

ASBA  2024

ASBA TECHNICAL MEETING & TRADE SHOW
DECEMBER 3-6, 2024 | ORLANDO, FLORIDA

Cracking the Code: Demystifying Synthetic Turf Performance Data



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The logo for ASBA 2024 features the text "ASBA" in green, a stylized sunburst over a teal semi-circle, and "2024" in blue.

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Organizations & History of Tolerances



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Organizations

- Governing Bodies:



- Trade Organizations:



- Standards Organizations:



Where Do Performance Standard Tolerances Come From?

Synthetic turf being meant to replicate natural grass, historically considered as the gold standard for sports fields, the most prestigious grass sports venues were looked the ultimate benchmark.



First performance tolerances set for soccer by FIFA (2001)

- **Benchmark:** elite soccer stadiums, mostly Europeans
- **Objective:** «...*replicate the playing characteristics of good-quality natural grass...*»

➤ Followed by others with similar approaches (FA, CEN, World Rugby, etc...)

Where Do Performance Standard Tolerances Come From?

Same properties, different requirements: **tolerances are always sport specific**

	FIFA QPro	World Rugby	FIH (Cat. 1)	EN 15330 (soccer)	STC Guidelines
Shock Absorption	60 – 70 %	55 – 70 %	45 – 60 %	55 – 70 %	60 – 70 %
Vertical Deformation	4.0 – 10.0 mm	5.5 – 11.0 mm	4.0 – 9.0 mm	4.0 – 9.0 mm	4.0 – 8.0 mm
Energy Restitution	None	20 – 50 %	None	None	None
Rotational Resistance	30 – 45 Nm	30 – 45 Nm	25 – 45 Nm*	25 – 50 Nm	30 – 45 Nm
Ball Roll	4.0 – 8.0 m	None	≥ 10.0 m**	4.0 – 10.0 m	4.0 – 8.0 m
Ball Rebound	60 – 85 cm	60 – 100 cm	10 – 40 cm**	60 – 85 cm	60 – 85 cm

*World Athletics:

The acceptable range for shock absorption is between 35% and 50%

Futsal: Shock Absorption (FIFA Test Method Fustal01)

Surface Construction Type	Requirements
Point Elastic	≥ 18.0 % ≤ 75.0 %
Area Elastic	≥ 40.0 % ≤ 75.0 %
Combined Elastic	≥ 40.0 % ≤ 75.0 %



Beyond Suggested Tolerances?



Performance Based Standard

Risk Management Standard



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Performance Based Testing: Player Interaction



Force Reduction / Shock Absorption (Player Interaction)

Definition: ability of a system to dissipate energy from an impact and decrease the amount of force transmitted through the material.

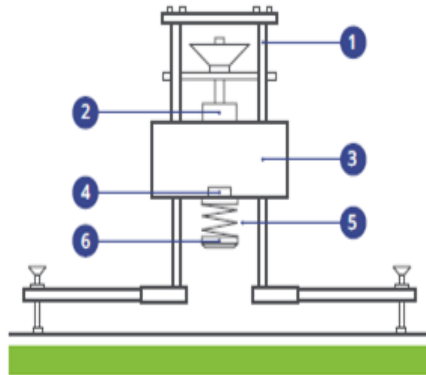
Principle: determined by comparing the maximum force exerted on the test specimen with the reference force of impact on concrete, allowing for the calculation of the reduction in impact force.

Test equipment:

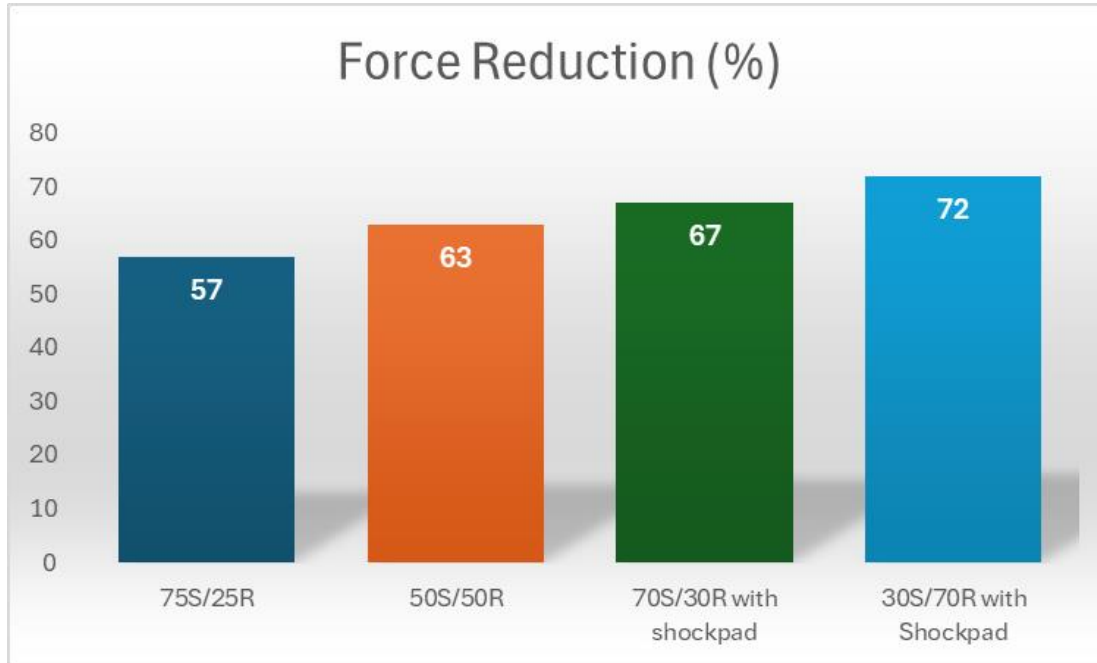
Advanced Artificial Athlete (AAA)

Test methods:

FIFA 04a / EN 16717 / ASTM F3189



Force Reduction



The data used in this presentation is for example purposes only.

Player Interaction

What does the test tell us?

Higher (softer)

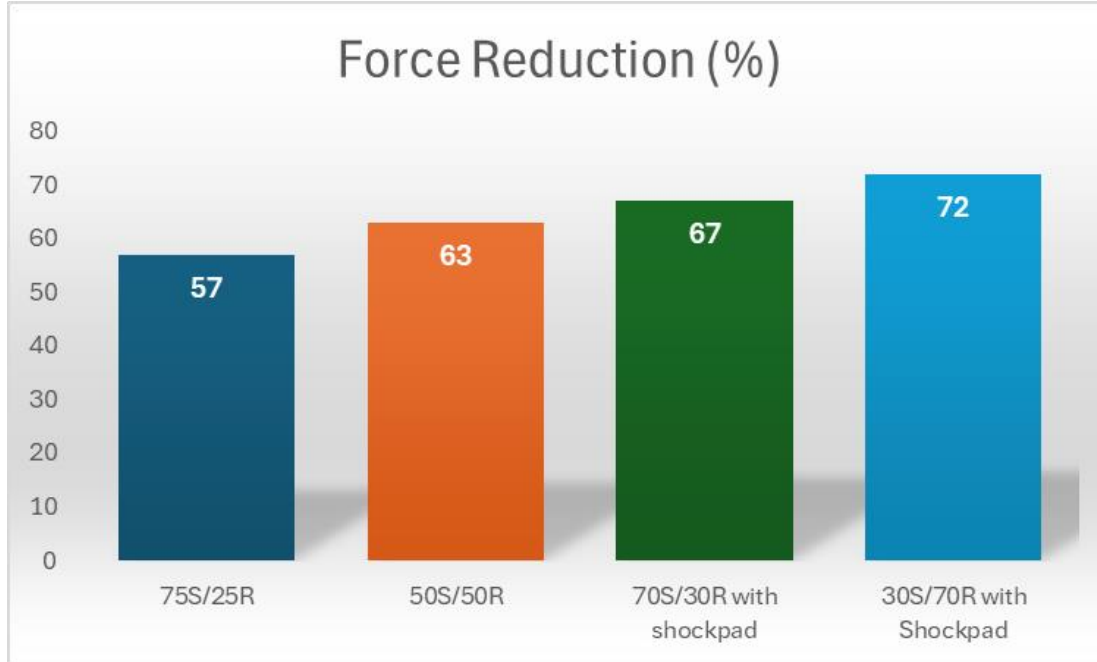
What are the pros of a higher force reduction result?

- Reduced impact on joints, muscles, and bones
- Improved cushioning provides more comfort during extended play or practice
- Gentler on the body, ideal for recovery or athletes with conditions like arthritis

What are the cons of a higher force reduction result?

- Energy loss: Reduced energy return may lower speed, jump height, and movement power
- Decreased responsiveness: Softer surface can slow reaction times and agility
- Increased muscle fatigue: More effort required to maintain performance, leading to quicker fatigue
- Overuse of certain muscles: Compensating for reduced energy return may lead to overuse.

Force Reduction



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Player Interaction

What does the test tell us?

Lower (harder)

What are the pros of a lower force reduction result?

- Improved agility and speed: Faster, more efficient movements with easier direction changes and acceleration.
- Optimal for sprinting/jumping: Maximizes propulsion for explosive sports movements.

What are the cons of a lower force reduction result?

- Higher impact forces: More stress on joints, muscles, and bones,
- Quicker muscle fatigue: Increased effort may lead to faster fatigue over time.
- Less cushioning: Less comfort during long sessions on harder surfaces.
- Longer recovery times: Increased strain leads to longer recovery periods after intense activity.

Vertical Deformation (Player Interaction)

Definition: change in height or displacement of a surface in the vertical direction when subjected to a load or force, in order to measure how much a material compresses or deforms along the vertical axis under pressure.

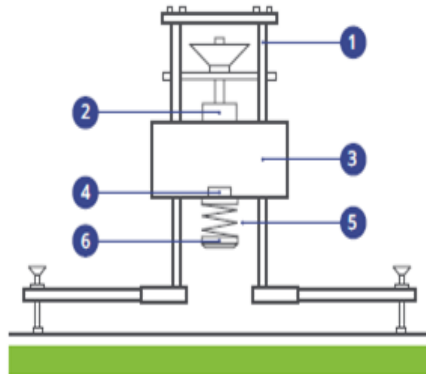
Principle: determined by calculating the displacement of the falling mass into the surface after its impact on it through the measurement of its acceleration / deceleration.

Test equipment:

Advanced Artificial Athlete (AAA)

Test methods:

FIFA 05a / EN 16717 / ASTM F3189



Vertical Deformation

Higher

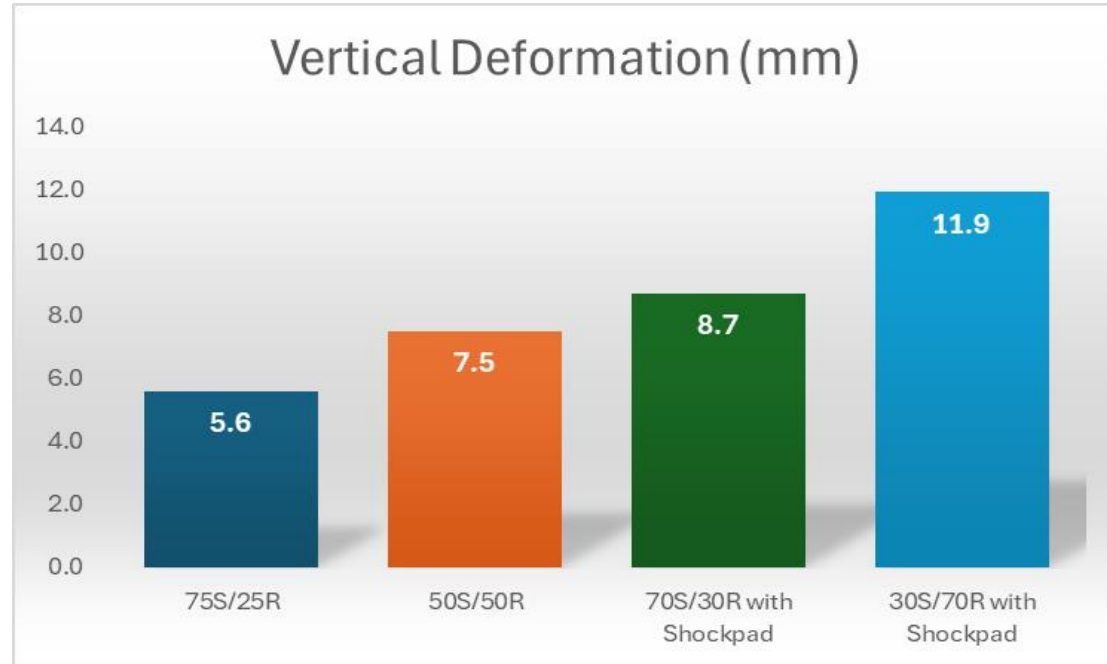
What are the pros of a higher vertical deformation result?

- Enhanced shock absorption: Reduces stress on joints and muscles, lowering injury risk.
- Injury prevention: Provides cushioning, beneficial for athletes prone to injury or in recovery.
- Increased comfort: Softer surface is more comfortable for prolonged activity, especially for younger and older athletes.
- Support for recovery: Gentler surface is ideal for athletes recovering from injury.

What are the cons of a higher vertical deformation result?

- Slower movements: Increased surface "give" reduces sharpness and responsiveness.
- Energy loss: More energy absorbed by the surface, leading to slower speeds, lower jumps, and reduced power.
- Decreased performance: Softer surface requires more effort, making peak performance harder to achieve

What does the test tell us?



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Player Interaction



Vertical Deformation

Lower

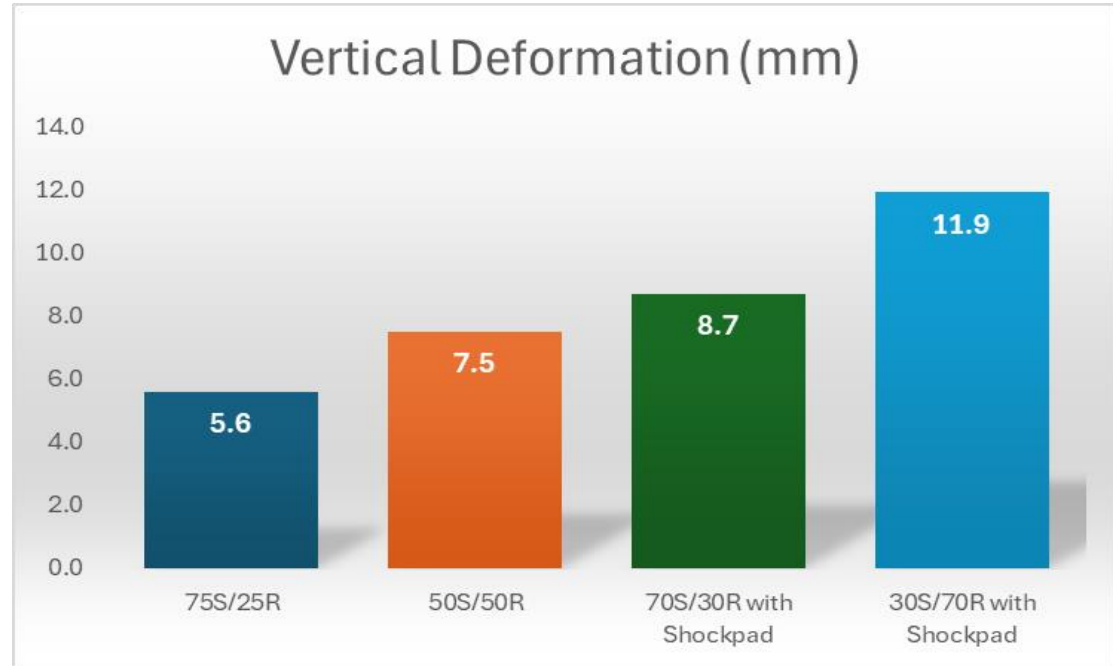
What are the pros of a lower vertical deformation result?

- Enhanced stability: Firm, predictable surface improves balance and footing.
- Optimized for speed: Low energy loss allows athletes to achieve higher speeds, ideal for speed-oriented sports.

What are the cons of a lower vertical deformation result?

- Higher impact forces: More impact is transferred to the athlete's body.
- Less cushioning: Harder surface leads to discomfort and fatigue during prolonged activity.
- Longer recovery times: Increased stress on muscles and joints results in longer recovery periods.

What does the test tell us?



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Player Interaction



Energy Restitution (Player Interaction)

Definition: amount of energy returned by a surface to the athlete during a surface interaction. It measures the efficiency of a material in bouncing back or restoring energy, as opposed to the energy being absorbed by it.

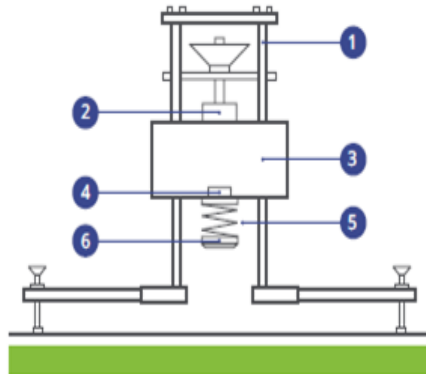
Principle: calculated from the comparison of energy of the falling mass before and after impact on the surface.

Test equipment:

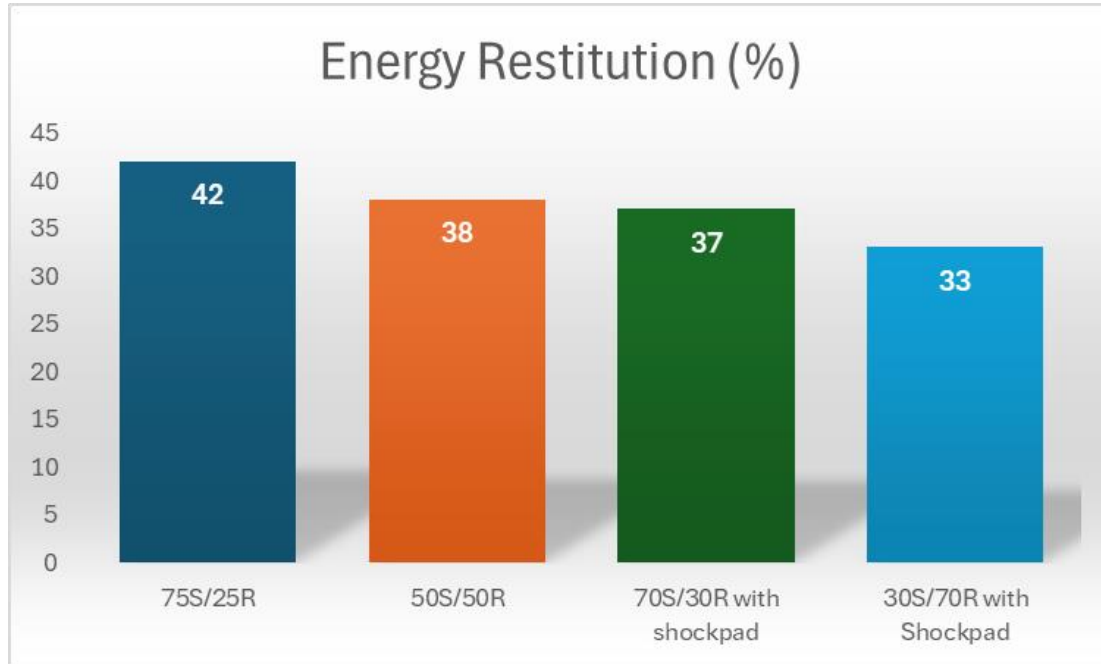
Advanced Artificial Athlete (AAA)

Test methods:

FIFA 05a / EN 16717 / ASTM F3189



Energy Restitution



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Player Interaction

What does the test tell us?

Higher ER %

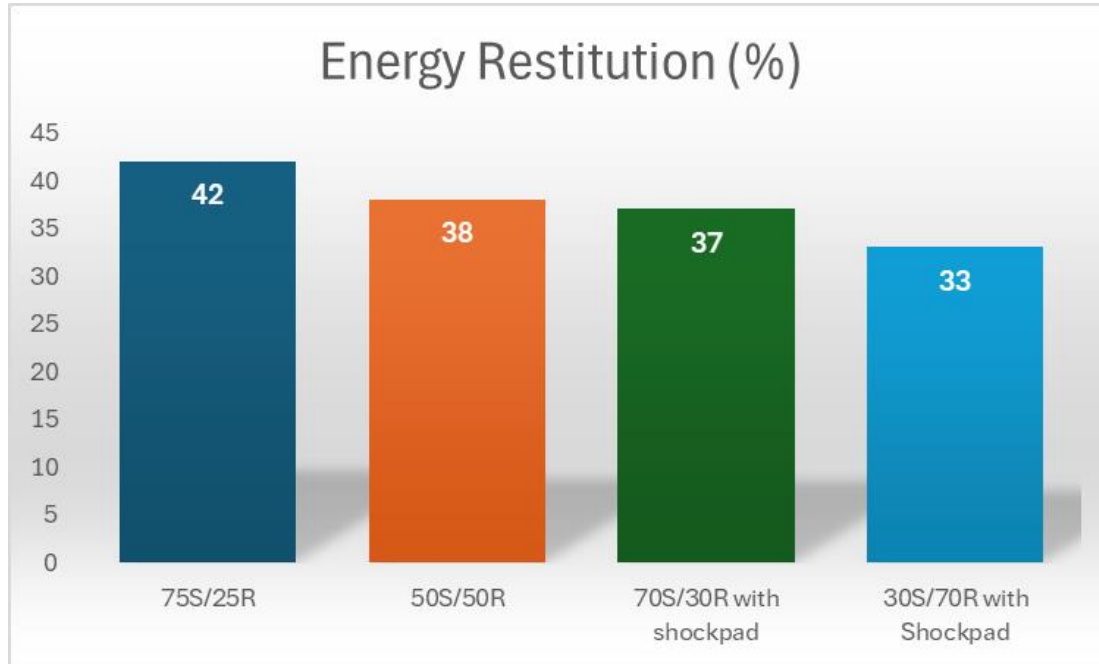
What are the pros of a higher energy restitution percentage?

Surfaces with high energy restitution can help athletes perform better by reducing energy loss, allowing them to run faster, jump higher, or change direction more efficiently.

What are the cons of a higher energy restitution percentage?

Higher energy restitution could also lead to surfaces feeling too "bouncy," leading to increased stress on joints, tendons, and muscles.

Energy Restitution



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Player Interaction

What does the test tell us?

Lower ER %

What are the pros of a lower energy restitution percentage?

Natural sports fields typically have low energy restitution (12-18%), which provides a more realistic surface interaction when the goal is to replicate natural playing conditions.

What are the cons of a lower energy restitution percentage?

A lower energy restitution can slow down athletes as they struggle to maintain momentum.

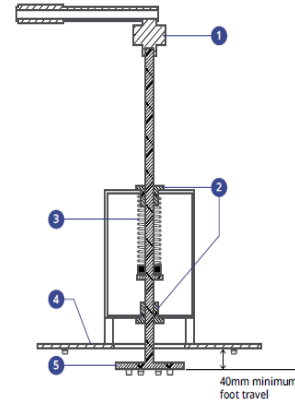
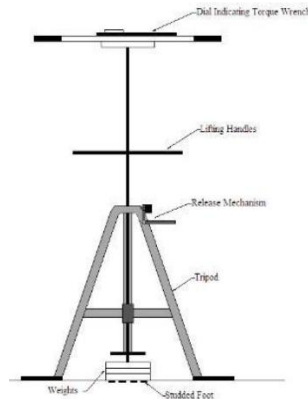
Rotational Resistance (Player Interaction)

Definition: force required to initiate or maintain the rotation of an athlete foot on the surface. It measures the resistance a surface offers against rotational movement.

Principle: maximum force measured using a torque wrench when a loaded foot is allowed to horizontally rotate when in contact with the surface.

Test equipment:

Rotational Resistance (weighted) (EN) or Lightweight Rotational Resistance (FIFA)



Test methods:
FIFA 06 / EN 15301-1

Rotational Resistance

Higher

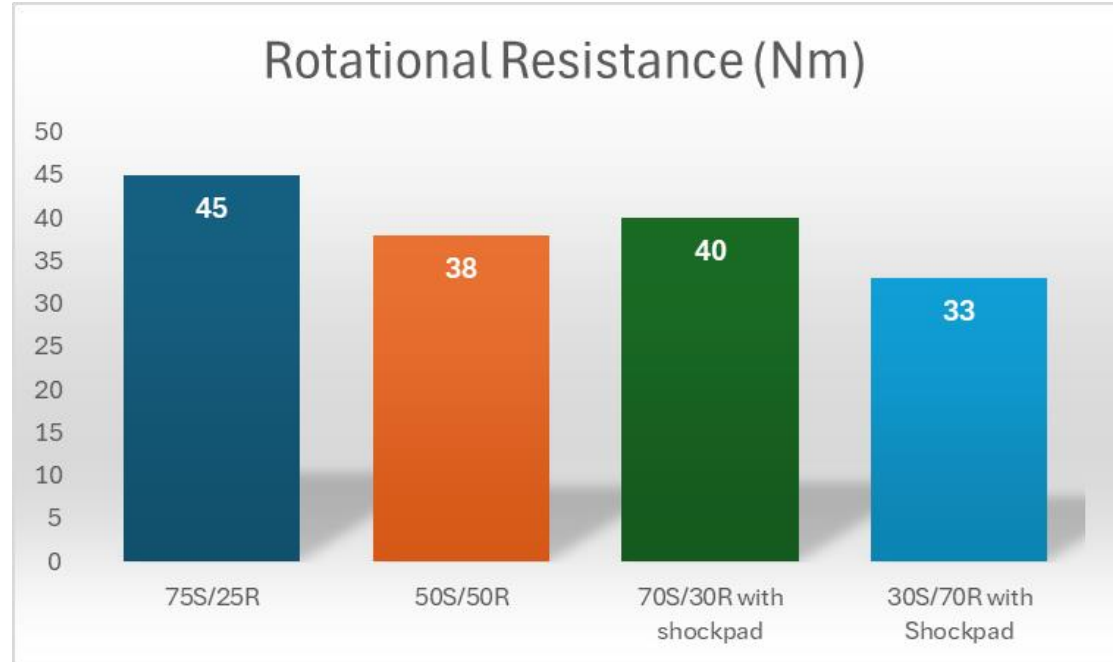
What are the pros of a higher rotational resistance result?

- Enhanced traction: High rotational resistance improves stability during cutting, pivoting, and quick direction changes.
- Reduced slipping: Athletes are less likely to lose footing, crucial in sports like football, soccer, and rugby.
- Increased power transfer: More efficient energy transfer during rotational movements, enhancing overall performance.

What are the cons of a higher rotational resistance result?

- Difficulty in quick movements: Excessive resistance hinders fluidity, requiring more effort to overcome friction.
- Potential slowdown: Increased effort may slow down athletes during rapid actions.

What does the test tell us?



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Player Interaction



Rotational Resistance

Lower

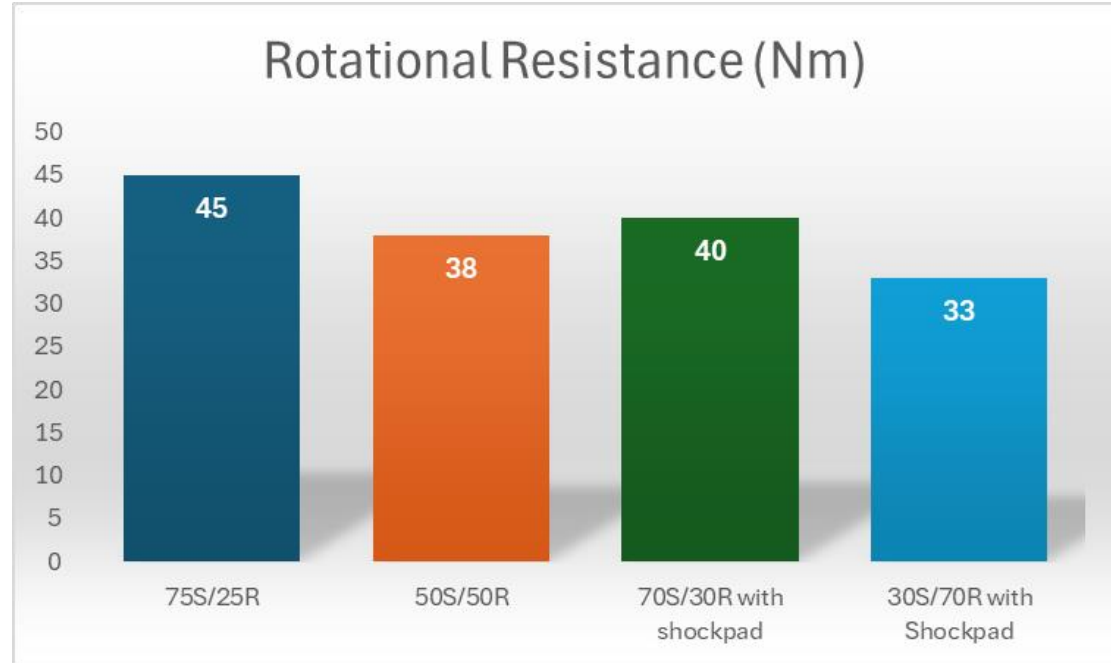
What are the pros of a lower rotational resistance result?

- Smooth movements: Low resistance enables smoother, more natural rotational movements.
- Increased agility: Easier pivoting and turning on low rotational resistance surfaces enhances responsiveness and agility.

What are the cons of a lower rotational resistance result?

- Reduced traction and stability: Low rotational resistance increases the risk of slipping and losing balance during quick movements.
- Higher slippage risk: Particularly problematic in sports like soccer and rugby, where balance is critical.
- Uncontrolled movements: Athletes may face unintended movements, such as over-rotation, impacting performance and increasing fall risk.
- Decreased power transfer: Inefficient energy transfer during rotational movements reduces power and effectiveness in play.

What does the test tell us?



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Player Interaction



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Performance Based Testing: Ball Interaction



Ball Rebound (Ball Interaction)

Definition: A calibrated association soccer ball is released from a 2 meter height and rebound height is recorded

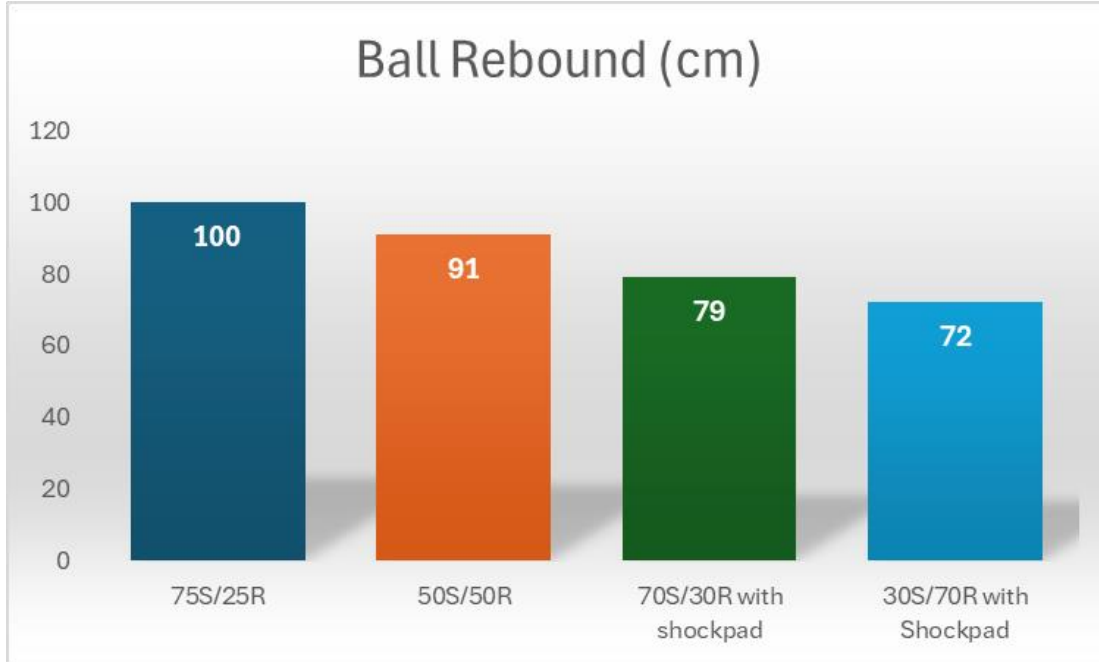
Principle: The test measures the maximum force exerted on the ball when it is dropped from a set height onto the surface, recording how high the ball rebounds. The ratio of the rebound height to the drop height indicates the surface's ability to return energy to the ball.

Test equipment: Association Ball & Ball release mechanism

Test methods: ASTM F2117 / ASTM F2569 / EN 14877



Ball Rebound



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Ball Interaction

What does the test tell us?

Ball rebound is an indication of the field Energy return as it relates to the ball. High ball rebound may indicate a surface is not absorbing enough energy in a ball to ground contact. Ball rebound will also give insight to fiber condition, need for maintenance, & predictable ball play.



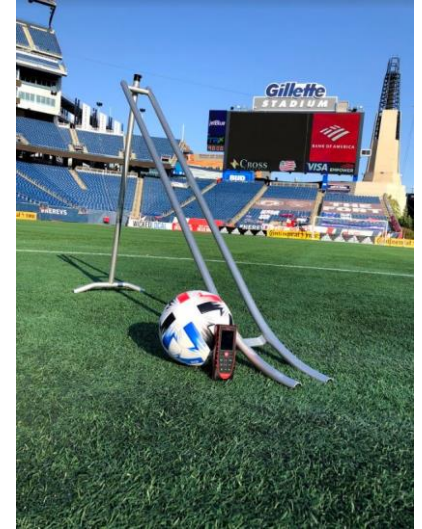
Ball Roll (Ball Interaction)

Definition: Ball roll refers to the distance a ball travels across a playing surface after being released with a controlled force. This measurement evaluates the surface friction, smoothness, and consistency, which are critical for determining the playability and performance of sports fields.

Principle: A calibrated association soccer ball is rolled down a ramp angled at 45 degrees from a 1 meter height and the distance of travel is recorded.

Test Equipment: Ball Roll Ramp, standardized ball, measurement device

Test Methods: EN 12234



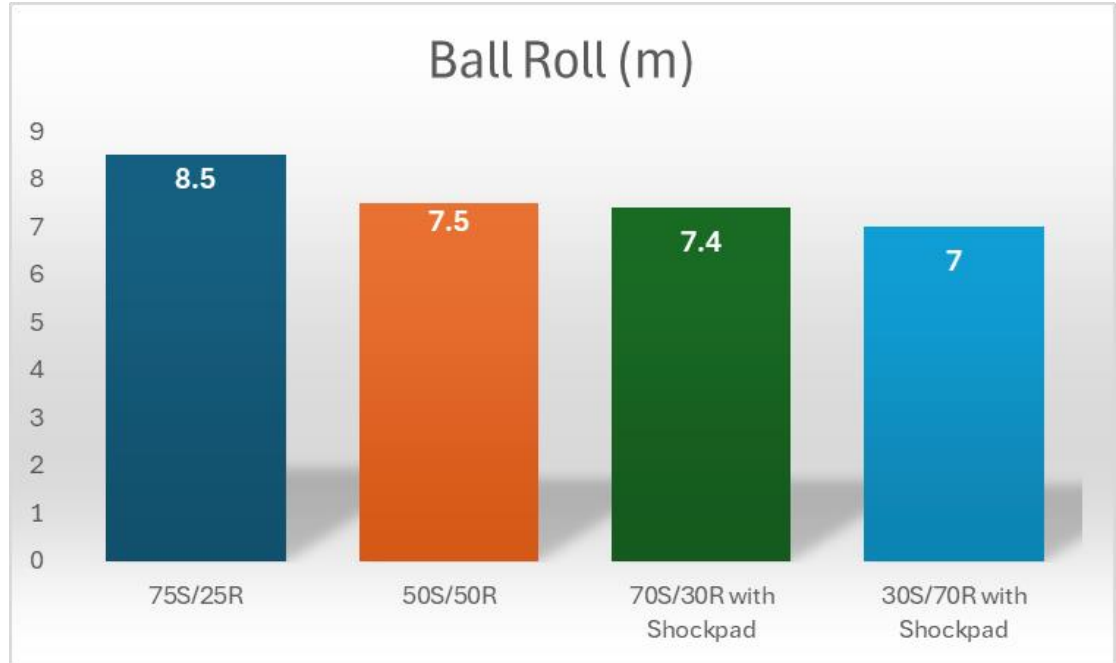
Ball Roll

Ball Interaction

What does the test tell us?

While Ball Roll is a specific playability requirement for soccer and field hockey, the use of Ball Roll as a tool to identify the condition and orientation of the fibers is recognized by all sports.

It is included here as a maintenance indication tool. A high Ball Roll indicates that the fibers may be lying flat promoting a fiber memory break. High ball roll often means there is a need for maintenance.



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Risk Management Testing



G-Max (Risk Management Testing)



Definition: Used to measure the shock-absorbing properties of a surface by evaluating the maximum impact force exerted upon it. It quantifies how much force is transferred to an object (such as a player) when it impacts the surface. The resulting g-max value is expressed in g-forces, where 1g equals the force of gravity.

Principle: A 20 lb missile is dropped from a 24” fall height to help establish the risk of a head to surface impact.

Testing Equipment: G-max Machine

Test Methods: ASTM F1936

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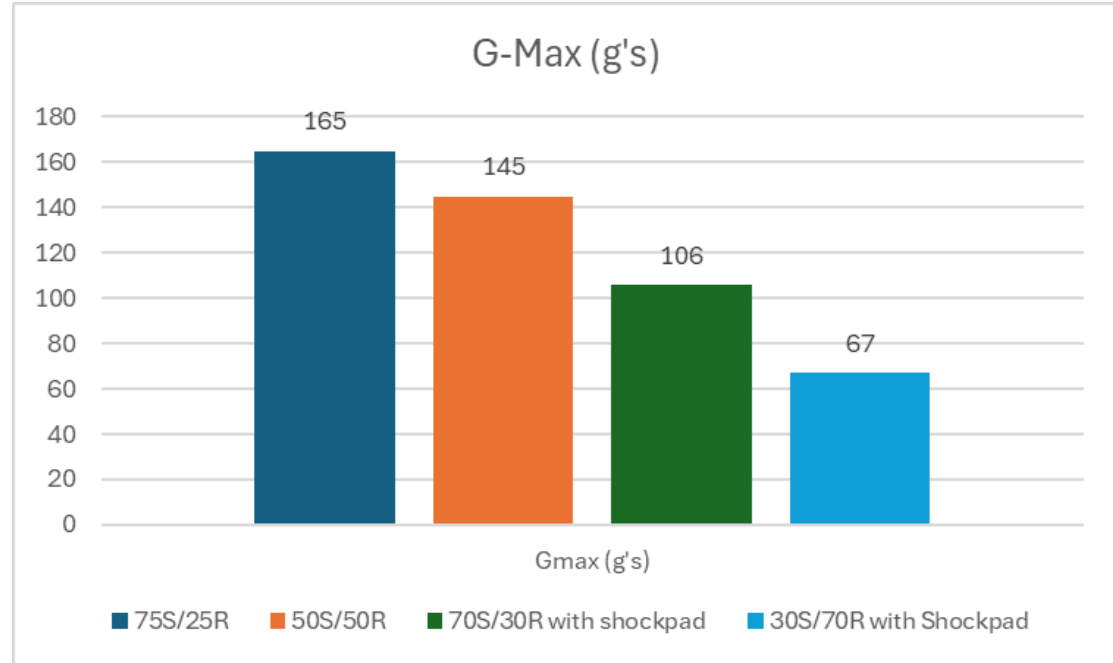
G-Max

What does the test tell us?

The purpose of g-max testing is to measure the absorption capabilities of the surface by mimicking a head to ground impact. This testing is not intended to replicate a player's performance interaction with the surface.

A low g-max value does not necessarily mean that there is a lack of stability in the surface.

Risk Management Testing



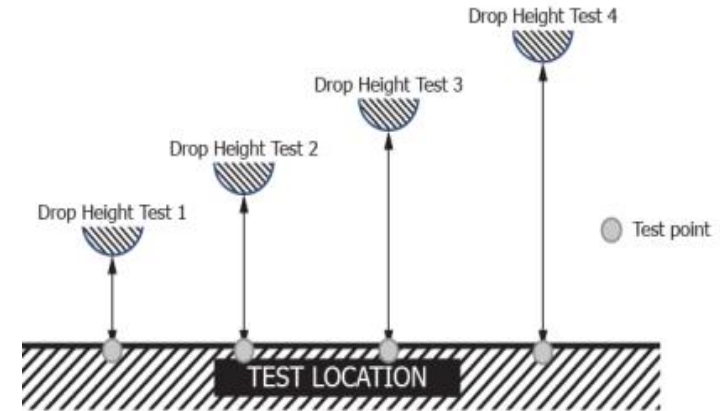
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HIC (Risk Management Testing)

Definition: "Critical fall height" in Head Injury Criterion (HIC) testing refers to the maximum height from which a person could fall onto a tested surface without experiencing a potentially life-threatening head injury. In technical terms, it's the height at which the impact from a fall produces a HIC value of 1000.

Test Equipment: Headform, Drop Test Apparatus, & Data Acquisition System

Test Methods: ASTM F3146 / EN 1177 (2018) /ASTM F1292



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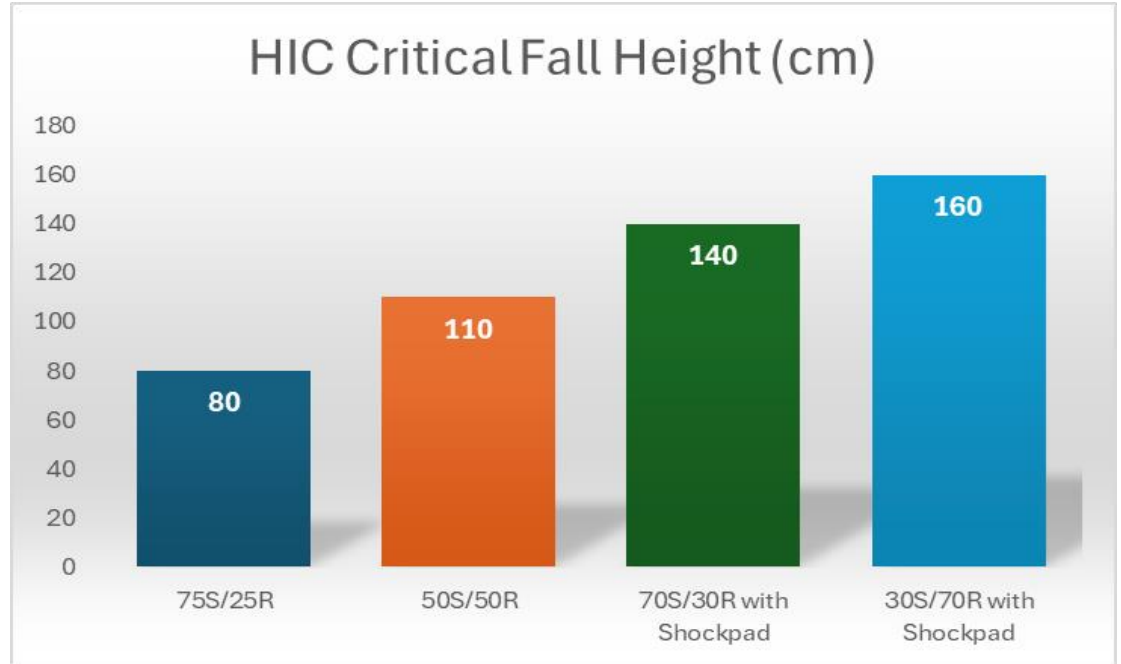
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HIC



Performance requirements: When all four characteristic HIC values for known drop heights have been calculated, the values are plotted as drop height versus representative HIC.

Risk Management Testing



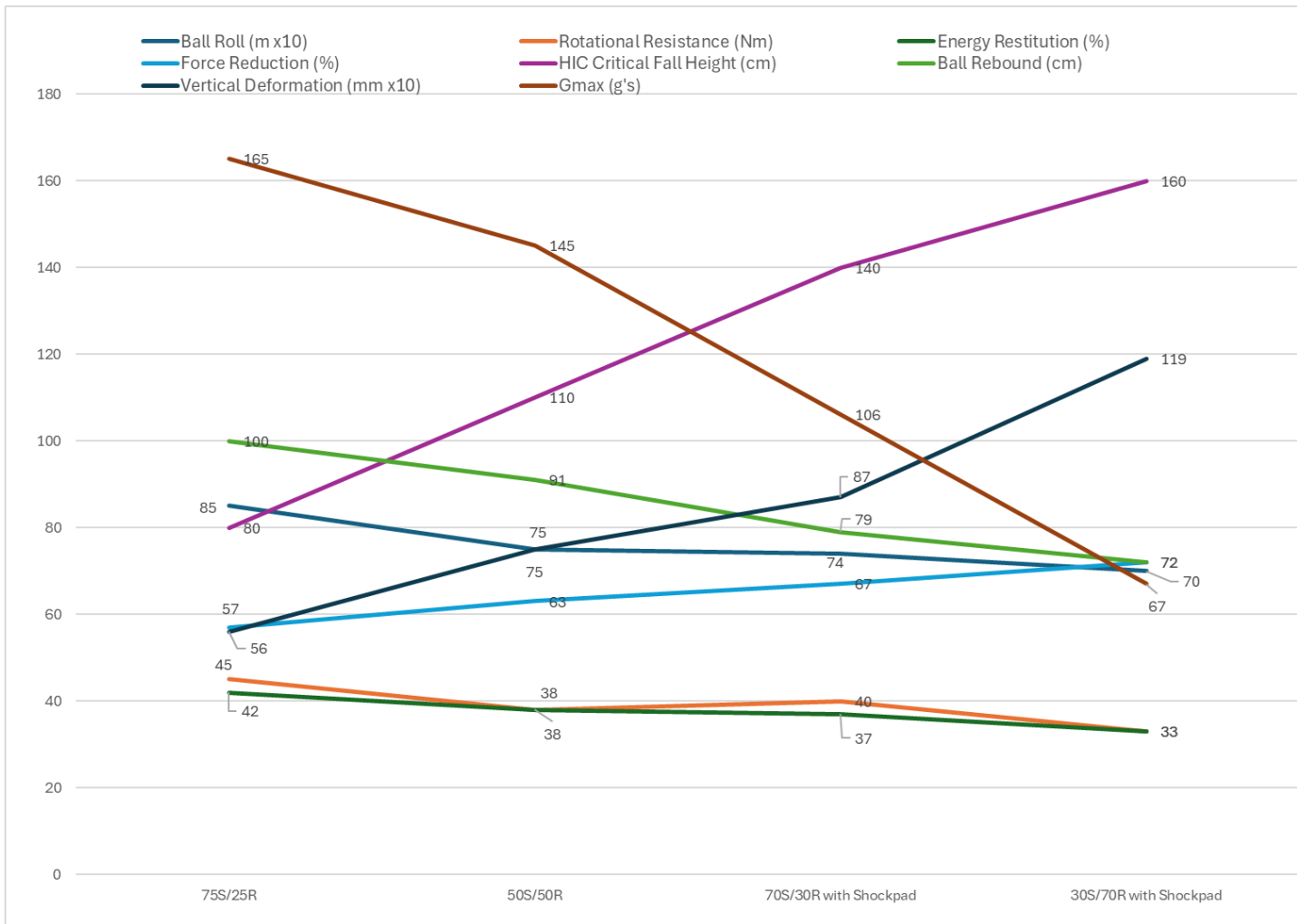
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Test Comparison





Player Perception

Does being within standards guarantee a happy customer?

Proper expectations lead to a happy customer

The industry tolerances we all use for guidance are not one description of surface.

A surface can be described as fast or slow, comfortable or high performance

Our duty as “interpreters” is to guide our clients to what fits their situation best

No one system fits all & it is up to us to ask the right questions.

What field do they currently like that they play on?

What do they like and don't like about their current surface?

What are the concerns they have about using artificial turf?



Consistency



Consistency & Predictability are key

Consistency is often looked at as important, or even more important than a particular surface. The internal algorithm that an athlete uses while making contact with the surface needs consistency to be accurate.

Uniform Performance: Consistent field conditions allow athletes to perform at their best, minimizing unexpected changes that could affect their game.

Injury Prevention: A uniform surface reduces the risk of injuries caused by irregularities, such as uneven ground or inconsistent traction.

Skill Development: Consistent playing conditions help athletes hone their skills more effectively, as they can predict how the ball will behave and how to maneuver on the field.

Fair Competition: Uniformity in the playing surface ensures a level playing field for all teams, reducing the likelihood of one team gaining an unfair advantage due to field conditions.

Game Flow: Consistent surfaces contribute to smoother gameplay, allowing for a better flow and rhythm during matches, which enhances the overall experience for players and spectators.

Mental Focus: Knowing that the field conditions are reliable allows athletes to focus more on strategy and performance rather than worrying about external factors.

Training Effectiveness: Consistency in practice conditions helps coaches develop training plans that translate well to competitive scenarios, improving overall team performance.

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Other Tests

Lab Testing

Lab testing a surface system provides an understanding of how the surface will function prior to installation. This knowledge helps with product evaluation and selection, as well as creates realistic expectations for the installed surface.

On-Site Testing

Inspections, whether for quality control, certifications, annual monitoring, diagnostics, end-of-life evaluations, or specification reviews, are valuable tools for gathering comprehensive information, enabling you to become an expert in your field. Inspections are crucial for optimizing performance, maintaining compliance with industry standards, extending surface lifespan, and reducing costs.

PLAYER INTERACTION

Artificial Athlete Tests
Force Reduction
Vertical Deformation
Energy Restitution
Rotational Resistance
Linear Friction Skid
Surface Abrasion

BALL INTERACTION

Vertical Ball Rebound
Ball Roll Distance
Angle Ball Rebound



*Testing
Toolbox*

IMPACT SAFETY

Synthetic Turf Impact Gmax
Playground Impact Gmax
Wrestling Mat Impact Gmax
Clegg Hammer Impact
HIC Head Impact
Pole Vault Collar Impact

UV TESTING

UVA and/or UVB

BASE CONSTRUCTION

Base Drainage Testing
Base Planarity Evaluation
Compaction Testing
Slope Evaluation

SURFACE QUALITY

Surface Durability Testing
UV & Artificial Weathering
Temperature Evaluation
Surface Drainage Testing
Turf & Infill Identification
Line Marking Verification
Surface Planarity Evaluation
Heavy Metal Toxicology Analysis
Seam & Surface Loading Strength

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Thank you!

