WORLD BOWLS

World Bowls Performance Standards For Flat Green Bowls Surfaces

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Acknowledgements

These Standards were prepared for World Bowls by Dr Keith McAuliffe on behalf of the recognised World Bowls greens testing houses and World Bowls. The Board and Officers of World Bowls wish to congratulate, and acknowledge Dr McAuliffe's considerable contribution, along with that of all those involved in the Performance Standards Review Process.

Disclaimer

The information in this standard is provided in good faith. The publishers accept no responsibility for the use or misuse of the information herein.

Contents

Foreword

This document outlines the testing procedure and performance standards for flat green bowls surfaces.

The Standard is primarily intended to be of relevance to clubs and local authorities requiring guidance when purchasing a synthetic sports surface for flat green bowls. The performance requirements given in this Standard are intended to meet top level competition and club standards but are also suitable for recreational needs.

Whilst this Standard details the performance requirements of a synthetic bowling green, it does not address materials, ageing and changes in performance, durability or environmental characteristics for which appropriate national standards may apply, or individual site requirements and methods used during the construction of an installation.

The characteristics detailed in this Standard may be influenced by the entire structure of a facility and not just the synthetic sports surface. It is important when testing surfaces or reviewing test results that the surfacing and its supporting layers are representative of the entire construction being considered.

A site should be investigated before a facility is constructed, with a view to ensuring its suitability. The investigation should include a measurement of existing site dimensions, site levels, contact with statutory services (gas, electricity, water etc) and for outdoor greens, determination of the ground's load bearing capacity, its ability to drain and the soil structure. From this data, a design for the construction of the green should be drawn up. If expertise is not readily available for this type of work, help should be sought from technical experts.

Prior to the laying of the carpet or synthetic turf on a bowling green, it is recommended that the base be surveyed by an independent third party to make sure that the green will meet the surface evenness, design level, drainage performance and dimensions criteria as outlined in this document. The only way a base of a bowling green can be rectified once the carpet is installed is to remove the carpet (which can be extremely heavy in the case of a sand filled green) and the surface re-levelled and the carpet re-laid, which can be a very costly exercise.

Part 1. Overview of the testing system

1. Testing houses

1.1 Pre-requisites for recognition as an accredited World Bowls Field Testing House

In order to obtain World Bowls accreditation as a Field Testing House an organization must:

1. Be independent of any commercial product that could be used in the construction of a synthetic turf bowling green surface (including supply of surfacing or sub-base materials and supply of greens construction and maintenance contracting services).
2. Employ at least one specialist staff person who have proven technical competence and experience in the testing of lawn bowls greens. Competence will be evaluated at the Round Robin meet (see below).
3. Have direct access to the necessary equipment required for World Bowls testing and ensure that the equipment used conforms with the specified calibration requirements.

Round Robin testing events will be held every 4 years. The event may involve actual site testing or by using electronic media. A representative from each current testing house must be present at the Round Robin meet in order to gain or retain accreditation. World Bowls may at its discretion opt to invite any applicant wishing to become accredited. World Bowls will set the required standards that must be achieved by testing houses. World Bowls acknowledge the potentially significant cost associated with any site testing exercise and will endeavor to find the most affordable means of hosting a Round Robin event.

1.2. Pre-requisites for recognition as an Accredited World Bowls Testing Laboratory

In order to obtain accreditation as a World Bowls Accredited Testing Laboratory the organization must have:

1. Globally-recognized (e.g. ISO 17025) laboratory accreditation.
2. A recognised and fully equipped and staffed laboratory.
3. All the testing equipment needed to undertake rapid processing of the full synthetic carpet/mat testing in line with the tests required.

World Bowls may from time to time undertake a Round Robin event with the accredited testing laboratories in order to ensure consistency of testing methodology.

2. World Bowls approved lawn bowls surfacing products

2.1 General

World Bowls will offer official endorsement to both products and fully constructed greens (including the respective manufacturing, supply and installation companies) that meet the required World Bowls performance standards and fulfil other requirements as outlined below.

Three (3) types of World Bowls greens certification are available, namely:

- Provisional Product Certification;
- Full Product Certification; and
- Full WB Green Certification.

2.2 Provisional product certification

Companies wanting to introduce a new, untried product to the market can apply for ***Provisional Product Certification.*** The “product” is defined as the carpet or mat layer along with any underlying cushion or shockpad layer.

To obtain *Provisional Product Certification* the product to be used must be sent to and tested by a World Bowls Accredited Laboratory to determine if the materials meet key performance criteria (see Part 2). If the product meets the specified requirements World Bowls may issue a *Provisional Product Certificate*.

The certificate, and other information provided by World Bowls, will make it clear that obtaining *Provisional Product Certification* provides no guarantee that a full installation using the product will meet the

requirements for *Full Product Certification nor Full Green Certification.* Provisional Certification will remain for a maximum of 12 months.

2.3 Full Product Certification

Full Product Certification is to be awarded where at least one green has been built in accordance with a clearly documented standard specification for all components of the construction (including the sub-base, surface product, shock pad if present and any infill) and the green has been successfully tested by a World Bowls testing house and satisfies the World Bowls performance standards.

The supplier of the system used to manufacture and construct the tested and approved product is then permitted to market the product as a ***World Bowls Certified Product***, provided they can ensure that any new green built using the product does not have any significant change *1 in the specifications for all components of the green construction.

**1 Significant change is defined as any alteration (such as pile height or carpet weight) that deviates by more than 5% of the value documented in the original laboratory test report. It is accepted that sub-base and drainage layer materials can vary from site to site, provided the performance of the system meets the value(s) specified.*

The manufacturer of the approved product must ensure that at least one green using the certified product is tested every two years by an accredited testing house in order for the product to retain Full Product Certification.

2.4 World Bowls green certification

Greens that are tested and meet the required World Bowls standards will receive ***World Bowls Green Certification***. This certification only applies to greens that have been tested and approved.

In order to achieve *World Bowls Green Certification* a sample of the product used in the construction of the specific green, along with specifications for the materials used in the construction and the laboratory testing fee, must be sent to an accredited testing laboratory to verify that the material's properties match with the original approved product.

2.5 Additional notes

As part of the process to obtain Provisional Product Certification or Full Product Certification the manufacturing company will be required to provide an endorsement fee to World Bowls, the sum of which is set by the Board and will be reviewed periodically by the Board.
In approving products and systems for certification World Bowls will bear in mind the capacity of the company to provide the required backup and support to clubs in the event of any required remedial work.

3. Promotion of a Greens Quality Assurance Scheme

World Bowls will take a lead in promoting quality standards for greens surfacing globally, to highlight the benefits of using an approved product/company and to have greens tested and ratified as a World Bowls Approved Green.
Manufacturers and installers of newly-built certified surfaces are recommended to promote to clients the benefits of using the World Bowls standards and having greens tested as part of any contract process.

Part 2. Laboratory testing of synthetic bowling green products

1. Brief

The following describes the process for a manufacturer/supplier of a bowls green surfacing product to obtain *Provisional Product Certification* from World Bowls for a bowling green surface (and any associated shock pad).

2. Procedure

The manufacturer shall submit a 2 x 1m sample of the carpet or mat and a 1 x 1m sample of the shock pad (where used) along with the specified testing fee to the testing laboratory. For sand infill carpets a 1 kg sample of the sand to be used as infill is also to be forwarded to the laboratory. The 2 x 1m sample will include a seam that has been joined using the methodology to be used for field installation.

The laboratory will conduct the following tests:

Testing of the carpet/mat.

Test	Method	Recommended standard
Tensile strength of backing		
	ISO 13934-1	8 N/mm
Peel joint strength - bonded joints (before and after En 13744 hot water ageing		
	EN 12228	25N/100mm
Water permeability (complete system)	EN 12616	≥ 500 mm/hr
Artificial weathering - UVB – 2550h	EN 14836	≥ 3 (grey scale) Tensile strength: percentage change from unaged to be below 50%
Colour change	EN 20105-A02	Colour (PPA) shall be green and shall match the reference sample within one position of the Methuen Colour Atlas.
Mass per unit area	ISO 8543	Variation ≤ 10 %
Pile length or thickness	ISO 8543	Match the reference Sample to within +/- 1.0mm; Variation ≤ 10 %
Yarn colour (RAL)	RAL	
Abrasion resistance	EN13672	Weight loss <2% after 2000 cycles
DSC **Note:** Testing will also determine if the pile is non-directional	ISO 11357-3	

Testing of the shock pad and any infill (where used).

Property	
Tensile strength and elongation of shock pad	Shall be at least 0.1MPa. In addition the tensile strength of any prefabricated sheet shockpad shall be no lower than 0.25MPa.
Shock pad thickness	Shall match the reference sample to within +/- 5%, and the density and wt/unit area, to within +/- 10% of the respective values.
Sand infill	Shall consist of non-abrasive, non-staining, well-rounded, dust-free particles matching the reference sample. Reference is made to Standard EN 933 with regard to particle size grading, shape and density of infill material.

Part 3. Performance Standards for Flat Green Bowls Surfaces

1. Scope

This Standard specifies requirements for flat green bowls surfaces, in particular synthetic surfaces. The requirements apply to the complete installation including the synthetic surface, base, sub-base, sub-grade and drainage system.

2. Definitions

For the purpose of this Standard the following definitions apply:

Green The playing area is defined in the current version of the World Bowls Laws of the Sport of Bowls

Rink A division of the Green normally not more than 5.80m or less than 4.30m wide.

Surfacing Top layer or layers, including any shock-pad or other shock absorbing or load spreading layers, which directly provide the sports performance and bio-mechanical response qualities.

Green Speed The number of seconds taken by a bowl from the time of its delivery to the moment it comes to rest approximately 27.4m from the mat line.

Maximum Draw A measure of the greatest distance between the trajectory of a rolling biased bowl and a straight line between its starting and finishing points.

Cushioning The ability of the surface to deflect and absorb energy as a player walks on it.

Infiltration Rate The rate at which water enters the green surfacing.

Design Level A comparison of theoretical and actual levels of an installation at defined locations.

3. Dimensions

The dimensions of the Green shall be as detailed in the Laws of the Sport of Bowls – Crystal Mark, Edition 3, Section 4 – The green, ditch and banks, as published by World Bowls:

The Green

- The green should be either rectangular or square.
- The length of the green in the direction of play shall be between 31m and 40m.
- The green should have a suitable level playing surface.
- The playing surface should be either vegetative or a synthetic surface.
- For domestic play Member National Authorities can decide the standards for greens constructed in line with previous editions of this law.

The Ditch

- The green should be surrounded by a ditch.

- The ditch should be:
  - Between 200mm and 380mm wide.
  - Between 50mm and 200mm deep.
- The ditch should have a holding surface which is free from obstacles and made of a material which will not damage the jack or the bowls.
- For indoor greens, only the end ditches in the direction of play should meet the standards mentioned in paragraphs 2 and 3 above.

The Bank

- The ditch should have a bank against its outer edge.
- The top of the bank should be at least 230mm above the surface level of the green.
- The bank should be vertical and set at a right angle to the surface of the green, or sloped at an angle of not more than 35° from the vertical.
- The surface of the face of the bank should be made of, or be covered with, a material which will not damage the jack or the bowls.
- There should be no steps that could interfere with play either cut into or positioned against the face of the bank.

Division of the green

The green shall be divided into sections called rinks, each not more than 5.80m, nor less than 4.30m wide. They shall be identified in order (e.g. using numbers, letters, Roman numerals etc) with the centre line of each rink being marked on the bank at each end by a peg, disc or other suitable device.

The four corners of the rinks shall be marked by white or brightly coloured pegs made of material which will not damage the jack or bowls and fixed to the face of the bank and flush therewith, or alternatively, fixed on the bank no more than 100mm back from the face thereof.

The corner pegs may be connected by a green thread drawn tightly along the surface of the green, with sufficient loose thread to reach the corresponding pegs on the face or surface of the bank, in order to define the boundary of the rink.

4. Performance

The surfacing shall comply with Clauses 4.1 to 4.5 of this Standard as appropriate.

Unless indicated by the manufacturer or supplier, the surfacing shall meet the appropriate parameters in all climatic conditions in which it may reasonably be expected to be used. In countries in which surfacing could be expected to be damp for significant periods of the year, tests shall be carried out on damp areas. In countries in which the surfacing could be expected to be dry for significant periods of the year, tests shall be carried out on dry areas.

Note: *World Bowls or their accredited laboratories shall determine in advance of testing which surface condition should apply.*

Before commencement of verification tests a facility should be maintained in accordance with the supplier's detailed procedures to the satisfaction of the supplier and facility owners/users.

Greens shall be tested in locations detailed in each test method. If the results obtained are variable or border-line, the test officers shall use their discretion and select additional field locations to evaluate the whole green's ability to comply with this Standard.

If a green is only designed to be used in two opposing directions the test locations for Green Speed and Draw shall be adjusted accordingly.

If an installation is not designed as a full green but only comprises one or more rinks, each rink shall be assessed in the directions of play as appropriate.

4.1 Green Speed

The Green Speed of the surface when measured in accordance with Test Method WBB-01 shall be in the acceptable World Bowls competition range of 10s and 18s. The Green Speed obtained in each test location shall be within ±0.5s of the mean Green Speed.

It is up to each Club and installer to decide what speed is appropriate dependent on the level (international, national or Club level events) of use required and the expectations of the end users (i.e. the bowlers).

4.2 Surface Draw and end point uniformity

Draw
The maximum Draw, when measured in accordance with Test Method WBB-02, of surfaces having green speeds in the range 10s to 14s shall be greater than 750mm, whilst the maximum Draw on surfaces having green speeds in excess of 14.1s shall be greater than 1000mm. The maximum difference between pairs of left and right maximum Draws shall be less than 40%.

Consistency
The perimeter (circumference) of spread of five (5) delivers from the same point of delivery on each hand as measured using WBB-02 shall be:

- <2.3m for greens of speed 10.0-12.0 secs;
- <2.8m for greens of speed 12.1 to 14.0 secs;
- <3.3m for greens of speed 14.1 to 16.0 secs and
- <3.8 secs for greens of speed over 16 secs.

4.3 Surface Evenness

Undulations found on the surface shall be no greater than 3mm, when measured using a 3m straight-edge in accordance with Test Method WBB-03. Undulations of up to 5mm are permissible providing they do not affect the trajectory of a bowl, particularly as it rolls slowly. Undulations greater than 5mm should not occur anywhere on the green.

4.4 Design Levels

The green shall be level. The finished level of the green shall not deviate from the design level when measured in accordance with recognised civil engineering practice, using an optical or laser level, by more than ±7mm.
The difference in height between adjacent spot levels shall not be greater than 3mm.

4.5 Infiltration Rate

The green surfacing shall have an infiltration rate, at the time of construction, greater than 100mm/hr when tested in accordance with WBB-04 B. Such surfaces shall be designated 'Permeable'. The infiltration rate of greens over 12 months old shall be greater than 50mm/hr.

5. Test Report

The test report shall contain the following:

a. The title and date of this Standard: World Bowls Performance Standard for Flat Green Bowls Surfaces.

b. Complete identification of the surfacing tested, manufacturer's reference and previous history.

c. The ambient temperature of test(s) and relative humidity, if tested.

d. The values of Green Speed and maximum difference between the Green Speed in each test location.

e. The mean Green Speed.

f. The values of maximum Draw and percentage difference between left and right draws in each test location.

g. A plan showing all areas where the surface evenness exceeds 3mm.

h. The values of infiltration rate, if tested.

i. The values of surface friction, if tested.

j. The values of surface cushioning, if tested.

k. A plan showing the finished levels of the Green.

l. The designations *Very Fast, Fast, Medium* or *Slow and Permeable* as appropriate.

m. The individual test results, if required.

n. Details of any deviation from the specified procedures.

o. The condition of the surface at the time of the test, i.e. wet or dry.

p. The procedure used to measure infiltration rate.

q. Photographs highlighting key points, including close -up of surface.

Note: *Meeting "World Bowls Performance Standard for Flat Green Bowls Surfaces" on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of this Standard. The accuracy of the claim is therefore solely the responsibility of the person making the claim. Such a declaration is not to be confused with third party certification of conformity, which may also be desirable.*

6. Essential information

The following information shall be supplied by the manufacturer to the purchaser. This information should also, as far as possible, be included in any test reports.

a. Details of which types of paint and/or tape can be applied effectively and without damage to the surface or significantly affecting the sports performance and bio-mechanical response, or other making methods available, e.g. inlaid or woven lines.

b. The method and substances to be used to carry out regular maintenance or cleaning of the surface.

c. The details of any other periodic maintenance, e.g. care during non-playing season, pre-season maintenance, storage, topping up the level of particulate infill and, where appropriate, the materials that may be used.

d. An assurance that the surface does not contain in its finished state any substance which is known to be toxic or carcinogenic when in contact with skin and that no toxic or carcinogenic substance(s) will be released as a vapour, dust or solution during normal use.

e. An assurance by the manufacturer that the surface is capable of being disposed of in a safe manner at the end of its useful life.

Part 4. Methods of Test

This part of the Standard outlines the test methodology for determining the performance of flat green bowls surfaces, in particular synthetic surfaces.

1. WBB-01 Method of Test for the Determination of Green Speed

1.1 Scope

This method is suitable for testing all types of sports surfaces, both on test pieces in the laboratory and surfaces installed on site. The results obtained give a measure of the Green Speed of a rolling bowl on a sports surface.

1.2. Principle

A bowl is made to roll along the surface under test by being released down a standardised ramp from a height of 1m onto the surface. The distance the bowl rolls is measured and the Green Speed calculated from a standard calibration equation.

1.3. Apparatus

Bowl - Only an unbiased World Bowls-assigned speed test bowl shall be used.

Bowl Roll Ramp - A ramp consisting of two parallel bars mounted a fixed distance apart at an angle to the horizontal on a rigid frame, down which a bowl may be rolled onto the surface under test (Figure 1). The height of release of the bowl (base of bowl) shall be 1.00m. At their lower ends the radius of curvature of the bars must be sufficiently large and become tangential with the ground to ensure that the bowl does not bounce when it meets the surface.

The bowl roll ramp used for this test should be approved as being fit for purpose.

Tape Measure - A tape measure, at least 30m in length graduated in increments of 0.01m or smaller.

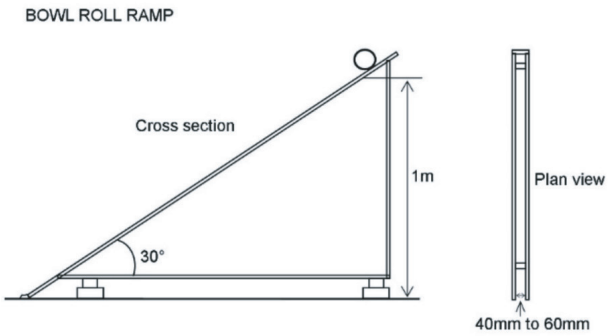

Figure 1. Ramp used for measurement of green speed and surface draw.

Wind Measurement - Means of determining wind speed to an accuracy of 0.1km/hr or equivalent.

1.4. Test piece and test locations

For tests in the laboratory, a piece of surfacing of length greater than the expected distance of bowl roll and of minimum width 1m shall be used. Where information on the expected bowl roll distance is not available, a piece of surface 35m in length shall be used. The test piece shall be taken in the directions of intended use. The surface shall be seamed and attached to the supporting layers using the recommended methods of seaming and attachment in accordance with the manufacturer's instructions.

When testing an installation, existing rink markings can be used for each direction of test but, in the case of any dispute, the Green shall be divided into rinks of equal width not less than the minimum permitted by the Laws of the Sport of Bowls, ignoring the outer 2m on each side of the Green.

1.5. Conditioning

For tests in the laboratory, condition the test piece for a minimum duration of 3 hours at the test temperature of 23 ± 2°C. For tests on dry surfaces, where the material is known to be sensitive to humidity, condition the material for a minimum of 88 hours at 50 ±5% RH at the test temperature.

Tests on site shall be made at the ambient temperature and humidity.

1.6 Procedure

For carpet-based surface systems the direction of testing is limited to the direction of tournament play, which is across (at 90°to) the seams of the carpet.
Speed to be tested on a minimum of six (6) rinks used in regular play. Where a green is used in all four directions a minimum of eight (8) positions (2 rinks on each end) are to be tested. An exception to this is where there are fewer than 4 rinks on the green. A minimum of three (3) speed readings are to be taken at each test position.

Place and level the apparatus on the surface (so that the end of the ramp is in line with the front of the normal mat position, when testing an installation) and aim down the centre of the area under test. Release the bowl from a height of 1000 ±5mm measured from the top of the surfacing to the lower edge of the bowl. Allow the bowl to come to rest and measure to within 10mm the distance from the end of the ramp to the centre of the bowl resting on the surfacing.

Where test pieces are being used, the test shall be conducted in the direction of play relative to the material's manufacturing direction.

Where the test is being conducted outdoors, the wind speed shall be measured during the test. If the wind speed is greater than 3.2km/h tests should not be undertaken.

Note: The 27m test detailed in the Laws of the Sport of Bowls gives a good approximation of the true Green Speed.

1.7. Calculation and expression of results

From the 3 results at each location, determine the median distance (D) travelled in metres. Green speed (GS) is then calculated from the equation:

$$GS = 6.01 + 0.36D$$

Calculate the Green Speed for each test position and direction.

Calculate the mean Green Speed for the installation or test piece.

Report the mean Green Speed for the installation or test piece and the median values for each test location.

2. WBB-02 Method of Test for the Determination of Surface Draw and end point uniformity

2.1. Scope

This method is suitable for testing all types of sports surfaces on both test pieces in the laboratory and surfaces installed on site. The results obtained give a measure of the draw of a rolling bowl on a sports surface and the uniformity of the end point bowl positioning.

2.2 Principle

A bowl is made to roll along the surface under test by being allowed to roll down a ramp from a specified height onto the surface. The trajectory of the bowl is monitored and the maxi mum draw and end point uniformity calculated.

2.3. Apparatus

Bowl - A World Bowls assigned biased bowl must be used.

Bowl Roll Ramp - A 30° inclined ramp as described in WBB-01.

Means of determining the value of maximum draw and resting point of the bowl during the trajectory of the bowl. Chalk or markers could be used for this.

Tape measure - A tape measure graduated in lengths of 10mm or smaller.

String Line - String line, minimum 30m in length.

Wind Measurement - Means of determining wind speed to an accuracy of 0.1km/hr or equivalent.

2.4 Test piece location and test location

For tests in the laboratory, a piece of surfacing of minimum length 35m and minimum width 4m shall be used. Test pieces shall be taken in the directions of intended use. The surfacing shall be seamed and attached to the supporting layers using the recommended methods of seaming and attachment in accordance with the manufacturer's instructions.

When testing an installation existing rink markings can be used but, in the case of any dispute, the Green shall be divided into rinks of equal width not less than the minimum permitted by the Laws of the Sport of Bowls ignoring the outer 2m on each side of the Green.

2.5 Conditioning

For tests in the laboratory, condition the test piece for a minimum duration of 3 hours at the test temperature of 23± 2°C. For tests on dry surfaces, where the material is known to be sensitive to humidity, condition the material for a minimum of 88 hours at 50 ±5% RH at the test temperature.

Tests on site shall be made at the ambient temperature and humidity.

2.6. Procedure

Draw and uniformity are to be tested on a minimum of six (6) positions used in regular play. Where a green is used in all four directions a minimum of eight (8) positions (2 rinks on each end) are to be tested. An exception to this is where there are fewer than 4 rinks on the green.

Position the ramp near the end of the rink and level the apparatus on the surfacing (so that the end of the ramp is at the front of the normal mat position when testing an installation) at an appropriate angle so the bowl comes to rest within 200mm of the middle of the rink (as marked by a string line).

Five (5) bowls are to be delivered on each hand from the exact same position. During each delivery track the trajectory with markers and record the maximum distance or draw of the bowl from the string line (see Figure 3).

Also record the end point of each delivery using chalk or a marker.
After delivery of all five bowls use a tape measure or marked string line to record the circumference of spread of the 5 deliveries.

Repeat the above-mentioned procedure using the opposite bias on the bowl having first rotated the ramp about the starting point to a similar but opposite angle to that used in the first part of the procedure

Where test pieces are being used, the tests shall be conducted in the directions of play relative to the material's manufacturing direction.

Where the test is being conducted outdoors, the wind speed shall be measured during the test. If the wind speed during the test exceeds 3.2km/h the result shall be considered invalid.

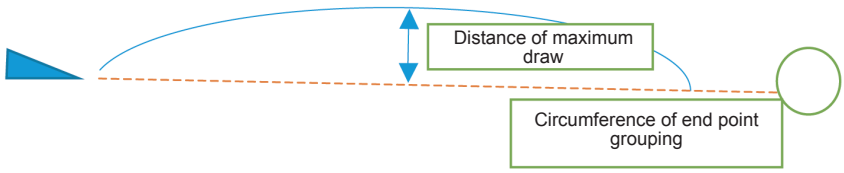

Figure 2. **Measurement of maximum draw and end point grouping of bowls.**

2.7. Calculation and expression of results

Maximum draw

Record the maximum distance of draw for each delivery and average the 5 readings.

Note: Maximum Draw is the furthest distance of the bowls trajectory from the centre line.

Calculate the percentage difference between maximum Draws on both hands for each series of tests using:

% Distance = WD – ND x 100/ND

Where: WD = Widest Maximum Draw and ND = Narrowest Maximum Draw

Uniformity of draw

Record the circumference of spread of the 5 deliveries using a tape (in m).

3. WBB-03 Method of Test for the Determination of Surface Evenness

3.1. Scope

This method is suitable for testing the surface evenness on all types of sports surfaces. The result obtained gives a measure of the extent of localised surface undulations that may affect bowl roll behaviour.

3.2. Principle

A 3m long straight edge is towed over the entire green surface in both a N-S and E-W direction, ensuring there is an overlap of approximately 300mm with each pass. A graduated wedge is used to measure any noticeable gaps between the straight edge and the surface. Deviations are to be accurately marked on a scale map of the green in order to aid follow-up location.

3.3. Apparatus

Straight-edge - A straight-edge 3m in length and preferably minimum weight of 5kg with an attached rope to tow the straight edge.

Graduated wedge - A graduated wedge with a range of 0-25mm and a resolution of 1mm.

3.4. Procedure

Starting in one corner of the green tow the straight edge up and down the green. The entire green in both directions (N-S and E-W), must be checked.

Where any significant deviation is observed measure and record the maximum gap to the nearest millimetre from the underside of the straight edge to the surface using the graduated wedge.

3.5. Expression of results

Draw a plan of the surface showing all areas where the surface evenness exceeds 3mm.

4. WBB-04B Method of Test for the Determination of Infiltration Rate using the Steady State Wetted Footprint Method

4.1. Scope

This method is suitable for testing all types of synthetic sports surfaces, both on test pieces in the laboratory and surfaces installed on site. The method can also be used for measuring infiltration rate into the sub-base. Results obtained reflect the permeability of the greens system as a whole (surface and base layer).

4.2. Principle

Water is applied to the green surface using a hose with a flow control valve. Aim to have the spread of water in a circular pattern. Once the wetting front spread has stabilised (no further spread) the circumference of the wetted (saturated) area is measured using a marked string line or tape.
Flow rate is then recorded by using a measuring cylinder to calculate L per minute. Infiltration rate is then calculated from flow rate (l/min) per unit area (m2).

4.3. Apparatus

A World Bowls approved water application kit consisting of a water dispersal unit, flow regulation valve and flow meter.

4.4. Procedure

The testing unit is coupled to a standard hose fitting located near the green. Water is applied to the surface of the green and the wetted circle allowed to spread. Adjust the flow rate through the apparatus so that the wetted circle reaches around 1 to 3 m in diameter. A constant flow rate is then maintained at this point, such that the wetting front remains stable

Once it is apparent the wetted front has stabilized the circumference of the wetted circle is measured using a tape measure. An alternative to measuring the wetted circumference is to use a quadrat (frame with squares of 100 x100mm in size) to calculate the ponded area in m2.

The steady state flow rate is measured, either using a bucket and stop watch or a flow meter attached to the delivery hose.

Testing is to be done in 4 locations over the green, with 2 locations to be within 2m of the ditch and 2 locations nearer the centre of the green.

4.5. Calculation and expression of results

The wetted area (in m2) can be calculated from the measured circumference, knowing D (diameter) = Circumference/π and Area = π r2
The infiltration rate is calculated as flow rate (l/hr) per ponded area (m2). Note that 1mm = 1 l per m2.

5. WBB-05 Method of Test for the Determination of Surface Cushioning (optional test)

5.1. Scope

The surface cushioning or hardness of a synthetic bowls surface may influence players' views of the surface's acceptability. If this particular aspect of a surface construction is considered important, the cushioning characteristics should be determined using the following procedure. This method is suitable for testing all types of sports surfaces, both on test pieces in the laboratory and surfaces installed on site.

5.2. Principle

An indentor is dropped onto the test piece and the deceleration during the impact monitored. The deceleration profile is processed to give specific energy absorption data.

5.3. Apparatus

2.25 kg Clegg Impact Soil Tester.

5.4 Test piece

Tests in the laboratory shall be carried out on a piece of surface of minimum length 1000mm and minimum width 1000mm in conjunction with the supporting layers to be used in service, using the recommended method of attachment in accordance with the manufacturer' instructions.

5.5. Conditioning

Condition the test piece for a minimum of 3 hours at the test temperature except where the material is known to be sensitive

to humidity, in which case condition for a minimum of 88 hours at 50 ±5% RH at the test temperature. Unless otherwise specified the test temperature shall be 23 ±2°C.

Tests on site shall be made at ambient temperature and humidity.

5.6. Procedure

Position the indentor so that the striking face is 550 ±2mm above the surface of the test piece. Ensure that the guide tube is held vertically.

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

Record the Impact Value (CIV).

Repeat the tests to obtain five readings, moving the apparatus between each drop so that the test piece is not impacted on the same spot twice nor impacted nearer than 100mm to any edge.

When the test is being carried out on an installation, measurements shall be made in the positions shown in Figure 3.

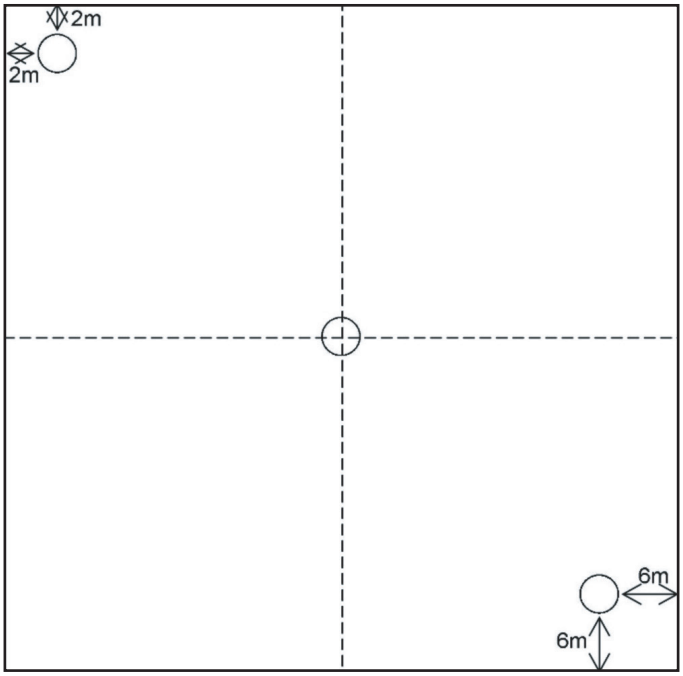

Figure 3. Positions of test for determining surface cushioning.

5.7. Calculation and expression of results

Determine the Median Impact Value from the five tests.

Report the Median Impact Value for each test location.

Surfaces that have impact value of less than 320 gravities are considered to offer a degree of cushioning that may assist player comfort.

6. WBB-06 Determination of surface levels

6.1. Scope

A surveyor's unit is to be used to determine overall levelness and variance of levels on a 3m grid basis.

6.2. Apparatus

A surveyor's unit of high quality and an accuracy of +/-0.5mm over 20m.

6.3. Procedure

The green is marked out on a 3 x 3m grid.
The surveyor's unit is used to record spot heights at each of the grid points.
Care should be taken to ensure the staff is kept vertical during readings.

Participating Organisations

Contact details for World Bowls Accredited Testing Organisations are available on the World Bowls website or via World Bowls headquarters.

Manufacturers/Suppliers of Synthetic Bowls Surfaces

Contact details for Manufacturers/Supplies of approved synthetic bowling green products may be found on the World Bowls website www.worldbowls.com

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(e) any defects or abnormalities in the bowling green areas,
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