# Football Turf



# Experiences learned and shared by Sportfloor TechnologieS

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# Advises for the choice, design, construction, warranty and maintenance

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### INTRODUCTION

The author of this document has been active during 30 years in the field of sport surface constructions, first as owner of a construction company and later as an independent consultant. His aim is to share with the world of sport his experiences hoping that in this way, high quality construction will prevail for the good of the user / sportifs.

The document may be used as a useful reference document for football clubs and owners of football pitches. It should provide easy-to-understand instructions and recommendations on this complex subject of Football Turf. These recommendations are not only an aid for the choice, design, construction and maintenance, but also an explanation of facts learned from many construction, installation and use of Football Turf, mainly in Europe.

The use of the term "FOOTBALL TURF" instead of artificial or synthetic turf of the 3<sup>rd</sup> generation" is recommended in order to specify clearly a turf which is best adapted to the game of football with criteria identical to those of the best natural turf!

### **DEVELOPPMENT OF PLAYING STANDARDS**

### FOOTBALL TURF

### What is Football Turf and how can something artificial replace natural grass?

### Facts

Football players prefer a perfect natural grass field to all other surfaces, therefore certainly the majority of good football pitches in Europe will remain natural grass pitches.

- But what about those pitches whose condition gets disastrous at the end of the season (November to March). The European football season is very long, lasting into late autumn and starting again in the spring, sometimes before the snow melts. Some of the matches are therefore played on mud fields instead of turf.
- Lately many major stadia in Europe underwent big transformations (to add higher tiers, to totally enclose the stadium) or are newly built with a partly or fully closed roof. In these modern football arenas the new design of the tiers and the projecting roofs make it impossible for the grass to grow (example: Amsterdam Arena). In these cases very little or no wind and sun can enter the stadia, so their natural turf just does not want to grow any more, or it grows a little bit at the cost of a lot of artificial light, big fans, more limited use and unusually intensive maintenance, which means high expenditures. In such cases, the only solution is to change the natural turf several times a year.
- What about all those amateur pitches in Germany made of "Schlacke" material from the furnaces which can be harmful, or in the south of Italy and Spain where many pitches are only a mixture of sand and dirt, where no grass will ever grow?
- > Natural grass can also present many acute problems. Question: Is natural grass still a 'natural' product when it requires so much maintenance and the use of so much fertilizer?

Since their initial market launch of artificial turf in 1964, the 1<sup>st</sup> and the 2nd generations of artificial turf have been widely adopted, above all for American football, Baseball, Tennis, Hockey. For several reasons, neither type of artificial product has proved suitable for soccer nor have they ever really gained a foothold in this market – being used only on training pitches or for matches played at the lowest levels of the various national competitions.

The artificial-turf industry has now taken advantage of the experience gained from the negative aspects of these first two generations to develop a third-generation product that is more football friendly.

UEFA observed this development and started to investigate in 1999 the synthetic surfaces available on the market. In spring of 2000, it decided to install a synthetic field built in front of its headquarters in Nyon (Switzerland).

At about the same time FIFA also became interested in the subject and financed the first synthetic pitch that was built in Liberia as part of its Goal project.



Colovray Sport Centre, Nyon-Switzerland 2001



A.Tubman-Stadium, Monrovia-Liberia 2002

### FOOTBALLISTIC TEST

Recognising the potential these new forms of artificial turf surface offered the game of football UEFA decided to investigate them further and if it could be established that the surfaces provided a playing environment that was no more hazardous than natural grass and allowed the game to be played in the traditional manner sanction their use in UEFA competitions. In order to achieve these objectives UEFA established it's Artificial Turf Experts Panel that was given the responsibility of coordinating a programme of research and monitoring that would provide the data for an assessment of the suitability of artificial grass to be made.

As UEFA's aim was to ensure artificial turf would only be used if it replicated the best quality grass pitches the first step was to define how such pitches performed. Surprisingly up until this time only limited research (UK and Holland) had been carried out. All the basic tests have been made on the main pitch of the stadium in Nyon - Switzerland, and afterwards on a number of natural turf pitches considered to be amongst the best in their respective countries (Arsenal FC, England; Parma FC, Italy; FC Nantes, France; FC Bayern Munich, Germany; etc...)

A series of tests were therefore adopted that simulate the interaction between the player and the surface and between the player and the ball. Whilst it is accepted that playing football can result in players becoming injured, sometimes seriously, it was stipulated by UEFA that artificial turf would only be considered if it could be shown to offer no greater risk than playing on natural grass.

The tests were made by test laboratories specialising in sports surface testing and in collaboration with the International Association for Sport Sciences. Initially tests were made using existing test protocols based on standards for athletics, indoor sports floors, etc but it soon became clear that if meaningful and reliable tests methods were to be adopted new methods were required. This resulted in UEFA finally adopting tests that measured the following playing qualities of a surface (natural or artificial) – described be many as the footballistic qualities.

By comparing the results of each test on the natural turf pitches it was possible for UEFA to establish ranges of acceptable performance. These ranges became the parameters that artificial turf fields would have to achieve to be considered suitable for the use in UEFA competitions and win the designation "Football Turf".

### Interactions between the player and the field

- shock absorption (running and protection)
- > deformation of the turf due to the impact of the player
- > torsion between the player's boot and the turf

### Interactions between the ball and the field

- ball roll
- vertical ball rebound
- > angular ball rebound; ball rebound after a long pass



Angular ball rebound: standard pass of a ball

Ball-Roll; measurement of the ball roll distance

In October 2003 UEFA published its initial findings and specification in a document entitles *"UEFA Manual for Football Turf in UEFA Competition"*. At the time of publication non of the artificial surfaces could achieve the UEFA criteria, this was the challenge to the artificial turf surfacing industry, one that they rose to with admirable enthusiasm but it still took them some six months to develop a Football Turf which fulfilled all UEFA test criteria.

### UEFA pilot project 2003-2005

Five UEFA-monitored "Football Turf" pitches have been installed all over Europe. National championship matches have been played since the beginning of the season 2003/04. Note: The naming "Football Turf" is used to prevent sales people of the industry from using expressions such as  $4^{th}$ ,  $5^{th}$  or more generations. The artificial turf has only to comply with the best criteria for football on natural turf.

These five pitches are:

- Luzhniki, Moscow-Russia
- Salzburg, Austria
- > Oerebro, Sweden
- > Dunfermline, Scotland
- > Almelo, Holland

### The pilot project made it possible to:

- monitor all the reactions and opinions of the players of the home and the visiting teams.
- study the home team's injuries which occur during the full season both when playing at home on "Football Turf" and away on natural grass.
- gather additional biomechanical data by comparing the two different surfaces.







### **Research results extracts**

### General tendency after discussion with players:

- Home teams: Good natural turf is best but over the entire season, Football Turf is an excellent alternative.
- Visiting teams: Players give bad marks when they lost the game!







**Visiting teams: 5 and above = equal or better than the players own home natural turf** Note: Not all UEFA Pilot projects pitch did fulfil the UEFA quality criteria and today all the pilot project Football Turf products have been replaced by new products which fulfil the FIFA 2 Star criteria.

### **QUALITY STANDARDS**

The two organisations, FIFA and UEFA had two distinct sets of criteria. Establishing one world-wide standard for Football Turf under the banner of FIFA with their world wide responsibility for football made sense and in March 2005 FIFA published the *FIFA Quality Concept, Handbook of Test Methods and Requirements for Artificial Turf* (subsequently amended to Football Turf). This new manual harmonised the original *FIFA Quality Concept for Artificial Turf and* the *UEFA Artificial Turf Manual,* whilst benefiting for the on-going research that both organisations had been undertaking in the proceeding years. Recognising the differing needs of high level professional competitions and more community and training based activities the new FIFA manual has two categories of Football Turf; FIFA Two Star is aimed for professional football and has demanding footballistic requirements designed to replicate the best quality natural grass pitches. The slightly lower FIFA One Star category has more open bands of performance and recognising the need to provide reasonable and safe pitches at costs developing communities and countries can afford.

### **FIFA Quality Concept**

### > FIFA 2 Star

Very strict footballistic requirements for pitches used by top professional football

### > FIFA 1 Star

A less strict level of requirements for artificial Football Turf used worldwide

The harmonisation of all the test criteria and requirements will help both the industry to develop new turf products, and the owner of a pitch to choose the most appropriate turf product system, and most important, it will provide the players with the best possible product for the game.

In many European countries the use of Football Turf is already allowed, but very few clubs used this possibility. The reason in the past was that should a club qualify for an UEFA competition; the team had to play its matches in another stadium on natural turf. This was the case in 2003 with Salzburg but on the other hand the Spanish club Villa Real agreed to play in Moscow on Football Turf in 2004.

Therefore many countries have been waiting for the final go-ahead from UEFA in November 2004 before accepting Football Turf in their top leagues.

### National requirements / standards

National requirements as BS, DIN, AFNOR, etc..., are today replaced by the European Standard "CEN" which have been published in 2007. For clubs and owners of a pitch with a Football Turf, the lifetime, the maintenance, the environmental impact, the safety (national fire regulations), the price and the warranty of the turf product are in most of the cases more important than the footballistic criteria. In many cases, the communities and small clubs do not have the means to replace their turf every few years in order to comply with the high footballistic FIFA2\* requirements and need tougher criteria for longevity than required in the present FIFA 1Star criteria. In most big stadium with a professional home team the problems may be different, for them it is certainly more cost-effective to install one artificial Football Turf every few years than to replace a natural turf once or many times every year.

Many of the European National Football Federations (Italia, Norway, Sweden, The Netherlands, Switzerland etc...) have their own national regulations.

### Example:

Switzerland requires a FIFA 2 Star certificate for its top professional league. The two following leagues require a FIFA 1Star certificate. In the lower leagues, the pitches have to be tested by an ISO 17025 certified test laboratory according to EN 15330-01.



FIFA 2Star turf installed in Almelo used in The Netherlands during the season opening game in 2005 between Almelo and PSV Eindhoven.

### Technical state of the art

Football Turf systems manufactured and installed exist

- with or without any infill material;
- with or without any elastic pad and
- with our without any stabilised base (asphalt base).

Football Turf systems **with infill** have fibre length of over 40mm up to 70mm. They use a first infill layer of silica sand, essentially for a carpet-like stability purpose. The second or main infill layer consists of small plastic or rubber granules on top of the silica sand. The remaining (approximately) 5 to 20mm of fibres is left loose and free of any infill. These loose lengths of turf fibre correspond somewhat to the blades of grass of natural turf growing out of the soil. Football Turf systems **without any infill** have fibre length between 25 and 40mm, mostly with several different turf fibres, lengths and densities.

Footballers are now being offered a playing surface that is highly similar to natural turf. With this Football Turf, the following characteristics are the most important where the players themselves are concerned:

- Sport-specific criteria, such as ball-roll and ball-rebound, have been drastically improved with respect to first- and second-generation artificial turf, and are now virtually identical to those achieved on a natural playing surface.
- > The risk of incurring graze injuries has been reduced; stability and safer stopping are guaranteed.
- > The playing surface is as soft as a well maintained humid turf and soft enough to absorb impacts and shocks.
- The player's boots sink into the turf-filling material, just as they would in the earth under natural turf and boot studs can rotate within the turf without any effort.

The best known natural grass pitches in mayor stadium have been tested by UEFA all over Europe. The findings of the measurements where used as base criteria for the best football surface. Therefore UEFA decided that only the best surfaces can be used for its competition.

Based on this decision, Football Turf producers are free in designing, manufacturing and installing Football Turf (type and height of the fibres, with or without any infill material and with or without any elastic pad) as long all the criteria for either the 1Star and the 2Star quality as laid down in the FIFA Quality Concept (FQC) are fulfilled.



### FROM THE PAST TO THE PRESENT

The use of artificial turf as sports surface now goes back over forty years. The first types (now often described as the first generation turf) comprised short dense piled carpets without any infill. Best suited to American Football and field hockey these surfaces were never considered a serious alternative to natural grass for football surfaces. The turfs of the second generation were developed in the 1970s. These comprised longer and more open piled surfaces that were infilled with sand. Although used at several professional clubs in the English Football League for a couple of seasons in the mid 1980s it soon became obvious that this surface was also not suitable for high level football, although its use as a surface for community facilities has been extensive.

It was not until the mid 1990s that the introduction of much longer piled carpets that were infilled with a mix of rubber and sand provided the first type of artificial turf that had the potential to provide a valid alternative to high quality natural grass. In the following ten years significant developments and innovations have led to the point that both FIFA and UEFA consider these surfaces a viable alternative to natural grass and have sanctioned their use in their competitions.

### Key stages in the development of artificial turf

- B.C. Football was played in China on clay and sand and the football was made out of leather-filled goat stomach
- 1874 Founding of the first football association in England

### 1<sup>st</sup> generation of artificial turf

- 1962 US educational facilities laboratory (a Ford Foundation agency) calls for the development of all-weather playing surfaces for kids in crowded city areas.
- 1964 Chemstrand Corporation, a Monsanto subsidiary, installs the first synthetic textile playing surface, "Chemgrass®", at the Moses Brown School, Rhode Island, USA
- 1966 The construction of Houston's astrodome baseball arena was the origin of a new problem for stadium builders everywhere: how to get over the fact that natural grass cannot grow or survive in a roofed-in area. Monsanto offered its newly invented "Chemgrass", renamed "Astroturf®" as a solution. This was the first commercial installation of a textile base synthetic playing surface. The product was a woven carpet with monofilament nylon 6.6 pile fibres, backed with open celled Plastisol foam, laid over an acrylic felt cushion. The substrate was compacted clay soil. The initial installation was designed for baseball and American football.
- 1967 Padding systems moved to closed cell foams made of polyvinyl chloride or polyethylene.
- 1970 First synthetic pitch for Hockey installed at the Empire Stadium Vancouver, Canada and first Hockey match played between teams from Argentina and Canada.
- 1970 Synthetic turf installed in several professional level convertible sports facilities.
- 1971 First synthetic turf installed in Europe on football and hockey pitches in Caledonian Park, Borough of Islington and Hackney marshes in London, England.
- 1972 A German company imitated the American original by producing an artificial turf made of polypropylene instead of nylon 6.6. Both turfs were always produced with various elastic backings.
- 1974 FIH approves synthetic turf as surface for Montreal Olympics.
- 1976 First time in Hockey history, artificial turf used for Olympic Games, Montreal, Canada
- Note: These two types of artificial turf are up to this date referred to as "first-generation", i.e. turf made of artificial fibres and without infill material of any kind.

### 2nd generation

- 1978 Advent of the **2nd generation** "sand-filled turf produced with polypropylene fibrillated fibres" coming from Canada and immediately adopted in The Netherlands and copied by Dutch turf producers. The innovation, where this new product was concerned, lay in the fact that the fibres were twice as long as before and were tufted into strands that were far more widely spaced than previous products. In the earlier days, this new second generation turf did at the start not use any elastic pads / backings or Monofil fibres.
- 1984 Sand filled turf installed at Queens Park Rangers stadium, London in the English Football League
- 1985 Ban on artificial turf in the English League, as the ball rebound properties were excessive and the surface highly abrasive to players and equipment.
- 1987 FIH, establishment of the artificial turf requirements for all the international competitions.

### 3<sup>rd</sup> generation

- 1997 Advent of the 3<sup>rd</sup> generation artificial turf including a rubber infill
- 1998 Beginning of the UEFA study of artificial turf
- 2001 Publication of the FIFA Quality Concept concerning the 3rd generation artificial turf
- 2002 Publication of the UEFA turf manual
- 2003 Launch of the UEFA pilot project by installing 3<sup>rd</sup> generation turf in five different countries and stadia with professional football teams.
- 2003 June; first Football Turf successfully tested according to very stringent UEFA test criteria.
- 2004 At its meeting in February 2004, the International Football Association Board (IFAB) decided that a reference to 'Field Surface', including artificial turf, be added to the Laws of the Game.
- 2004 FIFA published its revised Quality Concept, creating a Two Star and One Star quality system.
- 2004 UEFA; at its Executive Committee meeting in November 2004, it is decided to accept artificial turf for its top competition as from the season 2005/2006 on.

Seas	SUI 2003/2000 01.
FIF/	A and UEFA announce collaboration on artificial turf
(FIF/	A.com) Monday 22 November 2004
Refe	rring to the common presentation held on November 2 during the Turf Summit
in Be	erlin and to the decision of the UEFA Executive Committee from November 10,
to a	ccept artificial turf for its competitions as of the season 2005/06, both FIFA and
UEF/	A are pleased to further inform about their collaboration in the area of artificial
turf,	which unifies the standards, testing methods and testing criteria into a
com	mon approach for artificial turt. Specifically, this collaboration has produced the
follo	wing:
⊔ A :	single artificial turr testing manual, including all procedures for
labo	radiuly- and neur-tests and the respective criteria, will be published in
spill	ig 2003. The manual will be publicly available on both FIFA and OLFA
	sites and will be published under the name of FIFA
□ Ur	initiation of definition of aboratory and field test institutes.
whe	re the certification according to ISO 17025 will become a
requ	lirement
🗆 Jo	int-funding of medical research into the biomechanical and
dern	natological effects of artificial turf on players. This research will
com	mence early in 2005
🗆 Th	e FIFA RECOMMENDED 2 STAR standard would be the relevant
qual	ity standard for all UEFA top competitions, including the Qualification
for t	he European Football Championship, the UEFA Champions League and
the	UEFA Cup.
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- 2005 FIFA published its revised Quality Concept, creating a 1Star and 2Star quality system, where the 2Star system included all the UEFA test criteria. UEFA decided that if an artificial turf system is intended to be used in UEFA competitions, only FIFA 2Star turf, tested once a year, would be allowed for its top competitions. This quality level becomes the standard for professional football. Based on this decision, no new UEFA test certificates were issued.
- 2006 The term "Football Turf" is adopted to identify these high quality turfs.
- 2009 FIFA published revised Football Turf criteria.







### 3<sup>rd</sup> generation of artificial turf now named "Football Turf »

- tuft distance, gauge ¾ etc.. turf (pile) height, 40 70 mm monofilament and fibrillated fibres
- Infill of quartz sand and rubber, or
- only rubber

Turf without infill

manufactured similar to the 1st generation turf but less dense tufted and with fibre length over 25mm

### FOOTBALL TURF CHARACTERISTICS

# Football Turf is a "System" which consists of an infrastructure (stable base for the artificial turf) and an artificial turf (with or without an elastic pad and / or infill material).

- Infrastructure (similar to road construction)
- Soil heating (if the national football association requires it)
- Water sprinkler (wished by the professional players)
- Elastic pad (shock absorption element) if required by the "Turf system"
- Woven fabric (backing of the turf)
- Synthetic fibres (artificial grass element)
- and if required by the "Turf system" quartz sand and infill rubber granules





### **TECHNICAL CHARACTERISTICS**

# The technical and footballistic characteristics and test requirement of a football turf system are descript in the handbook "FIFA Quality Concept for Football Turf".

- > Pile height, density, shape and weight
- > Type and weight of carpet backing
- > Type and height of infill material or no infill at all
- > Length of fibres free on top of any infill
- > Type, thickness and elastic factor of the elastic pad, if part of the turf system
- Colour etc, etc...

### In addition, artificial Football Turf must be produced and installed in conformity with national laws and rules.

- This concerns in particular environment and fire / safety requirements on
- the elastic layer (rubber and bonding agent)
- the turf fibres
- > the turf backing
- > the infill material
- > Security

Refer to the national government or European regulations or to the recommendations.

FOOTBALL TURF SYSTEM



### FOOTBALLISTIC CHARACTERISTICS

- According to FIFA, a Football Turf has to be tested in the laboratory and afterwards on the installed pitch. Only an installed pitch does receive the label: FIFA recommended. No test results are published
- According to the European (EN) criteria, no laboratory tests are required. An installed turf is tested and test certificates with test results are delivered.

### Ball roll

The ball roll depends on the height and the density of the grass, the evenness of the playing field, the humidity and, of course, on the strength of the stroke given by the player.

Consequently, it is important that an artificial turf field provides similar ball roll behaviour as experienced on a natural turf field in good condition.

The test value describes the minimum and maximum ball roll length.

### Requirements

```
FIFA 03/05-01
```

```
2Star
Initial assessment 4m - 8m
After 12 months 4m - 10m
1Star
4m - 10m
```

EN 15330-01

```
≻ 5m – 10m
```



### **Ball rebound (vertical)**

There is nothing worse for a football player than a ball rebounding too high or with no rebound at all. Again, while a player adapts very fast to any such situation, it is important to ensure that the rebound is similar to a natural turf in good condition.

While the ball rebound may dramatically vary on natural fields (hard surface, a wet or totally water emerged field, etc.), this should not be the case on Football Turf.

The test value describes the minimum and maximum ball rebound height of a football.

### Requirements

```
FIFA 01/05-01

2Star

≻ 60cm - 85cm

1Star

≻ 60cm - 100cm
```

**EN 15330-01** > 60.8cm - 101.2cm



### Angled ball rebound

UEFA has initiated a test simulating a long pass whereby the horizontal speed and the rebound angle of the ball before and after hitting the surface were measured and compared.

It is essential for football that this action, which occurs very frequently during a match, will not be affected in a negative way by the use of artificial turf. The scientists who carried out this rather new test were positively surprised by the results obtained with artificial turf, which are very similar to those obtained on natural grass.

The test value describes the speed reduction after the impact between the football and the surface.

### Requirements

### FIFA 03/05-01

### **2Star** ➤ Dry 45% - 60%



### 1Star

Dry 45% - 70%
Wet 45% -80%

### EN 15330-01

No requirement



"Round Robin" of the UEFA test laboratories in Nyon 2004

### Shock absorbency

No doubt football is not a harmless sport. Numerous dangers and risks are hidden while playing a football match on any level and under any conditions. It is also recognised that many former players both professional and amateur suffer from joint and back problems in the later age and scientists as well as medical staff are currently investigating the reasons for these symptoms obviously created by the Game.

A key role must certainly be attributed to the field of play. Playing regularly on a hard field may probably cause more pain than on a "soft" surface. It is the duty of the football governing bodies to ensure that the short and long-term consequences of playing football be reduced to a minimum. Consequently, a Football Turf should provide a degree of softness similar to a natural grass field in good condition and safety to the players. The test value describes the minimum and maximum shock absorption of a human body.

### Requirements

FIFA 04/05-01 (flat foot - mean 2<sup>nd</sup> / 3<sup>rd</sup> impact) 2Star

➢ 60% - 70%
 **1Star** ➢ 55% - 70%

## EN 15330-01

> 55% - 70%



Test apparatus "Berlin Artificial Sportive"

### **Vertical deformation**

A player should not have an uneasy feeling when moving on the field. His feet should be stable at any time without giving the feeling that they are wobbly. **The test value describes the minimum and maximum deformation of a foot.** 

### Requirements

```
FIFA 05/05-01 (flat foot – mean 2<sup>nd</sup> / 3<sup>rd</sup> impact)

2Star

> 4mm – 8mm

1Star

> 4mm – 9mm

EN 15330-01

> 4mm – 10mm
```

### **Rotational resistance**

Another very important and frequent movement of a player consists of a rotation. The field must allow a player to carry out such actions without running the risk of blockage, which could result in serious ankle and knee injuries. Consequently, a Football Turf system should not be too resistant to such a rotation while still providing a sufficient stability to the player. **The test value describes the minimum and maximum rotations resistance of a foot.** 

### Requirements

```
FIFA 06/05-01 (flat foot – mean 2<sup>nd</sup> / 3<sup>rd</sup> impact)

2Star

> 30Nm – 45 Nm

1Star

> 25Nm – 50Nm

EN 15330-01

> 25Nm – 50Nm
```



### In addition and before the field test, FIFA requires many laboratory tests

- All footballistic test before and after the Lisport
- Many technical tests concerning the turf fibres, the turf backing, the infill material, etc.
- Some security test are made only in the laboratory as:

### Skin and linear friction

On all previous generation of artificial turf, friction injuries (skin burning) were very common. Even if the Football Turf has now much better friction characteristics, to assure a consistency in the quality, the friction of the Football Turf system is tested.

The test value describes the minimum and maximum friction on a human body.



### PLAYING CHARACTERISTICS (UEFA medical studies)



Football Turf vs. natural grass: is there a difference in injury risk?

### AIM

To compare the injury risk when playing elite football on football turf to the risk playing on natural grass.

### **INJURY INCIDENCE**

974 injuries were registered among the 10 male teams participating in the study. The main mechanism was overuse for 370 injuries (38 %), whereas 604 (62 %) were traumatic and could be related to the surface. The injury incidences when playing football on football turf (2.6 injuries/1000 training hours and 19.9 injuries/1000 match hours) did not differ from that when playing on natural grass (2.9/1000 training hours and 21.8/1000 match hours).

### **INJURY PATTERN**

The rate of severe injuries such as fractures and joint dislocations did not differ between football turf and grass. An increased risk of ankle sprains (ligament injury) was observed on football turf compared to natural grass, whereas the rate of muscle strains in the lower extremity was lower on football turf.

### **INJURY SEVERITY**

The majority of injuries (59 %) were minor injuries (absence  $\leq 1$  week), whereas one out of ten injuries were severe (absence >4 weeks). The risk of suffering a severe injury did not differ between surfaces.

### DISCUSSION

The study does not show any evidence of an increased injury risk when playing elite football on football turf as compared to playing on natural grass. The increased risk of ankle sprains associated with play on football turf warrants further attention.

A limitation of the study design is that a number of different types (brands) of artificial surfaces were included in the study, and this could partly explain the varying results observed among different teams. Future analyses will control the association between different types of football turfs and the rate of injury. The effect of intrinsic (player related) risk factors for injury (age, height, weight, and sex) will also be considered.

The study was limited by small numbers of specific injury types. With a larger dataset, analyses of the risk for specific injury types in relation to playing surfaces will be more detailed and accurate.

Jan Ekstrand MD, PhD Professor, Sports Medicine Linköping University, Sweden Vice-Chairman of the UEFA Medical Committee

### CONCLUSION

Playing elite football on Football Turf is not associated with an increased risk of injury as compared to playing on natural grass. Teams playing on pitches with an elastic pad have less overuse injuries compared to teams playing on pitches without an elastic pad! Therefore elastic pads are recommendable – but how soft should they be?

FOOTBALL TURF www.sportfloor.ch

### FOOTBALL TURF MANUFACTURING

There are no specific recommendation regarding the composition, thickness, length and height of the turf fibres, without any infill or with and what type of infill in order to manufacture a Football Turf. Each manufacturer has to deliver and install a turf product designed to ensure that all the technical and footballistic performance fulfil the FIFA requirements.



### **TURF BACKING**

The backings of the Football Turf can be made of various materials. The most important characteristics of the backings are: **Dimensional stability** 

- This can be achieved with a double backing with a weight of over 300gr/m2, the latex induction not included. • Strong attachment of the turf fibres
- This can be achieved with a heavy water resistant latex induction, none petrified



Different types of turf backings and methods of tufting the fibres into the backing

### **TURF FIBRES**

The fibres used for manufacturing Football Turf can be produced in various combinations of material and extrusion.

### Material

- Polypropylene
- $\div$ Polyethylene
- Nylon

- Manufacturing ↔ Fibrillated (split fibres)
- ✤ mono-blades
- ✤ mono-filaments
- thickness (expressed in mµ)
- weight (expressed in dtex)
- shape (cross-section)

### Visual aspect

- straight
- ✤ curled
- twisted





Monofilament

fibrillated fibres



One fibre,



several of the same type of fibres per knot and...



different type of fibres per knot

# Moreover the shape of the fibres can be different for each turf product.

The thickness is different from one fibre to the other; the thicknesses are measured in mu ( $\mu$ m= 0,001mm). Therefore the question: Where does one measure the thickness, in the middle or the mean measurement; which one is important?

# All the turf manufacturers offer turf fibres of a wide range and in various combinations.

Open question: which type of fibre?

- in what thickness,
- > length,
- > width,
- $\succ$  colour,
- combination
- shape
- etc...,

will eventually succeed as the best turf product system for football?

### At this stage of development, who is able to predict it?



# Example of a non filled Football Turf construction with different fibres qualities within one product





Problems which may occur when manufacturing a Football Turf



Turf fibres burned during the application and drying of the turf backing

### Non UV resistant turf fibres



Comparison of an installed turf after 2 years compared with an original turf sample...



... and in the final stage the turf fibres will finally be just fine loose particles.

Note: UV stabilised fibres may lose their strength with infill, especially with black rubber (= sulphur migration). The visible signs are: loss of colour or additional loss of strength = easy fibre breaking. An UV/A test of 400hours represents in Europe about 5 years of exposition (only 2 years in the Caribbean's).

### Examples of different turf fibres type, size and colour qualities



FOOTBALL TURF www.sportfloor.ch

### **INFILL MATERIAL**

A Football Turf System may be filled with granular infill material or not at all.

There are many different types of rubber or similar infill material available. Each of them has its advantages and disadvantages.

Some of the infill materials are made from material originally designed for another application and some are especially designed or Football Turf which should have an added value towards sport performance, required safety level towards human and environment.

### No Infill

Football Turfs without any infill have a much denser tufting construction; much denser fibres and a height fibre weight per square meter but shorter fibres.

### With infill

If the Football Turf needs infill material, the infill consists mainly of two materials:

Stabilising infill layer: A mineral layer of fire-dried quartz sand (Note: some products do not need any mineral layer)



### Performance infill: A second layer of rubber or plastic granules

Quantities and qualities of the performance infill

The type of material, quality, size and shape of its infill influences most of the playing characteristics (rotational resistance [grip], ball rebound, sliding and stability of artificial turfs containing infill material, similar of the top soil in natural grass. There are many different types of infill materials available. Each of them has its advantages and disadvantages. Some of the infill materials are made from material originally designed for other applications, some are especially designed for Football Turf, and they should have a benefit concerning sport performance. As there is such a huge variety of infill products on the market, it is difficult, even impossible, to give definitive advice and to describe the advantages and the disadvantages of all the varieties of products listed below. (every day new products and product variations are launched on the market).

### Many of the playing characteristics of the turf with infill material are influenced by the quality and shape of its infill

- Rotational resistance (grip), ball rebound, sliding and stability
- Maintaining excellent playing performance / characteristics even after years of use
- Health of the players (injuries)
- Environment protection
- Resistance to wear
- Security (fire and fumes)



### SBR (black)

### Recycled, black rubber granulates, called SBR

SBR is recovered and granulated from "end-of-life" car and truck tyres.

- Tyres are typically produced from two different raw materials.
- Natural rubber (N-poly isoprene butyl rubber BR)
- Synthetic rubber (styrene butadiene rubber butyl rubber BR) SBR

Truck tyres are produced with a higher NR content (+/- 57%) versus car tyres (+/- 46%) to achieve the necessary strain resistance.

SBR infill is usually produced from a mix of truck and car tyres. To improve the appearance and to avoid a "blackening" effect (see also below) from the rubber on the ball and shoes, a polyurethane (PU) coating in various colours is proposed.

These granules are the most commonly used as they are the cheapest Infill product on the market. They are derived from vehicle tyres (originally designed for cars, trucks, tractors, etc.), or from other types of industrial waste rubber (tubes, sealing's, etc...). Due to their different original uses, recycled rubber granulates vary enormously in their components / composition.

Advantages	Disadvantages		
price	The material burns easily and releases a lot of fumes (health and security problem)		
very supple and therefore less abrasive on the turf fibres than only sand.	When the ambient temperature is high this material produces very quickly large amounts of heat energy which can easily reach 40-50°C. Quote of the Norwegian Football Associatio n: "the players feel very uncomfortable and take their shoes off as soon as the match is over". it may release a rather unpleasant odour which can bother even the residents in the immediate vicinity of the pitch, especially at high ambient temperatures. Remarks from players: "It feels quite often very uncomfortable, really some times too hot. We take the shoes off as soon as the match is over".		
in certain circumstances and cleaned from the dust, can be re-used.	It may release an unpleasant rubber odour.		
Excellent UV resistance.	The carbon in the tyres protects them generally very good against UV. However if they are derived from different industrial rubber, they can become brittle when subjected to UV radiation, which can lead to a gradual hardening of the entire playing surface.		

good playability properties	If the production is not continuously quality controlled, the zinc content may exceed some national ecology requirements (refer to Safety, Environment and Health)
colouration possible by coating	The Eco-toxicological aspects are controversial. Relatively high sulphur content (compared to other materials). The shredded tyres leak chemical components into the soil. Therefore in some European countries, the use of this material is forbidden by the environmental legislation as it is regarded as a waste product not healthy for the environment. Example: in Switzerland, in areas where the ground water is treated for the use of drinking water, the disposal of tyres is forbidden! Were one to measure the infill only in terms of the amount of mobilised zinc in acid leachate, the predominant part of the old tyre rubber granulates would not be able to meet the requirement because of the high zinc content of the non-volatile matter. This also applies inter alia to waste from technical rubber. Here, the situation is even more complicated because of the quite different rubber requirements, and no approximately constant quality can be guaranteed. However, since ecologically sound recycling possibilities should be encouraged, selected old tyre rubber granulates have a fair chance through the alternative claim that the zinc content in neutral aqueous leachate may not exceed 0.5 mg/l. This requires however a strict choice and therefore a relatively close continuous supervision of the quality of these recycled materials.
	The recycled tyre rubber seems to be much more resilient than the especially designed infill material, and some biomechanical studies show that they may induce tiredness for the players (Ref. University of Parma)
	Problem of quality control parameters (certificate of origin). Discolouration (blackening).

### **Coloured SBR**

These granules are re-treated with a PUR coating (encapsulated) and are available in various colours. It seems, at the time of the printing of this document, that the above mentioned standard environment problems of the black SBR are significantly reduced.

### EPDM

### Virgin rubber granules (EPDM = ethylene propylene diene monomer)

Initially coloured EPDM have been manufactured for shock absorbency pads in children playgrounds and athletic tracks. EPDM is a cross linked terpolymer rubber and is often also referred to as "virgin" material. A good granulate composition should be made of a pure EPDM rubber of 20% and above and fillers. The filler composition varies and is not constant, different formulations depending on the availability and economics are proposed. The cross linked structure is achieved with sulphur or peroxides; the types based on sulphur clearly show a cost advantage but the peroxides based EPDM is preferred and show better aging properties. The granule size ranges are similar to SBR. Because this is a new material, all type of colouring is possible.

Advantages	Disadvantages
very supple (similar to SBR) and therefore less abrasive on the turf fibres	Price
slower absorption of heat from sunlight.	some type of granules can compact and lead to a gradual hardening of the entire playing surface.
extinguishes by itself if the source of the fire is removed and flame retardency added.	Can be too resilient (vibration) and therefore induce tiredness of the players. (Ref. University of Parma)
the granulates can be manufactured either in sulphur-cured variants or in peroxide-cured variants. Nowadays, using the latest technical advances, it is possible to manufacture sulphur-cured EPDM granulates with relatively low zinc content and low-zinc and zinc-free peroxide-cured EPDM granulates which satisfy most of the environment regulations.	It may release an unpleasant rubber odour.
when cleaned from the dust, can partly be re-used.	
good eco-toxicological properties.	Note: it has been observed that in the southern countries with a lot of sunshine, only high quality products with an EPDM content of min 25% do not get powdery, hardening and therefore get abrasive.

### Coloured EPDM especially manufactured for football turf

Lately manufacturers have modified the production in order to adapt EPDM especially for Football Turf and at the same reduce the basic costs.

Advantages	Disadvantages
very supple and therefore less abrasive on the turf fibres.	price
good stability under UV radiation	a bit too resilient/nervous and can therefore induce tiredness of the players.
slower absorption of heat from sunlight	
the granulates can be manufactured either in sulphur-cured variants or in peroxide-cured variants. Nowadays, using the latest technical advances, it is possible to manufacture sulphur-cured EPDM granulates with relatively low zinc content and low-zinc and zinc-free peroxide-cured EPDM granulates which satisfy most of the environment regulations.	

Note: it has been observed that by trying to reducing the cost, the EPM content was reduced and in southern countries with a lot of sunshine they do hardening and therefore get abrasive.

### TPE / TPU / TPV, thermoplastic elastomere

The chemical composition of this type of coloured infill granules are in general made of copolymers of ethylene, butadiene and styrene or are polyurethane Elastomers utilising a variety of isocyanides depending on the formula. Commonly called: thermoplastic elastomere, thermoplastic polyurethane and vulcanised thermoplastic Different types are commercially available but the TPE-S, based on hydrolysed styrene bloc-copolymers (SEBS or SEPS), is presently most used.

Colouration is possible and the material is either chopped or extruded in the form of pellets.

Lately many manufacturers modified the production in order to reduce the basic costs. However lower cost may also represent lower qualities with a negative effect on long-term performance.

Advantages	Disadvantages
good stability under UV radiation	price
slower absorption of heat from sunlight than SBR	not so resilient and may therefore be more abrasive to the turf fibres
no compaction if the chemical composition is SEBS	danger of compaction with chemical composition as SBS
less resilience, therefore less or little energy return , closer to natural turf behaviour (Ref. University of Parma)	
after cleaning, the granules can easily be recycled	
after cleaning, the non vulcanised granules can easily be re- melted	
excellent recycling properties; can easily be recycled/re- melted	
no heavy metal (trace levels only)	
mechanical properties can be tailored to requirements	
does not burn at all, especially if a fire retardant is included	

### **TPE-SBR or TPU-SBR**

These TPE granules contain SBR powder (Note: the Italian Football Association allows a maximum content of 30% SBR per TPE granule).

Advantages	Disadvantages		
price	cannot be recycled		

### Summary

Inf	ill	Manufacturing technology	Origin	Environment	Elastic rebound effect	Security	Aging	Recycling after use		
s	SBR Rec EPDM black Vulcanised	Recycled	Depending on the origin, can		Burns easily		20			
EPD		material		Depending on the origin, can	nding on igin, can yes an impact n the onment	Extinguishes by itself	good	no		
EF col	PDM oured	rubber	Virgin plastic hane	on the environment				partially		
El foa	PDM amed				reduced					
TPE	SEBS	EBS Virgin								
	SBS					Slow burning, even without	poor	can be re-		
TP	U	Thermoplastic polyurethane Neutral products n		Neutral products	Neutral products	Neutral products	Neutral products	neutral	fire retardant	good
Org mat	ganic terials	Densification	natural			When dry, burns easily	poor	can be burned		

### **Advice**

### It is important when choosing a Football Turf

- that the studs of the football boot can penetrate into the turf / infill without touching the turf backing or the sand infill layer
- that there are enough turf fibres free on top (identical to the natural turf blades).

### With granular infill, it is recommended to have

- a thickness of granulates of not less than 15mm
- and not less than 10-15mm free fibres on top of the Football Turf.

### The infill material for Football Turf should be specifically designed

- to be an added value towards sport performance
- to fulfil the required safety level towards human and environment
- for good durability

Any turf product (turf fibres and infill) which may burn, is not recommended in stadiums (and Indoor halls) used for UEFA competitions where in case of fire the pitch is part of the exit route unless the material contains fire retardants and is self extinguishing.

### Important for the choice of any type of turf fibres and infill material

### The granular infill should maintain its characteristics even after 10 years of use.

- Not alter its footballistiques qualities (remain supple as on the day of the installation)
- Not transform its physical composition (remain juvenile as on the production day)
- Not leach any chemical components into the soil (remain environment friendly)

# In order to guarantee the long term qualities, fibres and granules should be tested and documented by a specific test report by a FIFA accredited test laboratory, according to national standards.

Looked over two or more lifecycles of a Football Turf, by choosing high quality products the overall cost of a construction will not increase, then despite higher investment the turf fibres will last longer and a large proportion the infill material can last two turf lifecycles or can be re-melted / re-used.

### Shock pad

It is recommended to install an elastic pad as part of the Football Turf, but is not a requirement. It is up to the turf manufacturer to propose a Football Turf system with or without an elastic pad.

### There is no specific recommendation regarding the quality or thickness of the elastic pad.

Each manufacturer of a Football Turf where an elastic pad is part of the Football Turf System has to deliver and install a pad designed to ensure that the technical and footballistic performance fulfils the corresponding test requirements also on the long term.

Even though Football Turf with no elastic pad performs well at the outset, from a sporting and technical point of view, with respect to shock absorbency, its performance can deteriorate quite quickly as a result mostly of general wear / tear and compaction. This can mean that after some time, the footballistic requirements may no longer be fulfilled, especially the shock absorption.

Experience with the first and second generations of artificial turf has shown that turf products without an elastic pad cannot retain its initial qualities over a long period of time, while those with an elastic pad perform much better. In the last decade most of the high quality turfs of the first two generations have been installed with an elastic pad.

But today (state of the art, 2006) many Football Turf systems continue to be designed and installed without any elastic pad and it seems that history is repeating itself.



Existing elastic pads after being used during the life time of a 2<sup>nd</sup> generation artificial turf After some level correction, re-useable for some additional turf lifetimes



Prefabricated elastic pads in rolls

Prefabricated elastic pads as a puzzle

### **Advice**

An elastic pad (prefabricated or installed in-situ) offers the following advantages:

- Provides additional comfort to players
- A published medical study indicates that a turf system with an elastic pad reduces the number of injuries
- An elastic layer is helps to increase the turf lifetime
- An elastic layer can usually be re-used several turf lifetimes, particularly if installed in situ.
- The use of an elastic pad is therefore highly recommended in order to maintain the long-term functions of Football Turf, but it is the responsibility of the turf producers to assure the footballistic and technical qualities of the turf system over the years, irrespective of the presence of an elastic pad.

According to UEFA medical studies, an elastic pad reduced significantly the injury risk.

### CHOICE OF A FOOTBALL TURF SYSTEM

All turf producer / distributer / installer claim that they have the best Football Turf product



with the best fibre and infill combination



with the best look and feel for the players



### **TENDER CRITERIA**

# FIFA 2\* turfs are within certain ranges of requirement all of similar quality, and can be compared to good natural turf. Therefore the choice of a Football Turf for a club or a community will mostly depend on the following criteria:

FIFA 2 Star quality for any main stadium pitch in Europe intended to be used for UEFA competitions.

For all other use, there are no requirements except if any of the European National Football Association has made particular provisions for its competition (FIFA 2 Star, FIFA 1 Star, IATS or CEN) otherwise it s recommended to choose a turf which fulfils one of the standards.

### Important questions which should first be answered before defining tender criteria

	Professional players
	Amateur players
Who will use the pitch?	> Youth
	Schools
	Part or all categories together
	14hours or less
How many hours of play par weak are expected?	Around 28hours
now many nours of play per week are expected?	Around 42hours
	More than 56hours
Will the nitch be used for other sports and events?	What types of sport and events?
will the pitch be used for other sports and events?	How many times per year?
	➤ Urban
	Rural
	Near trees
What is the proposed environment,	Frost penetration depth
location and existing infrastructure?	Soil permeability
	Soil stability
	<ul> <li>Water sprinkler</li> </ul>
	Soil heating

Consideration of the above points may help identify which of the many different types of surface are best suited to their needs. Having addressed these factors it is then possible to consider the characteristics of the products being offered, paying particular attention to the to applied competition regulation (FIFA 2Star, FIFA 1Star, IATS, CEN or national regulations).

### Example of tender criteria, importance in %

When a club / community plan to choose an artificial turf pitch instead of a natural turf, they may be tempted to choose the cheapest product satisfying all the FIFA criteria.



### Footballistic criteria

Part of the choice of the footballistic criteria could be made on the following aspects:

- Shock absorption = softer or harder
- $\succ$  Friction = higher or lower
- Rotational resistance = easy or hard turning
- Deformation = more or less stability
- ➢ Ball Roll = slow or fast
- Vertical ball rebound = high or low
- Angled ball rebound = high or low

### **Technical criteria**

### Elastic pad

- > Thickness
- Shock absorbency
- Elastic factor
- Resistance to break
- > Prefabricated or in-situ installed

### **Turf backing**

- Quality and weight of the backing = one two or more layers
- Quality, weight and type of the latex

### Turf fibres

- > Type and quality (monofilaments, monoblades, fibrillated fibres, etc...)
- Thickness in microns
- Number of dtex
- Number of tuft (stitch / knots) per m2
- > Number of fibres per stitch (the same or several different fibres)
- Weight in kg per m2
- > Length of the stretched fibre (double length including the tuft loop)
- Length of fibres free on top of any infill
- Extrusion shape of monofilament fibres

### Infill or non filled

- > Type and quality of fire dried quartz sand
- > Type and quality granular infill (SBR / EPDM / TPE / TPU, etc...)
- Weight in kg per m2
- > Height in mm
- Particle size and shape
- No infill

# It is the work of the turf manufacturer to define the product specification in order to fulfil the required test criteria; however it is recommended to choose between the following items:

Filled or unfilled turf	Ideal : personal view and appreciation
Elastic pad	
Shock absorbency value	min. 50%
Prefabricated or in-situ installed	In situ = longer lasting
Turf backing	
Quality and weight of the backing = one two or more layers	min. 2 layers of min. 250gr/m2 = dimension stability
Turf fibres	
Type and quality (monofilaments, monoblades, fibrillated fibres, etc	
Length of the stretched fibre (double length including the tuft loop)	min. 40
Length of fibres free on top of any infill	10-15mm
Extrusion shape of monofilament fibres	Personal view
Infill (if applicable)	
Quartz sand	Personal view
Type and quality granular infill (SBR / EPDM / TPE / TPU, etc)	Personal view, however big differences in price and quality
Height in mm	approx. 15mm
Health	
Environment	Local environment regulation
Fumes at fire	National regulation
Safety	
Fire resistance	Important for INDOOR halls

### Installation

- Well known and experienced installation companies generally represent the turf manufacturers with a performance guarantee.
- It should be noted that most of the manufacturers do not install the turf themselves, but rely on local partner companies (which should be) specialised in the construction of sport surfaces. These are quite often also able to construct the necessary infrastructure. However if possible, it is advisable to award the supply and installation of the base construction, the turf and the guaranty of the turf product to a single entity (local infrastructure Construction Company, turf manufacturer, and recognised turf installer).

### **Quality insurance / Warranty**

It is highly recommended that quality control (material and footballistic characteristics) be carried out by the turf manufacturer and his appointed installer in order to insure that the product which is ordered corresponds to the product which has been manufactured and installed.

- > The installer, the turf producer or jointly together they should provide a guaranty
  - with a validity of minimum of 5 years
  - or XXX hours of play in relation
  - both, time or hours of play connected to the strict maintenance programme
- > A warranty that fulfils the technical and footballistic criteria during the warranty time, to be verified by a FIFA accredited laboratory test.
- An instruction of the type of non-sporting events which are allowed and, if necessary, give instructions of the type of protection to be used.
- Refer also to chapter "D, Warranty and Maintenance"

### The FIFA 2 Star specifications

require that most of the materials used for manufacturing a Fottball Turf have to be laboratory tested before any field installation can take place.

In addition, UEFA requires that a turf has to be tested according to the FIFA 2 Star field test criteria within the last 12 months prior to any UEFA competition matches.

**Product identification:** Football Turf can be manufactured in many ways. The manufacturer can namely choose between many different fibre qualities, manufacture the turf in various heights and densities (and many more subtleties), fill the turf with various products and in varying quantities or have no infill at all, and, finally, install it onto different infrastructures built according to local conditions.

Turf product properties: Does the manufacturer/supplier observe his own specifications for the quantity and quality of the material used in his turf system? This is in general cross checked within the warranty of the FIFA Quality Concept! The FIFA accredited test laboratory keeps a sample of the tested and registered football turf system and is thus able to test and compare the installed turf with the certified turf system. If the quality of the turf does not seem satisfactory, or should any visible polymer change occur (fibres and rubber infill), some of the following recommended tests can be carried out:

**Wear and abrasion resistance:** As a general rule, the best way is to visually inspect actual turf installations and to compare the various fields in terms of year of installation and hours of play, if available. A more accurate way is to resort to the Lisport test according to the FIFA specifications. The aim of this test is to characterize the interaction between studded shoes and the turf and to determine the changes in physical and sport properties.

**Pile fibre quality:** The quality of the turf fibres depends on the quality and degree of the fibre stabilisation. The chemical composition of the fibre can be analysed with the DSC and UV - light resistance test.

**Tear strength:** In tufted fabrics, the fibres ("the blades of grass") are inserted into a backing fabric and fixed with latex or other adhesive. How strong are the backing and the fibres? Will they withstand the forces of competing athletes? Are they hard to pull out, or do they break?

Static charges: The turf system with its infill material has to be designed so that the infill will not stick to the ball.

**Surface colour:** The colour of the turf fibre must be green and the markings must be white. It is not acceptable to incorporate material that can cause glare to the players from sunlight or artificial lighting.

Installation and climatic conditions: The purchaser has to inform the manufacturer and the installer of all specific prevailing climatic conditions and the manufacturer has to take these into consideration when establishing the turf specifications.

To assure good installation - quality, the football turf system should be laid in dry conditions and at temperatures above 10°C and levels of air humidity below 70%.

In order to avoid any warranty litigation after the installation of the turf, it is advisable to have all the construction phases recorded in a specific report containing all decisions made during the construction process (minutes of meeting, photos, weather reports, etc...).

Quality control: How to make sure that the quality of the ordered material corresponds to that of the installed turf?

By keeping samples of the turf and the elastic layer removed on the construction site, to be kept by the owner, the installer/manufacturer and the testing laboratory.

By compiling a photo report concerning the

- different layers of the infrastructure
- Elastic layer
- Football Turf
- Various infill
- Test the installed the Football Turf according to FIFA's technical and footballistic requirements.
   First test between 2 and 3 months after the installation
  - After every 12 months of use
- The manufacturer and his installer should be made jointly liable.

# The turf producer and the turf installer should provide a joint warranty for the Football Turf which should fulfil the technical and footballistic criteria during the warranty time

- Warranty validity minimum xxx years and minimum of xxx hours of play per year and both, time limit and hours of
  play should be linked to a strict maintenance programme (\*number to be agreed between supplier and
  purchaser).
- Together with the warranty provide a maintenance logbook where all events on the surface are clearly registered; along with the hours of use and maintenance carried out and provide.
- Recommend the type of maintenance equipment to be used for each type of maintenance work.
- Guidance on the type of non-sporting events which are allowed and, if necessary, instructions as to the type of protection to be used.
- Define that the quality of the Turf can be tested at any time during the warranty by a FIFA accredited test laboratory.
- If the turf does not fulfil the agreed quality level, e.g. FIFA 2 Star criteria, during the warranty period of xxxx years (to be defined between the turf producer and the purchaser), the turf should be replaced at the expense of the manufacturer provided that the maintenance conditions described in the log-book are strictly respected by the purchaser.
- Excluded from the guarantee should be: penalty points (to be replaced regularly during annual maintenance operations) and goals mouths.

### Not acceptable warranties are

- If the proposed warranty refers only to material damage to the artificial grass carpet itself, and relates exclusively to possible repair or partial or complete replacement of said artificial grass carpet.
- If any product repairs or replacements performed under the terms of this warranty does not lead to any extension whatsoever of the warranty.
- If the warranty is curtailed with similar conditions: After xxx years after completion of installation: max. xxx % reimbursement of the invoiced amount of the carpet
- If the compensation consists of only identical replacement of the area recognised as defective, without the labour costs (removal, re-installation).

Should the manufacturer should be unable to perform the replacement with an identical covering, a product closest to the original in appearance and quality will be used.

### Life expectancy

Based on the knowledge of the earlier types of artificial grass, the carpet fibres should have a life of 10 to 15 years. Based, however, on current technology the carpet may have to be replaced much sooner as the footballistic criteria deteriorate faster the material qualities.

The life expectancy may depend on the following quality factors:

- manufacturing and the material
- infrastructure
- turf backing
- turf fibres
- turf installation
- infill installation
- Local climatic conditions
- Frequency of use
- The elements that adversely affect the original footballistic characteristics of the turf are above all
  - insufficient turf fibre quality
     insufficient and / or inadequate maintenance
  - and of course the frequency of type of use of the playing surface.
- Maintenance guality

### The elements that adversely affect the original footballistic characteristics of the turf are above all:

- Insufficient and/or inadequate maintenance
- poor turf material quality
- and, of course, the frequency of use of the playing surface

### The life expectancy can be observed when a turf is tested with the Lisport machine.

The Lisport apparatus was invented to test the resistance of artificial turf and its infill material.

It consists of two cylinders provided all around with standard football studs which roll over a turf sample which moves sideways at the same time. At the end of test length, a free roll movement prevents the studs from touching the turf at the same spot. All these movements are meant to simulate the running and sideways movement of a player. Experience shows that 5000 Lisport cycles can represent about 2 to 5 years of use depending on the intensity of use of a pitch. That means that the values obtained with Lisport test can give an indication of the alteration of the Football Turf and its longevity.

FIFA 2Star products have to undergo the 5000 test cycle. The footballistic criteria have to be fulfilled before and after the test cycles (FIFA 1Star, 20'000 cycles).



Examples of turf fibres (yarn) before and after the Lisport test



New fibres



breaking after 15'000 cycles





New fibres

worn out and breaking fibres after 10'000 cycles





after 10'000 cycles significant wear (splicing)!

New fibres

Some other turf fibres are showing little or no significant wear



Fibres after 15'000 cycles



and after 30'000 cycles!

### What is the most important item when choosing a Football Turf product?

• Initial optical look and footballistic qualities when the turf is new

or based on the long term technical / footballistic qualities (after some years of use)?

### Example of a choice:

- if the turf is to be used in a stadium where the turf will be changed after two to three years = Product A or B
- if the turf has to last as long as 8 years or more, with still very good technical and footballistic qualities = Product C or E
- and an additional criteria is of course the tender price.



This graph show different product qualities tested under the "Lisport long term simulator". 5'000 Lisport cycles are estimated to represents a pitch being used over 1800 hours per year during approximately 2 years.

### **Advice**

The choice of the technical criteria can be made by asking the tenders

- To fulfil all the FIFA criteria after a period of 3 to 5 years, or
- To fulfil the footballistic quality criteria after a LISPORT test with over 20'000 30'000 cycles.

However it is not recommended to make a choice only on the basis of the technical data sheets of the turf manufacturer. As a minima requirement, 5'000 cycles are far too little.

It is recommended to base the choice not on fibre thickness, weight, length etc..., but on quality based on Lisport test comparing new products and the products after more than 20'000 - 30'000 cycles.

### Maintenance

The turf manufacturer / installer should:

- indicate the maximum playing hours allowed to be played per year to cover the warranty. This concerns every playing hour, all played matches, events and yearly FIFA test results.
- provide a logbook where all event on the turf are clearly registered; the number and type of use and maintenance of the turf in order to fulfil the warranty
- provide a clear maintenance programme
  - weekly or monthly maintenance by ground keepers depending of the hours of use
  - heavy maintenance every six or twelve months
  - maximum hours of play allowed per year
- > provide or recommend the type of maintenance equipment to be used for each type of maintenance work.

More about maintenance "see chapter D Maintenance"
## SAFETY, ENVIRONMENT AND HEALTH CONSIDERATIONS

Football Turf should be manufactured and installed in conformity with national laws and rules concerning environment, health and safety requirements. No turf components should have any impact on the environment (no hazardous components leaching into the soil) and there should not arise any health risks for the users of the Football Turf.

Below you will find some published research conclusions:

## Norwegian Institute for Water Research, 2006

#### Conclusion

The risk assessment shows that the concentration of zinc poses a significant local risk of environmental effects in surface water which receives run-off from artificial turf pitches. In addition, it is predicted that concentrations of alkyl phenols and octal phenol in particular exceed the limits for environmental effects in the scenario which was used (dilution of run-off by a factor of ten in a recipient). The leaching of chemicals from the materials in the artificial turf system is expected to decrease only slowly, so that environmental effects could occur over many years. The total quantities of pollution components which are leached out into water from a normal artificial turf pitch are however relatively small, so that only local effects can be anticipated.

## Norwegian Institute of Public Health and the Radium Hospital Oslo, January 2006 Conclusion

Recycled rubber granulate contains many chemical substances which are potentially harmful to health. The concentrations of these substances are however extremely low, they are only leached from the rubber granulate in very small quantities and they are only present in low concentrations in the hall air. The quantities of this type of substance are consistently lower than in the other types of rubber granulate which are used. The assessment of health risk was therefore based on measurements (concentrations in the rubber granulate and in airborne dust, PM10, and VOC in the hall air) in halls in which recycled rubber granulate is used.

A number of worst case scenarios were prepared which are used in the risk characterisation. These scenarios are based on information concerning the use of the halls (matches and training sessions; frequency and duration); physiological parameters (skin surface area, inhalation volumes during exertion and body weight) and analyses (content in rubber granulate, airborne dust/PM10 and VOC). Exposure calculations were performed for adults, juniors, older children and children based on measurements of VOC, airborne dust, concentrations of chemicals in recycled rubber granulate and leaching from the granulate.

On the basis of estimated exposure values and the doses/concentrations which can cause harmful effects in humans or in animal experiments, it is concluded that the use of artificial turf halls does not cause any elevated health risk. This applies to children, older children, juniors and adults. The estimated Margins of Safety (MOS) also give no cause for concern.

As regards total VOC, higher values were measured than are normally found in homes. Values of up to 200-400 µg/m fall within the normal range for housing. It is concluded that the values which were measured for total VOC do not constitute any elevated health risk but our knowledge of this area is rather inadequate. It is reasonable to assume that the relatively high VOC values could contribute to the hall air being perceived as" poor" without this in itself actually causing any elevated health risk.

As regards allergies, it is concluded that exposure to the low concentrations which were measured does not constitute any elevated risk with respect to the development of contact allergies. It is known that car tyres can contain relatively high concentrations of latex and therefore possibly also latex allergens. Latex is a potent airway allergen, but it would appear that latex in car rubber dust is either less available for uptake and/or deactivated. As no information is available concerning levels of latex in the rubber granulate that is used, it is not possible to assess the risk of developing an airway allergies cannot be entirely eliminated. Studies have been carried out which indicate a link between exposure to phthalates and the development of asthma/allergies. At the present time, it is not possible to carry out a risk assessment in this area because of a lack of available knowledge.

## Federation International de Football Association, Zurich, 12 July 2006

## Open Letter concerning the potential cancer risk from certain granulates infill from artificial turf

As you will be aware both FIFA and UEFA have invested substantial resources in recent years in the development of artificial turf to ensure more people, more often have more opportunities to participate in Football at all levels of the game in a safe environment. Both organisations have both been aware of recent reports that have suggested a potential cancer risk from certain granulate infills from artificial turf.

FIFA and UEFA have investigated this issue and analysed the risk involved. In particular we have reviewed the results of numerous studies into this issue and our findings to date are listed below:

- The list of publications which FIFA and UEFA have scrutinised is given below.
- The studies to date have concluded that "Path's [Polynuclear Aromatic Hydrocarbons] are not released or at most negligibly
  released from tyre abradate" (The University of Dortmund Institute for Environmental Research 1997). Epidemiological studies
  conducted by the Health Effects Institute, The World Health Organisation and other investigators do not implicate tyre wear
  particles in ambient air as contributing to human health effects (respiratory and cardiovascular diseases)
- In general tyre abradate is a much finer particulate than the granules used as infill materials in Football Turf. The research demonstrates that the finer the particles the greater the surface area and higher potential for chemicals to leach out of the rubber.
- The majorities of the studies have been on higher surface area particles and have concluded they are currently acceptable. Therefore the larger granules used in artificial turf will have even less potential for emissions. For example a study undertaken by the Danish Ministry of the Environment concluded that the health risk on children's playgrounds that contained both worn tyres and granulate rubber was insignificant. The available body of research does not substantiate the assumption that cancer resulting from exposure to SBR granulate infill's in artificial turf could potentially occur. For further information of the issue and the risk, please consult the references below.

Prof. Dr. Jiri Dvorak, FIFA

## Italian National Amateurs' League (L.N.D.)

Bearing witness to the disciplinary measures of the Interdepartmental Committee (Ministry of the Environment and the Ministry for Health), the Italian National Amateurs' League (L.N.D.) is forbidding since 2006 all usage of all recycled car type granulates in artificial turf football fields.

## Swiss Federal Office of Sport (FOSPO) Institute, November 2007

### Investigation into the behaviour of synthetic surfaces and artificial turf exposed to natural weather conditions

#### Conclusion

On the basis of the lysimeter field tests (duration of main test from May 2006-May 2007) and the other investigations, the following summary conclusions may be drawn:

Both the lysimeter tests and the eluate tests demonstrated that organic substances are eluted by rainwater in traces, i.e. in very small quantities, from all the surfaces containing rubber granulates (EPDM and recycled rubber, mostly from tyres). Analytically detectable traces substances - compounds which are also analysed in road runoff as a result of tyre abrasion - are dissolved from the surfaces and from the polymer matrix of the granulates in a concentration which falls over the time. For further detailed information's, contact FOSPO in 2532-Magglingen, Switzerland Author: Edwin Müller, Laboratory Dr. Meyer AG, Bern.



### Advice

- > Invite companies with a neutral tender document prepared by a turf expert as no layman (or sometimes even an expert) is able to chose between so many different technical details! The tender document should never be based on a document prepared by a turf producer as he will naturally favour his own construction principles and on turf product!
- > When two or three turf products are pre selected (offers according to the tender criteria) the players should be involved and the final choice between the pre selected products should be left to the players.
- When choosing a turf to be used for UEFA competitions, the price should not be the most important criterion, but rather its footballistic qualities! However if the turf is used for amateur competition or community football, then the price criterion and especially the life term of the turf product may be the most influential criteria.

It is advisable to conclude a warranty contract where the turf manufacturer and the turf installer (eventually even the civil work contractor) are jointly liable and the warranty be linked to the hours of use and the frequency and quality of the maintenance.

The best warranty is a manufacturer / installer contract which links

- the total number of years
- the total hours of use per year
- the type of maintenance
- the retesting of the pitch with a defined minima of footballistic test results
- with the number of years the footballistic gualities are guaranteed.

In the event of any technical or footballistic defect, the turf should be replaced entirely with an identical product by the turf producer or if he cannot supply it, then with a similar product of another turf producer. Always verify national regulations (laws for health issues, security / fire and environment)

## **DESIGN & CONSTRUCTION RECOMMENDATIONS**

As long as the Football Turf fulfils all required test criteria, even with completely different infrastructures and turf characteristics / components, its footballistic qualities are similar to the best natural turf pitches as it has been tested all over Europe.

# Any buyer would like to acquire a Football Turf System with the best qualities turf at the lowest possible price.

Therefore it is recommended to receive the written insurance from the turf manufacturer of the long term technical and footballistic qualities of the, to be installed, Football Turf.

This can be achieved by including into the guaranty of the manufacturer that the installed turf will meet all the required test criteria during a minimum of five years, to be confirmed by a yearly field test report.

The choice of a Football Turf can be based on the price, but certainly more important are

- The long term qualities of the
  - o footballistic criteria,
  - o technical criteria,
- and the warranty.



## PLANNING

Planning procedures must take into account the fact that Football Turf is an overall system that consist of the sub-base (including any under-soil heating and irrigation system) any elastic layer, the Football Turf and its infill (or no infill, depending the turf system). For all Football Turf systems, these components are of equal importance! To be approved for the game of football, a Football Turf playing surface must match the quality of a well-cared-for natural pitch; ref. FIFA Quality Concept. The construction / laying of Football Turf must be planned with great care. Among other things, errors in the construction / installation stage can seriously shorten the working life of a playing surface – with negative consequences in both financial and sporting terms.

Planning procedures must take into account the fact that **Football Turf is an overall system** that could consists of the following elements:

## "infrastructure – soil heating – water sprinkler - elastic layer - turf - infill"

Depending of the Football Turf System, all the components are of equal importance! To be approved for the game of football, a Football Turf playing surface must match the quality of a well-cared-for natural pitch, ref. FIFA Quality Concept.

## CHOICE OF A FOOTBALL TURF EXPERT

Deciding whether to choose natural turf or opt for an artificial alternative has never been a simple affair, and probably never will be. If merely reaching an initial decision seems difficult in itself, implementing the project can become a nightmare. Countless questions need to be answered concerning the following elements of the turf system:

- site
- dimensions
- substructure
- bearing layer
- elastic pad
- turf
- infill
- maintenance
- warranty
- price

Without experience it is difficult to select

- from the wide range of available options.
- a product or system that is just right for specific local conditions,
- or to try and tell and make the choice between quality EPDM rubber granules and coloured granules made from old vehicle tyres (SBR) or PTE and PTU granules,
- or distinguish between polyethylene, polypropylene, nylon fibres,
- or a fibrillated (split), mono tape and mono filament fibres.

It is of course not the wish to imply with these examples that the artificial turf industry could in any way be untrustworthy, nor do we wish to cause discouragement. We would just like to point out that to purchase and supervise the laying of Football Turf systems requires a certain level of expertise.

One could argue that the involvement of an expert will increase the overall cost of a project, but that investment is well worthwhile in the long run. It is an investment in quality, functionality, economy and the life of the Football Turf. Entrusting the planning, selection and construction supervision to a specialist in artificial turf is not only recommended but essential. It is therefore advisable to involve a football turf expert either alone or together with a civil engineer who is familiar with the local conditions.

# The turf expert should be present on site to ensure that all the tasks are carried out correctly and according to specifications:

#### Phase I

Analysis of existing installation (or new stadium project).

Type and intensity of use of the future pitch which will define the type of Football Turf needed

Planning

- Choosing an appropriate infrastructure
- Define the construction period

Phase II

Cost estimate

Phase III

Acceptation of the project

#### Phase IV

- Tender documents
- infrastructure design and quality
- turf material quality
- footballistic requirements

Tender analysis and construction award

#### Phase V

Construction supervision

- infrastructure designed to conform to local conditions and FIFA requirements
- · laying of the turf and its quality control in order to assure a long life

#### Phase VI

Testing the installed turf according to FIFA 2\* requirements; only necessary for a pitch to be used for UEFA competition matches.

## CHOICE OF THE CONSTRUCTION SITE

The choice of the site is obviously limited. However, wherever possible, it is advisable to consider the following aspects:

- Sites, for example next to a forest or near an incineration plant.
- Leaves from trees, meadows, soot from industrial plants and busy roads will render the pitch dirty, thus requiring more maintenance work.
- Heavy pollution can quickly cause the turf to lose its qualities.
- Animals can damage and soil the turf.

The purchaser must take the prevailing climatic conditions into consideration when establishing surface specifications. Note: To assure good installation - quality, the football turf system should be laid at certain temperatures and levels of air humidity (above 10°C and below 70%).



## **GEOTECHNICAL BASE** (infrastructure, drainage and base layer)

The geotechnical base vary from country to country and even from one region to another. Consequently, it would be inappropriate to set up requirements which could not be met all over Europe. The avantage of a well-planned base that has been designed without regard to cost is that it does not have to be rebuilt each time the turf itself is replaced. This involves an investment that pays for itself over a period of two to three turf life cycles of a Football Turf, provided the corresponding precautions have been taken with respect to planning and installation. Cost-restricted (i.e. cheap quality) base construction – for example one involving an infrastructure without any stable base element – will often reduce the life cycle.

It is therefore necessary to establish certain constructional recommendations:

- The infrastructure must be permeable to water, although in hot climates it can be impermeable as this may and advantage (less water consumption for the cooling effect).
- The Football Turf is not the only item of importance as the sub-base is a fundamental aspect of the overall system and demands the same level of quality assurance.



<image>

## Water drainage



Water drainages below the infrastructure and installation of drainage systems on top of a reinforced textile



Drainage installed below the existing excavation level



Installation of a drainage system into a sand base and electronically controlled base levelling



Drainage control pit

Access for the cleaning of the drainage pipes

Installation of a Football turf on top of a roof of a shopping centre



Size and distance between the drainages, depending of the quantity of the local rainfall

## Stable base above the drainages



Crushed stone base





Sand base

## Planie



Surface levelling with fine crushed stone



Control of the evenness of an unbounded / non-stabilised base with an improvised handmade control level



Laying of a geotextile on top of an unstabilised base as protection for the turf backing

## Final geotechnical base / layer

A bitumen asphalt base (or a similar stable construction as a cut back bitumen) does not need to be reconstructed every time the turf is replaced and solid bases can last some decades.



Fine gravel stabilised and bonded with cut-back bitumen, water permeable



Installation of a single, water permeable, asphalt layer



Paver working with an automatic laser levelling device



Heating and rolling the joints to a even level



Verification of the evenness Evenness and compression control



the level differences are too big = unacceptable, to be corrected



Level correction of the asphalt base



Uncompacted asphalt: to be replaced

# When the support of a Football Turf is not level the pitch surface is not acceptable for playing football.



## **Advice**

Experience has shown that an asphalt bases can be a guaranty

- For a more even and durable surface
- > therefore can last at least three turf lifetimes
- > which is equal to an investment in the quality and cost reduction for the future!

## Requirements

- > Water permeability: EN 12616 / ≥ 180 mm/h
- > Evenness: EN 13036 / ≤ 10mm under a 3m straightedge

and ≤ 2mm under a 300mm straightedge

Author's recommendation: ≤ 8 mm under a 4m straightedge

## SOIL HEATING

In regions where cold climatic conditions prevail over a long period of the year, it is recommended that a heating system be built into the sub-base. Some European National Football Associations require a soil heating system for their top division (examples: The Netherland, Norway, and Russia).



Ground heating under a non-stabilised base



Insulation and ground heating installed below a stabilised base



Ground heating installed within a sand base



Ground heating inserted into an elastic pad just below the Football Turf



Final snow melting / removal with the soil heating in action



## **Advice**

If a pitch is intended to be used in the winter months in countries that regularly have freezing conditions, the installation of under-soil heating is highly recommended. If played on in frozen conditions the Football Turf may be too hard / frozen and the required shock absorption may not be achieved.

## WATER SPRINKLER

In principal there is no need for watering the pitch. However the pile fibres are smoother when humid. Therefore the professional players prefer to play on wet turf the turf. This can be achieved by wetting the turf before

- the warm-up,
- the start of the game
- at half time.



Installation of the sprinkler system





Extreme strong water canon; four pieces per pitch

Design of six sprinklers per pitch



The sprinkler should always be placed outside of the pitch; at least not within the playing lines





Protection of the cover outside of playing lines

Cover inside of the pitch = dangerous for the players



Acceptable solution of water sprinkler within the pitch as the sprinkler head is very small and



## **Advice**

- > Water sprinkler should be installed outside of the playing field, not within the pitch (safety of the player)
- It is a fact that the water sprinkling could only be similar to a drizzle rain just too wet/humid the turf fibres. A big quantity of water is not necessary but the uniformity of the distribution on the totality of the pitch is important.
- For professional matches, the players prefer the turf fibres to be wet/humid before the warm-up session, before the match and again during the half time.

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## SHOCK PAD

It is recommended to install an elastic pad as part of the Football Turf, but is not a requirement. It is up to the turf manufacturer to propose a Football Turf system with or without an elastic pad. There is no specific recommendation regarding the quality or thickness of the elastic pad.



Installation of an in-situ elastic pad and close-up (on top of a bitumen stabilised base)



Prefabricated elastic pads in rolls or as puzzle

### **Advice**

An elastic pad (prefabricated or installed in-situ) offers the following advantages:

- Provides additional comfort to players
- A published medical study indicates that a turf system with an elastic pad reduces the number of injuries
- An elastic layer is helps to increase the turf lifetime
- An elastic layer can usually be re-used several turf lifetimes, particularly if installed in situ.

The use of an elastic pad is therefore highly recommended in order to maintain the long-term functions of Football Turf, but it is the responsibility of the turf producers to assure the footballistic and technical qualities of the turf system over the years, irrespective of the presence of an elastic pad.

## FOOTBALL TURF

Installation companies generally represent the Football Turf manufacturers as most manufacturers do not install their products themselves. Some of the installation companies also construct the sub-base, drainage system and supporting infrastructure themselves or have it executed by a sub-contractor.

- Experience suggests installation companies with long-term relationships with their manufacturers will have a greater understanding of the surfaces they offer.
- > Experienced installation companies generally represent the turf manufacturers with a performance guarantee.
- If possible, it is advisable to award the supply and installation of the base construction, the turf and the guaranty of the turf product to a single entity (local infrastructure Construction Company, turf manufacturer, and recognised turf installer).



Installation of a Football Turf on an unbounded infrastructure, but on top of a reinforced textile



Laying the turf onto a bonded infrastructure or an elastic pad

## Turf joints and line markings

The joints can be either glued or sewed, however a minimum joint strength is required. If they are glued a minimum width of the joint tape is recommended.



Cutting the irregular or damaged edge of the turf rolls and preparation for the gluing of the turf joints



Cutting the turf for the line markings and gluing the joints of the carpet and the markings



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### Turf joints



Quality control of the joints strength holding the carpet rolls / line markings together



Loose joints without glue or and glue which was already to dry when the carpet was applied



Open joints are unacceptable, shortens the live time and are dangerous for the players





Good and acceptable joint quality

good gluing quality but joints spaced too far apart

Sewn turf joints



Note: In this system the turf joints are sewn, but the line marking are glued.

## **Painted lines**



When the turf joints are sewn, it is recommended to paint the lines

## **INFILL MATERIAL** (if any)



First layer with dried quartz sand; second layer with synthetic granules Installation of the infill material with speed quantity controlled machines



Application of the infill material with machines initially not conceived for this type of work...



...which leads to even thicknesses difficult to be controlled and too much infill in one go with many turf fibres imprisoned below the infill.



### Causes of unacceptable infill installations

- granular size
- granular composition
- applied in humid conditions
- irregular infill thickness
- infill applied at ones in too big qualities (mostly in order to gain installation time)

#### Main observed problems

- there will always be some fibres buried below the infill (max. 10% of all the fibres can be acceptable), but
- many times it can be observed that from 20 up to 40% of the turf fibres are buried below the infill!
- Buried and bend down turf fibres can stop the players shoe with its studs to slide through the turf and can lead to injuries to the players





Unacceptable joint quality of a newly installed turf; far too dangerous for the players.

## **Advice**

## **Turf joints**

It is important to use cluing tapes that do not allow the glue to be in contact with the elastic layer. The standard width of the gluing tape should be 30cm and 50cm when used to for the line markings. There are examples when

- turf joints are opening because the turf is glued to the ground
- every joint sticks to the elastic layer, making it necessary to replace the pad when renewing the Football Turf.

Football Turf should not be installed with temperatures below 10°C and above 50°C, or if it rains and the turf is wet / humid otherwise the quality / strength of the turf joints can not be assured.

### INFILL

When the turf with infill, the infill should

- not be applied when the turf is wet / humid otherwise it may lay on top instead between the fibres!
- be applied in layers of 5mm in order to assure that very few fibres will be trapped below the infill as later on they can most of the time not be straighten again.

When too many turf fibres are imprisoned under the infill, they could be very dangerous to the player as the studs may be trapped within theses fibres and cause injuries to ankles and knees.

Last not least: Football Turf should not only have the best footballistic criteria, but it also has to look like natural grass!

Before start with filling the turf, all joint should be controlled for their quality.

## **PITCH SURROUNDING & FENCES**

Installation of curb stones and path ways and fences around the pitch





Handrails and special finish for drainage covers outside of the playing surface



Turf finish in competition areas

## **Advice**

In stadia used for UEFA competition, the security zone between the markings of the pitch and the first obstacle should largely exceed any national requirements, which mean between 5 to 6m.

## MAINTENANCE

The purpose of this guide is to show what needs to be done to conserve the aesthetic qualities and more importantly, the technical and playing characteristics of your new pitch. If a pitch is poorly maintained, its performance declines and its life-span are shortened. The pitch may cease to meet the footballistic criteria and later even at worst the safety norms, leading to more frequent injuries. There is a general, but erroneous, opinion that once a Football Turf surface has been laid the grounds man can go home. This impression is not only misleading, but also dangerous; however with each new generation of turf, and this since over 30 years, this belief is repeated.

It is true that the construction of Football Turf supposes numerous cost savings, especially by comparison with natural turf, as there is no more need to spread fertiliser or insecticide, the turf no longer requires regular watering or lawn mowing, and in most Football Turf systems there is not even a need to paint markings.

A suitable plan of maintenance increases the live span of your turf pitch and keeps the footballistic characteristics constant for a longer period. Pollution is fatal to every Football Turf. Debris, leaves and small twigs, but also small particles like moss, algae and fine grains of sand can compact the top layer and reduce the shock absorbency, the porosity, and the live span and increase the susceptibility to injuries.

#### The turf manufacturer / installer should:

- Indicate the maximum playing hours allowed to be played per year to cover the warranty. This concerns every playing hour, all played matches, events and yearly FIFA test results.
- All this elements should be registered in the provided logbook which indicates clearly the number and type of use and maintenance of the turf in order to fulfil the warranty.
- Provide a clear maintenance programme
- o weekly or monthly maintenance by ground keepers depending of the hours of use
- o heavy maintenance every six or twelve months
- o maximum hours of play allowed per year
- Indicate or provide the type of maintenance equipment to be used for each type of maintenance work.

## Log-book

The logbook which contains the frequency and type of use and maintenance of the pitch has to be an integral part of the warranty requirements.

- standard maintenance per week
- heavy maintenance every 6 months to once a year
- the maximum hours played according to the guaranty
- all hours played have to be noted in the logbook
- all non sporting events.

Playing hours registration		Month		Febr	March					April					
and maintenance schedule		Week	10	13						14			Ļ	I	
Object	Type of activities	Manufacturer's requirements	Day		27	28	29	30	31	1	2	3	4	5	Total
Playing hours	daily playing hours registration'	all training and playing hours			2	8	8	4	2	2	4	3	3	2	82
	brush the surface every 20 playing hours		urs					1							1
	brush, clean and add infill*	weekly			1										1
Pitch	brush, clean and add infill**	every month										1			1
	deep infill cleaning, brushing	every 4 months & after every		nse											0
	and if necessary add infill	multifunctional use												v	
Penalty	add infill	every 20 playing hours		н С	1			1				1			3
Corner	add infill	every 40 playing hours		oite				1							1
5m area	brush thoroughly	every 40 playing hours		0				1							1
16m area	brush thoroughly	every month		2								1			1
Sprinkler	clean	every month										1			1
Joints-penalty	check and glue open joints	every months										1			
Multifunctional	light turf covering	(Specify weight/sort of cover)													
use	heavy turf covering	(Specify weight/sort of cover)													
FIFA 2 Star Testing, if required by the organisation		every year before the season	ne new												

#### \*Registration

In a match of 11 players against another team of 11 players; record every hour of play

One full team training with more than 11 players; record every hour of training

Two matches of juniors playing across the pitch, record the double playing hour

**Note:** This is an example of a log-book for the registration of all events being held on the Football Turf. It is recommended that the Football Turf Producer proposes similar log-books to his clients, each adapted to the need of the proposed turf product

**Important:** The hours of use, the type and maintenance intensity should be related to the years of warranty (footballistic quality and quality of the turf material). Footballistic warranty: maintaining the footballistic qualities (play related quality) over a defined period

## Necessary maintenance actions and observed problems



Removal of the leaves in autumn, brushing the infill after heavy rains



Replacing missing penalty point



Replace the missing infill at much used spots





After a snow shower and its removal in Norway

Future owners of artificial football turf should heed the following advice:

As with its natural counterpart, the areas of Football Turf that are most likely to show the first signs of wear are those located where the majority of the action takes place, that is of course the area around the goal mouth and the penalty area.

For this reason, these areas are liable to lose their original quality extremely fast and will fail to meet FIFA criteria after a certain time. As worn patches cannot be replaced with "fresh" turf as easily as on a natural pitch, ground staff are advised to take special care of these parts of the playing surface.

The partial replacement of used turf is in any case possible, especially with a stabilised infrastructure (Note: the problem with an unstabilised infrastructure is how to maintain the surface perfectly level after the replacement of an area of turf).

#### MAINTENANCE SCHEDULE

The manufacturer/supplier/Installer should be asked to provide a "major clean-up / maintenance programme" at the pitch owner's expense once or twice a year over a warranty period, or the maintenance is made by the personnel of the turf owner on the basis of a logbook provided by the turf producer, contractually agreed upon at the time the turf is ordered.

- Major clean-up: When the pitch is dry the infill material is extracted from the turf system using a suitable sweeping and suction machine. The main requirement for this important cleaning work is that the surface of the turf should be "open", so that the brushes in the machine can draw up the infill material.
- After the infill material has been picked up, the machine separates out all the fine particles (fibres, rubber, shoe wear and sand) and the remaining infill materials are then brushed back into the turf system.

#### DAILY AND WEEKLY MAINTENANCE RECOMMENDATIONS

- The infill material must be kept (depending on the football turf system) to approx. 10mm to 20mm under the fibre tips and brushed regularly to keep it even.
- The goal mouth, penalty spot and corner areas must be checked to ensure that the rubber infill is even and to the correct level. The infill material in these areas suffers the most displacement in every game or training session. Only if these areas are permanently and correctly infilled do they offer optimum protection and therefore a long service life for the football pitch.
- Displaced infill material must therefore be replaced continuously, which means that the ground staff must have an adequate supply of infill material at all times.









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- Only by regular dragging, drag-matting, brushing, aspiration etc. can the level of infill material be kept at the prescribed level and the football turf system in perfect condition. Note: The infill material also protects the fibres!
- After every xxx hours of use (see warranty of the turf manufacturer), the pitch must be dragged or drag-matted, brushed and aspirated. If the pitch is used more frequently, the maintenance schedule has to be increased to maintain its performance characteristics in the long term.
- The regular drag-matting of the so-called edge zones (for example the outside areas) is also important to ensure that natural grass, moss and weeds do not start to grow there. Plants will only start to grow if you fail to maintain certain areas. Any existing vegetation growth must be removed mechanically (tear the plants out, cut them or spray them).
- In extreme circumstances, weed killer (in the appropriate dilution) may be used for specific areas. To prevent the large - scale migration of vegetation into the edge areas, it is advisable to cut back the vegetation outside the edge zones periodically.
- Remove surface dirt on a regular basis. Remove leaves, twigs, etc. immediately (use a leaf blower if necessary).
- After the initial phase (three to four months after installation depending on the number of play hours), the infill will settle/compact. Check the infill level of the system and redress with new infill where necessary.
- Wear losses (fine particles) must be removed by thorough cleaning.
- Dirt such as sand, topsoil and grass cuttings from neighbouring natural grass pitches should be removed immediately using sweeping machines where necessary.
- Sharp objects (stones, shards of glass, etc.) must be removed immediately.
- Chewing gum waste can be removed easily after it has been iced with refrigerant spray.
- Oil and fuel must be soaked up as quickly as possible using sand or sawdust and then removed in full.
- Other contaminants can be scraped off the surface by shovel. Residual animal faeces can be treated with vinegar and water.
- In autumn, fallen leaves must be thoroughly removed from the turf. If not, they will decompose into mulch, favouring growth of moss and eventually even weeds. As a preventive measure, annual herbicidal treatment is strongly recommended. It is much easier to avoid the appearance of weeds than to try and eliminate them once they have been allowed to take root.
- Snow removal :
  - In principle when clearing snow, a layer of approx. 2-3 cm of snow should be left, so as to protect the artificial turf from mechanical damage. Partially iced pitch surfaces can be thawed using conventional "winter salt" (please consult your local department of the environment).
  - Note: Snow removal with a plough could easily damage the turf, either by tearing it apart or moving parts of the turf, often seen as "line dancing". Moving part of the turf appears either when the snow is wet or if it is frozen and sticks to the fibres. It is also advisable to use the plough alongside the joints, not from one goal line to the other.









### INSTRUCTIONS FOR PREVENTING DAMAGE

- Follow the aftercare and maintenance instructions of the turf supplier.
- When operating maintenance equipment on the surface, excessive braking, turning, etc... that could damage the synthetic turf fibres should be avoided.
- Do not drive on the pitch without the prior consent of the manufacturer.
- Do not apply any high static loads to the system.
- Proceed with care when clearing snow.
- Do not use any chemicals that may damage the surface.
- Do not light fires on the turf system.
- Do not drive motor cars on the turf.
- Ideally a turf should be fenced up to 1m (hand rail) to avoid the access to cats, dogs etc...
- It is advisable with a fence around the pitch to avoid unauthorized motor vehicles and bikes on the pitch.

### **RECOMMENDED MAINTENANCE EQUIPMENT**

- Drag brushes and drag mats and nets.
- Hand-held equipment such as a hard road-sweeping brush for brushing the infill material into the turf system.
- Sweeping machines
  - Manually-operated or elf-propelled hourly capacity of around 1,000 m<sup>2</sup>
  - Sweeping and suction machine with an hourly capacity of up to 3,000m<sup>2</sup>.



As with virtually everything else, Football Turf still requires care and maintenance and must not under any circumstances are allowed to fall into disrepair.

A lack, or indeed a total absence, of proper maintenance will inevitably shorten the service life of the turf and cause its playing surface to deteriorate.

The warranty should not mainly concern the material quality, but concern especially the playing characteristics (footballistic quality).

This means a warranty should be a mixture of

- > the maximum hours of play per year,
- the quality and frequency of maintenance and
- > a footballistic quality level over a defined time.

### Some maintenance equipment manufacturer

SMG	Germany
Hörger Maschienen	Germany
Greensgroomer	USA
Yvelines Motoculture	France
Redexim	Netherlands

Note: this list will never be exhaustive as the market expands rapidly





## APPENDIX

## **Competition regulations**

## IFAB

INTERNATIONAL FOOTBALL ASSOCIATION BOARD allows the use of artificial turf in its competitions and this decision in 2004 has been integrated into the 'Laws of the Game'.

## **FIFA**

#### **FIFA RECOMMENDED 1 STAR**

- FIFA allows the use of FIFA RECOMMENDED 1 STAR Turf for all its qualification matches.
- The FIFA Quality Concept for Football Turf set quality standards and criteria for artificial turf surfaces worldwide. Part of the process is that all products must undergo a series of laboratory and field tests.
- If they meet the rigorous testing standards published on March 1<sup>st</sup>, 2005, a FIFA RECOMMENDED 1 STAR or FIFA RECOMMENDED 2 STAR certificate is awarded.

#### **FIFA RECOMMENDED 2 STARS**

- An annual field test must be undertaken to ensure it still meets the criteria to the original test.
- If the field is retested and does not meet the FIFA RECOMMENDED 2 STAR criteria but meets the FIFA RECOMMENDED 1 STAR test, the field becomes FIFA RECOMMENDED 1 STAR for 3 years.
- If the field is retested and does not meet either the FIFA RECOMMENDED 2 STAR or 1 STAR requirement, the certificate for the field becomes revoked.
- If a 2 STAR field is not retested, it automatically becomes a FIFA RECOMMENDED 1 STAR installation for the next two years.

#### IATS

International Artificial Turf Standard, identical requirements then FIFA 1 Star, but without any licence requirement.

## UEFA

#### The UEFA competition regulations are edited new each year and refer to:

- Technical Recommendations and Requirements for the Construction or Modernisation of Football Stadium, and
- Regulations of the UEFA Champions League

The regulations require a playing field in perfect playing condition:

- > absolutely smooth and level
- > with an efficient watering system
- > equipped with a underground heating system in cold climates
- > with a recommended field area of 120m x 80m
- with playing dimensions of 105m x 68m
- > with a natural grass cover or an artificial turf\*

#### Article 7 – Playing surface

<sup>1</sup> The stadium must be equipped with either a natural playing surface or a Football Turf (artificial turf).

<sup>2</sup> A Football Turf must meet all of the following conditions:

- a) it must have been granted the required FIFA licence, which can only be delivered after the turf in question has been tested by a FIFA-accredited laboratory as meeting the FIFA quality standards for artificial turf;
- b) it must meet all the requirements of the national legislation in force;
- c) its surface must be green.

#### **UEFA Cup and UEFA Champions League competitions**

If the cover is a Football Turf, intended to be used for an UEFA competition, then the pitch has to be certified according to the FIFA Quality Concept 2 Star system and must show a valid test certificate (validity: maximum 12 months).

#### UEFA competitions for Under-17, Under-19, Under-21 and women

Type of test certificate depending of the UEFA product manager; minimum according to IATS.

## **National Competition Regulations**

## **Example Switzerland**

### Field of play

- The field of play must be absolutely smooth and level.
- It must be equipped with a drainage system to eliminate the possibility of its becoming unplayable due to flooding.

• It must comply with the following dimensions and requirements

Stadium category	Length	Width	Additional requirements					
Super league	105m	69m						
Challenge league	105111	0011	Slopes:					
1st league	100m	64m	Length: max. 0.5%					
Regional leagues			Width: max 1%	Proportionally maximum 10% less				

• The stadium must be equipped with either a natural playing surface or a Football Turf (artificial turf).

Stadium category	tested according	Additional requirement				
Super league	FIFA 2 Star	FIEA cortificato				
Challenge league	min. FIFA 1Star	TH A Certificate				
1st league	min. FIFA 1Star	No FIFA certificate required, but tested by a ISO 17025 accredited laboratory				
Regional leagues	min. EN 15330	Tested by a ISO 17025 accredited laboratory				



## DIMENSIONS OF THE FIELD OF PLAY

#### Note:

The security zone for UEFA is minimum 3m, however this depend national regulation.

In addition, it is recommended to add a stabilised 3m surrounding between the security zone and the spectators.

Elements such as filed markings goalpost etc..., have to be according to the laws of the game and the local competition regulation.

## Use of Football Turf for other sports- and non sporting events

### FOOTBALL TURF HAS BEEN SPECIFICALLY DEVELOPED FOR THE USE OF FOOTBALL.

A Football Turf can, however, also be used for other sports or even for non-sporting events.

UEFA made, in 2003, some investigations as in many main stadia athletic events may be held. The results of this investigation are described below, However, any manufacturer / installer is responsible and should always state in the clients warranty / maintenance logbook, if any, which, how and how many times non footballistic events can be held on the pitch.

#### OTHER BALL SPORTS

Rugby

Possible, refer to the IRB regulations.

#### **American Football**

Possible, but so far there are no regulations.

#### **Field hockey**

The game is difficult with a lot of loose infill or too high fibres.

These turfs are not allowed for competitions. However, the Equipment Committee from the World Hockey may review the pitch standards by the end of 2006; refer to the IHF regulations.

#### Tennis, Volleyball, Basketball, etc...

Not possible because of a too low ball rebound.

#### ATHLETIC FIELD EVENTS

#### Running, warm-up:

Very good; shock absorption similar to that of a track with woodchips.

#### Throwing events

In stadia with athletics facilities, the pitch is normally used for throwing events. This can however damage the surface. In order to determine the consequences of such use, UEFA has carried out a number of trials on Football Turf installed on top of asphalt layer, with and without an In-Situ elastic layer.

#### Shot-put

Shot-put events do not seriously damage this type of Football Turf. The accuracy of the length measurement is max. 2 cm.



#### Discus

Discus events cause no serious damage to this type of Football Turf. The accuracy of the length measurement is max. 2 cm.

#### \* Hammer

The impact of the hammer can result in damage to or deformation of the base layers. As on natural turf main pitches, hammer throwing is not allowed on Football Turf!

#### Javelin

### Competition javelin

No competition should be held on a Football turf without an elastic pad as the point of the javelin may be damaged and moreover not hold in the turf so that no distance reading can be made.

With a Football Turf with an elastic layer, the tip of a javelin penetrates the Football Turf and may remain stuck in the in-situ elastic layer. Each throw tears the backing of the Football Turf over 1-2 cm.

Therefore a Football Turf in which an in-situ elastic layer or ET layer is part of the system may be used occasionally and strictly for competitions, as the tears will be limited in number and they will close again when the javelin is removed. Should any pitch be used for this event, the manufacturer should deliver a special written permission in order to fulfil the warranty obligations.





## Training javelin with a rubber point

This type of javelin may be used without damages. It is important to note, that in each situation, a test should be executed as not all Football Turf do have the same thickness and technical characteristics.


#### MULTIPLE SPORTS and NON-SPORTING USES

Football turf may be used for non-sporting events. However, it should be adequately protected in order to avoid any change in the material and footballistic qualities of the turf and expenses associated with dirt removal.

Should a pitch be used for this type of events, the manufacturer should deliver a special written permission in order to fulfil the warranty obligations, before any heavy duty equipment is put on the turf, in order to avoid load - related damages.



FOOTBALL TURF www.sportfloor.ch

### Example of a tender document

In every region of Europe the soil and atmospheric condition varies a lot. The following tender document sample is based on general conditions found in Switzerland. Therefore on every new site, the conditions may vary and impose other construction requirements.

Even when the turf product has undergone the strident FIFA quality check, the Football Turf is not the only item of importance. Without a stable geotechnical base, which is a fundamental aspect of the overall system and demands the same level of quality assurance as the turf, the overall systems live time will be shorten.

The Football Turf producer should confirm that the turf installer is an approved installer experienced with the product.

TENDER CONDITIONS	Note: this document is a sample and has to be adjusted, modified according to local soil conditions.		
PLAYING AREA	105 m x 68 m		
SAFETY AREA	111 m x 74 m Safety area according to national requirements or min. 3m on each side of the playing area.		
TOTAL SURFACE	3214 m2		
ACCESS AREA	Recommended width: 3m		
SLOPE	If the sub base is well drained the slope can be 0%, otherwise 0% - 0.8%		
FIRE REGULATIONS	If the pitch may be used as escape exit; Join safety test certificate for the turf and infill material		
ENVIRONMENT REGULATIONS	According to National requirements -recommendations; join test certificate		
	Tenders should supply a guaranteed Defect Liability Period that shall commence on the day of the completion of the Turf installation.		
	The period shall run for two years from the date of completion for all materials, workmanship and performance for the football pitch and all associated ancillary works.		
	All defects of materials, workmanship and performance shall be made good at the expense of the contractor that guarantees the Defect Liability Period.		
DEFECTS LIABILITY PERIOD	The tender shall undertake under the written guarantee to make good within 14 days of notification in writing, any seam or edging failure.		
	The tender shall further guarantee that all repairs will be carried out within not more than 28 days (except as previously stated) from the receipt of notice in writing that, repairs under guarantee are required.		
	Repairs shall be carried out with identical materials and to an identical specification to those of the original installation and at time so as not to interfere with the planned usage of the artificial grass football pitch.		
MAINTENANCE SCHEDULE - CONTRACT	Supply a logbook for the entire warranty period. Provide detailed maintenance schedule for proposed artificial grass surface for a minimum of five years (same period of product guarantee) and provide solution for implementation of maintenance schedule.		
WARRANTY	Not withstanding the obligation under the Defects Liability Period, the tender shall further provide guarantee that after a minimum of five years of service and/or 10'000 hours of play, the properties of the Football pitch shall still fulfil the FIFA 2Star criteria. The properties of the Football Turf will be tested and verified on site at every end of the year during 5 years by a FIFA accredited testing institute. The cost for testing shall be borne by the contractor.		
	The tender shall be jointly liable with the turf producer and its approved installer.		
	No sub contracting work is permitted except written go ahead by the purchaser.		
WORKMANSHIP	The tender has to provide site samples (turf / infill / elastic layer) and have all construction phases recorded in daily/weekly reports containing all decisions made during the construction process (minutes of meeting, photos, permanent hygrometry measurements, weather reports, etc).		
	The whole of the workmanship necessary for the execution of the works shall be of best quality, in accordance with the current relevant National Codes (Civil Engineering) of Practice, executed by workers who are appropriately careful, capable and skilled in the work they are executing.		

	PRELIMINARY WORK				
1	Design	Allow for the design and drawings.			
2	Site Investigation	Geometric and geotechnical survey.			
3	Surface Preparation	Safe removal of unsuitable earth material.			
4	Preliminaries	Allow for the insurance of works, and of all materials plant and equipment on the site.			
5	Site Establishment	Allow for general site establishment.			
6	Plant to and from Site	Allow for all necessary plant and equipment to and from site.			
7	Site Accommodation	modation If required allow for the provision of a safe and secure storage facilities for the duration of the contract.			
8	Setting Out	Allow for the setting out of the works and for the provision of such.			
9	Supervision	Allow for the employment of a competent supervisor for the duration of the contract.			
10	Road Cleaning	Allow for keeping access roads and public highways clean and free from construction debris during and on completion of contract.			
11	Site Access	Allow for forming access to site suitable for delivery of all materials to be maintained for the contract duration and reinstated upon completion.			
12	Sign Boards and Vehicle Management	If required allow for provision and erection of site contract sign boards and vehicle management boards.			
13	Protection of Public and Works	Allow for the provision of adequate protection to the public and the works and include for such watching and lighting as is required for the duration of the contract.			

	EARTHWORKS AND SU	B-BASE			
100	Demolition	Demolition of existing infrastructure (buildings, fences, goalpost, etc)			
110	Top soil	Excavation and removal of the top soil			
120	Earthwork	Excavation to the required depth (depth: below the frost penetration and or to assure the required bearing capacity)			
130	Sub-grade	Compaction of the sub-grade, slope according to local requirements			
140	Re-Grade existing Sub- Base	Repair and re-grade existing, water permeable, sub-base work as required by proposed Football Turf system			
150	Geotextile	Install a Geotextile over the entire surface and below the drainages			
160	Sub-base	Crushed rock aggregates, water permeable; sieve gauge 02 / 11 – 02 / 16mm; thickness: 30cm to 100cm depending on bearing capacity and level of frost penetration,			
170	Top levelling	Fine crushed rock aggregates, water permeable; sieve gauge 02 / 06mm, average thickness: 5cm			
180	Load bearing capacity	Bearing capacity without any deformation Crushed stone base and top levelling: min. 40 / 45 N/mm2			

	DRAINAGES	
200	Investigate existing pipes	Carry out investigative work on existing drainages and allow for incorporation of any existing drainage into new system.
210	New drainages	Drainage pipes installed below the level of frost penetration. Concrete drainages, diameter: 60 mm to 120 mm including all connections according to the local weather conditions.
		Space between parallel laid pipes: every 4 to 12 meters according to the local conditions
220	Perimeter and collector drains	Concrete perimeter drains installed length way to the field, dimensions according to the local weather conditions
230	Connection to existing drainages	Manhole and access to the existing drainage system outside of the pitch
240	Drainage end-caps	End-caps for inspection and cleaning of the drainage system
250	Perimeter drainage	Surface drainage at the low side of the pitch (if any slope, in general not necessary)

	BEARING LAYER / WATER SPRINKLERS / SOIL HEATING		
300	BEARING LAYER		
300	Macadam Base	Single layer of water-permeable bituminous mortar base thickness: 40/50 mm; sieve gauge: 02 / 11 mm. Note: a macadam base is the ideal foundation, which will last several lifetimes of a Football Turf without any renovation!	
301	or Bituminous asphalt penetration layer	Thickness: 20/25 mm; sieve gauge: 02 / 06 mm	
302	or ET elastic layer	Gravel and rubber mixture); thickness: 20 /35 mm	
310	Water permeability	Porosity min. 15% (Countries with hot climate : possibility to install an impervious bearing layer)	
320	Laser graded	Installation with an electronically-controlled levelling system	
330	Load bearing capacity	Single asphalt wearing course or asphalt penetration layer: min. 60 / 70 N/mm2.	
340		To comply with FIFA 2* construction requirement	
341	Tolerance of bearing layer	max. 8 mm under a 3 meter straight edge.	
400	CURB STONES	Install any pitch curbing as required by proposed artificial grass surface. Note: The artificial grass should not be more than 20 mm above the curb	
500	WATER SPRINKLER	Highly recommended for countries with a hot climate and for pitches used for professional matches	
600	SOIL HEATING	Recommended in cold climates or in accordance to national requirements	
610	Stabilised base	Soil heating within a sand layer	
620	Elastic bearing layer	Soil heating below or within the elastic layer	
630	Bituminous asphalt base	Soil heating within or below the stabilisation layer	
640	Insulation	Insulation below the heating pipes	

	FIFA 2Star Footbal	ll Turf
700	SHOCK PAD	Allow for a shock pad, if part of the tested FIFA 2* turf system. If any, recommended shock absorption factor, min. 50%
710	Prefabricated pad	Loosely installed mats or rolls - in southern countries: have the ability to retain water - in Nordic countries: should not freeze and retain is shock absorbency
720	In - Situ layer	Fixed /glued onto the bearing layer
730	ET - layer	Installed with a double function: bearing and elastic layer
800	FOOTBALL TURF	Supply and install Football Turf: according to the FIFA 2* requirements Name: Type: Code: FIFA certified no:
801		Pile height of the turf fibres, in mm
802		Stretched pile length (double length), in mm
803	Turf fibres	Free length of fibres on top of the infill, in mm
804		Type of fibres, chemical composition
805		Type and number of fibres, per stitch
806	Number of stitches, per m2	
810		Basic layer, 90% round and fire dried quartz sand, kg/m2, heightmm
811		Green or brown TPE, TPU or EPDM granules, kg/m2 andmm
812	111111	Total height of the infill material: mm
813		Free fibre length above the infill: mm

820	Line markings	Line markings as per Laws of the Game (International Football Association Board). Marked playing surface of exactly 105m x 68m. When possible, lines should be tufted into the turf. Should the seams be sewn, the lines have to be painted. In this case not any turf cutting is permitted.		
830		Shall maintain a continuous surface that does not impair playing performance. All joints shall be flush with the finished surface.		
831	Joints	Impermeable joint tapes: width 30cm; including line markings: width 50cm		
832		The integrity of all seams and edges shall be retained. There shall be no failure of bonds or stitching at any point. The space between the seams/joints shall not be more than 10mm.		
840	Maintenance after 2 to 3 months	Refill infill material to its final height, before testing according to FIFA 2Star		
850	FIFA 2* test	<ul> <li>Test by a FIFA accredited test institute</li> <li>Testing according to the turf within 3 months after the installation</li> <li>Re-testing every 12 month during the next 5 years of the warranty time</li> </ul>		

	EQUIPMENT		
900	GOAL POSTS	Supply and erect safe football goalposts complete with nets and ground sockets, as per Laws of the Game	
910	FLAG POSTS	Supply and erect safe, freestanding flag posts complete with set of flags and ground sockets, as per Laws of the Game	
920	SUBSTITUTES BENCHES	Supply 2 rows of benches including cover/roof	
930	HAND RAILING	Installation of a hand railing at the edge of the security zone; height 110cm	
940	MAINTENANCE	Supply and delivery of maintenance equipment for the yearly heavy maintenance work	
941	EQUIPMENT Daily and weekly maintenance by the ground keeper	Allow for maintenance training	
943	Maintenance by the turf producer	Yearly heavy maintenance including the supply of the necessary additional infill material	
950	FENCING Perimeter fencing	Mesh size mm Heightm	
951	Fencing behind the goal	Mesh size mm Height m	
953	Gates	3m x 3m and door 1m x 2.20m	
960	PATHWAYS ACCESS	Access area around the pitch: width: 3m asphalt base incl. curb stone	
970	ARTIFICIAL LIGHTING Existing lighting	Service and repair existing flood lighting system according to the UEFA regulations	
971		Mast height, m	
972		Lamps,lux	
973		Mast foundations	
974	New lighting	Trenches	
975	_	Electrical distribution	
976	4	Switches	
977		Casings etc.	

### **Advice**

Tender documents should be neutral not prepared by a turf producer/installer.

When two or three turf products have been pre-selected, it is recommended that the club/players be involved in the selection of the final product.

When choosing a turf for UEFA competitions, the footballistic qualities should be the most important criteria not the price.

Always ensure that the turf system complies with national regulations (health, safety and environment)

## Examples of a cost estimates

### (Prices base on a construction in Switzerland, 2005)

#### Investment and running cost calculation

- Land acquisition ۶
- ۶ The infrastructure should in the average last three life cycles of a turf, a minimum of 30 years
- If a In-situ elastic pad is installed, it should at last minimum two life cycles ≻
- The turf carpet should have an average life time of 12 years (Note that based on the state of the art 2006, ≻ the footballistic criteria will not last this long)
- > Daily maintenance, over an average life cycle of 12 years
- Infill material, over an average life cycle of 12 years
   Maintenance equipment during an average of 12 years
   Testing cost according to the FIFA 2 Star Quality Concept
- - within 3 months of the installation •
  - retesting every year during the next 5 years of the warranty time

Note: The investment for heavy maintenance equipment always pays off for a turf owner.

INSTALLATION OF A FIFA 2STAR FOOTBALL TURF	Euro
SUMMARY Playing dimensions: 105 x 68 m Turf surface including surroundings: 8200m2	
INSTALLATION AND PREPARATORY WORKS	20 000,00
EARTH WORK	140 000,00
DRAINAGES AND RUN OFF	40 000,00
<b>BASE LAYER</b> Crushed stone, thickness about 450 mm Fine levelling, thickness 50 mm One layer of water permeable bituminous wearing course, 40 to 50 mm	270 000,00
SOIL HEATING	160 000.00
FOOTBALL TURF In-situ elastic pad, min. 50% shock absorption Football Turf FIFA 2 Star with 20mm green TPU infill	100 000,00 320 000.00
EQUIPMENT	10 000,00
NEW FENCING AND HAND RAIL	60 000,00
SURROUNDING WORKS	10 000,00
TOTAL BRUT	1 130 000,00
PROJECT MANAGEMENT AND QUALITY CONTROL	60 000,00
MISCELLANEOUS	20 000,00
VAT: 7.6%	90 000,00
TOTAL	€ 1 300 000,00

### NATURAL GRASS VS. FOOTBALL TURF

COST PER PLAYING HOURS OVER A LIFE TIME OF 30 YEARS	NATURAL GRASS	FOOTBALL TURF	
INITIAL CONSTRUCTION COST	500 000.00	1 300 000.00	
<b>RESURFACING AFTER 15 YEARS</b> One time the natural turf after 15 years; Two times the Football Turf: after 10 and 20 years	150 000.00	1 000 000.00	
MAINTENANCE COST during 30 years: per year 60'000 / 10'000	1 800 000.00	300 000.00	
TOTAL COST AFTER 30 YEARS	2 450 000.00	2 600 000.00	
COST PER PLAYING HOURS Calculation base on 700 / 1500 hours per year	117.00	58.00	

Yearly maintenance cost	Own maintenance	Maintenance by the turf installer	
Investment for small maintenance equipment € 5'000 during 15 years	not applicable	340.00	
Investment for a heavy maintenance machine € 50'000 over 15 years	3'400.00	not applicable	
Heavy maintenance by the turf installer € 5'000 2 x per year	not applicable	10'000.00	
Heavy maintenance by the turf owner's staff € 40,10 x per year, 4 hours	1'600.00	not applicable	
Weekly maintenance by the turf owner's staff € 40, 50 weeks, 2 hours € 40, 42 weeks, 2 hours	3'700.00	4'000.00	
Infill replacement An average of 1'000 kg / € 1.00 during15 years	1'000.00	1'000.00	
Total yearly maintenance cost estimate	€ 10'000	€ 15'000	

- In comparison: yearly maintenance cost of natural grass pitch
   Investment for maintenance equipment; € 100'000. Yearly maintenance cost

   Village pitch
   up to
   € 30'000. 
   € 30'000.-€ 70'000.o Town pitch up to
  - Professional club pitch up to € 100'000.- (extreme 200'000.)-



### Examples of a construction planning

- Political decision by the owner of the pitch
- Compiling the tender documents
- Tendering time
- Tender analysis
- Contract award
- Start of the base construction
- Start of the laying of the Turf
- Reception
- First training / match

Note:

It is important to planify enough time between the contract award and the delivery of the turf to allow the turf producer to produce and deliver the turf according to the requirements and size of the installation site (first ordered = first served).

Middle of August

August/September

October/November

December/January

February

Mid June

End of July

March

May



## FAQ, frequently asked questions

#### **Elastic layer**

Are both types (prefabricated and made in situ) valid?

Yes, however on unbound sub base, in-situ made elastic pads can not be used (see the reasons bellow). When using an unbound sub-base with loose stones, an in-situ e-layer is not a good choice. The machine installing the e-layer on the sub base, will with its wheels /chains, remove stones from the sub base causing a lot of problems in evenness and shock absorption uniformity.

Open cell elastic layer can not be used in countries with freezing condition, because it can freeze.

#### Thickness requirement of 20mm?

Not thickness indication of the e-layer as only the force absorbing capacity value is important.

#### Force absorbing capacity?

Depending on the system, e-layers values are recommended around 50%, the whole system has to be above 60%.

#### Spaces between e-layer?

Absolutely no space is acceptable when speaking about e-layer; any space will affect the turf.

Amount of water absorbing capacity? Is not to be specified; requirement according to EN and/or FIFA.

What type of adhesive tapes made of polyurethane for prefabricated layers? Is not to be specified, however the gluing tape width should be at least 30cm; with line markings = 50cm

When made in situ, the granules should be 2-7 mm? Not to be specified; it is up to the turf producer to define his product and reach the requested shock absorption value

Tensile strength, min. 600N? Not to be specified, specification according to FIFA

Evenness of the e-layer: 5 mm +-/ under 4 m alu stick? FIFA requirement: Max 4 mm under 4 m I prefer a more stringent quality: Max 4 mm under 4 m

#### Artificial turf carpet

Structure of the yarn: 100% monofilament All fibres are ok but the monofilaments have a longer life span

Yarn height: 3,0-3,5 for mini-pitch and 5,5-6,0 cm for big size pitches Absolutely not to be specified

Tufts: min 9500/m2 Absolutely not to be specified

Colour: green FIFA requirement

D-Tex: 11000 dtex (+-10%) Absolutely not to be specified

Total carpet weight: 2100 g/m2 It would be more helpful, to give the weight of the backing without the latex (min. of 200/250 g/m2) and the weight of the fibres

Force absorbing capacity: cross way 650 N, lengthwise: 700 N Absolutely not to be specified; according to FIFA

Rolls: according to the length of the pitch, Width of rolls: min 4 m  $\ensuremath{\text{Ok}}$ 

Space between installed turf rolls: max. 20mm Max. 5 mm

### Line markings

The material of line markings is identical with the artificial turf, colour of line: white; width 8 and 10 cm. Out of 6 fibres in line markings could be white

The line markings are cut, and glued on 40 cm wide rolls, with 2 component gluing material: When using line markings tapes should be 50cm wide

#### Fibres

Material: PE, UV redundant, heat stabilized Absolutely not to be specified The weights of yarns are from 900g up to 1800g/m2, but the weight of 10mm should also have to be given, because it depends on the length of the yarn (40mm or 60mm turf fibres)!

#### Infill

To be specified in kg/m2

Sand and Granules should be specified by the thickness in mm

- There are 3 main types of granules:
- SBR, waste of car tyres
- EPDM, when using EPDM, stick to a min. of 20 % EPDM content, because of quality, the best products have about 25%
- > TPE/TPU/TPV, these are the recommended granules as they do not have any elastic response

### Sand infill

Classified quartz sand, dry, round, 0,3-08 mm

95% round quartz sand, otherwise no specification

The usage of sand is not important. It depends on the backing carpet, because, a very good, carpet, up from 300 g/m2, has the weight to give stability to the pitch, and in this cases, you only need the sand on big size pitches, and only for fire safety reasons (fire)

As an estimated construction price, for in situ e-layer a 15 EUR is correct, on prefabricated it depends on the product (4 to 10 EUR; a list of suppliers of prefabricated e-layers have been given to us).

#### Turf with granular infill vs. non infilled turf

What is recommended?

As long as the required specifications are fulfilled, both systems are valid. The players should then make the final choice of the turf

#### Granule infill

1,0-2,0 mm SBR, without any metallic leftover or dusty Granules? No granules should be under 0,5 mm, Granules should be added / infilled in layers of 5 mm, with the type of SMG machine. Sewn pitches joints; then the line markings should be painted! The cleats of the shoes are usually 10-15 mm, and the depth of the granule proportion should be according to this.

#### Installed turf to be tested?

Generally it is recommended to conclude a FIFA testing. If there are problems with costs, a good idea would be, to take the 3 most important tests, like shock absorbency, torque/rotational resistance, and the ball roll, and they should be executed on 3 FIFA spots, and on 2 spots on the choice of the client. No more than 10% of fibres bellow granules!!!

#### Watering the pitch

Should a pitch always be wet? The professional players like to play on a humid turf (natural or artificial) but it is not an obligation, however the turf fibres will be smoother.

# **Football shoes**



Notice: advice / publicity from a football shoe distributor

FOOTBALL TURF www.sportfloor.ch

# Football Turf manufacturer

Football Turf manufacturer	Country	Fibre producer	Turf producer	FIFA accredited
Advantage Sport	Canada			
Astro Corporation	Japan			
Astroturf LLC	USA			
ATC Global Sports	USA			
Balsam Pacific (APT) Bonar Yaros / Xirion	Australia			
Cabrita Carpets n.v.	Belgium			
Challenger	USĂ			
*Desso Sports Systems	Belgium & NL			
Dinarsu Imaiat Domo Sports Systems	Turkey Belaium			
Edel Grass	Holland			
Eurofields	France			
*Fieldturf Tarkett Sport Systems SA	Canada & France			
Greenfields BV	Netherlands			
Italgreen S.p.A.	Italy			
Ineas	Belgium			
Jiangsu Co-creation Grass Co.,Ltd.	China			
Kinnears	Australia			
Kolon Glotech, Inc.	South Korea			
Lano Sports NV	Belgium			
Lankhorst	Netherlands			
Leling Taishan Artificial Turf Industry	China			
Limonta Sport Surfaces	Italy			
Mondo S.p.A.	Italy			
Nordon Enterprises Ltd	UK			
*Nexel	USA			
Nurteks Carpet	Turkey			
Otsuka Chemical Co. Ltd	Japan			
Pe-Ba Tekstil San. Ve Tic. Ltd. Şti.	Turkey			
Playfield International Inc.	USA			
Polygras Iberica	Spain			
*Polytan GmbH	Germany			
Radici Group	Italy			
RADICI S.p.A.Sit-in SPORT	Italy			
Rossifloor	Italy			
Ryoko Co. Ltd. Ltd.	Japan			
Saltex Ov	Finland			
Sportex	Turkev			
*Sportexe Construction	Canada			
Sports Technology International	Germany			
*Sprinturf	USA			
Sumitomo Rubber Industries Ltd	Japan			
Тарех	Australia			
TaiShan Artificial Turf Industry Co. LTD	China			
T.E.A.M Sport Surfaces	Australia			
Technograss	Spain			
Ten Cate Thiolon / Mattex	NL & Dubai & USA			
Texgrass	Spain			
Tiger Turf Ltd	UK			
Tisca-Tiara AG	Suisse			
Toray Industries Inc.	Japan			
Trofil	Germany			
*Turfstore	USA			
Unitika Ltd.	Japan			
Uniecogreen	Italy			
XL Generation	Canada			

\*Private equities Note: due to the rapid change of the market, this list will never be exhaustive



## Football Turf Turnover, Statistics 2007



### Key to abbreviations

Apparent density Backing	Weight / volume in kg/m3 of a granular material (including the empty space) Material that forms the back of a carpet, regardless of the type of construction. Primary backing – In a tufted carpet, the material to which surface yarns are attached. May be made of jute, cotton woven or non woven synthetics. Secondary backing – Also called "double backing". Any material (jute, cotton woven or non woven
	synthetics, scrim, foam or cushion) laminated to the primary backing.
Density	Weight / volume in kg/m3 of the material
Dtex	Unite of weight in grams of a single textile fibre or yarn 10'000 meters long
EPDM	Ethylene-Propylene-Dien-Polyethylene
Epidemiology	The study of the incidence, distribution and control of disease or injury within a population
Filament	A single strand of any kind of fibre.
Gauge or Gage	The distance between two needle points expressed in fraction of an inch. (width between the tuft lines)
Latex	A rubbery fluid found in several seed plants (now mostly synthetic), used to seal the back of the carpet
Micron	Thickness of the turf fibres in microns (mµ)
Monofilament	A filament large and strong enough to be used directly as a yarn
Multifilament	Yarn made of many filaments plied and spun together
NM Ola fin	Newton Meter
Olefin	Any long chain synthetic polymer composed of at least 85% by weight of ethylene, propylene of other olefin units
Pile	The upright ends of yarn that forms the wearing surface of the carpet
Pile height	The height of pile measured from the surface of the back to the top of the pile
Pile density	The number of tufts both across (gauge) and lengthwise (stitches)
PP	Polypropylene – High-molecular weight paraffin fibre made by the polymerization of propylene
PE	Polyethylene
SBR	Styrene Butadiene Rubber
Split filament yarn	Yarn made by a process in which a relatively wide film is slit at various points across its width so as to break
TDU	apart in the course of use into molitiple manent segments
TPE	Evirudad Thermoniastic Elastomers
Tuffing	Process of stitching fabric leaving the stitches long enough to be cut off or left as loops
Tufts - knots	The cut or uncut loops of a pile fabric - Number of knots per m2
Yarn	A continuous strand for tufting: varn formed into a continuous strand from two or more continuous filaments



#### Literature

- UEFA medical study Jan Ekstrand MD, PhD
- UEFA manual "Football turf in UEFA competitions" •
- FIFA Quality Concept "Handbook of test methods and requirements for Football Turf surfaces"
- STC Synthetic Turf Council "Suggested guidelines for the essential elements of synthetic turf systems" •
- BASPO, Reihe 113 • Verfasser Edwin Müller

#### Illustrations

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- Rolf Hediger •
- Ole Myhrvold, NFA
- The Football Turf Industry

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