

| Duroplast   | Technopolymer  | Elastomers   |
|---|--|--|
| <p>This group includes plastic materials which solidify by chemical reactions. They closely crosslink into spatial lattice patterns of macromolecules which gives Duroplast material high mechanical strength and surface hardness. Their elasticity is low, however.</p> <p>The curing process is irreversible. Unlike Technopolymer, Duroplast cannot be melted because it is rigid up to degradation temperature. Phenolic resins are among the most commonly used Duroplast materials.</p> <p>In general, the molecular crosslinking of Duroplast creates good chemical stability.</p> <p>The coloring options of components made of Duroplast are limited.</p> | <p>With increasing temperature and once the softening point is exceeded, this group of Technopolymer melts, can be heat distorted and solidifies again after cooling. This process can be repeated any number of times. Unlike Duroplast, there is no chemical reaction during processing.</p> <p>Technopolymer materials can be subdivided into amorphous and partially crystalline plastics. The disordered structure of amorphous materials allows the production of transparent components by injection moulding right through to crystal-clear parts. Partially crystalline Technopolymer have a structure resulting in enhanced mechanical properties and temperatures of use.</p> <p>The wide variety of different Technopolymer and their options of modifications allow the production of “tailor-made” construction materials with respect to mechanical properties, chemical resistance, temperature resistance and different colors.</p> | <p>A feature of elastomers is that they can be deformed under minimal tensile or compressive stress. When the force effect decreases or no longer exists, the parts automatically return to their original, undeformed shape. Thus, they demonstrate the typical behavior of rubber.</p> <p>In chemical terms, these are macromolecules which are interconnected by only a few chemical crosslinking bridges.</p> <p>With thermoplastic elastomers, the cross-links soften under the influence of heat, thus demonstrating a thermoplastic behavior.</p> <p>By way of modification, elastomers can be made in varying degrees of hardness. They can be dyed easily by adding color pigments.</p> <p>Material characteristics of Elastomers<br/>→ Page 2162 ff.</p> |

Information

The above details are general values without claiming to be complete. Material properties may vary widely through additives, modifications and environmental influence factors.

The details are unsuitable as the sole basis for constructions. The data may not be used in place of tests to determine the suitability of a material for a specific purpose.

No warranty or liability will be accepted for the above specifications and details.

|   | Duroplast   | Technopolymer |                                 |                            |                       |
|---|---|---------------|---------------------------------|----------------------------|-----------------------|
| Symbol                                  | PF 31   | PA 6          | PA 6 GF30                       | PA-HP                      | PA-T                  |
| Description                             | Phenolic resin  | Polyamide     | Polyamide with 30 % glass fibre | High performance Polyamide | Polyamide transparent |
| <b>Yield stress</b> in MPa              | –   | 80 / 50       | – / –                           | – / –                      | 90                    |
| <b>Tensile strength</b> in MPa          | 60  | – / –         | 180 / 110                       | 240 / 165                  | –                     |
| <b>Tension-E-Module</b> in MPa          | 9000  | 3000 / 1500   | 9000 / 6500                     | 21000 / 15500              | 2800                  |
| <b>Ball indentation hardness</b> in MPa | 250   | 150 / 70      | 220 / 150                       | – / –                      | 140                   |
| <b>Temperature resistance:</b>          |   |               |                                 |                            |                       |
| • max. short-term                       | 180 °C  | 180 °C        | 200 °C                          | 215 °C                     | 180 °C                |
| • max. long-term                        | 140 °C  | 80 °C         | 120 °C                          | 150 °C                     | 90 °C                 |
| • min. application temp.                | –20 °C  | –40 °C        | –40 °C                          | –40 °C                     | –30 °C                |
| <b>Resistance to: *</b>                 |   |               |                                 |                            |                       |
| • Oil, greases                          | +   | +             | +                               | +                          | +                     |
| • Solvents: Tri                         | o   | +             | +                               | +                          | +                     |
| Per                                     | o   | +             | +                               | +                          | +                     |
| • Acid: weak                            | +   | o             | o                               | o                          | –                     |
| strong                                  | –   | –             | –                               | –                          | –                     |
| • Alkalines: weak                       | +   | +             | o                               | o                          | +                     |
| strong                                  | –   | o             | –                               | –                          | +                     |
| • Petrol                                | +   | +             | +                               | +                          | +                     |
| • Alcohol                               | +   | +             | +                               | o                          | –                     |
| • hot water                             | o   | o             | o                               | o                          | –                     |
| • UV light / weather exposure           | –   | o             | o                               | o                          | o                     |
| <b>Fire behaviour (UL 94)</b>           | V-0   | HB            | HB                              | HB                         | V-2                   |
| <b>General</b>                          | <p>This Duroplast material on phenolic resin basis with organic filler has the following properties:</p> <p>High stiffness and hardness, low tendency to creep, high heat forming resistance, low thermal linear expansion, high surface slip resilience, low flammability.</p> <p>Phenolic resins are available only in dark colour shades. They are not suitable for use with food.</p> <p>Typical applications include thermally insulating operating elements.</p> <p>The material group Polyamide 6 (partially crystalline) offers universal materials for mechanical function components in mechanical engineering.</p> <p>Polyamides are:</p> <ul style="list-style-type: none"> <li>- cold-temperature resistant</li> <li>- impact stress resilient and impact resistant</li> <li>- abrasion resistant</li> </ul> <p>Reinforced Polyamides, such as PA 6 GF30 or PA-HP, combine high stiffness and rigidity with extreme impact strength, properties which make them highly robust under mechanical stress.</p> <p>Polyamide PA-T (amorphous) is translucent with a slightly yellow transparency. Typically used for oil level sight glass.</p> |               |                                 |                            |                       |

\* + resistant, o conditionally resistant, – non-resistant



|  | Technopolymer   |                            |   |                             |
|--|---|----------------------------|---|-----------------------------|
| Symbol                                     | PE-HD   | PE-LD                      | POM-C   | POM-H                       |
| Description                                | Polyethylene<br>high density  | Polyethylen<br>low density | Polyacetal<br>(Copolymer)   | Polyacetal<br>(Homopolymer) |
| <b>Yield stress</b> in MPa                 | 30  | 10                         | 65  | 72                          |
| <b>Tensile strength</b> in MPa             | 25 ... 30   | 8 ... 10                   | –   | 70                          |
| <b>Tension-E-Module</b> in MPa             | 1450  | 200                        | 2700  | 3100                        |
| <b>Ball indentation hardness</b><br>in MPa | 57 (Standard H132/30)   | 15 (Standard H49/30)       | 145   | 174                         |
| <b>Temperature resistance:</b>             |   |                            |   |                             |
| • max. short-term                          | 100 °C  | 100 °C                     | 140 °C  | 140 °C                      |
| • max. long-term                           | 90 °C   | 70 °C                      | 90 °C   | 80 °C                       |
| • min. application temp.                   | -80 °C  | -80 °C                     | -50 °C  | -50 °C                      |
| <b>Resistance to: *</b>                    |   |                            |   |                             |
| • Oil, greases                             | +   | +                          | +   | +                           |
| • Solvents: Tri                            | +   | –                          | –   | –                           |
| Per  | +   | –                          | +   | +                           |
| • Acid: weak                               | +   | +                          | +   | +                           |
| strong                                     | +   | –                          | –   | –                           |
| • Alkalines: weak                          | +   | +                          | +   | +                           |
| strong                                     | +   | +                          | +   | +                           |
| • Petrol                                   | +   | +                          | +   | +                           |
| • Alcohol                                  | +   | +                          | +   | +                           |
| • hot water                                | +   | o                          | +   | o                           |
| • UV light / weather exposure              | o   | o                          | o   | o                           |
| <b>Fire behaviour (UL 94)</b>              | HB  | HB                         | HB  | HB                          |
| <b>General</b>                             | <p>Polyethylene is a very versatile thermoplastic polymer. It is colorless in its basic form.</p> <p>Polyethylene is physiologically safe, practically odorless, and tasteless. These properties make it ideal for the food and packaging industry.</p> <p>Polyethylene is shockproof and impact-resistant. It has good sliding properties and absorbs virtually no moisture.</p> |                            |   |                             |
|  |   |                            | <p>Polyacetals (partially crystalline) are universal materials used in function components for precision engineering and in apparatus construction.</p> <p>They feature excellent properties:</p> <ul style="list-style-type: none"> <li>- low friction resistance</li> <li>- good abrasion resistance</li> <li>- good resilience</li> <li>- good fatigue resistance</li> <li>- good chemical resistance</li> </ul> <p>Typical applications include snap-fit elements (form-locking connecting elements).</p> |                             |

\* + resistant, o conditionally resistant, – non-resistant

|   | Technopolymer   |   |  |  |
|---|---|---|--|--|
| Symbol                                  | PC  | PP GF20   | PSU  | PTFE   |
| Description                             | Polycarbonate   | Polypropylene with 20% glass fibre  | Polysulfon   | Polytetrafluorethylene   |
| <b>Yield stress</b> in MPa              | 63  | 33  | 70   | 4  |
| <b>Tensile strength</b> in MPa          | –   | –   | 70   | 20   |
| <b>Tension-E-Module</b> in MPa          | 2400  | 2900  | 2400   | 600  |
| <b>Ball indentation hardness</b> in MPa | 110   | 80  | 147 (H358/30)  | 26   |
| <b>Temperature resistance:</b>          |   |   |  |  |
| • max. short-term                       | 140 °C  | 140 °C  | 180 °C   | 300 °C   |
| • max. long-term                        | 125 °C  | 100 °C  | 160 °C   | 260 °C   |
| • min. application temp.                | –100 °C   | 0 °C  | –100 °C  | –200 °C  |
| <b>Resistance to: *</b>                 |   |   |  |  |
| • Oil, greases                          | o   | +   | +  | +  |
| • Solvents: Tri                         | –   | o   | o  | +  |
| Per                                     | –   | o   | o  | +  |
| • Acid: weak                            | +   | +   | o  | +  |
| strong                                  | –   | +   | o  | +  |
| • Alkalines: weak                       | –   | +   | +  | +  |
| strong                                  | –   | +   | +  | +  |
| • Petrol                                | –   | +   | –  | +  |
| • Alcohol                               | o   | +   | +  | +  |
| • hot water                             | –   | +   | +  | +  |
| • UV light / weather exposure           | o   | o   | –  | +  |
| <b>Fire behaviour (UL 94)</b>           | V-2   | –   | V-0  | V-0  |
| <b>General</b>                          | <p>Polycarbonates (amorphous) are translucent plastic materials with following properties:</p> <p>High strength, in particular high impact resistance, good optical properties, self-extinguishing.</p> <p>but: sensitive to chemicals and stress cracking, not suitable for high dynamic stress loads, notch sensitive at edges and corners.</p> | <p>Propylenes (partially crystalline) are universal standard plastic materials with balanced property levels:</p> <p>Average strength, stiffness, impact resistance, low density, excellent chemical resistance but very bad cold temperature properties.</p> <p>Embedded glass fibre, e.g. PP GF20, enhances stiffness and strength.</p> <p>Typical applications for propylenes are armatures.</p> | <p>The primary feature of Polysulfon is its very high heat resistance and good resistance to chemicals.</p> <p>Typical fields of application are electrical engineering, electronics, mechanical engineering, and medical technology where high heat resistance is needed, while also allowing transparency.</p> | <p>Polytetrafluor-ethylene is characterized in particular by very low friction coefficients and very high chemical and thermal resistance.</p> <p>PTFE is a preferred material for friction bearings, guides, seals, anti-stick coatings and insulators.</p> |

\* + resistant, o conditionally resistant, – non-resistant



|  | Elastomers  |   |   |
|--|---|---|---|
| Symbol                                   | NR  | CR  | FKM, FPM  |
| Trade name                               |   | Neoprene®   | Viton®  |
| Chemical description                     | Natural rubber  | Chloroprene rubber  | Fluorine rubber<br>Fluorine elastomer   |
| Hardness (Shore A)                       | 30 ... 90   | 30 ... 90   | 65 ... 90   |
| Temperature resistance                   |   |   |   |
| • short-term                             | –60° ... +130 °C  | –30° ... +150 °C  | –   |
| • long-term                              | –40° ... + 80 °C  | –25° ... +100 °C  | –5° ... +200 °C   |
| Tensile strength<br>in N/mm <sup>2</sup> | –   | 25  | 17  |
| Wear resistance /<br>Abrasion resistance | good  | good  | very good   |
| Resistance to: *                         |   |   |   |
| • Oil, greases                           | -   | +   | +   |
| • Solvents                               | o   | o   | +   |
| • Acid                                   | o   | +   | +   |
| • Alkalines                              | o   | +   | +   |
| • Petrol                                 | -   | -   | +   |
| • UV light / weather exposure            | -   | +   | +   |
| General                                  | NR is a material with very good physical properties and excellent mechanical strength. It is used e.g. for spring elements. | CR is one of the most frequently used synthetic rubbers with a wide range of applications for parts which require exceptional resistance to ageing. | FKM combines the excellent properties of EPDM and HNBR while offering outstanding chemical and thermal resistance.<br><br>Viton® is a registered trademark of DuPont performance rubbers. |

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Information of hardness data for Elastomers

Hardness data of vulcanized or thermoplastic elastomers are measured using the Shore scale. This value is determined by measuring the indentation depth of a spring-loaded indenter into the material. A low indentation depth is a high Shore value, a high indentation depth a low Shore value.

Different indenter shapes are used depending on the materials being examined. The elastomer materials used in Ganter products are measured according to “Shore A” with a blunt indenter with a tip angle of 35°.

|  | Elastomers   |   |  |
|--|--|---|--|
| Symbol                                   | NBR  | H-NBR   | EPDM   |
| Trade name                               | Perbunan®  | -   | -  |
| Chemical description                     | Acrylonitrile butadiene rubber   | Hydrogenated acrylonitrile butadiene rubber   | Ethylene propylene diene rubber  |
| Hardness (Shore A)                       | 25 ... 95  | 85  | 70 ... 85  |
| Temperature resistance                   |  |   |  |
| • short-term                             | -40° ... +150 °C   | -   | -40° ... +150 °C   |
| • long-term                              | -30° ... +120 °C   | -25° ... +150 °C  | -40° ... +120 °C   |
| Tensile strength<br>in N/mm <sup>2</sup> | 25   | 11  | 14   |
| Wear resistance /<br>Abrasion resistance | good   | good  | very good  |
| Resistance to: *                         |  |   |  |
| • Oil, greases                           | +  | +   | -  |
| • Solvents                               | o  | +   | o  |
| • Acid                                   | o  | o   | +  |
| • Alkalines                              | +  | +   | +  |
| • Petrol                                 | +  | +   | -  |
| • UV light / weather exposure            | -  | +   | +  |
| General                                  | <p>NBR is a synthetic special rubber for rubber parts with high requirements for resistance to swelling when in contact with oils and fuels.</p> <p>Standard material for o-rings.</p> | <p>H-NBR is obtained through full or partial hydrogenation of NBR. This significantly improves the resistance to heat, ozone and aging.</p> <p>The resulting materials are characterized by high mechanical strength and high abrasion resistance. Media resistance is comparable to NBR.</p> | <p>EPDM is a synthetic all-purpose rubber characterized by its high steam and hot water resistance.</p> <p>Also worth mentioning are its outstanding resistance to aging, weathering and environmental influences as well as acids and alkalines.</p> <p>The material is used in sealings and tubings.</p> |

\* + resistant, o conditionally resistant, - non-resistant



|  | Elastomers  |   |  |
|--|---|---|--|
| Symbol                                   | MVQ, VMQ  | PUR   | TPE  |
| Trade name                               | Elastosil®  | Bayflex®  | Santoprene®  |
| Chemical description                     | Silicone rubber   | Polyurethane  | Thermoplastic elastomer  |
| Hardness (Shore A)                       | 3 ... 90  | 65 ... 90   | 55 ... 87  |
| Temperature resistance                   |   |   |  |
| • short-term                             | –50° ... +250 °C **   | –40° ... +130 °C  | –40° ... +150 °C   |
| • long-term                              | –30° ... +200 °C **   | –25° ... +100 °C  | –30° ... +125 °C   |
| Tensile strength<br>in N/mm <sup>2</sup> | 12  | 20  | 8,5  |
| Wear resistance /<br>Abrasion resistance | good  | excellent   | good   |
| Resistance to: *                         |   |   |  |
| • Oil, greases                           | o   | +   | +  |
| • Solvents                               | o   | o   | +  |
| • Acid                                   | o   | -   | +  |
| • Alkalines                              | o   | -   | +  |
| • Petrol                                 | -   | +   | +  |
| • UV light / weather exposure            | +   | +   | +  |
| General                                  | <p>MVQ offers very good mechanical properties over a very wide temperature range with satisfactory oil resistance.</p> <p>In comparison with other elastomers, MVQ has exceptionally high purity and is therefore used in particular in food and pharmaceutical applications.</p> | <p>PUR is known for exceptionally good mechanical characteristics with very good resistance to atmospheric and environmental influences.</p> <p>In addition, the extreme resistance to tearing and to wear, should also be mentioned.</p> | <p>TPE is a thermoplastic rubber, the performance characteristics of which are comparable to those of many customary vulcanised special rubbers.</p> <p>TPE is a multi-purpose material with outstanding dynamic fatigue strength and excellent resistance to ozone and atmospheric influences (environmental influences).</p> |

\* + resistant, o conditionally resistant, – non-resistant \*\* Do not expose to hot water or steam

|  | Elastomers  |
|--|---|
| Symbol   | TPU   |
| Trade name   | Desmopan® / Elastollan®   |
| Chemical description   | Thermoplastic polyurethane  |
| Hardness (Shore A)   | 55 ... 85   |
| Temperature resistance <ul style="list-style-type: none"><li>• short-term</li><li>• long-term</li></ul>  | <div>-50° ... +120 °C</div> <div>-30° ... + 90 °C</div>   |
| Tensile strength<br>in N/mm²   | 50  |
| Wear resistance / Abrasion resistance  | very good   |
| Resistance to: * <ul style="list-style-type: none"><li>• Oil, greases</li><li>• Solvents</li><li>• Acid</li><li>• Alkalines</li><li>• Petrol</li><li>• UV light / weather exposure</li></ul> | <div>+</div> <div>-</div> <div>-</div> <div>o</div> <div>o</div> <div>+</div>   |
| General  | <p>TPU has generally good physical properties, making it ideal for demanding applications in virtually all industrial areas.</p> <p>In addition to the very high wear and abrasion resistance, the excellent tear growth resistance and cold flexibility of the material at low temperatures should also be mentioned.</p> <p>TPU can be made for a large hardness range and from an ergonomic point of view it can also be used advantageously due to its good surface feel (Softline!).</p> |

\* + resistant, o conditionally resistant, - non-resistant

