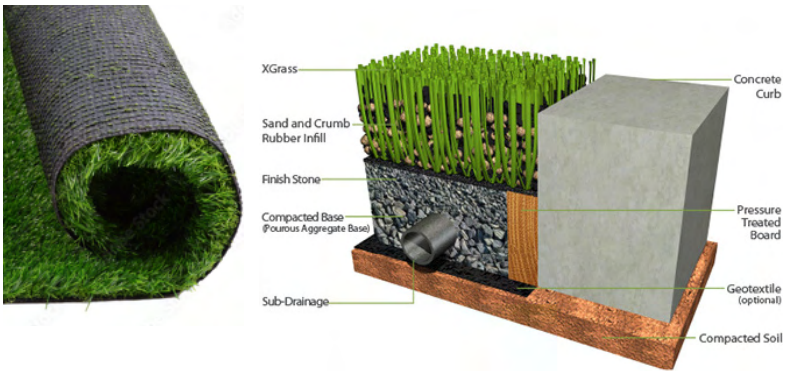
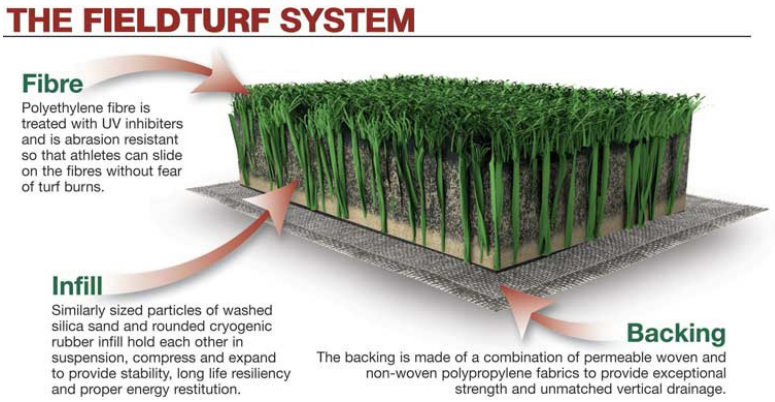




LAMP RYNEARSON

Synthetic Turf Selection & Implementation Strategies

White Paper by Joe Zadina, PE & Randy Kuszak, PE

Client

Nebraska MultiSport Complex

Completion Date

2016

Not all turfs are created equal, and our professionals have been evaluating and specifying athletic playing field turf for the past 18 years and have the depth of knowledge desired to ensure each project identifies the optimum playing surface that will meet the goals and stand up to the countless play-hours that athletic facilities experience.

The selection of synthetic turf for an athletic facility must consider a variety of factors that will impact the overall safety, performance and longevity of the playing fields. The most up to date trends in product research and development must be considered as well as geographical product availability and local climate concerns. The purpose and expectations for the synthetic turf field must be clearly identified in order to properly evaluate available options such as turf backing and fiber, turf infill, and turf markings and certifications. The white paper provides topics for consideration as well as some guidance and recommendations to assist with the selection of the proper turf to meet the project needs.

Authors Joe Zadina and Randy Kuszak deliver a comprehensive guide to playing surface selection. Providing a Field Selection Decision Matrix with pros and cons of surfaces, along with a detailed description of synthetic turf types and infill materials.

Additional information is provided on indoor facilities, installation, climate concerns, and floodplain considerations. Player safety concerns and turf care maintenance are also addressed in the document along with recommendations.

Synthetic Turf Selection & Implementation Strategies

(for the Nebraska MultiSport Complex)

A White Paper

November 18, 2016

Lamp, Rynearson & Associates

Joe Zadina, P.E. & Randy Kuszak, P.E.

Contents

1. Introduction / Background

The selection of synthetic turf for an athletic facility must consider a variety of factors that will impact the overall safety, performance and longevity of the playing fields. The most up to date trends in product research and development must be considered as well as geographical product availability and local climate concerns. The purpose and expectations for the synthetic turf field must be clearly identified in order to properly evaluate available options such as turf backing and fiber, turf infill, and turf markings and certifications. This paper will provide topics for consideration as well as some guidance and recommendations to increase the synthetic turf knowledge base needed to select the proper turf to meet the project needs.

2. Field Selection Decision Matrix

Below is a matrix providing a summary of information gathered by LRA at the time of this report. LRA has not conducted any independent testing of the products described below and therefore cannot guarantee the accuracy of information provided.

Playing Field Surface Type

- Natural Grass – Bluegrass/Fescue, Bluegrass/Ryegrass, or another proprietary blend.
  - Pros
    - Known effects of flooding on a grass surface
    - Low risk of catastrophic loss during short duration flood event
    - Preferred high level performance soccer surface when in prime condition.
  - Cons
    - Limited usable hours to maintain field in prime condition
    - Long recovery time to re-establish full stand in worn/damaged areas
    - Irrigation and mowing required
    - Weed/pest control required
    - No free draining base, so limited to sheet flow across slope of the field or permeability of soil. May require idle time to dry out.

- Natural Grass/Synthetic Turf Hybrid –natural grass turf reinforced with artificial fibers (example – XtraGrass Reinforced Turf ©).
  - Pros

- Low risk of catastrophic loss during short duration flood event
- Will remain visually green from a distance even in high wear areas
- High level performance soccer surface as surface is still predominantly natural grass
- No free draining base, so limited to sheet flow across slope of the field or permeability of soil. May require idle time to dry out.

▪ Cons

- Limited usable hours
- Long recovery time to re-establish full stand in worn/damaged areas
- Although green, fiber spacing is large enough that performance will still be impacted in high wear areas
- Over time organics may reduce the permeability of the natural grass layer.
- Risk of catastrophic loss of turf during flood event as carpet only attached at edges, to our knowledge no studies have been performed to quantify the velocity at which the product may transport
- Irrigation and mowing required
- Weed/pest control required

o Synthetic Turf – synthetic turf carpet and infill installed over a drainable rock base with an underdrain storm sewer collector system. Turf fiber and infill types vary.

▪ Pros

- Allows for nearly 24/7 use with no "recovery" time required
- Not limited to growing season pushing potential use into any season where weather conditions are suitable for play
- Free draining rock base system allows for play during and immediately following rain events
- Minimal regular maintenance required, though not maintenance free

▪ Cons

- Replacement of turf carpet required every 8-12 years dependent on use.
- Increased playing field temperatures when compared to natural grass

- Unknown effects of floodwater for both inundation and stream flow/velocity
- Risk of catastrophic loss of turf during flood event, to our knowledge no studies have been performed to quantify the velocity at which turf carpet and/or infill may transport downstream or become displaced

Synthetic Turf Fiber Type

- Monofilament – Monofilament systems are known for their resilience and aesthetics. These fibers are by far the most visually appealing and grass-like. Monofilament turf blades are extruded through a spinneret as a single strand. Monofilament systems have been in use for over seven years.

  Local example of facility type – UNO Soccer Stadium, Creighton Morrison Stadium, Papillion LaVista South High School, Lewis Central High School, and Plattsmouth High School.

  - Pros
    - Perceived performance superiority for soccer due to consistency in ball roll
    - Preferred fiber type for soccer only facilities due to playability
    - Fibers are upright, providing a more aesthetically pleasing "natural" look to the field
  - Cons
    - Provides less encapsulation of fibers, providing less containment/protection to infill and could increase potential infill migration during potential flood events. Infill type and composition becomes more important.
    - More pronounced infill "spray" than slit-film
    - Failure method for fiber is either full pull out of the backing or layover at the top of infill level. Layover can be reduced by consistent proper maintenance of the field, as per manufacturer's recommendation.
- Fibrillated Slit-Film – The fiber is made up of a single width of yarn, being partially slit down the length of the fiber. As the fiber is used, the individual slits disconnect from each other above the infill level, then layover and encapsulate the infill. An individual yarn fiber give the appearance of multiple individual fibers above the infill level. This style of fiber allows for the looping of the yarn through the backing, leading to the durability of the fiber and lack of pull out on individual fibers. Slit film systems have been in use for over thirteen years.

Local example of facility type – All Omaha Public Schools for their high school multipurpose fields, including regulation sized soccer fields at Omaha South Collin Stadium and Bergquist Stadium, and is used for the majority of Omaha area metro high school level fields. Slit-film remains in use at all levels of competition for football. University of Nebraska – Lincoln, memorial stadium is a slit-film field.

- Pros
  - Original technology with a well-documented past
  - Considered the workhorse fiber type, as separation of fibrillated fibers occur through use, the fibers lay down to encapsulate the infill
  - Encapsulation provides more protection against infill migration during potential flood events
- Cons
  - Not as aesthetically similar to natural grass or monofilament
  - Fibers have the tendency to lay down with heavy use
  - Faster ball roll performance for soccer, not the preferred soccer-only fiber type.

o Hybrid – Monofilament fiber weaved through the same stich as a slit-film fiber. Previous versions of the hybrid concept stitched the two fiber types separately distinct rows, leaving a "corn row" effect, causing poor aesthetics and performance as the turf wears. We would not recommend a hybrid turf that did not have both fibers through the same stich. Over time, the hybrid system will look and perform like a slit film system.

Local example of facility type – Millard North High School Baseball Field, Norris High School, Firth, NE and Veterans Memorial Park, Norfolk, NE.

- Pros
  - Provides aspects of both fibers with ball roll and aesthetics of monofilament and infill encapsulation of slit-film
- Cons
  - Limited product history so there long term wear characteristics are less known.
  - Monofilament fibers are more likely to lay down in conjunction with the slit-film fibers tendency to lay down.
  - Limited to smaller diameter monofilament fibers (less rigidity) that can be tufted together with the slit-film fibers.

Infill Material Type

The turf industry has been developing a number of alternate infill materials over the past 5 years in response to safety concerns over the rubber being used as well as the temperature of fields. The base infill material has generally been rubber from recycled tires in combination with silica sand. This section will investigate the alternate infills that are available that are believed to match the performance and safety of the base infill of sand and rubber.

- Recycled Tire Rubber (SBR)/Sand Mix – This mixture has been used on the majority of synthetic turf projects locally and nationally since the products inception. The (SBR) rubber component of the mix is produced from the grinding of used tires. There are two methods of achieving the correct size of rubber particle, cryogenic and ambient temperature grinding methods. In general, the cryogenic grinding produces a more smooth edged rubber particle than ambient which reduces the air pockets in the infill, reducing migration. To our knowledge, all high school synthetic facilities in the Omaha metro area utilized (SBR) rubber from recycled tires.
  - Pros
    - Most cost efficient infill, considered baseline cost for system
    - Little maintenance and potential to last more than one field life cycle if reclaimed
    - NDEQ Recycled Tire Grant allows for a potential 25% cost reimbursement for the infilled turf system when 100% Nebraska Recycled tires are used.
    - Proven track record
    - No shock pad required to maintain g-max requirements
    - UV stable, little breakdown over life of carpet
  - Cons
    - Perceived safety concerns (see section 3 "Synthetic turf safety discussion" for more information on past and current safety studies
    - No heat reduction
- Coolplay– Extruded composite, made up primarily of a propriety natural mineral composition, recycled polyethylene from the turf manufacturing process and elastomers. This product is used in conjunction with the typical "SBR"/sand infill mix and merely acts as a top dressing. Previous generations of this product contained a natural cork component.

  Local example of facility type –University of Nebraska – Lincoln, Memorial Stadium.

  - Pros

- Non “SBR” material on top of field where athletes are most likely to contact the infill
- Promises heat reduction
- Good compaction/compression characteristics
- No shock pad required to maintain g-max requirements
- UV stable, little breakdown over life of carpet
- More natural look than “SBR”
- Slightly more dense than water, limited buoyancy
- Least costly alternative infill
- Environmentally sustainable, as top dressing is manufactured from recycled turf.
- No natural organics contained within the infill matrix

▪ Cons

- Still contains “SBR” rubber under top-dressing
- Additional cost to “SBR”, least of alternatives (~$0.40/sf)
- Manufactured material may lead to low availability, need lead time so product can be produced in quantities sufficient for large project.

o Virgin Rubber Running Shoe Byproduct – Rubber mixture from by-product of running shoe production process. We are not aware of any local examples of this infill type.

▪ Pros

- Not “SBR” rubber
- No shock pad required to maintain g-max requirements
- Similar playability performance to “SBR” rubber

▪ Cons

- Low density causes material to float
- Additional cost to “SBR”, least of alternatives (~$1.80/sf)
- Limited control over sourcing of material
- Limited availability
- Multi-colored look may not be aesthetically pleasing

- Virgin Rubber EPDM – A copolymer of ethylene and propylene having diene linkages that can be cross-linked with peroxides or sulfur. We are not aware of any local examples of this infill type.
    - Pros
        - Not "SBR" rubber
        - No shock pad required to maintain g-max requirements
        - Similar playability performance to "SBR" rubber
        - Medium UV stability
    - Cons
        - Low density causes material to float
        - Additional cost to "SBR" (~$1.50/sf)
        - Limited availability
        - Not proven for long term use
- Alternative Plastics Virgin TPE – Thermoplastic elastomers consist of materials with both thermoplastic and elastomeric properties. Manufactured material. We are not aware of any local examples of this infill type.
    - Pros
        - Not "SBR" rubber
        - Slight heat reduction
        - Similar playability performance to "SBR" rubber
        - Does not float
    - Cons
        - Shock pad required to maintain g-max requirements
        - Additional cost to "SBR" (~$2.55/sf)
        - Limited availability
        - Medium abrasiveness, more abrasive than rubber products
        - Quality can vary greatly
- Alternative Plastics Recycled TPE – Mixture of recycled turf and TPE. We are not aware of any local examples of this infill type.
    - Pros
        - Not "SBR" rubber
        - Slight heat reduction
        - Similar playability performance to "SBR" rubber

- Does not float
- Recycled material provides good environmental story for less impact

▪ Cons

- Shock pad required to maintain g-max requirements
- Additional cost to "SBR" (~$2.25/sf)
- Limited availability
- Medium abrasiveness, more abrasive than rubber products
- Quality can vary greatly

o Acrylic Coated Sand – Coated sand product. Requires a shorter pile height (~1.5"), typically with a nylon thatch layer woven into the bottom ½" of the carpet to hold the sand in place. We are not aware of any local examples of this infill type. This type of infill has been gaining momentum on the east coast

▪ Pros

- Not "SBR" rubber
- UV resistant coating
- Coating provides resistance to bacteria compared to uncoated sand
- Does not float

▪ Cons

- Shock pad required to maintain g-max requirements
- Additional cost to "SBR" (~$2.30/sf)
- Medium abrasiveness, more abrasive than rubber products
- Coating may break down prior to full life of carpet
- Sand can stay hard under cold/frozen conditions

o Organic (cork, coconut/rice husks) – Natural products derived from ground organic husks primarily from coconut or rice. Often with top dressing of natural cork.

Local example of facility type – University of Nebraska – Omaha, Caniglia Field.

▪ Pros

- Not "SBR" rubber
- Slight heat reduction

- Natural UV resistance
- Visually looks like natural soil

- Cons
  - Shock pad required to maintain g-max requirements
  - Additional cost to "SBR" (~$2.00/sf + irrigation)
  - Requires irrigation to maintain playability
  - Additional maintenance to reduce compaction
  - Low density causes material to float
  - Fiber material will break down over time

Indoor Playing Field Considerations

Selection of synthetic turf for indoor play generally follows suit with outdoor turf when considering playability and sport injury related concerns. The turf materials, both fiber and infill, are manufactured by the same companies that offer outdoor turf and are of generally the same quality and composition. However, there are additional turf options for indoor play that offer greater flexibility for space use beyond athletic applications and can be investigated and evaluated further, based on specific program needs. It should be noted that a 2010 study found that one indoor turf field had potential for increased exposure to VOC off-gassing from the rubber infill, and either alternate infills, and/or additional building ventilation should be considered. It should be noted that VOC levels that were measured were determined not to be at a Hazard Index for acute risk above 1.0 (See the appendix for the related study).

Synthetic Turf Manufacturer & Installer Considerations

The turf manufacturer selected for this project will be an integral team member who assists in educating the project team on product material options and selection as well as construction means and methods, material manufacturing and delivery schedules, installation schedules, and most importantly, the training, warranty and customer service following the turf product installation. Serious consideration should be given to companies who have a local presence and past experiences on projects in our area, as well as companies who have a history of financial stability and viability, and finally, references should be provided and vetted thoroughly from past installations.

FIFA Certification

FIFA has established a program for certifying turf installations, both natural and synthetic, with an emphasis on safety, performance and durability. Local suppliers in our area that have certified products through FIFA on previous projects are FieldTurf and Shaw Sports Turf, but there are other national suppliers who can also provide certified turf field products. There are two levels of certification, FIFA Quality (1st Tier) and FIFA Quality Pro (2nd Tier). Both certifications require annual inspections and fees to be

able to maintain the designation. We are unaware of any FIFA rated synthetic turf fields in Nebraska.

3. Additional Considerations

Site Environmental/Climate concerns

The NMSC facility is situated partially in the 100-year floodplain and also floodway of West Papillion Creek as determined by studies used by the Federal Emergency Management Agency to issue the Flood Insurance Rate Map (FIRM). There are three primary concerns for synthetic turf fields in flood conditions, migration of infill, movement and detachment of the synthetic turf carpet itself, and residual silt/debris on and in the field infill matrix following recession of flood waters. To fully understand the risk associated with a flood event, first the probability of different frequency occurring in a given year versus that of the probability of an event occur over a certain time period. The table below shows that, for example,

Table 2B-2.01: Chance of a Storm Equaling or Exceeding a Given Frequency During a Given Time Period

Return Period (years)	Time Period in Years					
	1	*5*	*10*	*25*	*50*	*100*
2	50%	97%	99.9%	99.9%	99.9%	99.9%
5	20%	67%	89%	99.6%	99.9%	99.9%
10	10%	41%	65%	93%	99%	99.9%
25	4%	18%	34%	64%	87%	98%
50	2%	10%	18%	40%	64%	87%
100	1%	5%	10%	22%	40%	63%

Based upon the preliminary review of the modeling software used to develop the floodplain and floodway limits, it can be anticipated that the depth of water and overbank velocity of floodwaters will vary depending upon location along West Papillion Creek. Below is a summary of three locations along the site's frontage to the creek that were reviewed for the depth and velocity of flow at the overbank location. It should be noted that the velocities presented below are located at the top edge of the creek bank and lower velocities may be encountered at locations further from the creek bank.

Flood Elevation and Velocity Summary Table:

	Location 1	Location 2	Location 3
Approx. Ground Elevation	1034	1032	1031
10 Year Water Elevation	1036.87	1033.2	1031.09
10 Year Overbank Velocity	2.05 ft/s	1.6 ft/s	-
50 Year Water Elevaton	1037.9	1035.52	1034.02
50 Year Overbank Velocity	2.25 ft/s	2.08 ft/s	1.8 ft/s

100 Year Water Elevation	1039.03	1037.4	1036
100 Year Overbank Velocity	2.30 ft/s	2.6 ft/s	2.7 ft/s

An exhibit showing the approximate locations and identified is included in Appendix A.

Below is a further breakdown of each primary concern for a synthetic turf field.

- Migration of Infill – Synthetic turf fields can be comprised of any number of infill mix ratio and component breakouts. Attached in Appendix C is a list of potential infill media. For fields located in potential flood locations, infill materials including cork, coconut husks and other organics that can float should not be considered. The remaining rubber (virgin or recycled tire) and sand alternatives listed in Appendix C do not float, however migration may still occur due to the velocity and depth of the floodwaters.
- Movement of Synthetic Turf Carpet – The typical sports synthetic turf systems are attached to the ground using a nailer board at the perimeter curb of field. The remainder of the field is held down simply as a function of the weight of the carpet/infill combination. Typical weights for turf range are approximately 12 lbs per square foot but may vary on infill type/composition and by manufacturer.

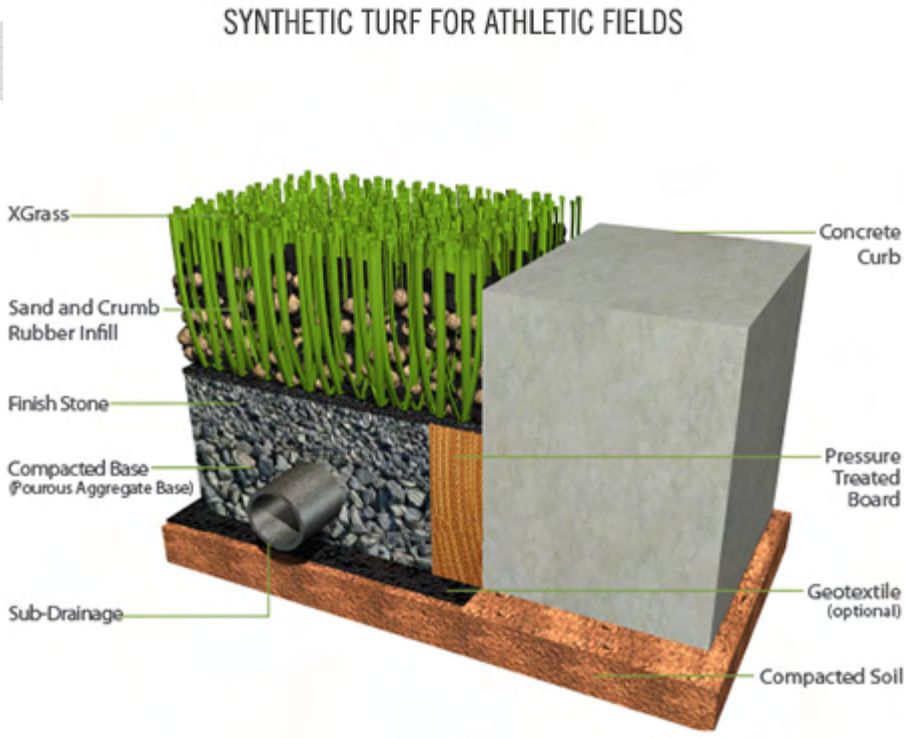
(photo example of displaced turf carpet – location unknown)

(photo example of surcharged synthetic turf due to hydrostatic pressure from an inundated/overwhelmed storm sewer system – location unknown)

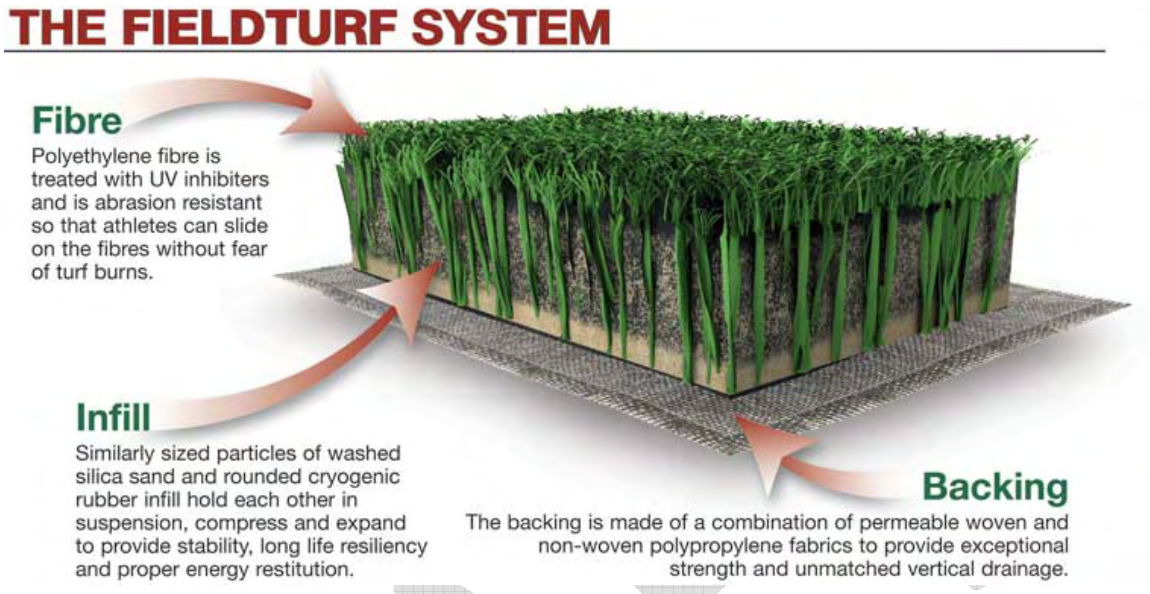
- Residual Silt/Debris – Upstream sections of the Papillion Creek System as well as the channel itself pass through active construction areas, farmland, and erodible areas. This contributes to the flood stage waters of the creek to contain a significant amount of silt and debris. As floodwaters recede, especially in areas where flood waters move slowly, silt will be deposited on the ground surface.

The basic components of a synthetic turf system

- The following is a typical cross section of a complete synthetic turf system:



- The following is a typical composition of a complete synthetic turf system:



Synthetic turf safety discussion

To date, there has not been a comprehensive study on the safety of recycled tire crumb used in playing fields in the United States. Limited studies previously conducted by a variety of agencies and industries have not shown an elevated health risk from playing on fields with tire crumb rubber, however these studies have not comprehensively evaluated concerns about health risks from exposure to the tire crumb rubber. The U.S. Environmental Protection Agency (EPA) has developed a Tire Crumb and Synthetic Turf Field Literature and Report List (Nov. 2015) which provides a list of many of the studies which address specific concerns regarding turf safety completed to date. This list has been included as Appendix I.

In response to public concern and the lack of a comprehensive study about health risks from exposure to the tire crumb rubber, on February 12, 2016 the EPA, the Centers for Disease Control and Prevention/Agency for Toxic Substances and Disease Registry (ATSDR), and the U.S. Consumer Product Safety Commission (CPSC) launched a multi-agency action plan to study key environmental human health questions. The Federal Research Action Plan on Recycled Tire Crumb Used on Playing Fields and Playgrounds has been developed (included in appendix XX) and is currently under implementation. The Action Plan identifies the end of 2016 as the target release of a draft status report that describes the preliminary findings and conclusions of the research. This report will identify key areas of concern, potential exposures to potentially harmful constituents, initial evaluation of potential cancer and non-cancer toxicity, and identify follow-up activities that could provide additional insights into potential risks. Updates to this study will be provided on https://www.epa.gov/chemical-research/federal-research-recycled-tire-crumb-used-playing-fields as they become available.

Synthetic turf care and maintenance

Synthetic turf will require maintenance and care, though it will be dramatically less than what is required for natural grass playing fields. Typical maintenance will involve regular visual inspection of the turf field along with picking up any trash or debris either by hand or with the pull-behind sweeper provided by the turf company. Additionally, the turf company will supply a grooming piece of equipment that is a pull behind machine that gently brooms and rakes (with tines) the synthetic turf field. The frequency of the grooming should be evaluated based on field usage, as too much grooming could prematurely break down the turf fibers and reduce the expected life of the turf field. The turf supplier/manufacturer can provide recommendations for grooming frequency.

4. Recommendations

Selection Process Recommendation

The selection of synthetic turf will require a number of conversations with a multitude of professionals along with a handful or more of field visits to existing athletic facilities and possibly even a visit to a turf manufacturing plant. LRA recommends that the project team arrange for site visits to UNO's Caniglia Field, Creighton's Morrision Stadium, and at least one site visit to a local field that has each type of turf fiber (3 total). Additionally, each site visit should be conducted in the presence of the facility manager so that we may obtain their opinion of the field along with understanding the playability, safety, performance and maintenance of the field. We recommend engaging a preferred synthetic turf supplier to begin discussions on field discussion and to assist with the required site visits – for this service, we recommend Midwest FieldTurf out of Denison, Iowa.

Product Recommendation

To reach the usage levels that this facility is programmed for, we would recommend the selection of a synthetic turf system. As this facility looks to be a predominantly soccer use type, a monofilament fiber type would be the ideal fiber for the highest level of performance. With a monofilament fiber, we would recommend a three-layer infill system containing cryogenically fractured SBR, silica sand and the latest generation (currently the 3rd generation) of *Coolplay* as a top dressing. We believe the three-layer system best addresses the main concern of a monofilament system with less encapsulation/more infill spray by combining the density characteristics of cryogenically fractured SBR and sand as a base layer and having a non-SBR infill as the contact surface for users. The *Coolplay* top dressing will help to mitigate concerns/perceptions of the safety of rubber infill by providing a non-SBR rubber top contact surface material.

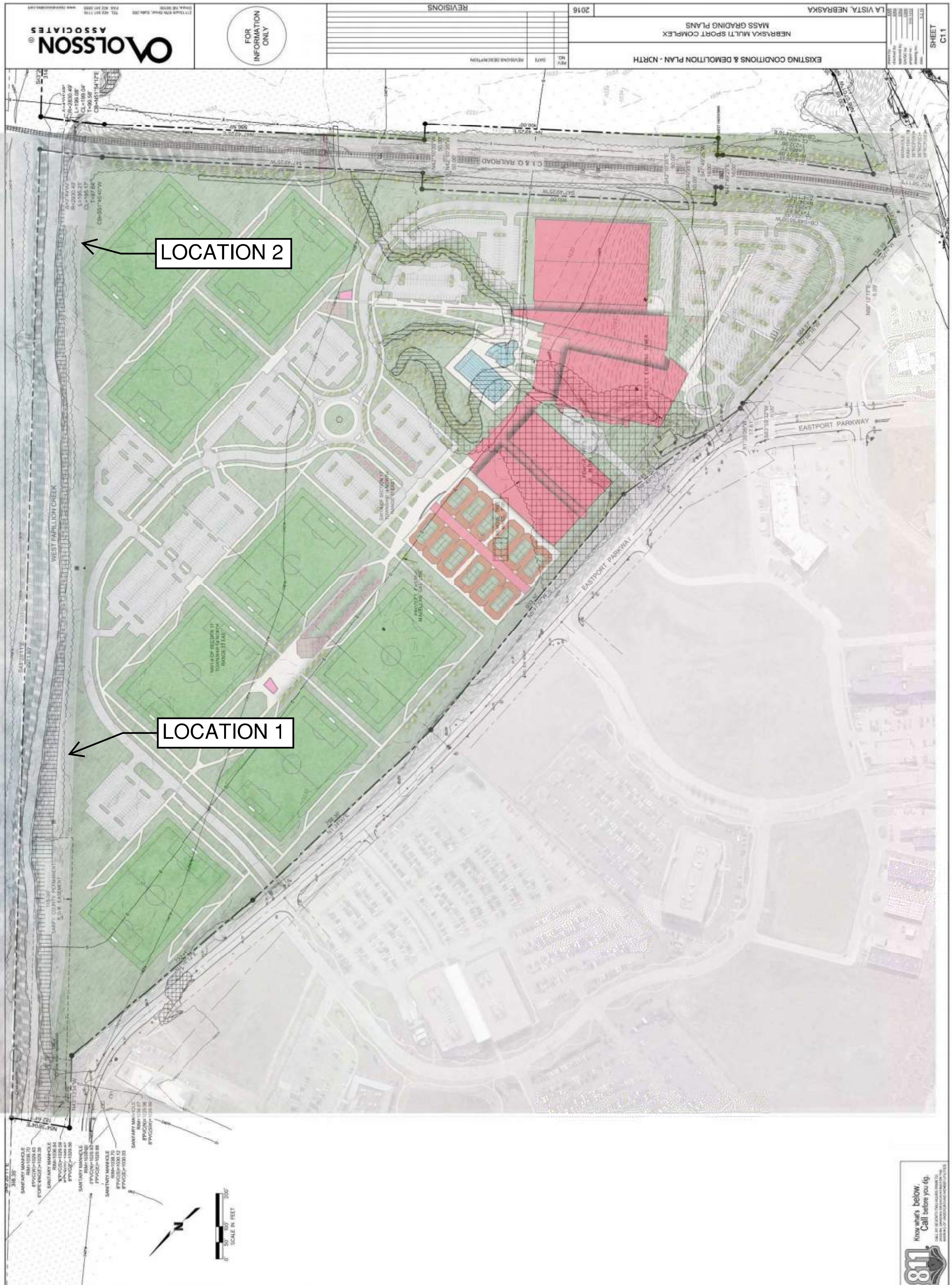
In addition to the selection of the components of the synthetic turf system, selecting a turf manufacturer with high levels of internal QA/QC for the product as well as proven warranty response over the entire 8-year warranty period will be paramount. Based upon our experience in this region over the past 10 years, as well as visits to the manufacturing facility, we would recommend using FieldTurf as the preferred supplier/installer.

FieldTurf is the industry leader with more than 50% of yearly installs and a long track record of innovation, honoring the warranty, and timely support for their products. FieldTurf's product line includes the Revolution 360 monofilament fiber system which exhibits product line leading fiber wear performance and the *Coolplay* infill system. Additionally, FieldTurf's local distributer, Midwest FieldTurf located in Denison, Iowa, provides exceptional service and warranty/maintenance response for our local market.

In summary, we recommend the selection of the Revolution 360 monofilament synthetic turf system (and finger coated backing) with the *Coolplay* three-layer infill system manufactured and installed by FieldTurf for all outdoor playing fields. This product may also be suitable for the interior installation at the fieldhouse, but further investigations are necessary before the product can be determined. Appendix J contains product data for the recommended system.

Appendix A

Floodplain Review Exhibits

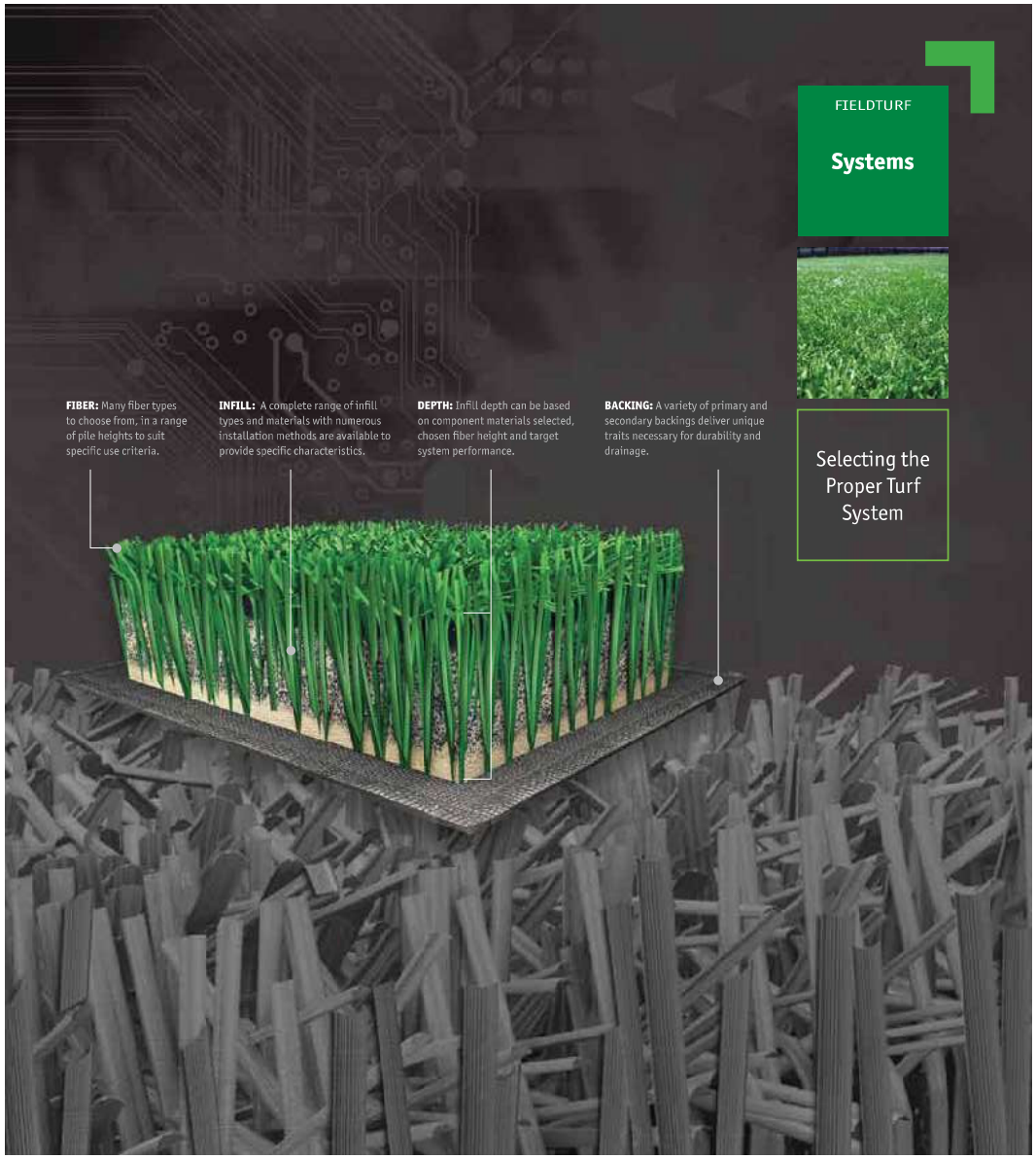


LOCATION 2
LOCATION 1
EASTPORT PARKWAY
WEST PAPILLION CREEK
C B & Q RAILROAD
EXISTING CONDITIONS & DEMOLITION PLAN - NORTH
NEBRASKA MULTI SPORT COMPLEX
MASS GRADING PLANS
LA VISTA, NEBRASKA
2016
REVISIONS
FOR INFORMATION ONLY
OLSSON ASSOCIATES
SHEET
C11
Know what's below. Call before you dig.


LOCATION 3
WEST PAPILLION CREEK
SOUTH PAPILLION CREEK
GILES ROAD
C.B. &Q. RAILROAD
EXISTING CONDITIONS & DEMOLITION PLAN - SOUTH
MASS GRADING PLANS
NEBRASKA MULTI SPORT COMPLEX
LA VISTA, NEBRASKA
2016
REVISIONS
FOR INFORMATION ONLY
OLSSON ASSOCIATES
SHEET
C12
Know what's below. Call before you dig.

Appendix B

Selecting the Proper Turf Type



FieldTurf®
A Tarkett Sports Company

THE ULTIMATE
SURFACE EXPERIENCE

PROCESS

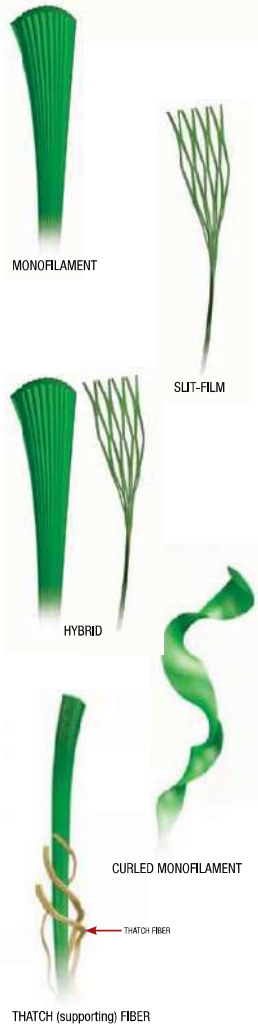
The process of selecting an infilled artificial turf system can be confusing. There are over 20 suppliers, each presenting multiple offers. Before you start evaluating different brands, it is important to determine which system is best for your application. While many take the approach of trying to sell their most expensive system, FieldTurf takes a different approach – we like to match our systems to our customers. Each system's components have their own functions that contribute to the artificial turf product's performance as a whole.

This document provides an in-depth review of these five major turf system elements that affect a field's performance and longevity. The last section brings together the five elements as part of FieldTurf's lineup of engineered systems that have been tailored to deliver tangible and unique benefits for a wide variety of needs.

THERE ARE FIVE MAIN ELEMENTS TO REVIEW IN ORDER TO CHOOSE THE PROPER TURF SYSTEM FOR YOUR NEEDS.

- FIBER
- PILE HEIGHT
- INFILL
- BACKING
- SEAMS

FIBER



What fiber type is right for you?

When it comes to fiber type, there are three options – Monofilament, Slit-Film, and Hybrid. Let's start off by taking a look at these options.

What does fiber "do"?

Turf fibers are responsible for the aesthetics and the longevity of a field. They provide a natural grass-like look and need to be durable to maintain their resilience for the life of the field. They also serve for the comfort and safety of the player. The ideal fibers should reduce skin friction, skin abrasion and offer superior durability, high resilience and temperature stability.

★★ **MONOFILAMENT** - Monofilament systems are known for their resilience and aesthetics. These fibers are by far the most visually appealing and grass-like. Monofilament turf blades are extruded through a spinneret. The die hole of the spinneret determines the cross section of the blade. The geometry of the turf blade plays an important role in the performance characteristics of the synthetic turf system. Monofilament systems have been in use for over five years with continued success. Due to the increased aesthetic value, the majority of fields installed on an annual basis are Monofilament.

★★ **SLIT-FILM** - Highly used artificial turf systems require a fibrillated grass fiber tough enough to stand up to constant wear. Slit-Film, in use for well over 10 years, is ideal for high use areas such as mini-pitches (under 40,000 square feet) and baseball infields. We also recommend Slit-Film systems for indoor facilities that use the surface for over 4,000 hours per year. Slit-Film is known to reduce infill splash better than other types of systems due to the fibers laying over more quickly. Older Slit-Film was extruded in sheets then cut into "tape" but the cutting of the fibers caused premature wear. Newer Slit-Film fiber is extruded, preserving the integrity of the fiber.

HYBRID - Hybrid systems are very new to market. They combine Slit-Film and Monofilament fibers. While there are differences in the long term performance and aesthetics of the two fiber types, hybrid systems have proven to perform fairly well. Over time, the system will look and perform like a Slit-Film system.

CURLED MONOFILAMENT - The curled, texturized monofilament fiber is designed to be extremely durable and aesthetically pleasing - delivering excellent grass-like performance. Each fiber undergoes a high-heat texturized process to give it a crimped appearance and strong resilience.

THATCH (supporting) FIBER - The thatch zone is a shorter, curled fiber that is combined with a monofilament system. It is designed to support the base of the longer monofilament fiber and reduce the quantity of infill in the system to give a full, lush grass-like appearance to the field. The thatch zone can consist of polyethylene or nylon fibers. It has been used in landscaping turf products for many years and is now being used in multi-purpose sports turf.

Once a fiber type is selected, the next step is choosing the proper system. FieldTurf offers a variety of systems, all of which cater to the unique needs of each client.

PILE HEIGHT

What pile height is right for you?

Different pile heights are offered based on the sport and the level of play the field will be used for. The height of the pile is directly related to the amount of infill that can be installed in a turf system. The five most typical pile heights are listed and explained below.

What does pile height "do"?

Pile height refers to the length of the grass blade. The length of the blade is directly related to the amount of infill that can be inserted into a given system. The more infill the system has, the better the shock absorption properties will be. Shock absorption is directly related to player safety. With that in mind, different pile heights are recommended for different sports/uses.

1.5" PILE HEIGHT

Shorter pile infilled systems are relatively new and becoming more prevalent due to the introduction of various underlayment systems which provide drainage and shock absorption. The increased shock absorption properties allow for the fiber to be shortened and for less infill to be used. FieldTurf features this pile height in some of our Flex Series systems, offering customers the combination short pile with several infill and underpad options. An underpad must be used with any pile height less than 2.0" if the desired use is for sports.

2.0" PILE HEIGHT

This height is ideal for non-contact sports such as Soccer, Baseball, and Lacrosse. With respect to soccer, FIFA recommends that a 2" pile height mainly be used for recreational, community and municipal fields. FieldTurf's 2" fields have achieved FIFA 1 Star approval.

2.25" PILE HEIGHT

A mid-range pile height ideal for all sports, contact included, but not recommended beyond high school football with respect to contact sports. This height is ideal for park and recreation applications looking for the ideal compromise between shock absorption and cost.

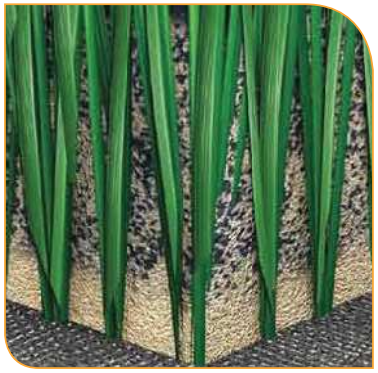
2.5" PILE HEIGHT

This high performance pile height is the ultimate in safety and performance for athletes of all ages and is by far the most popular pile height offered in the industry today. This system is used for contact sports (NFL and NCAA football) and high-level soccer (FIFA 2 Star Recommended fields).

2.75" PILE HEIGHT

A little extra pile height makes room for extra infill which is required for IRB (International Rugby Board) and AFL (Australian Football League) approval. Both the IRB and AFL have put into place HIC requirements which require extra infill.

INFILL



What infill type is right for you?

There are two important factors to consider – infill type and infill system. There are a multitude of infill types with new "alternative infill" options being introduced to the market. It is important to look at the durability, performance, and cost of each infill type. The type of infill selected will help to determine the possible infill systems (i.e. how the infill will be layered / installed). It is important to make sure that the infill type and infill system meet the required performance characteristics.

What does infill "do"?

The infill system is the single most important aspect of all synthetic turf fields. It is the basis for the safety of the turf system by providing the appropriate cushioning to absorb impact as well as being the foundation to a field's performance level by offering traction for players to cut, plant and release just like they would on natural grass. Whereby turf fibers are directly related to the aesthetics of the field, the infill – which is spread between the fibers – delivers what the athlete needs: A safe surface with proper performance attributes. The infill market is becoming more complex with new products being introduced at a rapid rate. With so many choices, it is important to understand the difference between the various systems.

INFILL METHODS

SAND-AND-RUBBER (3-LAYERED) INFILL

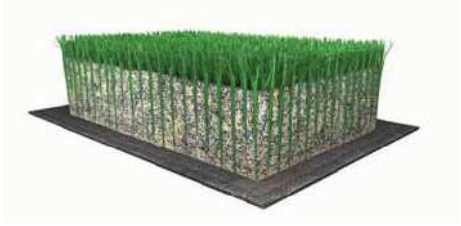
The 3-layered infill system is the most intricate and most meticulous infill system available on the market. It can only be performed by experienced installers. This infill method has been proven to offer the best Gmax (shock absorption) and energy restitution results for both the safety and the performance of athletes playing on the field.

- **The infill consists of sand at the base of the turf carpet to stabilize the whole system.**
- **The middle layer contains a mix of sand and rubber granules to offer the ideal firmness.**
- **The top is entirely made up of crumb rubber for a soft landing on impact.**

This layered process may require up to 14 passes of infill layers and is slightly more time consuming but offers the ultimate proven ground for the highest level of performance and safety.

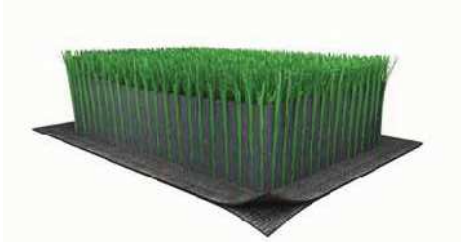
SAND-AND-RUBBER INFILL (HETEROGENEOUS MIX)

The heterogeneous infill mix is a simpler method. Sand is deposited at the base of the turf carpet to stabilize the whole system and to offer a firmness which is required for athletic performance. Crumb rubber is laid over the sand to create a soft surface with safe shock absorption.



SAND-AND-RUBBER INFILL (HOMOGENEOUS MIX)

The homogeneous mix is an infill method where the sand and crumb rubber are mixed together before the particles are deposited between the turf fibers. Such a method will typically offer inconsistencies in the level of Gmax and energy restitution across the surface due to the varying levels of each component at different parts of the field.



ALL-RUBBER INFILL

An all-rubber infill field is exactly as it sounds. Crumb rubber is the only element used to fill up the entire turf system. All-rubber fields have been identified as being far too soft and subject to quick deterioration. The infill migrates easily and the lack of mass at the base of the turf makes the field vulnerable to other damages. It simply does not offer suitable safety and performance characteristics. Today, all-rubber fields are all but extinct.

INFILL COMPONENTS

STANDARD INFILL MATERIALS

Since the introduction of long pile artificial turf, sand and SBR (Styrene-Butadiene-Rubber) crumb have been used in the installation of turf fields. Both environmental and practical, these components have safety, performance and cost advantages which have made them the preferred infill materials of artificial turf fields.

Cryogenic Rubber

CRYOGENIC (SBR) RUBBER

Cryogenic rubber is the cleanest and highest grade of recycled rubber granule. This rubber consists of ground-up recycled tires which have been cryogenically frozen to allow for a cleaner partition of the pieces and turning the rubber into small, smooth-edged particles.

IT IS THE ULTIMATE FORM OF AN ENVIRONMENTALLY-FRIENDLY PRODUCT.

Cryogenic rubber works to promote effective and consistent drainage by eliminating the potential for migration caused by water. The cryogenic rubber's smooth shape facilitates a consistent flow of water through the infill without raising and displacing any rubber. The shape also allows the granules of rubber and sand to remain in suspension in a layered system, creating the optimal mix for a safe and realistic playing surface.

Ambient Rubber

AMBIENT (SBR) RUBBER

Ambient-processed rubber results in a looser rubber material. Also made from ground-up tires, ambient rubber differs from cryogenic rubber in its grinding phase, where it is processed through a high powered rubber cracker mill at ambient temperature. The result is a more jagged rubber granule creating air pockets which can increase its propensity to float and facilitate infill migration. Due to its more jagged shape, ambient rubber does not stay in suspension with silica sand, and therefore, ambient rubber should not be used in a layered system. Nonetheless, ambient rubber offers an environmental, cost-efficient solution for a sports field.

Nike Grind Rubber

TPE

EPDM

ALTERNATIVE INFILL MATERIALS

In recent years, an influx of new infill products has been introduced to the market, all with their own claimed benefits and some noteworthy drawbacks. Here is a description of the alternative infill materials that are currently available:

NIKE GRIND

Nike Grind infill is a solution for those who wish to have a recycled, environmentally-friendly infill other than SBR. Nike Grind consists of recycled athletic shoes and Nike manufacturing scrap which are ground up and turned into infill crumb. Nike Grind is also a non-marking rubber, leaving balls, shoes and uniforms clean from any markings obtained on a typical turf field. This product is also the most cost-efficient material other than SBR.

THERMOPLASTIC ELASTOMER (TPE)

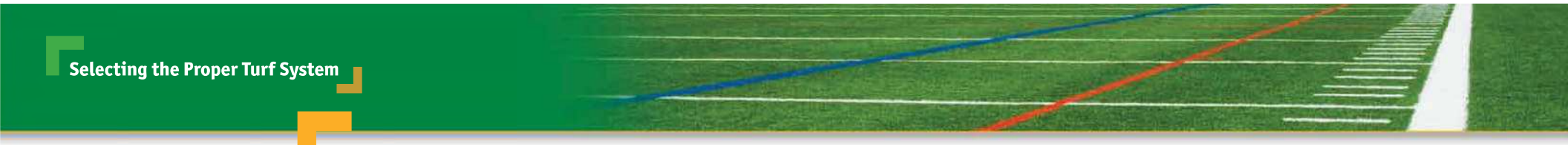
TPE is an alternative rubber to the recycled tire rubber. It is produced by using prime raw materials which offer a stable shock absorption for synthetic turf fields. The infill pellets are harder than typical SBR granules but are also quite durable. TPE has an environmental aspect because the material can be recycled after its use as infill.

A high-grade of TPE is required in order for the infill material to be durable in a sports field. Only the best grades of TPE have characteristics which allow them to remain durable by rebounding back to their original shape after compression. Such material comes at a higher price, often three to five times higher than that of SBR.

Many forms of lower grade TPE can easily deform after athletic use and turn into an ineffective gummy piece with no safety or performance attributes.

ETHYLENE PROPYLENE DIENE MONOMER (EPDM)

Similarly sized to SBR rubber, EPDM consists of a virgin, non-recycled material which can be made into any color to make the artificial turf system look as closely as possible to natural grass. However, EPDM is known for breaking down over time. The material is soft yet does not withstand sports use quite as well as SBR. EPDM also comes at a significantly higher price tag due to its complex manufacturing process.



INFILL


Cork


Coconut / Walnut


Coated SBR Rubber


Coated Sand

ORGANIC INFILL MATERIALS - Natural infills are currently being made available by some manufacturers in the market. Some of these infills present worthy benefits while others have proven to be ineffective for sports fields use.

CORK - As a replacement for rubber, cork has attained high results for athletic performance and field durability when tested as infill for sports turf fields. With installations in different parts of the world, cork infill is quickly becoming a popular option. Furthermore, testing has demonstrated that surface temperature is lower when using cork as infill, rather than any type of rubber.

COCONUT / WALNUT SHELL - Although viewed as organic due to the materials they consist of, the playing conditions of fields which have any coconut or walnut shell infill are far from being "natural". The material will become soggy and migrate during rainfall and then harden once it dries up creating a stiff, inconsistent surface. Such infill material is not recommended.

COATED (SBR) RUBBER - Polyurethane-coated (colored) rubber has been introduced to the market as an attempt to reduce the temperature of fields in warm areas. This effort has proven to be ineffective. The process simply involves coating standard crumb rubber with a light color, in hopes that less heat would be absorbed by the infill. Coated rubber is also more expensive than standard SBR and offers no added performance or safety benefit. It is not commonly used in sports fields.

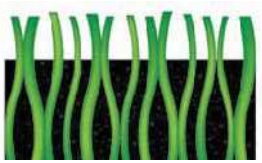
COATED SAND - Coated sand has been presented as another alternative to SBR, with companies stating that infill-splash is reduced due to the low quantity of infill. However, testing has proven that coated sand is not sufficiently robust to withstand sports field use. The infill material breaks down quickly and the fibers are subject to more degradation. Furthermore, fields require a high quantity of this infill, driving the cost up. Overall, such infill material is not recommended.

COMPARISON CHART

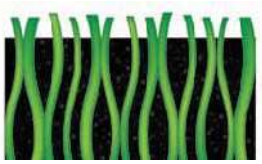
This comparison chart will help you make the right decisions on the best infill solution for your needs.

	Affordability	Durability	Performance	Safety	Environment	Product History
SBR Cryogenic	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
SBR Ambient	✓✓✓	✓✓	✓✓	✓✓	✓✓✓	✓✓✓
High Grade TPE	✓	✓✓✓	✓	✓✓	✓✓	✓✓
EPDM	✓	✓✓	✓✓✓	✓✓✓	✓	✓
Nike Grind	✓✓	✓✓	✓✓	✓✓	✓✓✓	✓
Coated Sand	✓	✓	✓	✓	✓✓	✓
Cork	✓✓	✓✓	✓✓	✓✓	✓✓✓	✓
Coconut/Walnut Shell	✓✓	✓	✓	✓	✓✓✓	✓

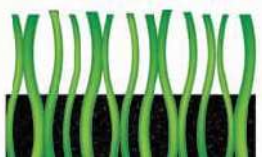
Here is a look at the effects of varying infill depths:



Infill Depth - Ideal
Infill at approximately 2/3 (two-thirds) depth of the fiber height will provide the necessary fiber support for a longer lasting field along with less maintenance and a very minimal amount of infill displacement.



Infill Depth - Too High*
Too much infill depth in a turf system leads to rooster tails following ball roll and running, along with the potential for severe infill displacement.



Infill Depth - Too Low*
An infill level that is too low interferes with the anchoring of the turf surface, causes wrinkling and/or buckling of the turf surface, fails to protect the turf fibers from premature wear and abrasion and compromises athlete safety.

* It is important to note that fiber manufacturers will not provide a warranty for these systems.

THE IMPORTANCE OF PROPER INFILL DEPTH

There are three key aspects to constructing the ideal turf system – turf spacing (gauge), pile height, and infill depth. All three properties must be engineered to deliver maximum safety, performance, and durability.

Turf Spacing – The spacing of the system must be open enough for the athlete to cut, plant, and release in the infill system – providing for grass-like traction. The right spacing for a turf system is ¾" as it has proven to provide ideal cleat interaction.

Pile Height – The height of a system's fiber is proportionate to the amount of infill required by a given system. For contact sports, a 2.5" pile height is desired because it allows ample infill for proper cushioning and impact resistance. For non-contact sports, a 2" fiber height is acceptable. Systems shorter than 2" should not be used for sports unless accompanied by an underpad.

Infill Depth – Infill depth is key to maintaining a grass-like appearance, while also ensuring proper playability and longevity of the fiber. The infill is the athlete's source for cutting, planting, shock absorption and energy restitution. Moreover, ensuring proper infill depth will contribute to the longevity of the turf fiber and lead to the natural progression of an artificial turf field. This aspect is the most important part of turf construction. It is important to note that the leading fiber manufacturers recommend free pile heights between 5/8" and 3/4". The free pile height refers to the portion of the fiber that is left exposed after the infill is added to the artificial turf system.

The critical mistake of competitive turf systems, regardless of the type of infill, is the under-filling or over-filling of the turf system.

Avoid the major risk of over-infilling or under-infilling your turf system - demand 2/3 of infill depth in your specifications!

BACKING

What type of turf backing is right for you?

Choosing a backing type is arguably the most difficult part of putting together an artificial turf system as most people do not pay attention to its importance because it is not visible from the surface.

However, the proper turf backing construction will provide a solid foundation for the entire artificial turf field. The composition and performance of the backing simply cannot be overlooked.

What does a turf backing "do"?

Artificial turf backings are comprised of a primary backing and a secondary backing. Both the primary and secondary backings work together to provide dimensional stability to the entire system. The primary backing is comprised of woven polypropylene fabrics that allow the artificial turf fibers to be tufted into material in rows and facilitate seaming between artificial turf panels. The secondary backing is often referred to as the 'urethane coating' and is applied to the reverse side of the primary backing in order to permanently lock the tufted fibers in place. It is important to note that there are different coating styles that can affect the tuft bind of the fibers and the drainage rate of the system. Turf backings are either precision coated using the 'Finger Unit' method or they are 'Solid Coated and Perforated'.

PRIMARY BACKING

2-LAYER

A quality two-layer primary backing will provide enough strength, tuft bind, and dimensional stability to last for many years. Two-layer permeable woven and non-woven polypropylene backings are ideal due to their ability to provide for ease of precision tufting, product strength, flexibility and - combined with a finger-unit urethane coating (see next page) - their proven ability to drain better than backings with too many layers. There are almost 10,000 fields worldwide using a two-layer primary backing because of its proven performance.

3-LAYER

Three-layer backings are more common among lighter weighted turf systems in order to provide extra stability to compensate for the lack of infill material present in the artificial turf system. While more infill material and less primary backing layers are the safer alternative in terms of player injuries, three-layer backings can provide good tuft bind results. Due to the little amount of installed fields with true three-layer primary backings, the effect these tri-layer primaries have on promoting effective drainage remains to be seen.

SECONDARY BACKING

FINGER-UNIT COATED

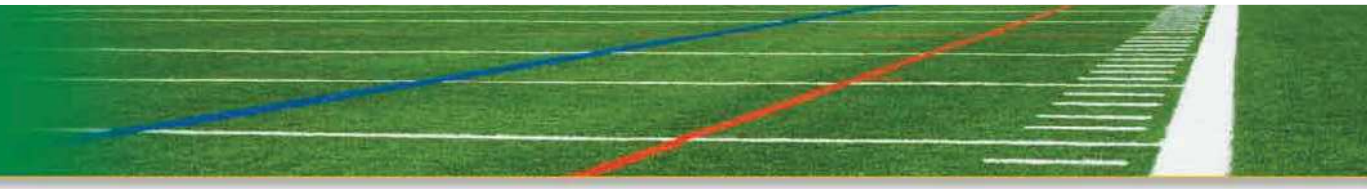
The success of thousands of all-weather artificial turf systems already installed is due largely to the permeability of the backing along with the quality of the base upon which the field is installed. FieldTurf's backing is naturally 40% porous thanks to a patented finger-unit coating system. In order to secure the fiber's tuft bind, a quality urethane coating is only applied along the fiber rows, allowing for the remainder of the backing to be made available for drainage. This has been the preferred backing design of over 4500 organizations at every level of sport across North America.

SOLID COATED

While not quite as effective as the Surelock Finger-Unit method, backings that are solid coated and perforated do provide some benefits. Holes are perforated through the primary and secondary backings to facilitate drainage. The proper way to do this is to puncture 0.25" holes that are approximately 3" apart in both directions. While creating many holes through the backing can weaken its overall strength, the backing can still perform well given that it is used in a quality artificial turf system. In this scenario, the application of the secondary backing/urethane coating is not as precision-focused as the Surelock Finger-Unit method. However, this type of backing configuration does still provide for good tuft bind and stability.

THERMO-BONDED

Thermo-Bonded backings are new to the marketplace. The high cost associated with these tri or quad layer backings have yet to yield any real advantages over traditional primary backings. Thermo-Bonded backings are generally comprised of thermoplastic materials that are heated until fused together. While initial controlled laboratory testing shows good tuft bind results, the stability and drainage properties of these systems have yet to be proven in outdoor climates for extended periods of time.



SEAMS

What do seams "do"?

The field seam is the lifeline of the field. Seams join the large turf panels to create one unified field surface. Having solidly bound seams is the most important aspect for a durable field.

What type of seam is right for you?

With so much riding on the quality of the seam construction job, it is critical to invest in a quality sewn seam method that has proven its strength on thousands of fields - rather than the cheap sewn method or glued alternative. The long-term risks associated with poorly sewn or glued seams are simply not worth the short-term costs. Reoccurring problems with seams are the number one maintenance issue affecting fields around the globe.

SELVEDGE EDGE SEWING

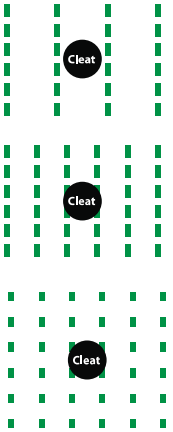
Sewn seams have quickly become the preferred method of joining artificial turf rolls on-site because of the proven durability associated with a proper sewing technique. The selvedge edge sewing method is proven in use on thousands of fields. The key advantage to this technique is that the thread does not go through the pile fibers; rather an extra flap of backing material, called the selvedge edging, acts as the sewing medium. This seaming method ensures that seams are actually hidden under the pile fabric.

NON-SELVEDGE EDGE SEWING

This alternative features a picking procedure which often makes the seams visible. The thread in the fiber matrix can pose a threat to players if their cleats come in contact with the thread. Since the thread is sewn through the fabric itself, the process damages the backing. The turf backing is punctured excessively along both sides of the seam, which affects the integrity of the fabric backing, weakening it significantly at the seam.

GLUED SEAMS

Glued seams are a very low quality option in order to 'temporarily' join artificial turf panels. With glued seams, the large turf panels can shift and raise over time. Eventually the glued seams will no longer be able to endure the wear and tear caused by regular play. As a result the glued seams will literally bust open allowing for the panels to shift. With the seam compromised, infill can reposition itself beneath the panels resulting in a mound, or the infill will migrate from beneath a panel leaving a hollow zone in the field.



TURF SPACING

The space between the rows of turf tufted into the backing is known as turf spacing (or stitch gauge). The turf space can vary from a tight gauge of 3/8" to a wide gauge of 3/4". This gauge is directly linked to the quantity of infill that can be laid between the turf fibers, and how evenly each layer can be distributed.

WIDE GAUGE

A wide gauge of 3/4" allows the infill layers to be deposited evenly into the turf system and act as artificial earth. Turf carpets with wide gauges are the ones which can best benefit from heavyweight infill systems. The wide gauge provides athletes with the right amount of space between the fibers for their cleats to dig into the infill, in order to cut, plant, and release in a grass-like system.

TIGHT GAUGE

A tighter gauge of 3/8", 1/2" or even 5/8" means the rows of fibers are closer together, and they do not provide sufficient space for larger quantities of infill to be deposited into the turf system. Less infill means that it is increasingly difficult for the athlete to get solid footing. The amount of contact between the cleat and the plastic fibers often causes much slippage.

SQUARE-GRID GAUGE

Some companies will recommend an equal amount of space between each individual tuft, so that the turf resembles a matrix-like grid. The space between each tuft is usually no more than 3/8". The claimed benefit of this type of system is that the ball roll (for soccer) would remain the same regardless of the direction the ball rolls in. This claim is simply speculative as there have been no documented changes in ball roll for non square-grid gauges. In fact, nearly every single FIFA-recommended field in the world uses standard row tufting systems.

ROLE OF THE UNDERPAD

Underpads, also known as e-layers or shock pads, were introduced along with carpet-type turf systems in the 1960's. Underpads were vital to these systems as they provided the shock absorption required to limit player injuries. The introduction of long pile artificial turf systems with heavy weighted infills in the 90's, eliminated the need for a separate underpad as this component's main function – providing proper shock absorption – was easily accomplished through the turf's infill system. There has been a recent movement by some to re-introduce underpads to the marketplace.

Currently there are over 15 companies who specialize in the production and installation of underpads. The majority of these products were built without any specific turf systems in mind.

TODAY, UNDERPADS ARE USED FOR TWO REASONS:

1) Shock Absorption - Lightweight turf systems (4 lbs of infill or less) typically require a separate underpad to allow for proper shock absorption (Gmax). Short pile turf systems (less than 1.75") also require a separate shockpad for the same reason. Typically underpads designed for shock absorption are closed cell systems with adequate drainage.

2) Drainage - The "synthetic subbase" market continues to grow as systems were designed to improve drainage below the turf system. These systems are designed to eliminate the need for excessive amounts of stone and also provide for some shock absorption. Typically underpads designed for drainage are open cell systems with adequate shock absorption properties.

The use of an underpad is optional for pile heights of 2.0" or more, but must be used with any pile height less than 2.0" if the desired use is for sports.

TURF SYSTEMS

What artificial turf system is right for you?

An artificial turf system is comprised of artificial turf fibers, infill, and backing. Each component has its own functions that contribute to the artificial turf system's performance as a whole. Since the very beginning FieldTurf has built its artificial turf systems to match the specific needs of its clients. Below is a list of FieldTurf's engineered systems that have been designed to provide the highest performance in athletic surfacing.

REVOLUTION®
The New Age of Artificial Turf.®

Classic HD
Durability Redefined.

XM
Best in Class.

XT
Best in Class.

Multi40
The Every Day Turf Solution.

MultiCurl
The Every Day Turf Solution.

Recommended Pile Heights by Application:
Multi-Purpose Use – 2.25", 2.5"
Football – 2.25", 2.5"
Soccer – 2.00", 2.25", 2.5"
Lacrosse – 2.00", 2.25", 2.5"

Recommended Pile Heights by Application:
Multi-Purpose – 2.25", 2.5"
Baseball – 2", 2.25", 2.5"
Football – 2.25", 2.5"
Lacrosse – 2.00", 2.25", 2.5"

FieldTurf Revolution

FIBER: MONOFILAMENT - The unique shape and precise extrusion process of the Revolution fiber eliminates breaking points. Designed and produced in our state of the art fiber plant, the Revolution fiber is based on the three key principles of fiber manufacturing - polymer, process and geometry - and features the latest in UV protection.

INFILL: SAND-AND-RUBBER (3-LAYERED) - The Revolution system features the cryogenic rubber and silica sand heavy infill where specially sized cryogenic rubber particles and washed silica sand granules are layered, in a patented installation process. This specific infill composition is the only recipe to have proven long-term safety and performance.

BACKING: FINGER-UNIT - The patented SureLock finger-unit coating system leaves the backing 40% porous for unmatched drainage and contributes to the most consistently high performing tuft bind in the industry. Other products can randomly achieve good tuft bind but no one else can do it with the same level of consistency as FieldTurf.

FieldTurf Classic HD

FIBER: SLIT-FILM - Designed to be the very best slit-film fiber ever produced, Classic HD fibers are manufactured through an upgraded production process which reduces the amount of slits made to the fiber - allowing for much wider fibers that are built to be much stronger. The fibrillation process of the Classic HD fibers split the open ends at the top of each fiber which then lay over on the surface and encapsulate the infill.

INFILL: SAND-AND-RUBBER (3-LAYERED) - The Classic HD system features the cryogenic rubber and silica sand heavy infill where specially sized cryogenic rubber particles and washed silica sand granules are layered, in a patented installation process. This specific infill composition is the only recipe to have proven long-term safety and performance.

BACKING: FINGER-UNIT - The patented SureLock finger-unit coating system leaves the backing 40% porous for unmatched drainage and contributes to the most consistently high performing tuft bind in the industry. Other products can randomly achieve good tuft bind but no one else can do it with the same level of consistency as FieldTurf.

FieldTurf XM

FIBER: MONOFILAMENT - FieldTurf XM features a spined monofilament fiber that demonstrates strong wear resistance and superior pile recovery. It is a non-abrasive fiber that withstands long-term testing.

INFILL: SAND-AND-RUBBER (HETEROGENEOUS MIX) INFILL - FieldTurf XM features a two-layer infill comprised of ballast layers of sand and top layers of recycled rubber granules for proper shock absorption and world-class performance.

BACKING: SOLID & PERFORATED - FieldTurf XM systems feature a dimensionally-stable backing that is coated and perforated at FieldTurf's manufacturing facility. The result is a strong tuft bind that others cannot consistently achieve along with excellent drainage characteristics.

Recommended Pile Heights by Application:
Multi-Purpose – 2.25", 2.5"
Soccer – 2", 2.25", 2.5"

FieldTurf XT

FIBER: SLIT-FILM - FieldTurf XT uses an engineered technology consisting of specially designed slit-film fibers that are fibrillated to encapsulate infill and provide a grass-like appearance. XT fibers have withstood thousands of cycles of testing. They are very durable, yet soft fibers that were designed to resist matting.

INFILL: SAND-AND-RUBBER (HETEROGENEOUS MIX) INFILL - FieldTurf XT features a two-layer infill comprised of ballast layers of sand and top layers of recycled rubber granules for proper shock absorption and world-class performance.

BACKING: SOLID & PERFORATED - FieldTurf XT systems feature a dimensionally-stable backing that is coated and perforated at FieldTurf's manufacturing facility. The result is a strong tuft bind that others cannot consistently achieve along with excellent drainage characteristics.

Recommended Pile Heights by Application:
Multi-Purpose – 2.25", 2.5"
Soccer – 2", 2.25", 2.5"

FieldTurf Multi40

FIBER: CHOICE OF MONOFILAMENT OR SLIT-FILM - The low pile Multi40 system comes with either a strong and soft monofilament fiber for ideal ball roll and "fiber memory" or with an extremely durable slit-film fiber for superior infill encapsulation.

INFILL: SAND-AND-RUBBER (HETEROGENEOUS MIX) INFILL & SHOCKPAD - A ballast layer of sand and a choice of top layer cushions including SBR Rubber, TPE Granules and Nike Grind coupled with an underpad gives the Multi40 systems ideal shock absorption in addition to high performance playability for multi-purpose applications, specifically for soccer and field hockey.

BACKING: SOLID & PERFORATED - Multi40 systems feature a dimensionally-stable backing that is coated and perforated at FieldTurf's manufacturing facility. The result is an exceptional tuft bind strength that others cannot consistently achieve along with excellent drainage characteristics.

Recommended Pile Heights by Application:
Multi-Purpose – 1.5"
Soccer – 1.5"
Field Hockey – 1.5"

FieldTurf MultiCurl

FIBER: CURLY MONOFILAMENT - The curly texturized monofilament fiber is designed to be extremely durable and aesthetically pleasing - delivering excellent grass-like performance. Each fiber undergoes a high-heat texturization process to give it a crimped appearance and strong resilience. Unlike some other fibers of its type, it is available in a wide variety of colors.

INFILL: SAND-AND-RUBBER (HETEROGENEOUS MIX) INFILL & SHOCKPAD - A ballast layer of sand and a choice of top layer cushions including SBR Rubber, TPE Granules and Nike Grind coupled with an underpad gives the MultiCurl system ideal shock absorption in addition to high performance playability for multipurpose applications, specifically for soccer and field hockey.

BACKING: SOLID & PERFORATED - The MultiCurl system features a dimensionally-stable backing that is coated and perforated at FieldTurf's manufacturing facility. The result is a strong tuft bind that others cannot consistently achieve along with excellent drainage characteristics.

Recommended Pile Heights by Application:
Multi-Purpose – 1.5"
Soccer – 1.5"
Field Hockey – 1.5"

Selecting the Proper Turf System

Information
(800) 724-2969
info@fieldturf.com
www.fieldturf.com

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Appendix C

Alternative Infill Comparison

Alternative Infill Comparison

Infill	Description	Shock Pad Required?	Additional Maintenance Required?	Advantages	Disadvantages	*Price difference vs SBR (per sq ft)
CoolPlay	Extruded cork composite, made up primarily of natural cork, polyethylene and elastomers.	No	No	• Organic material on top of the field where athletes come into contact with the infill • Proven heat reduction - Significant 30-35 degree heat reduction • No change in playability vs. sand/cryogenic rubber system • Natural UV resistance • Good compression/compaction characteristics • Least expensive option	• Crumb rubber still utilized in the system • Breakdown of top cork layer over time • Virgin material	$0.40
Nike Grind	Proprietary rubber mixture for running shoes. By-product of the shoe production process.	No	No	• Not "SBR" rubber. Less public perception of health risks • Play is similar to a sand/rubber field • No pad needed • Post-industrial recycled material	• Still rubber, just not SBR tire rubber • Multi-color rubber, different "look" • Limited supply (40 fields/year) • Unknown control over source of supply • Waste from Asia	$1.50
Organic (Cork Based)	100% cork, derived directly from cork trees.	Yes	Yes	• Fully organic material • Good compression/compaction characteristics • Proven heat reduction • No water needed • Natural UV resistance • Infill looks like natural soil • Fire-retardant • No smell	• Expensive option with additional long term maintenance requirements • Some migration of infill may occur • Low density allows material to float, cling to fibers with static charge	$1.90
EPDM	A copolymer of ethylene and propylene having diene linkages that can be cross-linked with peroxides or sulfur.	Yes	No	• High to medium resiliency depending on filler level • Can be colored	• Similar to TPE (many put them in the same family), but high filler level can result in chalking and advanced degradation of materials • Expensive; higher quality materials must be imported from Europe • Improper crosslinking can lead to premature aging • Virgin material	$2.35
EcoMax	Mixture of recycled turf and TPE.	Yes	No	• Great playability characteristics (plays close to high end cryogenic rubber/sand infill system) • Good compression/compaction characteristics • Tested rigorously for mechanical wear and weathering • Slight heat reduction • High quality TPE with a strong environmental story (recycled turf) • Made in North America	• Expensive • Limited supply • Limited installation history	$2.60
Organic (Fiber Based)	Primarily coconut husks, coconut peat and rice husks.	Yes	Yes	• Fully organic material • Proven heat reduction • Natural UV resistance • Infill looks like natural soil • Natural product – not chemically produced • Provides playing characteristics similar to natural turf • Retains water for evaporative cooling	• Fiber material will break down over time • Requires a watering system and water to maintain playability • Some migration of infill may occur • Additional maintenance needed • Higher price • Requires more maintenance and refreshing than crumb rubber fields • Limited resilience	$2.85 (plus irrigation)
TPE	Thermoplastic elastomers consist of materials with both thermoplastic and elastomeric properties.	Yes	No	• Strong history; product has been installed on over 500 fields worldwide in the past 10 years • Consistent shape • Good compression/compaction characteristics • Can be melted so they can be recycled after use • Can be colored	• Varying grades of TPE; improper formulation can lead to premature aging issues and potential failure (well documented cases) • Very expensive; higher quality materials must be imported from Europe • All particles are the same size– do not settle together • Round particles can create slipping problems on sidewalks or tracks • Virgin material	$3.20

*Price difference is versus standard two layer infill system. All prices include the pad, if required.

Appendix D

Playing Field Injury Studies

Injury Studies

GET READY

INCIDENCE, MECHANISMS, AND SEVERITY OF MATCH-RELATED COLLEGE MEN AND WOMEN'S SOCCER INJURIES ON FIELDTURF VERSUS NATURAL GRASS

A Two Year Prospective Study

Michael C. Meyers, PhD, FACSM

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Montana State University, Bozeman, MT 59717
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MONTANA STATE UNIVERSITY

Methods – Men's Soccer

- Prospective cohort study
- Total of 5 NCAA Division-1A universities
- Total of 169 matches
  - 69 FieldTurf (41.1%)
  - 99 Natural Grass (58.9%)
- Two-year period of competitive seasons and post-season matches from 2007-2008
- Various stadiums
  - Big East, Ivy League, Missouri Valley
- School selection based on:
  - Availability of surfaces
  - Uniformity of sport-skill
  - Full-time ATC staff

Methods

Two-sided, injury surveillance form consisting of:

- Date of injury
- Athlete weight
- School
- Type of playing surface
- Surface quality and age
- Temperature/humidity
- Year/skill level of athlete
- Where injury occurred
- Weather/field conditions
- Injury category
- Time period of injury
- Injury classification
- Injury time loss
- Position played at injury
- Injury situation
- Injury mechanism
- Injury site location
- Principle body part
- Primary type of injury
- Grade of injury
- External bleeding
- Injury due to illegal action
- Surgical intervention
- Specific musculoskeletal joint or organ location of injury

Statistical Analyses

- Data were grouped by:
  - Injury category
  - Time of injury
  - Injury classification
  - Injury time loss
  - Position played at time of injury
  - Injury mechanism
  - Injury situation
  - Injury site location
  - Primary type of injury
  - Grade of injury
  - Anatomic location of injury
  - Type of tissue injured
  - Head diagnosis
  - Knee diagnosis
  - Shoulder diagnosis
  - Environmental factors
  - Specific lower extremity joint and muscle trauma

- Tabular-frequency distributions (SPSS)
- Injury Rates and 95% Confidence Intervals
- Multivariate analyses (MANOVAs, Wilks' Lambda criterion)
- Post hoc analyses (ANOVAs, Tukey HSD)

Incidence of Match-Related College Men's Soccer Injuries between FieldTurf and Natural Grass

	FieldTurf	95% CI	Natural Grass	95% CI
Matches Evaluated				
Number of team-matches	69		99	
Team-matches (%)	41.1		58.9	
All Injuries[a]				
Number of injuries	59		125	
Injuries (%)	32.1		67.9	
Injuries per 10 team-matches	8.6	7.5-9.2	12.6	11.5-13.6
Minor Injuries[b]				
Number of injuries	47		112	
Injuries (%)	79.7		89.6	
Injuries per 10 team-matches	6.8	5.6-7.8	11.3	10.4-12.1
Substantial Injuries				
Number of injuries	8		11	
Injuries (%)	13.6		8.8	
Injuries per 10 team-matches	1.2	0.6-2.1	1.1	0.6-1.9
Severe Injuries				
Number of injuries	4		2	
Injuries (%)	6.8		1.6	
Injuries per 10 team-matches	0.6	0.2-1.4	0.2	0.1-0.7

[a] $P < 0.05$; [b] $P < 0.05$

Methods – Women's Soccer

- Prospective cohort study
- Total of 7 NCAA Division-1A universities
- Total of 205 matches
  - 85 FieldTurf (41.5%)
  - 120 Natural Grass (58.5%)
- Two-year period of competitive seasons and post-season matches from 2007-2008
- Various stadiums
  - Big East, Big Sky, Missouri Valley, WAC
- School selection based on:
  - Availability of surfaces
  - Uniformity of sport-skill
  - Full-time ATC staff

Incidence of Match-Related College Women's Soccer Injuries between FieldTurf and Natural Grass

	FieldTurf	95% CI	Natural Grass	95% CI
Matches Evaluated				
Number of team-matches	85		120	
Team-matches (%)	41.5		58.5	
All Injuries				
Number of injuries	50		92	
Injuries (%)	35.2		64.8	
Injuries per 10 team-matches	5.9	4.8-6.9	7.7	6.8-8.3
Minor Injuries				
Number of injuries	44		78	
Injuries (%)	88.0		84.8	
Injuries per 10 team-matches	5.2	4.1-6.2	6.5	5.6-7.3
Substantial Injuries				
Number of injuries	5		8	
Injuries (%)	10.0		8.7	
Injuries per 10 team-matches	0.6	0.3-1.3	0.7	0.3-1.3
Severe Injuries				
Number of injuries	1		6	
Injuries (%)	2.0		6.5	
Injuries per 10 team-matches	0.1	0.0-0.6	0.5	0.2-1.0

Summary

At this time, when comparing FieldTurf to natural grass over a two-year period of competitive collegiate soccer play, there are no significant differences in:

- Substantial or severe injury
- Injury time loss
- Position played at time of injury
- Injury mechanism
- Injury situation
- Field location
- Grade of injury
- Anatomical location of injury
- Type of tissue injured
- Lower extremity joint and muscle trauma
- Player classification
- Player weight
- Head trauma
- Knee trauma
- Shoulder trauma

INCIDENCE, MECHANISMS, AND SEVERITY OF GAME-RELATED COLLEGE FOOTBALL INJURIES ON FIELDTURF VERSUS NATURAL GRASS

A Three Year Prospective Study

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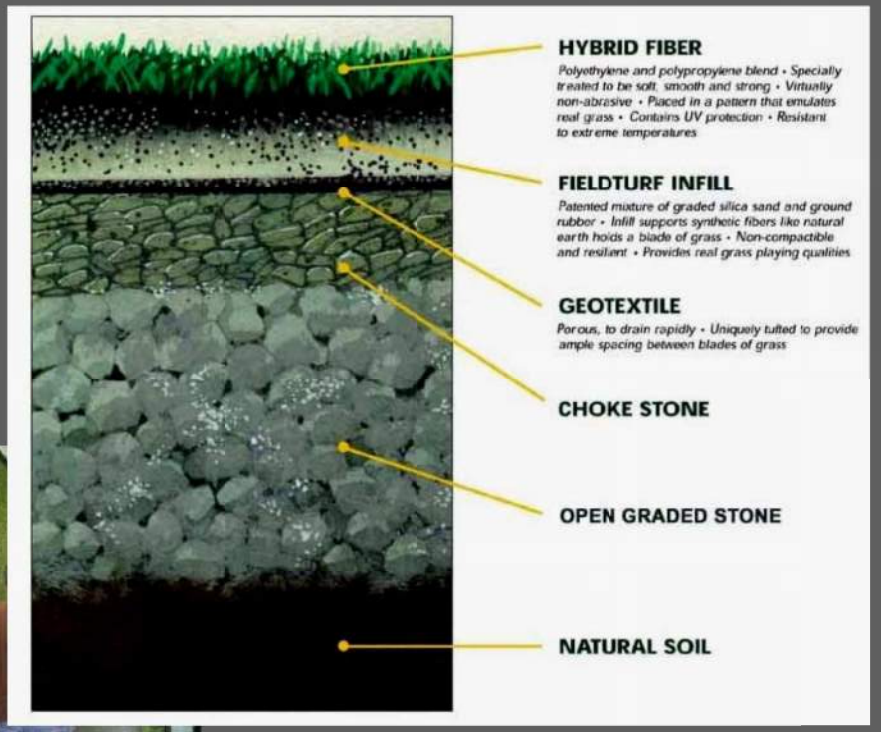
Background

- Over the past decades, numerous studies attributed a greater risk and incidence of articular and concussive trauma to playing on an artificial surface when compared to natural grass

Adkison et al., 1974; Guskiewicz et al., 2000; Jamison & Lee, 1989; Levy & Skovron, 1990; Naunheim et al., 2002; Rodeo et al., 1990; Skovron et al., 1990

Background

- A new generation of synthetic surface known as FieldTurf, comprised of a polyethylene fiber blend stabilized with a silica sand and cryogenically ground rubber infill, was developed in an attempt to duplicate the playing characteristics of natural grass



Recent Research

Incidence, Causes, and Severity of High School Football Injuries on FieldTurf Versus Natural Grass

A 5-Year Prospective Study

Michael C. Meyers,*† PhD, FACSM, and Bill S. Barnhill,‡ MD
From the †Human Performance Research Center, West Texas A&M and ‡Panhandle Sports Medicine Associates, Amarillo, Texas

Background: Numerous injuries have been attributed to playing on artificial turf. Recently, the playing characteristics of natural grass. No long-term study has been conducted comp ball injuries between the 2 playing surfaces.

Hypothesis: High school athletes would not experience any difference in the incidence, injuries between FieldTurf and natural grass.

Study Design: Prospective cohort study.

Methods: A total of 8 high schools were evaluated over 5 competitive seasons for injury incidence, injury category, time of injury,

Higher incidences of 0-day time loss injuries, noncontact injuries, surface/epidermal injuries, muscle-related trauma, and injuries during higher temperatures were reported on FieldTurf. Higher incidences of 1- to 2-day time loss injuries, 22+ days time loss injuries, head and neural trauma, and ligament injuries were reported on natural grass.

Rationale

- Although FieldTurf has been recommended as a viable option to natural grass in the prevention of injuries at the high school level of play, research into the incidence of college football injuries occurring on FieldTurf vs natural grass, during actual game conditions over several seasons of competition, had not been published in the scientific literature

Meyers & Barnhill, 2004

Purpose

- To quantify the incidence, mechanisms, and severity of game-related college injuries on FieldTurf versus natural grass
- It was hypothesized that college athletes would not experience any difference in the incidence, mechanisms, and severity of game-related trauma between FieldTurf and natural grass

Methods

- Prospective cohort study
- Total of 24 NCAA Division-1A universities
- Total of 465 games
  - 230 FieldTurf (49.5%)
  - 235 Natural Grass (50.5%)
- Three-year period of competitive seasons and bowl games from 2006-2008
- Various stadiums
  - ACC, Big 12, Big East, Conference USA, Mountain West, WAC, Pac-10
- School selection based on:
  - Availability of surfaces
  - Uniformity of sport-skill
  - Full-time ATC staff

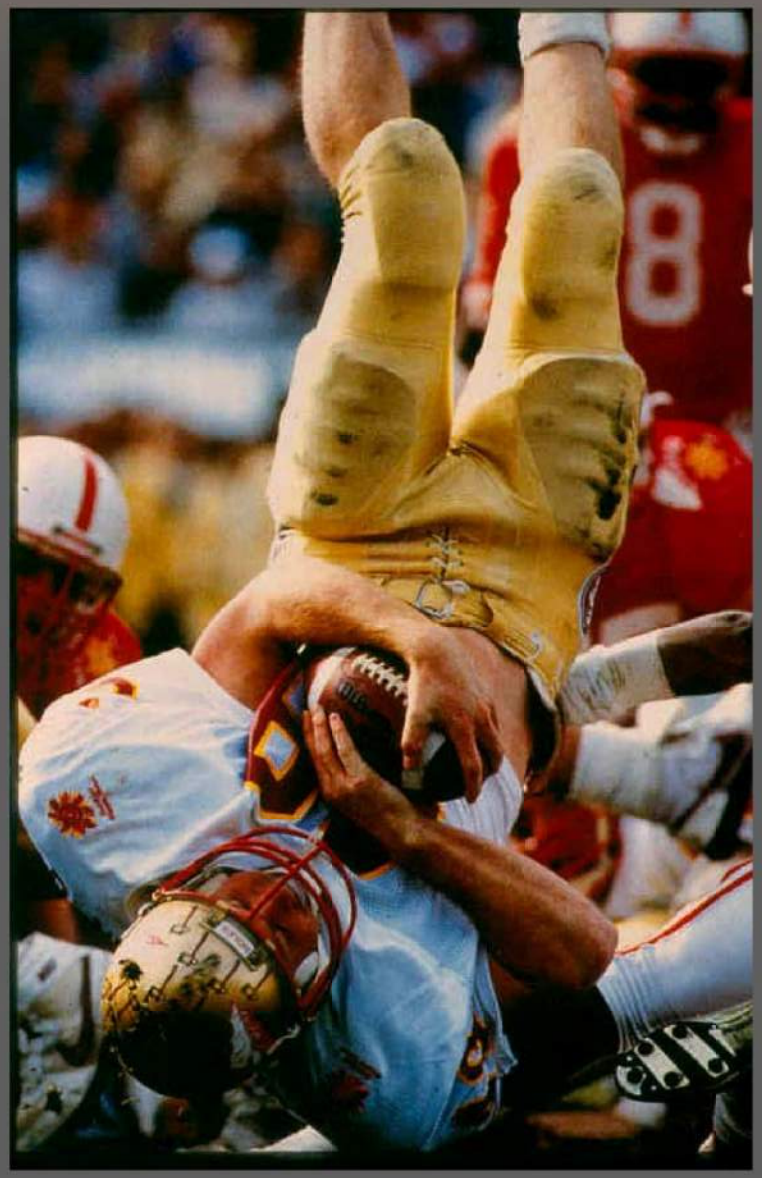
Methods

Two-sided, injury surveillance form consisting of:

- Date of injury
- Athlete weight
- School
- Type of playing surface
- Surface quality and age
- Temperature/humidity
- Year/skill level of athlete
- Where injury occurred
- Weather/field conditions
- Injury category
- Time period of injury
- Injury classification
- Injury time loss
- Position played at injury
- Injury situation
- Injury mechanism
- Injury site location
- Principle body part
- Primary type of injury
- Grade of injury
- External bleeding
- Injury due to illegal action
- Surgical intervention
- Specific musculoskeletal joint or organ location of injury

Definitions

- Although any definition of injury and level of trauma lacks universal agreement and has its shortcomings, definition of injury was based on a combination of:
  - Functional outcome
  - Observation
  - Treatment



DeLee & Farney, 1992; Hagel et al., 2003; Meyers & Barnhill, 2004; Noyes et al., 1988; Prager et al., 1989; Thompson et al.,1987

Definitions

- A reportable injury was defined as any game-related football trauma that resulted in:
  - An athlete missing all or part of a game
  - Time away from competition
  - Any injury reported or treated by ATC or physician
  - All cranial/cervical trauma reported

Meyers & Barnhill, 2004; Meyers, in press 2009

Definitions

- Injury Time Loss
  - Minor: 0-6 days time loss
  - Substantial: 7-21 days of time loss resulting in the athlete unable to return to play at the same high school competitive level
  - Severe: trauma that required 22 or more days of time loss

DeLee & Farney, 1992; Meyers & Barnhill, 2004; Thompson et al., 1987

Statistical Analyses

- Data were grouped by:
  - Injury category
  - Time of injury
  - Injury classification
  - Injury time loss
  - Position played at time of injury
  - Injury mechanism
  - Injury situation
  - Injury site location
  - Primary type of injury
  - Grade of injury
  - Anatomic location of injury
  - Type of tissue injured
  - Head diagnosis
  - Knee diagnosis
  - Shoulder diagnosis
  - Environmental factors
  - Specific lower extremity joint and muscle trauma

- Tabular-frequency distributions (SPSS)
- Injury Rates and 95% Confidence Intervals
- Multivariate analyses (MANOVAs, Wilks' Lambda criterion)
- Post hoc analyses (ANOVAs, Tukey HSD)

Results

- MANOVAs
  - Injury incidence rate ($F_{3,2249} = 3.468$; $P = 0.016$)
  - Injury category ($F_{5,2247} = 0.494$; $P = 0.781$)
  - Time of injury ($F_{5,2247} = 0.833$; $P = 0.526$)
  - Injury time loss ($F_{5,2247} = 2.480$; $P = 0.030$)
  - Position played ($F_{2,2250} = 0.300$; $P = 0.741$)
  - Skill position ($F_{9,2243} = 0.538$; $P = 0.848$)
  - Injury mechanism ($F_{12,2240} = 1.091$; $P = 0.363$)
  - Injury situation ($F_{14,2238} = 2.170$; $P = 0.007$)
  - Primary type of injury ($F_{14,2238} = 1.771$; $P = 0.042$)
  - Injury grade ($F_{2,2250} = 12.337$; $P = 0.0001$)
  - Anatomical location ($F_{3,2249} = 1.675$; $P = 0.170$)
  - Type of tissue ($F_{5,2247} = 0.559$; $P = 0.732$)
  - Field Conditions ($F_{2,2249} = 5.450$; $P = 0.001$)
  - Temperature Conditions ($F_{1,2251} = 82.360$; $P = 0.0001$)

Incidence of Game-Related College Football Injuries between FieldTurf and Natural Grass

	FieldTurf	95% CI	Natural Grass	95% CI
Games Evaluated				
Number of team-games	230		235	
Team-games (%)	49.5		50.5	
All Injuries[a]				
Number of injuries	1,050		1,203	
Injuries (%)	46.6		53.4	
Injuries per 10 team-games	45.7	44.2-46.3	51.2	49.8-51.7
Minor Injuries[b]				
Number of injuries	875		938	
Injuries (%)	83.3		78.0	
Injuries per 10 team-games	38.0	36.9-38.5	39.9	39.1-40.0
Substantial Injuries[c]				
Number of injuries	114		169	
Injuries (%)	10.9		14.0	
Injuries per 10 team-games	5.0	4.3-5.6	7.2	6.6-7.7
Severe Injuries[d]				
Number of injuries	61		96	
Injuries (%)	5.8		8.0	
Injuries per 10 team-games	2.7	2.1-3.3	4.1	3.5-4.7

[a] $P = 0.016$; [b] $P = 0.0001$; [c] $P = 0.020$; [d] $P = 0.049$

Frequency and Rate of Game-Related College Football Injuries Between FieldTurf and Natural Grass By Injury Category and Time of Injury

	FieldTurf			Natural Grass		
	# of Injuries	IIR	95% CI	# of Injuries	IIR	95% CI
Injury Category						
Player-to-player collision	570	24.8	23.7 – 25.4	660	28.0	27.1 – 28.5
Player-to-turf collision	102	4.4	3.8 – 5.1	108	4.6	4.0 – 5.2
Shoe surface-contact	229	10.1	9.8 – 10.0	276	11.7	11.1 – 12.3
Shoe surface-noncontact	35	1.5	1.1 – 2.0	41	1.7	1.3 – 2.3
Muscle-tendon overload	114	5.0	4.3 – 5.6	118	5.0	4.4 – 5.7
Time of Injury						
Pregame	5	0.2	0.1 – 0.5	4	0.2	0.1 – 0.4
First quarter	161	7.0	6.4 – 7.6	182	7.7	7.2 – 8.2
Second quarter	297	12.9	12.2 – 13.5	371	15.8	14.9 – 16.4
Third quarter	303	13.2	12.4 – 13.8	359	15.3	14.4 – 15.9
Fourth quarter	282	12.3	11.6 – 12.8	284	12.3	11.6 – 12.9
Overtime	2	0.1	0.0 – 0.3	3	0.1	0.1 – 0.4

IIR, Injury incidence rate (number of injuries ÷ total number of injuries) x 10

Frequency and Rate of Game-Related College Football Injuries Between FieldTurf and Natural Grass By Injury Time Loss and Position Played

	FieldTurf			Natural Grass		
	# of Injuries	IIR	95% CI	# of Injuries	IIR	95% CI
Injury Time Loss						
0 days	507	22.0	21.2 – 22.6	526	22.4	21.5 – 23.0
1-2 days	209	9.1	8.6 – 9.4	225	9.6	9.2 – 9.8
3-6 days	159	6.9	6.3 – 7.5	187	8.0	7.4 – 8.4
7-9 days	66	2.9	2.3 – 3.5	108	4.6	4.0 – 5.2[a]
10-21 days	48	2.1	1.6 – 2.7	61	2.6	2.1 – 3.2
22 days or more	61	2.7	2.1 – 3.3	96	4.1	3.5 – 4.7[b]
Position Played at Time of Injury						
Offense	483	21.0	20.3 – 21.5	539	22.9	22.0 – 23.5
Defense	421	18.3	17.6 – 18.7	505	21.5	20.7 – 22.0
Special teams	146	6.3	5.7 – 6.9	159	6.8	6.1 – 7.3

IIR, Injury incidence rate (number of injuries ÷ total number of injuries) x 10; [a]$P = 0.017$; [b]$P = 0.044$

Frequency and Rate of Game-Related College Football Injuries Between FieldTurf and Natural Grass By Injury Mechanism

	FieldTurf			Natural Grass		
	# of Injuries	IIR	95% CI	# of Injuries	IIR	95% CI
Injury Mechanism						
Blocked below waist	76	3.3	2.7 – 3.9	80	3.4	2.8 – 4.0
Blocked above waist	65	2.8	2.3 – 3.4	92	3.9	3.3 – 4.6
Tackling	210	9.1	8.7 – 9.4	261	11.1	10.6 – 11.6
Tackled below waist	99	4.3	3.7 – 5.0	93	4.0	3.4 – 4.6
Tackled above waist	125	5.4	4.8 – 6.1	144	6.1	5.5 – 6.7
Blocking	174	7.6	7.0 – 8.1	183	7.8	7.2 – 8.3
Impact with playing surface	84	3.7	3.1 – 4.3	82	3.5	2.9 – 4.1
Stepped on/fallen on/kicked	85	3.7	3.1 – 4.3	111	4.7	4.1 – 5.4
No contact-rotation/plant	34	1.5	1.1 – 2.0	40	1.7	1.3 – 2.2
Sprinting/running	45	2.0	1.5 – 2.5	41	1.7	1.3 – 2.3
Catching/blocking pass/punt	17	0.7	0.5 – 1.2	25	1.1	0.7 – 1.5
Heat illness	16	0.7	0.4 – 1.1	31	1.3	0.9 – 1.8
Overuse	18	0.8	0.5 – 1.2	14	0.6	0.4 – 1.0

IIR, Injury incidence rate (number of injuries ÷ total number of injuries) x 10

Frequency and Rate of Game-Related College Football Injuries Between FieldTurf and Natural Grass By Injury Situation

	FieldTurf			Natural Grass		
	# of Injuries	IIR	95% CI	# of Injuries	IIR	95% CI
Injury Situation						
Warmup	3	0.1	0.0 – 0.4	7	0.3	0.1 – 0.6
Rushing	365	15.9	15.0 – 16.5	416	17.7	16.9 – 18.2[a]
Passing	40	1.7	1.3 – 2.3	42	1.8	1.4 – 2.3
Pass catching	123	5.3	4.7 – 6.0	138	5.9	5.2 – 6.5
Pass protection	99	4.3	3.7 – 5.0	107	4.6	3.9 – 5.2
Pass rush	115	5.0	4.4 – 5.6	105	4.5	3.8 – 5.1
Pass defense	149	6.5	5.8 – 7.1	213	9.1	8.6 – 9.4[b]
Kickoff return	34	1.5	1.1 – 2.0	39	1.7	1.2 – 2.2
PAT/FG	9	0.4	0.2 – 0.7	5	0.2	0.1 – 0.5
Kickoff	73	3.2	2.6 – 3.8	57	2.4	1.9 – 3.0
Punting	11	0.5	0.3 – 0.8	28	1.2	0.8 – 1.7[c]
Punt return	19	0.8	0.5 – 1.3	27	1.1	0.8 – 1.6
Fumble recovery	7	0.3	0.1 – 0.6	4	0.2	0.1 – 0.4
Piling-on	3	0.1	0.0 – 0.4	15	0.6	0.4 – 1.0[d]

IIR, Injury incidence rate (number of injuries ÷ total number of injuries) x 10; [a]$P = 0.040$; [b]$P = 0.023$ [c]$P = 0.020$; [d]$P = 0.011$

Frequency and Rate of Game-Related College Football Injuries Between FieldTurf and Natural Grass By Primary Type of Injury

	FieldTurf			Natural Grass		
	# of Injuries	IIR	95% CI	# of Injuries	IIR	95% CI
Primary Type of Injury						
Surface/epidermal	10	0.4	0.2 – 0.8	16	0.7	0.4 – 1.1
Contusion	243	10.6	10.1 – 10.9	247	10.5	10.1 – 10.9
Concussion	70	3.0	2.5 – 3.7	90	3.8	3.2 – 4.5
Inflammation	36	1.6	1.2 – 2.1	31	1.3	0.9 – 1.8
Ligament sprain	331	14.4	13.6 – 15.0	385	16.4	15.6 – 17.0[a]
Ligament tear	28	1.2	0.9 – 1.7	55	2.3	1.9 – 2.9
Muscle strain/spasm	142	6.2	5.5 – 6.8	170	7.2	6.6 – 7.8
Muscle tear	3	0.1	0.0 – 0.4	21	0.9	0.6 – 1.3[b]
Tendon strain	24	1.0	0.7 – 1.5	28	1.2	0.8 – 1.7
Hyperextension	16	0.7	0.4 – 1.1	9	0.4	0.2 – 0.7
Neural	56	2.4	1.9 – 3.0	55	2.3	1.8 – 2.9
Subluxation/dislocation	37	1.6	1.2 – 2.1	43	1.8	1.4 – 2.4
Fracture	42	1.8	1.4 – 2.4	42	1.8	1.4 – 2.4

IIR, Injury incidence rate (number of injuries ÷ total number of injuries) x 10; [a]$P = 0.024$; [b]$P = 0.002$

Frequency and Rate of Game-Related College Football Injuries Between FieldTurf and Natural Grass By Grade of Injury and Anatomical Location

	FieldTurf			Natural Grass		
	# of Injuries	IIR	95% CI	# of Injuries	IIR	95% CI
Grade of Injury						
1st degree	812	35.3	34.1 – 35.9	819	34.9	33.6 – 35.5
2nd degree	145	6.3	5.7 – 6.9	235	10.0	9.8 – 10.0[a]
3rd degree	93	4.0	3.4 – 4.7	149	6.3	5.7 – 6.9[b]
Anatomical Location of Injury						
Cranial/cervical	120	5.2	4.6 – 5.9	145	6.2	5.5 – 6.8[a]
Upper extremity	319	13.9	13.1 – 14.5	411	17.5	16.7 – 18.0
Thoracic	73	3.2	2.6 – 3.8	75	3.2	2.6 – 3.8
Lower extremity	538	23.4	22.4 – 24.0	572	24.3	23.3 – 25.0

IIR, Injury incidence rate (number of injuries ÷ total number of injuries) x 10; [a]$P = 0.0001$; [b]$P = 0.007$

Frequency and Rate of Game-Related College Football Injuries Between FieldTurf and Natural Grass By Type of Tissue Injured

	FieldTurf			Natural Grass		
	# of Injuries	IIR	95% CI	# of Injuries	IIR	95% CI
Type of Tissue Injured						
Bone	42	1.8	1.4 – 2.4	42	1.8	1.4 – 2.3
Joint	485	21.1	20.3 – 21.6	555	23.6	22.6 – 24.2
Muscle	385	16.7	15.9 – 17.3	441	18.8	18.1 – 19.1
Neural	126	5.5	4.8 – 6.1	144	6.1	5.5 – 6.7
Other	12	0.5	0.3 – 0.9	21	0.9	0.6 – 1.3

IIR, Injury incidence rate (number of injuries ÷ total number of injuries) x 10

Frequency and Rate of Game-Related College Football Injuries Between FieldTurf and Natural Grass By Head Injuries

	FieldTurf			Natural Grass		
	# of Injuries	IIR	95% CI	# of Injuries	IIR	95% CI
Head Injuries						
1☜ Cerebral concussion	49	2.1	1.7 – 2.7	60	2.6	2.0 – 3.1
2☜ Cerebral concussion	20	0.9	0.6 – 1.3	27	1.1	0.8 – 1.6
3☜ Cerebral concussion	1	0.0	0.0 – 0.2	1	0.0	0.0 – 0.2
Posttraumatic headache	0	0.0	0.0 – 0.0	2	0.1	0.0 – 0.3
Second impact syndrome	0	0.0	0.0 – 0.0	0	0.0	0.0 – 0.0
Epistaxis	1	0.0	0.0 – 0.2	5	0.2	0.1 – 0.5
Concussion injuries combined	70	3.0	2.5 – 3.7	88	3.7	3.2 – 4.4

IIR, Injury incidence rate (number of injuries ÷ total number of injuries) x 10

Frequency and Rate of Game-Related College Football Injuries Between FieldTurf and Natural Grass By Knee Injuries

	FieldTurf			Natural Grass		
	# of Injuries	IIR	95% CI	# of Injuries	IIR	95% CI
Knee Injuries						
Medial collateral	55	2.4	1.9 – 3.0	58	2.5	2.0 – 3.1
Lateral collateral	5	0.2	0.1 – 0.5	5	0.2	0.1 – 0.5
Anterior cruciate	7	0.3	0.1 – 0.6	17	0.7	0.5 – 1.1
ACL and associated tissue	15	0.7	0.4 – 1.0	13	0.6	0.3 – 0.9
Posterior cruciate	5	0.2	0.1 – 0.5	5	0.2	0.1 – 0.5
PCL and associated tissue	1	0.0	0.0 – 0.2	2	0.1	0.0 – 0.3
Arcuate-popliteal complex	8	0.3	0.2 – 0.7	11	0.5	0.3 – 0.8
Lateral meniscus	6	0.3	0.1 – 0.6	5	0.2	0.1 – 0.5
Medial meniscus	5	0.2	0.0 – 0.5	4	0.2	0.1 – 0.4
Patellar tendon/syndrome	27	1.2	0.8 – 1.7	25	1.1	0.7 – 1.5
ACL injuries combined	22	1.0	0.6 – 1.4	30	1.3	0.9 – 1.8

IIR, Injury incidence rate (number of injuries ÷ total number of injuries) x 10

Frequency and Rate of Game-Related College Football Injuries Between FieldTurf and Natural Grass By Shoulder Injuries

	FieldTurf			Natural Grass		
	# of Injuries	IIR	95% CI	# of Injuries	IIR	95% CI
Shoulder Injuries						
AC separation	60	2.6	2.1 – 3.2	73	3.1	2.5 – 3.7
Rotator cuff tear	2	0.1	0.0 – 0.3	9	0.4	0.2 – 0.7
Dead arm syndrome	41	1.8	1.3 – 2.3	37	1.6	1.2 – 2.1
Impingement syndrome	0	0.0	0.0 – 0.0	1	0.0	0.0 – 0.2
SLAP lesion	5	0.2	0.1 – 0.5	16	0.7	0.4 – 1.1
Hill-Sachs lesion	2	0.1	0.0 – 0.3	5	0.2	0.1 – 0.5
Bankart lesion	2	0.1	0.0 – 0.3	3	0.1	0.0 – 0.4

IIR, Injury incidence rate (number of injuries ÷ total number of injuries) x 10; AC, Acromioclavicular; SLAP, Superior labrum anterior to posterior

Frequency and Rate of Game-Related College Football Injuries Between FieldTurf and Natural Grass By Environmental Factors

	FieldTurf			Natural Grass		
	# of Injuries	IIR	95% CI	# of Injuries	IIR	95% CI
Field Conditions						
No precipitation/dry field	906	39.4	38.4 – 39.6	974	41.4	40.3 – 42.0[a]
Rain	101	4.4	3.8 – 5.0	123	5.2	4.6 – 5.9
Snow	2	0.1	0.0 – 0.3	4	0.2	0.1 – 0.4
Sleet	0	0.0	0.0 – 0.0	0	0.0	0.0 – 0.0
No precipitation/wet field	41	1.8	1.3 – 2.3	102	4.3	3.7 – 5.0[b]
Temperature						
Cold days (≤69°F)	570	24.8	23.7 – 25.4	426	18.1	17.4 – 18.6[b]
Hot days (≥70°F)	480	20.9	20.2 – 21.3	777	33.1	31.9 – 33.7[b]

IIR, Injury incidence rate (number of injuries ÷ total number of injuries) x 10 [a]$P = 0.003$; [b]$P = 0.0001$

Summary

- Although similarities did exist between FieldTurf and natural grass over a three-year period of competitive play, there were significant differences in injury incidence, severity of injury, injury time loss, injury situation, grade of injury, injuries under various field conditions, and temperature between playing surfaces

- No significant difference in head, knee, or shoulder trauma observed between playing surface

- Both surfaces, from a statistical and clinical standpoint, exhibited unique injury etiology that need to be addressed to reduce the number of game-related, college football injuries

Conclusion

- The hypothesis that college athletes would not experience any difference in the incidence, etiology, and severity of game-related injury between FieldTurf and natural grass was not supported
- FieldTurf is, in many cases, safer than natural grass
- It must be reiterated, however, that findings of this study may only be generalizable to this level of competition
- Since study is still in the early stage, investigation continues

Appendix E

Sample Industry Standard Warranty

FieldTurf
A Tarkett Sports Company

Manufacturer's Limited Warranty

FieldTurf warrants that if **FieldTurf** XTHD-65 (Product) for multi-sport use synthetic turf proves to be defective in material or installation workmanship, UV degradation, resulting in premature wear, during normal and ordinary use of the Product for the sporting activities provided herein or for any other uses for which FieldTurf provides its written authorization, within eight (8) years from the date of completion of installation (as indicated in this Warranty), FieldTurf shall either repair or replace the affected area of the Product in accordance with the terms of this Warranty. FieldTurf's sole liability under this Warranty shall be limited to either repair or replacement of the affected area of the Product, at its sole discretion, and FieldTurf shall have no other obligations or liabilities with respect to defects of the Product. FieldTurf will, at FieldTurf's option, either repair or replace the affected area to the extent required to meet the Warranty period, but no cash refunds will be made. **FieldTurf** warrants that all materials installed meet or exceed the product specifications and further warrants that replacement material will be available through the Warranty period. **FieldTurf** will verify that their representative has inspected the installation and that the work conforms to **FieldTurf**'s requirements and further warrants that the installation was done in accordance with both **FieldTurf's** recommendations and any written directives of FieldTurf"s representative. This Warranty shall commence upon the date of completion indicated in this Warranty. The accompanying Warranty service will not come into effect unless and until FieldTurf's Certificate of Completion is sent for validation to the corporate office of FieldTurf indicated herein within thirty (30) days of the date of completion or Purchaser's first use, whichever occurs first. In all cases, the Warranty shall be deemed to commence upon the date of completion indicated in this Warranty. The acceptance form of the terms and conditions contained in FieldTurf's Maintenance Guidelines must also be provided to FieldTurf's corporate office within thirty (30) days of completion of installation. **FieldTurf** warrants that the G-max to maintain a value of below 135 at installation and no greater than 185 for the life of the warranty, as per ASTM 1936 and F-355 standards, providing that the customer has performed the regular maintenance as outlined in the maintenance guidelines. This Warranty is limited to the remedies of repair or replacement, which shall constitute the exclusive remedies available under this Warranty; all other remedies or recourse which might otherwise be available are hereby waived by the Purchaser. FieldTurf will have no other obligations or liability for damages arising out of or in connection with the use or performance of the Product, including, without limitation, damages for personal injury and/or economic losses. This Warranty shall not come into effect, and FieldTurf shall have no obligations under this Warranty, unless and until FieldTurf is paid in full for the Product to be warranted hereunder.

Field Markings: Football, Soccer

Other Exclusions

EXCEPT AS EXPRESSLY SET FORTH IN THE MANUFACTURER'S LIMITED WARRANTY ABOVE, FIELDTURF DISCLAIMS ALL OTHER WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, IN FACT OR IN LAW, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

THIS WARRANTY SHALL BECOME NULL AND VOID IF THE PURCHASER FAILS TO MAINTAIN THE FIELD IN ACCORDANCE WITH THE FIELDTURF MAINTENANCE GUIDELINES AND SCHEDULE PROVIDED BY FIELDTURF THEREIN. ALL MAINTENANCE SHALL BE PERFORMED BY FIELDTURF-TRAINED AND/OR FIELDTURF-AUTHORIZED MAINTENANCE PERSONNEL ONLY.

Furthermore, this Manufacturer's Limited Warranty ***does not cover****:*

1. Damage resulting from accident, *force majeure*, misuse, intentional and unintentional abuse, infill displacement, and neglect or from other than normal play and ordinary use of the Product. For purposes of this Warranty, normal play and ordinary use shall mean usage up to 3,000 hours per year of regular play and utilization for the sporting activities provided herein; normal play and ordinary use also includes a reasonable number of users or participants, but does not include repetitive marching, repetitive training or high-intensity drills on the same part of the field, especially in the areas of, but not limited to, home plate, pitcher's mound, base areas, base paths, soccer penalty mark/spot areas, goal areas, sideline areas and lacrosse crease areas, all of which require frequent maintenance in accordance with FieldTurf Maintenance Guidelines and may require regular replacement.

FieldTurf
A Tarkett Sports Company

Manufacturer's Limited Warranty

2. Damage resulting from failure to maintain the Product in accordance with FieldTurf's Maintenance Guidelines provided to the Purchaser. The Purchaser shall keep a log of all maintenance performed on the Product and supply FieldTurf with a copy upon request.
3. Damage resulting from repair, attempted repair and/or maintenance by anyone other than FieldTurf or an authorized FieldTurf distributor or authorized FieldTurf maintainer.
4. Damage due to causes which include, but are not limited to, the application of chemicals and/or cleaning agents, adhesive backing, dirt, traffic, negligence, vandalism, fire, flood, windstorm, animals, improper care and Acts of God.
5. Failure and/or improper design of the base; depression of the soil, subsurface or other matter upon which the base or Product rests; and any and all resulting damage to the Product arising therefrom.
6. FieldTurf does not warrant the percolation rate, long term planarity and/or compaction of the base which the product is installed. **FIELDTURF DISCLAIMS ALL WARRANTIES AS TO THE BASE, EXPRESS OR IMPLIED, AND ANY AND ALL RESULTING DAMAGE TO THE PRODUCT ARISING THEREFROM**.
7. Damage resulting from the use of improper footwear such as long-spiked track shoes, regular and repeated use of steel cleats, and flat-soled shoes. Standard molded soccer or football cleats are recommended.

All synthetic turf is subject to normal wear and tear, which is not a manufacturing defect and is not covered by this Warranty. In addition to the other factors listed in this Warranty, wear and tear depends on, without limitation, the construction of synthetic turf (fiber face weight, stitch rate, fiber pile height and gauge, infill components and maintenance of the field) and the intensity of use of the synthetic turf. The Product will be stable to light fading with the maximum fading of the Product during the Warranty period not to exceed fifteen percent (15%) of color loss annually based upon an acceptable grey scale. This Warranty does not cover slight variations or gradations of color within the Product and/or face distortion. Normal behavior of the fiber and infill with respect to the wear pattern of a field can be found in the "Field Settling" document, provided in the FieldTurf after-sales service package.

FieldTurf disclaims all liability for incidental and consequential damages for breach of any express or implied warranty, including any implied warranty of merchantability, with respect to the Product. In the event that the Product is used for purposes other than the sporting activities provided herein or any other uses for which FieldTurf gives its written authorization, it being understood that FieldTurf has tested the Product for use in connection with these sporting activities and may not have tested it for other uses, FieldTurf shall not be responsible for any and all damages incurred and the Manufacturer's Limited Warranty, as well as all legal warranties, shall become null and void. Any Product repairs or replacements performed under the terms of this Warranty shall not extend the term of this Warranty.

Name of Purchaser:	
Date of completion:	*Sporting Activities:*
Location:	*Installed by:*
Address:	*City:*
State:	*Zip:*
Tel:	*Fax:*
Signature:	*(Please Print Name)*
Date:	*Reference:*

This warranty is insured by a third party.
For more information please contact Customer Service at FieldTurf at the number listed below.
7445 Côte-de-Liesse Road Suite 200, Montreal, QC, Canada H4T 1G2 • Toll Free: 1-800-724-2969 •

Appendix F

NDEQ Recycled Tire Grant Program Guidelines & Application

Nebraska Department of Environmental Quality
Waste Reduction and Recycling Incentive Grant Fund

Grant Application Packet

PARTIAL REIMBURSEMENT FOR PURCHASE OF TIRE-DERIVED PRODUCTS AND/OR CRUMB RUBBER

Nebraska Department of Environmental Quality
Waste Planning & Aid Unit
PO Box 98922
Lincoln, NE 68509-8922
402-471-3388 Toll Free 1-877-253-2603
Website: www.deq.state.ne.us

November 2003

Printed on recycled paper

This application is to apply for partial payment for the purchase of tire-derived products and/or crumb rubber. Other scrap tire grant categories include:

- Cost-sharing for scrap tire processing, manufacturing, and civil engineering uses.
- Scrap tire collection site cleanup for political subdivisions.
- Capital and startup costs for processing, manufacturing, collecting, and transporting scrap tires.

Other grant programs available through the Nebraska Department of Environmental Quality's Waste Planning & Aid Unit are described inside the back cover. To obtain a copy of any grant application form, call 402-471-3333 or toll-free 1-877-253-2603.

Application Form

PARTIAL REIMBURSEMENT FOR PURCHASE OF TIRE-DERIVED PRODUCTS AND/OR CRUMB RUBBER

NEBRASKA DEPARTMENT OF ENVIRONMENTAL QUALITY
Waste Management Division - Planning and Aid Unit

1. Applicant: _____

2. Federal identification number or social security number: _____

3. Applicant mailing address: _____

   City: _____ Zip code: _____ County: _____

4. Designated contact person: _____ Title: _____

   Telephone: _____ E-Mail: _____ Fax: _____

If purchasing a tire-derived product:

5. Identify the item purchased. Include manufacturer, product name, intended use, and percent of scrap tire content and number of Nebraska scrap passenger tire equivalents used. **Attach certification and/or documentation from your vendor that the tires used were generated in Nebraska:**

   _____

   Total retail cost: $_____ X 25% (.25) = $_____ - Total amount requested

If purchasing crumb rubber:

6. Identify the amount purchased. Identify the company where the crumb rubber was produced and purpose for which crumb rubber will be used. **Attach certification and/or documentation from your vendor that the tires used were generated in Nebraska:**

   _____

   Total retail cost: $_____ X 50% (.5) = $_____ - Total amount requested

7. **Attach a copy of the invoice and paid receipt or invoice and canceled check if requesting a reimbursement for a tire-derived product or crumb rubber you have already purchased. Attach three bids if this is a proposed purchase (see page 2 for additional information on bids.)**

8. I, the Authorized Representative, certify to the Nebraska Department of Environmental Quality that

   _____
   Name of applicant Date

   A. Possesses all necessary authority to undertake or participate in the proposed project;
   B. Is in compliance with Nebraska State Affirmative Action Requirements and is committed to provide a drug free workplace environment;
   C. Holds or can acquire title to all lands or has the necessary easements and right-of-way for the project and related lands;
   D. Does not operate a landfill without a permit from the Nebraska Department of Environmental Quality; and
   E. Is in compliance with the local zoning ordinances pertaining to the proposed project.

   _____
   Signature of Authorized Representative Typed/printed name of Authorized Representative

Please mail the completed form to: Nebraska Department of Environmental Quality
Waste Management Division - Planning and Aid Unit
PO Box 98922 - Lincoln, NE 68509-8922

GENERAL INFORMATION

The following are eligible for reimbursement grant funding:

1. Reimbursement of up to 25% of the retail cost to purchase tire-derived products with a minimum of 25% Nebraska recycled tire content. Retail cost includes installation, shipping, handling, sales tax, etc.

   - Only purchases made after May 30, 2001 are eligible for partial reimbursement.

2. Reimbursement of up to 50% of the cost to purchase crumb rubber generated and used in Nebraska.

   - Only purchases made after May 30, 2001 are eligible for partial reimbursement.

The following information on cost estimate/bids applies only if the project is a proposal. If the product has already been purchased, only a copy of the invoice and paid receipt or invoice and canceled check are necessary.

Cost Estimate/Bid Requirements. The main reason applications are ineligible is because the application does not comply with cost estimate/bid requirements for equipment and contractual services. Please read the following very carefully.

In order to establish a fair price for equipment and contractual services, a cost estimate/bid is required. A cost estimate/bid is an estimate of cost in response to detailed specifications. A cost estimate/bid should be in writing from the vendor and obtained from at least three different vendors. Three cost estimates or bids from one vendor for different models or services do not meet this requirement.

Exceptions to the three cost estimate/bid rule may include: 1) the product or service can only be purchased from one source; or 2) the applicant was unable to receive three bids even though a good faith effort was made to solicit three bids. Documentation must be provided to explain why three bids were not obtained. Justification for fewer than three bids must be reasonable, verifiable, and is subject to Department approval. The expense will not be considered eligible for grant funding if the justification is not approved by the Department.

The lowest responsible bid must be used in the application budget. If the lowest bid is not considered to be the lowest responsible bid, the applicant must provide justification for accepting a bid other than the lowest bid. Justification must be reasonable, verifiable, and is subject to Department approval.

The Department reserves the right to change application budgets if these guidelines are not followed.

HOW TO COMPLETE THE APPLICATION FORM

The following information must be provided in the appropriate section of the application:

1. Name of the applicant.

2. A federal identification or social security number is required to process payments.

3. Mailing address where grant award is to be sent.

4. Name of contact person knowledgeable of the project and available to answer questions.

5. If purchasing a tire-derived product, identify the item purchased. Include information on the manufacturer, product name, intended use, percentage of scrap tire content, etc., and calculate the reimbursement amount.

6. If purchasing crumb rubber, identify the amount purchased. Identify the company where the crumb rubber was produced and purpose for which crumb rubber will be used. Calculate the reimbursement amount.

7. Attach a copy of the invoice and paid receipt or invoice and canceled check if requesting a reimbursement for a tire-derived product or crumb rubber you have already purchased. Attach three bids if this is a proposed purchase (see page 2 for additional information on bids.)

8. Attach certification and/or documentation from your vendor that the tires used were generated in Nebraska.

9. An authorized representative must sign the application form. An authorized representative is an individual with authority to do business for the applicant.

PROGRAM DESCRIPTION

The Scrap Tire Reduction and Recycling Incentive fund was created by LB 1034 in 1994 as part of the Waste Reduction and Recycling Grants Program. LB 1034 placed the revenue generated from the $1 tire fee into a separate fund available for programs that assist in the management of Nebraska's scrap tires. The tire fee remained in a separate fund until July 1, 1999 when it went into the Waste Reduction and Recycling Incentive Fund.

Under LB 491, passed in the 2001 legislative session, the first $1 million of the tire fees collected annually will be available until June 30, 2007 for new scrap tire projects if enough acceptable applications are received. These funds will be available to all applicants, public and private. Funds over $1 million will go to the Waste Reduction and Recycling Incentive fund and be available to political subdivisions only for eligible waste reduction or recycling projects.

APPLICATION DEADLINES

The application deadline is February 1 of each year. Applications must be hand-delivered or postmarked by the deadline.

ELIGIBILITY REQUIREMENTS

In order to receive funding for partial reimbursement for the purchase of tire-derived products and/or crumb rubber through the Scrap Tire Reduction and Recycling Incentive fund, all projects must be consistent with Title 136 – Scrap Tire Management Rules and Regulations, Title 132 – Integrated Solid Waste Management Regulations, Title 199 – Waste Reduction and Recycling Incentive Grants Program, and any other applicable federal, state, and local rules and regulations.

Eligible applicants:	• Political subdivisions or other entity or organization, public, private, or non-profit.
Eligible activities Include:	• Reimbursement of up to twenty-five percent of the retail cost of the purchase of a tire derived product which utilizes a minimum of twenty-five percent recycled tire content. •Reimbursement for the purchase of crumb rubber generated and used in Nebraska, with disbursements not to exceed fifty percent of the cost of the crumb rubber.
Non-eligible activities:	• Projects which do not represent a permanent use. • Projects which are not consistent with applicable federal, state, and local rules and regulations.

APPLICATION DENIAL

Applications may be denied for the following reasons:

1. Application is not in conformance with these guidelines.
2. Application does not reflect reasonable costs for the type of project proposed.
3. Application contains inaccurate, incomplete, or misleading information.
4. Other reasons that the Director determines are necessary to properly administer the program.

PENALTIES

Pursuant to Neb. Rev. Stat. Sec. 81-15,161, penalties may result from a violation of the award conditions. Penalties imposed by the Director may include, but are not limited to, withdrawal of grant funds; reimbursement of improperly expended funds; forfeiture of Department funded property; ineligibility for future funding; or a combination of the above.

APPLICATION AND AWARD PROCEDURE

1. The applicant completes the application and submits it to the Department of Environmental Quality, Waste Planning and Aid Unit, PO Box 98922, Lincoln, NE 68509-8922 by February 1, of each year. Applications may be delivered in person to the Department at 1200 "N" Street, Suite 400, Lincoln, NE. Use a separate application for each type of project.

2. Department staff review the application.

3. If the application is incomplete, it is returned for further information and will be considered if additional information is received prior to the application deadline. If additional information is received after the February 1 deadline, it cannot be considered for award.

4. If application is complete and eligible, staff will make recommendation to the Director based on availability of funds.

5. In making grant awards, the Director:
   A. Shall give preference to projects which utilize scrap tires generated in Nebraska;
   B. May provide partial funding;
   C. Shall balance the needs of all geographic areas, all sizes and classes of communities, and all manner and scale of projects; and
   D. Shall give consideration to eligible projects which specifically employ disabled persons.

6. Each applicant will be notified in writing of grant award or denial.

7. All awards shall be formalized by a written agreement between the Department and the applicant.

Description of grants available through the Nebraska Department of Environmental Quality's Waste Planning and Aid Unit

FUND NAMES	LITTER REDUCTION AND RECYCLING FUND	WASTE REDUCTION AND RECYCLING INCENTIVE FUND		
ESTIMATED ANNUAL FUNDS	$1,200,000	Business Fee $700,000	Disposal Fee $1,100,000 Scrap Tire Fee $600,000	Scrap Tire Fee $1,000,000
FUNDING SOURCES	Annual fee assessed to manufacturers, wholesalers, and retailers on products which commonly contribute to litter	$25 annual retail business fee on sales of tangible personal property	50% of a $1.25 disposal fee on solid waste disposed of in a regulated landfill AND Funds transferred from the $1 tire fee collected on the sale of new tires	$1 tire fee collected on the sale of new tires
ELIGIBLE APPLICANTS	Political subdivisions, public, and private entities and organizations	Political subdivisions or other entity or organization, public, private or non-profit	Counties, municipalities, and agencies	Political subdivisions or other entitity or organization, public, private, or non-profit
ELIGIBLE ACTIVITIES	Public education, litter cleanup of public areas, recycling, and source reduction	Integrated solid waste management programs and projects	Planning and implementing facilities and systems to further the Integrated Solid Waste Management Act	1) Partial payment for purchase of tire-derived products and/or crumb rubber. 2) Cost-sharing for manufacturing, processing, and civil engineering applications. 3) Collection site cleanups for political subdivisions. 4) Capital and startup costs for processing, manufacturing, collecting and transporting.
DEADLINES	September 15	February 1	February 1	February 1
REQUIRED COPIES	Original application and six copies (seven total)	Original application and six copies (seven total)	Original application and six copies (seven total)	Original application and six copies (seven total)

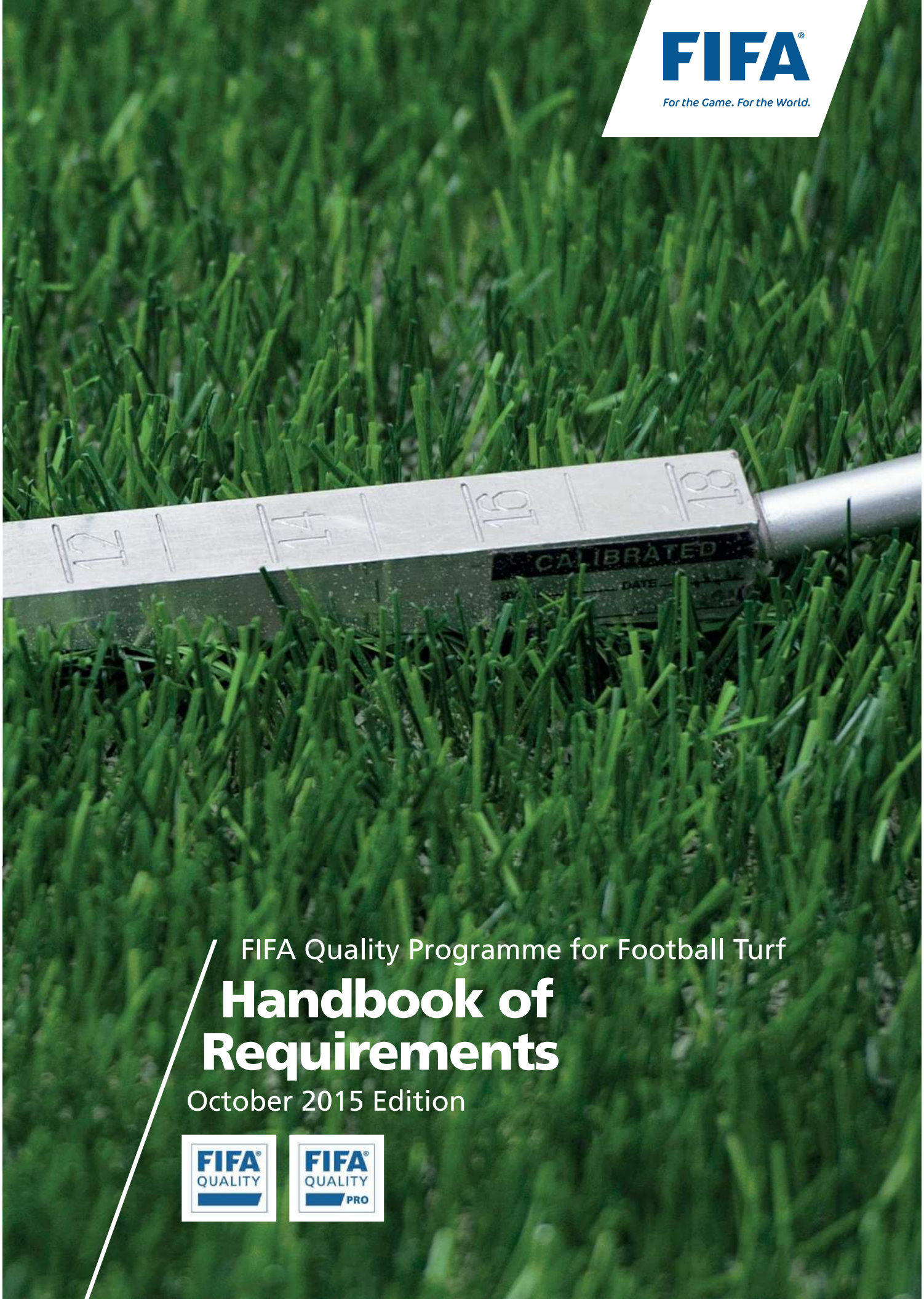
Applications must be <u>delivered to the NDEQ office in Lincoln by 3:00 p.m. on the due date or postmarked on or before the due date</u> .
Mail or hand-deliver applications to:

Nebraska Department of Environmental Quality
Waste Management Division, Planning and Aid Unit
Suite 400, The Atrium
1200 N Street
PO Box 98922
Lincoln, NE 68509-8922

Phone: 402-471-3388
Toll Free: 877-253-2603
www.deq.state.ne.us

Appendix G

FIFA Quality Programme for Football Turf – Requirements



FIFA Quality Programme for Football Turf

Handbook of Requirements

October 2015 Edition

FIFA QUALITY

FIFA QUALITY PRO

Contents

1 Introduction

The development of artificial grass surfaces (designated 'Football Turf' by FIFA) that replicate the playing qualities of good quality natural grass has led to the rapid acceptance of the surfaces by the football world. Manufacturers are producing surfaces that provide a credible alternative solution to parts of the world where climate or resources make the provision of good quality natural grass pitches difficult or impossible. Likewise the development of Football Turfs has provided a potential solution to facility operators wishing to maximise the use of their facilities through community use and those struggling with stadium microclimates that make the maintenance and growth of natural grass difficult.

To ensure these new forms of playing surface replicate the playing qualities of good quality natural grass; provide a playing environment that will not increase the risk of injury to players; are of adequate durability (providing they are adequately maintained) FIFA developed the FIFA Quality Programme for Football Turf. Launched in 2001 the Quality Programme is a rigorous test programme for Football Turf that assesses the ball-surface interaction, player-surface interaction and durability of products and allows successful manufacturers to enter into a licensing programme for the use of the prestigious FIFA QUALITY (formerly FIFA RECOMMENDED) marks.

Football Turf was allowed for official competitive matches in July 2004. The International Football Association Board included the option of using artificial turf surfaces meeting the FIFA Quality Programme for Football Turf in the Laws of the Game. To service the need of professional clubs further, FIFA introduced a second category geared specifically towards the demands of the professional game (FIFA QUALITY PRO, formerly FIFA TWO STAR). The broader category (FIFA QUALITY, former FIFA ONE STAR) has wider bands of acceptability as it is geared towards durability and safety for more intense use at community level. Both categories are entitled to host international matches subject to the relevant competition rules.

The laboratory test programme that a Football Turf must satisfy as part of the FIFA Quality Programme includes a programme of simulated use to assess the ability of a surface to perform for a period of time. The degree of simulated use undertaken on FIFA QUALITY PRO compliant products is designed to replicate low to moderate levels of use often found on football specific stadium fields; whilst the degree of simulated use undertaken on FIFA QUALITY compliant products is designed to replicate the higher levels of use found on training and community fields. Potential installers of Football Turf fields should note, however, that experience has shown fields subjected to very high intensity use may not be able to retain the demanding performance criteria of the FIFA Quality Programme for the life of the playing surface. Failure to undertake adequate maintenance will also reduce the period of time a field may satisfy the requirements of the FIFA Quality Programme.

This edition of the manual supersedes previous editions with effect from 26 October 2015. The changes incorporated into this edition of the manual are:

General changes

- Change of the designation of the certification types: the FIFA QUALITY PRO mark supersedes the FIFA 2 STAR category and the FIFA QUALITY mark replaces the FIFA 1 STAR category. On top of rebranding, both categories have seen some user-specific requirements added to the particular level.

- The following new test methods have been included for all FIFA QUALITY and FIFA QUALITY PRO fields:
    - Method for the determination of heat on artificial turf products
    - Advanced wear simulation device: Lisport XL
    - Method for calculating reduced ball roll on samples tested in the Lisport XL
    - Method for the measurement of free pile height
    - Method for the measurement of infill depth
    - Method for the determination of UV stabiliser content in yarns
    - Method for clarification of the particle size distribution measurement
    - Method for clarification for the measurement of differential scanning calorimetry (DSC)
    - Method for clarification for the measurement of yarn decitex
    - Method for clarification of product identification on woven carpet products
    - Method for clarification of porosity testing on artificial turf systems
    - Method for clarification of yarn thickness measurement
- The following tests have been removed from the handbook of test methods:
    - Stud slide and stud deceleration removed from laboratory testing
    - Wear simulation with lisport removed from laboratory testing
- All products used for field markings (lines and logos where applicable) need to be tested as independent products.
- Only one specific product may be used per field. No combination of different products (different colours, yarn compositions or other) may be used on one single field.
- Tighter requirements for product test in the laboratory
- Recommendations for the testing of run-off areas (both with natural and artificial playing surfaces) have been included in this handbook

Category-specific changes

FIFA QUALITY PRO level

- A new method to assess infill splash has been introduced for this level of the game
- Requirement relating to the quality of lines, goals and all relevant playing equipment have been included in the test institute assessment
- Performance tests in the laboratory after 3010 cycles on the lisport XL including reduced ball roll
- Ball roll requirements for re-tests reduced from 10m to 8m

FIFA QUALITY level

- Performance tests in the laboratory after 6010 cycles on the lisport XL including reduced ball roll

2 Field certification

The FIFA Quality Programme is the certification of a particular field that has been found to fully meet the requirements of the Quality Programme. It is not the approval of products. In order to be certified, football turf fields must reach the performance and quality criteria established to provide the best possible playing conditions. To this end, each field must undergo four steps as outlined below:

Fig. 1.2 Approval process steps and the related documents / parties

Legend:

LT FT Tests performed by FIFA accredited Test Institutes only

MS PD Originated by the manufacturer (FIFA licensee)

The phases of testing are described below.

2.1 Step 1: a thorough test of the product in the laboratory

- The manufacturer (as existing or potential licensee) submits the appropriate samples to a FIFA accredited laboratory test institute. A list of accredited test institutes is available on www.fifa.com/quality.
- The FIFA accredited laboratory will undertake all the statutory tests laid out in the FIFA Quality Programme – Handbook of Requirements. If the sample submitted has fulfilled all the requirements a Test Report is submitted to FIFA confirming that the manufacturer's product has met the requirements of the FQP Laboratory Test Procedure. Note: this document is not a product certificate.
- The licensee will be informed that the product is available for installation and eligible for the next steps of testing (subject to completion of the license contract between FIFA and the manufacturer).

2.2 Step 2: the installation of the product as declared, applying the outlined procedures

- The product must be installed with similar composition of materials within the required tolerances as was tested in the laboratory in the previous step.
- Further documentation (method statement and product declaration) shall be filled out by the licensee to document the installation procedure.

2.3 Step 3: initial field assessment

2.3.1 Test procedure and technical assessment of the playing surface

- Following the installation of the field, the Licensee must request the field test by means of the FIFA online database (access is granted to each licensee upon signature of the agreement).
    - The licensee shall appoint one of the FIFA accredited field test institutes (list available on www.fifa.com/quality).
    - The test request must contain the details of the product as well as the method statement and product declaration. In addition the licensee shall indicate which FIFA accredited test institute it has appointed for the test of the field.
    - FIFA approves the complete request and allocates a test number to the field
- The field shall be fully tested in accordance with the procedures specified in Table 3.
- Samples of the artificial grass and any infill used to construct the field shall be taken from site by the Test Laboratory and tested using the procedures detailed Table 4 to ensure they are of the same specification as those submitted for the initial laboratory type approval (subject to the tolerances specified in Table 4).

- The results of the field and quality control tests will be entered onto a FIFA Field Test Report by the Test Laboratory which shall be sent to FIFA (via the online database) for review.

  Note – if the field fails the initial field test the test institute is still required to prepare and submit a FIFA Field Test Report informing FIFA of the failure. If a second initial test is required a new Field Test Report Number should be requested from FIFA.

2.3.2 Important additional notes regarding testing and eligibility for use of the field

- The Laws of the Game allow international matches to be played on fields with several sets of lines. The IFAB ruling on Law 1 states: “Where artificial surfaces are used, other lines are permitted provided that they are of a different colour and clearly distinguishable from the lines used for football.” Tournament organisers may however have stricter rules on the use of additional linage.

- The test institute shall take note of any additional markings (logos, writing, adverts) other than those specified in the Laws of the Game.

    - As the professional standard, FIFA QUALITY PRO installations must meet the requirements for international match dimensions as indicated in Law 1 and may not bear additional marking (such as logos) other than those accounted for in the Laws of the Game. In addition, field equipment (goals and corner flags) shall be in the correct position and of the correct dimensions.
    - FIFA QUALITY installations may lose their eligibility to host competitive matches in accordance with the Laws of the Game by the presence of marks

(logos etc.) on the field. The certificate is awarded to confirm the technical compliance with the requirements only.

- The test institute shall verify that the end user received both the product declaration and method statement in accordance with the FIFA licensee agreement.
- The test institute shall verify that adequate maintenance equipment is on site or an appropriate maintenance contract (evidence needed) is in place.

2.4 Step 4: Field certification

If the field satisfies all the aspects of the above steps within the FIFA Quality Programme, FIFA will grant the appropriate certification to the installation.

2.4.1 Eligibility for (international competitions)

FIFA QUALITY PRO fields are designed to meet the criteria for international competitions. FIFA QUALITY fields may have varying dimensions or markings. In order for competitive matches to be carried out, the compliance with the Laws of the Game as well as national or local regulations must be ensured. While the FIFA Quality Programme certificate is essential to this eligibility, the compatibility of pitch markings and dimensions need to be verified.

2.4.2 Period of field certification

FIFA QUALITY PRO field certification is valid for 12 months and FIFA QUALITY certification is valid for three years unless:

- the field is subsequently found to no longer satisfy all the aspects of the FIFA Quality Programme following a scheduled or random spot check field test

or

- the Football Turf is removed or replaced.

2.5 Field retesting

- A retest can be requested on any field that has previously been tested and not been modified. Where a pitch has been resurfaced, an initial test shall be performed.
- A field shall be re-tested according to the standard that is was first tested to but can, on request, be tested to the newest standard
- Retesting of a field may be requested by the licensee or the field owner/operator or a FIFA accredited test institute for Football Turf that was contacted by a field's stakeholder or a national association/confederation or FIFA. The licensee shall request the field test through the online database. All other requestors shall do so by email to the FIFA Quality Programme (quality@fifa.org).
- Testing shall be undertaken by a FIFA accredited Field Test Institute in accordance with the above-noted procedure and in full accordance with the procedures specified in Table 3.
- Retesting may be undertaken up to three months in advance of a field's renewal date without the subsequent renewal date changing. Fields may only be tested more than

three months before the expiration of the certification in exceptional cases such as requirements by national competition rules to test at more frequent intervals.

- The results of the field and quality control tests will be entered onto a FIFA Field Test Report by the Test Laboratory which shall be sent to FIFA (via the online database) for review.

2.5.1 Certification following re-tests

- If a field is found to fully comply with Tables 3 and 5 as well as the Laws of the Game in regard to line marking and marks on the field, as detailed below, it is recertified for a further 12 months.
- If a field fails to satisfy the FIFA QUALITY PRO category, it loses its FIFA certification. A re-certification as FIFA QUALITY is not possible. Certification as FIFA QUALITY must be obtained by carrying out a new initial test in accordance with step 1.
- If a field fails to satisfy the FIFA QUALITY category, it loses its FIFA certification.
- There is no limit to the number of re-tests on any given field provided the procedure in 2.5 is adhered to.

3 Test methods

The test methods used to assess Football Turfs and installed fields are described in either the FIFA Handbook of Test Methods for Football Turf 2015 edition (identified by the prefix FIFA), International Standards (identified ISO) or European Standards (identified EN). Where a test method is given a dated reference, subsequent amendments to or revisions of the method will apply to this Handbook of Requirements only when incorporated into it by amendment or revision. For undated references, the latest edition of the publication referred to applies.

Note: Fields submitted for initial testing in accordance with the 2015 handbook may only be surfaces with Football Turf that meets the 2015 edition of the FIFA Handbook of Requirements for Football Turf.

4 Laboratory test requirements

4.1 General

When tested in the laboratory for initial type approval the Football Turf shall fully satisfy the requirements of Table 1 using the methods of test specified.

The entire set of laboratory tests must be carried out for all different products used to make the football pitch: this explicitly includes, the Football Turf system, the Football Turf system used for the lines and, where applicable, any other systems used for representations on the field (for example for logos, each coloured yarn shall be tested as an individual system).

The components of the Football Turf shall be identified using the test methods specified in Table 2 and the results compared to the data supplied by the licensees (Section 3 of the FQP Laboratory Report Form). The differences between the product identification tests and licensee's data shall be within the tolerances specified in Table 2.

4.2 Resistance to artificial weathering

If a Football Turf pile is manufactured from a pile yarn that has been previously tested by a FIFA Test Laboratory for Resistance to Artificial Weathering the results may be used for the new Football Turf providing that:

- a pile yarn characterisation (DSC) shows the yarn to be within normal manufacturing tolerances of that previously tested;
- the declared pile thickness is no less than 90% of the declared value. For clarification: for a group of otherwise identical yarns with different thicknesses, only the thinnest must be tested;
- the profile of the yarn is the same as the yarn tested previously;
- the colour (RAL Classic) of the yarn is within normal manufacturing tolerances of the yarn tested previously;

4.3 Use of existing shockpads / elastic layers

If an existing artificial turf pitch is to be converted to Football Turf or an existing Football Turf surface is to be replaced, any existing shockpad or elastic layer may be incorporated into the new surfacing system provided:

- the shock absorption of the existing shockpad is between 90% and 110% of the shock absorption value declared by the manufacturer when the Football Turf system was initially type approved;
- the deformation of the existing shockpad is ± 2mm of the deformation declared by the manufacturer when the Football Turf system was initially type approved;
- the water permeability of the shockpad is greater than 180mm/h when tested in accordance with EN 12616.

The installed shockpad shall be tested for each property detailed above in the positions detailed in the FIFA Handbook of Tests Methods for Football Turf (section 4) by a FIFA Field Institute. Despite practical implications when a turf has not yet been replaced, it is not acceptable to determine the suitability based on the values obtained from testing the corner areas only. Tests shall be made no sooner than 12 months before the initial field test after resurfacing. The results of the shockpad tests shall be appended to the FIFA Field Test Report and issued to FIFA following the initial field test.

Compliance with the above requirements does not override the need for the field to fully satisfy the field test requirements of the FIFA Quality Programme.

4.4 Calculation of Variations

Unless explicitly stated, variations are to be calculated as percentage of the declared value and not of the site sample.

4.5 Order of testing

To ensure consistency of test results, all test institutes should carry out the procedures in the same order. The five samples should therefore be used as listed below. Where laboratory conditions allow, the tests performed in dry conditions may be carried out on samples 2a or 2b instead of 1 or 3:

Sample 1 NEW	**Sample 2a LISPORT XL 3010**	**Sample 2b LISPORT XL 6010**	**Sample 3 NEW**
Size: 1 x 1 m	*Size: 4 x 1 m*	*Size: 4 x 1 m*	*Size: 1 x 1 m*
Preparation of sample	Preparation of sample	Preparation of sample	Preparation of sample
FIFA 18 – free pile height & FIFA 21 infill depth	FIFA 17 Reduced Ball roll Dry	FIFA 17 Reduced Ball roll Dry	FIFA 08 Surface Friction & Abrasion
Conditioning	FIFA 15 Mechanical Abrasion	FIFA 15 Mechanical Abrasion	Re-conditioning
	FIFA 17 Reduced Ball roll Dry	FIFA 17 Reduced Ball roll Dry	
	Redistribute infill by hand	Redistribute infill by hand	
FIFA 01 Ball rebound Dry	FIFA 01 Ball rebound Dry	FIFA 01 Ball rebound Dry	FIFA 02 Angle ball rebound - dry
Redistribute infill by hand	Redistribute infill by hand	Redistribute infill by hand	Redistribute infill by hand
FIFA 04a Shock absorption – Dry FIFA 05a Vertical deformation - Dry FIFA 13 Energy Restitution	FIFA 04a Shock absorption – Dry FIFA 05a Vertical deformation - Dry FIFA 13 Energy Restitution	FIFA 04a Shock absorption – Dry FIFA 05a Vertical deformation - Dry FIFA 13 Energy Restitution	FIFA 16 Infill Splash
Redistribute infill by hand	Redistribute infill by hand	Redistribute infill by hand	
FIFA 06 Rotational resistance - Dry	FIFA 06 Rotational resistance - Dry	FIFA 06 Rotational resistance - Dry	**Sample 4 & 5 NEW**
Re-conditioning	Re-conditioning	Re-conditioning	Size: 0.4x0.4 m (2x)
Wetting	Wetting	Wetting	FIFA 04a -5°C & +50°C tests
FIFA 01 Ball rebound wet	FIFA 17 Reduced Ball roll Wet	FIFA 17 Reduced Ball roll Wet	End of tests
Redistribute infill by hand			
FIFA 04a Shock absorption Wet FIFA 05a Vertical deformation wet FIFA 13 Energy Restitution wet			**Sample 6 NEW**
Redistribute infill by hand			Size: 0.4x0.4 m
FIFA 06 Rotational resistance wet			FIFA 14 Heat Test
Redistribute infill by hand			End of tests
FIFA 02 Angle ball rebound wet			
End of tests			

Table 1 – Laboratory test requirements

Property	Test Method	Test conditions			Requirements	
		Preparation	Temperature	Condition	FIFA QUALITY PRO	FIFA QUALITY
Vertical ball rebound	FIFA 01 & FIFA /15	Pre-conditioning	23ºC	Dry	0.60m - 0.85m	0.60m – 1.0m
				Wet		
		Simulated Wear – 3010 cycles		Dry	0.60m - 0.85m	N/A
		Simulated Wear – 6010 cycles		Dry	N/A	0.60m – 1.0m
Angle ball rebound	FIFA 02	Pre-conditioning	23ºC	Dry	45% - 60%	45% -70%
				Wet	45% - 80%[1]	
Reduced Ball roll	FIFA 17 & FIFA 15	Pre-conditioning	23ºC	Dry	4 – 8 m	4 – 10 m
		Simulated Wear – 3010 cycles		Dry	4 – 8 m	N/A
				Wet	4 – 8 m	N/A
		Simulated Wear – 6010 cycles		Dry	N/A	4 – 12 m
				Wet	N/A	4 – 12 m
Shock Absorption	FIFA 04a & FIFA 15	Pre-conditioning	23ºC	Dry	62% - 68%	57% - 68%
				Wet		
		Simulated Wear – 3010 cycles		Dry	62% - 68%	N/A
		Simulated Wear – 6010 cycles		Dry	N/A	57% - 68%
		Pre-conditioning	50ºC	Dry	62% - 68%	57% - 68%
	FIFA 04a 1st impact	-	-5ºC	Frozen	62% - 68%	57% - 68%

[1] There shall be no more than a relative 40% increase between the value of the dry test and the wet test.

Property	Test Method	Test conditions			Requirements	
		Preparation	Temperature	Condition	FIFA QUALITY PRO	FIFA QUALITY
Vertical Deformation	FIFA Test Method 05a & FIFA Test Method 15	Pre-conditioning	23ºC	Dry	4mm – 10mm	4mm – 11mm
		Pre-conditioning		Wet		
		Simulated Wear – 3010 cycles		Dry	4mm – 10mm	N/A
		Simulated Wear – 6010 cycles		Dry	N/A	4mm – 11mm
		Pre-conditioning	50ºC	Dry	4mm – 10mm	4mm – 11mm
	FIFA 05a 1st impact		-5ºC	Frozen	4mm – 10mm	4mm – 11mm
Rotational Resistance	FIFA Test Method 06 & FIFA Test Method 15	Pre-conditioning	23ºC	Dry	32Nm - 43Nm	27Nm - 48Nm
				Wet		
		Simulated Wear – 3010 cycles		Dry	32Nm - 43Nm	N/A
		Simulated Wear – 6010 cycles		Dry	N/A	27Nm – 48Nm

Property	Test Method	Test conditions			Requirement	
		Preparation	Temperature	Condition	FIFA QUALITY PRO	FIFA QUALITY
Skin / surface friction	FIFA Test Method 08	Pre-conditioning	23ºC	Dry	0.35 - 0.75	0.35 - 0.75
Skin abrasion	FIFA Test Method 08	Pre-conditioning	23ºC	Dry	± 30%	± 30%
Heat determination	FIFA Test Method 14	Pre-conditioning	N/A	Dry	For information	Optional information
Infill splash	FIFA Test Method 16	Pre-conditioning	23°C	Dry	Note <1.5% or ≥1.5%	N/A

Artificial Weathering (FIFA 10)				
Component	**Property & test method**		**Requirement**	
			FIFA QUALITY PRO	**FIFA QUALITY**
Artificial turf	Colour change	EN ISO 20105-A02	≥ Grey scale 3	
Pile yarn (s)	Tensile strength	EN 13864	Percentage change from unaged to be no more than 50%	
Polymeric infill	Colour change	EN ISO 20105-A02	≥ Grey scale 3, no change in shape	
Joint strength: stitched seams	Joint strength – unaged	EN 12228 Method 1	1000N/100mm	
	Joint strength - after immersion in hot water	EN 13744 & EN 12228 Method 1		
Joint strength: Bonded seams	Joint strength – unaged	EN 12228 Method 2	75N/100mm	
	Joint strength - after immersion in hot water	EN 13744 & EN 12228 Method 2		

Property	**Test Method**	**Condition**	**Requirement**	
			FIFA QUALITY PRO	**FIFA QUALITY**
Tuft withdrawal	ISO 4919	Unaged	≥30N	≥30N
	EN 13744 & ISO 4919	After immersion in hot water	≥30N	≥30N
Tensile strength of shockpads and e-layers (if supplied as part of system)	EN 12230	Unaged	≥0.15MPa	≥0.15MPa
Water permeability[1] - using a single ring infiltrometer in which the artificial turf carpet is sealed prior to infilling and testing	FIFA Test Method 24	Unaged	≥ 180mm/h[(2)]	≥ 180mm/h[(2)]

1 Not applicable to surfaces designed specifically for indoor use

2 To ensure adequate drainage of a field all individual elements of the football turf should satisfy this requirement. Any value above 2000mm/h shall be recorded as “>2000mm/h”

Table 2 – Product identification tests

Component	Characteristic	Test method	Permitted variation between laboratory component and manufacture's declaration
Artificial turf	Total mass per unit area	ISO 8543	≤ ± 10%
	Tufts per unit area Knots per unit area (woven carpets)[2]	ISO 1763	≤ ± 10%
	Tuft withdrawal force[3]	ISO 4919	≥ 90% of manufacturer's declaration
	Pile length above backing	ISO 2549	≤ ± 5%
	Free pile height	FIFA Test Method 18	-
	Thickness of yarn	FIFA Test Method 25	≥ 90%
	Total pile weight Pile weight above backing (woven carpets)[4]	ISO 8543	≤ ± 10%
	Water permeability	FIFA Test Method 24	≥180mm/h[5]
Pile yarn(s)	Pile yarn characterisation	FIFA Test Method 22	Same polymer
	Pile Dtex	FIFA Test Method 23	≤ ± 10%
Performance infill (if supplied as part of system)	Particle size	FIFA Test Method 20	Maximum 1 sieve difference
	Particle shape	EN 14955	Similar shape
	Bulk density	EN 1097-3	≤ ± 15%
	Composition	TGA	-
	Infill depth	FIFA 21	-

[2] A lot of woven carpets are using W bindings. Pay attention to count the complete W as one knot. It can be easier to count the number of knots by splitting warp and weft yarns or shearing off the pile yarns
[3] If all piles are breaking, then the tuft withdrawal force is bigger than this breaking force. Report the mean of the broken results
[4] Try to split warp and weft of the carpet. If the coating that is applied makes this impossible, shear off the piles following the procedure in ISO 8543. This is the pile weight above the backing
[5] Not applicable to surfaces designed specifically for indoor use

Component	Characteristic	Test method	Permitted variation between laboratory component and manufacture's declaration
Stabilising infill (if supplied as part of system)	Particle size	FIFA Test Method 20	Maximum 1 sieve difference
	Particle shape	prEN 14955	Similar shape
	Bulk density	EN 1097-3	≤ ± 15%
Shockpads / e-layers (if supplied as part of system)	Shock Absorption	FIFA Test Method 04a	≤ ± 5% absolute Force Reduction
	Thickness	EN 1969	≥ 90% of manufacturer's declaration
	Tensile strength of shockpads and e-layers	EN 12230	0.15MPa
Unbound sub-bases (if tested as part of system)	Composition	-	Similar composition
	Particle size range (attach particle size grading to test report)	EN 933 - Part 1	≤ ± 20%
	Particle shape	EN 14955	Similar shape

5 Field Test Requirements

5.1 Field tests procedures

When tested a field (pitch) shall fully satisfy the requirements of Table 3 in any position on the field using the methods of test specified. The field shall be tested in the positions specified in the FIFA Handbook of Test Methods for Football Turf. Field tests should not be made on joints or inlaid lines, other than ball roll that will cross them. Maintenance of the field shall not be undertaken during a field test.

If a field fails to satisfy the requirements of Table 3 the report must be completed and submitted to FIFA indicated what the field failed on. The field may be tested again at a later stage.

Metrological conditions during the field tests shall be as specified in the FIFA Handbook of Test Methods for Football Turf.

5.2 Visual inspection

During the field test programme the Field Test Institute shall make a visual inspection of the field to ensure there are no significant defects they consider to be hazardous to players. In particular there shall be no:

- failed or excessively open joints (greater than 3mm),
- no looped piles
- excessively uneven distribution of infill: difference in infill height between lowest and highest spot should not exceed 10mm.
- exposed irrigation sprinkler heads within the playing area
- exposed goal post sockets
- hazards within 3 metres of the perimeters of the field of play

Checks will also be made to ensure line markings are straight. Comment on significant deviations.

If unacceptable joints, looped piles, non-straight lines or any other defect considered hazardous to play are found they shall be reported to the Licensee who shall rectify the defects to the satisfaction of the Field Test Institute prior to the Field Test Institute issuing the Field Test Report to FIFA. Add visual evidence of the improvement work to the report.

In addition the Test Institute shall note the following characteristics:

- presence of logos on the field of play or the run-off area (within 3 metres of the field of play or in accordance with the local definition of run-off area)
- Presence of different line markings on the field

Important note: The visual inspection undertaken by the Test Laboratory does not constitute a formal site audit and does not remove the legal responsibility of the installation company and or the facility operator to ensure the field is safe and fit for use. Neither FIFA nor its accredited test laboratories accept any liability for any defects or other issues that subsequently result in an injury to a player or other users.

5.3 Material identification – first field test

In order to ensure the components of Football Turf installed on a field are the same as those previously tested in the laboratory the first field test shall include the identification tests detailed in Table 4. The maximum variation between the installed materials and the

manufacturer's declaration, as detailed on the FIFA Quality Programme Laboratory Report, shall be as specified in Table 4.

The samples of artificial turf and infill shall be collected on site by the laboratory when they undertake the field test. **Where alternative suppliers of infill materials to those detailed in the original laboratory test report are to be used, samples of the infill should also be submitted in advance of construction so that compliance of these materials with the requirements of the FIFA Handbook can be determined prior to installation**. In any case, the name of the supplier shall be noted. Samples should be submitted in adequate time so that if it is found they do not comply with the requirements of the FIFA Handbook a new laboratory test using the new materials can be made prior to installation of the Football Turf and subsequent field testing.

Note: each field may only consist of one product (defined by a system with a fully compliant laboratory test report). In particular the use of two different coloured yarns in alternating rolls (to create visual patterns) are not permitted.

5.4 Material identification – field retests

To check that the Football Turf installed on a field has not been materially altered from that tested previously any retest shall include the identification tests detailed in Table 5 and the Football Turf shall comply with the requirements of Table 5.

5.5 Maintenance equipment

For a field to be certified under the FIFA Quality Programme for Football Turf the facility operator shall ensure that all the equipment specified by the surface manufacturer for the installed Football Turf product is available to maintain the field in accordance with the manufacturer's instructions. This may either be achieved by the facility operator purchasing the equipment or entering a service agreement with a specialist maintenance contractor of a combination of both. In the case of maintenance being outsourced, the manufacturer shall present written evidence of such an agreement to maintain the field.

Maintenance equipment on site must at least include a tractor unit, either a drag brush or drag mat, additional infill to top up the field, the maintenance log and a ball roll ramp. If this is not the case, the test institute shall note this on the field test report and indicate the field as failed.

The facility operator shall ensure all required maintenance equipment is available for inspection by the test institute during the field test.

5.6 Sprinklers

FIFA do not endorse the use of sprinklers within the playing area of a football field. However, FIFA does acknowledge that occasionally sprinkler systems have to be installed within the playing area because, primarily due to a lack of water pressure available to project water from outside of the play area onto the central portion of the field; such systems have been installed in both natural and artificial turf football fields.

One of the primary aims of the *FIFA Quality Programme for Football Turf* is to take into consideration the comfort and safety of players. Therefore where a sprinkler system has been installed within the playing area there will be an additional test requirement to check that the sprinklers do not present an additional hazard to the players. The Field Test Institute will undertake Shock Absorbency and Vertical Deformation evaluation, in accordance with this manual, on two separate sprinklers (either side of the field). The values obtained must be within the requirements for the particular performance level that the field has been constructed to meet. Neither FIFA nor the field test institute shall be liable for any damage occurring to the sprinklers as a result of these tests. In requesting/allowing a FIFA field test the facility operator is deemed to have accepted this condition of test.

It should be clearly stated by the contractor responsible for installing the Football Turf whether or not additional maintenance work is required, to ensure the consistency of the infill, after the sprinkler has been elevated and returned to its lowered position. If an additional maintenance procedure is required the Test Institute shall undertake a further test of Shock Absorbency and Vertical Deformation after the maintenance procedure to ensure the area above the sprinkler meets the requirements. Obviously to achieve this, the sprinkler system must be activated and the maintenance procedure carried out before the tests can take place.

5.7 Maintenance during field tests

Maintenance of the field shall not be undertaken during a field test.

Table 3 – Field Test Requirements

Characteristic	Test Method	Requirement					
		FIFA QUALITY PRO		Consistency[6]	FIFA QUALITY		Consistency[7]
Vertical ball rebound	FIFA 01	60cm - 85cm		± 5% relative	60cm - 100cm		±10% relative
Ball roll	FIFA 03	Initial assessment	4m - 8m	±10% relative	Initial assessment	4m – 10m	±15% relative
		Re-tests	4m – 8m	±10% relative	Re-tests	4m – 12m	±15% relative
Shock Absorption	FIFA 04a	60% - 70%		± 5% relative	55% - 70%		±10% relative
Vertical Deformation	FIFA 05a	4mm – 10mm		±10% relative	4mm – 11mm		±15% relative
Rotational Resistance	FIFA 06	30Nm - 45Nm		± 6% relative	25Nm – 50Nm		±10% relative
Surface regularity of playing surface	FIFA 12	<10mm		-	<10mm		-
Free pile height	FIFA 18	For information		-	For information		-
Infill depth	FIFA 21	For information		-	For information		-

Table 4 - Material identification and consistency – first site test

Component	Characteristic	Test method	Permitted variation between manufacture's declaration and installed materials
Artificial turf	Mass per unit area	ISO 8543	≤ ± 10%
	Tufts per unit area	ISO 1763	≤ ± 10%
	Tuft withdrawal force	ISO 4919	≥ 90% of manufacturer's declaration, min. 30N
	Pile length above backing	ISO 2549	≤ ± 5%
	Total pile weight	ISO 8543	≤ ± 10%
	dtex	FIFA Test Method 23	≤ ± 10%

[6] No result from any defined position may vary from the average of the set of results within the field test.
[7] No result from any defined position may vary from the average of the set of results within the field test.

	Water permeability of carpet (non infill)[8]	FIFA Test Method 24	≥180mm/h and greater than 75% of laboratory result[9]
	UV stabilizer	FIFA Test Method 19	Report for every masterbatch
Pile yarn(s)	Pile yarn characterisation	FIFA Test Method 22	Same polymer
Performance infill (if supplied as part of system)	Particle size	FIFA Test Method 20	60% between d and D
	Particle shape	EN 14955	Similar shape
	Bulk density	EN 1097-3	≤ ± 15%
	Composition	FIFA Test Method 11	≤ ± 15% relative

Component	**Characteristic**	**Test method**	**Permitted variation between manufacture's declaration and installed materials**
Stabilising infill (if supplied as part of system)	Particle size	FIFA Test Method 20	60% between d and D
	Particle shape	prEN 14955	Similar shape
	Bulk density	EN 1097-3	≤ ± 15%
Shockpads / e-layers[10] (if supplied as part of system)	Shock Absorption	FIFA Test Method 4a	≤ ± 5% Force Reduction
	Thickness	EN 1969	≥ 90% of manufacturer's declaration

[8] Outdoor pitches only. Compliance with this requirement may also be wavered by FIFA for fields located indoors or in arid parts of the world. Such wavers will be granted on a case by case basis and permission should be sought from FIFA at the design stage of a field's construction.
[9] If the result exceeds 2000mm/h, denote "> 2000mm/h"
[10] When measured in at least four locations

Table 5 - Material identification and consistency – site retests

Component	Characteristic	Requirement	Sampling procedure
Artificial turf[11]	Pile height (above primary backing)	≤ ± 5% of the value measured on the site sample tested during the initial site test	Measurements shall be made in four different areas of the field not subjected to high areas of wear or usage. The number of tufts per m^2 shall be calculated by multiplying the number of stitches per 100mm by the stitch gauge.
	Number of stitches per 100mm	The number of tufts per m^2 shall not differ by more than ± 10% of the manufacturer's declaration	
	Stitch spacing (mm)		
Performance infill[12]	Particle grading	The largest sieve retaining at least 10% by mass of the infill shall be within the range detailed in the manufacturer's declaration forming Section 4 of the product's FIFA Laboratory Test Report.	A minimum sample of 250g shall be taken from the performance infill (20mm) on each of the six tests positions detailed in the FIFA Handbook of Test Methods for Football Turf. The infill shall be graded in accordance with EN 933 Part 1 and the largest sieve retaining at least 10% by mass of the infill determined.

[11] These measurements are made to check the carpet has not been replaced
[12] This test is carried out to ensure that coarser infill material has not been installed on the field

6 Field dimensions and markings

6.1 Field dimensions

Dimensions should be in accordance with the Laws of the Game. The field of play must be rectangular. The length of the touchline must be greater than the length of the goal line. **Special dispensation may be granted for FIFA QUALITY PRO fields that do not meet the requirements subject to a request by one of FIFA's Member Associations.**

	FIFA QUALITY	FIFA QUALITY PRO
Length	Min. 90.0m, max. 120,0m	Min 100.0m, max 110.0m
Width	Min 45.0m, max 90.0m	Min 64.0m, max 75.0m

Run-offs shall be in accordance with national and or competition rules. In the absence of any such rules a minimum of 3m per boundary is recommended. Provision of adequate run-offs does not form part of the FIFA Quality Programme.

Note: International Matches must be played on a field with following dimensions

Length	Min. 100.0m	max 110.0m
Width	Min 64.0m	max 75.0m

6.2 Field Markings

The field shall be field marked in accordance with Law 1 - The Field of Play as detailed in the Laws of the Game. The goal posts must also have the same depth as the width of the line.

Note: If a FIFA certified field is to be used for competition the respective competition regulations must be met and checked by the responsible local authorities.

In accordance with the decisions of the International Football Association Board:

No kind of commercial advertising, whether real or virtual, shall be permitted on the field of play and field equipment from the time the teams enter the field of play until they have left it at half time and from the time the teams re-enter the field of play until the end of the match. In particular no advertising material of any kind may be displayed on goals nets flag-posts or their flags (Decision 3)

The reproduction of, whether real or virtual of representative logos or emblems of FIFA, confederations, member associations leagues clubs or other bodies is forbidden on the field of play and field equipment (including goal nets and areas they enclose) during playing time, as described in Decision 3 (Decision 5).

7 Run-off area

Where artificial turf is used within the run-off area (starting directly on the outer limit of the touchline and goal line), the quality should reflect the high standard of the FIFA Quality Programme for Football Turf as it is an area which players and match officials interact on and with. Due to the use of artificial turf surfaces in the run-off areas around both natural and artificial turf playing fields, a simplified testing protocol based on the testing of Football Turf fields has been developed to ensure a minimum quality for these areas.

The definition of the run-off area in terms of dimensions and surface quality is subject to the competition organiser's regulation. For FIFA the run-off area is defined as being 3 metres starting at the outer edge of the goal line and of the touch line.

7.1 Football Turf fields

For a field of play with an artificial turf surface, the run-off areas shall be of the same product and tested at 4 representative locations (one on each of the four sides) around the pitch including the area most likely to be used by the assistant referee. The product used in the run-off area, should be identical with the one in the field of play.

Characteristic	Test Method	Requirement	
		FIFA QUALITY PRO	FIFA QUALITY
Vertical ball rebound	FIFA 01	60cm - 85cm	60cm - 100cm
Shock Absorption	FIFA 04a	60% - 70%	55% - 70%
Vertical Deformation	FIFA 05a	4mm – 10mm	4mm – 11mm
Rotational Resistance	FIFA 06	30Nm - 45Nm	25Nm – 50Nm
Surface regularity of playing surface	FIFA 12	<10mm	<10mm
Product identification	-	Same as field of play	Same as field of play

7.2 Natural turf fields

For a field of play with a natural turf surface, the run-off areas shall be tested at 10 representative locations (at the test institute's discretion) around the pitch including at least 2 spots within the touchline areas most used by the assistant referee.

Characteristic	Test Method	Requirement	
		FIFA QUALITY PRO	FIFA QUALITY
Vertical ball rebound	FIFA 01	60cm - 85cm	60cm - 100cm
Shock Absorption	FIFA 04a	60% - 70%	55% - 70%
Vertical Deformation	FIFA 05a	4mm – 10mm	4mm – 11mm
Rotational Resistance	FIFA 06	30Nm - 45Nm	25Nm – 50Nm
Surface regularity of playing surface	FIFA 12	<10mm	<10mm

Due to the diverse nature of natural turf fields, it is strongly recommended to use a surface in the run-off area with as similar characteristics as the playing surface itself. This should be taken into consideration when selecting the product.

For avoidance of doubt, section 7 (both 7.1 and 7.2) does not constitute a part of the FIFA Quality Programme for Football Turf testing requirements but may have an impact on the eligibility to play competitive matches in accordance with the Laws of the Game and the regulations of the tournament organiser.

8 Maintenance requirements

At the time of submitting a Football Turf for laboratory testing the Licensee shall provide the Accredited Test Laboratory with a fully descriptive list (including photographs) of all equipment required to under routine maintenance of the surface. This list shall form part of the FIFA Laboratory Test Report.

At each Field Test (initial and retests) the Test Institute will compare the Licensee's list of equipment to that present on site with supportive photographic evidence. Where the maintenance equipment is held by a third party it will be necessary for the licensee to supply a copy of the maintenance contract to the Testing Institute.

At handover of the field the Licensee shall provide the owner/operator with a maintenance log with instructions that the owner/operator complete it in accordance with the maintenance instructions.

When requesting a FIFA Field Test Report Number from FIFA in advance of the field retest the Licensee shall provide a copy of the maintenance log (in electronic format i.e. a scanned copy of original) for the preceding 12 months. If required by FIFA the Licensee shall translate the maintenance log into English.

When requesting a FIFA Field Test Report Number from FIFA in advance of an initial test or field retest the Licensee shall also confirm in writing the ground staff responsible for maintaining the field have been trained and are deemed competent; this shall include details of all training (including dates) undertaken.

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ANNEX A: Laboratory test report

ANNEX B: Field test report – FIFA QUALITY PRO

ANNEX C: Field test report – FIFA QUALITY

ANNEX D: Field test report – FIFA QUALITY PRO Retest

ANNEX E: Field report – FIFA QUALITY Retest

ANNEX F - General requirements

F1 Gloss

It is not acceptable to incorporate materials or constructions that will cause glare from the reflection of sunlight or artificial lighting to players.

F2 Bearing Capacity

The formation and sub-soil should have sufficient bearing capacity to support the playing surface and any machinery used to maintain the surface. The bearing capacity can be assessed using methods described by EN/TC 250/SC7. No responsibility shall be accepted for any damage caused to the surface by the use of equipment or structures (e.g. collapsible seating) that the surface was not intentionally designed for.

F3 Staining

Every effort should be employed to use non-staining materials where practicable.

F4 Toxicology

The manufacturer should be asked to supply to the purchaser an assurance that the sports surface together with its supporting layers, does not contain in its finished state any substance which is known to be toxic, mutagenic, teratogenic or carcinogenic when in contact with the skin. Furthermore that no such substances will be released as a vapour or dust during normal use.

F5 Environmental Compatibility

The manufacturer and purchaser shall abide by all local relevant environmental legislation during the construction, material utilisation, operation and disposal of the surface and it's supporting layers.

F6 Climatic Conditions

The manufacturer and purchaser shall take into consideration the prevailing climatic conditions when designing the surface specification.

F7 Resistance to fire

When installing an artificial turf surface the manufacturer / supplier shall ensure the completed installation complies with all relevant building and fire safety regulations.

ANNEX G - Factory Quality Control Procedures

G.1 Introduction

This specifies a factory production control system for constituent components to ensure that they conform to the relevant requirements of this standard.

The performance of the factory production control system shall be assessed according to the principles used in this document.

Note: The overall quality of the surface remains the responsibility of the licensee.

G.2 Organization

G.2.1 Responsibility and authority

It will be necessary to produce a quality assurance line management diagram outlining the individuals responsible for quality. One individual shall be highlighted as the contact person in cases of quality disputes. These individuals should have the capability to:

- Initiate action to prevent the occurrence of product non-conformity;
- Identify, record and deal with any product quality deviations.

G.2.2 Management representative for factory production control

For every manufacturing plant the licensee must satisfy himself that an appropriately qualified person with appropriate authority will ensure that the requirements given in this document are implemented and maintained.

G.2.3 Management review

The factory production control system adopted to satisfy the requirements of this document shall be audited and reviewed at appropriate intervals to ensure its continuing suitability and effectiveness. Records of such reviews shall be maintained. It is assumed that for most manufacturers this would be covered within an ISO 9000 scheme.

G.3 Control procedures

The licensee shall establish and maintain a factory production control manual setting out the procedures by which the requirements for factory production control are satisfied for those products he directly produces. Furthermore they should establish similar procedures for all suppliers of products that are part of their systems.

G.4 Document and data control

Document and data control shall include those documents and data that are relevant to the requirements of this standard covering purchasing, processing, inspection of materials and the factory production control system documents.

A procedure concerning the management of documents and data shall be documented in the production control manual covering procedures and responsibilities for approval, issue, distribution and administration of internal and external documentation and data; and the preparation, issue and recording of changes to documentation.

G.5 Sub-contract services

If any part of the operation is sub-contracted by the producer a means of control shall be established. The producer shall retain overall responsibility for all components sub-contracted.

G.6 Knowledge of the raw material

There shall be documentation detailing the nature of the constituent parts as specified in the licensees Technical Data Sheets.

It is the licensee's responsibility to ensure that if any dangerous substances are identified their content does not exceed the limits in force.

Note: See EU Council Directive 76/769/EEC.

G.7 Management of production

The factory production control system shall fulfil the following requirements:

- There shall be procedures to identify and control the materials.

Note: these can include procedures for maintaining and adjusting processing equipment, inspection or testing material sampled during processing, etc.

- There shall be procedures to identify and control any hazardous materials identified above to ensure that they do not exceed the limits.
- There shall be procedures to ensure that material is put into stock in a controlled manner and the storage conditions are appropriate for the materials being stored.
- Certain materials are known to deteriorate in storage. There shall be procedures to ensure that material taken from stock has not deteriorated in such a way that its conformity is compromised.
- The product shall be identifiable up to the point of sale as regards source and type.

G.8 Inspection and test

G.8.1 General

The licensee shall ensure that they have all the necessary facilities, equipment and trained personnel to carry out the required inspections and tests.

G.8.2 Equipment

The licensee shall be responsible for the control, calibration and maintenance of inspection, measuring and test equipment

Accuracy and frequency of calibration shall be in accordance with the appropriate standards.

Equipment shall be used in accordance with documented procedures.

Equipment shall be uniquely identified.

Calibration records shall be retained.

G.8.3 Frequency and location of inspection, sampling and tests

The production control document shall describe the frequency and nature of inspections.

G.8.4 Records

The results of factory production control shall be recorded including sampling locations, dates and times and product tested with any other relevant information.

Where the product inspected or tested does not satisfy the requirement laid down in the specification, or if there is an indication that it shall not do so, a note shall be made in the records of the steps taken to deal with the situation (e.g. carrying out of a new test and/or measures to correct the production process).

The records required by all the clauses of this standard shall be included.

The records shall be kept for at least the statutory period.

Note: “Statutory period” is the period of time records are required to be kept in accordance with regulations applying at the place of production.

G.9 Control of non-conforming product

Following an inspection or test that indicates that a product does not conform, the affected material shall be:

- Reprocessed; or

- Diverted to another application for which it is suitable; or
- Rejected and marked as non-conforming.

All cases of non-conformity shall be recorded by the producer, investigated and if necessary corrective action shall be taken.

Note: Corrective actions can include:

- Investigation of the cause of non-conformity including an examination of the testing procedure and making any necessary adjustments;
- Analysis of processes, operations, quality records, service reports and customer complaints to detect and eliminate potential causes of non-conformity;
- Initiating preventive actions to deal with problems to a level corresponding to the risks encountered;
- Applying controls to ensure that effective corrective actions are taken;
- Implementing and recording changes in procedures resulting from corrective action.

G.10 Handling, storage and conditioning in production areas

The manufacturer shall make the necessary arrangements to maintain the quality of the product during handling and storage. This is of particular importance to those materials that may deteriorate in storage.

G.11 Transport and packaging

The producer's factory production control system shall identify the extent of his responsibility in relation to storage and delivery.

Products should be packaged appropriately to prevent any damage of the materials in transit. Any precautions necessary to achieve this during handling and storage of the packaged goods shall be marked on the packaging or accompanying documents.

G.12 Training of personnel

The producer shall establish and maintain procedures for the training of all personnel involved in the factory production system. Appropriate records of training shall be maintained.

G.13 Minimum test frequencies for general properties

The manufacturer shall be asked to give details of the frequency which the products are tested for compliance with the product data sheet. If it is felt that these are inadequate then extra testing maybe requested and/or third party attestation.

G.14 Communication

Before any goods are to leave the factory for site installation the product quality assurance sheets should be signed and dispatched to a third party for attestation. These documents should state unequivocally the testing that has taken place and the frequency of testing.

The minimum testing that is acceptable is full compliance with the technical data sheet for that product. If the data sheet is deemed to be inadequate more testing can be requested to show compliance with the data sheet.

Only upon approval from the third party attestation should the goods be dispatched. This does not however pass the responsibility of quality assurance onto the third party. At all times the quality assurance of the product (including its constituent parts) and the installation is the sole responsibility of the licensee.

Third party attestation would usually be provided by the test laboratory undertaking the field test.

Site samples will be taken by third party's (FIFA accredited test laboratory or FIFA's appointed representatives) in accordance with the requirements of the FIFA Quality Programme for Football Turf. The above quality assurance measures are additional to the provisions outlined in the FIFA Quality Programme for Football Turf Manual.

G15 **Design and construction verification**

As requested by FIFA the FIFA licensee shall make available all design drawings and bills of quantities for any field submitted for FIFA certification together with details of materials actually used during the constriction. This shall include:

i) Depth of sub-base materials, density of sub-base materials (when compacted), tonnage of material delivered to site (checked against delivery notes)

ii) Length and type of drainage pipes delivered to site (checked against delivery notes)

iii) Quantity and quality of drainage aggregate delivered to site (checked against delivery notes)

iv) Quantity and quality of synthetic grass delivered to site (checked against delivery notes)

v) Quantity and quality of infill sand delivered to site (checked against delivery notes)

vi) Quantity and quality of infill rubber/elastomer delivered to site (checked against delivery notes)

vii) Quantity and quality of adhesive delivered to site (checked against delivery notes)

viii) Quantity and quality of seaming tape delivered to site (checked against delivery notes)

ix) Quantity and quality of sewing thread delivered to site (checked against delivery notes)

x) Quantity and quality of sports equipment delivered to site (checked against delivery notes)

xi) Quantity and quality of maintenance equipment delivered to site (checked against delivery notes)

xii) Quantity and quality of edging kerbs delivered to site (checked against delivery notes)

xiii) Quantity and quality of haunching materials delivered to site (checked against delivery notes)

xiv) Quantity and quality of additional contract materials delivered to site for example perimeter paths (checked against delivery notes)

xv) Quantity and quality of maintenance testing equipment delivered to site (checked against delivery notes)

All information shall be sent to:

FIFA
FIFA Quality Programme for Football Turf
FIFA STRASSE 20
8044 ZURICH
SWITZERLAND

Appendix H

Risk Assessment of Artificial Turf Fields

Connecticut Department of Energy & Environmental Protection

Risk Assessment of Artificial Turf Fields

In response to public interest and concern, four state agencies, the University of Connecticut Health Center (UCHC), The Connecticut Agricultural Experiment Station (CAES), the Department of Public Health (DPH) and the Connecticut Department of Environmental Protection (DEP) completed a two-year comprehensive evaluation of the health and environmental impacts associated with artificial turf fields containing crumb rubber infill. The reports generated by each agency were peer reviewed by the Connecticut Academy of Science and Engineering (CASE) whose comments were incorporated into the final report.

The Final Report is a compilation of the separate state agency reports listed in the table below. The table includes links to each report component and identifies the main areas of study responsibility for each of these participating agencies.

Agency	Activity	Methods
UCHC	Human exposure field investigation **Report**	Measured air concentrations of approximately 200 chemicals at five fields during active play.
DPH	Human health risk assessment **Report**	Convert air concentrations measured by UCHC to the level of health risk to users of the fields from inhaling emitted chemicals.
CAES	Laboratory study **Report**	Measured offgasing and leaching of chemicals from crumb rubber and select alternative infill materials under defined laboratory conditions.
DEP	Environmental field investigation **Summary**/**Report**	Measured leaching of metals from fields during rain events.
CASE	Document review **Report**	Assembled nine member expert panel to review all aspects of the State of CT reports on artificial turf fields.

July 30, 2010 Press Release on Result of State Artificial Turf Fields Study
January 2, 2009 Press Release on Study of Artificial Turf Fields

Overall Executive Summary

Questions have been raised about possible exposures when playing sports on artificial turf fields cushioned with crumb rubber infill. Rubber is a complex mixture of various chemicals with some having toxic and carcinogenic properties. Exposure is possible, primarily via inhalation, given that chemicals emitted from rubber can end up in the breathing zone of players and these players have high ventilation rates. Rainwater may leach chemicals from the rubber into underlying groundwater or nearby streams.

Previous studies from Europe and the United States provide useful data but are limited particularly with respect to the variety of fields and scenarios evaluated. The current investigation involved air sampling at 1 indoor and 4 outdoor artificial turf fields under summer conditions in Connecticut. The main goal of that sampling was to document air concentrations of volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), rubber-related chemicals (e.g. benzothiazole), and particulate matter less than 10 micron (PM10) at these fields under conditions of active use. These data were then used in a human health risk assessment that focused on children or adults using these fields. In companion studies, offgas studies were performed in two separate laboratories (Connecticut Agricultural Experiment Station; Wisconsin

Occupational Health Laboratory) to evaluate the range of chemicals that could volatilize from crumb rubber from these fields at elevated temperature. Chemical migration in runoff from the outdoor fields was evaluated by collecting leachate in association with rain events. These reports were reviewed by the Connecticut Academy of Science and Engineering (CASE) and these comments were incorporated into the final report.

The laboratory studies showed offgassing of numerous compounds including polycyclic aromatic hydrocarbons (particularly naphthalenes), VOCs (e.g., benzene, hexane, methylene chloride, styrene, toluene), and rubber-related SVOCs (benzothiazole, tert-octylphenol, butylated hydroxytoluene). The primary constituent detected by both laboratories was benzothiazole. Pre-weathering the crumb rubber outdoors for ten weeks decreased the volatile emissions 20-80%.

The field investigation detected a variety of compounds that were present above the fields at concentrations greater than the range seen in background samples. Based upon the pattern of detection, it is considered likely that benzothiazole, acetone, toluene, methyl ethyl ketone, methyl isobutyl ketone, butylated hydroxytoluene, naphthalenes and several other PAHs were field-related, with other detected chemicals less certain to be field related. For example, benzene, methylene chloride, methyl chloride and acrolein were detected only in personal monitoring samples and not in the stationary samplers placed just above the field. This suggests that sampling equipment or host exhaled breath may be a source of some of these VOCs. In general, detections were higher at the one indoor field compared to the outdoor fields, in some cases (e.g., benzothiazole), more than 10 times higher. Testing for volatile nitrosamines and PM10 failed to find detections above background while detections of lead in crumb rubber and grass blades were below well accepted criteria.

The risk assessment considered compounds detected above background as potentially field-related unless they were not detected on turf fields in the current or previous studies or in the offgas studies (e.g., acrolein). This led to a list of 27 chemicals of potential concern (COPCs) on both indoor and outdoor fields. These COPCs were entered into separate risk assessments for outdoor and indoor fields and for children and adults. Exposure concentrations were pro-rated for time spent away from the fields and inhalation rates were adjusted for play activity and for children's greater ventilation than adults. Toxicity values (cancer unit risks, RfCs, acute targets) were taken from national databases or derived by CT DPH. The risk assessment represents a screening analysis in which high end assumptions were used including the use of the maximum detect found at any field across all chemicals, assessing risks for benzene and methylene chloride even though they were only detected in the personal monitors and thus may not be coming from the fields, and the use of sunny low wind conditions to represent every day of playing. A screening level risk assessment is used to determine whether there is the potential for elevated risks under worst case assumptions. If risks are not elevated, no further analysis is needed.

Results indicate that in spite of worst case assumptions, cancer risks were only slightly above de minimis levels for all scenarios evaluated. This includes children playing indoors, the scenario with the highest exposure. These risks are well within typical risk levels in the community from ambient pollution sources and are below target risks associated with many air toxics regulatory programs. Further, the main cancer risk driver, benzene, was only above background in personal monitoring samples. Chronic non-cancer risks were not elevated above a Hazard Index of 1. The Hazard Index for acute risk was also not elevated above 1 but was close to 1 for children playing at the indoor field. The main contributor to this Hazard Index was benzothiazole, a rubber-related SVOC. This presents an uncertainty regarding the potential for benzothiazole and other volatile irritants to create a slight irritation response in sensitive individuals playing indoors.

Based upon these findings, outdoor and indoor artificial turf fields are not associated with elevated health risks from the inhalation of volatile or particle-bound chemicals. However, it would be prudent for building operators to provide adequate ventilation to prevent a buildup of rubber-related VOCs and SVOCs at indoor fields. New indoor fields should consider alternatives to crumb rubber infill as a cushioning agent.

A total of eight stormwater samples were collected from three synthetic turf fields and analyzed for total metals, hardness, pH, volatile organic compounds, semi-volatile organic compounds, pesticides/ polychlorinated biphenyls (PCBs) and acute aquatic toxicity (48 hours for Daphnia pulex and 96 hours for Pimephales promelas). The sampling analysis detected various metals and semi-volatile compounds in the stormwater, with three samples exhibiting acute toxicity for both Daphnia pulex and Pimephales promelas. The only analyte in the stormwater detected in concentrations exceeding acute aquatic toxicity criteria for surface waters was zinc. Zinc exceedences of the acute criteria were detected in the same three

stormwater samples that exhibited acute toxicity for both Daphnia pulex and Pimephales promelas. These results showed that there is a potential risk to surface waters and aquatic organisms associated with whole effluent and zinc toxicity of stormwater runoff from artificial turf fields.

The CASE review found 1) the cancer risks calculated by DPH may have been overestimates because of the inclusion of benzene detections that are likely not coming from the playing field but from the players themselves; 2) uncertainty with respect to the benzothiazole risk assessment since so little toxicology data are available for benzothiazole; and 3) the potential for allergic reactions to occur due to the presence of latex antigen in natural rubber. To address these comments, the risk assessment describes the issues and finds that they do not change the overall conclusions and are unlikely to present added risk. However, we cannot rule out the possibility for certain individuals to be sensitive to allergens present in crumb rubber; if allergic reactions occur, this should be reported to the family physician and the local health department. The CASE review agreed that zinc concentrations in the stormwater generated from artificial turf fields in the Study posed a potential environmental risk.

For further information, please contact:

University of Connecticut Health Center (UCHC)
Nancy J. Simcox, MS, Occupational and Environmental Health Center, 860-679-4634

Department of Public Health (DPH)
Environmental & Occupational Health Assessment Program, 860-509-7740

Connecticut Agricultural Experiment Station (CAES)
Dr. Jason White, Department of Analytical Chemistry, 203-974-8523

Department of Environmental Protection (DEP)
Brian Golembiewski, Office of Environmental Review, 860-424-3867

Content Last Updated on July 27, 2010

Appendix I

EPA Literature and Crumb Rubber Report List as of November 2015

United States Environmental Protection Agency

Tire Crumb and Synthetic Turf Field Literature and Report List as of Nov. 2015

The views expressed in all these studies and reports do not necessarily reflect the views or policies of the US Environmental Protection Agency. The purpose of this list is to provide the public with a list of studies and reports that have addressed the topic of tire crumb, it may not be fully up-to-date or comprehensive. Links are provided when available.

- Leaching of DOC, DN and Inorganic Constituents from Scrap Tires
  Selbes M., Yilmaz O., Khan A.A., Karanfil T. (2015). Chemosphere. 139:617-23.
- Environmental and Health Impacts of Artificial Turf: A Review
  Cheng H., Hu Y., Reinhard M. (2014). Environ Sci Technol. 48(4):2114-29.
- Environmental Sanitary Risk Analysis Procedure Applied to Artificial Turf Sports Fields
  Ruffino et al. (2013). Environ Sci Pollut Res Int.
- New Approach to the Ecotoxicological Risk Assessment of Artificial Outdoor Sporting Grounds
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Appendix J

Revolution 360 With Coolplay Infill Product Data

THE COMPLETE FIBER

REVOLUTION 360

FieldTurf®
A Tarkett Sports Company

Here's the future.
It's on us.

In 2011, FieldTurf changed the game with the introduction of Revolution. Now, FieldTurf is setting the bar with Revolution 360.

No development program has ever subjected a fiber to more rigorous requirements. Or, faced a higher standard.

Revolution 360. The fiber that delivers complete performance.

Yes, we did it again.

Designed and built, in our house.

FIELDTURF INNOVATION AND ENGINEERING.

FieldTurf has unlocked the secrets behind the keys to producing some of the best fibers in the world.

POLYMER, PROCESS AND GEOMETRY.

POLYMER

FieldTurf Revolution 360 uses a high grade polymer that was designed specifically for our turf. We gave it a great catalyst (Metallocene) and a super protective UV package (10,000 HALS of the best stuff we could find).

PROCESS

Very few companies make their own turf fibers. We do. FieldTurf Revolution 360 is made with state-of-the-art extrusion and precision manufacturing processes. Our extended, slower production line increases the "healing" time of the fiber, creating a much longer-lasting fiber.

GEOMETRY

Revolution 360's intricate design eliminates breaking points and provides a more natural looking fiber.

REVOLUTION 360

THE COMPLETE FIBER

THE BEST WAY TO IMPROVE THE FUTURE ...IS TO CREATE IT

FPI

WE BUILT IT TO BE THE BEST
TESTING PROVED IT

Perfect 10
Penn State
Wear Test
30,000 Cycles

PENN STATE WEAR TEST

Number of Cycles	Good	Hair Splitting	Fractured	Complete Splitting
30,000	10	0	0	0
50,000	10	0	0	0
75,000	10	0	0	0
100,000	10	0	0	0
125,000	10	0	0	0
150,000	10	0	0	0

FIBER PERFORMANCE INDEX **83**
TEAR 84 | RECOVERY 84 | U.V. 90 | FEEL 62 | TESTED BY LABOSPORT
FieldTurf Revolution 360 2.5"

FIBER PERFORMANCE INDEX **82**
TEAR 84 | RECOVERY 87 | U.V. 90 | FEEL 51 | TESTED BY LABOSPORT
FieldTurf Revolution 360 2.25"

FIBER PERFORMANCE INDEX **81**
TEAR 84 | RECOVERY 83 | U.V. 90 | FEEL 50 | TESTED BY LABOSPORT
FieldTurf Revolution 360 2.0"

WHAT IS THE FIBER PERFORMANCE INDEX?

Responding to the needs of architects, facility owners and operators, Labosport is proud to introduce Fiber Performance Index (FPI) - the first true measurement of fiber quality. As part of the Labosport Certification Program, FPI establishes an "index" – a rating or score of an artificial turf fiber, to help prospective turf buyers understand and weigh the individual qualities of a turf fiber. FPI provides a comparative measuring tool to help architects, facility owners and operators make the right artificial turf selection from a wide number of options.

TEAR - Measuring a fiber's cross tenacity – a key indicator of fiber durability. This test is commonly used by the plastics industry for quality control purposes.

UV - Measuring a fiber's resistance to UV exposure. This test is designed to match the most demanding standards in force in this domain.

RECOVERY - Measuring fiber resilience after an exhaustive 6,000 cycle compression test. This test uses specially designed equipment to reproduce athletes running on a field.

FEEL - Measuring a fiber's softness using an innovative method from the consumer goods industry. This test is conducted by qualified technicians, whose results are then processed through a statistical model to ensure repeatability and accuracy.

Proven Safety.

On a natural grass field the athletes cut, plant and release in the earth – not in the blades of grass. On an artificial turf field, the infill is the earth.

FieldTurf's infill provides the same biomechanical properties as natural grass, as athletes cut, plant and release. Like in natural grass, athletes play in the infill, not on the turf fibers.

FieldTurf's infill system contains up to 9.2 lbs. per square foot. It's the "heavyweight" in the turf industry.

Exhaustive study confirms that infill weight plays a key role in reducing player injuries.

REVOLUTION 360
THE COMPLETE FIBER

FieldTurf Revolution 360

Fiber Height	Face Weight	Sand Weight	Rubber Weight	Total Weight
2.5"	42 oz/yd²	6.2 lbs/ft²	3 lbs/ft²	1388 oz/yd²
2.25"	38 oz/yd²	6.2 lbs/ft²	2.2 lbs/ft²	1269 oz/yd²
2"	36 oz/yd²	3.65 lbs/ft²	2.6 lbs/ft²	957 oz/yd²

* Other alternative infill systems available upon request.

Infill Matters

The most recent ongoing safety study on synthetic turf confirms the importance of heavy infill weight as it relates to player injuries at the high school football level. This represents another major finding for quality artificial turf systems designed for player safety.

Systems with > 9.0 pounds proven safest.

"As the artificial infill surface weight decreased, the incidence of game-related high school football trauma significantly increased across numerous playing conditions."

Incidence, Mechanisms, and Severity of Game Related High School Football Injuries Across Artificial Turf Systems of Various Infill Weight – A Four-Year Study

The future is now.

REVOLUTION 360
THE COMPLETE FIBER

"We have been playing on FieldTurf for 9 years, and on every aspect, the surface and company has delivered at the highest level. When it came time to replace our field, it was an easy decision to choose FieldTurf again. The new Revolution 360 system has impressed our entire organization – from the coaching staff, to the players – we all love it and are proud to be one of the first to install it. The field now has permanent markings for men's and women's soccer, men's and women's lacrosse and football. These markings have made the field a beautiful playing surface for all sports."

George Smith, Athletic Director
St. Thomas Aquinas

"The FieldTurf product that was installed in 2011 has performed well especially considering the increase in stadium events, specifically soccer matches and concerts. The new field will offer the field maintenance crew an outstanding and extremely durable product to meet the requirements of each event."

Peter McLoughlin, President
Seattle Seahawks

"We are looking forward to the installation of our new field for 2016 and beyond. FieldTurf has been a great partner for us and they are rightly recognized as the global leader, having the highest amount of FIFA certified pitches in soccer stadiums and training facilities around the world."

Adrian Hanauer, Owner
Seattle Sounders FC

"We are extremely excited to have a new playing surface in the Sun Bowl that will be safe for players and opponents. We're also ecstatic about having the same exact playing surface on our practice facility at Glory Road."

Sean Kugler, Head Football Coach
University of Texas at El Paso

THE BEST WAY TO IMPROVE THE FUTURE ...IS TO CREATE IT

REVOLUTION 360

THE COMPLETE FIBER

FieldTurf®
A Tarkett Sports Company

THE ULTIMATE
SURFACE EXPERIENCE

Information | (800) 724-2969 | info@fieldturf.com | www.fieldturf.com

ANOTHER COOL INNOVATION FROM FIELDTURF

FieldTurf continues to sweat the details so athletes can enjoy a safe environment to challenge their limits and maximize their performance.

The experts at our Innovation and Performance Center have been hard at work finding a solution to high surface temperatures on those hot, sunny days. Years of experimenting with materials and systems have finally paid off.

CoolPlay was designed to reduce the heat without any reduction in field performance. No matter the age, sport or skill level of the athlete, CoolPlay is the cool solution.

High Performance. Low Temperature.

FieldTurf CoolPlay

FieldTurf CoolPlay

High Performance. Low Temperature.

Information

(800) 724-2969
info@fieldturf.com
www.fieldturf.com

FieldTurf A Tarkett Sports Company | THE ULTIMATE SURFACE EXPERIENCE

High Performance. Low Temperature.

HOT FIELD? CHILL OUT.

FieldTurf CoolPlay

FieldTurf A Tarkett Sports Company | THE ULTIMATE SURFACE EXPERIENCE

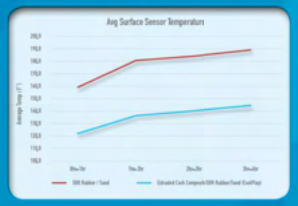
HIGH PERFORMANCE. LOW TEMPERATURE.

-35°F

LABORATORY TESTED TO BE 35 F COOLER THAN TRADITIONAL SAND/RUBBER SYSTEMS.

CHILLING RESULTS

Hard work pays off. Our team tried everything until they found the perfect solution to the problem of hot fields. We tested it. And tested it again. Independent laboratory results concluded that CoolPlay was 35 F cooler than traditonal sand / rubber infill systems.



Evaluation of synthetic turf infill temperature when exposed to elevated temperature. August 18, 2014.

CHILLING PERFORMANCE

CoolPlay is cool. FieldTurf's exclusive and innovative Extruded Cork Composite (ECC) top dressing allows the CoolPlay system to deliver the same behavior and overall stability as FieldTurf's Elite system fields found in the world's most famous stadiums. CoolPlay takes nothing away from performance ... except the heat!

University of Georgia

"When we were looking to replace our synthetic turf practice fields I wanted to continue our relationship with FieldTurf," said Head Football Coach Mark Richt. "We like the quality and we're very excited about using CoolPlay. It will reduce the temperature of our turf for the safety of our players."

University of Arizona

"We've been extremely pleased with our FieldTurf CoolPlay that was installed at Arizona Stadium," said University of Arizona Director of Athletics Greg Byrne. "The surface has provided a great enhancement to our stadium and has served as a benefit for our coaches and student-athletes because of the quality of service and its much lower temperature than normal artificial surfaces. The FieldTurf, along with our other stadium upgrades, has made a tremendous difference in our environment at Arizona Stadium."

CHILLING DESIGN

CoolPlay wasn't developed just to be cool. In designing the system, we ran a multitude of tests with one goal in mind: cooler surfaces with no compromise to the safety and performance of our fields.

- Crumb rubber as a top layer absorbs heat, causing the surface temperature to rise.
- An all-sand system may be cool, but the surface would be far too hard.
- Our organic and sand system is also cooler, but only CoolPlay offers a surface with ideal safety and performance.

Testing finally led us to the special ECC top dressing that could replace the top layer of crumb rubber on our patented three-layer infill system – which is proven to offer better performance and safety in over 4,500 fields around the world.

The ECC granule is durable, shock absorbing and absorbs far less heat than other alternatives.

SAVING MONEY IS ALSO PRETTY COOL

The existing alternative to CoolPlay is irrigation – which only provides temporary relief from high temperatures. Compared to a cost of about $75,000 to install an irrigation system on a typical field, CoolPlay can save you a significant amount of money. Besides, irrigating an "artificial" turf field just doesn't make any sense. Any way you look at it, CoolPlay is an excellent alternative ... and saving $40,000 is pretty cool, too!

University of Maryland

"This FieldTurf project has been an overall success for the University of Maryland," said University of Maryland Director of Athletics Kevin Anderson. "Our playing surface at Capital One Field at Byrd Stadium has improved student-athlete safety through this innovative CoolPlay technology. We also now have had the ability to attract outside events to our campus, generating revenue and continuing to improve the on-campus lives of our students and our community."

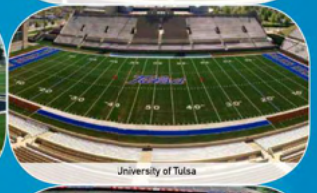
University of Tulsa

"We couldn't be happier with the new FieldTurf CoolPlay turf system," said University of Tulsa Associate Vice-President Terry Hossack. "The field is noticeably cooler as promised and the players love it! The CoolPlay system is a great way to battle the Oklahoma heat and keep our players safe. It is impressive how FieldTurf created a cool high performance artificial turf system; it's just what we needed."

University of Nebraska

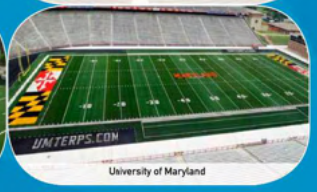
University of Arizona

University of Notre Dame



University of Tulsa

University of Georgia



University of Maryland

FieldTurf CoolPlay

HOT FIELD? CHILL OUT.

FieldTurf CoolPlay