



## BIO-BASED TPE INFILL

- COOLER > REDUCED FIELD TEMPERATURE, NO WATERING AFTER INSTALLATION
- HIGH PERFORMANCE TPE > HIGH MELT POINT AT 350°F
- CUSTOMIZABLE > CUSTOM COLORS AVAILABLE
- CLEANER > BIO-RENEWABLE + RECYCLABLE, MADE WITH CORN & SOY OILS, NO DUSTING, NO SPLASH
- SOFTER > 30% AIR IN EACH PELLET, SOFT-YET FIRM, NON-ABRASIVE, IMPROVED GMAX

LOWER COST

FDA & NSF CERTIFIABLE

MADE IN THE USA

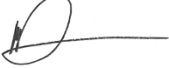

DELIVERED PRICING

PATENT PENDING

# LABORATORY TESTING TEMPERATURE EVALUATION



## Project Information

<b>Project Name</b>	Temperature Evaluation SBR Rubber vs TPE		
<b>Client Info</b>	Guardian Innovations 3044 Adriatic Court Peachtree Corners, GA 30071		
<b>Report Date</b>	11/1/2016	<b>Test Date</b>	4/21/2016
<b>Report Status</b>	Final	<b>Job no.</b>	90905/991
<b>Prepared by</b>	Kieran O'Donnell Field Operation Manager		
<b>Checked by</b>	Jeffrey Gentile Laboratory Director		

### Notes:

1. This report has been prepared by Sports Labs USA with all reasonable skill, care and diligence within the terms of the contract with the Client and within the limitations of the resources devoted to it.
2. This report is confidential to the Client and Sports Labs USA accepts no responsibility whatsoever to third parties to whom this report, or any part thereof, is made known. Any such party relies upon the report at their own risk.
3. This report shall not be used for engineering or contractual purposes unless signed by the Author and the Checker and unless the report status is "Final."

## Summary

The following testing was performed to determine the relative effect infill can have on the surface temperature of a synthetic turf system. A number of synthetic turf systems were tested, each used the same synthetic turf carpet with only the infill varied between systems. All were exposed to infra-red heat lamps for a prolonged period to simulate the heating of the sun in a controlled environment. The resulting temperatures were observed and recorded.

INFORMATION, ADVICE & KNOW-HOW: FROM THE SYNTHETIC SPORTS SURFACE EXPERTS



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# LABORATORY TESTING TEMPERATURE EVALUATION



## Introduction

Sports Labs USA was commissioned to perform a temperature evaluation on two turf systems, each with a different infill composition paired with the same synthetic turf carpet. The results will be compared to show a relative temperature difference.

## Procedure

Each system was constructed and prepared per EN 12229: Surfaces for sports areas - Procedure for the preparation of synthetic turf and textile pieces.

Each system was constructed using the infill combinations shown in the systems description table below.

The samples were conditioned to room temperature for at least 24 hours.

The following sensors were used to capture and record measurements to a digital data logger every 60 seconds:

- (2) thermo-couples mounted in series to provide a 2 point average of the surface temperature.

The samples were heated for 3.5 hours. All of the data was compiled and the average temperatures for each hour were found. This report will present for each system, the hourly average temperature recorded at each sensor as well as the average for each type of temperature measurement sensor.

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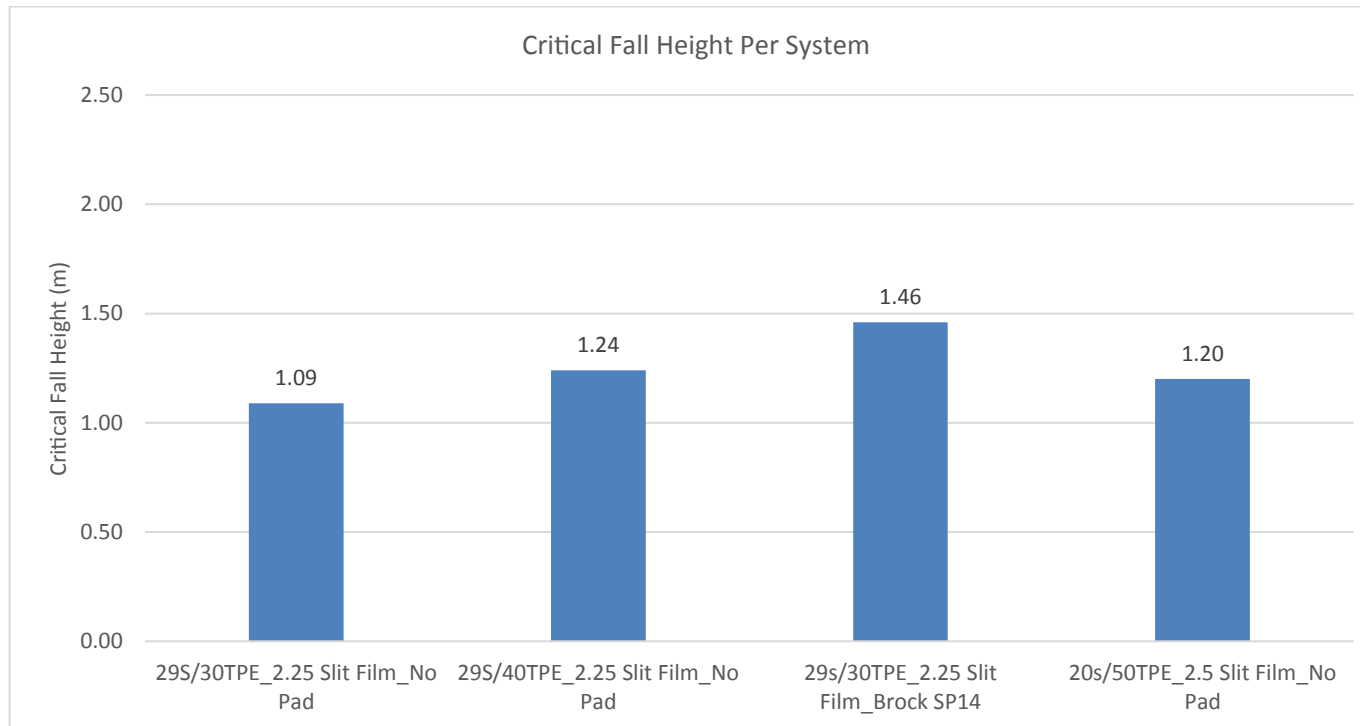


# LABORATORY TESTING PERFORMANCE EVALUATION



## EN 1177- HIC Impact Attenuation (Hemispherical Drop Missile)

The EN 1177- Impact attenuating play surfacing determination of critical fall height method is similar to the method commonly used for assessing playground surfacing in the United States. Internationally it is the primary method for both synthetic turf and playground surfacing. This device calculates the Head Injury Criteria (HIC). This is used to gauge the probability of head injury potential resulting from a surface impact. This device is a hemispherical 10 lb “missile” with a tri-axial accelerometer. The hemisphere is dropped from (4) different heights to determine the height at which the HIC would be 1000. This height is referred to as the critical fall height. It is recommended that the critical fall height values be greater than 1.3 meters.



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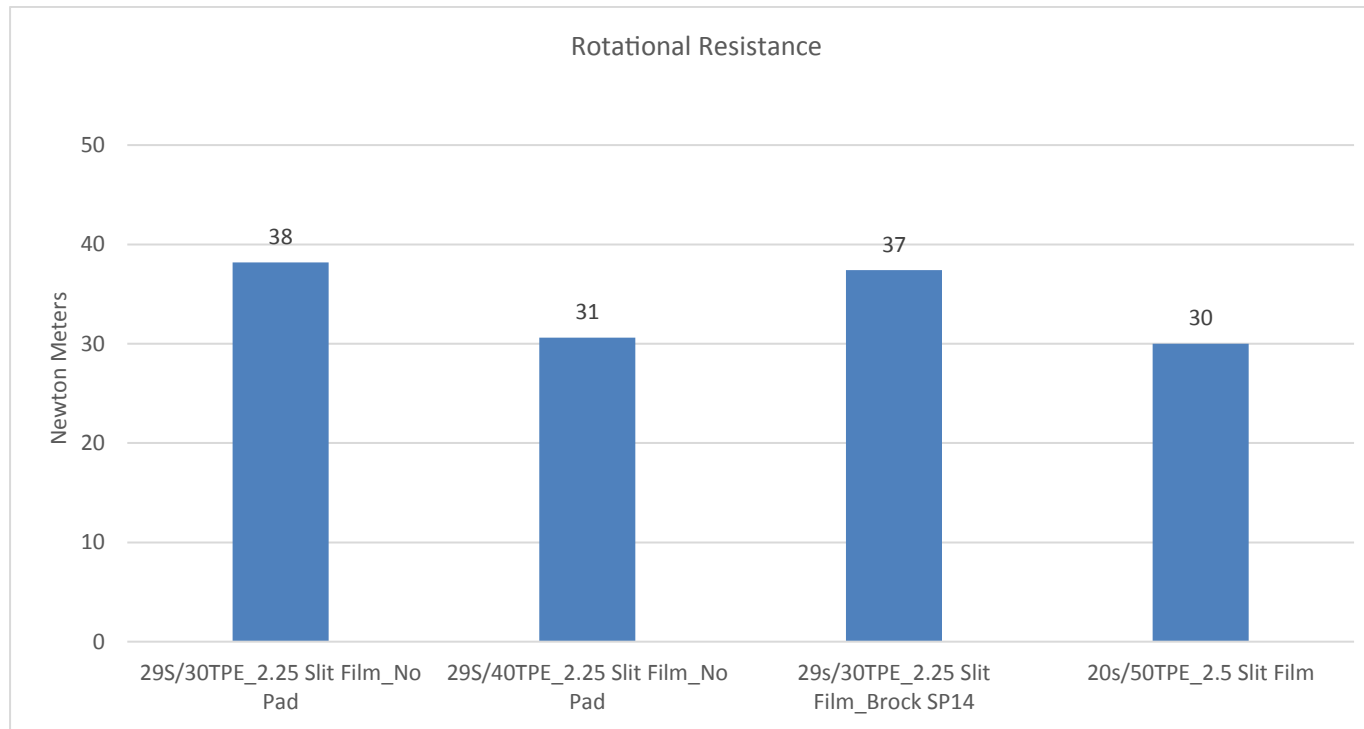


# LABORATORY TESTING PERFORMANCE EVALUATION



## Rotational Resistance – EN15301

Rotational Resistance measures the interaction between the cleat sole and the surface relating to the ability of a player to change direction. Higher values can relate to a surface that resists the rotation of a foot when a player is changing direction and increase the potential for lower extremity injury. \*STC guidelines recommend the results being 30n to 45n. The test results can be found in the results table below.



\*Referring to Guidelines for Synthetic Turf Performance, updated with 2015 manual guidelines



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# LABORATORY TESTING PERFORMANCE EVALUATION



Summary Results Table

System ID	Force Reduction (%)	Vertical Def (mm)	Energy Restit (%)	355A "Flat" Gmax	355A "Flat" HIC	Critical Fall Height (m)	Rotational Resistance	Ball rebound	Pill Burn	Infiltration (in/hr)
29S/30TPE_2.25 Slit Film_No Pad	53	6	29	174	571	1.09	38	0.87	PASS	88
29S/40TPE_2.25 Slit Film_No Pad	58	7	27	144	421	1.24	31	0.88	PASS	78
29s/30TPE_2.25 Slit Film_Brock SP14	65	8	27	92	208	1.46	37	0.69	PASS	n/a
20s/50TPE_2.5 Slit Film_No Pad	66	9	23	108	269	1.20	30	.9	n/a	n/a



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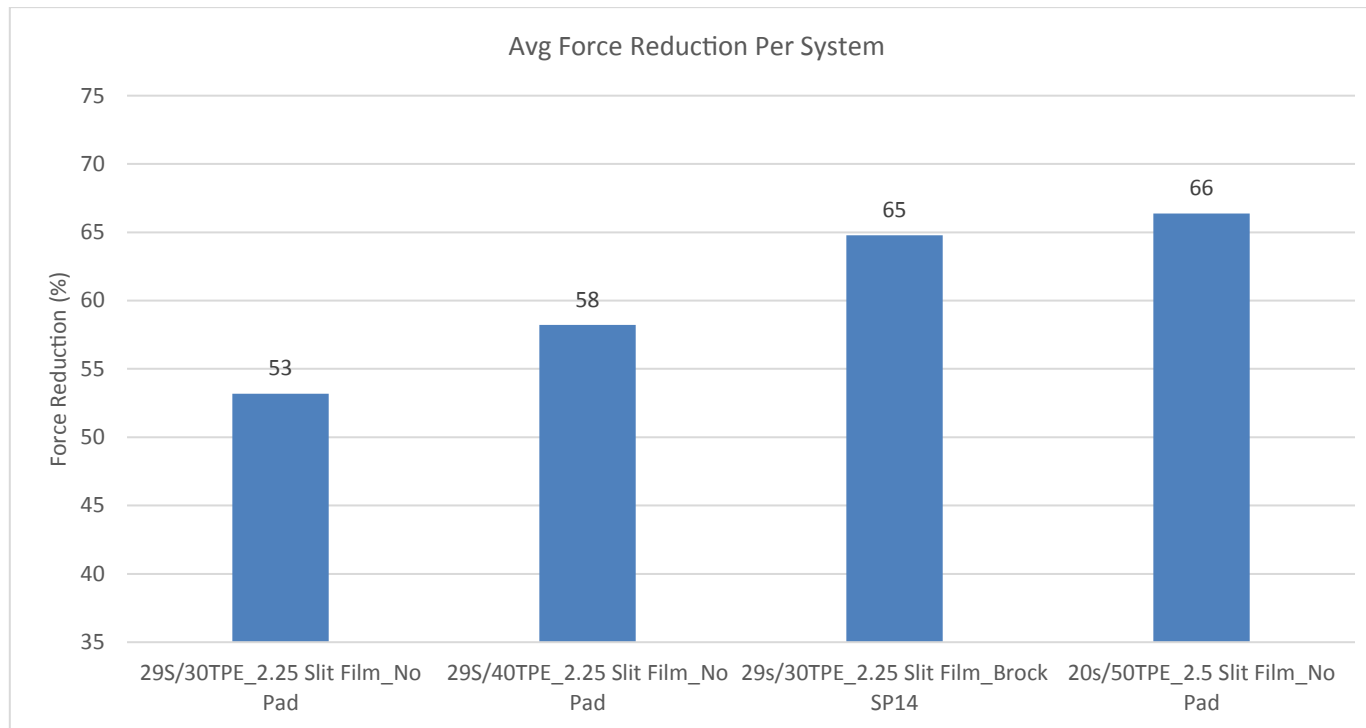


# LABORATORY TESTING PERFORMANCE EVALUATION



## Force Reduction (Advanced Artificial Athlete)

Force Reduction measures the impact absorption provided by surface to a player under foot as they run. A lower value describes a surface that is harder underfoot. The results are compared to the \*STC performance guidelines of 57% to 68% for a Community Field and 62% to 68% for Stadium Field.



\*Referring to Guidelines for Synthetic Turf Performance, updated with 2015 manual guidelines



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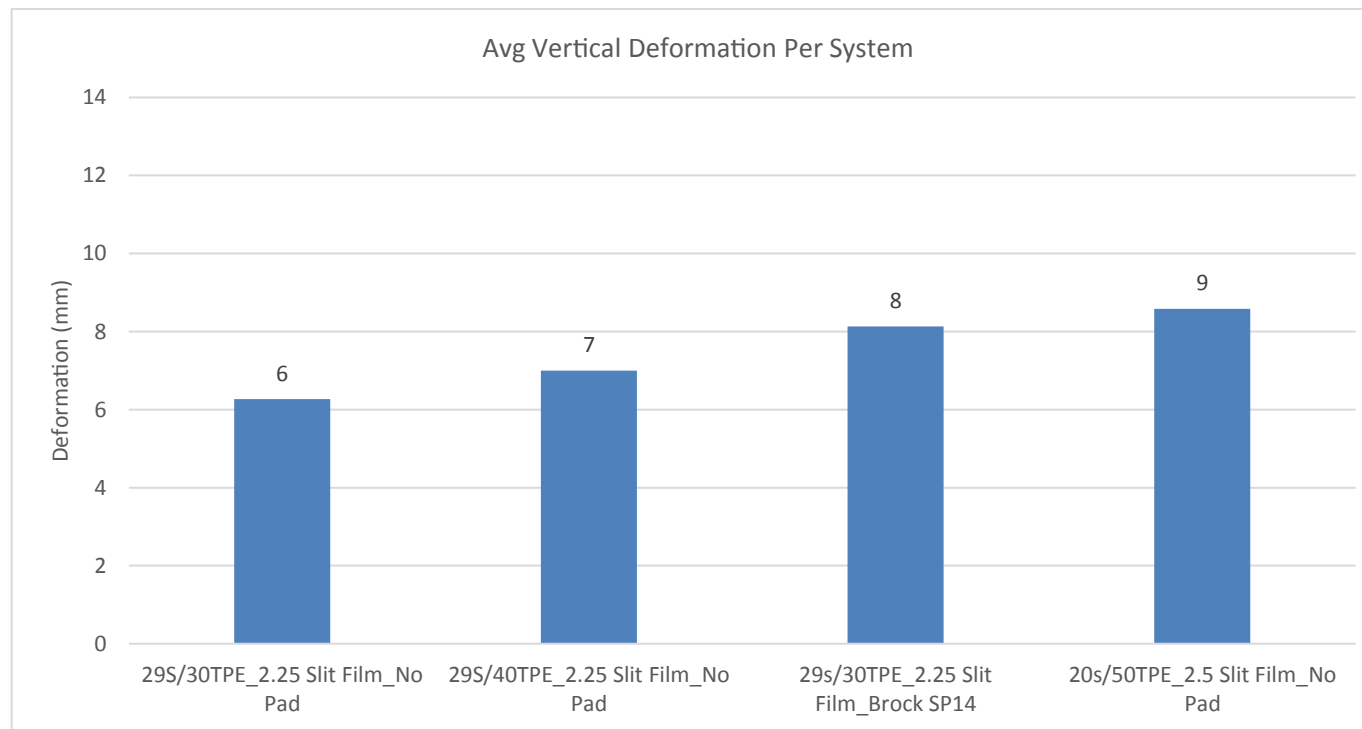


# LABORATORY TESTING PERFORMANCE EVALUATION



## Vertical Deformation (Advanced Artificial Athlete)

Vertical Deformation measures the amount a surface compresses as an athlete runs across it. This value is often related to speed of play and surface stability. The results are compared to the \*STC performance guidelines of 6 mm to 11 mm for a Community Field and 6 mm to 10 mm for Stadium Field. Vertical Deformation typically will reduce over time as a field receives use.



\*Referring to Guidelines for Synthetic Turf Performance, updated with 2015 manual guidelines



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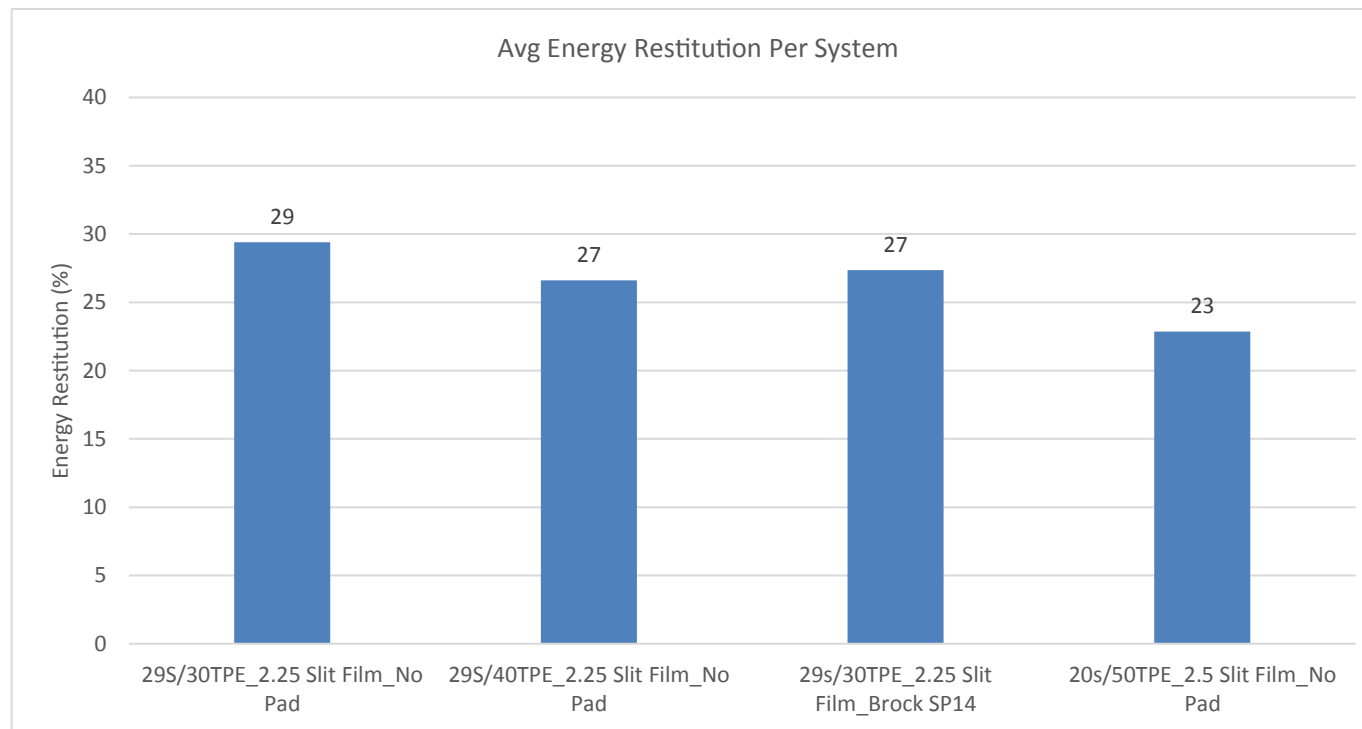


# LABORATORY TESTING PERFORMANCE EVALUATION



## Energy Restitution (Advanced Artificial Athlete)

Energy Restitution is defined as the energy returned as a percentage of the energy of applied. This can be thought of as the springiness of the surface. This value relates to the feel underfoot as well as the speed of play. Although this measurement is not a part of the official standard, it is a useful measure. The recommended range is 20% to 50%.



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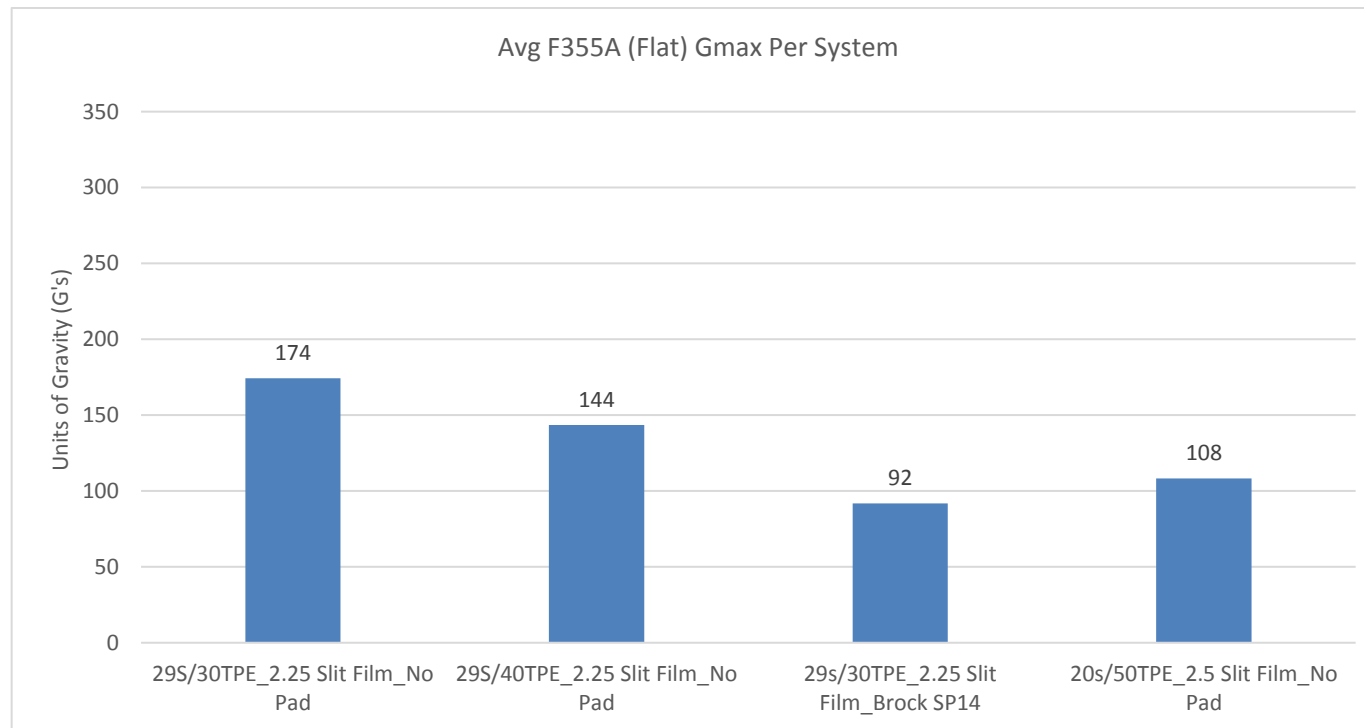


## LABORATORY TESTING PERFORMANCE EVALUATION



### ASTM F355A Gmax/HIC Impact Attenuation (Flat Faced Drop Missile)

The ASTM F355A Impact Hardness is the official device / method for assessing the hardness of synthetic turf athletic fields. It is used to gauge impact attenuation based on a predetermined head / body impact. This is a 20 lb "missile" with a tri-axial accelerometer dropped from a height of 24 in. The \*STC recommends that the Gmax values be less than 165.



\*Referring to Guidelines for Synthetic Turf Performance, updated with 2015 manual guidelines



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# LABORATORY TESTING TEMPERATURE EVALUATION



## System Descriptions

System ID	System Description
SBR Rubber / Sand	<p>Synthetic Turf Carpet: 2.25" Slit Film</p> <p>Infill Combination: 50% SBR Rubber/50% Silica sand (by weight)</p> <p>¾" Pile Exposure</p>
TPE/Sand	<p>Synthetic Turf Carpet: 2.25" Slit Film</p> <p>Infill Combination: 50% TPE/50% Silica sand (by weight)</p> <p>¾" Pile Exposure</p>

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# LABORATORY TESTING TEMPERATURE EVALUATION



## System Results

### SBR Rubber / Sand

Avg Temperature per Time Period		
Temperature (F°) per Sensor		
Exposure Time Period	Surface Sensor #1	Surface Sensor #2
0hr-1hr	160.3	163.5
1hr-2hr	182.3	183.4
2hr-3hr	198.6	190.7
3hr-3.5hr	208.2	204.3

### Guardian Innovations TPE/Sand

Avg Temperature per Time Period		
Temperature (F°) per Sensor		
Exposure Time Period	Surface Sensor #1	Surface Sensor #2
0hr-1hr	144.9	158.2
1hr-2hr	167.5	178.7
2hr-3hr	173.3	180.5
3hr-3.5hr	174.6	181.7

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# LABORATORY TESTING ABRASION & INFILL ID



## Project Information

<b>Project Name</b>	Guardian Innovations TPE Abrasion Infill Identification	<b>Sample Received</b>	4/11/2016
<b>Client Information</b>	Guardian Innovations 3044 Adriatic Court Peachtree Corners, GA 30071		
<b>Date</b>	May 5, 2016		
<b>Report Status</b>	Final		
<b>Job No.</b>	90905/991		
<b>Prepared by</b>	<i>Kieran O'Donnell</i> Field Operation Manager		
<b>Checked By</b>	<i>Jeffrey Gentile</i> Laboratory Director		

*Notes:*

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## Summary

Sports Labs USA was commissioned to perform infill identification and abrasion testing. Infill samples were sent to our laboratory. The tests performed were per the standards listed below.

Each system sample was constructed using the infill combinations shown in the component legend below per ASTM E11 – Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves.

ASTM F1015 - Standard Test Method for Relative Abrasiveness of Synthetic Turf Playing Surfaces

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# LABORATORY TESTING ABRASION & INFILL ID



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## General Information

<b>Test Methods</b>	ASTM F1015 Abrasion Plate, Trymer 2000 foam	ASTM E11 – Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves	
<b>Test Date</b>	5/3/16	<b>Total dry sample weight (g)</b>	422.70
<b>Material</b>	TPE		
<b>Weather Conditions</b>	5/3/16	<b>Air Temp (° F)</b>	72
<b>Humidity %</b>	45	<b>Misc. Notes</b>	None

## Abrasiveness Results Tables

PreWeight					Post Weight				
Trial 1	Trial 2	Trial 3	Trial 4	Total	Trial 1	Trial 2	Trial 3	Trial 4	Total
1.9792	2.0292	2.0507	2.043	8.1021	1.4015	1.366	1.473	1.5118	5.8

<b>Abrasiveness Index (%)</b>
39.2

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# LABORATORY TESTING ABRASION & INFILL ID



## Infill Description

	Characteristic	Results
Guardian Innovations TPE	Particle Size (mm)	1-1.6
	Particle Shape	Round/High Sphericity
	Bulk Density (g/cm3)	0.37

## Sample Photos



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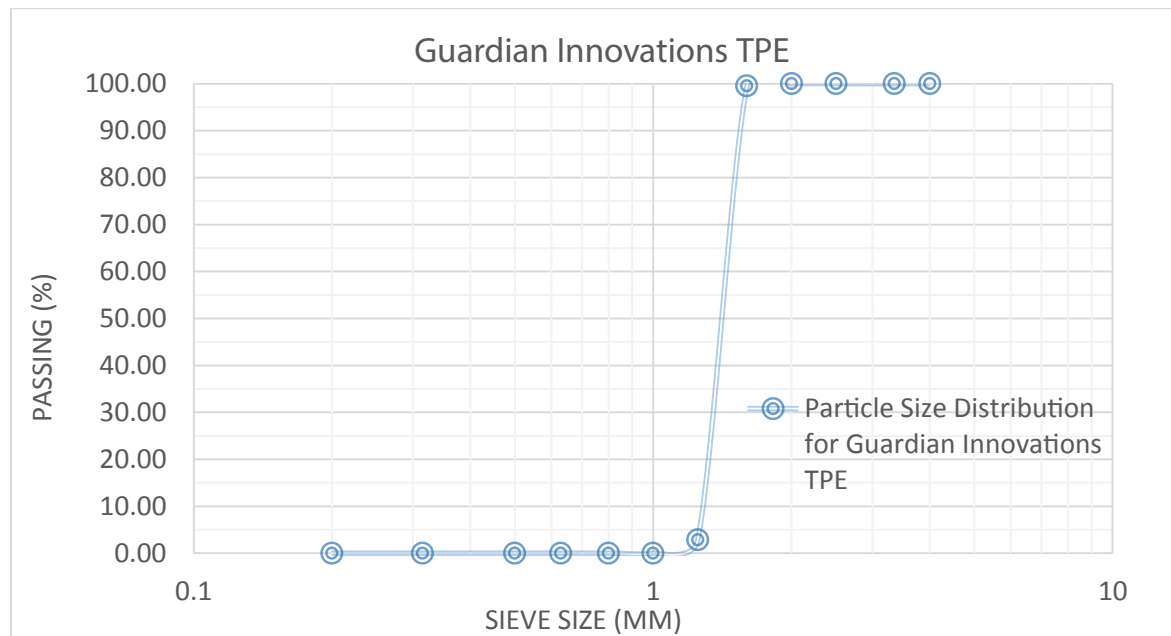




# LABORATORY TESTING ABRASION & INFILL ID

## Infill Grading

Particle Size Distribution for Guardian Innovations TPE			
SEIVE SIZE (mm)	Weight (g)	Retained (%)	Passing (%)
4	0	0.00	100.00
3.35	0	0.00	100.00
2.5	0	0.00	100.00
2	0	0.00	100.00
1.6	2.1	0.50	99.50
1.25	408.6	96.66	2.84
1	11.9	2.82	0.02
0.8	0.1	0.02	0.00
0.63	0	0.00	0.00
0.5	0	0.00	0.00
0.315	0	0.00	0.00
0.2	0	0.00	0.00
Passing to base tray	0	0.00	0.00
Check	422.7		



End of Report

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# LABORATORY TESTING PERFORMANCE EVALUATION



## Project Information

<b>Project Name</b>	Comparative Lab Testing Combination Testing Performance Evaluation		
<b>Client Information</b>	Guardian Innovations 3044 Adriatic Court Peachtree Corners, GA 30071		
<b>Report Date</b>	November 9, 2016	<b>Test Dates</b>	4/15/2016, 5/13/2016
<b>Sample Arrival</b>	4/11/2016	<b>Report Status</b>	Final
<b>Job No.</b>	90905/991		
<b>Prepared by</b>	<i>Kieran O'Donnell</i> Field Operation Manager		
<b>Checked by</b>	<i>Jeffrey Gentile</i> Laboratory Director		

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## Summary

Each system was constructed and prepared per EN 12229: Surfaces for sports areas - Procedure for the preparation of synthetic turf and textile pieces. Sports Labs USA was commissioned to perform laboratory testing for the following characteristics listed below.

Advanced Artificial Athlete Tests: Force Reduction Vertical Deformation, & Energy Restitution – STC  
Advanced Artificial Athlete Protocol  
EN 1177- HIC Impact Attenuation (Hemispherical Drop Missile) – EN 1177  
Gmax Impact Attenuation (Flat Faced Drop Missile) – ASTM F355A  
Rotational Resistance – EN15301  
Vertical Ball Rebound  
Pill Burn  
Infiltration – DIN 18-035

Complete results and background information can be found in the subsequent sections of this report.

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# LABORATORY TESTING PERFORMANCE EVALUATION



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## System Description

System ID	System Description
29S/30TPE_2.25 Slit Film_No Pad	2.70 lbs Sand per sq. ft. /2.79 lbs TPE per sq. ft over 2 1/4" 42 oz Slit film, No Pad
29S/40TPE_2.25 Slit Film_No Pad	2.70 lbs Sand per sq. ft. /3.72 lbs TPE per sq. ft over 2 1/4" 42 oz Slit film, No Pad
29s/30TPE_2.25 Slit Film_Brock SP14	2.70 lbs Sand per sq. ft./2.79 lbs TPE per sq. ft. over 2 1/4" 42 oz Slit film, Brock SP14
20s/50TPE_2.5 Slit Film	1.86 lbs Sand per sq. ft./4.65 lbs TPE per sq. ft. over 2 1/2" 48 oz Slit Film Carpet, No Pad

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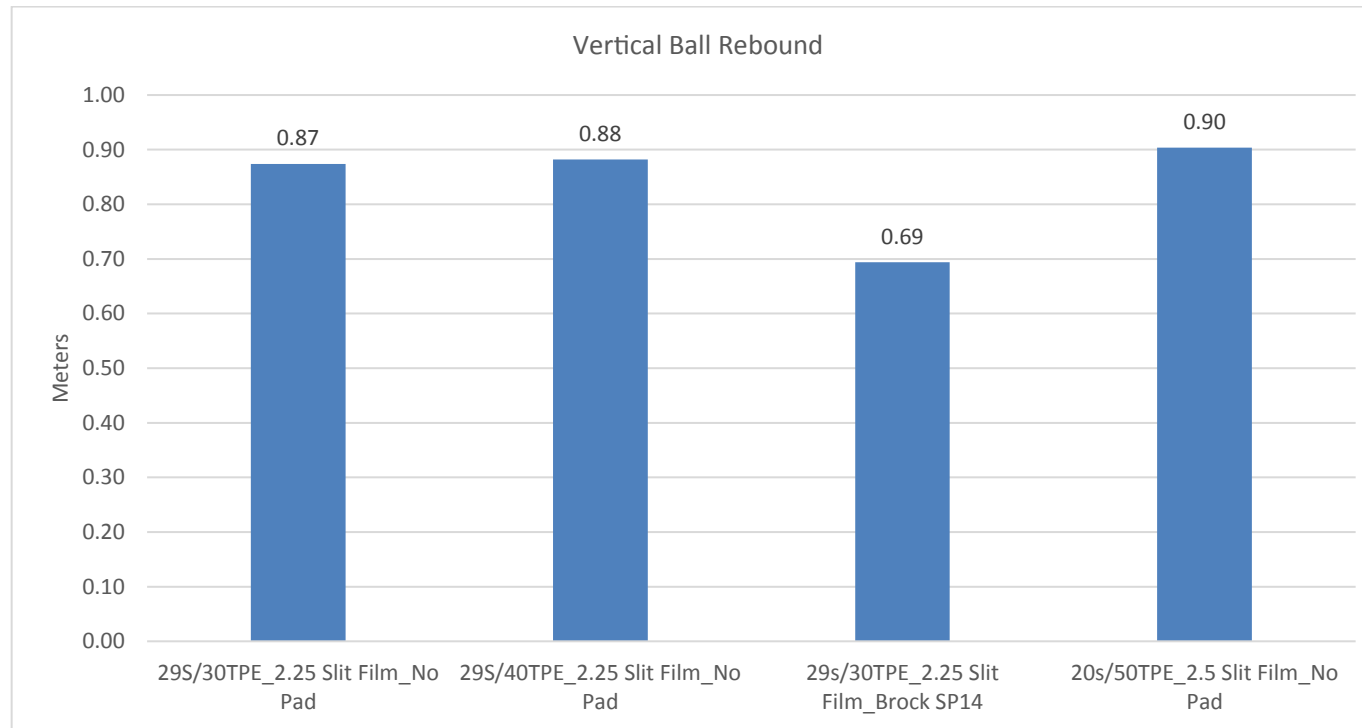


# LABORATORY TESTING PERFORMANCE EVALUATION



## Vertical Ball Rebound – EN 12235

Measures how high the ball bounces when falling vertically onto a synthetic turf field. A Ball is released from 2m and the height of its rebound from the surface is calculated. The ball is first calibrated on a level concrete surface to 1.35m. \*STC recommends from 60cm to 85cm. The test results can be found in the results table below.



\*Referring to Guidelines for Synthetic Turf Performance, updated with 2015 manual guidelines



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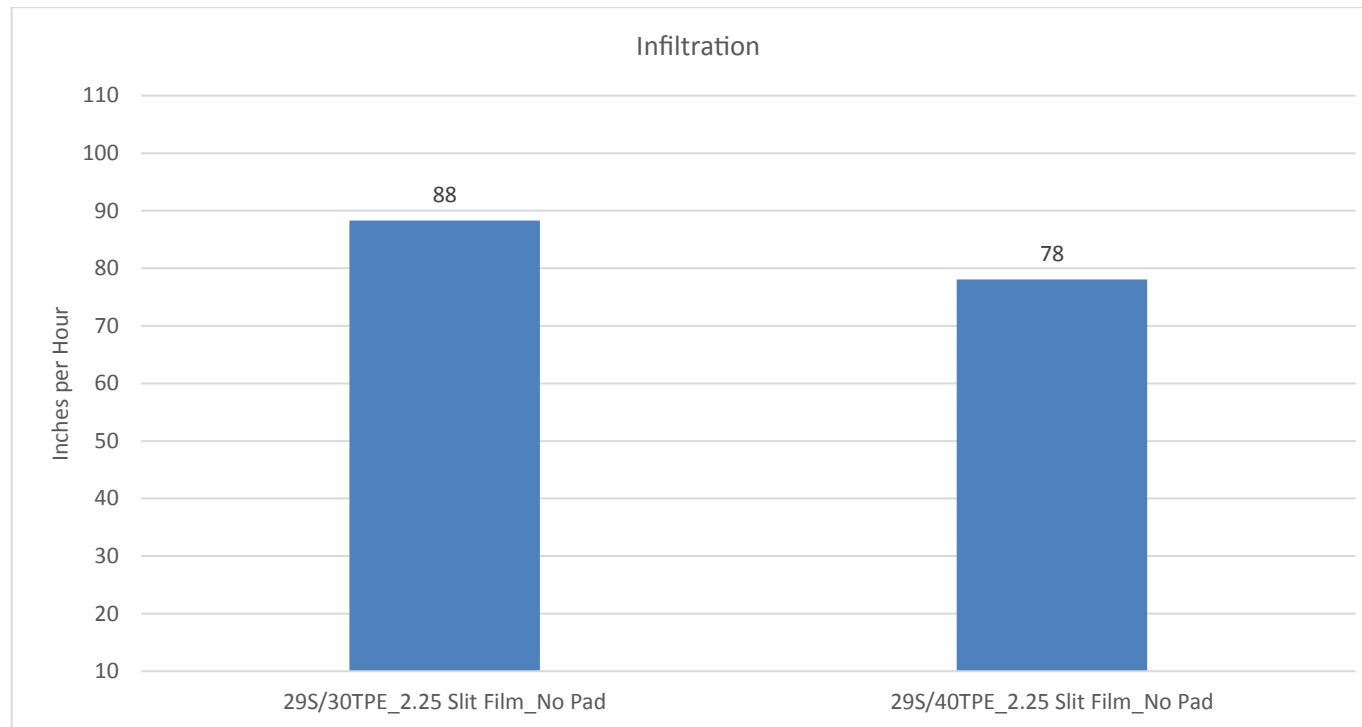


# LABORATORY TESTING PERFORMANCE EVALUATION



## Infiltration – DIN 18-035

Surfaces for sports areas - Determination of water infiltration rate test. The purpose of this testing was to provide permeability rates for the tested surface. \*STC recommends >7 inches per hour. A temperature correction factor of .919 was used per EN 12616. Test results can be found in the table below.



\*Referring to Guidelines for Synthetic Turf Performance, updated with 2015 manual guidelines

End of Report



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GMAX TEST RESULT TS

GUARDIAN TPE INFILL

\*Patent Pending

TEST 1

GMAX Performed by: Astroturf ®

GMAX Over Stone

2.0ss/1.0 Guardian TPE Infill

At 1500 Cycles on the JE108 with an infill loss of 8%

	Control	Powerbase	ASP15	Rebounce 12	E-Core 10mm
1	162.46	79.08	86.11	99.71	115.36
2	186.79	85.76	96.17	107.6	126.27
3	195.35	87.21	98.63	110.14	129.17
Avg:	181.53	84.02	93.64	105.82	123.60

TEST 2

GMAX Performed by: GreenFields ®

	1.5" GSI - Sand	1" GSI 1/2" Sand	3/4" GSI 3/4" Sand	1.5" GSI 1" Sand	1.5" GSI - Sand	1" GSI 1/2" Sand
1	70	99	102	125	109	143
2	88	113	113	130	120	173
3	90	126	125	133	122	185
Avg:	82.67	112.67	113.33	129.33	117.00	167.00
	With Pad				Without Pad	