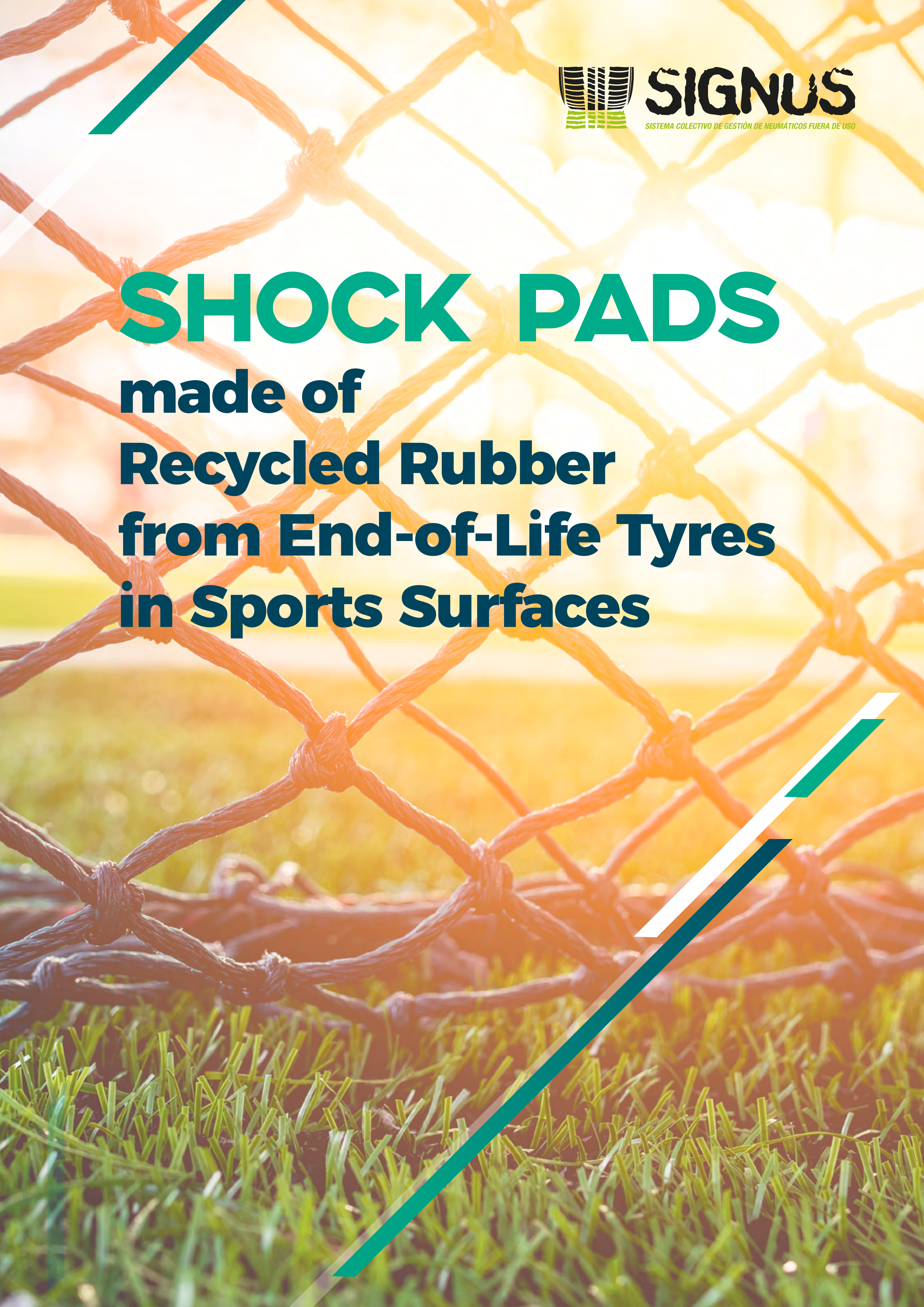
SIGNUS
SISTEMA COLECTIVO DE GESTIÓN DE NEUMÁTICOS FUERA DE USO



SHOCK PADS

made of Recycled Rubber from End-of-Life Tyres in Sports Surfaces

DESCRIPTION

Since the 1960s, the use of artificial turf on sports surfaces, such as football, rugby, or hockey pitches, has spread worldwide due to the reduced maintenance costs and the increased hours of play these surfaces offer compared to natural grass.

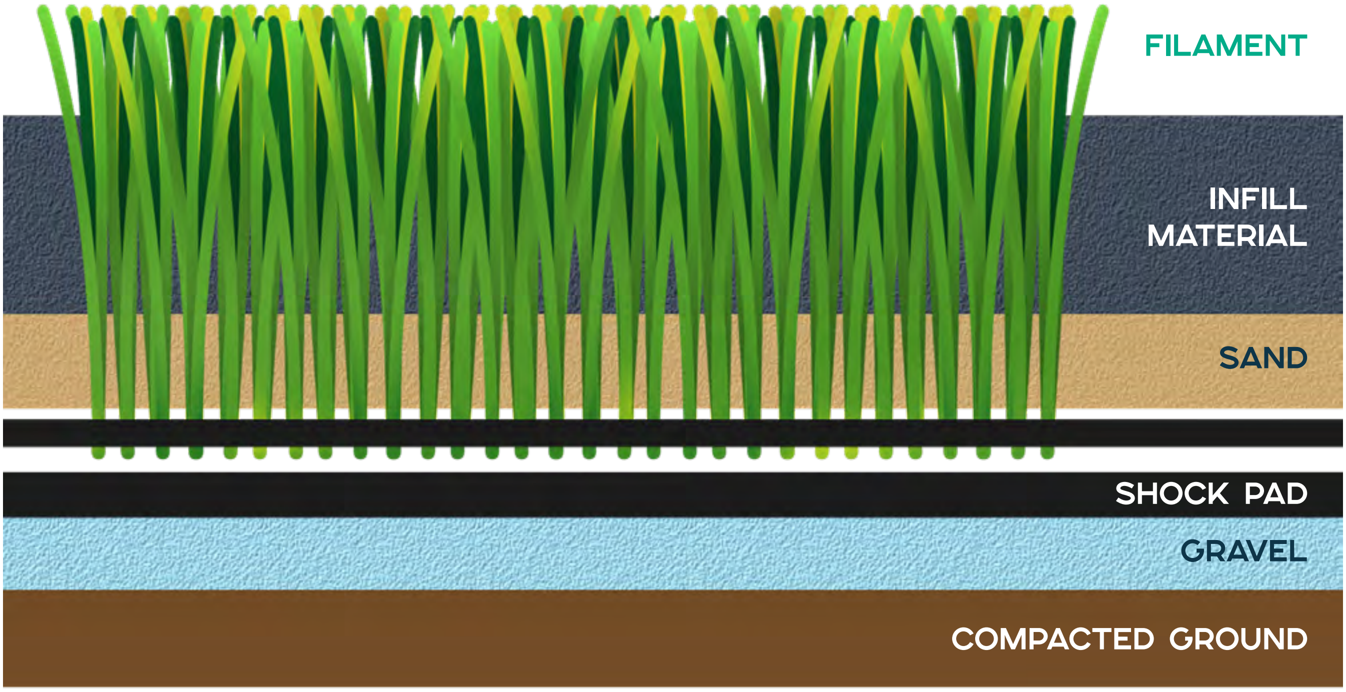
Depending on the sport played and the setup used, these types of surfaces may be equipped with a shock pad that provides the necessary properties to meet the specifications required by FIFA, World Rugby, or the International Hockey Federation (FIH), which sports clubs commonly adopt. These shock pads are also used on other sports surfaces that require elasticity and shock absorption, such as athletics tracks or multi-sport facilities (handball, basketball, volleyball, indoor football, etc.). However, this document focuses only on sports surfaces with artificial turf.

Among the shock pads available on the market are those manufactured in situ with recycled rubber granulates from tyres (particle sizes 2 - 8 mm) bonded with polyurethane resin. For instance, on an 11-a-side artificial turf football pitch (typical dimensions 105 m x 63 m), approximately 90 tonnes of rubber granulate are recycled as shock pads (25 mm thick, 14 kg/m^2), equivalent to about 20,000 passenger car tyres.

The trend in the market is for artificial turf systems not to include infill or for the infill materials used not to be elastic and to require the installation of a shock pad to achieve the required mechanical properties and performance.

Therefore, the demand for shock pads is expected to increase significantly. Market studies indicate that artificial turf pitches with a shock pad currently represent **an average of 40% in the markets analysed** (Spain, Portugal, France, Italy, and the UK). Hence, there is a long way to go to reach 100% of the pitches, translating to a significant potential for the consumption of systems with shock pad, especially in countries like Spain, Portugal, and Italy.

This represents an opportunity to contribute to the Circular Economy, since shock pads are made from a material derived from waste, in this case, End-of-Life Tyres (ELT).



RECYCLED RUBBER GRANULATE IS A KEY ELEMENT IN THE MANUFACTURE OF SHOCK PADS TO PROVIDE THE ELASTICITY NEEDED FOR SPORTS SURFACES

WHAT ROLE DO SHOCK PADS PLAY?

MAIN FUNCTIONS

They allow for a reduction in the infill material and, in turn, the height of the artificial turf fibre necessary to achieve the complete system specifications of the sports surface.

They protect players' health: their high impact or fall absorption capacity helps prevent injuries and provides safety against traumas

They contribute to improving system properties: ball bounce, shock absorption, and vertical deformation.

REQUIRED PROPERTIES

Hydraulic conductivity: must allow surface water drainage through the complete artificial turf system.

Durability against thermal stress, humidity, and compression.

Must meet health and environmental standards.

MAIN TECHNICAL FEATURES

Shock absorption and vertical deformation.

Thickness and mass per unit area.

Tensile strength.

Water permeability.

QUALITY CRITERIA

Below are the quality tests and reference documents dedicated to the characterization and technical specifications of shock pads used in sports surfaces with artificial turf.

Note: Work is currently underway on applying new standards within the European Standardization Committee CEN/TC217, including the draft standard EN 15330-4 dedicated exclusively to shock pads.

QUALITY TESTS

Performance and characterization

TEST	STANDARD AND FEDERATIONS PRODUCT CERTIFICATION
Shock absorption	UNE-EN 15330-1, FIFA, WR[a], FIH[b], ESTC[c]
Vertical deformation	
Water permeability	
Tensile strength	
Thickness	
Mass per unit area	
HIC (head injury criterion)	ESTC

[a] World Rugby; [b] International Hockey Federation; [c] EMEA Synthetic Turf Council.

Durability

TEST	STANDARD AND FEDERATIONS PRODUCT CERTIFICATION
Dimensional variations	ESTC, FIH, LND[d], draft standard EN 15330-4
Bowing and Curling	FIH, draft standard EN 15330-4
Resistance to dynamic fatigue	FIH, draft standard EN 15330-4
Resistance to permanent deformation *(short term and static loading)*	draft standard EN 15330-4
Transverse tensile strength	FIH, draft standard EN 15330-4
Horizontal water flow	ESTC, FIH, LND, draft standard EN 15330-4
Thermal conductivity	draft standard EN 15330-4

[d] Lega Nazionale Dilettanti

Environment, health and comfort

TEST	STANDARD AND FEDERATIONS PRODUCT CERTIFICATION
Lixiviate – Toxicology testing	LND, ESTC, draft standard EN 15330-4
PAH, EN 71-3	LND

TECHNICAL SPECIFICATIONS

Technical specifications of shock pads

TEST	FIFA	UNE-EN 15330-1, NF P 90-112 (INFORMATIVE)
Shock absorption	≥ 20%	≤ ±5% of absolute value with the declaration
Vertical deformation	± 2 mm from the declaration	-
Thickness	Informative	≥ 90% from the declaration
Mass per unit area	Informative	≤ 15% of variation with the declaration
Tensile strength	≥ 0.15 MPa	≥ 0.15 MPa
Thermal conductivity	Informative	-

Technical specifications of artificial turf systems
(SHOCK PAD + ARTIFICIAL TURF + INFILL)

<table>
<tr><th>TEST</th><th>FIFA QUALITY</th><th>FIFA QUALITY PRO</th><th>WORLD RUGBY</th><th>EN 15330-1, NF P 90-112 (INFORMATIVE)</th></tr>
<tr><td>Shock absorption</td><td>57% - 68%</td><td>62% - 68%</td><td>57% - 68%</td><td>55% - 70%
(EN 14808)</td></tr>
<tr><td>Vertical deformation</td><td>4.0 – 11.0</td><td>4.0 – 10.0</td><td>6.0 – 10.0</td><td>4.0 – 9.0
(EN 14809)</td></tr>
<tr><td>Energy restitution</td><td>-</td><td>-</td><td>22% – 48%</td><td>-</td></tr>
<tr><td>HIC (head injury criterion)</td><td>-</td><td>-</td><td>≥ 1.30</td><td>-</td></tr>
<tr><td>Surface Temperature</td><td colspan="3"><table>
<tr><th>Classification</th><th>Temperature range (°C)</th></tr>
<tr><td>Category 1</td><td>< 50</td></tr>
<tr><td>Category 1-2</td><td>50 – 54</td></tr>
<tr><td>Category 2</td><td>55 – 59</td></tr>
<tr><td>Category 2-3</td><td>60 – 65</td></tr>
<tr><td>Category 3</td><td>> 65</td></tr>
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MOSA

WHY USE SHOCK PADS MADE OF RECYCLED RUBBER?

PERFORMANCE AND SAFETY

Excellent playability: Thanks to the properties of rubber derived from tyres, such as energy absorption, elasticity, and durability, artificial turf systems that include these shock pads meet the playing characteristics in terms of shock absorption, vertical deformation, vertical ball bounce, and rotational traction, complying with FIFA (Quality and Quality Pro), World Rugby, and the International Hockey Federation (FIH) specifications.

High hydraulic conductivity: Its high water drainage capacity prevents flooding on the playing surface.

Long durability: The excellent energy absorption and elasticity properties of recycled rubber ensure that the properties of these shock pads remain unchanged under the loads and deformations they undergo during use.

Behaviour against thermal stress and humidity: Its low water retention and excellent behaviour in freeze/thaw cycles ensure its properties do not change over time.

Protects players' health: The recycled rubber in the shock pads contributes to the absorption of impacts that players suffer on the pitch, preventing injuries and providing safety against traumas.

SUSTAINABILITY

CIRCULAR ECONOMY

In an 11-a-side artificial turf football pitch **approximately 90 tonnes of rubber granulates from tyres** (particle sizes 2 - 8 mm) are recycled in the shock pad (25 mm thick, 14 kg/m^2), equivalent to about 20,000 passenger car tyres.

Considering the approximately 5,000 artificial turf pitches in Spain[1], a potential consumption of about 450,000 tonnes of tyre rubber is estimated.

LONG DURABILITY

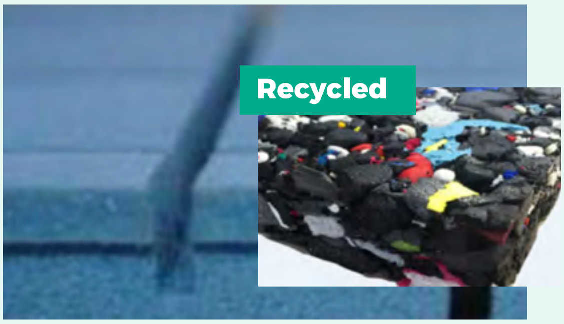
ASSESSMENT OF ALTERNATIVES (LABOSPORT STUDY 2022)

TYPES OF SHOCK PADS

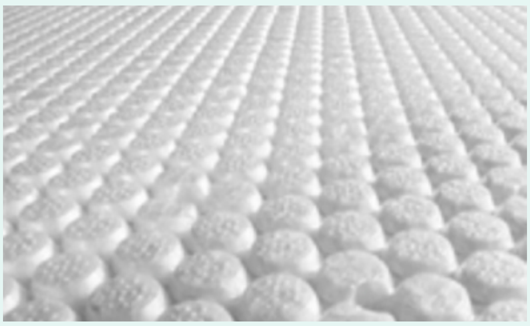
BY MATERIALS USED IN THEIR MANUFACTURE

ELT recycled rubber

Polyethylene foam



Polypropylene foam



Polyurethane foam

Image source: LABOSPORT SAS

BY INSTALLATION METHOD

IN SITU

PREFABRICATED

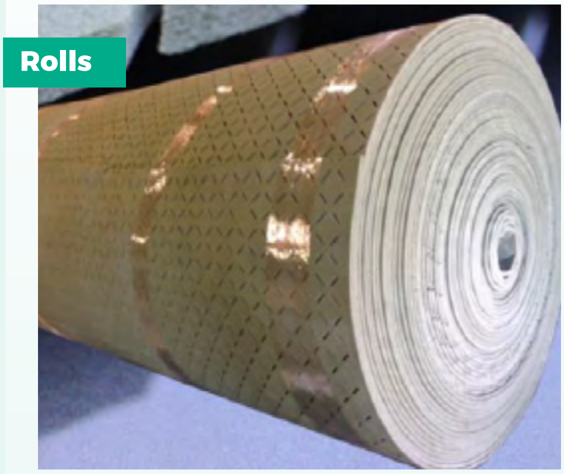
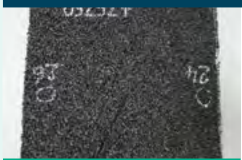
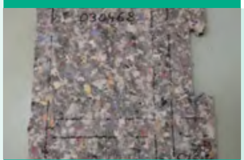
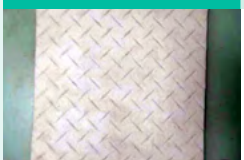


Image source: LABOSPORT SAS, Gestión Medioambiental de Neumáticos S.L.

COMPARATIVE OF TECHNICAL PERFORMANCE OF SHOCK PADS

The following tables present the results obtained from the SIGNUS study carried out by LABOSPORT[2], whose aim is to compare the technical performances of three commercial shock pads commonly used in the European market.

Technical performance of shock pads

Type of Shock Pad	Description	Water Permeability (mm/h)	Water Retention (%)	Freeze/Thaw Cycles	Durability*
 **In situ ELT recycled rubber (25 mm thickness)**	In situ manufacturing with ELT rubber granulate	> 2,000	5 min: 18 1 h: 8	🟢	🟢
 **Prefabricated recycled PE (23 mm thickness)**	Prefabricated of recycled PE foam	> 2,000	5 min: 42 1 h: 18	🟠	no data
 **Prefabricated virgin PE (12 mm thickness)**	Prefabricated of virgin PE foam	> 2,000	5 min: 143 1 h: 61	🟠	no data

*In the LABOSPORT study, the behaviour of a shock pad was evaluated after 15 years of use, comparing its properties with the initial values of its installation, concluding that its mechanical properties remain constant over time. On the other hand, the durability of prefabricated shock pads could not be evaluated because, during the study execution, no sports surface was found where they were installed.

🟢 **Meets specifications**

🟠 **Meets specifications at the limit**

🔴 **Does not meet specifications**

FREEZE/THAW CYCLE TESTS

The results obtained in the AAA tests (shock absorption, vertical deformation, and energy restitution) before and after **freeze/thaw cycles** (test method described in annex F of the prEN 15330-5 standard) are presented.

Technical performance after freeze/thaw cycles

Test	Method	Conditions	Shock Pad		
			In situ ELT recycled rubber (25 mm thickness)	Prefabricated recycled PE (23 mm thickness)	Prefabricated virgin PE (12 mm thickness)
Shock Absorption (%)	AAA, FIFA Test Method 04a	New	**56.5**	**58.1**	**45.2**
	Annex F prEN15330-5 + AAA, FIFA Test Method 04a	After 10 cycles	**55.9**	**56.4**	**43.7**
	Absolute difference		**-0.6**	**-1.7**	**-1.5**
Vertical Deformation (mm)	AAA, FIFA Test Method 04a	New	**7.6**	**6.9**	**8.1**
	Annex F prEN15330-5 + AAA, FIFA Test Method 04a	After 10 cycles	**7.6**	**6.4**	**8.2**
	Absolute difference		**0**	**-0.5**	**0.1**
Energy Restitution (%)	AAA, FIFA Test Method 04a	New	**57**	**40**	**64**
	Annex F prEN15330-5 + AAA, FIFA Test Method 04a	After 10 cycles	**57**	**42**	**64**
	Absolute difference		**0**	**2**	**0**

Based on the data presented, it can be observed that there is no significant difference in the in situ ELT rubber shock pad in any of the tests evaluated before and after thermal aging. Therefore, it can be concluded that its behaviour over time is better than the other two studied shock pads.

DURABILITY ASSESSMENT OF IN SITU SHOCK PADS WITH ELT RECYCLED RUBBER

The methodology to carry out the durability assessment of shock pads consists of the following:

- Sampling in existing facilities.
- Sample characterization: mass per unit area, density, thickness.
- AAA tests: shock absorption, vertical deformation, energy restitution.

An in situ ELT rubber shock pad installed in 2007 (15 years) has been selected among all those whose monitoring and quality control were carried out by LABOSPORT. The manufacturer's product declaration and the quality control carried out by LABOSPORT in 2007 after its construction are available for this shock pad. Additionally, it is compared with reference values for this type of shock pad.

To evaluate the current status of this shock pad, 10 points were inspected in different areas of the playing surface. In all of them, a good state of preservation was observed without damage. The average water permeability value obtained was 2,440 cm/h (>36 cm/h according to NF P 90-112), and the average thickness was 26.3 mm. The results below indicate that the shock pad mechanical properties are maintained over time after being used for 15 years.

Durability

Test	Method	Manufacturer's Declaration
Thickness (mm)	EN 1969 Method A	**25.0**
Mass per unit area (kg/m²)	ISO 8543	**14.1**
Density (kg/m³)	Internal test method	**564**
Shock absorption (%)	EN 14808	Not declared
Vertical deformation (mm)	EN 14809	Not declared
Tensile strength (MPa)	EN 12230	Not declared

Test	Results			Requirements (informative)	
	2007 sample collected in the pitch analysed in laboratory	2022 sample collected in the pitch analysed in laboratory	Reference values for in situ ELT rubber shock pad	EN 15330-1 (2013)	NF P90-112 (2016)
Thickness (mm)	**30.0**	**26.3**	**25.0**	≥ 90% of the manufacturer's declaration	-
Mass per unit area (kg/m²)	**18.0**	**16.4**	**15.0**	-	±15% of the manufacturer's declaration
Density (kg/m³)	**610**	**660**	**600**	-	-
Shock absorption (%)	Not declared	**57.2**	**58.0**	Between -5% and +10% difference between the value and the manufacturer's declaration	-
Vertical deformation (mm)	Not declared	**6.6**	**6.0**	-	± 2 mm of the value of the laboratory report
Tensile strength (MPa)	**0.11**	**0.13**	**0.15**	≥ 0.15 (≥ 0.10 en 2007)	-

CONCLUSIONS OF THE COMPARATIVE STUDY (LABOSPORT STUDY 2022)

- In all the parameters evaluated (water permeability, water retention, freeze/thaw cycles), the in situ ELT rubber shock pad shows similar or even better performance than prefabricated shock pads.
- The ELT rubber shock pad has lower water retention, which positively affects behaviour under freezing conditions.
- Regarding freeze/thaw cycles, which aim to evaluate the performance of a shock pad after thermal stress, the properties of the ELT rubber shock pad are not affected after such aging.
- The **durability** of an in situ ELT rubber shock pad has been evaluated, concluding that the mechanical properties of this type of shock pad are maintained over time.

The choice of in situ ELT rubber shock pad contributes to the Circular Economy, recycling around 90 tonnes of ELT rubber granulate per pitch.

REFERENCES

1 **"Análisis Socioeconómico del potencial impacto en el sector del granulado de caucho de la propuesta ECHA – microplásticos en España"** PwC, 2020.

https://www.signus.es/wp-content/uploads/2021/04/Impacto_Socioeconomico_Prohibicion_Microplasticos-2020_PwC.pdf

2 **"Empleo de caucho reciclado en bases elásticas de campos de césped artificial",** report developed by LABOSPORT SAS for SIGNUS, 2022.

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