

# QUALITY ASSURANCE FOR STADIUM TURF

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The Working Group/Expert Commission of the DFL

“The truth lies on the pitch” (Otto Rehhagel). A statement that everyone involved in football can agree with. The pitch is and remains the most important part of a football stadium and the centrepiece of first-class competition in the Bundesliga and Bundesliga 2.

Just as football continues to evolve at a rapid pace, so too are the requirements in terms of the properties and conditions of the playing field permanently rising. In this third edition of the Handbook, the Working Group, under the direction of the DFL, has again intensively addressed the new developments and expanded the guidelines to include numerous valuable aspects.



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# I. Preliminary Observations

This “Greenkeeping Handbook”, now in its third edition, features updates on issues such as measuring methods and provides a comprehensive overview of developments in recent years since regulations on safeguarding playing field quality in Bundesliga and Bundesliga 2 stadiums were first devised and implemented. At the same time, it covers the spectrum of international requirements in terms of playing field quality, the key objective being to assist all those concerned with ensuring the best possible quality of natural turf playing surfaces in stadiums. The Working Group/Expert Commission is comprised of the following members: Ansgar Schwenken, Sylvia Wahl, Andreas Nagel, Birger Naß, Joachim Baur (all DFL), Andreas Bornemann (club representative), Rainer Ernst, Dr Klaus Müller Beck, Dr Harald Nonn (all German Turfgrass Society), Sebastian Breuing, Klaus Peter Sauer, Mathias Eichner, Josef Lindermayer (all greenkeeper representatives), Prof. Wolfgang Prämaßing (DEULA), Jürgen Muth (Association of German Stadium Operators), Matthias Eiles (DFB).

## Introduction

In March 2011, the League Board approved the formation of an Expert Commission tasked with safeguarding playing field quality in Bundesliga and Bundesliga 2 stadiums under the direction of the DFL.

At the time, League President Dr Reinhard Rauball said: “In view of the fact that some matches have lately been marred by particularly bad turf conditions, we feel it is both useful and necessary to create this Commission. The objective is to ensure the best possible playing surface quality – for the good of the game as such, to avoid any distortion of competition and, just as importantly, to present the Bundesliga in the best possible way, both at home and abroad.”

Over the course of four meetings, the Expert Commission members developed a concept that responded to the League Board’s concerns and is based on three main building blocks:

- I. Standard Evaluation System (from 2012-13)
- II. Training and Further Education
- III. Greenkeeping Award “Pitch of the Year” (from 2013-14)

This Handbook is a key component covering the requirements of the first building block; it describes the application and documentation, in regular intervals, of standard measuring and evaluation criteria and procedures.

We hope to have provided the football greenkeeping community with a useful tool to ensure turf quality in their respective stadiums.

Frankfurt/Main, July 2018

# II. The Basics – Grass Pitch Requirements in Licensed Football.

## Competition-based Quality Concept

### 1. Background

A stadium is what it is not only because of its architecture; it also lives through the pulsating atmosphere which arises during a match.

The main focus of interest is on the grass pitch at the centre of the stadium, the condition of which is often used to justify a defeat; only rarely do winning teams give it any credit for their victory.

The grass pitches in the 36 Bundesliga and Bundesliga 2 stadiums are often subjected to a great amount of wear and tear, and other conditions also influence both the appearance and the quality of the grass (stadium architecture, climate, light, shade, ventilation, maintenance, etc.). The development and maintenance of the grass pitch at the centre of the stadium is therefore a challenge for everyone involved, above all for the football greenkeepers.

At least in professional football the grass pitch is expected to be both visually immaculate and perfect for the game throughout the season. The clubs and operators are highly competent in fulfilling this expectation using effective, well-targeted measures.

The concept presented here aims to support their efforts.

### 2. Objective

The main aim of this concept is to identify the parameters that create the best possible playing conditions in licensed football. It has been developed to describe and sustain in the long term the high standards existing at the players’ “place of work” – the stadiums operated by the members of the licensed leagues.

Sports turf is played on at all times of the year and in all weathers, regardless of the natural needs of the grass and it is important to ensure that the conditions necessary for a proper match are provided. As a result, high demands are made of the

**evenness,  
stability,  
shear strength**

and

**permeability of the substrate.**

Other functional and safety-related requirements include turf density and surface hardness.

The amount of stress which can be borne differs, and is determined by design, the ground, the grass selected, intensity of care and the weather.

The main requirements for the Bundesliga are that the pitch is absolutely level, in good condition and playable for each of the matches during the entire season. The pitch requirements are described in more detail below, both to give football greenkeepers clear and explicit standards to follow and to ensure that Bundesliga and Bundesliga 2 pitches present a uniform appearance.

### 3. Requirements\*

#### 3.1 Pitch Dimensions

##### 3.1.1 Definitions

Usable sports area: The area required by the match rules, including the perimeter strip required for safety reasons (safety zone).

Unobstructed area: Additional area which should be kept free of any constructions.

The term infield area shall be construed to comprise the actual sports area as described above and the unobstructed area.

##### 3.1.2 Dimensions

The infield area must meet national and international standards. In newly-built developments the minimum size for the grass pitch and the adjacent areas up to the stands should therefore not be smaller than

**125m x 85m between the nearest opposite stand sections (cf. section 6 no. 3 (4) of the Licensing Regulations).**

As a rule, the infield area dimensions of already existing stadiums shall not be smaller than 120m x 80m.

Nevertheless, creating an infield area of 125m x 85m should be the target whenever a stadium is converted or refurbished. Smaller dimensions are allowed for existing facilities whose dimensions cannot be improved due to the stadium's location (protection of status quo).

\* Figures relate to national matches in the Bundesliga and Bundesliga 2 and may differ from international match conditions.

The grass pitch should have

<b>line dimensions of</b>	<b>105m x 68m</b>
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whereby the following safety margins should be observed for natural grass pitches, alternatively with an artificial turf surface:

Stretch of turf behind the goal lines	at least 3m (target 4m)
Stretch of turf along the touchlines	at least 1.5m (target 2m)

Please note: The grass pitch area shall offer sufficient space beyond the pitch markings that can be used as a warm-up zone for substitute players. FIFA recommends a minimum of 4m behind the goal lines (target 5m in the middle and 3m near the corner flags), and a minimum of 2m along the touchlines (target 5m).

The minimum margins for the unobstructed area required under DIN standard 18035-1 (cf. page 8) are

Behind the goal lines	2m (target 3m)
Along the touchlines	1m (target 2m)

The minimum dimensions for the sports area are therefore as follows:

Gross area	111m x 71m (target 113m x 72m)
Playing field	105m x 68m

#### 3.2 Adjacent Areas

The type of surface required for the adjacent areas to the natural grass depends on the use of these areas, whereby the DFL considers the use of third-generation filled artificial turf acceptable.

The artificial turf should be laid in such a way that transition to the natural grass is smooth (avoidance of injury). The artificial turf should have a foundation layer or, alternatively, a cover which makes it fit for traffic. The requirements as to shock absorption pursuant to DIN standard EN 15330-1 and DIN standard 18035-7 must be met. The design of artificial turf areas should otherwise follow the principles of the DFB Compendium on Sports Field Construction and Maintenance.

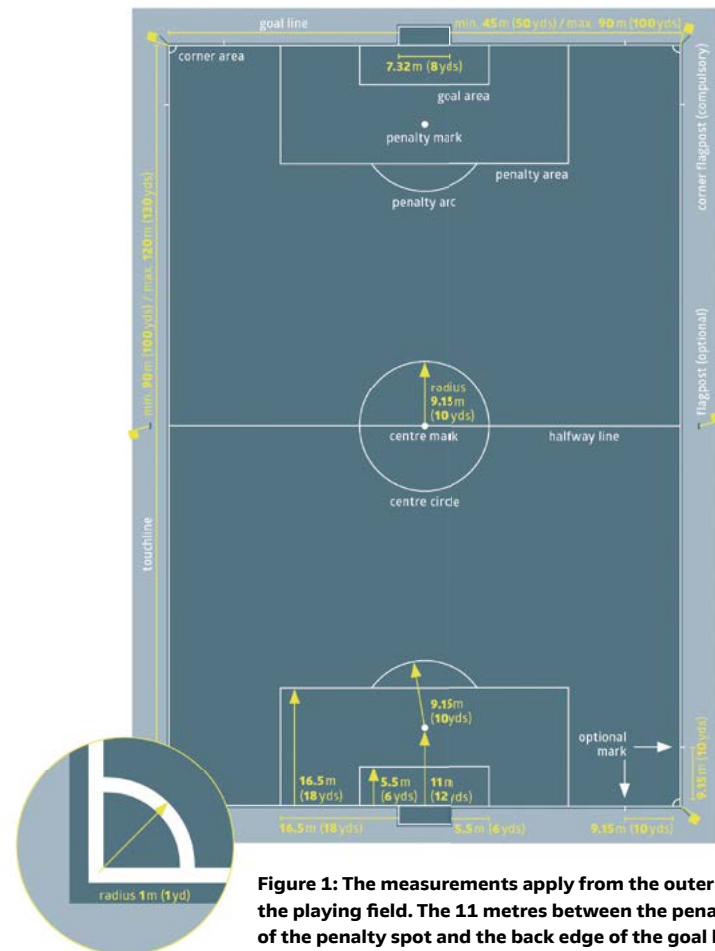
For further explanations, please refer to the Annex in Chapter II (cf. page 17).

### 3.3 Pitch Markings

The pitch should be marked in accordance with the DFB football rules, specifically Rule 1 – The Field of Play.

The lines should have a maximum width of 12cm.

The goal line is as wide as the goal posts and the crossbar.



**Figure 1: The measurements apply from the outer edge of the lines, as the lines themselves form part of the playing field. The 11 metres between the penalty spot and the goal line are measured from the middle of the penalty spot and the back edge of the goal line (source: IFAB)**

All markings (goal lines, touchlines and halfway line), boundary lines (goal area, penalty area, corner area), circles (centre circle, penalty arc, corner arc) and marks (penalty spot, centre spot) must be clearly visible.

The lines should normally be marked with a water-soluble, white paint well before the match to ensure that they are dry and rain-proof before play begins.

When there is snow on the ground in winter the lines should be marked in blue, alternatively in luminous orange.

Please note that no provision is made for flags at each end of the halfway line.

The penalty spot and centre spot should have a diameter of 22cm.

### 3.4 Cut Height of the Grass Pitch

The sports turf should normally be cut when the weather is dry. It should only be cut in humid conditions if it is absolutely unavoidable, e.g. in the case of persistent rain and considerable growth. In this case, the greatest care should be taken, if necessary using a hand mower with catch tray.

On match days, the grass should be cut to a height of between 25mm and 28mm.

Please note: The general UEFA recommendation is for the cutting height not to exceed 30mm, with the entire turf surface cut to the same height. Turf height shall be the same on match day and for the official pre-match training session.

A grass height of 35mm might be advisable in periods when no football is played, for turf regeneration purposes or in the event of turf disease, and in the winter months.

The direction of the cut should be altered constantly during the maintenance cycle.

### 3.5 Cut Quality

The quality of the cut is determined by the type of mower, and the number and sharpness of the blades.

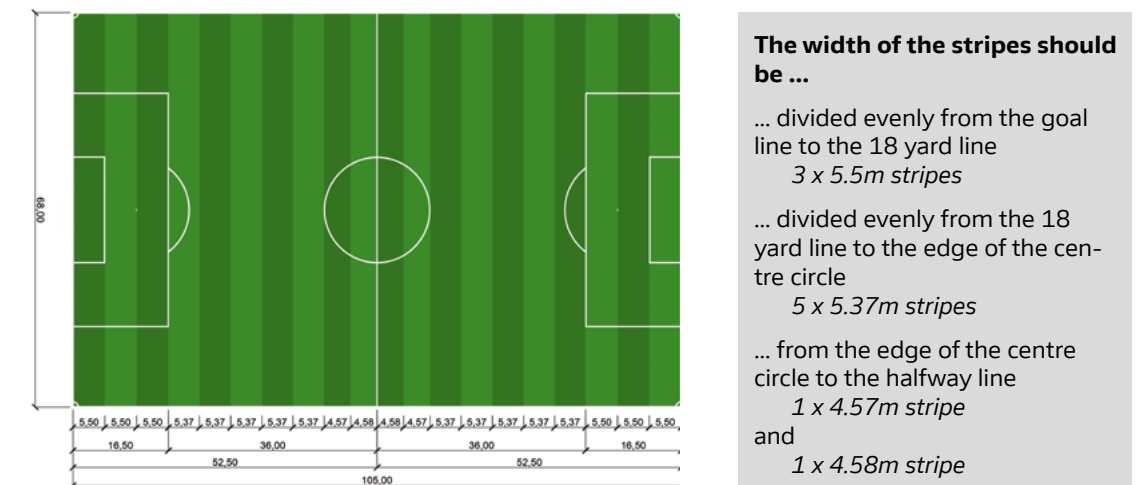
The blades of the mower must cut the grass cleanly and to the same height.

### 3.6 Grass Pattern

As it is desirable for Bundesliga and Bundesliga 2 clubs to offer a standardized picture, however, the turf area shall be mown such that the pattern runs parallel to the goal lines, making it much easier for assistant referees to position themselves and thereby enabling them to make more accurate offside decisions.

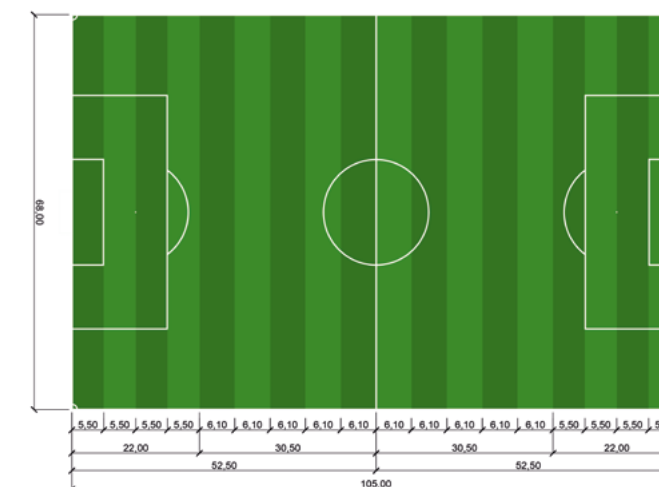
The grass should be mown in straight, even lines across the width of the pitch, i.e. parallel to the goal line.

The diagram below shows the correct system to use for Bundesliga and Bundesliga 2 matches.



### Figure 2

The diagram below should be used for UEFA Champions League and UEFA Europa League matches.



### Figure 3

### 3.7 Turf

The quality of the turf is determined not only by colour and density, but also by its shear strength.

#### 3.7.1 Colour

The colour of the turf reflects the nutrients provided and can be influenced by selective fertilisation. The ideal colour is dark green, but this can vary through the seasons and should be matched to the microclimatic conditions in the stadium and plant physiological conditions.

#### 3.7.2 Turf density

The density of the turf is determined by the projective ground cover, i.e. the degree to which the area is covered with grass. DIN standard 18035-4 requires the finished turf area in new developments to have a projective ground cover of 95%.

Bundesliga and Bundesliga 2 pitches should have the best possible degree of coverage, whereby a

**projective ground cover of 60% is considered the minimum**

allowed.

Suitable maintenance measures such as complementary seeding or the replacement of certain areas or of all of the turf should be used to ensure that the turf density remains compact.

#### 3.7.3 Shear strength

The shear strength is influenced by the composition, moisture content and permeability of the substrate, grass thatch, turf density and root penetration. Further factors are the effects of use such as patches which have been sheared, compaction, or different stages of growth resulting from the influence of light and shade.

Shear strength shall be measured following the clearly-defined procedure described in Chapter III, Part One.

#### 3.7.4 Ball roll

The quality of a pitch is judged not only on the basis of evenness, turf density and shear strength, but also on the basis of ball roll. Together with the German Turfgrass Society (Deutsche Rasengesellschaft) and the football greenkeepers, the DFL intends to develop a suitable method of assessment and subsequently to formulate the necessary requirements. FIFA recommends the proven test method in accordance with the Handbook of Test Methods (2012) which was also used for the 2014 FIFA World Cup in Brazil. The length of the ball roll distance for this test method should be between 4m and 8m.

### 3.8 Irrigation

Irrigation should be carried out as required by the weather and in accordance with the microclimatic conditions in the stadium. The high-performance irrigation systems installed in Bundesliga and Bundesliga 2 stadiums generally ensure an even distribution of water.

**Irrigation** of the pitch should generally be concluded **60 minutes** before play begins. All irrigation measures on match day must be agreed with the production manager at Sportcast.

Please note: In accordance with the pertinent UEFA regulations, the home club is to announce the irrigation plan at the organisational meeting on match day. All areas of the pitch shall be irrigated the same, i.e. without any distinctions made between the different zones. In principle, irrigation shall be complete 60 minutes prior to kick-off. However, further irrigation is possible, subject to the agreement of the referee and the two clubs concerned, and in keeping with the following schedule:

a) during the time window between 10 and 5 minutes before kick-off, or b) during the half-time break (for a maximum duration of 5 minutes). The referee is entitled to demand that changes be made to the irrigation plan.

### 3.9 Warming Up by Players

During the preparations for the match, the pitch is normally used by all of the squad players to warm up. The zones in shaded areas critical from a plant physiological point of view are often those preferred for sprints, “five-against-two” or other intensive training techniques. Goalkeeper training takes place in the goal area, even if the grass there is already badly damaged or the ground is bare.

#### 3.9.1 Preparation for play/half-time

Solutions should be found which help to improve turf quality. These could include goalkeeper training outside the penalty area using mobile training goals or training short sprints away from the critical areas or the flat cameras of the base signal production. This also applies to the use of the pitch during half-time, as preceding damage to the turf is “stamped in” during this period (approx. 10 minutes).

#### 3.9.2 Warm-up zones for substitutes

Uniform warm-up zones for substitutes should be specified for all stadiums and have the same surface as the pitch. However, the surface material must be suitable for studded boots and have a minimum shock absorption of 45%. Warming up should take place where possible at the narrow end of the pitch, but the long side may also be used where space is limited. The warm-up area should be decided in line with media interests.

Area for warm-up zone	30m x 4m (target)
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For further explanations, please refer to the Annex in Chapter II.

### 3.10 Other Requirements

#### 3.10.1 Football goals

The football goals used must have net supports and a depth of at least 2m. To ensure that the cameras of the goal-line technology system recognize the ball when it crosses the goal line, the goal nets must meet the following requirements:

Material thickness:	4mm max.
Mesh size:	12cm x 12cm

This applies to all Bundesliga and Bundesliga 2 clubs.

A gauge 2.44m in height should be available in each stadium for control purposes and for assembly of the goals.

The 2015-16 Bundesliga season saw the introduction of the Hawk Eye goal-line technology (GLT). In order to avoid misunderstandings or confusion on the part of TV audiences watching replays of match scenes, it is essential that the goal posts are perpendicular to the ground (cf. Figure 4) and parallel to the goal line (cf. Figure 5). The goal-line marking must not be broader than the goal posts or painted laterally offset from the goal post anchors.

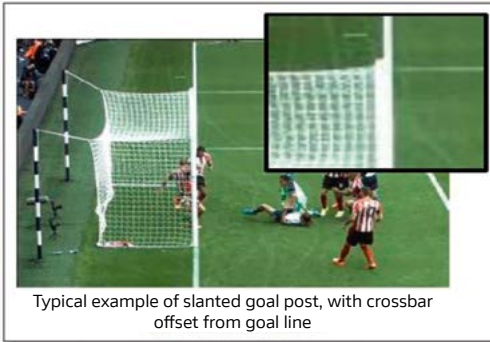


Figure 4

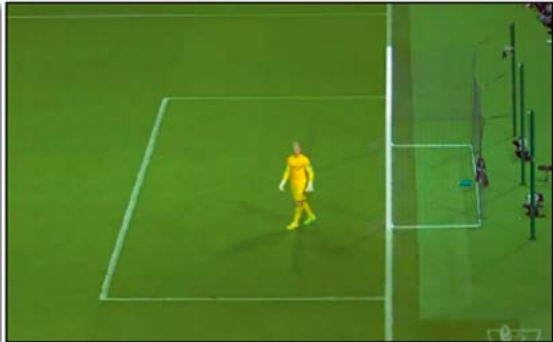


Figure 5

#### 3.10.2 Replacement goal

A fully equipped goal (goal with net supports and net) identical to the goal(s) in use shall be kept in reserve for match days.

#### 3.10.3 Properties and condition of goal netting

According to the DFL Media Regulations, the mesh width of the goal netting must not be narrower than 12cm x 12cm and the netting must be made of the thinnest possible yarn so as not to impair the (TV camera) view through the netting and to meet the requirements of goal-line technology. By the same token, the TV camera view of the goal posts and the crossbar must not be obstructed by the goal net supports.

#### 3.10.4 Underfloor heating

Underfloor heating must be installed if a stadium wishes to be licensed, as this will keep the pitch free of frost and thus guarantee identical match conditions.

Please note that for matches

**the heat output should amount to between 900kW and 1,200kW,**

whereby the heat output chosen should be determined by the local climatic conditions. If the heating systems which supply heat to the buildings and the pitch are run at the same time, the

**heat output for the underfloor heating may not be lower than 900kW.**

#### 3.10.5 Machinery and equipment

Appropriate machinery and equipment must be kept available for turf maintenance and recovery. The following list represents the minimum equipment for greenkeeping purposes. Special requirements or measures require additional technical equipment.

- Cylinder mower (manual or ride-on)**
- Rotary mower (manual or ride-on)**
- Aerator (manual or attachment)**
- Tractor**
- Fertiliser spreader (manual or attachment)**
- Sand spreader**
- Field sprayer (liquid fertiliser, plant protection)**
- Seed drill**
- Marker**
- Plugger**
- Pitchforks or similar**

#### 3.10.6 Turf lighting

The construction features of modern football stadiums, and tall stands and stadium roofing in particular, serve to reduce the incidence of natural light that is required for grass to grow. This energy deficiency can lead to patchy turf with no possibility of regeneration, especially in the more shaded areas of the stadium and during the winter months. In these situations, the necessary light can be provided using mobile lighting units. Turf lighting can be tailored using different unit sizes. The intensity and duration of lighting and the additional maintenance measures necessitated by continuous growth mean that the greenkeeping team is required to intensively monitor the growth factors in order to ensure optimal turf quality.



The necessary infrastructure measures, e.g. electricity requirements, transportation routes, storage for the lighting units during matches, must be clarified before a lighting system is installed.

### 3.10.7 Hybrid sports turf systems

The DFL Expert Commission has defined hybrid sports turf systems, also known as reinforcement systems, as follows:

“Hybrid sports turf systems are grass pitches whose substrate and/or turf are partially or fully reinforced in order to optimise their in-use properties.”

Reinforcement may take the form of materials mixed into the substrate (e.g. rigid or elastic fibres) or synthetic fibres extending into the turf. Depending on the reinforcement system used, this has a positive effect in terms of evenness, shear strength and turf density in particular.

Maintenance management is essential to the function and durability of a hybrid sports turf system. The nature and intensity of the maintenance measures must be adapted for the respective system. Based on current experience, turf lighting that is tailored to the respective location and load represents another precondition for the permanent functionality and economic efficiency of any reinforcement system.

### 3.10.8 Training sessions in the stadium

Generally speaking, training should not take place in the stadium on the day of a match. However, the club has the final say in the matter.

## 4. Final Remarks

This competition-based quality concept for the requirements made of a grass pitch in licensed football describes only the main criteria. Important areas in qualified turf maintenance such as

**maintenance concept and resources, personnel, third-party services, maintenance and storage depot and turf nursery**

have not yet been considered. The DFL therefore considers it of the utmost importance that all parties involved continue to exchange knowledge and experiences. This concept should be used as a basis for discussion and is reliant on suggestions if it is to be optimised. The objective must always be to permanently offer good conditions which are as identical as possible for competitions and football matches.

## 5. Annex

### Artificial turf bordering the grass pitch area

The following information has been formulated as minimum requirements for safeguarding the use of the zones surrounding the playing field. If, instead of the preferred natural turf, an artificial turf surface is used, the principal is to ensure that planning and execution of the project is carried out by experienced and qualified contractors. The club acting as principal should pay special attention to the design of the sports area and the choice of surface.

As a matter of principle, the artificial turf surface must be suitable for use wearing studded football boots.

Please observe the following instructions:

- 01.** Beyond all touchline and/or baseline markings, there should be a minimum 5cm stretch of natural grass before the artificial turf apron around the playing field begins, allowing all markings to be put on the grass in their full width. The goal net area should be natural grass, with the artificial turf apron to be laid around it.
- 02.** The artificial turf apron should have a sand (specifically: quartz sand) and rubber (specifically: EPDM or cork granules) infill. The free pile height (above the infill) should be around 10mm. FIFA recommends to perform a short test on the material's shock absorption and rotational resistance properties. Both test methods and their requirements are described in detail in the respective Handbook of Test Methods and Handbook of Requirements.
- 03.** Tuft height of the artificial turf fibres should be between 40mm to 42mm above ground and the type of fibre should be straight.
- 04.** The artificial turf used should have a high density with a total pile weight of more than 1,300g/m² and a total weight of more than 2,500g/m².
- 05.** Stitch density should be 220 stitches/m.
- 06.** The areas between the playing field and the minimum sports area as recommended by the DFL (gross area 111m x 71m, target area 113m x 72m) should have an elastic sub-base, e-layer or elastifying layer laid in lengths under the artificial turf. This applies above all to the immediate area crossing over into the grass pitch. It is necessary to fulfil the requirements for shock absorption pursuant to DIN standard 18035. When using an e-layer, a larger difference in height between the level of the playing field and that of the edge of the playing field must be observed. When using artificial turf with an e-layer, it must be ensured that it can be used in such a way that the playing field and the artificial turf apron still form an even surface. FIFA recommends an additional evenness test for the critical surface area concerned.
- 07.** It must be ensured that the entire recommended grass pitch (as a rule 113m x 72m) is heated sufficiently and always remains frost-free even given the difficult conditions of the artificial turf cover.

**08.** The crossover from artificial turf to grass pitch must be firmly interlocking, stable and level to the playing field. The surface must not detach itself from its base when players slide across it with studded football boots.

**09.** The markings of the technical zones must be tufted in.

**10.** In principle, all applicable standards as at the time of planning and installation should be applied, in particular DIN standard EN 15330-1 and DIN standard 18035-7.

**11.** Due to the high degree of stress and wear and tear on the artificial turf, suitable specialist maintenance measures should be taken to decompact the infill (sand and granules) and in particular to check on and top up the infill level in the crossover from grass pitch to artificial turf. Selvedge formation and a too low level of infill must be avoided at all cost.

## III. Standard Evaluation System, Part 1 – Instructions on Selected Test Methods

### 1. Projective Ground Cover (Synonym: Turf Density)

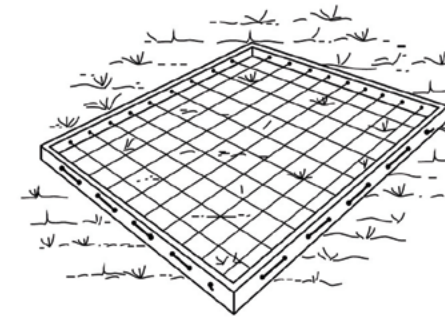
The projective ground cover is determined based on DIN standard EN 12231:2003-07.

The standard applies Test Method B “Determination of ground cover using a square frame.” The frame used enables a systematic determination of the ground cover.

#### 1.1 Measuring Device

Frame with inside measurements of between 0.75m x 0.75m and 1.0m x 1.0m, divided by thread, cord or thin wire into 100 small squares of equal size (Figure 6). Each square represents 1% of the overall area.

**Source:** Wire screen with the above measurements, or DIY wood or metal frame, potentially easily dismantled, strung with cord.



**Figure 6: Frame for determining the ground cover.**  
**Source: DIN standard EN 12231**



**Figure 7: Frame being used on a proper football pitch**

### 1.2 Test Procedure

Standing next to the test site, the tester visually determines the proportion of the sports area that is covered by living plants, dead material or uncovered ground, and where necessary, any areas characterised by one specific type. Only living plants can be considered ground cover. Dead material and uncovered ground are determined separately where necessary. Overlapping living plant material should be counted only once.

First, the number of sections in the frame must be determined that are full of the relevant components. The number of “full” sections is then determined as a percentage. Next, any incompletely filled sections are amalgamated visually into full sections and then these are added to the full sections.

### 1.3 Recording of Readings

The result should be given as a percentage of ground covered by living grass and, where necessary, the individual components of the ground cover should be listed.

### 1.4 Location, Repetitions and Frequency of Measurements

The locations of the measurements are stipulated in the enclosed field test positions plan (Chapter 8). As a rule, turf density is determined once per field test position.

## 2. Water Infiltration Rate

The water infiltration rate of the substrate (turf-bearing layer) is determined using a double ring infiltrometer in accordance with DIN standard EN 12616:2013-12, Test Method B.

This method collects water inside two rings or cylinders which have been driven concentrically into the substrate. The outer ring forms a buffer area which is used to prevent the water from pouring laterally out of the inner ring. The water flowing from the inner ring into the substrate is then measured.



## 2.1 Measuring Device

The double ring infiltrometer to be used should have an inner ring with an inside diameter of 300mm ( $\pm 5$ mm) that covers the area to be tested and an outside ring of 500mm ( $\pm 25$ mm) that forms the buffer area.

**Sources:** DIY or e.g. Umwelt-Geräte-Technik, 15374 Müncheberg

## 2.2 Test Procedure

The rings are driven 50mm ( $\pm 5$ mm) into the substrate. Any cracks between the soil and the rings should be filled by pressing the soil up against the outside of the infiltrometer.

Both rings are then filled with water until the amount of water in the inner ring is constant and the water level is constant. It must be ensured that the water level in the outside ring deviates at the most by  $\pm 2$ mm from the water level in the inner ring.

Please note: Ideally, the infiltration rate should be measured when the ground is highly saturated. In this case pre-saturation need not be earlier than 20 minutes before the test is carried out. If the tests are carried out on dry ground, at least one hour must pass between the build-up of water and the actual measurement.

Starting from an initial water depth of 30mm, the drop in water level in the inner ring is measured over a period of 20 minutes. If the water level falls more quickly, the time it takes to drop by 25mm should be recorded.

In both cases, it must be ensured that the water level in the outside ring deviates at the most by  $\pm 2$ mm from the water level in the inner ring.

After the measurements have been taken, the rings are removed to enable the water that has accumulated on the ground to drain away through the substrate. The shear strength is determined near the rings two hours after the measurements.



**Figure 8: Double ring infiltrometer during saturation phase (with float to determine the infiltration volume)**



**Figure 9: Double ring infiltrometer during measuring phase (with folding rule to determine the infiltration volume)**

## 2.3 Computation and Presentation of the Findings

The water infiltration volume  $I_B$ , given in millimetres per hour, is calculated using the following equation:

$$I_B = \frac{F_{WB}}{t_B}$$

Where:  $F_{WB}$  is the drop in water level (mm)  
 $t_B$  is the time in which the water level drops (h)

Sample measurement and calculation:

The water level took 18min (=0.3h) to drop by 25mm.

$$F_{WB} = 25\text{mm} \quad I_B = \frac{25\text{mm}}{0.30\text{h}} = 83.3\text{mm/h}$$

## 2.4 Location, Repetitions and Frequency of Measurements

The locations of the measurements are stipulated in the enclosed field test positions plan (Chapter 8). As a rule, the infiltration volume is determined twice at each field test position. Please note: Where parallel tests are conducted, four complete measuring sets are recommended to make the process more efficient.

# 3. Shear Strength

Shear strength describes the magnitude of the shear stress that substances can sustain. Where turf sports surfaces are concerned, shear strength consists of the stress-strain relationship between turf density, roots and the friction of ground particles.

Shear strength is determined pursuant to DIN standard 18035-4:2012-01.

### 3.1 Measuring Device

A shear vane tester with 40mm long and 20mm wide blades is used to carry out the measurements.

**Sources:** GEONOR Shear Vane Tester, Type H-60, Hand-Held Vane Tester. Geonor AS, NO-1361 Osteras



Figure 10: Shear vane tester



Figure 11: Before testing



Figure 12: After testing

### 3.2 Test Procedure

Shear strength is determined two hours after the water infiltration rate within the rings has been measured. Given sufficient permeability of the substrate, it can be assumed at this point that only the retained water remains in the substrate.

The shear vane tester should be driven with care vertically into the substrate no more than one blade length (i.e. 40mm). The test should be carried out in one flowing, slow and steady turn. The value should be read off the measuring scale and multiplied by a factor of ten.

### 3.3 Recording of Readings

The readings should be entered in kPa (kilopascal) both as individual values (six repetitions) and as an average of the individual field test positions.

### 3.4 Location, Repetitions and Frequency of Measurements

The locations of the measurements are stipulated in the enclosed field test positions plan (Chapter 8). The field test positions for testing the shear strength are the same as those for testing the water infiltration rate. The measurements should be repeated six times per field test position.

## 4. Evenness

The evenness of the turf pitch is determined pursuant to DIN standard EN 13036-7. The tests are carried out over an area of 4m using a folding straight edge.

### 4.1 Measuring Device

4m ( $\pm 4$ mm) straight edge, folding or non-folding, measuring wedge or folding rule.

**Source:** Various online shops



Figure 13: 4m folding straight edge

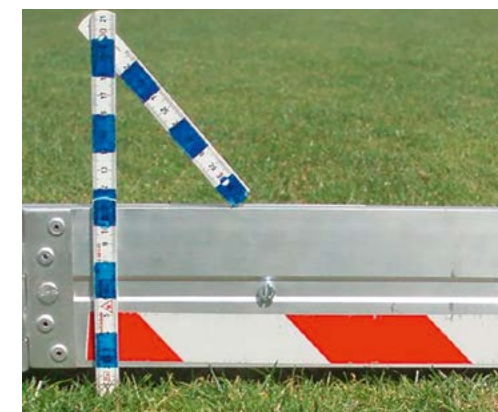


Figure 14: Measuring turf subsidence with a folding rule

### 4.2 Test Procedure

The straight edge is laid in its entirety on the turf area to be tested. In addition to the specified standard, any gaps between the bottom edge of the straight edge and the turf may also be determined using a measuring wedge or, alternatively, a folding rule.

### 4.3 Recording of Readings

The readings should be recorded individually in millimetres (mm), giving as accurate a description of the field test position as possible.

### 4.4 Location, Repetitions and Frequency of Measurements

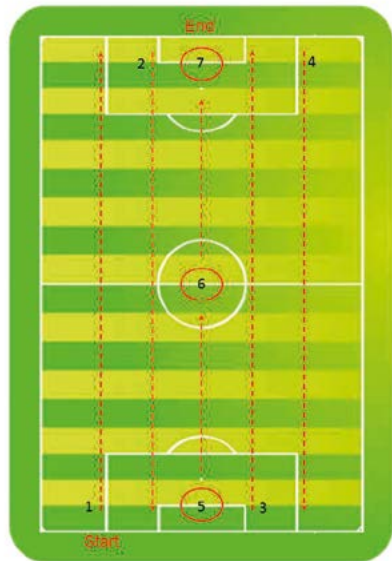
The evenness of the turf area is not a standard measurement. It is only measured if the need arises. Only the uneven areas are measured.



## 5. Surface Hardness

The quality parameters of shock absorption and ball rebound are primarily determined by the hardness and elasticity of the playing surface. A technique for measuring the surface hardness of turf that has already been introduced in other countries, including for ball sports other than football, is the use of the Clegg Impact Soil Tester (“Clegg hammer”). This measuring device is user-friendly and allows a number of measurements to be taken in a short amount of time. The measurement process is simple and highly reliable: The 2.25kg drop weight is raised to the marked height of 45cm and dropped. The surface hardness is shown in Gm (gravity units). In contrast to DIN standard EN 14954:2006-01, which requires surface hardness to be determined using five impacts at the same test position, only one impact per test position is used in this case. This reflects realistic usage conditions more accurately than the figure prescribed by the standard.

In the absence of official specifications, 70 individual measurements should be taken for each pitch being tested. As shown in Figure 10, ten measurements are taken at a distance of around 10m in each of four parallel bands along the longitudinal axis (series no. 1, 2, 3, 4), ten measurements in each of the penalty areas (series no. 5 + 7), and ten measurements in the centre circle (series no. 6) (Figure 15). These 70 individual measurements mean that a measurement is taken approximately every 100m<sup>2</sup>, thereby forming the basis for a meaningful assessment of the pitch.



**Figure 15: Potential measurement grid with ten individual measurements per area (= 70 individual measurements per pitch)**

## 6. Quality Criteria

### Projective Ground Cover

Evaluation scale for estimating the projective ground cover (turf density):

100%–90%:	Excellent
89%–80%:	Good
79%–60%:	Poor
<60%:	Inadequate

### Infiltration rate

The water infiltration rate should come to  $I_b \geq 60$  mm/h in analogy to DIN standard 18035-4:2012-01. The infiltration rate should not fall below  $I_b \geq 30$  mm/h.

### Shear strength

A reading of  $\geq 60$  kPa is deemed an adequate shear strength.

### Evenness

In line with DIN standard 18035-4:2012-01, the surface below the straight edge may not deviate by more than 20mm.

### Surface hardness

Surface hardness measurements are taken on a voluntary basis. To date, there are no scientifically proven thresholds for surface hardness. In addition, past experience shows that there is a great deal of subjectivity in terms of how players and coaches perceive surface hardness. As such, this quality handbook does not currently contain any binding upper or lower limits. In the pitch inspections conducted for the “Pitch of the Year” award, surface hardness was measured at between 70 Gm and 100 Gm. This range can be applied as a benchmark.

Irrespective of the actual measurements, it should be ensured that surface hardness is as consistent as possible across the entire playing surface.

## 7. Number, Timing and Documentation of Quality Checks

At least four on-site inspections must be carried out per season. Inspections are preferably carried out at the beginning of the season, before and after the winter break and at the end of the season in preparation of regeneration measures.

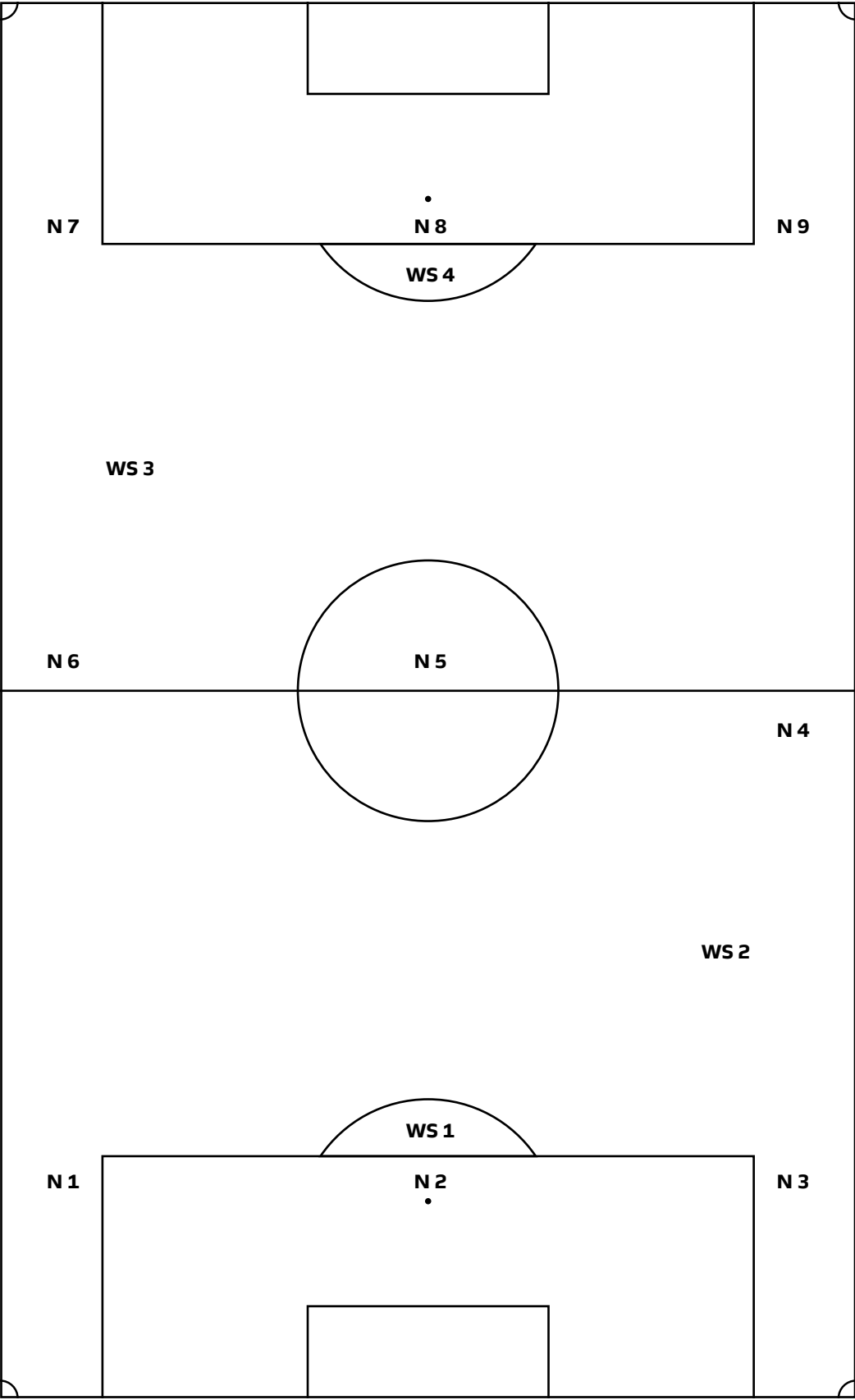
The readings may be documented using the tables contained in Annex 9.

Entering the readings into the DFL’s online greenkeeping portal ensures that the data is digitally documented and available at all times.

It goes without saying that further quality checks may be carried out as and when required, such as to determine the effectiveness of a measure.

8. Location of Test Field Positions

WS = Test positions for permeability and shear strength    N = Test positions for turf density



9. Annex

**Stadium turf quality:**  
**Season:**

**Turf density**  
Measuring device: Test frame 1m x 1m, divided into 100 squares of equal size  
Measuring system in accordance with DIN standard 12231, Test Method B

Date	Field position 1	Field position 2	Field position 3	Field position 4	Field position 5	Field position 6	Field position 7	Field position 8	Field position 9	Average
Average										

**Stadium turf quality:**  
**Season:**

**Permeability**  
Measuring device: Double ring infiltrometer  
Measuring system in accordance with DIN standard 12616, Method B

Permeability  $I_g$  (mm/h) =  $\frac{\text{Drop in water level (mm)}}{\text{Length of time for drop in water level (h)}}$

Field position	1			2			3			4			Average
Date	Sample A	Sample B	Average	Sample A	Sample B	Average	Sample A	Sample B	Average	Sample A	Sample B	Average	
Average													



Stadium turf quality:  
Season:

Shear strength

Measuring device: Shear vane tester with 40mm long and 20mm wide blades  
Measuring system in accordance with DIN standard 18035-4

Date

Field position	Sample A	Sample B	Sample C	Sample D	Sample E	Sample F	Average	Average
1								
2								
3								
4								

Date

Field position	Sample A	Sample B	Sample C	Sample D	Sample E	Sample F	Average	Average
1								
2								
3								
4								

Date

Field position	Sample A	Sample B	Sample C	Sample D	Sample E	Sample F	Average	Average
1								
2								
3								
4								

Date

Field position	Sample A	Sample B	Sample C	Sample D	Sample E	Sample F	Average	Average
1								
2								
3								
4								

Season average	
----------------	--

# IV. Standard Evaluation System, Part 2 – Sporting Criteria

For any standard evaluation system to be authoritative, it is vital to apply the same measuring criteria and procedures across all stadiums, and to document these on a regular basis. The data obtained is to be recorded in a standardized way and submitted if required.

It will assist clubs and/or stadium operators at the time of making decisions about further turf care and playing surface maintenance by the groundsmen and greenkeepers. **Sporting criteria** are the second key component of the standard evaluation system. This involves the two team captains and the match officials delivering their personal verdict on the state of the pitch after each match. They are asked to give marks on a scale from 1 to 5 (1 extremely poor, 2 poor, 3 average, 4 good, 5 excellent). Generally, this should always be possible, although there may be days where extraordinary circumstances (e.g. drastic changes in playing surface quality due to heavy snowfall in midmatch) do not allow any grading, so that “evaluation not possible” may also be entered. On the basis of these marks, the Greenkeeping Award “Pitch of the Year” was introduced from the 2013-14 season onwards.

After every game, the various marks given are gathered by way of an automatic e-mail re-sponse function, with the team managers responsible for entering their respective team cap-tain’s assessment.

To ensure that clubs are encouraged to improve their turf quality further, e-mails will be sent automatically to the managing directors of clubs with a “poor” pitch assessment in future. This is intended to inform the club management immediately if their pitch quality is deemed to be inadequate by the respective stakeholders. A warning notice including information on measures to improve pitch quality is sent out if two successive home matches are given an overall score of below 3.5 points. If at least two of the three marks for a match are “poor” or “extremely poor”, the club must immediately inform the DFL of the steps being taken to resolve the problem in order to ensure the best possible playing conditions for the next home match.

## V. Greenkeeping Award “Pitch of the Year” for Bundesliga and Bundesliga 2

The pitch nominated on the basis of the sporting criteria system ranking will be reviewed by the DFL jury, and at their recommendation will be awarded the title “Bundesliga Pitch of the Year” (and “Bundesliga 2 Pitch of the Year”, respectively) in the season in question for outstanding quality on match days of the club concerned.

To this end, the jury will consider the points system and the list of criteria outlined below in the elimination stage to assess the quality of the pitch on a previously determined cut-off date and thus to determine the two winning candidates and the second- and third-placed candidates. This selection will be confirmed by the DFL Expert Commission. The jury is currently made up of Dr Harald Nonn (jury foreman), Dr Klaus Müller-Beck and Prof. Wolfgang Prämaßing.

Block 1 – Sporting criteria (weighting 40 points):

- Ranking 1 to 18, cut-off date on match day #28 of the Bundesliga and Bundesliga 2 respectively
- Finalists ranked 1 to 3 according to ranking
- The six clubs’ performance over the season

Block 2 – Review of measured data (weighting 20 points):

- Match days #30 to #34: Jury check
- Spot checks on turf density, shear strength, permeability, and evenness
- Interviews with greenkeepers > special challenges, turf diseases, etc.

Block 3 – Stadium greenkeepers’ own records (weighting 30 points):

- Seasonal measured data and physical conditions (use of artificial lighting, ventilation, stadium architecture, frequency of matches, etc.)
- Turf care and maintenance documentation (e.g. timing, nature and extent of measures, special features, etc.)

**Points system:** A maximum of 90 points in total (Block 1: scale from 1 to 5 multiplied by a factor of 8; Block 2: scale from 1 to 10 multiplied by a factor of 2; Block 3: scale from 1 to 10 multiplied by a factor of 3)

In future, additional practical tests checking the ball’s bouncing and rolling behaviour remain a possibility.

## VI. Training and Further Education

As a rule, sports areas in the Bundesliga and Bundesliga 2 should be tended to and maintained by specially qualified staff. To obtain the relevant qualifications, the following options for training and further education are available in Germany at the training centres of DEULA Rheinland and DEULA Bayern (cf. Figure 16, page 32):

Level 1:

Members of the maintenance team have the option of attaining the fundamentals in the course series “Qualified football groundsman”, consisting of a basic course, continuation course 1 and continuation course 2 (one week of 45 units each, total units: 135). After passing the written, oral and practical exams, participants are issued with the **“Qualified Groundsman for Outdoor Sports Facilities”** certificate (issued by DFB and DEULA).

Level 2:

A more professional and in-depth course for those in charge of pitch maintenance and their substitutes is the further education course to become a certified greenkeeper. It consists of four blocks (for a total of 10/12 weeks of 45 units each, depending on the provider; total units: 450). With its final exam, this course meets the requirements of section 54 of the German Vocational Training Act (BBIG), allowing graduates to use the title **“State-Certified Greenkeeper/Agronomist for Outdoor Sports Facilities”** (issued by the NRW Chamber of Agriculture or the Bavarian Ministry of Food, Agriculture and Forestry).

Level 3:

To obtain important management skills and extend their knowledge on all things turf, a continuation course consisting of four blocks (for a total of eight weeks of 45 units each, total units: 360) to become a **“State-Certified Head Greenkeeper for Outdoor Sports Facilities”** (issued by the NRW Chamber of Agriculture) lends itself to state-certified greenkeepers with management responsibilities. This course is certified under section 54 of the German Vocational Training Act (BBIG). To obtain this certificate, candidates must pass the final exam and present a paper on a given assignment.

Successfully graduating as an agronomist for outdoor sports facilities and golf course maintenance (from level 2 upwards) also gives the respective individual access to higher education.

Pursuant to section 7 (4) of the Ordinance Governing Specialist Qualifications in Plant Protection (PflSchSachkV) in conjunction with section 9 (4) of the Plant Protection Act (PflSchG), the new PflSchSachkV requires professional users of plant protection products to update their current

and future knowledge every three years by attending a recognised further education course. Such specialist qualification courses in plant protection are provided by the DEULA training centres, amongst others. The courses impart current legislature, in particular that applicable to the sports turf and golf turf areas, the principles of integrated plant protection and the diagnosis of patterns of damage in the turf as well as the proper handling of plant protection products.

Please also note the additional training courses that are available from the DEULA training centres, the German Turfgrass Society and various other institutions, covering a spectrum of issues that go beyond the programmes offered to greenkeepers and groundsmen. The DFL can provide further information on the available courses on request.

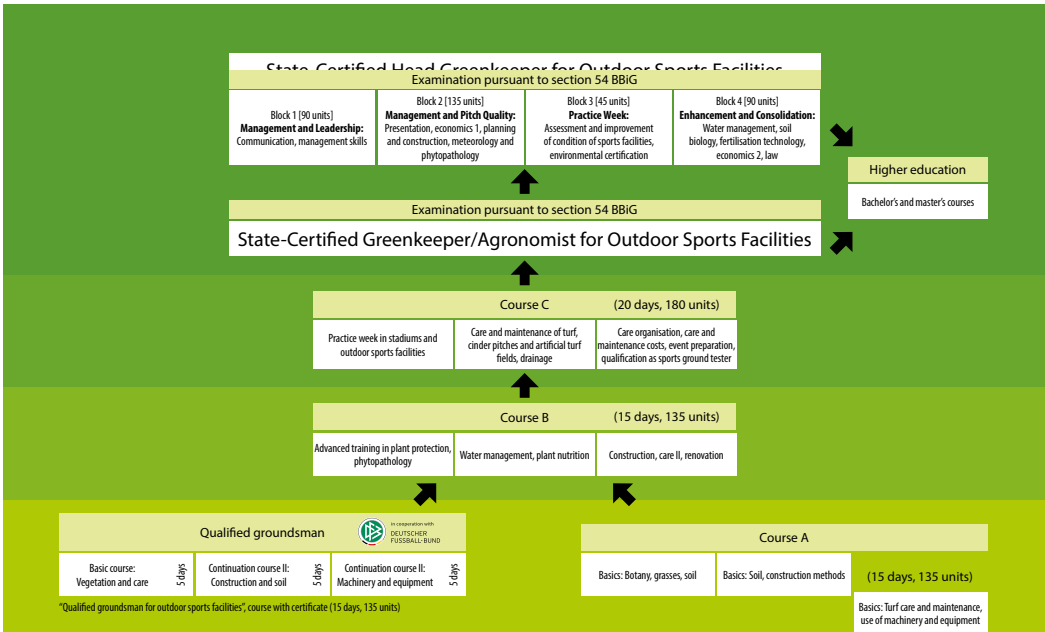


Figure 16

## VII. Useful Contacts and Sources of Information

Everything worth knowing about turf	<a href="http://www.rasengesellschaft.de">www.rasengesellschaft.de</a>
Training and further education	<a href="http://www.deula-kempen.de">www.deula-kempen.de</a> <a href="http://www.deula-bayern.de">www.deula-bayern.de</a>
Football in Germany	<a href="http://www.dfb.de">www.dfb.de</a>
Bundesliga and Bundesliga 2	<a href="http://www.dfl.de">www.dfl.de</a> <a href="http://www.bundesliga.com">www.bundesliga.com</a>
European Stadium and Safety Management Association	<a href="http://www.essma.eu">www.essma.eu</a>

Acknowledgements:

DFL, Licensing Regulations  
<https://www.dfl.de/dfl/files/statuten/Ligastatut/Lizenzierungsordnung-LO-2017-12-13-Stand.pdf>

DFL, Annex VI, Stadiums and Security Guidelines

DFL, Annex XI - Media Regulations for Bundesliga and Bundesliga 2 Matches  
<https://www.dfl.de/dfl/files/statuten/Ligastatut/Anhang-XI-Medienrichtlinien-ab-Spielzeit-2017-2018.pdf>

DFB, Laws of the Game, 2018-19

DFB, Compendium on Sports Field Construction and Maintenance (5th fully revised edition, 2017)  
[https://www.dfb.de/fileadmin/\\_dfbdam/165905-Sportplatzbau\\_und\\_Erhaltung.pdf](https://www.dfb.de/fileadmin/_dfbdam/165905-Sportplatzbau_und_Erhaltung.pdf)

DFB, Guidelines on Integrated Plant Protection (2017)  
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FIFA, Football Stadiums: Technical Recommendations and Requirements, 2011

FIFA, Quality Programme for Football Turf, Handbook of Test Methods, January 2015 Edition

FIFA, Quality Programme for Football Turf, Handbook of Requirements, January 2015 Edition

UEFA, <https://www.uefa.com/insideuefa/documentlibrary/aboutuefa/index.html>

UEFA Pitch Quality Guidelines 2018: [https://www.uefa.com/MultimediaFiles/Download/uefa-org/Stadium&Security/02/54/11/97/2541197\\_DOWNLOAD.pdf](https://www.uefa.com/MultimediaFiles/Download/uefa-org/Stadium&Security/02/54/11/97/2541197_DOWNLOAD.pdf)



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The DFL thanks the Working Group for its collaboration.

## The player's perspective

"Is there anything better for a footballer than coming out on to a lush, green pitch, smelling the grass and knowing that the ref is about to start what is going to be a great game?"

Players usually realise just how important a well-kept playing field is after having had to play on a pitch on which the ball bounces around badly and the ground of which just doesn't provide a good enough grip.

**"A great match needs a great pitch!"**

To feel at your best as a player, and to give the spectators their money's worth, you need an impeccable natural turf sports surface with good playing qualities. Only on a carpet-like pitch will you experience perfect ball roll behaviour, a key factor for players to show their true class. A decent playing field is also necessary to protect the players' health whilst at the same time enabling both a dynamic and safe style of play. Slippery and uneven patches can quickly lead to falls and injuries.

With this in mind, I would like to thank all those people who make sure that our pitches – regardless of which league or division – are in a good state, wishing them all the best of success for their future research and efforts into improving the quality of playing fields."

Carsten Ramelow is vice-president of the Players' Union (VDV) and honorary captain of Bayer 04 Leverkusen. His sporting pedigree includes competing in the 2002 Champions League final with Bayer 04 and, just a few weeks later, coming second at the 2002 FIFA World Cup with Germany's national side.



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## The coach's perspective

"Greenkeeping has become enormously important for football nowadays. The grass pitch is literally the foundation of any match. An uneven pitch can have a big impact on the match, and could even turn an attacker with a dead-cert chance into the one responsible for losing the points in the end. Different tuft lengths affect the speed with which a low pass is received, thus influencing the whole speed of the game. As a coach you naturally want the finest, smoothest turf during practice sessions and in the stadium. It allows you and the team the best possible preparation and performance on match day without that unwanted element of chance. A smooth pitch with short grass is the best basis for our sport."

**"The grass pitch is literally the foundation of any match."**

This is why it is important and conducive to the game that the findings in the science of greenkeeping literally grow, enabling heavily used and weather-beaten pitches to be put in order for practice sessions and proper matches."



© firo sportphoto

Benno Möhlmann is a founding member and honorary president of the Players' Union (VDV). After his playing career, in which he played for teams including SV Werder Bremen, he worked as coach for Hamburger SV, Eintracht Braunschweig, SpVgg Greuther Fürth, DSC Arminia Bielefeld, FC Ingolstadt 04, FSV Frankfurt, TSV 1860 München and SC Preußen Münster.



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