Challenges faced in selecting materials for CVJ boots:

- Abrasion resistance
- Grease and oil resistance
- Flexibility at very low temperatures
- Endurance at high temperatures
- Resistance to flexural fatigue
- Freedom of design
ARNITEL TPE IN CVJ BOOTS

Arnitel is the preferred material for constant velocity joint (CVJ) boots used by drive train manufacturers and supplied to leading vehicle manufacturers who have safety, reliability and durability as key requirements.

The drive shaft is a key part in the car. It transfers power from the engine to the wheels. Flexible couplings, such as the constant velocity joint on front wheel drive vehicles which allows the vehicle to change direction, are used at various points in the drive train.

These couplings are protected from the external environment by a flexible molding, referred to as a boot.

**Figure 1** CVJ boots.

**Boots**

In the past, boots were usually made from chloroprene rubber (CR). However, regular failures due to environmental damage initiated the change to more durable materials.

There are basically two types of boots: inboard boots and outboard boots (also known as CVJ boots). The typical locations of these two types of boots are shown in Figure 2, along with other protective moldings (bellows) used in the drive train. The environmental conditions around the CVJ out- and inboard boots are shown in Figure 3.

**Figure 2** Typical locations of protective boots in a car.

**Figure 3** Conditions around CVJ outboard and inboard boots.
CVJ outboard boots

CVJ boots have to be resistant to the very high abrasive conditions created by mud and grime coming off the road and to greases used to lubricate the coupling. Since these boots are mounted at the wheel, they have to be able to flex at acute angles in response to any tight turns that the driver makes, retaining their flexibility at all ambient temperatures likely to be encountered.

Under extreme environmental conditions, ambient temperatures can be as low as -40°C, subjecting the boot to extreme flexural forces at temperatures where other elastomers would be very brittle, leading to failure.

<table>
<thead>
<tr>
<th>Cost structure</th>
<th>CR-boot</th>
<th>TPE-E boot</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>90</td>
<td>60</td>
<td>g/boot</td>
</tr>
<tr>
<td>Material</td>
<td>38</td>
<td>38</td>
<td>%</td>
</tr>
<tr>
<td>Production</td>
<td>44</td>
<td>17</td>
<td>%</td>
</tr>
<tr>
<td>Sub total</td>
<td>82</td>
<td>55</td>
<td>%</td>
</tr>
<tr>
<td>Large clamp</td>
<td>10</td>
<td>26</td>
<td>%</td>
</tr>
<tr>
<td>Small clamp</td>
<td>8</td>
<td>19</td>
<td>%</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>%</td>
</tr>
<tr>
<td>Cost</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comparison</td>
<td>1.0</td>
<td>1.0</td>
<td></td>
</tr>
</tbody>
</table>

Table 1 Manufacturing cost structure for CR rubber vs. Arnitel.

<table>
<thead>
<tr>
<th>Performance property</th>
<th>Performance ratio of TPE-E boot / CR boot</th>
</tr>
</thead>
<tbody>
<tr>
<td>High speed</td>
<td>1.2</td>
</tr>
<tr>
<td>Durability</td>
<td></td>
</tr>
<tr>
<td>Room temperature</td>
<td>1.5</td>
</tr>
<tr>
<td>Low temperature</td>
<td>2.2</td>
</tr>
<tr>
<td>High temperature</td>
<td>1.4</td>
</tr>
<tr>
<td>High temperature after aging</td>
<td>2.0</td>
</tr>
<tr>
<td>Impact strength</td>
<td>1.4</td>
</tr>
<tr>
<td>Weight</td>
<td>0.47</td>
</tr>
</tbody>
</table>

Table 2 Performance benefit in using Arnitel for boots.

Arnitel provides significant performance advantages at the same manufacturing cost of CR rubber boot.
It is extremely important to design boots correctly for optimum boot life, which ideally should be the life of the car itself.

Table 1 and table 2 demonstrate the benefits of a boot made from Arnitel versus CR rubber.

Arnitel enables designers to design boots that are smaller and more compact. This not only brings in savings through a material cost reduction, but additionally the amount of grease required to lubricate the coupling is reduced, bringing savings to the car manufacturer.

An important concern of car manufacturers is that boots should not generate a squeaking sound during the running-in period of the car. The DSM portfolio contains two grades specially developed to address this concern.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Features</th>
<th>Features</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>EB463</td>
<td>Durability</td>
<td>High productivity</td>
<td>Standard grade</td>
</tr>
<tr>
<td>EB464-01</td>
<td>Higher durability</td>
<td>Anti-squeak</td>
<td></td>
</tr>
<tr>
<td>EB464-02</td>
<td>Higher durability</td>
<td>Anti-squeak</td>
<td>Compact design grade</td>
</tr>
</tbody>
</table>

Table 3
THE IDEAL SOLUTION

Arnitel is the ideal solution for CVJ boots

- Double the life of CR rubber boot
- Greater safety offered
- Easier to design
- Easier to process
- Antisqueaking grades available for highest user comfort

Arnitel is also used for Inboard boots, Rack and pinion bellows and Propeller shaft boots. For more information, please contact your local sales office.
Superior high temperature properties
Excellent flexural fatigue resistance
Outstanding resistance to creep
Special grades developed to meet different processes such as injection molding, extrusion and blow molding

Resistance to automotive oils and greases
Thermoplastic with excellent processability
Easy to design

Automotive boots and bellows
Soft touch applications, ideal for 2 component molding
High temperature electrical cable sheathing applications

Airducts for automobiles
Airbag covers with outstanding reliability

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