Infinergy®
The first expanded TPU –
Small beads, high performance
Infinergy® is the world’s first expanded thermoplastic polyurethane (E-TPU). The closed-cell, elastic particle foam combines the properties of TPU with the advantages of foams. The key features are:

- low density
- high elasticity
- outstanding resilience
- high abrasion resistance
- high tensile strength
- good chemical resistance
- good long-term durability in a wide temperature range

The individual Infinergy® beads have a size of from 5 to 10 mm and are supplied with a bulk density of approximately 110-130 kg/m³.

**Materials expertise** Elastollan® (TPU)  
**+** Particle foams know-how Neopolen®  
**= Innovation** Infinergy® (E-TPU)

**Products:**
- Infinergy® 32-100 U10 – produced by suspension polymerization
- Infinergy® X1125-130 U – produced by extrusion process

The closed cells inside an Infinergy® bead can be seen on the scan taken with the scanning electron microscope.
Applications

Infinergy® can be used anywhere where a combination of low weight, excellent mechanical properties and good long-term durability is required.

Possible areas of application for this durable material are:

- In the shoe industry
- In the Sports and leisure sector (paddle-tennis rackets, table tennis rackets, bicycle tires)
- In vehicle construction (e.g. for vibration decoupling)
- In mechanical engineering (e.g. as cushioning elements and buffers in industrial compressor)
- Reusable dunnage trays in the logistics sector

Infinergy® in the “Boost” shoes from adidas

The first product making use of Infinergy® was the running shoe “Energy Boost” from adidas, in 2013. Nowadays the German sports equipment manufacturer offers numerous collections of Boost shoes with Infinergy®. As the material used in the midsole, Infinergy® makes the shoe comfortable to wear and delivers excellent running properties. The sole springs back into its original shape immediately after impact: thanks to this high rebound effect resulting from the resilience of the material, runners use up less energy than they did before.

As Infinergy® withstands temperatures of between -20°C (-4°F) and over +40°C (+104°F) without changing its functional properties, the adidas shoe can be used at any temperature – whether in winter or in summer. Another advantage highlighted by the shoe manufacturer is the great long-term durability of the material which, just like the other properties, is significantly better than that of conventional midsole materials.
In principle, Infinergy® can be processed on the same molding machines which are designed for processing of expanded polypropylene (EPP). A steam chamber pressure of at least 5 bar is necessary. During processing, the steam pressures are usually in the range of 1.2 to 2.2 bar, depending on the applied product, geometry and density of the molding. Both crack splitting and pressure filling are possible methods that can be applied here. Appropriate injection systems should be used.

In addition, because polyurethane binders adhere so well to Infinergy®, there are other processing techniques such as gluing and foam sealing of the beads. This procedure enables large-scale processing of Infinergy®.

Converters can process panels made from Infinergy® on conventional splitting machines, punches and water jet cutting machines.
Properties

Like its starting material TPU, Infinergy® is noted for having high elongation at break, tensile strength and abrasion resistance as well as good chemical resistance. In addition, the innovative particle foam remains highly elastic and soft over a wide temperature range.

The feature of Infinergy® that is particularly striking is its high resilience. Tests of the resilience elasticity under ISO 8307 (the ball rebound test) and under DIN 53512 (using a defined pendulum hammer) show that Infinergy® achieves a rebound of over 55%. This is therefore significantly higher than comparable particle foams such as expanded polypropylene (EPP) at 30%, ethylene vinyl acetate (EVA) at 37% or expanded polyethylene (EPE) at 50%. Infinergy® does not lose its excellent resilience even under a continuous load.

Dynamic mechanical analysis has shown that, even at extremely low temperatures of -20°C (-4°F), Infinergy® still has a low dynamic modulus, is very soft and stretchy and thus does not go stiff.

Molded parts made from Infinergy® can be coated with a specially customized paint system from BASF Coatings.
Environment and Recovery

Infinergy® is compliant with the RoHS directive and does not have to be labeled under dangerous goods regulations. Information on other regulations, e.g. GADSL, will be provided on request. Infinergy® is also recyclable.

Physical properties of moldings made from Infinergy® 32-100 U10 and Infinergy® X1125-130 U

<table>
<thead>
<tr>
<th>Property</th>
<th>Test specification</th>
<th>Unit</th>
<th>Material density (MD) according to ISO 845 [kg/m²] (Core density) 250</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile strength</td>
<td>DIN EN ISO 1798</td>
<td>kPa</td>
<td>700 600</td>
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<tr>
<td>Elongation at break</td>
<td>DIN EN ISO 1798</td>
<td>%</td>
<td>90 70</td>
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<tr>
<td>Compressive stress</td>
<td>According to ISO 844</td>
<td>kPa</td>
<td>55 130 275</td>
</tr>
<tr>
<td>at 10% strain</td>
<td></td>
<td></td>
<td>130 95</td>
</tr>
<tr>
<td>at 25% strain</td>
<td></td>
<td></td>
<td>275 230</td>
</tr>
<tr>
<td>at 50% strain</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rebound</td>
<td>DIN 53512</td>
<td>%</td>
<td>&gt;60 &gt;68</td>
</tr>
<tr>
<td>Compression set</td>
<td>DIN EN ISO 1856</td>
<td>%</td>
<td>&lt;5 &lt;4</td>
</tr>
<tr>
<td>(50%, 22h, 23°C) 24h after stress release</td>
<td>(Method C)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dimensional stability under heat</td>
<td>According to DIN 2796</td>
<td>%</td>
<td>&lt;1 &lt;1 &lt;1</td>
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<tr>
<td>(Linear change in size after 4 days)</td>
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<td>&lt;10 &lt;5</td>
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<td>60°C</td>
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<tr>
<td>110°C</td>
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<td></td>
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<tr>
<td>Thermal conductivity</td>
<td>DIN EN 12667</td>
<td>W m⁻¹ K⁻¹</td>
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<tr>
<td>Water absorption (1 day)</td>
<td>According to DIN 53428</td>
<td>Vol-%</td>
<td>&lt;2 &lt;2</td>
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<tr>
<td>Flammability</td>
<td>FMVSS 302</td>
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</tbody>
</table>

For more information concerning physical properties of moldings made from Infinergy® please look at our Technical Information: Infinergy® 32-100 U10 and Infinergy® X1125-130 U.

Note
The data contained in this publication are based on our current knowledge and experience. In view of the many factors that may affect processing and application of our product, these data do not relieve processors from carrying out own investigations and tests; neither do these data imply any guarantee of certain properties, nor the suitability of the product for a specific purpose. Any descriptions, drawings, photographs, data, proportions, weights etc. given herein may change without prior information and do not constitute the agreed contractual quality of the product. It is the responsibility of the recipient of our products to ensure that any proprietary rights and existing laws and legislation are observed. (September 2016)