Footprints of the future
Huntsman TPU

Whether producing hard wearing, chemical resistant boots for the work place or soft, supportive shoes to encourage a child’s first steps, footwear manufacturers around the world generally want the same thing: innovative, cost-effective materials from a supplier that understands the market and can help them stay one step ahead of the competition.

Pioneering new footwear developments
At Huntsman we pride ourselves on making the procurement of footwear materials a painless process. Our dedicated footwear specialists were among the first to introduce polyurethanes to the footwear industry and today we continue to make enormous strides in product development – pioneering new technologies that leave a lasting impression on the sector.

Global support
We are a major global supplier to the footwear industry. Our international supply chain and research and development capabilities are world-class. With a specialist technical center in Belgium, and a team of experts located in all major regions, we serve customers in more than 70 countries – including famous footwear brands that apply our materials, advice and input to overcome complex design and manufacturing challenges.
Our dedicated range of thermoplastic polyurethane (TPU) materials for footwear is marketed under the trade name AVALON®. Suitable for use in top pieces for ladies fashion shoes, molded soles for casual footwear and specialist sports, hiking and safety shoe applications, AVALON® TPU is a premium material that can be used to create a variety of footwear components and is fully recyclable.

Known for its high quality, durability and aesthetics, AVALON® TPU is manufactured at production facilities around the world and is available at different hardness levels ranging from below 60 Shore A for unit soles, up to 65 Shore D for top pieces and sport shoe stabilizers.

The design benefits associated with using AVALON® TPU are numerous and include: excellent surface definition, matt or glossy effects, good colorability, transparent grades available, rubber-like look and feel and reliable bonding.

### Key properties

**Abrasion resistance:** For withstanding scuffs and scrapes, AVALON® TPU can be at least three times better than the best PVC and rubber soling materials.

**Cold flex performance:** At normal temperatures AVALON® TPU offers superior flex performance when compared to other soling materials. Below freezing it also functions where other competing materials start to fail.

**Scratch resistance:** AVALON® TPU can withstand harsh environments and helps to keep its original look for longer.

**Bonding:** AVALON® TPU is easy to bond with minimal surface preparation.

**Cost effective bonding:**

**UV resistance:** Incorporating a specifically designed UV resistance package, AVALON® TPU can be stabilized against premature yellowing and discoloration.
Safety shoes

To protect working feet on construction sites and in factories, international regulations for safety shoes are extremely precise.

TPUs can meet the high standards set for footwear in these specific environments, offering oil and solvent resistance as well as anti-slip properties and exceptional durability.

AVALON® TPU outsoles can be combined with the full range of Huntsman microcellular midsole systems in a direct-molded process.

This construction combines the outstanding wear and flex performance of a soft TPU for the outsole with the comfort and lightness of polyurethane for the midsole. Anti-static systems are also available to fulfill the requirements of the industrial boot sector.

Typical applications:
- **Outsole**: 60 Shore A – 65 Shore A
- **Stabilizer**: 95 Shore A – 65 Shore D

Key benefits
- Outstanding flex performance
- Excellent slip resistance
- Perfect surface definition
- Transparency and translucency
- Oil resistance
Sport shoes

Fitness enthusiasts and professional athletes require footwear that provide protection and stabilization while enhancing their performance.

Some of the world’s best football boots demand the performance levels provided by AVALON® TPU. Improved abrasion grades for integral studs are also available to meet the most demanding environments. These are marketed under the AVALON® ABR range of TPUs.

Transparent grades from the AVALON® TPU range bridge the gap between style and function, enabling manufacturers to create exciting designs that won’t impede performance.

Typical applications:
- **Studs and cleats** Shore 85 A – 65 D
- **Sports plates** Shore 85 A – 98 A
- **Eyelets** Shore 95 A – 60 D
- **Stabilizers** Shore 80 A – 65 D

Key benefits
- Fast cycle times
- Excellent multilayer bonding
- Flex performance, even at low temperatures
- Outstanding abrasion and scratch resistance
- Perfect color match with masterbatches
- Transparency effects
Casual shoes

AVALON® TPUs have been used in the creation of casual shoes since the 1970s. Providing superior durability and excellent surface definition, they are a reliable alternative to rubber and PVC, enabling manufacturers to create footwear soles that are soft, flexible and tactile.

Huntsman pioneered the development of plasticizer-free TPUs for the footwear industry – further increasing the breadth of design and color effects that are available to designers.

Innovative products include the AVALON® Light range of lightweight solutions. These expanded TPU grades are easy to process and suitable for direct molding.

Key benefits

- Perfect surface definition
- Transparency effects
- Matt finish
- Rubber-like look and feel
- Multiple color combinations
- Abrasion resistance
- Outstanding flex life
- Easy reliable bonding

Typical applications:

- **Outsoles** 60 Shore A – 75 Shore A
- **Unitsoles** 65 Shore A – 75 Shore A
- **Stabilizers** 95 Shore A – 65 Shore D
- **Direct molded** AVALON® Light
Fashion shoes

For some people shoes are a practical necessity. For others they are desirable objects that help them make a bold fashion statement. Whatever the motivation, one thing is clear: in an industry where trends regularly fluctuate, footwear designers and manufacturers need access to materials that allow their creativity to flow when it comes to form, function, color, style and design detail.

The production of fashion shoes requires the use of materials that look sharp and elegant but can also deliver the optimum balance between abrasion and slip resistance.

Delivering comfort and performance, a smooth or leather-like finish, with good paintability, AVALON® TPU grades can be used to create a wide range of components for the fashion shoe industry.

Typical applications:

- **Leather inserts**: 65 Shore A – 85 Shore A
- **Top pieces**: 90 Shore A – 65 Shore D
- **Thin soles**: 75 Shore A – 85 Shore A
- **Unit soles**: 65 Shore A – 75 Shore A

**Key benefits**

- Perfect mold definition
- Fast production cycle times
- Excellent bonding
- Transparency effects
- Outstanding abrasion and scratch resistance
- Perfect color match with masterbatches
- Slip resistance
Processing recommendations

The following information describes the most ideal machine and screw configuration for a compact and expanded AVALON® TPU. It is not seen as a definitive guide as AVALON® grades can perform on a wide variety of shoe processing machines. We recommend that screw configurations of the polyamide type are not employed due to their inherent high shear characteristics. Long dwell times should be avoided.

It is recommended that waterways are included to facilitate improved cooling in continuous production.

**Runners** should be short in length and large in diameter; ideally full-round or trapezoidal and tapered where possible.

**Hot runner** systems are recommended for continuous production runs of high volume.

The **gates** should be generous to ensure the best flow conditions.

**Sprues** should be kept as short as possible and a minimum 5° taper should be allowed.

**Molds** should be tapered and vapor- or lightly, bead-blasted to avoid sticking. All common mould making materials are suitable for use with AVALON® TPU and short run or prototype moulds can be produced in aluminium or by metallized spray.

For detailed information of AVALON® TPU grades please request a datasheet from your nearest sales office.
Global offer with local support

Technical support
At Huntsman we build partnerships with our customers based on knowledge, trust and experience. This commitment means that comprehensive levels of technical support are always assured. With locations around the world, our international network of footwear specialists combine global reach with local knowledge – a powerful offering that can help solve complex challenges and ensure the very best levels of customer service.

Development center
To keep pace with modern formulating and manufacturing techniques, we make regular investments at our global and regional technical centers – purchasing the very latest processing equipment. This approach ensures our work remains current and relevant. Using industry standard machines to test new products and create prototypes or customer samples, we can respond rapidly to emerging trends with practical solutions that are ready to go straight into production – a major benefit for customers.

Alongside our customers we work closely with industry associations, universities and research centers around the world to keep ahead of the latest innovations and market developments.

Regional technical centers

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### Overview for the AVALON® TPU range:

<table>
<thead>
<tr>
<th>Typical physical properties</th>
<th>Unit</th>
<th>Methods</th>
<th>DIN</th>
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<tbody>
<tr>
<td>Density</td>
<td>g/cm³</td>
<td>ISO 2781</td>
<td>DIN 53479</td>
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<tr>
<td>Hardness</td>
<td>A</td>
<td>ISO 868</td>
<td>DIN 53505</td>
</tr>
<tr>
<td>Hardness</td>
<td>D</td>
<td>ISO 868</td>
<td>DIN 53505</td>
</tr>
<tr>
<td>Tensile strength</td>
<td>MPa</td>
<td>ISO 37</td>
<td>DIN 53504</td>
</tr>
<tr>
<td>Elongation @ break</td>
<td>%</td>
<td>ISO 37</td>
<td>DIN 53504</td>
</tr>
<tr>
<td>100 % tensile modulus</td>
<td>MPa</td>
<td>ISO 37</td>
<td>DIN 53504</td>
</tr>
<tr>
<td>300 % tensile modulus</td>
<td>MPa</td>
<td>ISO 37</td>
<td>DIN 53504</td>
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<tr>
<td>Tear strength</td>
<td>kN/m</td>
<td>ISO 34B</td>
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<tr>
<td>Abrasion resistance</td>
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<td>BS 5131</td>
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<td>Flexural Modulus @23°C</td>
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<td>ISO 178</td>
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<tr>
<td>Electrical resistance</td>
<td>Mohm</td>
<td>Internal</td>
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</table>

#### Appearance

- amber
- semi-transparent
- transparent
- highly transparent
- opaque

#### End use applications

- Sport plates/studs
- Sport cleats
- Top-pieces
- Casual soles
- Safety Soes
- Thin soles
- Inserts/stabilizers
- Outsoles
- Midsoles

### AVALON® 90 A BR

**Hardness:**
- Shore A
- Shore D

**Chemistry:**
- B: improved performance
- E: standard grade
- K: transparent
- BR: improved abrasion resistance
- HT: high transparency
<table>
<thead>
<tr>
<th>Chemistry:</th>
</tr>
</thead>
<tbody>
<tr>
<td>B : improved performance in hydrolysis resistance</td>
</tr>
<tr>
<td>E : standard grade</td>
</tr>
<tr>
<td>K : transparent</td>
</tr>
<tr>
<td>BR: improved performance in abrasion resistance</td>
</tr>
<tr>
<td>HT: high transparency in thick parts, UV resistance</td>
</tr>
</tbody>
</table>

* expanded TPU
Huntsman Polyurethanes is committed to working closely with its customers and can offer a fast and flexible response to your needs. We offer direct links to our laboratories with full technical backup. Commercial support and dedicated customer service is available throughout Europe, the Middle East, Asia-Pacific and the Americas.

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About Huntsman
Huntsman is a global manufacturer and marketer of differentiated chemicals. Our operating companies manufacture products for a variety of global industries, including chemicals, plastics, automotive, aviation, textiles, footwear, paints and coatings, construction, technology, agriculture, health care, detergent, personal care, furniture, appliances and packaging. Originally known for pioneering innovations in packaging and, later, for rapid and integrated growth in petrochemicals, Huntsman approximately 12,000 employees and operates from multiple locations worldwide. The Company had 2010 revenues of approximately $9 billion. For more information about Huntsman, please visit the Company’s website at www.huntsman.com.

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