**Chemical structure**

Pibiflex® is a thermoplastic copolyester based elastomer with a partially crystalline sequential structure formed by rigid crystalline PBT segments and soft amorphous polyether/polyester long-chain segments. The soft segments provide elasticity and rubber-like properties, while the hard segments provide the processing ease and the strength typical of engineering plastics. The ratio between hard and soft segments determines the properties of the various grades.

![Chemical structure diagram](image)

**Pibiflex® hardness range**

<table>
<thead>
<tr>
<th>Shore A</th>
<th>0</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
<th>80</th>
<th>90</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shore D</td>
<td>20</td>
<td>30</td>
<td>40</td>
<td>50</td>
<td>60</td>
<td>70</td>
<td>80</td>
<td>90</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rockwell B</td>
<td>50</td>
<td>80</td>
<td>110</td>
<td>140</td>
<td>170</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Natural rubbers
- Polyuretanes
- Thermoplastic Vulcanizates
- Pibiflex®
- Plastics
- TPE - Styrenics
SO.F.TER. offers a complete portfolio ranging from soft to hard solutions.

- **Injection moulding grades** offering easy processability also for the rigid grades
- **Extrusion and blow moulding grades** providing excellent melt strength
- **Dolphin grades** for the production of soft-touch interior trims in a single phase (see Dolphin technology page 8)

### Summary of properties

- **Hardness**: from 25 up to 70 Shore D
- **Flexural Modulus**: from 30 up to 600 MPa
- **Elongation at break**: from 300 up to 850 %
- **Vicat 1Kg/120 °C**: from 80 up to over 200 °C
- **HDT (0,45 MPa)**: from 46 up to over 120 °C

### Applications

- **Automotive**: CVJ boots, airbags, air ducts, belt drives, conveyor belts, hoses and steering wheel covers, soft skins for dashboard, door panels and interior trims
- **Electrical appliance**: wire and cable jackets, buttons and grips of electric power tools equipment
- **Industrial**: railroad tie pads, high-pressure gaskets, silent gears, spring of dispensing machines, cable ties
- **Sport**: flipper blades

### Adhesion-2K moulding

Pibiflex® features very good adhesion properties to many polymeric materials including ABS, PBT, PC, PC/PBT, PC/ABS, EVA, TPU, SEBS (special grades) and to many paints, glues and metals.

### Approvals

Various Pibiflex® grades have been approved for automotive applications by the most important automotive manufacturers and Tier 1.

### Food contact grades

Pibiflex® grades 2560 and 3560 comply with the requirements of the FDA-CFR 21-parts 170 to 199 item 177.2600, paragraph a) b) c) d) e) f) for use in contact with dry foods, aqueous foods and fatty foods. Such grades can be used in food packaging and in alcohol, fruit juices and oil bottling.

### Medical grades

Pibiflex® grades 2560 and 3560 comply with the requirements of USP XXXII:2009 Class VI and ISO 10993-4/5/10 and can be used in medical applications.

- **Intracutaneous reactivity**
- **Systemic toxicity**
- **Implantation test in the rabbit**
- **Physicochemical test <661> Plastics: nonvolatile residue, heavy metals, buffering capacity**
- **Cytotoxicity, MEM Elution**
- **Hemolysis test, direct and indirect contact**

### Elastic properties

Pibiflex® features excellent mechanical properties, such as tensile strength and tear strength, exceptional toughness and resilience, high creep and flexural fatigue resistance.

### Temperature resistance

Pibiflex® has an excellent temperature behaviour:

- maintains flexibility at low temperatures (low temperature limit - 45 °C)
- retains properties at high temperatures (high temperature limit 150 °C, continuous use)

### Weathering resistance

**UV stabilized grades**

- Pibiflex® 3567 S2 Black 33
- Pibiflex® 50517 Black
- Pibiflex® 6097 Black

**Medical grades**

- Pibiflex® 2560 (ShD25)
- Pibiflex® 3560 (ShD35)
- Pibiflex® 4482 (ShD44)

**Weathering resistance**

- Test performed:
  - **Intracutaneous reactivity**
  - **Systemic toxicity**
  - **Implantation test in the rabbit**
  - **Physicochemical test <661> Plastics: nonvolatile residue, heavy metals, buffering capacity**
  - **Cytotoxicity, MEM Elution**
  - **Hemolysis test, direct and indirect contact**

---

**Compression Set - ASTM D395-8 type 1**

![Compression Set - ASTM D395-8 type 1](chart)

**UV resistance - tensile strain**

![UV resistance - tensile strain](chart)

**UV resistance - tensile strength**

![UV resistance - tensile strength](chart)

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**CVJ boots**

Pibiflex® B5050 MWR (Blow moulding grade)

Pibiflex® 4054 IM (Injection moulding grade)

**Bi-material air duct**

Blow moulded PBT ducts, heat welded to the TPC base

- Pibiter® BM521 (PBT, blow moulding)
- Pibiflex® 4632 (TPC, injection moulding)
Chemical resistance
Pibiflex® offers outstanding chemical resistance to fuels, oils, greases and it is particularly suitable for applications in the automotive sector where continuous contact with oils and greases at high temperature is required.

<table>
<thead>
<tr>
<th>Chemicals</th>
<th>Reaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oils, greases, hydrocarbons</td>
<td><img src="image1" alt="" /> <img src="image2" alt="" /> <img src="image3" alt="" /></td>
</tr>
<tr>
<td>Mineral oil, grease, non aromatic hydrocarbons</td>
<td><img src="image1" alt="" /> <img src="image2" alt="" /> <img src="image3" alt="" /></td>
</tr>
<tr>
<td>Benzene, toluene, aromatic hydrocarbons, chemicals, solvents</td>
<td><img src="image1" alt="" /> <img src="image2" alt="" /> <img src="image3" alt="" /></td>
</tr>
<tr>
<td>Water, alcohols, glycols</td>
<td><img src="image1" alt="" /> <img src="image2" alt="" /> <img src="image3" alt="" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Condition</th>
<th>Reaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>At ambient temperature</td>
<td><img src="image1" alt="" /> <img src="image2" alt="" /> <img src="image3" alt="" /></td>
</tr>
<tr>
<td>&gt;50 °C without specific stabilizer</td>
<td><img src="image1" alt="" /> <img src="image2" alt="" /> <img src="image3" alt="" /></td>
</tr>
<tr>
<td>&gt;50 °C with specific stabilizer</td>
<td><img src="image1" alt="" /> <img src="image2" alt="" /> <img src="image3" alt="" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Acids and bases</th>
<th>Reaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diluted</td>
<td><img src="image1" alt="" /> <img src="image2" alt="" /> <img src="image3" alt="" /></td>
</tr>
<tr>
<td>Concentrated</td>
<td><img src="image1" alt="" /> <img src="image2" alt="" /> <img src="image3" alt="" /></td>
</tr>
</tbody>
</table>

Processing conditions

**Injection moulding**
- Drying: 3-4 h @ 90-120 °C in dehumidifying hopper drier
- Plasticising screw: polyester-type screw
- Screw L/D ratio: ≥ 20:1
- Screw compression ratio: 3:1 to 4:1
- Plasticising speed: high
- Injection speed: high
- Injection pressure: high
- Runners: having circular section and gradually decreasing flow-through diameter
- Injection points (*): Ø ≥ 0.7 mm
- Mould air vents: Ø 0.03 – 0.05 mm

**Extrusion/blow moulding**
- Drying: 3-4 h @ 90-120 °C in dehumidifying hopper drier
- Plasticising screw: polyethylene-type screw
- Screw L/D ratio: ≥ 20:1
- Screw compression ratio: 2.5:1 to 3.5:1
- Die land: <10 mm
- Breaker plate: 60 Mesh

(*) We recommend not to use injection points having a diameter <0.3 mm without prior selection of the appropriate grades, to be agreed with SO.F.TER. Technical Support.

Indicative processing temperatures (°C)

- **Injection moulding**
  - 1st Zone: hardness 25-50 ShD, 210-225 °C
  - 2nd Zone: hardness 25-50 ShD, 220-230 °C
  - 3rd Zone: hardness 25-50 ShD, 225-240 °C
  - Nozzle: hardness 25-50 ShD, 230-250 °C
  - Mould: hardness 25-50 ShD, 40-60

- **Extrusion**
  - 1st Zone: hardness 45-60 ShD, 220-230 °C
  - 2nd Zone: hardness 45-60 ShD, 230-240 °C
  - 3rd Zone: hardness 45-60 ShD, 240-250 °C
  - Head: hardness 45-60 ShD, 230-250 °C
  - Die: hardness 45-60 ShD, 220-250 °C

- **Blow moulding**
  - 1st Zone: hardness 40-50 ShD, 200-220 °C
  - 2nd Zone: hardness 40-50 ShD, 210-230 °C
  - 3rd Zone: hardness 40-50 ShD, 220-240 °C
  - Head: hardness 40-50 ShD, 220-250 °C
  - Die: hardness 40-50 ShD, 220-250 °C

Recycling
Pibiflex® is a fully recyclable material. Production scraps can be re-used after grinding. Recovered material can be mixed with virgin material, but we recommend not to exceed a percentage of 20%, in order not to alter the compound final quality.

Packaging and storage
Pibiflex® is supplied in 25 kg moisture proof aluminium bags. The product should be stored in its original packaging in a cool, dry place at temperatures below 40 °C. Exposure to light and to other heat sources must be avoided.
## Technical data Pibiflex® Thermoplastic Copolyester Elastomer (TPC)

<table>
<thead>
<tr>
<th>Physical properties</th>
<th>Method</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>hardness 15°</td>
<td>ASTM D2240</td>
<td>Shore D</td>
</tr>
<tr>
<td>density</td>
<td>ASTM D792</td>
<td>g/cm³</td>
</tr>
<tr>
<td>water absorption</td>
<td>ASTM D570</td>
<td>%</td>
</tr>
<tr>
<td>melting point (dec)</td>
<td>ASTM D3417</td>
<td>°C</td>
</tr>
<tr>
<td>glass transition</td>
<td>INTERNAL</td>
<td>°C</td>
</tr>
<tr>
<td>MVR melt volume rate</td>
<td>ASTM D1238</td>
<td>cm³/10'</td>
</tr>
<tr>
<td>MFI melt flow index (220 °C - 2,16 kg)</td>
<td>ASTM D1238</td>
<td>g/10'</td>
</tr>
<tr>
<td>MFI melt flow index (230 °C - 2,16 kg)</td>
<td>ASTM D1238</td>
<td>g/10'</td>
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<tr>
<td>MFI melt flow index (230 °C - 5 kg)</td>
<td>ASTM D1238</td>
<td>g/10'</td>
</tr>
<tr>
<td>MFI melt flow index (240 °C - 2,16 kg)</td>
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<td>g/10'</td>
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<tr>
<td>Mechanical properties</td>
<td></td>
<td></td>
</tr>
<tr>
<td>tensile strength at break</td>
<td>ASTM D638</td>
<td>MPa</td>
</tr>
<tr>
<td>elongation at break</td>
<td>ASTM D638</td>
<td>%</td>
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<tr>
<td>flexural modulus</td>
<td>ASTM D790</td>
<td>MPa</td>
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<td>tear strength</td>
<td>ASTM D664</td>
<td>N/mm</td>
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<tr>
<td>fatigue resistance</td>
<td>ASTM D1502</td>
<td>mm/Kclicli</td>
</tr>
<tr>
<td>IZOD impact strength notched at 23 °C</td>
<td>ASTM D256/A</td>
<td>J/m</td>
</tr>
<tr>
<td>IZOD impact strength notched at -10 °C</td>
<td>ASTM D256/A</td>
<td>J/m</td>
</tr>
<tr>
<td>IZOD impact strength notched at -20 °C</td>
<td>ASTM D256/A</td>
<td>J/m</td>
</tr>
<tr>
<td>IZOD impact strength notched at -40 °C</td>
<td>ASTM D256/A</td>
<td>J/m</td>
</tr>
<tr>
<td>IZOD impact strength notched at -50 °C</td>
<td>ASTM D256/A</td>
<td>J/m</td>
</tr>
<tr>
<td>abrasion resistance (taber h18 - 1kg)</td>
<td>ASTM D1044</td>
<td>mg/Kclicli</td>
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<tr>
<td>Thermal properties</td>
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<tr>
<td>VICAT method A (120 °C/h at 10 N)</td>
<td>ASTM D1525</td>
<td>°C</td>
</tr>
<tr>
<td>H.D.T. Method B (0,45 MPa)</td>
<td>ASTM D648</td>
<td>°C</td>
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<td>Flammability properties</td>
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<td>flame rating 1,6 mm</td>
<td>UL 94</td>
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<tr>
<td>Electrical properties</td>
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<td>volume resistivity at 23 °C</td>
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<td>Ohm.cm</td>
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<td>Ohm.cm</td>
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<td>kV/mm</td>
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<tr>
<td>dissipation factor tan δ - 1 KHz</td>
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<td>-</td>
</tr>
<tr>
<td>dissipation factor tan δ - 100 KHz</td>
<td>ASTM D1502</td>
<td>-</td>
</tr>
</tbody>
</table>

All the figures reported in this publication are the result of tests and analyses carried out in our laboratories and are believed to be accurate and reliable. Tests are performed at 23 °C unless otherwise specified. Data may be subject to revision and are provided for general guidance only. The user is responsible for carrying out all the tests necessary to verify the suitability of the material for the specific application. SoF.ter makes no warranties and assumes no liability in connection with any use of this information.
Aesthetics meets technology
Dolphin is an innovative technology that enables the production of soft-touch dashboard and interior panels in a single phase.

The production of the three-layer structure takes place in a single moulding cell:
1. injection of the rigid structural carrier in Reblend® (PC/ABS alloy)
2. injection and foaming of the intermediate structural layer (MuCell® foamed Pibiflex®)
3. injection of upper soft-touch layer in Pibiflex®

Benefits
• leaner logistics and production cycle
• cost reduction

Application
Dashboard, door panels, armrest, consoles and soft-touch parts of automotive interiors.

Pibiflex® 3567 S2
The soft-touch skin is made with Pibiflex® 3567 S2 a grade specifically developed for this application which guarantees:
• very high UV and scratch resistance combined with excellent haptic properties
• preservation of properties (haptic and softness) even at very low temperature
• excellent aesthetic properties in various colours
• high chemical affinity with the gas used in the MuCell® foaming process
• high chemical affinity with the structural carrier made in PC/ABS

The high chemical affinity of the materials used ensures a perfect adhesion between rigid and soft part, as confirmed by specific tests.

Pibiflex® 3567 S2 meets the requirements of the following automotive norms:
• material properties DBL 5562.50
• climate resistance test (alternating climates) DBL 5471
• constant climate (dry hot) DBL 5471
• constant climate (wet hot) DBL 5471
• colour change after climate storage DBL 5471
• solar simulation DBL 5471
• abrasion resistance DIN EN ISO 105-X12
• scratch resistance DBL 5471
• emission analysis VOC DBL 8585 – VDA 278
• emission analysis FOG DBL 8585 – VDA 278
• odour test DBL 5471 – VDA 270
• fogging test DBL 5471 – DIN 75 201

Reblend
The rigid carrier is made with Reblend (PC/ABS alloy). The specific grade developed for this application has good flowability and high dimensional stability.