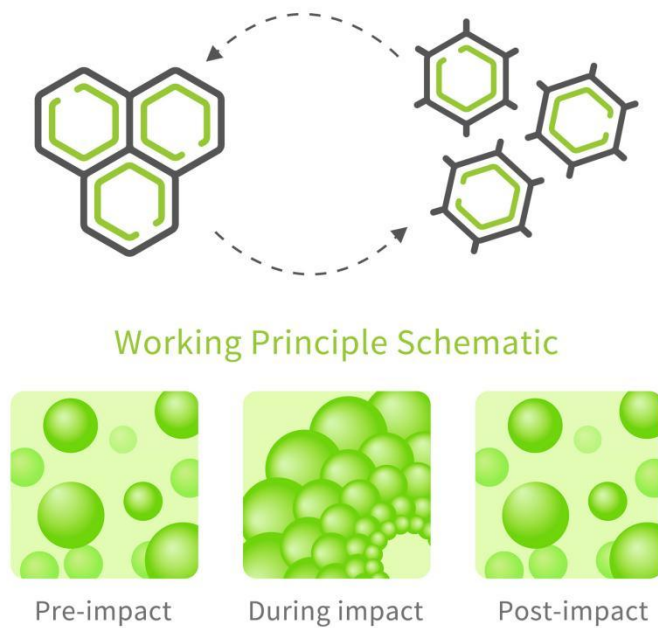


# **ESA impact-absorbing materials solutions on Protective Footwear**

## **1. Introduction of our products**

Shenzhen Innovation Advanced Materials Co., Ltd is a high-tech enterprise that researches, develops, produces, and sells impact-resistant and energy-absorbing materials. Relying on innovative core technologies and industrialized devices, it provides customers with professional protective and shock-absorbing solutions as well as customized product development services.

ESA is a new type of intelligent impact-absorbing material. It is soft and elastic under normal conditions, and once it is subjected to a strong impact, the material rapidly hardens to resist the external impact, and when the external force disappears, the material will return to its initial soft state. With excellent impact resistance and cushioning properties, it is a very ideal protective material. With a bio-based content of more than 40 %, the material meets USDA certification as a green product.



## 2. Performance indicators

### (1) Mechanical Performance

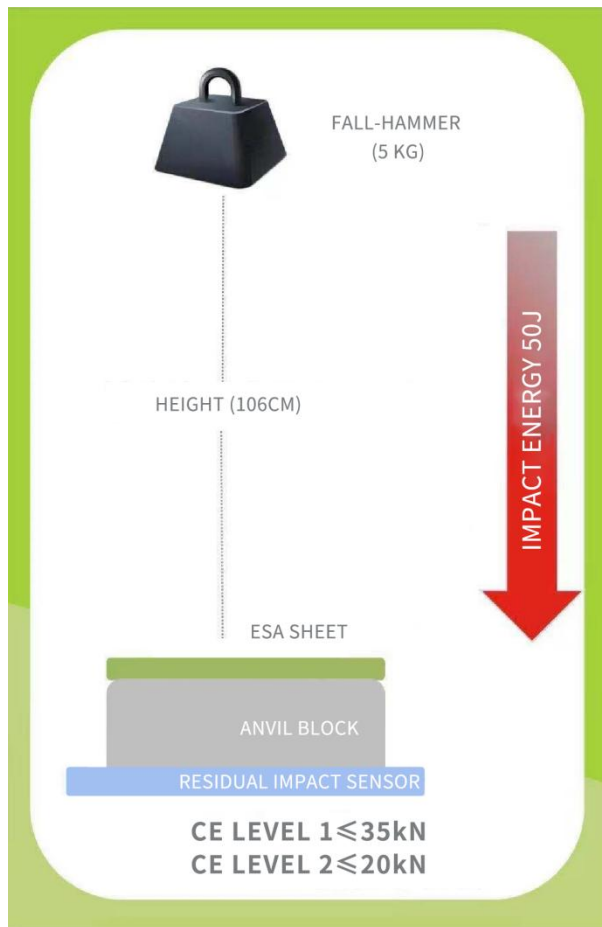
Tested items	Testing method	Technical Requirements	Test results	Footnote	Individual determinations
Shock absorption %	J4003/		Energy regression rate: 28.2%	20mm ESA Sheet	Real measurement
Shock absorption mm	J4003/		Maximum deformation: 12.0	20mm ESA Sheet	Real measurement
Shock absorption N/mm	J4003/		DS II :156.0	20mm ESA Sheet	Real measurement
			DS I :118.0		
Resilient property %	J4004/		1.3%	20mm ESA Sheet	Real measurement
Shock absorption property G value	J4004/		14.1	20mm ESA Sheet	Real measurement
Durometer (C)	J56 Aska C		Not restricted	20mm ESA	Real measurement

			to:44	Sheet	
Elongation at break	J57 C method/		219		Real measurement
Tensile strength Mpa	J57 C method/		1.8		Real measurement
Compression deformation %	J59 A method 50°C, 6h		2		Real measurement
Density g/cc	J60 method/		0.36		Real measurement
Tear strength at the right angle	J63 Without incision		5		Real measurement
	J63 Incision		3		
Shrinkage performance %	J64 B method 60°C, 10min		Modular base:0.0	The thickness of the ESA Sheet is 20mm	Real measurement
Folding resistance of upper materials	J66 A method-15°C, 40,000 times		Folding resistance on one side: break	4,000 times	Real measurement
	J66 A method, ordinary temperatures, 40,000 times		Folding resistance on one side: break	33,000 times	Real measurement
			Folding resistance on one side: Fracture	33,000 times	
Resilience rate	J86/		8	The thickness of the ESA Sheet is 10.20mm	Real measurement

## (2) Impact performance protection

No.	Indicator	Impact energy (J)	Impact force value (KN)	Energy absorption rate (%)	Sample thickness (mm)
1	Normal temperature impact performance	50	18.06	77.4	10
2	Low Temperature (-10°C) Impact Performance	50	17.64	78	10
3	High temperature (40°C) impact performance	50	23.22	71	10

Test standard: Impact test with 50 Joule energy according to EN 1621-1:2012.



**Working Principle Diagram**

(3) Use of protective footwear

## 1. Shin guards use

### 1.1 Shell introduction

Shin guard shell: TPU, carbon fiber, titanium materials

- 1) Commonly used materials: The TPU appearance can be done matte, mirror, and TPU price is the lowest.
- 2) Carbon fiber material is 'soft on the outside and rigid on the inside', lighter than aluminum metal, but stronger than steel, carbon fiber has corrosion-resistant properties and can withstand high temperatures, low

temperatures, and smoke, and has a longer service life than other materials.

3) Titanium alloy is the lightest and strongest of the metals and the price is the most expensive.

4) Molding cost: around 50,000/60,000 RMB.

Carbon fiber and titanium can only be fixed by assembling.

## 1.2 Built-in cushioning material

The cushioning material in the middle of the case is usually foam or EVA.

### **Advantages of ESA products:**

1) ESA is built-in for quick impact mitigation and efficient energy absorption.

2) Shell +ESA durable, wear-resistant, anti-deformation, double protection, and more comprehensive protection.

3) Built-in ESA can be designed following the design of the shell, to better fit with the shell and enhance the protective performance.

## 1.3 Testing report

Shenzhen Innovation Advanced Materials Co., Ltd

### Impact testing report

Sample name: EVA Sheet/ESA Sheet

Report Date: 2020/06/02

Testing standard: EN1621-1:2012 5J (5kg fall-hammer/ falling from a 10cm height)

Testing environment temperature: 23.5°C

Testing environment humidity level: 55%

Sample No.	Hardness(Type C)	Impact value(KN)	Average impact force value(kn)	Thickness(mm)
ESA Sheet	40	4.06	4.15	4
		4.35		
		4.05		
EVA-1	48	8.82	7.82	4
		7.25		
		7.39		
EVA-2	48	7.65	8.25	4
		8.98		
		8.12		
EVA-3	40	7.72	7.90	4
		8.30		
		7.70		

Note: The value of impact force is the impact force transmitted on the anvil after absorbing energy through the material, the unit is KN, the smaller the value of

impact force is, the better the effect of energy absorption of the material is.

Conclusion: The above test data for the same thickness of the ESA material and EVA cushioning material impact performance comparison, the smaller the impact value indicates that the material is more energy-absorbing effect, from the data can be seen that the energy-absorbing effect of the ESA material is about 1 times higher than that of the EVA material.

#### 1.4 Application cases

Currently used at the shin guards of trail riding boots, pictured below:





Shenzhen Innovation Advanced Materials Co., Ltd

Impact testing report

Sample name: Shin guard

Report Date: 2019/12/24

Photo of sample:



# Shenzhen Innovation Advanced Materials Co., Ltd

## Impact testing report

Sample name: Shin guard

Report Date: 2019/12/24

Testing standard: EN1621-1:2012, 10J

Testing environment temperature: 23.9°C

Testing environment humidity level: 42%

Sampling method: According to SCXC-ZL-WI-02, 'Sampling Methods for Product Inspection'.

Samples No.	Transmitted force(KN)	Thickness(mm)	Hardness(Shore 00)
1	4.67	7.5	82
2	4.64	7.4	81
3	4.60	7.4	82
4	4.63	7.5	81
5	4.35	7.4	82

## **2、 Use of ankle protection**

Common ankle protection methods are ankle reinforced TPU, rubber guards.

Foam or EVA is used on the inside of the block.

### **2.1 Advantages**

- 1) ESA material is soft and comfortable under normal conditions, and it can quickly dissipate the external force and disperse the vibration pressure when encountering impacts.
- 2) Flexible design, the ankle pads can be made thinner, or replace the pads according to the usage scenario.

## 2.2 Comparison Report with D30 Ankle Pads

Shenzhen Innovation Advanced Materials Co., Ltd

### Impact testing report

Sample name: Shin guard

Report Date: 2018/03/14

Photo of samples:



# Shenzhen Innovation Advanced Materials Co., Ltd

## Impact testing report

Sample name: ESA-H

Report Date: 2018/03/14

Testing standard: EN1621-1:2012, 10J

Testing environment temperature: 21.4°C

Testing environment humidity level: 69%

Sample No.	Test area	Transmitted force (KN)	Mean value(KN)	Hardness(Shore 00)	Thickness(mm)
ESA-H-1	A	3.76	3.67	90	8
	B	3.77			
	C	3.48			
ESA-H-2	A	3.43	3.90	90	8
	B	3.36			
	C	4.92			
ESA-H-3	A	3.33	4.07	90	8
	B	4.49			
	C	4.38			
D3O	A	3.87	4.05	90	8.5
	B	3.96			
	C	4.32			

Test result	With EN1621-1 standard 10J energy test, the impact protection performance of ESA-H products is less than 5KN.
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## 2.3 Application case



ARCX Riding Boots

### 3、Application on heel

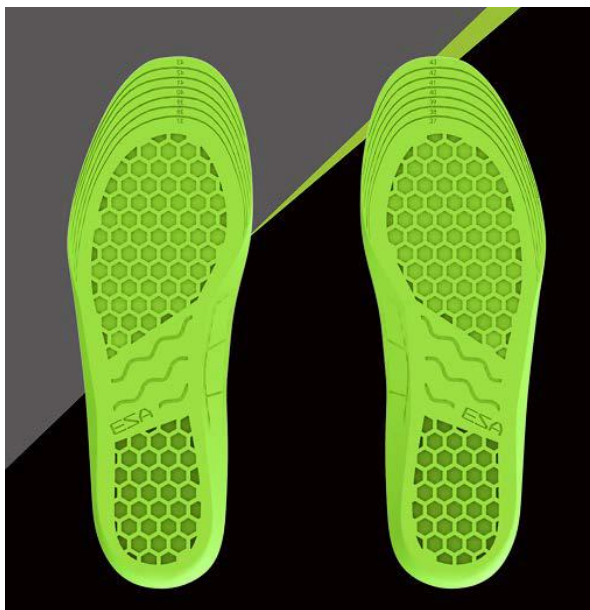
Heel protection is also an important protective position. ESA material can be moulded in one piece and used in the heel as protection.

The heel sample is shown below:



### 4、Insole Application Solutions

(1) For full palm use



Man-portable combat equipment insoles



Product function: With extreme shock absorption performance, it can absorb more than 90% of the impact. It has the functions of antibacterial deodorant, green environmental protection, soft and comfortable, anti-pressure, and anti-deformation.

Currently has been assembled in an airborne army paratroopers' combat equipment, paratroopers from high altitude parachute landing speed is fast, the foot and the ground contact instant foot to withstand the impact of the weight of 10 times or more, the use of the insole can maximize the absorption of external impact.

**Comparison test of ESA material insole with ordinary PU insole and EVA insole**

Shenzhen Innovation Advanced Materials Co., Ltd

Impact testing report

Sample name: ESA insole

Report Date: 2020/08/13

Testing standard: EN1621-1:2012 20J

Testing environment temperature: 24.1°C

Testing environment humidity level: 40%

Sample No.	Impact resistance performance (KN)		Thickness (mm)		Weight(g)
	Sole	Heel	Sole	Heel	
Ordinary PU insoles	36.13	35.05	4.20	4.30	23
EVA insoles	40.05	38.24	4.5	6.0	20
ESA insoles	16.75	12.83	4.5	6.5	45

Note: The smaller the impact test value, the better the energy absorption of the material.

Sample name: ESA Insole

Report Date: 2020/08/13



Ordinary PU insole



EVA Insole



ESA Insole

Conclusion: The impact test shows that the energy absorption effect of ESA insoles is significantly better than that of EVA insoles and ordinary PU

insoles. With the same thickness, the energy absorption effect of ESA insoles is 2.4 times more than that of EVA insoles and 2.1 times more than that of ordinary PU insoles.

## (2) Localization



**Schematic diagram of topical application of the product**

Product features: efficient cushioning, impact absorption, green, soft and comfortable, antibacterial, and deodorant.



Currently on the market, the majority of shock absorbing materials used in the heel are imported PORON materials from the United States. Compared with PORON material, ESA material energy-absorbing effect is 2 times of that of PORON material .

**ESA material and PORON material performance comparison test is as follows:**

Shenzhen Innovation Advanced Materials Co., Ltd

Impact testing report

Sample name: poronxrd gaskets

Report date: 2021/09/06

Testing standard: EN1621-1:2012

Testing environment temperature:25°C

Testing environment humidity level:48%

Sample Code	Testing condition	Average value of impact force	Durometer (C)	Thickness (mm)
poronxrd gaskets	Ordinary temperature 25°C 5J	15.66	25	4.16
ESA Sheet		7.64	46	4.00

Conclusion: ESA sheet has 50% better cushioning and energy absorption than poronxrd shims for the same thickness.

Shenzhen Innovation Advanced Materials Co., Ltd

Impact testing report

Photo of samples:

poronxrd gaskets



ESA Sheet

