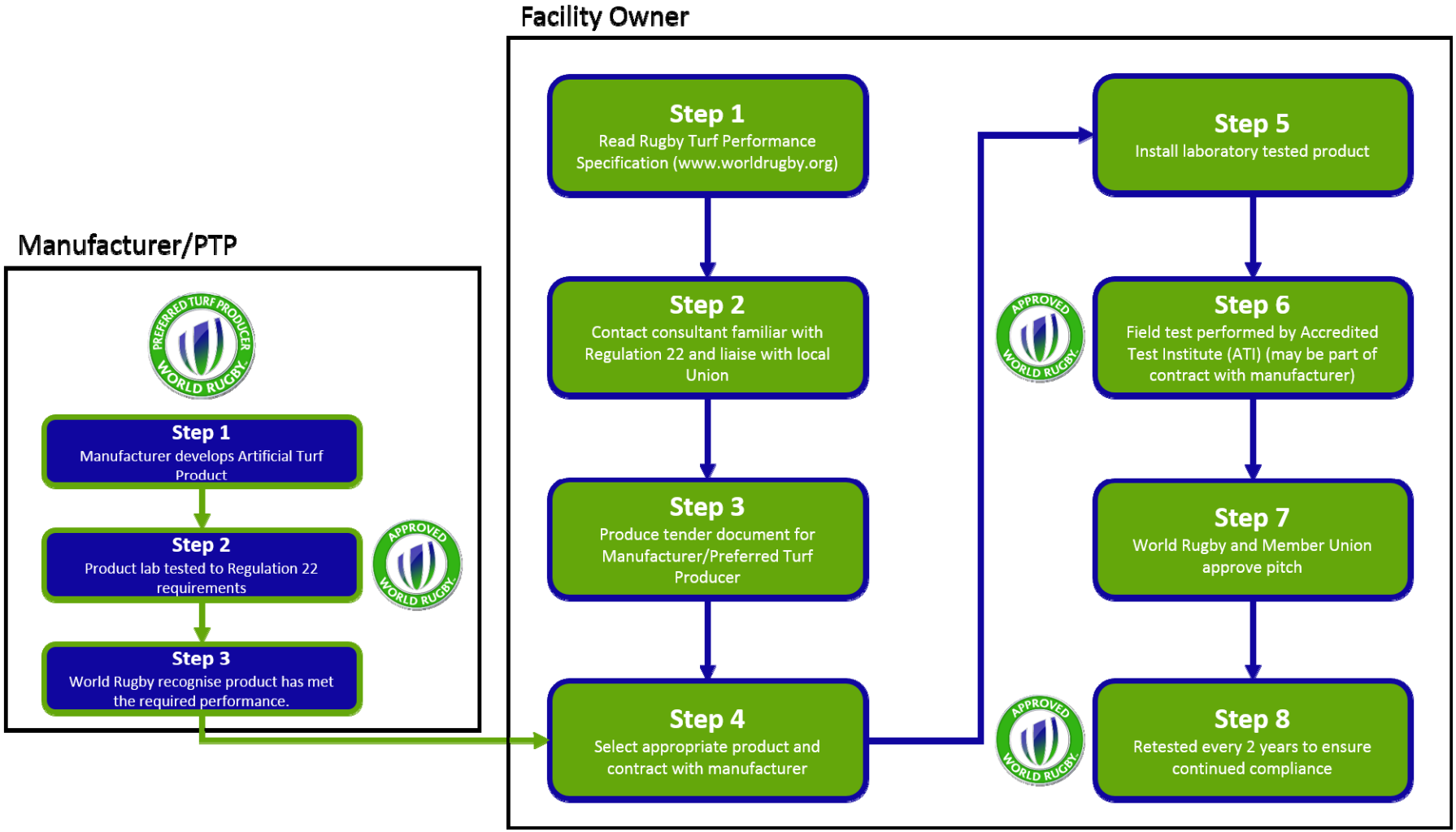
To ensure that these new types of playing surfaces replicate the playing qualities of good quality natural grass, provide a playing environment that will not increase the risk of injury to players (current statistics indicate that there is no increased risk of injury) and are of sufficient durability (provided they are maintained), World Rugby has developed the Rugby Turf Performance Specification. Revised in 2011, 2012, 2015 and again in 2016 the Performance Specification is a rigorous testing programme for artificial turf that assesses the ball surface interaction, player surface interaction durability and environmental resistance of products and encourages the continuing improvement of Rugby Turf to meet the needs of the game. In accordance with World Rugby Regulation 22 any artificial turf used for any form of competitive rugby (at all levels of the game) needs to comply with World Rugby Regulation 22 and the Rugby Turf Performance Specification.

The laboratory test programme, which an artificial turf must satisfy as part of the Rugby Turf Performance Specification, includes a programme of simulated use to assess the ability of a surface to perform over a period of time. The degree of simulated use undertaken on a product is designed to replicate levels of use which are significantly greater than those achieved by natural turf systems. Potential installers of artificial turf fields should note, however, that experience has shown fields subjected to overuse will not be able to retain the demanding performance criteria of the Rugby Turf Performance Specification for the life of the playing surface. Manufacturers of Rugby Turf systems should be able to clearly advise on the weekly usage of these surfaces for rugby. Failure to undertake adequate maintenance will also reduce the period of time a field may satisfy the requirements of the Rugby Turf Performance Specification.

This edition of the manual supersedes previous editions with effect from January 1st 2018.

2. The World Rugby Process to Achieve Successful Field Certification

Unions, clubs or organisations seeking to install/use Rugby Turf must comply with the Rugby Turf Performance Specification.



3. Manufacturers

It is the manufacturer's responsibility to ensure that any product being installed has been previously tested in the laboratory by an Accredited Test Institute (ATI) to ensure it meets the requirements set out in this specification.

The manufacturer should consult with an ATI to ensure that the correct components are submitted to enable the test to be carried out in accordance with this specification.

The minimum size of the samples provided for type testing must be in compliance with the performance specification. In instances where yarns of multiple thicknesses are to be tested, it is sufficient for the thinnest yarn to be tested for UV resistance and the thickest yarn (for simulated wear, assuming that the tuft density is equivalent) as long as the chemical composition of the yarns in question are technically similar.

Manufacturers must provide a product declaration to World Rugby before the product testing can be undertaken.

Prior to installation, manufacturers must be able to provide evidence (in the form of a World Rugby Product Test Certificate) that the product has been shown to comply with the product test requirements outlined in this Performance Specification to the client who is undertaking the installation and also to the Union which has jurisdiction over the venue.

World Rugby Preferred Turf Producers will be issued a certificate on verification from an ATI that a field is Regulation 22 compliant for fields that do not have the designation of "Suitable for training only".

4. Test Institute Requirements

Type of Accredited Test Institute

There are two distinct types of ATI:

- Product Testing ATI – the ATI is accredited to fully test artificial turf systems in the laboratory to determine if they [satisfy] comply with Step 4 (see above) of the field approval process.
- Surface Testing ATI – the ATI is accredited to fully test artificial turf fields to determine if they comply with World Rugby Regulation 22.

Some ATI are both surface testing and product testing ATIs and other ATIs are surface testing ATIs only.

Requirements

- All ATIs must be independently owned entities with no legal links (save for service contracts) with any manufacturer or other industry based entity.
- ATI's are required to demonstrate their capability of performing the tests required of Regulation 22. This is partly completed by their achievement of ISO 17025 certification for all tests required.
- In addition to ISO accreditation, ATIs are required to have at least one accredited technician within their organisation. Accreditation is achieved via a Round Robin, organized by World Rugby in conjunction with FIFA to ensure that they can demonstrate competence.
- All ATIs must have a current contract with World Rugby.

Round Robins

- Product testing Round Robins are expected to take place every 2-3 years and will require ATIs to test given products and to submit the results to World Rugby for assessment. World Rugby reserves the right to have an independent representative on site while the testing is being completed should it be deemed necessary.
- Surface testing Round Robins will take place at least annually in a location decided upon by World Rugby, in conjunction with FIFA. Further details on these prerequisites are available in the next section.

Equipment

ATIs must own their own equipment and have calibration certificates and any other requirements as set out in ISO 17025. Outsourcing of product testing is not permitted except in exceptional circumstances and only by a laboratory that is ISO 17025 accredited for that test and with acknowledged permission from World Rugby.

Accreditation Expiration

ATI accreditation must be renewed, by the signing of a new contract with World Rugby, every 2 years. ATI Accreditation will expire in instances where:

- They cease to be considered independent by World Rugby.
- The ATI contract expires and no new contract is signed.
- The ATI ceases to have an accredited technician employed/contracted.
- The terms of the contract are not met and the contract is invalidated.

In instances where product testing ATIs cease to be accredited they can, once the applicable requirements are met, continue to be a surface testing ATI.

Surface Testing Round Robin

Round Robins will be held at least annually by World Rugby in conjunction with FIFA in a location decided upon by World Rugby/FIFA and on a date to be confirmed by World Rugby/FIFA at least four months in advance.

Testing

Round Robins currently consists of the following tests being undertaken by all applicants on a minimum of two artificial turf fields:

- Evenness and Visual Inspection – ONE field ONLY
- Vertical Deformation
- Shock Absorption
- Energy Restitution

- Rotational Resistance
- Vertical Ball Rebound
- Impact Attenuation (HIC)
- Infill Depth

In addition to this, each ATI will be provided with turf, infill and shock pad samples at the Round Robin and will be required to undertake the appropriate tests specified in the Performance Specification. World Rugby reserve the right to add additional tests to the list of tests provided above.

World Rugby reserves the right to alter the format of the Round Robin as necessary.

Equipment

Each technician must complete all testing on his/her own with no assistance from any individual, except where assistance is needed in moving equipment. All ATI's must provide all technicians with their own full set of equipment for testing. It is permissible for equipment to be used by more than one technician during the Round Robin but not at the same time.

Successful Completion

Technicians must submit all test results in the format provided by World Rugby. If this is not done, then the technician will be deemed to have failed that individual test.

The variance of individual technicians' results from the mean for all benchmark technicians will be determined. The Grubbs standard statistical analysis method is used to determine outliers for each test on each field. Any technician who has three exceeded the specified number of permitted outliers on an individual test for an individual field will be considered to have failed that test.

For evenness and visual inspection testing, a technician must identify a minimum specified number of defects identified by the benchmark results. In this instance, World Rugby and FIFA will identify an individual tester to complete this task.

Technicians must pass all tests to be considered to have successfully completed the Round Robin.

Accreditation

Accreditation is received once the technician has been confirmed as passing the Round Robin and their ATI has successfully completed the identification element of the process. Accreditation commences on the day after the Round Robin was completed. Once a technician becomes accredited this accreditation will cease to be valid under any of the following circumstances:

- The accreditation is not renewed within 5 years from accreditation.
- The technician's affiliated test institute is no longer considered an ATI.
- The technician fails to successfully complete a Round Robin – in this instance the technician will be given a one year to successfully complete a Round Robin, if this is not done then accreditation ceases.
- A technician becomes affiliated to another ATI.

Technicians are permitted to reaccredit themselves at any time during the 5 year period, however subsequent reaccreditation must be completed within 5 years from the most recent successfully completed Round Robin.

Reaccrediting technicians who are completing the last possible Round Robin prior to their accreditation expiring will be considered as applicant technicians. Applicant technicians who do not complete the Round Robin successfully will not be considered accredited from the date that that Round Robin ends and will need to complete another Round Robin before they can become accredited.

5. Applicable Test Requirements

The requirements used to assess artificial turfs and installed fields are described in this Rugby Turf Performance Specification. Where a test method is given a dated reference, subsequent amendments to, or revisions of, the requirements will apply to this document only when incorporated into it by amendment or revision. For undated references, the latest edition of the publication referred to applies.

In general the applicability of this specification and others which have preceded it are:

- Products submitted for testing must comply with the performance specification in effect at the date of submission or more recent performance specifications.
- Products submitted for testing must comply with the performance specification in effect at the date of submission or more recent performance specifications.
- Fields installed between the dates given in the table below must comply with the performance specification in place at the time or any subsequent specification.

Table 5.1

Tendered for	Installed	Product Test Requirements	Surface Test Requirements
Pre January 1st 2017	Pre June 1st 2016	Either 2015 or 2016	Performance Specification in place at time of installation
	Post June 1st 2016		2016
Post January 1st 2017	Post January 1st 2017	2016	

In instances where a shock pad which was installed to comply with a previous version of this Performance Specification then the combination of new carpet and old shock pad should be treated as a new product and must comply fully with this latest version of the specification. The laboratory tests can be completed using a new sample of the same shock pad but the shock pad on site must comply with the requirements set out in Section 8.5 below. Furthermore, it is the sole responsibility of the manufacturer to ensure when re-using and existing shock pad that the combination with a new turf complies with the Regulation 22 field requirements.

6. Retest Requirements

As detailed in World Rugby Regulation 22, all fields must be retested a maximum of two years from the date of last test in order to maintain their status as Regulation 22 compliant. Fields intended for use at the following World Rugby tournaments must comply with the stated retest requirements:

Table 6.1

Competition	Applicable pitches	Testing requirements
Rugby World Cup	Match and training venues	A maximum of 3 months prior to the start of the competition
Sevens World Series	Match venues	A maximum of 3 months prior to the first day of competition for that Series

7. Product Test Requirements

7.1 General

Product Test Requirements are separated into 4 distinct groups:

- Performance Testing
- Laboratory Testing
- Ratings
- Identification Testing

Results should be recorded as accurately as the apparatus used allows, averages should be calculated to this number of decimal places or to one decimal place more than the permitted values are expressed in, whichever is the greater.

All white and yellow products used for markings (lines and logos where applicable) must be tested as if individual products. Additional colours used for markings must be subjected to simulated wear and must achieve similar performance when compared to the green, white and yellow markings. These additional colours can be tested when tufted together as long as the area of each colour is no less than 0.2m x 2.5m and the stripe of colour is in the direction of the stitching The FIFA method for assessing this comparison should be used.

7.2 Sample provision

The following samples must be provided to ATIs for product testing to be completed in the order laid out:

Table 7.1 Sample Provision

Sample	Sample 01	Sample 02	Sample 03	Sample 04	Sample 05
Size	3m x 1m	5m x 1m	1m x 1m	0.4m x 0.4m	0.4m x 0.4m
Conditioning	Dry	Lisport XL	Dry	-5°C	As per FIFA Method
Test 01	Shock Absorption	Shock Absorption	Angled Ball Rebound	Shock Absorption	Heat Test
Test 02	Energy Restitution	Energy Restitution	Re-condition	Energy Restitution	
Test 03	Vertical Deformation	Vertical Deformation	Infill splash	Vertical Deformation	
Test 04	Rotational Resistance	Rotational Resistance	Surface Friction and Abrasion	Impact Attenuation (HIC)	
Test 05	Impact Attenuation (HIC)	Impact Attenuation (HIC)			
Test 06		Reduced Ball Roll			
Test 07		Vertical Ball Rebound			
Test 08		Skin Friction/Abrasion			
Conditioning	Wet	Wet	Wet	+50°C	
Test 07	Shock Absorption	Shock Absorption	Angled Ball Rebound	Shock Absorption	
Test 08	Energy Restitution	Energy Restitution		Energy Restitution	
Test 09	Vertical Deformation	Vertical Deformation		Vertical Deformation	
Test 10	Rotational Resistance	Rotational Resistance		Impact Attenuation (HIC)	
Test 11	Impact Attenuation (HIC)	Impact Attenuation (HIC)			
Test 12	Vertical Ball Rebound	Vertical Ball Rebound			

7.3 Performance Testing

Table 7.2 below indicates the tests, test methods and permitted limits for the performance testing completed in the laboratory. Performance testing is used to mimic and measure how players and balls interact with the surface under different conditions.

Simulated Wear refers to conditioning of the product using the Lisport XL apparatus for 6,000 cycles plus 20 additional conditioning cycles.

Table 7.2 Performance Testing

Property	Test Method	Test Conditions			Requirements
		Preparation	Temperature	Condition	
Vertical Ball Rebound	EN 12235 (expressed as absolute)	Pre-conditioned	23°C (±2°C)	Dry	0.6 – 1.0m
				Wet	
		Simulated Wear		Dry	
Angled Ball Rebound	FIFA Method	Pre-conditioned	23°C (±2°C)	Dry	45% - 70%
				Wet	
Shock Absorption	AAA	Pre-conditioned	23°C (±2°C)	Dry	57% - 68%
				Wet	
		Simulated Wear		Dry	55% - 70%
		Pre-conditioned	50°C (±2°C)	Dry	57% - 68%
		Pre-conditioned	-5°C (±2°C)	Frozen	
Energy Restitution		Pre-conditioned	23°C (±2°C)	Dry	22% - 48%
				Wet	
		Simulated Wear		Dry	20% - 50%
		Pre-conditioned	50°C (±2°C)	Dry	22% - 48%
		Pre-conditioned	-5°C (±2°C)	Frozen	
Vertical Deformation		Pre-conditioned	23°C (±2°C)	Dry	6 – 10mm
				Wet	
		Simulated Wear		Dry	5.5 – 11mm
		Pre-conditioned	50°C (±2°C)	Dry	6 – 10mm
		Pre-conditioned	-5°C (±2°C)	Frozen	
Impact Attenuation (Head Impact Criteria)	World Rugby Test Method 01*	Pre-conditioned	23°C (±2°C)	Dry	≥ 1.3m
				Wet	
		Simulated Wear		Dry	
		Pre-conditioned	50°C (±2°C)	Dry	
		Pre-conditioned	-5°C (±2°C)	Frozen	
Rotational Resistance	EN 15301 – 1 (football studs)	Pre-conditioned	23°C (±2°C)	Dry	32Nm – 43Nm
				Wet	
		Simulated Wear		Dry	30Nm – 45Nm
Reduced Ball Roll ~	FIFA Method	Simulated Wear	23°C (±2°C)	Dry	≤ 10m
Skin / Surface Friction #	FIFA Method	Pre-conditioned	23°C (±2°C)	Dry	0.35 – 0.75
		Simulated Wear (undressed)			
		Simulated Wear (dressed)			
Skin Abrasion #	FIFA Method	Pre-conditioned	23°C (±2°C)	Dry	± 30%
		Simulated Wear (undressed)			
		Simulated Wear (dressed)			

Method A must be used for all laboratory testing

in the interests of clarity these are the most likely tests to be required to be completed on site if issues arise.

~ the reduced ball roll method should be used in the laboratory, the full method should be used if the test is required in the field.

Products that differ only in the number of stitches per linear metre do not require separate tests on the Lisport XL for each combination. In such circumstances, an otherwise similar product with a higher stitch rate than the previously tested one may be approved based on the previous laboratory report. Note: this applies to the requirements in place for after simulated wear only.

Systems that fail to meet the requirements when frozen (at -5°C) will require an underground heating system to comply with the Performance Specification if installed in countries where the temperature falls below freezing annually and must be designated as such, namely not suitable without an underground heating system.

7.4 Laboratory Testing

Table 7.3 below indicates the tests, test methods and permitted limits for the required laboratory testing. Where a test is indicated as aged, artificial weathering should be done in accordance with EN 14836:2005 (UVA) at 5,000 hours' exposure time. Laboratory testing is used to ensure that the product complies with the requirements of tests which cannot be practically performed in situ and relate to the strength and resistance to wear of the product.

Table 7.3 Laboratory Testing following artificial weathering

Property	Characteristic	Test Method	Requirements	
Artificial Turf	Colour Change – Aged	EN ISO 20105-A02	≥ Grey Scale 3	
Pile Yarn(s)	Tensile Strength	EN 13864	Fibrillated	≥ 30N
			Monofilament (per filament)	≥ 8N
	Tensile Strength – Aged		≤ 50% change from Unaged	
	Pile Height	ISO 2549	≥ 60mm	
Polymeric Infill	Colour Change – Aged	EN ISO 20105-A02	≥ Grey Scale 3	
Joint Strength (stitched and bonded)	Unaged	EN 12228 Method 1	≥ 2500N/100mm	
	After immersion in hot water	EN 13744 & EN 12228 Method 1		
Joint Strength (Peel – bonded seams only)	Unaged	EN 12228 Method 2	≥ 25N/100mm	
	After immersion in hot water	EN 13744 & EN 12228 Method 2		
Rugby Turf Strength	Direct Tension (both parallel and perpendicular to stitching)	ISO 13934-1	≥ 25N/mm	
Shock Pads / E-layers (if supplied)	Tensile Strength	EN 12230	≥ 0.15MPa	
Product	Water Permeability	FIFA Method	> 500 mm/h	

Notes on the Laboratory Testing Requirements:

- In instances where a local requirement exists, which exceeds the UVA exposure requirement of 5,000 hours, then local requirements shall supersede this requirement.
- In instances where the water permeability requirement is not met, the product may still be used specifically for indoor use and on bases designed to be impermeable. Furthermore, World Rugby reserves the right to provide dispensation on a case by case basis to systems that are installed in specifically low rainfall areas of the world where the permeability requirement may be irrelevant.
- In circumstances where the building materials used prevent the construction of a permeable sub-base the system should be designed to allow horizontal movement of rainwater to avoid the field flooding. In such circumstances, the tolerances permitted for the surface under a 3m straightedge should be reduced to ≤6mm.

7.5 Categories

Table 7.4 below indicates the tests and test methods for the turf categories that need to be defined. The ratings are used to give an indication as to the suitability of the product for different climatic conditions and also an indication of the amount of splash that can be expected from the surface.

Table 7.4 Ratings

Property	Test Method	Possible Ratings
Heat	FIFA Method	To be determined in line with FIFA
Splash	FIFA Method	Typical (<10%) – High (≥10%)

7.6 Identification Testing

Table 7.5 below indicates the tests, test methods and required limits for the identification testing completed in the laboratory. Identification testing is used to ensure that the product tested in the lab is identical to that installed on the field. It helps in protecting the owner's investment as well as ensuring that the surface can achieve the performance levels for those tests that cannot be completed on the field.

Table 7.5 Identification Testing

Component	Characteristic	Test Method	Permitted variation between laboratory component and manufacturer's declaration
Rugby Turf	Mass per unit area	ISO 8543	≤ ± 10%
	Tufts per unit area	ISO 1763	≤ ± 10%
	Tuft withdrawal force	ISO 4919	≥ 40N
	Tuft withdrawal force post immersion in hot water	EN 13744 & ISO4919	≥ 35N
	Pile Height	ISO 2549	≤ ± 5%
	Pile weight	ISO 8543	≤ ± 10%
Yarn (per yarn)	Pile Yarn Characteristic	DSC – ISO 11357-3	≤ ± 3°C (for all peaks)
	Pile Thickness (Width and Depth)	FIFA Method	≤ ± 10%
	Dtex*	See below	≤ ± 10%
	Shape	FIFA Method	>90% for all dimensions
Infill (per infill)	Layer thickness	EN1969	≤ ± 15%
Performance Infill (if supplied as part of the system)	Particle Size	EN 933 – Part 1	± 1 Sieve Size
	Particle Shape	EN 14955	Similar Shape
	Bulk Density	EN 1097-3	≤ ± 15%
	% Organic	TGA	≤ ± 10%
	% Inorganic		≤ ± 10%
Stabilising Infill (if supplied as part of the system)	Particle Size/Grading	EN 933 – Part 1	± 1 Sieve Size
	Particle Shape	EN 14955	Similar Shape
	Bulk Density	EN 1097-3	≤ ± 15%
Shock Pads / E-layers (if supplied)	Thickness	EN 1969	≥ 90%
	Shock Absorption	AAA	≤ 5% of the Absolute Force Reduction value
	Vertical Deformation	AAA	≤ 2mm from declared value

* Dtex (g per 10,000m) shall be calculated from the mean weight (measured to 0.01g) and mean length (measured to 1mm) of a minimum of 40 tufts removed from the artificial turf.

7.7 Use of Data from Previously Tested Artificial Turf – Resistance to Artificial Weathering

If an artificial turf product has been previously tested by a World Rugby Accredited Test Institute for resistance to artificial weathering the results may be used for the new rugby product where it complies with the requirements in Table 7.6 below.

Table 7.6

Property	Test Requirement	Tolerance
Pile characteristic	DSC - ISO 11357 - 3	Within ± 3°C of declared value for all peaks
Pile thickness	FIFA Method	≥ 90% of declared value
Colour	RAL Number	To be similar to declared colour

8. Surface Test Requirements

World Rugby and the World Rugby Member Union or the client must receive evidence, from an Accredited Test Institute, that the system that is due to be installed has gone through all the relevant laboratory testing and has met all requirements of such. The manufacturer/World Rugby Preferred Turf Producer must submit the relevant documentation to World Rugby and the World Rugby Member Union, or the client in whose jurisdiction the field lies, in advance of the installation.

Any product being installed must have been lab tested and be shown to comply with Regulation 22 prior to the installation taking place.

Surface Test Requirements are separated into four distinct groups:

- Performance Testing
- Laboratory Testing
- Visual Inspection
- Construction

The field shall be tested in the positions as specified in Section 8.6 below. Field tests should be carried out on areas of turf which do not contain seams, inlaid lines or painted on lines. Maintenance of the field shall not be undertaken during the field test therefore no brushing, levelling or topping up of infill should be carried out. Should a minor problem be identified during testing which can be resolved within 24 hours the World Rugby Accredited Test Institute may be commissioned to return to the field to complete the testing programme.

Weather conditions during the test should allow for the proper and correct performance of the test procedures which should not be hindered or altered by wind, rain or cold conditions. Testing will be conducted within the temperature range +5°C to +45°C (temperatures refer to the surface temperature of the infill materials). Wind speed should not be so great as to affect the testing process, namely a maximum of 2.0m/sec. Pitches must be re-tested every within two years from the date of the last successful test.

The number of test areas on smaller pitches, e.g. training pitches, must be pro-rated by area using the 15 test points within the field of play, where six test points is the minimum number for any field.

Results should be recorded as accurately as the apparatus used allows, averages should be calculated to this number of decimal places or to one decimal place more than the permitted values are expressed in, whichever is the greater.

In the event that an ATI becomes aware of any issues relating to testing, performance or compliance of a playing surface they must immediately report the issue to World Rugby.

In instances where there are safety or quality concerns that may affect the suitability of the field to be used for rugby, World Rugby reserve the right to include any lab based test that is not normally conducted on the field or any other additional test that it deems appropriate to assess the field's suitability or otherwise.

8.1 Performance Testing

Table 8.1 below indicates the tests, test methods and required limits that must be achieved for a surface to be considered Regulation 22 compliant.

Variance is the maximum variation that is permitted between the average reading for all locations and that of any individual location assuming all results are within the required limits.

Table 8.1 Performance Testing

Characteristic	Test Method	Requirements	Variance
Vertical Ball Rebound	EN 12235 (absolute)	0.60m – 1.0m	±0.1m
Shock Absorption	AAA Version	55% – 70%	±5%
Energy Restitution		20% – 50%	±6%
Vertical Deformation		5.5mm – 11.0mm	±2mm
Impact Attenuation (HIC)	World Rugby Test Method 01*	≥ 1.3m	-
Rotational Resistance	EN 15301 - 1	30Nm – 45Nm	±4Nm

* Procedure B must only be used where the CFH calculated is greater or equal to 1.45m

In instances where World Rugby deem it appropriate the inclusion of a ball roll test can be included in the performance testing.

Table 8.2 Performance Testing - Ball Roll

Characteristic	Test Method	Requirements	Variance
Ball Roll	FIFA Method	≤ 10m	±10%

8.2 Visual Inspection

Prior to, and during, the field test programme it is necessary to conduct a visual inspection of the surface to ensure that there are no significant defects in the surface which could be hazardous to players. Features including, but not limited to, the following should be noted:

- Seam failures of any type such as lumps of glue, incorrect stitch orientation and missing tuft lines
- Looped yarn/pile
- Delamination of the adhesive from the turf
- Free pile height
- Uneven fill - low or high areas
- Exposed irrigation heads
- Exposed goal and flag sockets
- Upright goals
- Position of goals
- Loose socket covers for goal sockets
- Loose or dangerous goal structures or flags which do not comply with safety requirements
- Checks should also be made to ensure that the line markings are; straight, in the correct position, the right colour and in line with the laws of the game.
- Presence of maintenance equipment.
- Any other untypical feature of the system

Where a World Rugby Accredited Test Institute deems that there is an issue which may constitute a hazard on the field of play then the manufacturer/World Rugby Preferred Turf Producer/installer shall be required to make safe the issue identified to the satisfaction of the World Rugby Accredited Test Institute, prior to the issue of the Field Test Report to the World Rugby Member Union in whose jurisdiction the field lies.

Note: The shock pad may have been sampled and tested to identify the aforementioned properties at tender stage however it is important that the exposed shock pad is checked when the old carpet is removed prior to the installation of the new turf by an ATI for the issues identified above to ensure it has retained its sports functional characteristics.

8.3 Identification Testing

Identification testing is completed at the initial test phase, on retest only those necessary identification tests are undertaken. Table 8.3 identifies the tests, test methods and required variations from the manufacturers' declarations that must be completed on initial and on retests. Table 8.4 identifies the tests, test methods and required variations that must be completed on initial test only.

The samples of artificial turf shall be supplied to the laboratory when they undertake the field test. Samples of yarn, sand and rubber from the field shall be obtained by the laboratory. Samples should be submitted in adequate time so that if it is found they do not comply with the requirements of the World Rugby specification a new laboratory test using the new materials can be made prior to installation of the artificial turf and subsequent field test.

Table 8.3 Identification testing – initial and retest

Component	Characteristic	Test Method	Permitted variation between laboratory component and manufacturer's declaration
Rugby Turf	Pile Height	ISO 2549	≤ ± 5%
Yarn (per yarn)	Pile Thickness (Width and Depth)	FIFA Method	≤ ± 10%
Infill (per infill)	Layer thickness	EN1969	≤ ± 15%
Performance Infill (if supplied as part of the system)	Particle Size/Grading	EN 933 – Part 1	± 1 Sieve Size
	Particle Shape	EN 14955	Similar Shape

Stabilising Infill (if supplied as part of the system)	Particle Size/Grading	EN 933 – Part 1	± 1 Sieve Size
	Particle Shape	EN 14955	Similar Shape

For Rugby Turf tests the above measurements shall be made in four different areas of the field not subjected to high areas of wear or usage.
For infill samples, a minimum sample of 250g shall be taken from the top portion of the performance infill (20mm) on six of the test positions detailed in Diagram 8.1.

Table 8.4 Identification testing – initial only

Component	Characteristic	Test Method	Permitted variation between laboratory component and manufacturer's declaration
Rugby Turf	Mass per unit area	ISO 8543	≤ ± 10%
	Tufts per unit area	ISO 1763*	≤ ± 10%
	Tuft withdrawal force	ISO 4919	≥ 40N
	Pile Height	ISO 2549	≤ ± 5%
	Pile weight	ISO 8543	≤ ± 10%
	Water Permeability of System	FIFA Method	> 500 mm/h & >75% of laboratory result
Yarn (per yarn)	Pile Yarn Characteristic	DSC – ISO 11357-3	≤ ± 3°C (for all peaks)
	dTex	See below	≤ ± 10%
	Shape	FIFA Method	>90% for all dimensions
Performance Infill	Bulk Density	EN 1097-3	≤ ± 15%
	% Organic	TGA	≤ ± 10%
	% Elastomer	TGA	≤ ± 10%
Stabilising Infill	Bulk Density	EN 1097-3	≤ ± 15%
Shock Pads / E-layers (if supplied)	Thickness	EN 1969	≥ 90%
	Shock Absorption	AAA	≤ 5% Force Reduction
	Vertical Deformation	AAA	≤ ± 10%
Unbound sub-bases (if tested as part of the system)	Composition	-	Same Composition
	Particle Size Range	EN 933 – Part 1	≤ ± 20%
	Particle Shape	EN 14955	Similar Shape

* When testing lines, the adjusted method of determining the stitch gauge included in Appendix 1 should be used.

Dtex (g per 10,000m) shall be calculated from the mean weight (measured to 0.01g) and mean length (measured to 1mm) of a minimum of 40 tufts removed from the artificial turf.

8.4 Construction

Table 8.5 details the tests, test methods and requirements that must be completed for a surface to be considered Regulation 22 compliant.

Table 8.5 Construction testing

Characteristic	No Specific Requirement	
Slope	Surveyor's Level	Maximum Slope 1%
Surface Regularity	EN 13036 3m straight edge	≤ 10mm
Infill depth	EN1969	2 locations are permitted to vary by >5mm from the average.

Table 8.6 Sub-base testing

Component	Characteristic	Test Method	Permitted variation between laboratory component and manufacturer's declaration

Unbound sub-bases (if tested as part of the system)	Composition	-	Same Composition
	Particle Size Range	EN 933 – Part 1	≤ ± 20%
	Particle Shape	EN 14955	Similar Shape

8.5 Use of Existing Shock Pad Systems and Other Base Types

If an existing artificial turf pitch is converted to an artificial rugby pitch in the refurbishment of an old pitch, there may be existing shock pad systems which can be retained and incorporated into the new pitch. Existing shock pad systems can be retained so long as the following requirements are verified by in-situ testing by an independent laboratory:

1. The mean shock absorption of the existing pad is between 90% and 110% of the manufacturers declared shock absorption value when the product was initially submitted for type approval.
2. The mean shock absorption of the existing pad is between 90% and 110% of the manufacturers declared shock absorption value when the product was initially submitted for type approval.
3. The water permeability of the laid shock pad is greater than 500mm/hr when tested in accordance with EN 12616.
4. Evenness testing as per EN 13036 with a 3m straight edge should be completed. No undulations greater than or equal to 10mm should be present.
5. No shrinkage gaps greater than 10mm should be present for assembled pads.
6. Visually, there is no apparent binder failure or loose friable rubber or significant variance in all areas.
7. There is no visible damage to the shock pad, any such areas would require replacement with new material.

Note: The shock pad may have been sampled and tested to identify the aforementioned properties at tender stage however it is important that the exposed shock pad is checked when the old carpet is removed prior to the installation of the new turf by an ATI for the issues identified above to ensure it has retained its sports functional characteristics.

The installed shock pad shall be tested for each property above in a minimum of 6 positions which provide for a range of usage levels across the field. Tests on the existing shock pad shall be carried out prior to refurbishment, but in any case no longer than 12 months prior to the initial field test, to ensure that the properties of the shock pad do not change in this period. The consistency requirements in place for the field will apply to each of these tests. If the pad has been exposed for any extended length of time then testing should be completed to ensure that UV exposure has not affected the performance. This dispensation does not negate the need for the field to fully meet the Rugby Turf Performance Specification.

8.6 Test Locations

The number of test locations depends on the size of the surface to be tested. For full size rugby fields Diagram 8.1 indicates the test locations to be used:

- All locations indicated must have AAA, infill depth and pile height tests performed
- Blue and yellow marked locations must have Impact Attenuation (HIC), Rotational Resistance and Vertical Ball Rebound tests performed on them.
- Ball Roll should be undertaken in six locations chosen by the technician but which give a good indication of the overall condition of the field.

Locations 17 and 18 should be identified as the most high-use areas along each of the touchlines.

Note that the location marked in yellow (No.19) is a variable location that should be selected as the location on the Playing Area which is closest to the point of entry of the field. In instances where there are multiple points of entry the most used or the location likely to experience the most wear should be selected.

Any additional areas of concern (for example, sprinkler head or man-hole covers) should be tested in addition to the locations indicated in Diagram 8.1.

Table 8.7 indicates the number of test locations that should be used for various surface areas:

Table 8.7 Applicable test locations

Area (m2)	AAA	VRB, HIC & RR Tests	Ball Roll	Infill depth
≤ 3,000	6	3	3	6
3,001 – 6,000	12	5	4	12

6,001 – 6,500	15	7	5	15
≥ 6,501	19	9	6	19

Pitch Plan with Test Points

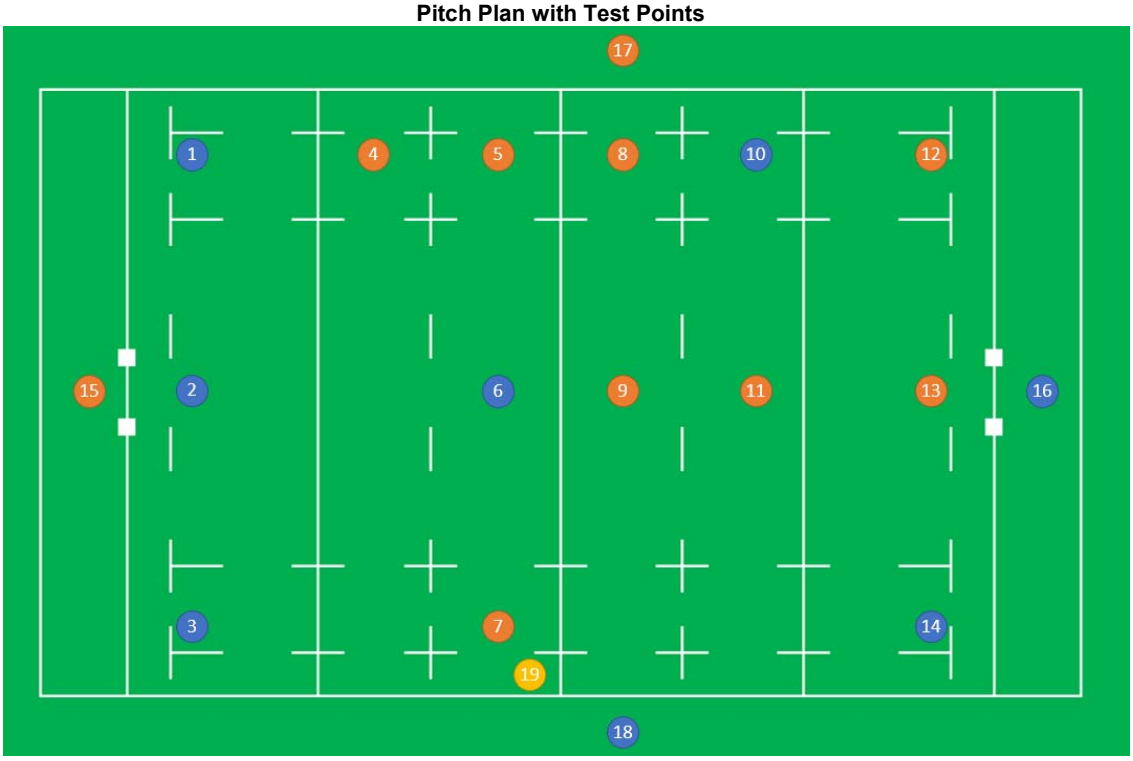


Diagram 8.1

9. Field dimensions and markings

The World Rugby Laws of the Game stipulate the required dimensions of the field of play in Law 1 – The Ground (www.worldrugby.org). In cases where there is variation from the World Rugby Laws of the Game and a preferred size cannot be achieved then it will be the responsibility of the World Rugby Member Union to declare a field of play suitable for matches in terms of dimensions.

9.1 Field Dimensions

To be deemed appropriate for hosting international matches the field of play must comply fully with the requirements set down in Law 1 of the Laws of the Game.

These measurements should be taken as follows:

- Field Width is measured from the inside of the touchline to the inside of the opposite touchline
- Field Width excludes the goal line
- The in-goal includes the goal line but excludes the dead ball line
- Carpet size and site dimensions are the dimensions of the entire area covered by rugby turf. In instances where this is not rectangular the shortest dimension should be declared.

Any field which has dimensions smaller than 80m long and/or 55m wide will be considered suitable for training only.

9.2 Field Markings

The field shall be field marked in accordance with Law 1 – The Ground as detailed in the World Rugby Laws of the Game. The line markings and respective competition regulations must be met and checked by the relevant World Rugby Member Union.

All turf used for line markings and any other inlaid designs included on the field must undergo and comply with the same identification tests as the turf used for the main field. On retest, the pile height for these areas must match that of the main field and be checked for fibrillation of fibres. In cases where substantial fibrillation has occurred, the field will be deemed to have failed and the sections must be replaced prior to the field being considered compliant. Guidance will be provided to test institutes regarding what constitutes substantial fibrillation on the test report document. If there is any doubt about whether substantial fibrillation has occurred World Rugby should be consulted for a decision.

Photographic evidence of the condition of the lines must be provided with every retest and justification for the opinion provided by the tester included.

In instances where lines for other sports are present, these must also comply with the requirements set out above.

10. Maintenance

The maintenance regime provided by the manufacturer must be available for inspection by the accredited technician during field testing. This should include the full package of maintenance training provided, equipment used and the maintenance testing equipment supplied. This equipment should be consistent with the recommendations of the manufacturer.

Following the maintenance practices as issued by the manufacturer/Preferred Turf Producer/installer forms a fundamental part of the care of an artificial turf pitch. Procedures and equipment are prescribed by the manufacturers of the artificial turf system which, if followed, will assist in keeping the field of play in good condition. The most important aspect of these procedures for Rugby is maintaining high performance and ensuring a safe surface for the players. It is essential that properties such as shock absorption are maintained due to the nature of the game which involves contact between players and the surface. Maintenance is crucial to player welfare, the quality of play, longevity of the playing surface and overall aesthetics of the field. Where World Rugby deems that in its opinion an inadequate maintenance regime is recommended, it reserves the right to adjust this regime accordingly.

The manufacturer/World Rugby Preferred Turf Producer's guidance document will contain specific instructions on how to maintain a pitch and what type of equipment to use. In the context of this document maintenance is referenced to highlight the impact it can have on the safety and performance of a field.

11. Temporary Run-offs

Where a temporary surface is required to extend the run-off areas around a natural turf rugby field, the specification above must be met in its entirety except for the following three aspects:

Table 11.1

Section	Property	Characteristic	Test Method	Requirements
7.4	Pile Yarn(s)	Pile Height	ISO 2549	≥ 50mm
7.4	Joint Strength		No Specific Requirement	
7.1	Simulated Wear		FIFA Method	3,000 Cycles

The following restrictions also apply:

- A temporary surface is defined as one which is installed for not more than 65 days per calendar year and not for more than 4 days at a time, unless being used for a tournament not lasting more than 8 weeks.
- The temporary surface cannot be installed on any part of the playing area, this also includes the touchlines, touch-in-goal lines and dead ball lines. Any artificial surface that is installed as part of any part of the playing area must comply fully with the requirements set out in Sections 1-10 above.
- The temporary surface must have a method of connecting individual sections securely to ensure that the pieces do not separate during use. The weight of the surface must not be the only factor ensuring that the surface stays in place.
- The installation of the temporary surface should be installed so as to minimise the risk to players when sliding across or treading upon the join between the two surfaces.
- Where the installation is on a running track, consideration of the presence of varying surface types and obstructions (jumping pits, throwing areas, water hazard, etc.) should be made to ensure that the consistency of performance of the field is met as required within this specification.
- Where the temporary surface is installed on an existing sports surface, performance of this surface must be taken into account when designing the performance of the temporary surface. It is recommended that the temporary surface is tested in the lab, using a sample of the intended sub-surface or something similar in performance prior to installation to ensure compliance will be achieved. The sample should be aged to perform to a similar level as the existing site where relevant.
- Meeting the above restrictions is not in itself validation that the surface will be safe, the venue management must undertake a risk assessment of the solution in situ and act on any issues arising from this assessment.

12. World Rugby Test Methods

Test Method 01 - Determination of Critical Fall Height (CFH) using Head Injury Criteria (HIC)

Determination of Critical Fall Height (CFH) using Head Injury Criteria (HIC) (World Rugby Test Method 01)

September 2017

1. Principle
   1.1. A head form is released from a series of four heights and the HIC for each impact is recorded, the critical fall height (CFH) at which HIC would equal 1,000 is then estimated using a regression model.
   1.2. This test is undertaken in the laboratory under various conditions including pre-and post-simulated wear as well as a field test.

2. Apparatus

   2.1. A 4.6kg (±0.05kg) hemispherical head form with a 160mm (±5mm) diameter with an accelerometer is used. The impacting part of the head form between the lower boundary and accelerometer shall be homogenous and free from voids. For wired head forms the mass of the wires and any connections should be accounted for in the determination of mass. For the purpose of clarity, this head form has the same specification as the head form defined in EN 1177[1].

   2.2. A means of suspending the head form statically prior to dropping it at various heights with the rounded surface (contact surface) facing towards the surface. Where required, it must be possible to reproduce the drop height for subsequent drops. The drop height must be measured using one or both of the two following options:
   - A direct measurement device from the bottom most part of the head form to the top of the infill or
   - A combination, where the two results must differ from each other by no more than 1%, of:
     i. Using Δt, the time between release and contact of the head form with the surface, and the formula $s = \frac{1}{2}a\Delta t^2$ where s is the drop height and a is the acceleration due to gravity.
     ii. Using the impact velocity (v) and the formula $s = \frac{v^2}{2a}$ where s and a have the same meanings as (i) above.

   Note: Attention should be paid to the potential for lag to be created by the release system

   2.3. A means of measuring the impact including:
   - an accelerometer measurement system capable of measuring, recording and displaying the acceleration and time duration for each complete impact. It should have a frequency range of 20-1,000Hz (-3dB).
   - Amplitude errors below 5%, in accordance with ISO 64873 Channel Class 1000. It shall be capable of measuring, recording and displaying the acceleration and time duration of each complete impact.
   - A recording device capable of measuring the acceleration/time signals of the accelerometer with a sampling rate of at least 5kHz and a means of displaying the recorded signal.
   - A means of calculating the HIC for each drop, as per Section 3 below, and a means of completing a regression analysis on the results achieved.

   2.4. The apparatus must be calibrated by a competent laboratory in accordance with ISO 17025[2] requirements.
   Signal conditioning and filtering shall be compatible with the accelerometer and the data channel specified. This process shall conform to ISO 6487.
   NOTE: According to ISO 6487[3], the analogue anti-aliasing filters should have an attenuation minimum of 30dB at half the sampling rate.

   2.5. Validate the apparatus using one drop at a known drop height which must be ≥1,000mm (to be physically measured and compared (±5%) with that calculated from the time between release and contact with the surface) on a reference against the expected HIC performance (±5%) for the sample before undertaking a series of lab tests or field tests. It is recommended that the reference sample be tested at a range of temperatures to allow for environmental variances on site at a frequency of at least once every 25 field tests or once a month, whichever is more frequent.

3. Test Procedure

3.1. For laboratory testing, testing shall be carried out on a flat, rigid, concrete substrate of sufficient mass, density and thickness that its deformation during the test makes no significant contribution to the test result. The minimum requirements for this surface are:
- Thickness of 100mm
- Concrete hardness of 40MPa, verified according to EN 12504-2[4]

3.2. For each location to be tested the characteristic HIC for four separate and distinct drop heights must be calculated.

3.3. Calculate the characteristic HIC for a given drop height by one of the following procedures:
- PROCEDURE A
  - Perform three drops of the head form from the same height onto the same location on the surface so that the impact centres for the three drops are as close as possible to the same point on the surface.
  - Calculate the HIC for each individual impact using the formula:
  - $HIC = \left\{\left[\frac{1}{t_2-t_1}\int_{t_1}^{t_2} a(t)dt\right]^{2.5}(t_2-t_1)\right\}_{max}$
  - Where t1 and t2 are the initial and final times (in seconds) of the interval during which HIC attains maximum value, and acceleration a is measured in terms of g.
  - If $t_2 - t_1 < 3ms$ then the impact will be considered invalid and the test will be restarted for that drop height on an area which has had no previous testing completed on it for that location.
  - Use the largest HIC value of the three calculated as the characteristic HIC value for that drop height.
  - The drop height (in mm) and the three HIC values calculated must be recorded.

- PROCEDURE B
  - Perform one drop of the head form from the drop height onto a point on the surface.
  - Calculate the HIC for this impact using the equation specified in 3.3.1 above.
  - Use this HIC value calculated as the characteristic HIC value for that drop height.
  - The height and HIC calculated must be recorded.

3.4. Calculate the characteristic HIC for four separate heights ensuring that the following has been achieved:
- The lowest and highest drop height are not more than 1,000mm apart
- There is at least 150mm difference between all individual drop heights
- There must be two drop heights with a characteristic HIC value greater than 1,000 and two drop heights with a characteristic HIC value less than 1,000..
- There must be no characteristic HIC values between 975 and 1,025.
- The impact centre for a given drop height test must be at least 200mm from the impact centre of any other drop height test, in instances where there is significant displacement of infill, this should be increased at the operator's discretion.
- All impact centres for a given test location must be within a square area of side 1,000mm.
- No impact centre must be closer that 150mm from the edge of the surface.

3.5. When the characteristic HIC for all four drop heights have been calculated plot the drop height (x-axis) against the characteristic HIC. Using a linear regression model (with the y-intercept calculated normally) determine the drop height at which the HIC value is predicted to be equal to 1,000.

3.6. This drop height is the Critical Fall Height (CFH).

4. Laboratory testing:

4.1. For laboratory testing on a sample size smaller than 0.64m2 it is permissible to use the following method:

4.2. Using a drop height equal to the minimum CFH requirement specified use Method A in 3.3.1 above to calculate the characteristic HIC value for that drop height.

4.3. If this characteristic HIC value is less than 1,000 then the test is deemed to have been passed the requirement.

4.4. If this characteristic HIC value is ≥1,000 then the test is deemed to have failed.

5. Expression of results

5.1. The following information must be reported for each test location:
- The four drop heights used (in mm)
- The HIC calculated for each drop at each of the four drop heights
- The characteristic HIC for each of the four drop heights
- The Critical Fall Height (in mm) determined.

6. Normative references
1. EN 1177 - Impact attenuating playground surfacing — Methods of test for determination of impact attenuation
2. ISO 17025 - General requirements for the competence of testing and calibration laboratories
3. ISO 6487 – Road vehicles – measurement of impact velocity instrumentation
4. EN 12504-2 – Testing concrete in structures -Part 2: Non-destructive testing – Determination of rebound number.