New Soft TPU Grades
in Automotive Applications

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Polyurethanes are created by polyaddition of 2 components:

- **Polyol**
- **Di-Isocyanate**

Polyurethane
Chemistry of Thermoplastic Polyurethanes (TPU)

Diisocyanate  Diol  Polyol

Belt Process

Reaction Tunnel (Belt)

Pellets  Extruder  Diced Material

Belt Granulator
European Business Management Thermoplastic Polyurethanes TPU (Elastollan®)

General TPU Properties

Influence of Polyols on TPU Properties

**Polyester-TPU**
- Heat Stability
- Mechanical Properties
- Resistance to oils

**Polyether-TPU**
- Resistance to Hydrolysis
- Microbiol Resistance
- Low-Temperature Flexibility

**Aliphatic TPU**
- Color Fastness
- UV - Stability

**HPM - TPU**
- Heat Resistance
- Low Compression Set
### General Properties of TPU Elastollan®

<table>
<thead>
<tr>
<th>Properties</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>• excellent mechanical properties:</td>
<td>• thin wall thickness,</td>
</tr>
<tr>
<td>high tensile and tear strength,</td>
<td>dimensional stability</td>
</tr>
<tr>
<td>low water up-take</td>
<td>and long term durability</td>
</tr>
<tr>
<td>• high abrasion resistance</td>
<td>• low wear</td>
</tr>
<tr>
<td>• very good impact strength</td>
<td>• excellent low temperature</td>
</tr>
<tr>
<td>at low temperatures</td>
<td>flexibility</td>
</tr>
<tr>
<td>• high chemical resistance</td>
<td>• good resistance to oils and greases</td>
</tr>
<tr>
<td>• good sound damping</td>
<td>• improved low-noise comfort</td>
</tr>
<tr>
<td>• low melt viscosity</td>
<td>• high reproduction of detail</td>
</tr>
<tr>
<td>• pleasant touch, dry feel</td>
<td>• high quality appearance</td>
</tr>
</tbody>
</table>
Major Requirements for Interior Applications

- High Quality Perception
- Haptics
- No Odor
- Freedom in Design
- Low Temperature Flexibility
- Low Emission
- Durability
- Mechanical Properties
- Colors (2-tone)
European Business Management Thermoplastic Polyurethanes TPU (Elastollan®)

Shore Hardness Range of TPU Elastollan®

soft PVC
TPE-S
TPE-V
TPE-E
TPE-O
rigid PVC
PC
ABS

ELASTOLLAN® TPU

NEW soft HPM-TPUs

plasticized

<table>
<thead>
<tr>
<th>Shore A</th>
<th>Shore D</th>
<th>Rockwell - R</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 30 40 50 60 70 80 90 95</td>
<td>45 55 65 75 85</td>
<td>50 70 90 110 120 130 140 150</td>
</tr>
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</table>
European Business Management Thermoplastic Polyurethanes TPU (Elastollan®)

Aromatic Standard TPU: Technical Car Applications
European Business Management Thermoplastic Polyurethanes TPU (Elastollan®)

Agenda

1. Aromatic TPU (Elastollan®) for Soft Touch Applications
2. Aliphatic colorfast TPU (Elastollan®) for Soft Touch Applications
3. Improvement of 2-Shot Adhesion TPU / PP

Aromatic Standard TPU
Soft Aromatic Standard TPU for Interior Applications

**Gear Knobs**

(2- and 3-Shot Design)

- pleasant touch, dry feel
- high *abrasion resistance*
- high *scratch resistance*
- non blooming
- replacement of foamed parts

Polyester-TPU
Shore 78 - 85 A
European Business Management Thermoplastic Polyurethanes TPU (Elastollan®)

Soft Aromatic Standard TPU for Interior Applications

Saab 9-3

Knobs

Polyester-TPU
Shore 78 A

Knobs, Handles

- pleasant touch, dry feel
- high scratch resistance
- high abrasion resistance
European Business Management Thermoplastic Polyurethanes TPU (Elastollan®)

Soft Aromatic Standard TPU for Interior Applications

Driver Airbag Covers

- pleasant touch, dry feel
- high abrasion resistance
- high scratch resistance
- good low temperature flexibility
- high long term stability
- high reproduction in detail

Polyether-TPU Shore 80 A
1. Aromatic TPU (Elastollan®) for Soft Touch Applications

2. Aliphatic colorfast TPU (Elastollan®) for Soft Touch Applications

3. Improvement of 2-Shot Adhesion TPU / PP
Innovation: Rigid - Segment - Modification (HPM)

Advantages of HPM vs. Standard TPU Grades:

- faster crystallisation
- better demoulding properties
- shorter process cycle time
General Characteristics of HPM - TPU - Grades

- low Shore Hardness 60 A - 95 A
- non-plasticized grades
- high mechanical properties level
- high service temperature (120° - 150°C)
- low compression set
- good resistance to oils and greases

Application Areas: Interior, Exterior, Under the Hood, Chassis
# European Business Management Thermoplastic Polyurethanes TPU (Elastollan®)

**Soft non-plasticized aromatic HPM - TPU Grades**

## Mechanical Properties of aromatic Elastollan® HPM - TPU

<table>
<thead>
<tr>
<th>Property</th>
<th>Unit</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hardness</strong></td>
<td>Shore A</td>
<td>DIN 53505</td>
</tr>
<tr>
<td><strong>Density</strong></td>
<td>g/cm³</td>
<td>DIN 53479</td>
</tr>
<tr>
<td><strong>Tensile strength</strong></td>
<td>MPa</td>
<td>DIN 53504</td>
</tr>
<tr>
<td><strong>Elongation at break</strong></td>
<td>%</td>
<td>DIN 53504</td>
</tr>
<tr>
<td><strong>Stress at 20 % elongation</strong></td>
<td>MPa</td>
<td>DIN 53504</td>
</tr>
<tr>
<td><strong>Stress at 100 % elongation</strong></td>
<td>MPa</td>
<td>DIN 53504</td>
</tr>
<tr>
<td><strong>Stress at 300 % elongation</strong></td>
<td>MPa</td>
<td>DIN 53504</td>
</tr>
<tr>
<td><strong>Tear strength</strong></td>
<td>N/mm</td>
<td>DIN 53515</td>
</tr>
<tr>
<td><strong>Abrasion loss</strong></td>
<td>mm³</td>
<td>DIN 53516</td>
</tr>
<tr>
<td><strong>Vicat Softening Temperature A 120</strong></td>
<td>°C</td>
<td>DIN EN ISO 306</td>
</tr>
<tr>
<td><strong>Compression Set at RT</strong></td>
<td>%</td>
<td>DIN ISO 815</td>
</tr>
<tr>
<td><strong>Compression Set at 70°C</strong></td>
<td>%</td>
<td>DIN ISO 815</td>
</tr>
<tr>
<td><strong>Compression Set at 100°C</strong></td>
<td>%</td>
<td>DIN ISO 815</td>
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</table>

<table>
<thead>
<tr>
<th></th>
<th>C 60 A 15 HPM</th>
<th>C 65 A 15 HPM</th>
<th>C 70 A 15 HPM</th>
<th>C 75 A 15 HPM</th>
<th>C 85 A 15 HPM</th>
<th>C 90 A 15 HPM</th>
<th>C 95 A 15 HPM</th>
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<td>70</td>
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<td>1,23</td>
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<td>1,23</td>
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<td>45</td>
<td>50</td>
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<td>45</td>
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<td><strong>Elongation at break</strong></td>
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<td>800</td>
<td>750</td>
<td>700</td>
<td>650</td>
<td>600</td>
<td>550</td>
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<td>1,5</td>
<td>1,5</td>
<td>2</td>
<td>3,5</td>
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<td>7,9</td>
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<td><strong>Stress at 100 % elongation</strong></td>
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<td>2,5</td>
<td>3,5</td>
<td>6</td>
<td>7,7</td>
<td>11,9</td>
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<td><strong>Stress at 300 % elongation</strong></td>
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<td>4</td>
<td>4,5</td>
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<td>11</td>
<td>13</td>
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<td><strong>Abrasion loss</strong></td>
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<td>35</td>
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<td>45</td>
<td>50</td>
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<tr>
<td><strong>Vicat Softening Temperature A 120</strong></td>
<td>70</td>
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<td>85</td>
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<td>152</td>
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<td>20</td>
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<td><strong>Compression Set at 70°C</strong></td>
<td>53</td>
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<td>25</td>
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<td>25</td>
<td>29</td>
<td>33</td>
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<tr>
<td><strong>Compression Set at 100°C</strong></td>
<td>69</td>
<td>55</td>
<td>45</td>
<td>44</td>
<td>50</td>
<td>43</td>
<td>45</td>
</tr>
</tbody>
</table>
Application Examples: Interior

- pleasant touch, dry feel
- high scratch resistance
- non-plasticized grades
- detailed surface structure

Gear Knob

(C 60 - C 75 A 15 HPM)

Hand Brake Handle

Knobs
Application Example: Interior

Electronic Key Housing
(LP 9303 (Shore 70 A HPM-TPU)
PPA GF50 / PA 66)

• Replacement of soft touch coat
• good abrasion resistance
• high scratch resistance
• pleasant touch
• passed endurance test (100,000 operations at -40°C to +70°C)
Application Examples: Exterior

- Wiper Housing Cover (C 70 A 15 HPM / PBT)
  - good scratch resistance
  - good weatherability

- Aerial (C 70 A 15 HPM / PC-ABS)
  - good abrasion resistance
  - high reproduction in detail
Application Examples: Chassis

Grommets for brake lining wear sensor
(C 70 A 15 HPM)

- excellent grease resistance
- good low temperature behaviour
- heat resistance
- good abrasion resistance

Dust covers for ball joints
(C 75 A 15 HPM)
Soft non-plasticized aromatic HPM - TPU Grades

Application Example: Gearshift

- Combination with other thermoplastic elastomers
- Excellent adhesion to substrate
- Good combination of softness and high temperature resistance
- Short production cycle time

Part for servo-steering mechanism

(C 65 A15 HPM / TPE-E)
Heat ageing of Elastollan Grades @ 150°C

Elastollan C 85 A 13

Elastollan C 85 A 15 HPM

Soft non-plasticized aromatic HPM - TPU Grades
Soft non-plasticized aromatic HPM - TPU Grades

Application Example: Under the Hood

- Replacement of Rubber Seal
- Cost reduction (no manual assembly)
- Service temperature of 120°C
- Peak service temperature up to 150°C
- High chemical resistance
- Excellent adhesion to substrate
- Short production cycle time

Gasket for Common Rail Protector

(C 85 A 15 HPM / PA 6 (GF10 / M20))
European Business Management Thermoplastic Polyurethanes TPU (Elastollan®)

Agenda

1. Aromatic TPU (Elastollan®) for Soft Touch Applications
2. Aliphatic TPU (Elastollan®) for Soft Touch Applications
3. Improvement of 2-Shot Adhesion TPU / PP

Aliphatic Colorfast TPU (soft, non-plasticized)
Aliphatic TPU for Soft Touch Interior Applications

Colour Fastness of Aliphatic TPU

(Atlas test device, 100°C black panel temp, wavelength: 420 nm, power: 1,2 W/m²)
General Characteristics of Aliphatic TPU Grades

- **colour fastness** (replacement of surface coat)
- Shore Hardness range 60 A - 55 D available
- **non-plasticized**, Polyester-based grades
- pleasant feel, soft touch
- low melt viscosity allows low section thickness
- detailed reproduction of surface structures
- good adhesion to substrates like ABS, ABS/PC
## Aliphatic TPU for Soft Touch Interior Applications

<table>
<thead>
<tr>
<th>Properties</th>
<th>Unit</th>
<th>Standard</th>
<th>LP 9273</th>
<th>SP 9269</th>
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</thead>
<tbody>
<tr>
<td>Hardness</td>
<td>Shore</td>
<td>DIN 53505</td>
<td>84 A</td>
<td>89 A</td>
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<tr>
<td>Density</td>
<td>g/cm³</td>
<td>DIN 53479</td>
<td>1.14</td>
<td>1.14</td>
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<tr>
<td>Tensile Strength</td>
<td>MPa</td>
<td>DIN 53504</td>
<td>18</td>
<td>16</td>
</tr>
<tr>
<td>Elongation at Break</td>
<td>%</td>
<td>DIN 53504</td>
<td>750</td>
<td>650</td>
</tr>
<tr>
<td>Stress at 100% Elongation</td>
<td>MPa</td>
<td>DIN 53504</td>
<td>4.3</td>
<td>7.3</td>
</tr>
<tr>
<td>Stress at 300% Elongation</td>
<td>MPa</td>
<td>DIN 53504</td>
<td>6.3</td>
<td>9.1</td>
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<tr>
<td>Tear Strength</td>
<td>N/mm</td>
<td>DIN 53515</td>
<td>50</td>
<td>38</td>
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<tr>
<td>Abrasion</td>
<td>mm³</td>
<td>DIN 53516</td>
<td>60</td>
<td>95</td>
</tr>
<tr>
<td>Melt Flow Rate</td>
<td>g/10 min</td>
<td>DIN ISO 1133</td>
<td>25 (220°C / 5 kg)</td>
<td>&gt;25 (180°C / 2.16 kg)</td>
</tr>
</tbody>
</table>

High MFR
Aliphatic TPU for Soft Touch Interior Applications

2-Shot Overmoulding

**Elastollan® LP 9273** (Shore 86 A)

Serial Application:
Slider Cover Center Console

OEM: Volkswagen
Models: Golf, Touran, Jetta / Bora

- pleasant touch
- high reproduction in detail
- good damping behavior
- good melt flowability
**European Business Management** Thermoplastic Polyurethanes TPU (Elastollan®)

**Aliphatic TPU for Soft Touch Interior Applications**

**Slush Moulding**

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**Elastollan® SP 9269** (Shore 89 A)

**Serial Application:**
**Slush - Instrument Panel Skin**

**OEM:** LandRover

**Models:** Discovery 3, Range Rover Sport, Freelander 2

- aliphatic colorfast TPU grade
- flexible at low temperatures
- good ageing properties
- detailed grain definition
- matt surface appearance
- low Fogging and Emission
## Aliphatic HPM - TPU Grades

<table>
<thead>
<tr>
<th>Property</th>
<th>Unit</th>
<th>Standard</th>
<th>LP 9299</th>
<th>LP 9277</th>
<th>LP 9307</th>
<th>LP 9306</th>
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<td>1,16</td>
<td>1,17</td>
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<td>15</td>
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<tr>
<td>Elongation at break</td>
<td>%</td>
<td>DIN 53504</td>
<td>1 500</td>
<td>1 300</td>
<td>600</td>
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<td>3,2</td>
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<td>1,6</td>
<td>2,3</td>
<td>4</td>
<td>5,5</td>
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<tr>
<td>Stress at 300 % elongation</td>
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<td>DIN 53504</td>
<td>2,3</td>
<td>3,8</td>
<td>5,8</td>
<td>7,8</td>
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<tr>
<td>Tear strength</td>
<td>N/mm</td>
<td>DIN 53515</td>
<td>35</td>
<td>40</td>
<td>45</td>
<td>50</td>
</tr>
<tr>
<td>Abrasion loss</td>
<td>mm³</td>
<td>DIN 53516</td>
<td>120</td>
<td>110</td>
<td>70</td>
<td>40</td>
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<tr>
<td>Compression set at room temperature</td>
<td>%</td>
<td>DIN ISO 815</td>
<td>25</td>
<td>25</td>
<td>22</td>
<td>20</td>
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<tr>
<td>Compression set at 70°C</td>
<td>%</td>
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<td>35</td>
<td>30</td>
<td>35</td>
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<tr>
<td>Compression set at 100°C</td>
<td>%</td>
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<td>58</td>
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<tr>
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<td>23</td>
<td>21</td>
<td>13</td>
</tr>
</tbody>
</table>
Aliphatic HPM-TPU for Soft Touch Interior Applications

2-Shot Overmoulding

**Aliphatic HPM - TPU Grade**

**Elastollan® LP 9277** (Shore 68 A)

**Application: Cupholder**

**OEM:** Audi

**Modelle:** A 6, A 3 (US)

- good resilience
- pleasant touch
- low wear
- good demoulding
Aliphatic HPM-TPU for Soft Touch Interior Applications
2-Shot Overmoulding

Aliphatic HPM - TPU Grade

**Elastollan® LP 9277** (Shore 68 A)

Application: Inner Door Handle

OEM: BMW, VW
Models: 3-er (E 90), X 5; Golf VI

- pleasant touch
- detailed surface reproduction
- resistance to tan lotion
- cost savings (replacement of coat)

Cover Inner Door Handle
European Business Management Thermoplastic Polyurethanes TPU (Elastollan®)

Aliphatic HPM-TPU for Soft Touch Interior Applications
2-Shot Overmoulding

Aliphatic HPM - TPU Grade

Elastollan® LP 9307 (Shore 80 A)

Application: Cover Center Console

OEM: VW
Model: Golf VI

- replacement of soft touch coat
- good abrasion resistance
- high scratch resistance
- pleasant touch
Aliphatic TPU for Soft Touch Interior Applications
2-Shot Overmoulding

Seat: Potential Application of soft touch aliphatic TPU

Cover Parts

Head Rest Cover

Adjustment Wheel Cover
European Business Management Thermoplastic Polyurethanes TPU (Elastollan®)

Agenda

1. Aromatic TPU (Elastollan®) for Soft Touch Applications
2. Aliphatic colorfast TPU (Elastollan®) for Soft Touch Applications
3. Improvement of 2-Shot Adhesion TPU / PP
## Improvement of Adhesion Level after Plasma - Treatment

<table>
<thead>
<tr>
<th>Thermo-plastics</th>
<th>no activation</th>
<th>after Plasma Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>PA 6</td>
<td>good bonding</td>
<td>perfect bonding</td>
</tr>
<tr>
<td>PC, PC / ABS</td>
<td>good bonding</td>
<td>perfect bonding</td>
</tr>
<tr>
<td>ABS, SAN, ASA</td>
<td>good bonding</td>
<td>perfect bonding</td>
</tr>
<tr>
<td>PA 6.6, PA 12</td>
<td>poor bonding</td>
<td>good bonding</td>
</tr>
<tr>
<td>PBT</td>
<td>poor bonding</td>
<td>perfect bonding</td>
</tr>
<tr>
<td>PE, PP, PS</td>
<td>no bonding</td>
<td>good bonding</td>
</tr>
<tr>
<td>POM</td>
<td>no bonding</td>
<td>poor bonding</td>
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</tbody>
</table>

*general indications; specific testing recommended*
www.elastogran.de -> Thermoplastic Polyurethanes Elastollan®