



# An Introduction to Synthetic Turf Design and Performance



IF PERFORMANCE IS IMPORTANT ENOUGH TO BE SPECIFIED SHOULDN'T IT BE VERIFIED?

FAST FACTS

## Synthetic and Natural Turf Fields - And Your School

by Paul W. Elliott, PhD, PE, CPSI

ASET decided to develop this publication because we see high-schools considering synthetic turf fields, and not getting the reliable information needed to make an educated selection.

First, you should know that we are a testing company. We evaluate and inspect natural and synthetic turf fields. We are not involved in the sales, manufacturing, design, or installation of the surfaces. Furthermore, ASET Services does not provide any additional maintenance services. ASET is neither for or against one type of field or another. The information presented comes from our years of testing and our ongoing involvement within organizations developing standards for turf fields.

### Synthetic and Natural Turf Tradeoffs

I often tell people that there are few clear-cut decisions. When we arrive at a decision we take certain information bits and give them greater significance than others. Both surfaces have their pros and

cons. This publication will focus on synthetic turf fields. Here are a few questions to consider:

- Are synthetic fields safer than natural grass fields?
- How long are turf field warranties?
- Do fields outlast their warranties?
- Does heavy use shorten the life of your synthetic turf field?
- What are the savings when you switch from a natural to a synthetic field?
- Where are expenses greater for a synthetic field than a natural field?
- What are the costs of owning a synthetic field?
- What are the benefits of a shock pad?
- Are the liabilities associated with injuries on natural or synthetic turf fields?

If your organization can not answer these questions, you should seek additional information. Remember decisions should be made based on facts and information, not emotion.

Synthetic turf does not last forever, many fields last 8-10 years but few last 12 years.

Synthetic turf supports more frequent usage, but heavy use causes the field to wear out quicker.

Disposal is an expense that is often overlooked, landfill fees for all of the old turf and infill can be a significant and unexpected expense.

Synthetic Turf must comply with standard for the field's life, but schools and some installers only care about the performance when it's new.

Many projects have 30 year debt service terms, replacement, testing and maintenance must be properly budgeted to keep the field from becoming unsafe.

## Synthetic Turf Facts

Our requests for information normally originate from schools considering a synthetic turf field. Here are some of the things to consider:

- ➔ **Warranty:** Most systems come with an 8-year warranty that guarantees the fields appearance and safety for 8 years. (Heavy use and other factors can void warranties)
- ➔ **Synthetic Fields Last 8-10 years:** It is possible for a field to last 12 years but it is very rare. That means that a 30-year bond program should include the original field and 2 to 3 replacements of the turf & infill
- ➔ **Infill moves and breaks down:** This means that the field will need to have infill added periodically to maintain safe performance levels.
- ➔ **Infill systems get compacted:** Just like soil, the rubber/sand infill can become compacted and require hiring special equipment to decompact the system.



*Failed, Patched and Poorly Repaired Turf Field*

- ➔ **Disposing of leaves and trash:** Mowing naturally breaks down leaves on a natural turf field, synthetic fields have to be vacuumed to clean them. Thus, vacuuming tends to somewhat offset reduced mowing expenses.
- ➔ **Synthetic Turf Fields are Hot:** A synthetic turf field is hotter than a natural turf field. It means that during summer practices coaches and band directors need to be more aware of dehydration. They may even benefit from irrigation systems for cooling.
- ➔ **Injury Liability:** Synthetic turf fields need to be tested annually. Routine testing establishes a defense should an injury occur, and it helps identify what, if any maintenance is needed. It can also extend the life of the field.
- ➔ **MRSA/Staph Infections:** Synthetic turf fields can lead to infections, but so can natural turf. These infections spread through cuts and scrapes. However, items like blocking pads, weight equipment and stretching tables were found to have higher bacteria levels than turf.

## Shock Pad Considerations

The first infilled systems introduced to the market were installed with the turf 'carpet' directly over the stone or concrete base. New systems incorporating 'Shock Pads' or Elastic layers are now being introduced. Shock layers provide several advantages:

- ➔ lower HIC (Head Injury Criteria) values and higher fall heights than infill only systems.
- ➔ allow HIC levels to be reduced to the levels that suggest they provide may reduce concussions.
- ➔ provide significant protection levels even when the turf-infill system has deteriorated.
- ➔ some can be reused when the field is renovated.
- ➔ Allow performance to be tuned to provide both head injury protection and lower extremity comfort

## Importance of Commission Testing New Turf Fields.

Architects develop performance specifications and the construction details for project specifications. Some installers will bid and submit a system that comes from a single manufacture. Others may submit a system that they have designed to meet the project requirements by selecting a turf from one manufacturer, infill from another, and an E-layer from yet another.

It is not uncommon for turf systems to be submitted during the bidding process in a configuration that has never undergone all of the specified tests. This unique aspect of the synthetic turf market makes commission testing even that much more important.

The performance of a turf field relies on the right products: turf, e-layer and infill being properly installed over the entire field. Infill properties are affected by the size of the materials, the shape of the materials, and the raw material itself. Commission testing is one of the fastest and easiest ways to verify that the field was installed properly using the proper components.

## Advances in Turf System Performance:

Synthetic turf safety has primarily been defined by Gmax testing using ASTM F1936. F1936 established a maximum allowable deceleration. Gmax may not exceed 200 g's, and that represents the ability of the turf to prevent fatalities, not injuries or concussions.

New evidence suggests that other tests can better assess a turf system's ability to prevent head injuries and concussions. There are those at ASTM who are adamant that no changes shall be made to synthetic turf impact testing. This has even gone as far as to reject Standard Methods without performance requirements.

This page has been developed to introduce some of the new performance and safety parameters that may be encountered in your next synthetic turf field selection.



*Suite of Turf Test Equipment (ASTM and FIFA)*

### Shock Absorption and Vertical Deformation & More

Attention has focused on head injuries within North America, but Europe has taken the position that the foot/surface interaction is key too. ASTM recently adopted F3189 establishes the methods used to determine the shock absorption and vertical deformation properties of a turf field using the same methods outlined by FIFA.

FIFA fields also specify several other properties and they may include: • Ball Roll • Vertical Soccer Ball Rebound • Rotational Resistance • Field Flatness

### HIC – The Basics

Gmax values obtained using ASTM F1936 have been commonly used in specifications for decades. New products are promoting HIC testing of turf fields. Essentially the HIC, or Head Injury Criteria, evaluates the ability of a surface to prevent head injuries not simply to prevent fatalities. The hemisphere impact missile used in HIC testing more closely represents the shape and impact forces generated by a human head, with or without a helmet. Unlike traditional Gmax testing (F1936 is only conducted with a 24" drop height), HIC tests can be performed at a variety of fall heights and can simulate a wide range of impact velocities. The higher fall heights and lower HIC values can be specified to increase the turf's ability to reduce concussions.

ASTM has been unable to develop a new HIC test method or specification. The efforts to develop even a basic test method have been blocked by a group of manufacturers and installers. There is data to suggest that HIC values should be below 700 if the field is to provide significant protection against concussions. There is no data to suggest what an appropriate impact velocity is, and that would be needed to establish a minimum allowable fall height. While this is true, some turf systems exceed 700 HIC at a 1 ft fall height, while others support fall heights of up to 5 ft. Owners and architects will have to decide what is right for each project. A minimum fall height value of 3 ft would provide assurance that the field would provide some concussion protection for at least some head-turf impacts.



*Testing 10-year-old infilled turf system*

### The bottom line:

Regardless of the properties you include in your specification, if they are important enough to specify, they should be important enough to verify that the surface performs as specified. This is especially true of properties directly related to athletic safety.

Furthermore, established standards such as F1936 for turf fields establish impact protection levels that apply throughout the life of the field, not just when it is new. Remember a field that is functioning properly protects the athletes as well as schools and communities from injury liability claims.

TESTING SERVICES BY SURFACE



### Turf Testing Capabilities

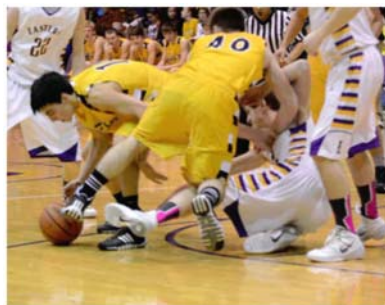
While not FIFA Certified ASET can perform all of the field tests required by FIFA:

- Shock Absorption, Vertical Deformation
- Ball Roll
- Ball Rebound
- Rotational Resistance
- Evenness.

We also offer several ASTM tests and those include:

- Gmax (Traditional)
- Gmax/HIC (Headform)
- Shock Absorption
- Vertical Deformation
- Abrasiveness

### Other Sport/Play Testing



### Indoor Courts

Evaluating surfaces for safety and performance properties like force reduction, rolling load, friction and ball rebound. Also conducting inspections of damaged surfaces and validating repaired surfaces.



### Tracks

Joint health is affected by impact forces and the injuries accumulate over time. We can verify that elastic tracks of all types (walk, jog, run) provide the specified performance levels.



### Playgrounds

Head injury prevention is also critical on playgrounds. Our on-site Gmax and HIC testing of playground safety surfacing can verify that it was installed properly and from installation through the warranty period.



### Protective Padding

Head injury protection is also a key property in protective pads found in sports facilities. They include wall pads, wrestling mats, landing mats and pits.

## About ASET Services, Inc.

ASET Services was founded in 2002 and will celebrate 16 years of providing testing, research, consulting and inspection services in 2018. We service indoor, and outdoor courts (natural and synthetic), tracks, artificial turf, and playground surfaces.

Our clients include architects, owners, manufacturers, installers, lawyers and insurance companies. Our focus is always on helping to ensure that every surface provides an attractive, safe place for athletes, kids train, compete and play.

The founder, Dr. Paul W Elliott, PE, CPSI received his Doctorate in Engineering from Purdue University for work related to the design and computer simulation of sports surfaces, served as the Research and Design Engineer for a sports surface manufacturer, is a licensed engineer in Indiana and Ohio, and is actively involved in ASTM Standards development.

ASET provides testing to several international sport and play surface manufacturers. ASET has also inspected and tested sports surfaces for high schools and universities across North America, as well as at several locations around the globe, including the United Kingdom, Qatar, and South Korea. ASET also provides testing of

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