



UEFA Pitch Quality Guidelines

Natural turf pitch management – 2018 edition

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Disclaimer

These guidelines have been drafted to provide generic advice in respect of pitch design, maintenance, preparation, management, monitoring and assessment. UEFA has taken all reasonable care to ensure that the information contained in these guidelines is accurate in all material respects. However, neither UEFA nor any of its representatives, agents or employees make any representation or warranty or accept any responsibility for the accuracy or completeness of any of the information contained in these guidelines, nor shall they be liable for any loss or damage suffered by any party in their application of these guidelines. Independent advice should always be sought from an expert for specific and tailored guidance in respect of each individual pitch.

1 INTRODUCTION

Pitch presentation and playing conditions need to be of the highest quality for professional football matches. In practice, this means that pitches should:

- be well-drained, smooth and level;
- be safe for the players;
- allow for optimal play;
- have a good visual appearance.

Pitch conditions influence the quality of the football being played and are a reflection of the competition, the stadium, the host club/national association and the country. Every pitch should be comparable in appearance and performance to other pitches considered to be of a similar international standard.

It is very important that all parties work as a team to ensure the best possible playing conditions and visual appearance. Not only must players be able to perform to the best of their abilities on a smooth and stable playing surface; it is also important to ensure that matches are not compromised by a pitch's inability to cope with adverse or challenging weather conditions.

This document provides an overview of the pitch quality guidelines for stadiums hosting UEFA matches, including:

- pitch construction and infrastructure requirements;
- pitch maintenance and match preparation guidelines;
- pitch quality assessment and monitoring procedures.

The guidelines include tasks to be carried out when overseeing pitch preparations for UEFA matches. As such they are aimed primarily at those responsible for pitch management, strategy and resource planning. Given the wide geographical spread of countries that host UEFA matches and the significant differences in climatic conditions experienced, some of the content of this document is inevitably fairly generic. It is therefore very important for those applying these generic guidelines to be fully familiar with any local specificities and constraints that will affect the development and management of their respective pitches (e.g. weather conditions, availability of materials and equipment, local competence and support services).

2 KEY ROLES AND RESPONSIBILITIES

2.1 Responsibilities of the head groundskeeper

The head groundskeeper is responsible for the successful delivery of the pitches used for matches and training sessions at his or her stadium. The importance of this job cannot be overestimated as the groundskeeper's abilities will be on public display, on-site and in the media, through the appearance and performance of the pitch.

The key responsibilities of the head groundskeeper in relation to UEFA matches are:

- agronomic tasks relating to pitch preparation and maintenance;
- operational tasks relating to pitch preparation and maintenance;
- accommodation of official training sessions;

-
- post-match pitch repairs;
 - dealing with challenging weather conditions before and during matches.

These responsibilities are fulfilled by:

- ensuring that all equipment is properly calibrated, well maintained and functional;
- thoroughly planning all staffing and pitch maintenance activities according to the schedule of events to be held at the stadium;
- ensuring that all staff perform their tasks to the best of their abilities;
- managing and coordinating staff to ensure the various pitch-related tasks are conducted as required;
- carrying out mowing, fertilising, spraying and specialist tasks;
- keeping accurate notes and records;
- reporting pitch ailments, problems and issues immediately;
- ensuring that the pitch is immaculately presented;
- maintaining the necessary range and stock of fertilisers, plant protection products and other consumables;
- monitoring weather conditions closely.

The head groundskeeper should keep a diary of all pitch operations carried out by his or her staff. This diary is an operational document which should be available for review by UEFA, stadium management officials and turf consultants.

The head groundskeeper is also responsible for coordinating equipment operators and divot repair staff. It is the head groundskeeper's responsibility to ensure that such staff are adequately trained and supervised.

2.2 Responsibilities of pitch contractors

If outside pitch contractors are used for pitch maintenance and renovation activities, it is important that they understand their role and responsibilities in the delivery of pitches for UEFA matches.

A pitch contractor is expected to:

- provide maintenance equipment as per UEFA's guidelines and recommendations;
- ensure that backup equipment is available and that if equipment is being shared between sites, it is always available where it is required;
- ensure that the products recommended and required for pitch maintenance are available on-site;
- ensure a sufficient number of staff are available to perform the activities required;
- ensure all staff are fully trained and competent to carry out their work in a safe and high-quality manner;
- ensure staff carry out the tasks and functions expected of them to a high standard and on time.

Even if outside pitch contractors are used for pitch maintenance and renovation activities, it is recommended that every stadium has a direct employee with qualifications and/or experience in turf management to oversee the contractors' operations and performance.

2.3 Responsibilities of turf consultants

UEFA may appoint turf consultants for specific matches and/or to provide ongoing pitch monitoring through the UEFA Pitch Quality Support Programme.

Turf consultants are expected to:

- develop a good understanding of a specific pitch's history and the current resources and capabilities available for its management (UEFA issues a standard pitch construction and management questionnaire for this purpose);
- carry out site visits to assist with pitch maintenance and preparation;
- advise on pitch operations and check that pitch operation teams are effective and efficient;
- carry out pitch performance tests and make recommendations accordingly;
- provide support and advice on pitch preparation, maintenance, use and repair;
- identify and advise on high-risk or high-priority pitch performance issues;
- update UEFA's databases on pitch characteristics and performance.

3 PITCH DESIGN AND INFRASTRUCTURE

3.1 Key considerations

For a pitch to be well designed, constructed and maintained, the following six points must be adequately addressed in light of local resources and conditions:

1. Selection of construction method and materials
2. Design and quality of drainage, irrigation and undersoil heating systems
3. Availability and quality of maintenance equipment, systems and consumables
4. Availability of supplementary lighting and pitch covers where the natural conditions are not suitable for year-round growth
5. Use of appropriate materials for weed, disease and pest control
6. Staff training and turf industry support services

A badly designed, constructed or maintained pitch will negatively affect the quality of play, limit the number of matches that can be played, increase the risk of matches being cancelled and be expensive to maintain. Many site-specific factors need to be considered when constructing high-quality pitches, including:

- the drainage and geotechnical characteristics of the site;
- the load-bearing strength and shape of the formation layer (sub-base);
- the extent of shade and restricted air movement;
- the need for undersoil heating and/or pitch cover systems (UEFA has specific expectations in relation to undersoil heating and pitch cover systems in certain environments, as stipulated in the UEFA Stadium Infrastructure Regulations (2018 edition) and section 3.5 of this document);
- the events schedule and planned usage of the pitch, including non-sporting events such as concerts;
- the risk of matches being cancelled as a result of the weather (e.g. in case of heavy rainfall, ice, snow, extreme heat or drought);
- the implications of retrofitting infrastructure (i.e. installing a new pitch in an existing stadium);
- the time available for pitch construction and turfgrass establishment (grow-in);
- the resources and budget needed to construct and maintain the pitch.

Some stadiums may appoint their own specialist turf consultant to:

- determine precise pitch design requirements;
- ensure that construction work is carried out in application of appropriate standards and suitable materials;
- provide an ongoing management programme for the pitch, including for any non-sporting events.

3.2 Drainage and profile design

A pitch that drains freely is better able to provide the required playing characteristics on the surface. The minimum design for a professional football pitch usually includes an imported sand-dominant root zone overlying a pipe-drained sub-base (Fig. 1), together with an automatic pop-up irrigation system. In some cases, the sand-dominant root zone can be created by mixing known quantities of a carefully selected sand with the existing soil in order to improve the physical properties of the surface layer.

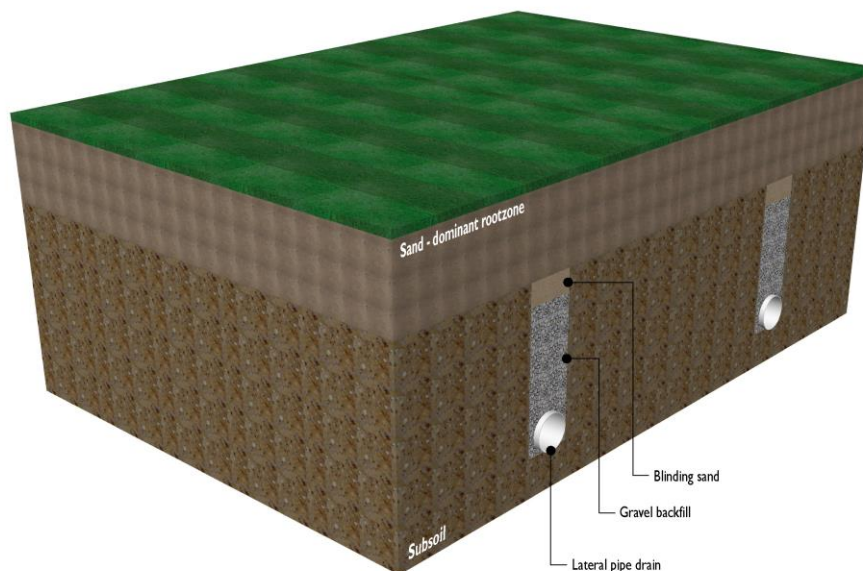


Fig. 1. Sand-dominant root zone overlying a pipe-drained sub-base.

Ideally, there should be a constructed gravel drainage layer between the sand-dominant root zone and the underlying pipe drainage system (Fig. 2). A gravel drainage layer is primarily used in wet areas, where good drainage is essential, but it can also be useful in dry climates, where water tends to be held in the sand profile layer. The selection of compatible materials for the different layers is critical to the success of this type of pitch construction, as is the correct calculation of the sizing, depth and spacing of lateral and main drainage pipes to a suitable outfall.

Laboratory analysis of all materials (sand, gravel, etc.) used to build any pitch is absolutely essential in order to ensure that materials with the right particle sizes are used. Specialist advice should always be sought.

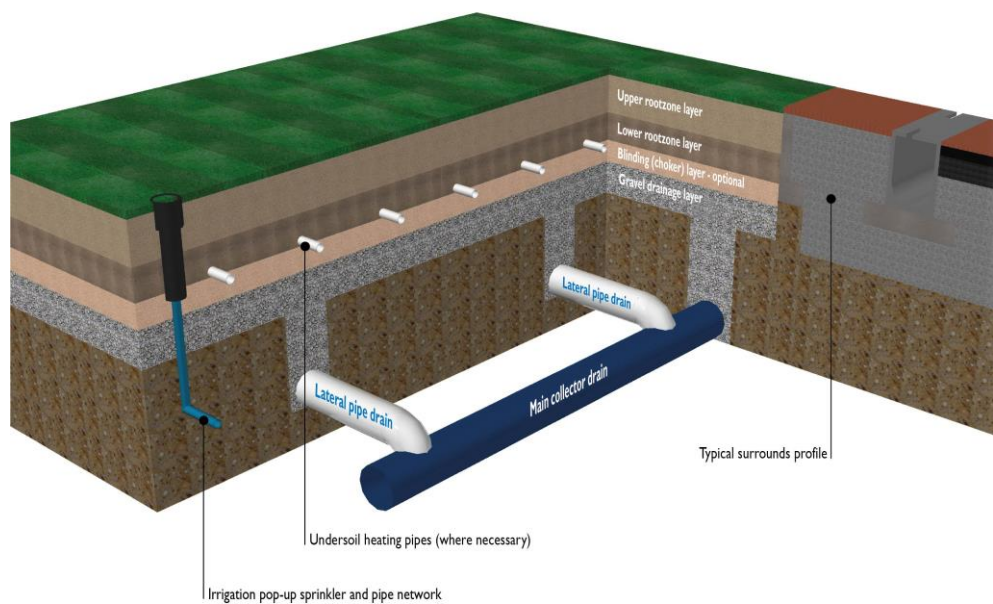


Fig. 2. Conventional sand-over-gravel suspended water table pitch design with automatic pop-up irrigation system.

Additional pitch infrastructure components may include:

- specialist turf reinforcement systems;
- undersoil heating systems;
- pitch cover systems;
- vacuum and ventilation systems for large stadiums with particularly difficult growing environments;
- lighting rigs;
- pitchside ventilation fans.

Many of these additional components are elaborated on below. The use and choice of such additional components will depend on the climate and local weather patterns, the micro-climate within the stadium bowl (e.g. light, airflow and ventilation), the species and cultivar of turfgrass being grown, the desired pitch quality and the budget available.

3.3 Irrigation systems

There are several systems used to irrigate pitches (e.g. self-travelling sprinklers, static sprinklers, canon sprinklers and pop-up sprinklers). It is strongly recommended that only fully automatic pop-up irrigation systems be installed in pitches used to host UEFA matches, because such systems are easier to control and manage and ensure uniform distribution of water, fast irrigation times and a syringe cycle of water post-match and at half-time. An automatic pop-up irrigation system also can apply water during the night, thereby reducing evaporation losses.



Fig. 3. Types of irrigation systems used in the sports turf industry. From left to right: cannon type, self-travelling type, static type and pop-up type. Only automatic pop-up irrigation systems are considered appropriate for pitches used to host UEFA matches.

Like with pitch drainage and profiles, designing a fully automatic pop-up irrigation system is a specialist task. The most important considerations are:

- the supply, storage and quality of irrigation water (mains, bore hole, etc.);
- the quantity of irrigation water required;
- the uniform application of irrigation water;
- the number and arrangement of irrigation heads;
- 'block' or 'individual head' control.

A suitable system may have around 20 pop-up sprinkler heads per pitch but some have 24 to 35 with full overlap between adjacent sprinklers (Fig. 4). Most existing irrigation systems have solid plastic sub-surface infield sprinkler heads with a small diameter at the surface (approx. 50mm). In-field sprinkler heads tend to be located 10-15mm below the soil surface and should not be detectable on the surface. However, some pitches will have much larger sprinkler heads and in these situations, the irrigation head must be suitably protected with a turf cup. The ultimate aim is player safety – any irrigation system that is not safe for players is unacceptable.

Ground staff must ensure that sprinklers do not wash out the area around the head. Grass coverage must be uniform around irrigation heads and erosion must not be allowed to occur.

Alternative irrigation options include perimeter pop-up sprinklers with mobile sprinklers in the centre of the pitch. However, coverage is less uniform with such systems and there is greater reliance on ground staff to carry out the irrigation.

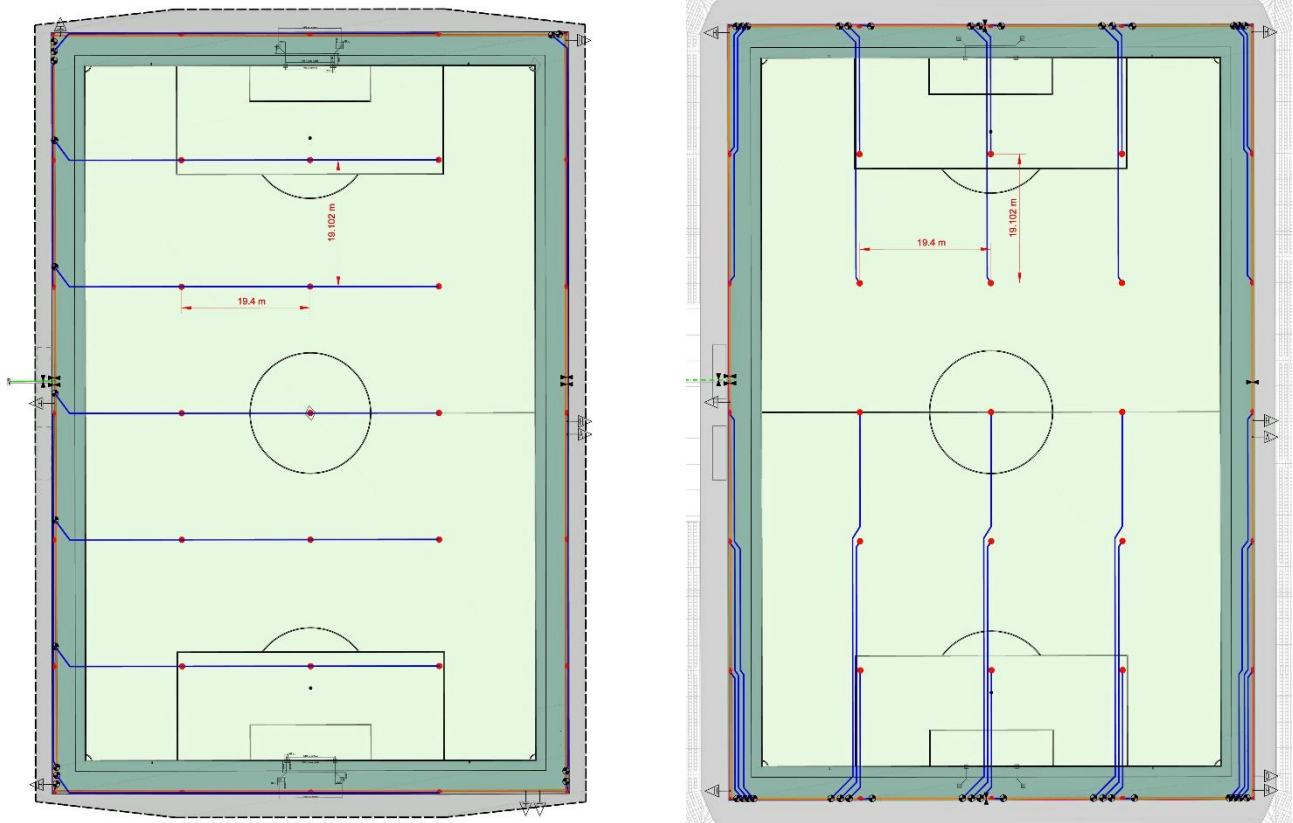


Fig. 4. Example of a 'block' type irrigation design (left) v individual head control layout (right), with both designs showing 'head-to-head' coverage.

It is advisable to have one person working at a stadium who is skilled in the basic servicing of the minor components of fully automatic irrigation systems, including servicing pop-up sprinklers and valves and changing sprinkler heads and nozzles. In the absence of a capable member of ground staff, it is worth having access to an irrigation engineer who can be on standby for matches.

To guarantee irrigation systems perform properly, regular checks should be made to ensure that:

- all sprinklers pop up;
- all sprinklers rotate and all at the same speed;
- all sprinklers retract correctly;
- no nozzles are blocked;
- no sprinklers are leaking (i.e. no wet patches on the pitch);
- all sprinklers are set at the correct level so that they do not pose a safety risk for players;
- all sprinklers are aligned correctly (vertically);
- all sprinkler nozzles are of the correct size.

A reliable supply of water must be available. This is often a bore hole source, although sometimes the mains water supply is used. The quality of water is equally important as turf quality can be significantly diminished if the water contains a high level of dissolved salts, particularly in drier climates.

Irrigation requirements may reach 8-10mm per day in Mediterranean, continental and sub-tropical climates (64-80m³ for an 8,000m² pitch), although requirements will be significantly lower in cooler, more

temperate climates. In case of failures in the water supply, it is advisable to have sufficient water storage on-site (in tanks) to ensure a safety margin of at least 24 hours until the water supply can be restored.

3.4 Specialist turf reinforcement systems

Turf reinforcement systems attempt to combine the playing quality benefits of natural turfgrass with the practical strengthening and engineering advantages of artificial materials.

Turf reinforcement systems can be grouped into three broad categories:

1. Intact fabrics or artificial turf carpet placed into or a little below the surface, filled with a sand-based material in which natural turfgrass is grown. This type of system lends itself to being used as part of a big roll turf system for the immediate establishment of a playable surface or rapid repair of damaged areas on an existing surface.
2. Individual strands of artificial turf fibres usually 200mm long, stitched vertically into the sand-dominated profile to a depth of 180mm at very close centres (typically 20mm), leaving 20mm of the artificial turf fibres above the surface like blades of grass. This type of system is particularly good for maintaining surface smoothness and the appearance of turfgrass once the natural turfgrass has worn away.
3. Randomly oriented elastic material or plastic (e.g. polypropylene) fibres or mesh elements that are incorporated into the upper layer of the sand-dominated profile usually before it is laid but sometimes in situ. These systems are profile stabilisers and may increase the load-bearing strength and shock absorbency properties of the root zone.

The expression 'hybrid' systems now seems to be commonly used to describe turf reinforcement systems because of the mixture of natural and artificial materials they represent.

Key considerations when deciding whether to install a turf reinforcement system into a sand-dominated root zone and which type of system to install include:

- the cost of the system;
- the specific features of the system in relation to the intended use of the playing surface;
- the intended management/maintenance requirements of the playing surface;
- the species of turfgrass grown;
- the longevity of the system (can it be easily renovated?);
- the cost of disposal (is the product classified as hazardous waste?).



Fig. 5. Types of turf reinforcement system. From left to right: carpet, stitched and fibre.

It is strongly recommended that all clubs/national associations hosting UEFA matches invest in reinforced pitches. There are many systems available to suit different budgets and stadium business models. A three-year period is a good timeline to allow for planning and installation.

3.5 Undersoil heating and pitch cover systems

Undersoil heating systems use buried water or glycol-filled pipes (a few systems use electrical wires instead of pipes) to heat the profile in order to help maintain a frost and snow-free profile during winter months and speed up turf recovery at the end of the winter period. The heating unit in undersoil heating systems (typically a gas or oil-fired boiler) usually has low, high and standby modes with intermediate settings for frost, severe frost, ice and snow.

Key considerations:

- An undersoil heating system should be installed if local climatic conditions regularly result in frost or snow.
- Venues with a lesser risk of frost or snow should at least invest in pitch cover systems so that some protection is available if and when required.
- Undersoil heating pipes should be at least 250mm below the surface to allow ground staff to carry out essential pitch maintenance.
- The pipes are typically spaced 250-300mm apart.
- Undersoil heating systems are often divided into separate zones on the pitch so that each zone can be heated individually. This is particularly useful if some sections of the pitch receive more prolonged shade than others during winter months.
- Undersoil heating systems should be installed under the entire natural turf area, including the surrounds (minimum of 2m for assistant referees and player over-runs)
- A consistent and known depth of installation is vital to avoid potential damage from maintenance operations and the installation of stitched turf reinforcement systems.

The design and installation of undersoil heating systems is a specialist task. Some systems involve laying the heating pipes in special racks directly on top of the gravel drainage layer (Fig. 6), while other methods of installation involve drawing heating pipes through the profile from the surface using special tractor-mounted equipment (Figs. 7 and 8). Pitch covers are often used in conjunction with undersoil heating systems for maximum efficiency (Fig. 9). It is an expectation that all teams participating in UEFA's flagship competitions have or can source a viable pitch cover system at short notice if required.

Fig. 6. Racks used over the gravel drainage layer to support undersoil heating pipes prior to root-zone placement.



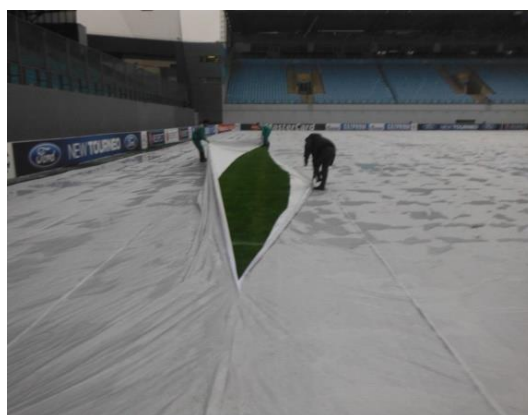
Fig. 7. Installing undersoil heating pipes through the profile.



Fig. 8. Completed installation.



Fig. 9. Pitch covers can be used in conjunction with undersoil heating to maintain turfgrass growth through winter.



It is strongly recommended that all stadiums that have undersoil heating systems and are used to host UEFA matches provide certification at the beginning of the season to demonstrate that their heating boiler has been properly serviced and is ready for the forthcoming winter.

3.6 Vacuum and ventilation systems

It is important to consider the need for vacuum and ventilation systems at stadiums with challenging growing environments and/or major matches to host (e.g. finals or final tournaments). Such systems:

- are powerful pumping and air-distribution systems designed to blow conditioned air into the profile;

- can decrease or increase soil temperature to extend the growing season or control turfgrass dormancy (Fig. 10);
- can also be switched to suction mode to remove excess rainfall from the surface in a matter of minutes, for example if there is a severe thunderstorm shortly before the start of a match.

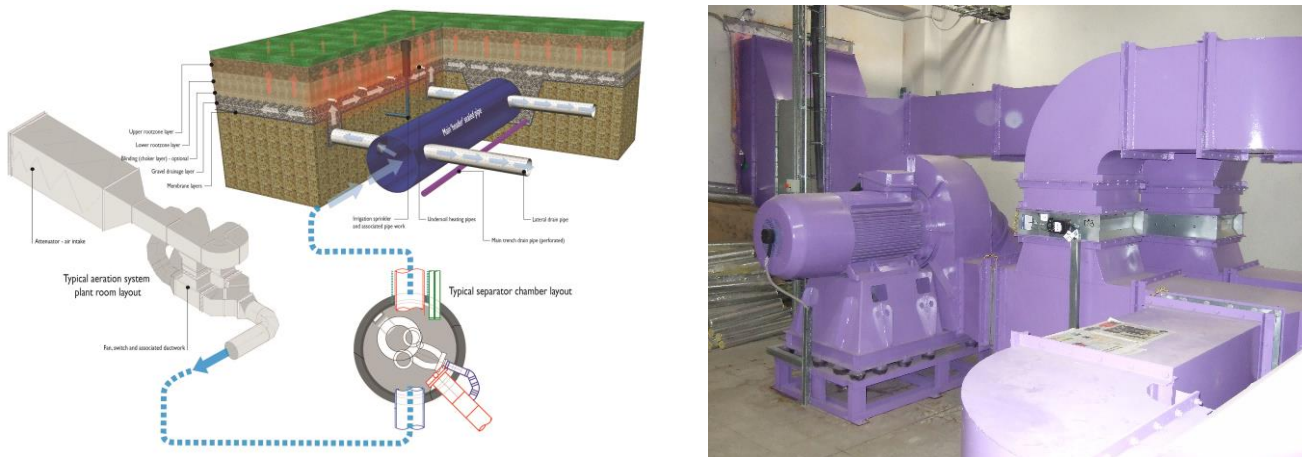


Fig. 10. Schematic diagram of a pitch vacuum and ventilation system (left) and installed blower unit (right).

Pitchside fans are also used in hotter climates to provide air flow within a stadium and a degree of surface cooling (Fig. 11). Some fans simply blow air across the pitch, while others produce water vapour to give an additional degree of cooling at the pitch surface, although care must be taken with the management of such fans, to avoid increasing the risk of turf disease.



Fig. 11. Examples of pitchside ventilation and cooling fans used to manage turf health.

3.7 Artificial lighting systems

Over a 10 to 12-hour period, artificial lighting rigs can supply sufficient photosynthetically active radiation to promote the active growth of temperate (cool-season) turfgrasses in heavily shaded stadiums and allow acceptable recovery from wear during winter periods.

The light output from artificial lighting rigs includes a photosynthetically active wavelength of 400-700nm (nanometres) and the red/green/blue light levels are measured in units of $\mu\text{mol}/\text{m}^2$ (micromoles per square metre).

Key considerations:

- The largest rigs currently on the market have a lighting footprint of between 360 and 590m² (Fig. 12).
- Between three and nine rigs will typically be required to provide sufficient light coverage of a stadium pitch, depending on the extent of heavy shade.
- Any decision to install lighting rigs should be based on a detailed light modelling exercise of the shaded areas within the stadium (e.g. a HemiView analysis).
- Fertiliser and irrigation programmes should be adjusted when lighting units are in use.
- The power source layout will need to be considered before installation.
- The average use of a full system of units is typically between 5,000 and 15,000 hours per season.

The majority of lighting rigs use conventional high-pressure sodium lamp technology, which also provides a source of heat – a useful attribute in cooler, temperate climates. The main advantage of this technology is that it avoids having to returf pitches several times a year in order to maintain their quality throughout the winter playing season. For many stadiums, the use of artificial lighting to keep turfgrass growing has become more cost-effective than regular returfing. However, such technology is not as well developed for warm-season turfgrass growth, due to the higher light intensities required by these grasses.

Developments over the next few years will probably involve greater use of light-emitting diode (LED) technology as an alternative light source.

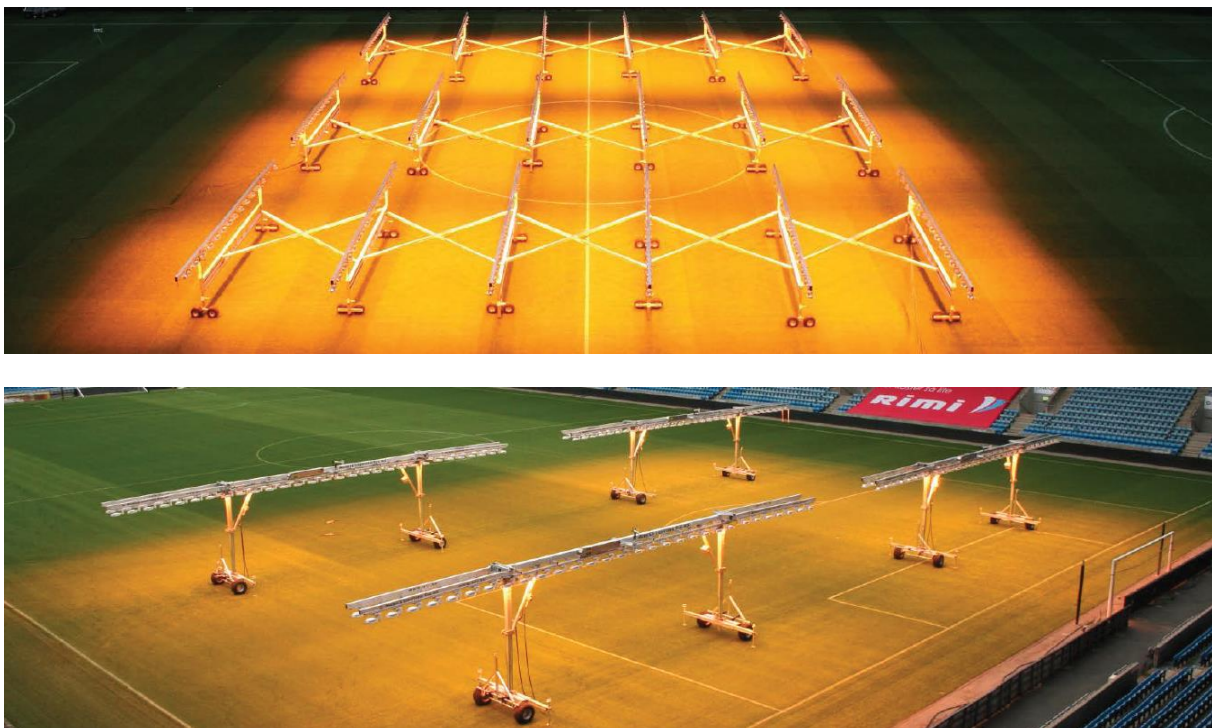


Fig. 12. Lighting rigs with folding arms (above) and interlocking arms (below).

It is strongly recommended that all stadiums that are used to host UEFA matches and have a known shade problem carry out a light/shade study of their pitch to ensure that sufficient lighting rig resources are provided for adequate grass growth in all areas of the pitch.

In summary, the combination of undersoil heating, pitch covers and artificial lighting rigs is very effective in cold climates, keeping cool-season pitches playable during winter months (Fig. 13).



Fig. 13. Combination of lighting rigs and pitch covers.

3.8 Turfgrass selection

A stadium's choice of turfgrass will depend on its location and climate. This is another highly specialist area, on which these guidelines can provide only very basic instruction.

There are two main types of turfgrass – cool-season turfgrass and warm-season turfgrass. The two types vary considerably in their basic biology and climate adaptation, and both can be found on pitches in various locations across countries that host UEFA matches:

- Cool-season turfgrass species are adapted to cooler regions. Species used regularly on football pitches include perennial ryegrass (*Lolium perenne*), smooth-stalked meadow-grass/Kentucky bluegrass (*Poa pratensis*) and tall fescue (*Festuca arundinacea*).
- Warm-season turfgrass species are adapted to tropical areas. Common species include bermudagrass (*Cynodon* species), zoysia species (mainly *Zoysia japonica* and *Zoysia matrella*) and seashore paspalum (*Paspalum vaginatum*).

The species of turfgrass selected will depend on factors such as tolerance to heat or cold, drought resistance and disease resistance. Extensive turfgrass breeding work has been carried out to improve the wear tolerance and local adaptation of individual cultivars (varieties) of each species.

Turfgrass selection is particularly tricky in those parts of the world that experience a relatively wide range of temperatures, in particular those countries with continental transition zone climates and some Mediterranean/dry summer subtropical climates. In such climate zones, cool-season grasses are poorly adapted to summer conditions, when high temperatures, water availability and possible salt accumulation may be significant issues. Conversely, warm-season grasses are intolerant of the colder winter conditions and tend to go brown and dormant. Consequently, it is often necessary to oversow warm-season turfgrass with a cool-season species before the onset of winter. Such transitioning represents the most challenging aspect of turf management.

3.9 Pitch perimeter

Ideally, there should be a minimum of 1m of natural turf extending beyond the touchlines of any pitch, with good quality artificial turf (ideally FIFA Quality Pro) extending another 2 to 3m or as far as the advertising boards, depending on the space available (Fig. 14).



Fig. 14. Ideal scenario of at least 1m of natural turf extending beyond the touchline.

4 PITCH MANAGEMENT

4.1 Staff resources

Pitch maintenance before and after matches requires sufficient numbers of staff with the necessary training. The exact number of staff required will be influenced by the amount and quality of machinery and other equipment available, whether any of the work is carried out by external pitch contractors and whether ground staff have other duties around the stadium.

As a general indicator, the following numbers of ground staff are recommended for major stadiums:

- Core staff: up to 5
- Additional staff for matchdays: minimum of 3 or 4
- Additional part/full-time staff: 8 to 10

The above numbers are based on the need to be able to prepare pitches with a short turnaround time between matches, deal with the many pitch-related liaison activities that arise on matchdays and carry out comprehensive pitch inspections and repairs in the limited time available during half-time.

4.2 Equipment

Table 1 below provides an overview of the minimum equipment recommended to ensure a pitch is well maintained throughout the season. This list is by no means exhaustive and specialist advice should be sought on a case-by-case basis.

Equipment	Description	Quantity	Required specifications
Mowers	¹ Pedestrian cylinder mower	2 (min.) 4 (preferred)	<ul style="list-style-type: none"> • 700-900mm mowing width • Mowing height range inclusive of but not restricted to 10-40mm • 6-8 blade mowing cylinders • Capable of delivering >90 cuts per linear metre and mowing the pitch in 3-4 hours • Interchangeable cassette system for brush and verti-cut units (strongly recommended)
	¹ Pedestrian rotary mower (for pitch clean-up)	4	<ul style="list-style-type: none"> • Self-propelled • Rear roller mounted • Mowing height range inclusive of but not restricted to 20-50mm
	³ Ride-on cylinder mower	1 (backup)	<ul style="list-style-type: none"> • 1.5-2m mowing width • 8-10km/h mowing speed • 6-8 blade mowing cylinder • Capable of delivering >90 cuts per linear metre • Mowing height range inclusive of but not restricted to 10-40mm
Aerators	² Deep aerator	1	<ul style="list-style-type: none"> • Capable of operating to a depth of >200mm • Modern 'fast type' capable of aerating a pitch in 6-8 hours • Capable of operating at a heave angle of >20° where required
	² Shallow aerator	1	<ul style="list-style-type: none"> • Can be tractor-mounted, but ideally pedestrian • Aeration depth of <150mm • Capable of close tine spacing (<40mm) • 800-2,000mm operating width
Seeding unit	² Dimple seeder	1	<ul style="list-style-type: none"> • Must be dimple type, not disc type • Operating width of 1.5-2m • Capable of applying seed at a rate inclusive of but not limited to 5-40g/m²
Spray unit	² Self-propelled (preferable) Tractor-mounted and pedestrian are suitable alternatives	1	<ul style="list-style-type: none"> • Capable of applying 200-800L/ha • Tank capacity >300L (mounted) and >100L (pedestrian)
Tractor unit	³ Compact tractor	1	<ul style="list-style-type: none"> • 20-40hp • Turf tyres essential • 3-point link attached

Equipment	Description	Quantity	Required specifications
Line marker	¹ Wheel-to-wheel or spray-type marker	1	<ul style="list-style-type: none"> Marking width of 120mm
Drag brushes	¹ Pedestrian brushes for dew removal and light grooming	1	<ul style="list-style-type: none"> 1.5-2m width
Fertiliser spreaders	¹ Pedestrian fertiliser spreaders	2	<ul style="list-style-type: none"> Spread width inclusive of but not limited to 2-6m
⁴ Water clearers	Pedestrian foam-backed roller with an integrated tank to collect water	1	<ul style="list-style-type: none"> 60L per minute collection capacity
	Pedestrian roller squeegee	4	<ul style="list-style-type: none"> 1m width
¹ Miscellaneous	Divot forks	8	<ul style="list-style-type: none"> 4 tines 100-150mm tines
	Spring tine rakes	6	
	Turf Doctor or hexagonal turf plugger	2	<ul style="list-style-type: none"> Will not work on a hybrid turf reinforced pitch
	Wetting agent applicator gun	2	
	100m hose pipes with appropriate irrigation connection	2	
	500m polyethylene builder's line	1	
	100m steel measuring tape	1	
Lighting rigs			<ul style="list-style-type: none"> Site and pitch-specific (essential for large stadiums)
Pitch covers and germination sheets			<ul style="list-style-type: none"> Site and pitch-specific (all stadiums should have germination sheets)
Pitchside fans			<ul style="list-style-type: none"> Site and pitch-specific (e.g. very enclosed stadiums)

¹ Items considered to be essential and should be permanently available on-site.

² Items necessary but may be available on a short-term contractual basis.

³ Not essential but would help to speed up some maintenance operations.

⁴ Particularly for high rainfall areas.

Table 1. Recommended maintenance machinery and other equipment for stadium pitches.

4.3 Maintenance operations

Pitch maintenance requirements are site-specific and determined by local climatic and weather conditions as well as the intrinsic qualities of each pitch. It is difficult to be prescriptive but the following sections summarise the principal maintenance activities required, including specific mowing requirements for UEFA matches.

4.3.1 Mowing and pitch presentation

The purpose of mowing is to ensure that the grass is a suitable height for matches, as well as to remove debris from the surface after matches. Regular mowing improves turfgrass density and allows the UEFA mowing pattern to be created for presentational purposes. It is essential for mowing blades to be set up properly and kept sharp to ensure a good quality of cut.

Cylinder mowing for grass cutting and match presentation is probably the most important task a groundskeeper carries out. Rotary mowing should be used only for cleaning up the playing surface (e.g. removing divots after a match).

- The acceptable grass height depends on the time of year and whether the grass is a warm-season or cool-season type. UEFA regulations state that grass height may not, in principle, exceed 30mm but 28mm is a better maximum. In any case, the entire playing surface must be cut to the same height.
- The height of grass should be the same for both training sessions and matches.
- If deemed necessary by the referee or a UEFA match officer, the head groundskeeper may be requested to cut the grass again for a training session and/or a match (note: sufficient time must be allowed to complete such operations – typically up to 6 hours, to allow time for additional line marking if required).
- Grass should be cut in straight lines, across the width of the pitch, perpendicular to the touchline. No other form of grass cutting (diagonal, circles, etc.) is permitted for UEFA matches.
- The lines across the pitch should be cut in the direction and sizes shown in Fig. 15, with a total of nine bands in each half of the pitch. Band preparation starts from the left-hand side of the pitch as seen from the main camera, starting with a band that is cut away from the main camera position.
- The first four bands of the pitch should always be exactly 5.5m wide. The five remaining bands in each half should then be of a uniform width, finishing at the halfway line (on 105m pitches these bands will be 6.10m wide; for shorter pitches the width of these bands should be adapted accordingly).
- To maximise the definition and clarity of bands, pitches should be cut into this pattern (using a cylinder mower) on MD-2 at the latest and for all subsequent mowing before the match.
 - Check mowers for oil and leaks before starting.
 - Check the height and quality of cut across the entire cylinder. This is carried out using an Accu-Gage or height-of-cut (HoC) bar. All mowers must cut newspaper cleanly before being used on the pitch.
 - Mowing bands should be set out using string to ensure even, straight lines.
 - Mow the line along the string first, always with the most-experienced, lead operator mowing along the string and another operator following along the centre of the bay.
 - Mow straight lines at a comfortable walking pace; do not race the mowers and ensure there are no skips.
 - Empty the boxes on the mowers when they are three-quarters full and keep a record of the amount of clippings removed to help determine nutrient applications.
 - Stop mowers off the pitch if streaks appear and adjust the settings accordingly.
 - Try not to spin mowers on the turf as this will damage the turf.
 - Do not drive mowers on hard surfaces with the front roller down as this may affect the height of subsequent cuts.
 - The final two cuts should be made towards the main camera position.
 - Dew brushing (see section 4.3.2 below) should always be carried out first to try to get the driest possible leaf to mow.

Note that during UEFA matches, the reproduction, whether real or virtual, of logos or emblems is forbidden on the field of play, the goal nets and the areas they enclose, the goals themselves and the corner poles. They are permitted only on the flags.



Fig. 15. UEFA mowing pattern.

4.3.2 Brushing

The purpose of brushing is to:

- stand the grass up after matches to give better growing conditions and more effective cutting;
- reduce the risk of algae forming on the surface;
- spread or work sand topdressing into the surface;
- disperse dew that may form on the pitch and thereby reduce the risk of disease attacks.

Various brush types are available but the best is a pedestrian drag brush, which is dragged across the surface within the mowing bands (Fig. 16). More aggressive brushing may be needed to stand the grass up for cleaner cutting or to pull out post-match debris. These types of brushing are generally performed using tractor-mounted brushes. Aggressive brushing should not be used on young seedlings.

If a brush is not available, dragging a long, heavy water hose or rope can also help remove dew from the surface of the pitch. One person should hold each end of the hose or rope and drag it up and down the pitch, while ensuring that each pass overlaps the last until the entire pitch has been covered.



Fig. 16. Pedestrian brush being used to stand grass up ahead of mowing.

4.3.3 Pitch dimensions and line marking

Line markings must conform to the International Football Association Board Laws of the Game.¹ Clear, well-defined lines are essential for pitch presentation and it is recommended that only proprietary line marking compounds be used.

The most common types of line marker are wheel-to-wheel transfer markers, combinations of wheels and a belt, or spray-type line markers. Where no other equipment is available, lines can be painted by hand using a brush or roller.

Key considerations:

- Pitches used for UEFA competitions must measure 105m x 68m (Fig. 17).
- Pitch markings must be white, perfectly straight or curved as required and all of equal width, ideally the width of the goalposts but never more than 12cm wide.
- Lines in goal mouths must be in line with the backs of the goalposts.
- Penalty spots must be solid spots 200mm in diameter, while centre circle spots must be solid spots with a diameter of 240mm.
- The technical area must be marked with dashed lines, extending 1m parallel to the touchline on either side of the relevant substitutes' bench/technical seats and forward to 1m from the touchline.
- Lines are considered part of the areas they delimit (e.g. the pitch length is measured from the outside of each goal line).

¹ www.theifab.com/laws/the-field-of-play/chapters/field-markings

Line-marking machines should be filled off the pitch before marking and sealed correctly, ensuring that the transport wheels do not transfer any paint.

Other points to consider:

- Check the line marker for leaks before starting.
- Set out the lines with string and leave the string in place until the line is dry, otherwise it will transfer paint.
- Lines must be painted at a slow walking speed, consistently and layer by layer; it normally takes at least two applications to achieve the correct level of brightness.
- A bucket of warm water and a soft brush/sponge should be used to remove any paint transferred accidentally when marking out lines. If paint transfer is a problem, the wider ground staff team should be consulted to resolve the problem.
- On matchdays, lines should be marked after the final cut, allowing sufficient time for them to dry before training, warm-ups and any other maintenance that is required (typically 1-1.5 hours before kick-off).
- The need for corner dashes (see Fig. 17 below) must be confirmed with UEFA.



Fig. 17. Overview of pitch dimensions and line marking requirements (source: IFAB). Note: lines are considered part of the areas they delimit. The optional corner dashes marked outside the pitch (9.15m from the outside of the corner areas) should be 24cm long, starting 12cm from the goal line/touchline.



Fig. 18. Wheel-to-wheel line marking following a string line (left) and marking out dashed lines (right).

4.3.4 Irrigation

Irrigation is used not only to maintain a dense, actively growing turfgrass sward and provide optimum soil moisture conditions for turfgrass establishment, but also to:

- wash in fertilisers and other chemicals applied to the pitch;
- moderate playing conditions (e.g. by watering the pitch at half-time to influence the 'slickness' of the surface);
- improve surface stability on sand-dominated profiles which may lose stability if they dry out too much;
- periodically 'wash' the turf, flush the profile and remove excess salts;
- 'syringe' the surface during peak summer temperatures to minimise the risk of heat stress.

When the irrigation system is being run, the groundskeeper must know the volume of water that is being applied per minute and per run in cubic millimetres (mm^3). Ideally, all water applications should be decided following a moisture assessment of the pitch using a soil moisture meter. It is important, particularly on pitches with a high sand content, to irrigate the pitch adequately before use to ensure the stability and binding of the root zone.

Pre-match irrigation requirements are covered in section 5.4 (match-play pitch preparation).

4.3.5 Fertiliser application

Fertilisers provide a range of essential nutrients to support turfgrass growth, help the grass to recover from damage and improve the colour of the grass for pitch presentation. It is essential to apply fertilisers accurately and uniformly, following a sound, well-developed fertiliser programme.

Granular fertiliser application

Granular fertilisers are applied using either tractor-mounted spreaders or, preferably, hand-operated pedestrian spreaders (Fig. 19). Uniform application is required to prevent streaks, burns or light and dark lines, which can cause problems in terms of both the appearance and the playability of the surface. Uniformity is usually achieved by applying the required quantity of fertiliser in two applications at right angles to each other (see Fig. 19).

- Mark out the spreading width with markers such as flags or cones before spreading.

- Set up and calibrate the machine off the pitch. Calibration should be carried out on a turf surface similar to that of the pitch to ensure consistency of application is achieved (width of spread).
- Do not overfill the spreader.
- Do not try to pick up flags while spreading.
- Operate the spreader at an even pace.
- Do not apply extra fertiliser to the surrounds or ends of runs; ensure these areas are included in the initial application.
- Plan the operation carefully before starting.
- Keep records of the product used and the rate at which it is applied.
- Double-check that the product being used is recommended for the pitch in question.
- The pitch may need to be watered after fertilisation to prevent scorch. Always follow specific recommendations.
- Take extra care when applying fertilisers close to matchday because any mistakes (overlaps and/or missed areas) will be picked up on camera.

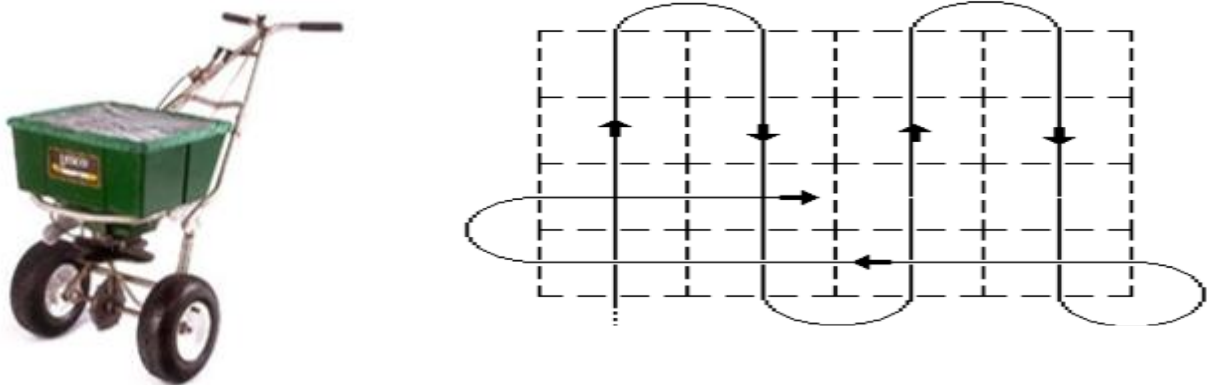


Fig. 19. Pedestrian fertiliser spreader and typical application pattern.

Liquid fertiliser, surfactant and pesticide application

Sprayers are used to apply liquid fertilisers, surfactants and any necessary plant protection products (Fig. 20). Spraying, also known as foliar feeding, offers more control over grass growth, particularly in a stadium environment.

- Mark out the spraying width with markers such as flags or cones before spraying.
- Put out safety warning flags on the pitch before spraying.
- Set up and calibrate the sprayer off the pitch.
- Ensure that (1) the correct nozzles are used; (2) the correct pressure is reached; (3) the machine is fully flushed of previous products used; (4) there are no leaks; and (5) all nozzles are operating correctly.
- Always test with water first on a hard standing area. The rate delivered from each nozzle can be easily measured using a measuring jug and timer. Check product labels and use the recommended water volumes. Do not assume that all products can be applied in the same concentrations.
- Do not overfill the sprayer.
- Only allow trained personnel to use the sprayer and ensure they wear personal protective equipment (PPE) at all times.
- Make sure all usage and products comply with local and national legislation.
- Keep the sprayer at an even pace and speed.

- Do not apply extra spray to the surrounds or ends of runs; ensure these areas are included in the initial application.
- Plan the operation carefully before starting.
- Keep records of the product used and the rate at which it is applied.
- If applying iron or liquid fertiliser, do not walk or drive on freshly sprayed areas as footprints and equipment tracks will show up.
- Allow for a minimum of around four hours' drying time.
- Generally speaking, spraying should not be done in direct sunlight; evening or early morning is best.
- Double-check that the product being used is recommended for the pitch in question.



Fig. 20. Dedicated sprayer.

4.3.6 Aeration

The successful aeration of a pitch depends on the equipment used and the timing of the operation in relation to the condition of the pitch.

Shallow pedestrian aerators

A shallow pedestrian aerator creates a network of holes in the surface of a pitch to improve water infiltration and air exchange. It can also achieve a controlled drop in hardness before a match without affecting pitch presentation. The depth to which the machine works can be adjusted and a number of different tine sizes can be used. Most operations are carried out with 6mm, 9mm or 12mm tines to soften the pitch. A range of tine sizes should be available. The impact of aeration on surface firmness should be ascertained before proceeding to treat the pitch.

- Carry out all operations within the mowing bands, which should be marked out using string.
- Ensure all tines are tight and of the correct diameter and length.
- Have a second operator walk behind the machine during set-up to ensure it does not rip the ground and the tines do not work loose. It is good practice to have an observer walk behind the machine at all times to make sure the tines do not work loose. If a tine is lost, operators must retrace their steps until it is found. Under no circumstances should tines be left in the pitch.
- A roller must be fitted to the rear of the machine.
- Test and check the depth and consistency of aeration.

Tractor-mounted deep aeration units

If used correctly, tractor-mounted deep aeration units can:

- relieve compaction in the profile and so promote better root development, air exchange and water infiltration;
- modify the firmness characteristics of the playing surface;
- remove fine material and organic matter that accumulates on the surface layer;
- create holes within the pitch that can be backfilled and stabilised using sandy materials;
- help iron out minor undulations.

The working depth of tractor-mounted deep aeration units will depend on the make and model of the machine and the tines used. It is good practice not to carry out deep aeration too soon before a match (i.e. no less than two to three weeks beforehand) and, as with shallow aeration, the impact of deep aeration on surface firmness should be ascertained before proceeding to treat the pitch.

- Place flags on the pitch to mark out areas to be avoided before aerating to avoid damaging sprinkler heads and other services.
- Ensure all tines are tight and of the correct diameter and length.
- Have a second operator walk behind the machine during set-up to ensure it does not rip the ground and the tines do not work loose. If a tine is lost, operators must retrace their steps until it is found. Under no circumstances should tines be left in the pitch.
- Ensure no tines spring back with the safety kick brake, as this can damage turf.
- The aeration machine must be of the same working width or wider than the tractor on which it is mounted.
- A roller must be placed on the rear of the machine and turf guards should be fitted.
- The depth of aeration should be tested regularly for consistency and uniformity.
- Buried service pipes (e.g. undersoil heating and irrigation pipework) must be avoided.



Fig. 21. Shallow aerator (left) and deep aerator (right).

Note that deep aerators are not an alternative for shallow pedestrian aerators; both are considered necessary for pitches on which UEFA matches are played.

4.3.7 Seeding/stolonising or turfing

The decision to turf a pitch is generally taken out of time-based necessity or in a crisis; for optimum long-term results, seeding or stolonising is preferable. In both cases, the machines used should operate with 'turf fingers' to prevent lifting.

Seeding or stolonising a pitch:

- is generally accepted to be superior to turfing, both from an agronomic perspective and in terms of playing quality;
- results in a more homogeneous profile, which in turn will usually produce better surface infiltration performance and root growth than turfing;
- is significantly cheaper than turfing;
- avoids compatibility problems between the turf and the underlying root-zone material, which in turn can lead to playing quality issues during matches;
- offers the opportunity to optimise cultivar selection for a given location to establish the sward.

Turfed pitches are usually playable much sooner than seeded or stolonised pitches. Although it is recommended that even turfed pitches be given at least a week to 'bed in', they could be playable after just a few days depending on the format and quality of the turf used.

A seeded or stolonised pitch, on the other hand, will take upwards of 50 days (seeds) or 100 days (stolons) to become confidently playable, depending on the growing conditions, the availability of lighting rigs and covers, the skill of the turf manager and the species/cultivars used. Specialist advice should generally be sought.



Fig. 22. Root development in a turfed pitch (left) compared with an adjacent pitch that was seeded (right).

4.3.8 Thatch removal and control

Thatch removal and control is carried out by means of scarification, during active growth periods when there is sufficient time for recovery before a match. Scarification removes excessive organic matter from the surface and upper root zone and cuts any lateral or creeping grass growth to give a denser, stronger sward, which in turn can help improve player traction. It also opens the surface of the pitch and weakens unwanted coarser grasses for removal prior to over-seeding.

A wide range of equipment is available, varying from rake attachments and harrows to powered reel-type scarifiers with rotating blades that cut into the turf surface. Any debris from these processes must be removed from the pitch.

The most aggressive form of scarification involves machinery that can physically skim off the surface to a working depth of up to 20mm in one pass, in an operation known as 'fraise mowing'.



Fig. 23. Different types of thatch control and removal. From left to right: complete surface removal, deep scarification and verti-cutting. All three types have very different aims and objectives.

4.3.9 Topdressing

Topdressing is carried out to:

- improve surface levels;
- dilute fine mineral and organic matter that accumulates on the surface of the pitch;
- improve drainage;
- provide a firmer playing surface;
- stabilise channels created by aeration work.

In cooler and wetter climates, pure sand is normally used but there are very specific requirements. If the sand is too fine it will tend to hold water and may impede drainage; if it is too coarse problems may be encountered in terms of stability, complaints from players and damage to mowers. In hotter, drier climates a mix of sand and soil or organic matter is often used as this can improve water and nutrient retention. It is recommended to have a soil particle size distribution analysis carried out to check that any new material that is added is compatible with the existing root zone.

In terms of equipment, rotary and drop spreaders are recommended as these ensure a uniform application of topdressing material.

The amount of topdressing applied depends on several factors, including the time of year, the type of turfgrass and the use of turf reinforcement systems. Typically, if topdressing is required during the playing season, then only light applications should be made (<20 tonnes per pitch). Conversely, topdressing during renovations typically involves much larger quantities (60-80 tonnes per pitch).

4.3.10 Weeds, pests and diseases

Selecting the right turfgrasses and applying good management practices helps minimise problems with weeds, pests and diseases. Hand weeding can be used to remove some weed types but is not effective against all, especially those with underground plant material (e.g. roots or tubers) from which the weed can recover.

When treatment becomes necessary, it is important for the problem to be identified correctly and for an appropriate herbicide, fungicide or pesticide to be used. There are strict regulations concerning the use of such chemicals on turf and all applicable legislation covering the chemicals used and the method of application must be complied with at all times. The application rate is also very important, and plant protection products must be applied with a properly calibrated sprayer.

A diary should be kept on-site by the head groundskeeper, with regular updates on observations made and work carried out. A wall calendar may also be used to highlight breaks in the playing season when remedial work can be carried out. A specific timeline should be incorporated into the maintenance programme leading up to any important event.

4.3.11 Preventive maintenance planning

Preventive maintenance plays a vital role in the provision of high-quality playing surfaces. It is considered best practice to try to identify potential problems before they appear.

Typical problems include one or a combination of the following:

- pest damage;
- disease outbreaks;
- heat stress;
- frost and snow;
- drainage, algae and black layer issues;
- loss of ground cover;
- shallow rooting and surface instability;
- poor micro-levels (e.g. following localised turf repairs);
- accumulation of organic matter on the playing surface;
- infestations of undesirable weed grasses (e.g. annual meadow-grass (*Poa annua*)).

Pitches should be monitored routinely, as early diagnosis and treatment will speed up recovery. Monitoring should involve a combination of visual checks of turfgrass health (e.g. daily), soil profile and root examinations using a soil corer (e.g. monthly), the use of specialist equipment that can help direct match preparations (e.g. Clegg soil impact testers and soil moisture meters), and the routine monitoring of weather conditions (e.g. daily). The following weather websites are useful:

www.yr.no

www.forecast.io

www.metoffice.gov.uk

www.msn.com/en-gb/weather

A photographic inventory of common problems associated with pitch presentation and playability is included in Appendix 1.

In the event of pitch issues encountered by clubs or national associations hosting UEFA matches, the club/national association should make UEFA aware of the situation immediately. UEFA turf consultants are available to conduct site visits, give advice on remedial works and produce site-specific maintenance schedules as required.

4.3.12 Dealing with actual or anticipated heavy rain

Step one is to study the weather forecast several times a day to get a good picture of changeable weather patterns (see recommended websites above). There are only two options for preventive aeration before rain arrives – deep aeration or shallow pedestrian aeration (guidelines on both are given in section 4.3.6) and/or the use of a waterproof pitch cover system. Like preventive aeration, the use of cover systems relies on the heavy rainfall being anticipated and the pitch being covered in advance.

In case of standing water following heavy rainfall during a match, the head groundskeeper should have a team of around eight staff available to hand-fork the wet areas in order to move the water through to the gravel layers below the upper 150mm of the surface (assuming a gravel layer is present). It would be prudent to also have a shallow aerator on standby to tackle any larger areas efficiently in the event of standing water affecting play but it is not a good idea to use such machines if water is already ponding on the surface, except in an absolute emergency.

If available, water clearers either in the form of pedestrian roller squeegees or foam-backed rollers with an integrated tank to collect water (see Table 1 in section 4.2) should be used to help clear standing water from a pitch.

4.4 Managing pitch use

Sustainable levels of pitch usage are heavily influenced by:

- the quality of the construction;
- the turfgrass species used;
- the standard of maintenance;
- the time of year;
- the quality of pitch required;
- the effects of shade and reduced air circulation in an enclosed stadium environment.

Excessive pitch use will increase maintenance demands and reduce the quality of the playing surface. For UEFA matches, presentation and playing quality are both of paramount importance.

A pitch protection policy should therefore be implemented to optimise the experience of the two teams playing any UEFA match. This policy will help ground staff carry out their pitch preparation and matchday duties. Such a policy should include:

- limiting the intensity of use before the match;
- avoiding using the pitch for training in adverse weather conditions (particularly on MD-1);
- avoiding using the pitch when it is badly waterlogged or frozen, particularly after partial thawing when the surface is soft but the underlying layer is still frozen;
- limiting team warm-ups where possible (around 70% of damage to goal areas is typically caused during match warm-ups);
- avoiding all non-essential on-pitch activities;
- encouraging repetitive work, such as 'fast feet' fitness exercises, to be carried out off the playing surface;
- encouraging the use of portable goals and mini-pitches at right angles to the normal direction of play, to spread the wear across the pitch and avoid concentrating wear within the main goal areas;

- identifying 'pitch protection zones' and displaying them in both teams' changing rooms to help reduce the risk of unnecessary damage to weaker parts of the playing surface, such as shaded areas and goalmouths.

Playing or training on pitches that are in poor condition can cause damage that will affect the pitch for the remainder of the season.

5 MATCH-PLAY PITCH PREPARATION

5.1 Planning

Weather conditions should be monitored on a daily basis so that a risk management strategy can be deployed in the event of adverse weather conditions. Such strategies are likely to be pitch-specific and depend on the type of pitch construction, the infrastructure available and the weather forecast.

To avoid conflicts between stakeholders and operations, it is important that pitch maintenance operations in the lead-up to a match respect UEFA's requirements, which may include:

- infrastructure set-up, e.g. the installation of LED boards;
- the use of pitch infrastructure elements (e.g. pitch covers and artificial lighting rigs);
- media and camera positions;
- team warm-up area requirements;
- team seating requirements and technical area markings;
- team and referee training sessions on MD-1;
- UEFA's countdown to kick-off on matchday;
- matchday pitch activities (e.g. ceremony rehearsals, goal-line technology testing and pre-match irrigation).

Pitch maintenance operations are likely to involve the following:

1. Pitch preparation for official training sessions

- Installation of (temporary) goalposts/nets
- Hosting and supervision of training and feeding of information to UEFA
- Divot repairs
- Surface clean-up after training (rotary)
- Cylinder mowing
- Removal of (temporary) goalposts/nets
- Pre-match irrigation (to be approved)

2. Pitch preparation for the match

- Nutrient or iron applications (no closer than 24 hours before the match)
- Plant protection/chemical applications (no closer than 48 hours before the match)
- Brushing
- Cylinder mowing
- Line marking
- Pre-match irrigation (to be approved)

3. Matchday operations

- Cylinder mowing (double mow if possible, depending on kick-off time)
- Re-marking of lines
- Installation of goalposts/nets
- Installation of corner poles and flags
- Irrigation (to be approved)
- Ceremony operations (if any)
- Match observation, including player-surface interaction
- Divot repairs after warm-up and before kick-off
- Divot repairs at half-time
- Divot repairs at full time

4. Post-match operations

- Removal of goalposts/nets
- Removal of corner poles and flags
- Clean-up of debris with rotary/suction mowers
- Preparation for next match (recommence cycle of operations from 1 above)

For fertiliser applications made prior to matchday, ground staff must comply with the relevant product health and safety regulations, for example in terms of the timing of the last applications. Likewise, in the unlikely event of any chemicals having to be applied for weed, pest or disease control, the relevant health and safety procedures and regulations must be followed to ensure the safety of the players and referees. UEFA must be notified of any such applications immediately.

5.2 Pitch equipment²

5.2.1 Goals

A goal must be placed on the centre of each goal line. The distance between the posts must be 7.32m and the distance from the lower edge of the crossbar to the ground must be 2.44m.

No additional structural elements or physical support may be used inside the net or in its immediate surroundings other than bars fixing the goal net to the ground and goal net stanchions behind and outside the net. The aim is to ensure that no element of the goal structure enables the ball to rebound onto the field of play (from outside or inside the goal) once it has crossed the line and that the goal structure does not cause any injuries to players. To this end, goal frames may be recessed into the ground (Fig. 24).



Fig. 24. Goal frames recessed into the ground.

² See Law 1 (The Field of Play) of the Laws of the Game for more details: www.theifab.com/laws

If screws or any other elements used to support the goal structures are deemed a potential hazard, additional protection such as tape or padding must be used (Fig. 25).



Fig. 25. Goal structures requiring further protection for player safety.

If goal stanchions are positioned in front of advertising boards and close to the goal line, additional protection is required in a discrete, uniform colour that is easily distinguishable from the goalposts (Fig. 26).



Fig. 26. Goal stanchion visibility and safety.

Posts and nets have to be installed for official training sessions but also for the pitch inspection on matchday morning (10.00 local time), the end-to-end test that afternoon, and goal-line technology (GLT) set-up and testing as requested and scheduled by UEFA. It is best practice to remove posts and nets after each match to allow maintenance procedures to proceed unhindered across the entire turf surface.

On matchdays, it is also good practice to check the nets following the pitch set-up, following the team warm-ups and at half time. A net repair kit should be available to repair any holes.

Two spare goals with identical goalposts (nets already attached) must be stored close to the goals with easy access to the pitch, and the removal and replacement of goals should be tried and tested well before the match.

5.2.2 Corner flags

Flagposts at least 1.5m high, each with a non-pointed top and a flag, must be placed at each corner of the field of play.

Corner flags and poles must be installed for official training sessions and for the pitch inspection on matchday morning (10.00 local time).

A spare set of identical flags and poles must be available on matchday and stored at an agreed location. These must be quickly available should a pole break or need replacing for any other reason during the match.

Corner flags and poles should be removed at the end of the match (i.e. on matchday still) and safely stored away.

5.3 Pitch surrounds

5.3.1 Safety for players and referees

The area immediately adjacent to the pitch ('safety zone') must be safe for the players and referees.

If the stadium is used for other sporting events such as athletics, additional high-quality artificial turf must be installed around the field of play, solidly fixed to the ground and marrying seamlessly with the natural turf (Fig. 27).

Any artificial turf installed around the pitch for UEFA matches (e.g. to cover a running track or extend the substitutes' warm-up area) must be green.



Fig. 27. Extension of turf perimeter around the field of play using high-quality artificial turf.

Any access lids and service boxes located within the safety zone must also be securely and safely covered with artificial turf that is a similar colour (if not the same colour) as the surrounding natural turf (Fig. 28), ensuring that no trip hazards are created in the process.



Fig. 28. Access and service boxes within the safety zone around the field of play.

5.3.2 Substitutes' warm-up during the match

A warm-up area must be determined (normally behind the first assistant referee) and large enough to accommodate three substitutes and a fitness coach per team, all at the same time, taking into account that a corridor at least 1m wide must be reserved for the first assistant referee immediately behind the touchline (Fig. 29).

Ideally, the surface of the substitutes' warm-up area should be the same as that of the field of play. In all other cases, it must be ensured that the substitutes can warm-up on high-quality artificial turf, solidly fixed to the ground (Fig. 30).

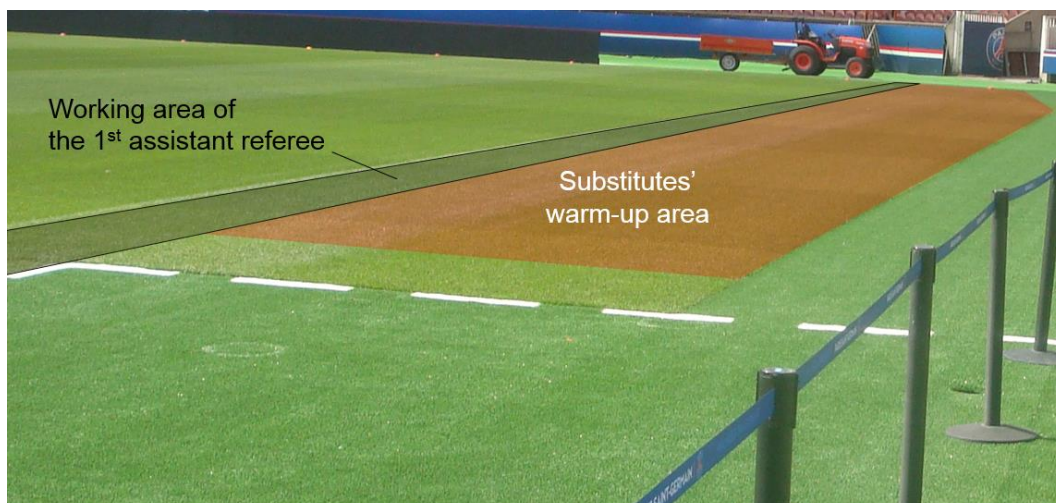


Fig. 29. Example of the ideal substitutes' warm-up area, with natural turf.



Fig. 30. Example of a substitutes' warm-up area that uses high-quality artificial turf.

5.3.3 First assistant referee's working area

If the substitutes' warm-up area is adjacent to the pitch, the working area of the first assistant referee should be protected/marked off:

- using a dashed line (50cm dashes spaced 1m apart) in a discreet shade of green;
- at a minimum distance of 1m from the touchline;
- starting from the edge of the technical area and extending as far as the corner flag.



Fig. 31. Example of a corridor and line markings for the first assistant referee.

Additional guidelines in relation to the technical area



If the boundary of the technical area is further than 1m from the touchline (e.g. 1.5m), the first assistant referee's working area should be aligned with the edge of the technical area, provided this leaves enough space for the substitutes' warm-up area.



If aligning the first assistant referee's working area with the edge of the technical area would not leave enough space for the substitutes' warm-up area, the dashed line marking the first assistant referee's working area should remain 1m from the touchline (i.e. independent of the technical area).

Additional guidelines in case of different surfaces



The boundary of the first assistant referee's working area should be 1m from the touchline, even if this means it encompasses a mix of natural and artificial turf. The priority is to ensure the first assistant referee has the necessary space to operate in.



A dashed line indicating the boundary of the first assistant referee's working area should be marked 1m from the touchline, even if the natural turf extends to the same point and the switch from natural to artificial turf provides a kind of natural segregation. This to ensure consistency at all venues where the substitutes' warm-up area is adjacent to the pitch.



A dashed line indicating the boundary of the first assistant referee's working area should be marked 1m from the touchline, even if a limited amount of natural turf extends beyond this point. From experience, substitutes are likely to encroach on the first assistant referees' working area otherwise.

5.3.4 Advertising boards and camera positions

The impact of advertising displays and camera positions on pitch maintenance operations (mowing, fertilising, irrigation, aeration, etc.) must be planned and allowed for well in advance, and access to specialist equipment and lighting rigs must be provided should they be required in the lead-up to a match.

In principle, LED advertising boards are installed in advance and should not be moved without consulting the UEFA signage team first. Only in exceptional circumstances will it be possible to move such boards. The grass in front of boards should be cut by hand using a technique that will not damage the screens.

Large cameras and rigs will be used on the pitch surface during matches, with photographers and others needing access to the areas behind the LED boards. It is important to ensure that the turf in these areas is well aerated and maintained so that it does not wear heavily but also does not hold water. It is very important to check and maintain these areas after matches.

Interview positions will also be earmarked in advance and these may require additional maintenance or protection to maintain full grass cover throughout the event.

5.4 Pitch watering

The head groundskeeper is asked to provide an irrigation system map (Fig. 32), indicating the full coverage of all sprinklers and to describe in detail how the irrigation system works (e.g. *"There are 6 rows of 4 sprinklers which work in succession; rows and individual sprinklers can be deactivated individually; duration of a full cycle is 18 min,"* etc.).

The head groundskeeper is also asked to confirm the system used to ensure uniform pitch watering within a five-minute window (e.g. which sprinklers are activated and how long the minimum cycle lasts).

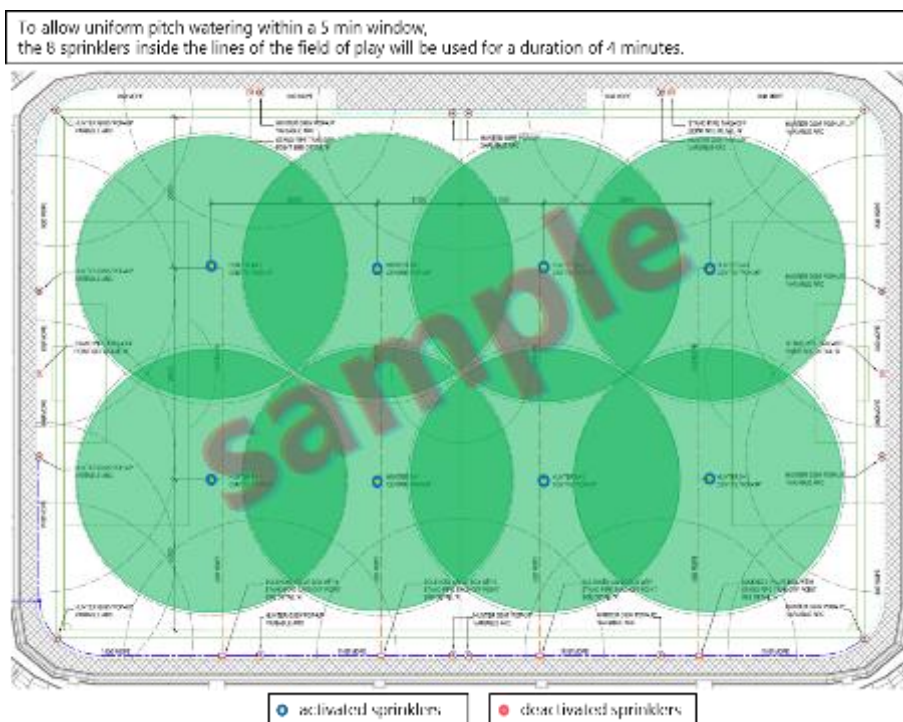


Fig. 32. Example of irrigation system information to be supplied to UEFA.

The schedule for pitch watering on matchday must be communicated by the host club/national association in advance of the match.

As a rule, pitch watering must finish 60 minutes before kick-off. However, additional irrigation (i.e. moistening of the grass surface) between 60 minutes before kick-off and kick-off may take place, provided the sprinkler system installed in the stadium technically permits it:

- between 10 and 5 minutes before kick-off; and/or
- during half-time (for no longer than 5 minutes).

All pitch watering must:

- ensure the whole pitch is irrigated evenly;
- be considerate of other activities and infrastructure, such as pre-match ceremonies, team warm-ups, pitch repairs, broadcasting equipment and LED boards situated around the pitch.

The referee is always entitled to request changes to the pitch watering schedule.

All irrigation systems should be switched off and isolated during matches (except at half-time, of course). The head groundskeeper must ensure that the irrigation system cannot be switched on accidentally or come on automatically during play.

5.5 Retractable roofs

Where available, retractable roofs should be used to protect pitches from inclement weather in the lead-up to matches.

If a stadium has a retractable roof, UEFA must be informed of any constraints that could prevent the roof from being closed in specific conditions (e.g. in the event of strong wind or rain/snow, or if people are already inside the stadium).

5.6 Training sessions and warm-ups

5.6.1 Teams' MD-1 training sessions

Weather and pitch conditions permitting, the teams are allowed to train on the pitch on which the match will be played for a maximum of one hour the day before the match. Subject to the same conditions, the referees may also hold a training session in the stadium the evening before the match, as long as this does not interfere with the teams' training sessions.

The head groundskeeper should advise UEFA about areas of the pitch that should ideally be avoided in order to preserve the pitch in the best possible condition for the match.

Pitch irrigation may take place in advance of MD-1 training sessions.

In addition to the two fixed goals, the teams should have two portable goals each for their training sessions and one portable goal each for their pre-match warm-ups (unless removing these goals before kick-off would be an issue). Materials such as cones and markers should also be made available to the teams (if requested).

UEFA reserves the right to cancel training sessions in the stadium if holding them could render the pitch unfit for the match. In this case, the host club/national association must make available an alternative training ground that has been approved by UEFA in advance.

5.6.2 Teams' pre-match warm-up

The head groundskeeper should advise UEFA about areas of the pitch that should ideally be avoided in order to preserve the pitch in the best possible condition for the match.

5.6.3 Referees' pre-match warm-up

A specific area of the pitch must be reserved for the referees' pre-match warm-up, on the opposite side of the pitch from the players' tunnel.

Ground staff should mark out the referees' warm-up area using cones/markers and remove them at the end of the warm-up session (Fig. 33).



Fig. 33. Referees' pre-match warm-up area.

5.7 Pitch inspections

At 10.00 local time on matchday morning, the UEFA delegate, the referee observer, a representative of the referee team and the venue director/match manager will jointly undertake a brief inspection of the pitch and its surrounding areas.

UEFA and the head groundskeeper must ensure that all equipment that will be used on and around the pitch during the match is in position for this inspection.

The following aspects will be checked:

- Pitch/field of play
- Goal dimensions and nets (incl. attachments)
- Field markings
- Technical area
- Fourth official's position
- Substitutes' benches and technical seats
- Corner poles and flags
- Spare goals
- Advertising boards
- Camera positions at pitch level
- Stretchers/injury cart position
- Pitch doctor's position
- Players' ambulance position
- Referees' dressing room
- Both teams' dressing rooms
- Doping control station
- Medical room

5.8 Post-match repairs

Post-match repairs should be completed immediately after each match. The two most immediate tasks required are divot repairs and rotary mowing to remove loose material from the surface (Figs. 34-36). Minor divot repairs involve no adding of sand or displacement of the root zone but instead:

- forking of the profile to restore levels;
- easing of the turf in from both sides;
- stretching of the turf to close the gap;
- tamping down the surface.

A full pictorial guide on divot repairs is available from UEFA.



Fig. 34. Minor divot repair – to be carried out at half-time and immediately post-match.



Fig. 35. Half-time pitch watering and divot repairs.








Fig. 36. Post-match clean-up.

5.9 Pitch assessments

During the lead-up to a match, pitch performance should be monitored regularly by the stadium’s in-house pitch maintenance team. Such monitoring helps provide objective data that can be used to guide and inform the maintenance programme. Monitoring is also extremely valuable in assessing trends that might be occurring over time, for example in relation to pitch firmness, and to ascertain where intervention might be necessary.

The basic tools for routine in-house pitch assessments are outlined in Table 2 below:

Equipment required	Pitch characteristic assessed	Photo
2.25kg Clegg soil impact tester**	Surface hardness	
Grass height prism gauge	Grass height	

Equipment required	Pitch characteristic assessed	Photo
Soil corer for profile observation and root assessment*	Rooting depth Depth of main rooting mass Presence of anaerobic conditions/layering	
Delta-T theta probe**	Volumetric soil moisture content	
Portable traction apparatus	Surface traction	

* Not practical on some forms of hybrid reinforced turf, for which wider split corers that can be hammered into the profile are required.

** Equipment requires routine calibration.

Table 2. In-house pitch assessment tools.

Following each assessment, the results should be recorded in relation to the specific ranges shown in Table 3 below. These ranges are based on a 'traffic light' system, whereby **green** values are within the preferred range, **amber** values are within the acceptable range but may require attention, and **red** values are outside the acceptable range and may have a significant effect on the playing quality of the pitch.

GRASS HEIGHT AND PLAYING QUALITY		SOIL PROPERTIES	
Test	Ranges	Test	Ranges
Surface hardness (gravities)	70-90	Volumetric soil moisture content (%)	20-30
	60-100		18-32
	<60 / >100		<18 >32
Surface traction (Nm) – portable	≥ 30	Max. rooting depth (mm)	> 85
	≥ 20		≥ 60
	< 20		<60
Grass height (mm)	24-28	Depth of main rooting mass (mm)	> 55
	20-30		≥ 45
	<20 / >30		<45

Table 3. Suggested classification of test values for in-house monitoring.

Much more in-depth assessments are carried out on pitches used for finals, for which an extremely high, well-documented pitch quality is expected.

5.10 Risk assessment

The above pitch assessment tools may also be used by UEFA turf consultants when they visit stadiums to assist with pitch preparations or repairs in the lead-up to specific matches. Here, the results of the measurements along with details of the pitch and turfgrass condition are used to support recommended agronomy actions or advice. The results are also fed into a five-point risk assessment system that has been adopted by UEFA in the context of its Pitch Quality Support Programme.

Grade 1 Risk description: high risk = pitch is unsafe for play and requires significant work; no play should take place and the match should be called off	Grade 2 Risk description: moderate risk = pitch is below standard but playable; work required; the risk is mainly aesthetic, and stability can be guaranteed for the match but the pitch may not sustain another match	Grade 3 Risk description: manageable risk = pitch is satisfactory; some improvements required; minimum expectation for UEFA Europa League	Grade 4 Risk description: low risk = pitch is good with minor concerns (e.g. slight wear to goalmouths); minimum expectation for UEFA Champions League	Grade 5 Risk description: very low risk = pitch is excellent with no limitations; immaculate condition
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5.11 Emergency re-turfing

Over the course of a playing season and following regular assessments of pitch condition by the head groundskeeper and potentially a UEFA turf consultant appointed as part of the Pitch Quality Support Programme, it may become apparent that a full turf replacement is needed.

The combination of inclement weather and excessive usage of a pitch often causes playing surfaces to deteriorate rapidly. Although full re-turfing during the season is relatively rare, it is imperative that UEFA be contacted immediately if any pitch issues arise. Such contact will enable UEFA to provide assistance and hopefully minimise the risk of a major re-turfing being required in the middle of a season, prior to a UEFA match. UEFA can also assist with turf-farm approvals and monitoring of the installation if re-turfing is required.

In the event of re-turfing, an approved contractor should be appointed and plans put in place to ensure a successful transition of the playing surface. The new turf should be installed at the earliest possible opportunity to allow the sward time to establish into the existing construction.

APPENDIX 1 – GLOSSARY

Term	Description
Aeration	Operations carried out to increase drainage and air exchange and to encourage better root development.
Annual meadow-grass	A cool-season grass species (<i>Poa annua</i>) usually considered to be a weed species.
Bermudagrass	A warm-season grass species (<i>Cynodon</i> species).
Boom sprayer	A machine with a line of nozzles on extending arms used to spread liquid chemicals.
Brush	A device consisting of bristles held in a suitable frame, used to sweep grass.
Clay	Soil particles smaller than 0.002mm in diameter. Clay-rich soils usually have poor drainage characteristics and retain water.
Cutting height	The height above ground level at which the sward is cut.
Cylinder mower	A grass mower with a cutting blade that moves in a vertical plane and cuts using the action of the cylinder blades against the sole plate.
Disease	A pathological condition, usually the result of a fungal infection often associated with environmental stress, which affects the quality of grass.
Drag mat	A flexible steel mat which is pulled along to work in top dressings, particularly on undulating turf surfaces.
Drainage system	A network of drains designed to remove excess water from a pitch.
Fertiliser analysis	Identification and measurement of the percentage of nitrogen, phosphorus, potassium and other plant nutrients found in a fertiliser.
Fungicide	Any chemical which controls or destroys the growth of a fungus.
Grass	Any of various plants having slender leaves characteristic of the grass family.
Gravel	Rock fragments or small pebbles typically 2-10mm in diameter.
HemiView analysis	The analysis and computer modelling of the natural light distribution in a stadium using computer-generated or actual stereographic images.
Hollow tine	A form of aeration in which cylindrical tines are used to remove cores from the soil.
Insect	Small arthropod animal of the class <i>Insecta</i> , which as an adult has three pairs of legs, a body segmented into head, thorax and abdomen, and usually two pairs of wings. Insects include flies, crickets and beetles.
Irrigation	The controlled application of water to turf.

Kentucky bluegrass	A cool-season grass species (<i>Poa pratensis</i>), also known as smooth-stalked meadow-grass in some countries.
Line marker	A machine used to mark lines on a pitch.
Mower	A grass-cutting machine
Peat	Material consisting largely of undecomposed or partially decomposed organic material accumulated under conditions of excessive moisture. Often used to improve water and nutrient retention.
Perennial ryegrass	A cool-season grass species (<i>Lolium perenne</i>).
Pest	An insect, grub or other soil organism that may cause damage to grass.
Pesticide	Any substance or mixture of substances intended to prevent or control any unwanted species of plant or animal, including any substance intended for use as a plant growth regulator, defoliant or desiccant. This includes fungicides, herbicides and nematocides.
Pipe drain	A trench containing a drain pipe backfilled with a suitable gravel.
Renovation	The act of repairing an area of turf by cultivating, re-levelling and reseeded, particularly carried out at the end of the playing season.
Roots	The underground portion of a plant that serves as support, draws minerals and water from the surrounding soil, and sometimes stores food.
Root zone	A mix of sand and soil or sand and organic matter used as the growing medium for grass.
Rotary mower	A powered mower that cuts turf using the high-speed impact of a blade or blades rotating in a horizontal cutting plane.
Sand	Granular mineral material ranging from 0.05mm to 2mm in diameter. Sand materials are regularly used in pitches because of their good drainage and other physical properties.
Scarifier	A machine used to cut through horizontal growth and thatch with a raking or vertical cutting action.
Seashore paspalum	A warm-season grass species (<i>Paspalum vaginatum</i>).
Seed	The reproductive structure of a plant, containing an embryo, food supply and protective coat. Seeds are used for the establishment of grass.
Silt	Intermediate-size fine particles between 0.002mm and 0.05mm in diameter. Silt-rich soils tend to have poor drainage characteristics and retain water.
Slit drainage	A drainage system in which a series of sand and/or gravel-filled channels link the pitch surface with porous aggregate over pipe drains allowing excess surface water to bypass the soil.
Slit tine	A knife or bladed tine.

Smooth-stalked meadow-grass	A cool-season grass species (<i>Poa pratensis</i>), also known as Kentucky bluegrass in some countries.
Sod	Strips of turfgrass, usually with adhering soil, used in vegetative planting (also known as turf in some countries)
Soil	The natural medium for plant growth, consisting of mineral particles mixed with organic matter.
Solid tine	A spike or blade used to create holes in the turf surface during aeration work.
Sowing	The process of adding seeds to soil to produce new grass.
Spiker	A machine used to create aeration holes in turf.
Stolon	Vegetative material (a sprig, rhizome or tiller or a combination thereof) used to establish turf, usually for warm-season grass species.
Stone	Large particles of mineral matter or rock typically greater than 10mm in diameter.
Sweeper unit	A machine with a rotating brush and collector.
Tall fescue	A cool-season grass species (<i>Festuca arundinacea</i>).
Thatch	A layer of intermingled dead and living shoots, stems and roots that develops between the zone of green vegetation and the soil surface.
Turf	(1) The grass-covered surface of the ground, growing within the upper soil layer. (2) Strips of turfgrass, usually with adhering soil, used in vegetative planting (also known as sod in some countries)
Vacuum unit	A suction device mainly used to lift grass clippings and other debris from the surface of a pitch.
Verticutting	The use of a machine with vertically rotating blades that cut into the turf to remove thatch or cut stolons.
Verti-Drain	A tractor-drawn turf aerator which can break up deep compaction by means of tines.
Weed	An unwanted grass or broad-leafed plant whose negative values outweigh the positives in a given situation.

APPENDIX 2 – PHOTOS OF COMMON PITCH PROBLEMS AND MAINTENANCE ISSUES



Poor surface stability, most likely caused by poor rooting and a lack of surface moisture, with no turf reinforcement system.



Poor surface levels in a re-turfed goal mouth.



Leaking irrigation sprinkler head – if not repaired, surface damage will be extensive.



Irrigation system with low sprinkler pressure – leads to poor irrigation coverage.



Damage to the artificial turf perimeter caused by poor mowing practices.



Weak pitch perimeter caused by low light levels and excessive traffic.



Hand forking to remove surface water.



Heavy rainfall on a pitch with poor surface drainage – such conditions can lead to matches being abandoned.



Poorly performing undersoil heating system failing to keep the surface uniformly free of frost and snow.



Poor-draining soil-based turf placed over free-draining root zone – will not perform well under heavy rainfall.



Invasion of annual meadow-grass (*Poa annua*) causing poor aesthetic appearance – resurfacing required.



Lack of weed control on artificial turf perimeter leading to poor aesthetic appearance.



Effect of shade on turf establishment – artificial lighting rigs will be essential in winter to maintain growth.



Excessive pitch damage caused by over-loading the pitch protection system during a concert.



Pitch without under-soil heating – unable to produce adequate grass cover for a UEFA match.



Spraying of pitch colourant on a dormant natural turf pitch.



Surface algae as a result of thin turf cover, heavy shade and excessive soil moisture.



Goals not removed prior to mowing – poor maintenance practice that creates unnecessary wear in the goalmouths.



Lengthways (goal-to-goal) mowing too strong – cross-pitch stripes should be dominant.



Wavy lines caused by mowing being carried out after line marking.



Heavily worn patches – to be disguised with fresh grass clippings two to three hours before a match.



Wet paint – accelerate the drying of line marking using a leaf blower.



Poor interface between natural and artificial turf at the perimeter of a pitch – a major trip hazard and likely to cause player injury.



Dangerous irrigation sprinkler within the field of play.

APPENDIX 3 – CEREMONIES

Ceremonies are an integral part of many UEFA matches and are designed to enhance the fan experience. It is important for UEFA, the LOC and the ground staff to work together to minimise the time spent on the pitch while maximising the impact of the ceremony and the promotion of the event.

In order to deliver a successful ceremony with as little disruption to the pitch surface as possible, discussions between key stakeholders are used to develop a risk mitigation strategy. An initial meeting between the ceremony organisers/suppliers, the LOC, UEFA/the UEFA turf consultant and the head groundskeeper is held to discuss the programme, timings, and pitch entry and exit points.

The following information should be presented at the initial meeting in order for the ground staff to understand the possible implications of the ceremony and rehearsals and to allow the ceremony organisers to deliver a successful ceremony with minimal disruption:

- PSI measurements of stage wheels
- Number of dancers and other ceremony participants
- Materials and equipment to be used
- Number and length of rehearsals required (this must be as accurate as possible, with 20-minute buffers to allow for possible delays)
- Proposed rehearsal days (e.g. MD-3)
- Anticipated weather and alternative solutions in case of adverse conditions

This initial meeting should be held approximately three months before the match, and in the case of finals it should coincide with a pitch assessment by the UEFA turf consultant. A further brief meeting should be conducted approximately one week before the match, when the ceremony organisers arrive at the stadium to prepare.

It is important to bear in mind that, in order for ceremonies to run smoothly, rehearsals have to take place on the pitch. These need to be carefully scheduled and communicated to the head groundskeeper, to ascertain and minimise their impact on pitch preparations. UEFA and the LOC will manage and communicate the scheduling and organisation of rehearsals accordingly.



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