Material Characteristics of Plastics and Elastomers

Duroplast	Technopolymer	Elastomer
This group includes plastics that solidify by chemical reaction. They closely crosslink into spatial lattice patterns of macromolecules, which gives duroplast materials a high mechanical strength and surface hardness. However, their elasticity is rather low. The curing process is irreversible. Unlike technopolymer plastics, duroplasts cannot be melted because they are rigid up to the degradation temperature. Phenolic resins are among the most commonly used duroplast materials. In general, the molecular crosslinking of duroplasts results in good resistance to chemical influences. The coloring options of components made of duroplast are limited.	When the temperature is increased and once the softening point has been exceeded, technopolymer plastics melt, can be thermoformed and solidify again after cooling. This process can be repeated any number of times. Unlike with duroplasts, there is no chemical reaction during processing. Technopolymer materials can be divided into amorphous and semi-crystalline plastics. The disordered microstructure of amorphous materials allows the production of transparent components by injection moulding right through to crystal-clear components. Semi-crystalline technopolymer has a microstructure resulting in enhanced mechanical properties and operating temperatures. The wide variety of different technopolymer plastics and their modification options allow the production of “tailor-made” construction materials with respect to mechanical properties, chemical resistance, temperature resistance and different colors.	A feature of elastomers is that they can be deformed even under low tensile or compressive stress. When the force decreases or no longer exists, the parts automatically return to their original, undeformed shape. Thus, they demonstrate the typical behavior of rubber. In chemical terms, elastomers are macromolecules that are irreversibly interconnected by only a few chemical crosslinking bridges. With thermoplastic elastomers, these cross-linking bridges soften under the influence of heat, thus demonstrating a thermoplastic behavior. By way of modification, elastomers can be produced in varying degrees of hardness. They can be dyed easily by adding color pigments.

Information

The details given are general guide values only or apply to typical representatives of the respective material group without claiming to be complete. The material characteristics may vary widely through additives, modifications and environmental influences.

The details are unsuitable as the sole basis for designs. 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 is assumed for the specifications and details given.

	Duroplast	Technopolymer			
Code	**PF 31**	**PA 6**	**PA 6 GF30**	**PA-HP**	**PA-T**
Description	Phenolic resin	Polyamide	Polyamide with 30% glass fiber	High performance polyamide	Transparent polyamide
Yield stress in MPa	-	80 / 50	- / -	- / -	90
Tensile strength in MPa	60	- / -	180 / 110	240 / 165	-
Tensile e-modulus in MPa	9000	3000 / 1500	9000 / 6500	21000 / 15500	2800
Ball impression hardness in MPa	250	150 / 70	220 / 150	- / -	140
Temperature resistance: • Max. short-term • Max. long-term • Min. application temperature	 +356 °F (+180 °C) +284 °F (+140 °C) -4 °F (-20 °C)	 +356 °F (+180 °C) +176 °F (+80 °C) -40 °F (-40 °C)	 +392 °F (+200 °C) +248 °F (+120 °C) -40 °F (-40 °C)	 +419 °F (+215 °C) +302 °F (+150 °C) -40 °F (-40 °C)	 +356 °F (+180 °C) +194 °F (+90 °C) -130 °F (-30 °C)
Resistance to:*					
• Oils, greases	+	+	+	+	+
• Solvents: Tri	o	+	+	+	+
Per	o	+	+	+	+
• Acids: 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
Fire behaviour (UL 94)	V-0	HB	HB	HB	V-2
General information	This duroplast material on phenolic resin basis with organic filler has the following properties: High stiffness and hardness, low tendency to creep, high heat forming resistance, low thermal linear expansion, high surface slip resilience, low flammability. Phenolic resins are only available in dark color shades. They are not suitable for use with food. Typical applications include thermally insulating operating elements.	The material group “Polyamide 6“ (semi-crystalline) offers universal materials for mechanical function components in mechanical engineering. Polyamides are: - cold-temperature resistant - impact stress resilient and impact resistant - abrasion resistant 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. Polyamide PA-T (amorphous) is translucent with a slightly yellow transparency, typically used for fluid sight glass.			

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

	Technopolymer			
Code	**PE-HD**	**PE-LD**	**POM-C**	**POM-H**
Description	Polyethylene High density	Polyethylene Low density	Polyacetal (Copolymer)	Polyacetal (Homopolymer)
Yield stress in MPa	30	10	65	72
Tensile strength in MPa	25-30	8-10	-	70
Tensile e-modulus in MPa	1450	200	2700	3100
Ball impression hardness in MPa	57 (Standard H132/30)	15 (Standard H49/30)	145	174
Temperature resistance: • Max. short-term • Max. long-term • Min. application temperature	 +212 °F (+100 °C) +194 °F (+90 °C) -112 °F (-80 °C)	 +212 °F (+100 °C) +158 °F (+70 °C) -112 °F (-80 °C)	 +284 °F (+140 °C) +194 °F (+90 °C) -58 °F (-50 °C)	 284 °F (+140 °C) +176 °F (+80 °C) -58 °F (-50 °C)
Resistance to:*				
• Oils, greases	+	+	+	+
• Solvents: Tri	+	-	-	-
Per	+	-	+	+
• Acids: Weak	+	+	+	+
Strong	+	-	-	-
• Alkalines: Weak	+	+	+	+
Strong	+	+	+	+
• Petrol	+	+	+	+
• Alcohol	+	+	+	+
• Hot water	+	o	+	o
• UV light / weather exposure	o	o	o	o
Fire behaviour (UL 94)	HB	HB	HB	HB
General information	Polyethylene is a very versatile technopolymer plastic. It is colorless in its basic form. Polyethylene is physiologically safe, practically odorless, and tasteless. These properties make it ideal for the food and packaging industry. Polyethylene is shock-proof and impact-resistant, has good sliding properties and absorbs virtually no moisture.		Polyacetals (semi-crystalline) are universal materials used in function components for precision engineering and in apparatus construction. They feature excellent properties: - Low friction resistance - Good abrasion resistance - Good resilience - Good fatigue resistance - Good chemical resistance Typical applications include snap-fit elements (form-locking connections).	

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	Technopolymer			
Code	**PC**	**PP GF20**	**PSU**	**PTFE**
Description	Polycarbonate	Polypropylene with 20% glass fiber	Polysulfone	Polytetrafluorethylene
Yield stress in MPa	63	33	70	4
Tensile strength in MPa	-	-	70	20
Tensile e-modulus in MPa	2400	2900	2400	600
Ball impression hardness in MPa	110	80	147 (H358/30)	26
Temperature resistance: • Max. short-term • Max. long-term • Min. application temperature	 +284 °F (+140 °C) +257 °F (+125 °C) -148 °F (-100 °C)	 +284 °F (+140 °C) +212 °F (+100 °C) +32 °F (0 °C)	 +356 °F (+180 °C) +320 °F (+160 °C) -148 °F (-100 °C)	 +572 °F (+300 °C) +500 °F (+260 °C) -328 °F (-200 °C)
Resistance to:*				
• Oils, greases	o	+	+	+
• Solvents: Tri	-	o	o	+
Per	-	o	o	+
• Acids: Weak	+	+	o	+
Strong	-	+	o	+
• Alkalines: Weak	-	+	+	+
Strong	-	+	+	+
• Petrol	-	+	-	+
• Alcohol	o	+	+	+
• Hot water	-	+	+	+
• UV light / weather exposure	o	o	-	+
Fire behaviour (UL 94)	V-2	-	V-0	V-0
General information	Polycarbonates (amorphous) are translucent plastic materials with the following properties: High strength, in particular high impact resistance, good optical properties, self-extinguishing. But: Sensitive to chemicals and stress cracking, not suitable for high dynamic stress loads, notch sensitive at edges and corners.	Propylenes (semi-crystalline) are universal standard plastic materials with balanced property levels: Average strength, stiffness, impact resistance, low density, excellent chemical resistance but very bad cold-temperature properties. Additionally embedded glass fiber, e.g. PP GF20, enhances stiffness and strength. Typical applications for propylenes are armatures.	The primary feature of polysulfone is its very high heat resistance and good resistance to chemicals. Typical application areas are electrical engineering, electronics, mechanical engineering, and medical technology where high heat resistance is needed, while also allowing transparency.	Polytetrafluorethylene is characterized in particular by a very low friction coefficient and high chemical and thermal resistance. PTFE is a preferred material for friction bearings, guides, seals, anti-stick coatings and insulators.

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	Elastomer		
Code	**NR**	**CR**	**FKM, FPM**
Trade name		Neoprene®	Viton®
Chemical description	Natural rubber	Chloroprene rubber	Fluorine caoutchouc Fluorine rubber
Hardness (Shore A)	30-90	30-90	65-90
Temperature resistance • Short-term • Long-term	 -76° to +266 °F (-60° to +130 °C) -40° to +176 °F (-40° to + 80 °C)	 -22° to +302 °F (-30° to +150 °C) -13° to +212 °F (-25° to +100 °C)	 - +23° to +446 °F (-5° to +392 °C)
Tensile strength in N/mm²	-	25	17
Wear resistance / Abrasion resistance	Good	Good	Very good
Resistance to:* • Oils, greases • Solvents • Acids • Alkalines • Petrol • UV light / weather exposure	 - o o o - -	 + o + + - +	 + + + + + +
General information	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 aging.	FKM combines the excellent properties of EPDM and HNBR while offering outstanding chemical and thermal resistance. Viton® is a registered trademark of DuPont Performance Elastomers.

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Information on hardness data for elastomers

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

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

	Elastomer		
Code	**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 • Long-term	 -40° to +302 °F (-40° to +150 °C) -22° to +248 °F (-30° to +120 °C)	 - -13° to +302 °F (-25° to +150 °C)	 -40° to +302 °F (-40° to +150 °C) -40° to +248 °F (-40° to +120 °C)
Tensile strength in N/mm²	25	11	14
Wear resistance / Abrasion resistance	Good	Good	Very good
Resistance to:* • Oils, greases • Solvents • Acids • Alkalines • Petrol • UV light / weather exposure	 + o o + + -	 + + o + + +	 - o + + - +
General information	NBR is a synthetic special rubber for rubber parts with high requirements for resistance to swelling when in contact with oils and fuels. Standard material for o-rings.	H-NBR is obtained through full or partial hydrogenation of NBR. This significantly improves the resistance to heat, ozone and aging. The resulting materials are characterized by high mechanical strength and high abrasion resistance. Media resistance is comparable to NBR.	EPDM is a synthetic all-purpose rubber characterized by its high steam and hot water resistance. Also worth mentioning are its outstanding resistance to aging, weathering and environmental influences as well as acids and alkalines. The material is used in seals and tubes.

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	Elastomer		
Code	**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 • Long-term	 -58° to +482 °F (-50° to +250 °C) ** -22° to +392 °F (-30° to +200 °C) **	 -40° to +266 °F (-40° to +130 °C) -13° to +212 °F (-25° to +100 °C)	 -40° to +302 °F (-40° to +150 °C) -22° to +257 °F (-30° to +125 °C)
Tensile strength in N/mm²	12	20	8.5
Wear resistance / Abrasion resistance	Good	Excellent	Good
Resistance to:* • Oils, greases • Solvents • Acids • Alkalines • Petrol • UV light / weather exposure	 o o o o - +	 + o - - + +	 + + + + + +
General information	MVQ offers very good mechanical properties over a very wide temperature range with satisfactory oil resistance. In comparison with other elastomers, MVQ has exceptionally high purity and is therefore used in particular in food and pharmaceutical applications.	PUR is known for exceptionally good mechanical characteristics. In addition, the extreme resistance to tearing and to wear should also be mentioned.	TPE is a thermoplastic elastomer, the performance characteristics of which are comparable to those of many customary vulcanized special rubbers. TPE is a multi-purpose material with outstanding dynamic fatigue strength.

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** Do not expose to hot water or steam

	Elastomer
Code	**TPU**
Trade name	Desmopan® / Elastollan®
Chemical description	Thermoplastic polyurethane
Hardness (Shore A)	55-85
Temperature resistance • Short-term • Long-term	 -58° to +248 °F (-50° to +120 °C) -22° to +194 °F (-30° to + 90 °C)
Tensile strength in N/mm²	50
Wear resistance / Abrasion resistance	Very good
Resistance to:* • Oils, greases • Solvents • Acids • Alkalines • Petrol • UV light / weather exposure	 + - - o o +
General information	TPU has generally good physical properties, making it ideal for demanding applications in virtually any industrial area. 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. TPU can be produced 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).

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