

Technical Data Sheet

Ultrafuse® PPSU

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General information

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Components

BASF Polyphenylsulfone (PPSU) based filament for Fused Filament Fabrication.

Product Description

Outstanding thermal stability, good chemical resistance and high strength are the key features of Ultrafuse® PPSU. Parts produced by fused filament fabrication show often mechanical limitations in z-direction - the good layer adhesion of Ultrafuse® PPSU leads to balanced flexural strength properties between z- and x-direction. Ultrafuse® PPSU can be used for functional applications which require a high mechanical strength as well as a high heat distortion temperature – properties, where existing 3D printing materials often show limitations. Further applications are support structures for PEI based high temperature materials, such as Ultem®9085.

Delivery form and warehousing

Ultrafuse® PPSU filament should be stored at 15 - 25°C in its originally sealed package in a clean and dry environment. If the recommended storage conditions are observed the products will have a minimum shelf life of 12 months.

Product safety

Recommended: Process materials in a well-ventilated room, or use professional extraction systems. For further and more detailed information please consult the corresponding material safety data sheets.

Disclaimer

The data contained in this publication are based on our current knowledge and experience. In view of the many factors that may affect processing and application of our product, these data do not relieve processors from carrying out their own investigations and tests; neither do these data imply any guarantee of certain properties, nor the suitability of the product for a specific purpose. Any descriptions, drawings, photographs, data, proportions, weights etc. given herein may change without prior information and do not constitute the agreed contractual quality of the product. It is the responsibility of the recipient of our products to ensure that any proprietary rights and existing laws and legislation are observed. Values in this document are average values, measured and calculated according to the instructions in the listed standards. The used specimens are produced with the Fused Filament Fabrication method. Measured values can vary depending on used print orientation and print parameters.

Please contact us for further product information, like for example REACH, RoHS, FCS.

Filament Properties

Filament Diameter	1.75 mm
Diameter Tolerance	±0.050 mm
Roundness	0 - 0.050 mm
Available Spool size	750 g
Available colors	Natural yellow/brown

Spool Properties

Available Spool size	750 g	2.5 kg			
Outer diameter	200 mm	300 mm			
Inner diameter	50.5 mm	51.5 mm			
Width	55 mm	103 mm			

Recommended 3D-Print processing parameters¹

Used for test specimens

Printer	FFF high temperature printer	GEWO HTP 260
Nozzle Temperature	390 – 410 °C / 734 – 770 °F	410 °C / 770 °F
Build Chamber Temperature	170 – 210 °C / 338 – 410 °F	190 °C / 374 °F
Bed Temperature	200 – 220 °C / 392 – 428 °F	220 °C / 428 °F
Bed Material	Glass (Vision Miner Nano Polymer Adhesive can increase bed adhesion)	Glass
Nozzle Diameter	≥ 0.4 mm	0.4 mm
Print Speed	25 – 100 mm/s	25 mm/s

Please check your standard and/or high speed print profile availability for an easy start at www.forward-am.com.

¹The recommended processing parameters apply for applications, where Ultrafuse® PPSU is used as a model material. In case of high temperature break away support material applications (for example for PEI based materials), nozzle, build chamber and bed temperatures can be lowered.

Further Recommendations

Drying recommendations to ensure printability and best mechanical properties

Ultrafuse® PPSU can be dried in a vacuum dryer at 125 °C / 257 °F for 8 hours and should be stored in a closed box, filled with desiccant bags, during printing. High moisture content is visible by bubbles in the material after the melting process.

Support material compatibility

Single material breakaway
Intamsys SP5080 breakaway

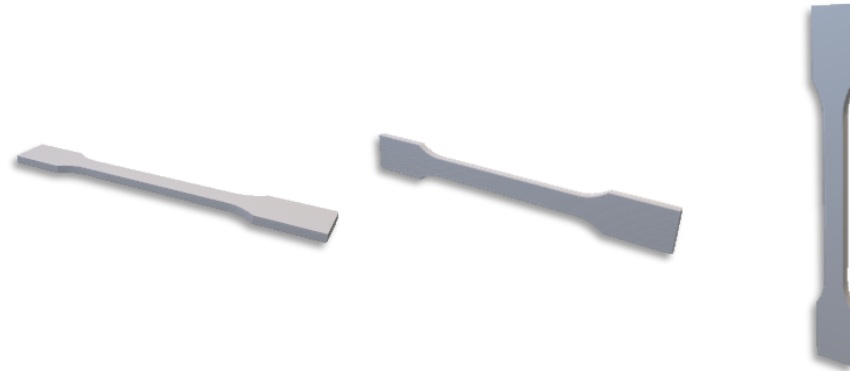
General Properties		Standard
Filament Density*	1327 kg/m ³ / 82.84 lb/ft ³	ISO 1183-1

*measured on filament

Classification and Certification		Standard
Fire protection on railway vehicles	R7 HL1-2 @ 1.5 mm and 3.0 mm thickness R23 HL1-3 @ 1.5 mm and 3.0 mm thickness R24 HL1-3 R26 HL1-3 @ 1.5 mm and 3.0 mm thickness	EN45545-2-2016
Food Contact Certification (FCC)	The used raw materials comply with food contact regulations of the European Parliament and the Food and Drug Administration	EC 1935/2004 EU 2023/1442 FDA 21 CFR

Thermal Properties		Standard
HDT A (at 1.8 MPa)	211 °C / 411.8 °F	ISO 75-2
HDT B (at 0.45 MPa)	215 °C / 419 °F	ISO 75-2
Vicat softening point at 50 N	217 °C / 422.6 °F	ISO 306
Vicat softening point at 10 N	220 °C / 428.0 °F	ISO 306
Glass Transition Temperature	222 °C / 431.6 °F	ISO 11357-2
Melt Volume-Flow Rate (MVR)	15.35 cm ³ /10 min / 0.94 in ³ /10 min (360 °C, 5 kg)	ISO 1133-1
Melt Flow Rate (MFR)	13.2 g/10 min / 0.03 lb/10 min (360 °C, 5 kg)	ISO 1133-1
Coefficient of Thermal Expansion	55 E-6/K	ISO 11359-2
Flammability F1 60 sec. vertical	Passed (thickness 1.6 and 6.35 mm)	FAR 25.853 (a)
Flammability F2 12 sec. vertical	Passed (thickness 1.6 and 6.36 mm)	FAR 25.853 (a)
HR Total Heat Release [KW*min/m ²]	Passed (thickness 1.0 and 4.0 mm)	FAR 25.853 (d)
HRRmax Maximum Heat Release Rate [KW/m ²]	Passed (thickness 1.0 mm)	FAR 25.853 (d)
Optical Smoke Density	Passed (thickness 1.0 and 4.5 mm)	FAR 25.853 (d)
Smoke Toxicity	Passed (thickness 1.5 and 4.5 mm)	AITM 3.0005
Flame class rating	V0 @ 1.5 mm and 3.0 mm thickness	UL 94
Glow wire test (GWEPT)	960 °C @ 1.5 mm and 3.0 mm thickness	IEC 60695-2-11

Mechanical Properties¹



Print direction	Standard	Injection Molded	XY Flat	XZ On its edge	ZX ⁵ Upright
Tensile strength ²	ISO 527	74 MPa / 10.7 ksi	74.5 MPa / 10.8 ksi	-	49.0 MPa / 7.1 ksi
Elongation at Break ²	ISO 527	7.8 %	7.3 %	-	2.9 %
Young's Modulus ³	ISO 527	2250 MPa / 326 ksi	2221 MPa / 322 ksi	-	2150 MPa / 312 ksi
Flexural Strength ⁴	ISO 178	-	105 MPa / 15.2 ksi	114 MPa / 16.5 ksi	88.9 MPa / 12.9 ksi
Flexural Modulus ⁴	ISO 178	-	1940 MPa / 281 ksi	1910 MPa / 277 ksi	1700 MPa / 247 ksi
Flexural Elongation at Break ⁴	ISO 178	-	No break	No break	6.8 %
Impact Strength Charpy (notched)	ISO 179-2	70 kJ/m ²	21.8 kJ/m ²	15.0 kJ/m ²	5.7 kJ/m ²
Impact Strength Charpy @-30 °C (notched)	ISO 179-2	35 kJ/m ²	-	-	-
Impact Strength Charpy (unnotched)	ISO 179-2	-	224.8 kJ/m ²	270.5 kJ/m ²	16.3 kJ/m ²
Impact Strength Charpy @-30 °C (unnotched)	ISO 179-2	-	-	-	-
Impact Strength Izod (notched)	ISO 180	55 kJ/m ²	13.7 kJ/m ²	15.8 kJ/m ²	5.3 kJ/m ²
Impact Strength Izod (unnotched)	ISO 180	-	No break	No break	21.0 kJ/m ²

Electrical Properties

Volume resistivity	IEC 62631-3-1	-	2.6E+15 [Ω cm]	-	-
Surface resistivity	IEC 62631-3-2	-	4.1E+15 [Ω]	-	-
Dielectric strength (orthogonal)	IEC 60243-1	-	18.5 [kV/mm]	-	-

¹Conditioning of the specimens: Standard climate (23°C, 50% RH 72h)

²testing speed: 5 mm/min, for injection molded specimens 50 mm/min

³testing speed: 1 mm/min

⁴testing speed: 2 mm/min

⁵measured on milled specimens

Mechanical Properties: Diagrams

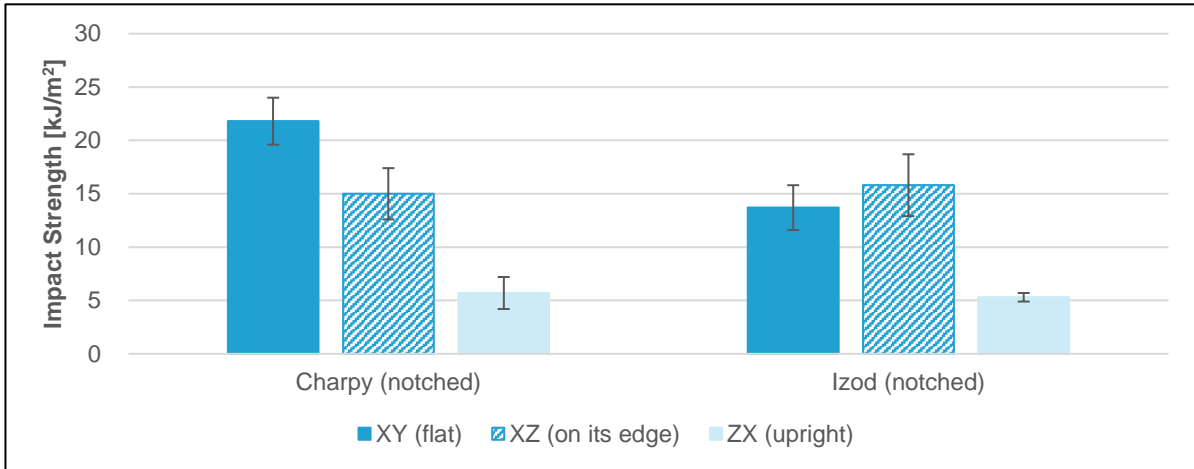


Figure 1: Impact Strength Charpy and Izod (notched) for different print orientations.

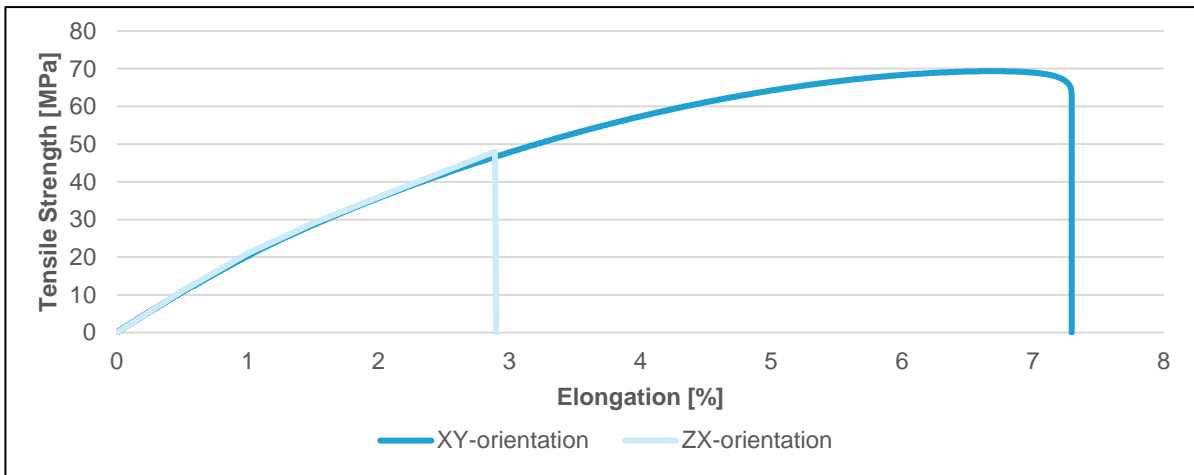


Figure 2: Typical Tensile Stress-Strain curves for the XY and ZX print orientation.

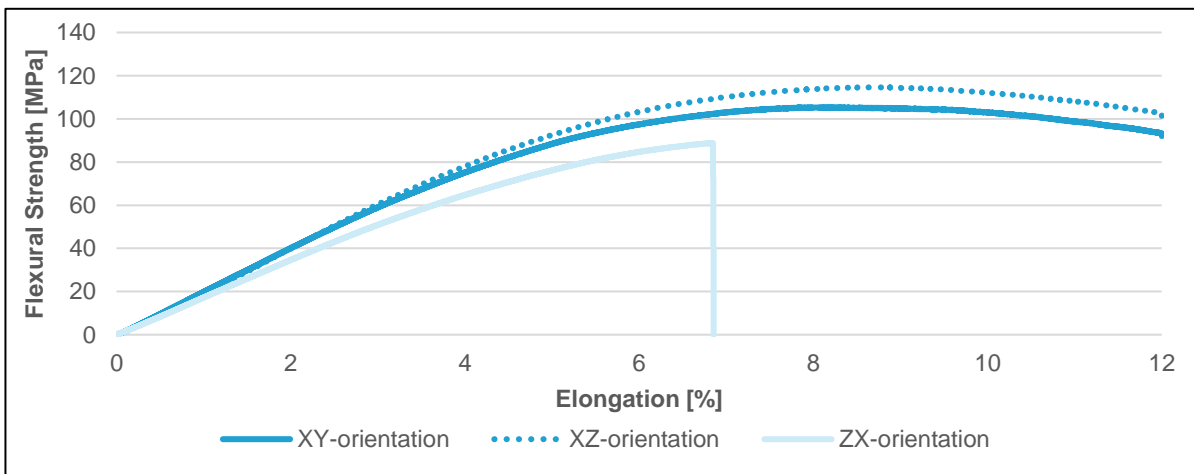


Figure 3: Typical Flexural Stress-Strain curves for the XY, XZ and ZX print orientation.

Outstanding resistance to Autoclaving (hot steam sterilization at 134°C)

The mechanical properties of Ultrafuse® PPSU show no significant deviation after 50 autoclaving cycles at a temperature of up to 134°C. The following diagrams present the mechanical properties after 50 autoclaving cycles at 134°C. “Untreated” specimens are manufactured in the same batch than the autoclaved specimens. As an additionally reference, the values from the technical data sheet (TDS) are added to the overview.

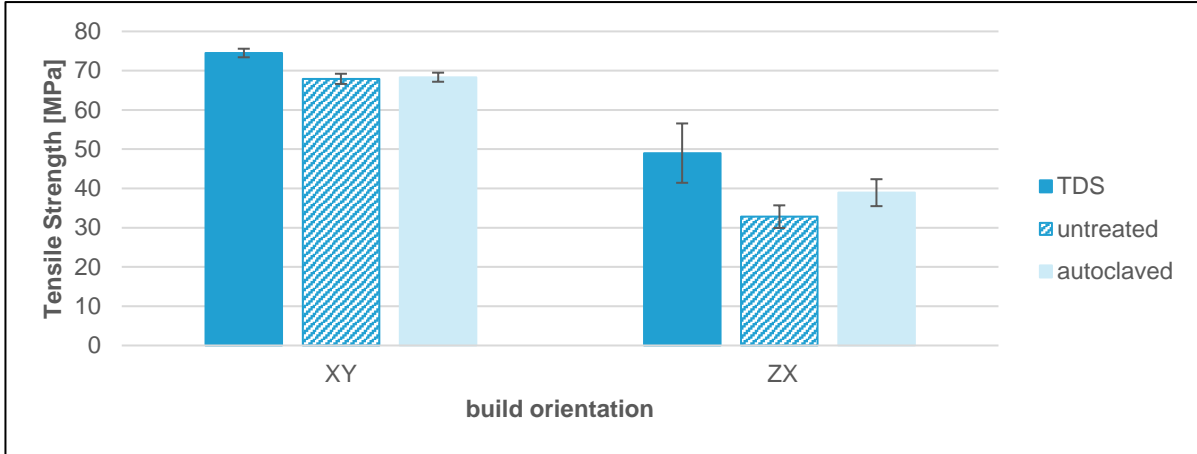


Figure 4: Tensile Strength comparison after 50 autoclaving cycles at 134 °C.

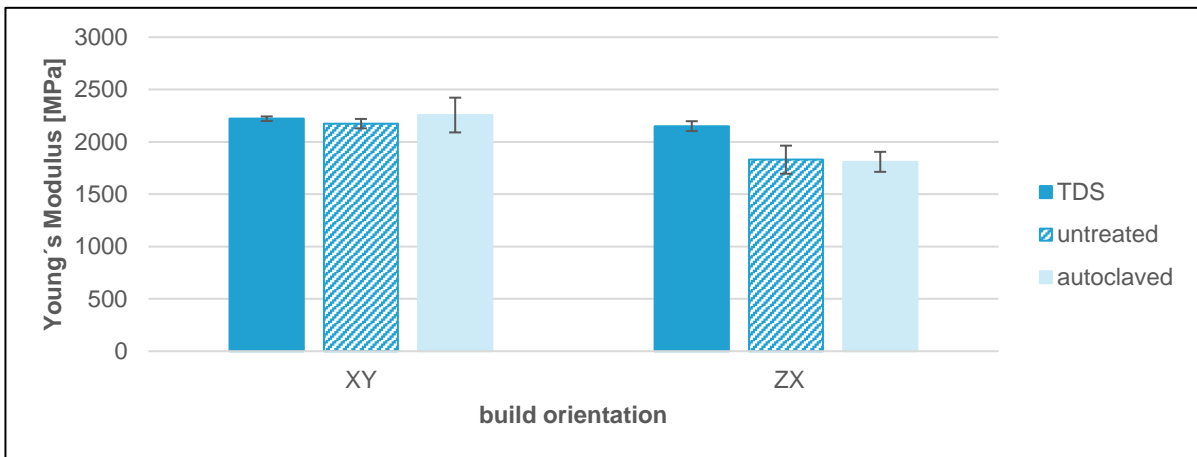


Figure 5: Young's Modulus comparison after 50 autoclaving cycles at 134 °C.

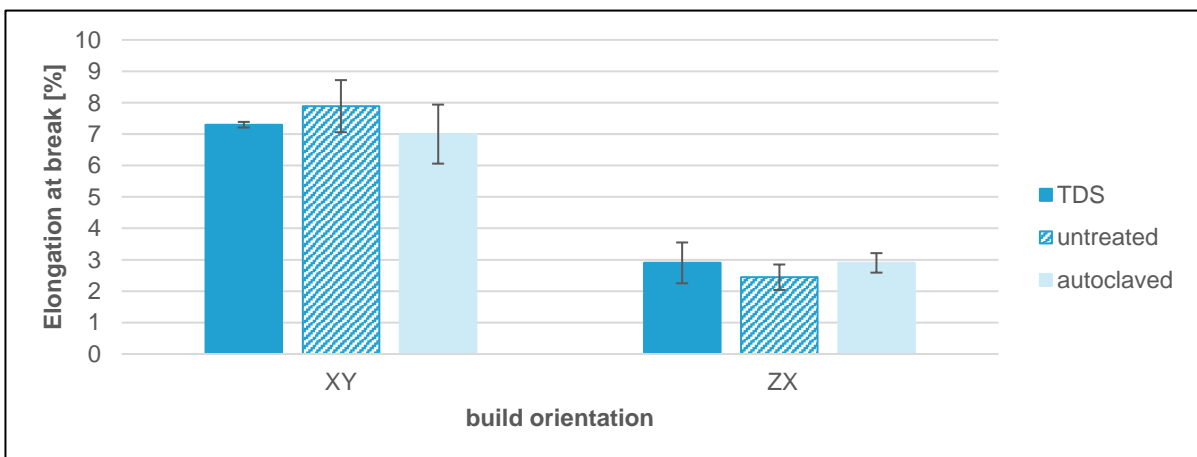


Figure 6: Elongation at break comparison after 50 autoclaving cycles at 134 °C.

Resistance tests to different media (based on raw material information)

Ultrafuse® PPSU has an outstanding stability against a brought variety of chemicals. The following tables show results of chemical ageing tests, based on injection molded tensile bars which were clamped on a bending block with a diameter of 265mm. With the applied bending stress, the specimens have been brought into contact with different media to assess the influence of these substances on the stress crack formation (damage). The rating was done in 5 categories:

- 0: no cracks
- 4: broken test bar

The performed tests are separated into the categories

- Chemical resistance at room temperature.
- Resistance against adhesives and sealants.
- Resistance against animal and vegetable fats.
- Resistance against dishwasher detergents.

Chemical Resistance (based on raw material information)

Media	Conc. [wt-%]	Time	Rating
Acetic Acid	10	1 min	0
	10	24 h	0
	100	1 min	1
Acetone	100	1 min	4
AdBlue (Urea solution)	100	1 min	0
Building foam: Hornbach Universal B2 (Polyurethane foam)	100	1 min	0
	100	24 h	0
Calcium chloride	20	1 min	0
	sat.	24 h	0
Citric acid	10	1 min	0
	10	24 h	0
	50	1 min	0
	50	24 h	0
Cleaning agent: Deconex HT 1169, HT 1170 (2-Amino-Ethanol, Polyethyleneglycol-5-Cocosamide, nonionic tenside)	100	1 min	0
	100	24 h	0
Cleaning agent: Deconex HT 1201 (Polyethylenglycole-5 Cocosamide, Triethanolamine, nonionic tenside)	100	1 min	0
	100	24 h	0
Cleaning agent: Deconex HT 1511 (Triethanolamine, Fatty Amine, nonionic tenside)	100	1 min	0
	100	24 h	0
Cleaning agent: Deconex 1401 (Potassium hydroxide, nonionic, amorphous, anionic tenside)	100	1 min	0
	100	24 h	0
Degreaser: Tangit (based on: Acetone, Butanone)	100	1 min	4
Degreaser: Kempt LO	100	1 min	0
	100	24 h	3
Degreaser: Lusin Clean 51	100	1 min	0
Demolding agent: Lusin Alro OL 151 (silicone-free)	100	1 min	0
Demolding agent: Lusin Alro OL 153 S (contains silicone)	100	1 min	0
Demolding agent: Lusin Alro OL 401 (silicone-free, high temp.)	100	1 min	0
Demolding agent: Lusin Alro 261 (silicone-free, based on Toluol, Ethylacetate)	100	1 min	4
Diethyl carbonate	100	1 min	2
Diisopropanol amine	80	1 min	0
	80	24 h	0

Chemical Resistance (based on raw material information)			
Media	Conc. [wt-%]	Time	Rating
Dimethyl carbonate	100	1 min	3
Diocetylphthalate	100	1 min	0
	100	24 h	0
Disinfectant: BIB Forte (tert. Alkylamine; Trialkylethoxyammoniumpropionate; tensides)	4	1 min	0
	4	24 h	0
	4	96 h	0
Disinfectant: Gigasept FF (Succindialdehyde; Dimethoxy tetrahydrofurane; tensides)	5	1 min	0
	5	24 h	0
	5	96 h	0
Disinfectant: Gigasept PAA (Peracetic acid; Hydrogen peroxide; Acetic acid; caustic potash)	2	1 min	0
	2	24 h	0
	2	96 h	0
Disinfectant: Korsolex basic Clutaraldehyde; (Ethylenedioxy)-dimethanol; tensides	5	1 min	0
	5	24 h	0
	5	96 h	0
Ethanol	100	1 min	0
	100	24 h	0
Ethanolamine	100	1 min	0
	100	24 h	0
Ethyl acetate	100	1 min	3
Ethylene glycols: Ethylene glycol	50	1 min	0
Ethylene glycols: Glysantin G 48 (Ethylene glycol, inhibitor)	100	1 min	0
	100	24 h	
Formaldehyde	37	1 min	0
Formic acid	98	1 min	0
	98	24 h	0
Fuel: Petrol	100	1 min	0
	100	24 h	1
Fuel: Petrol E 10	100	1 min	0
	100	24 h	0
Fuel: Biodiesel (Rapeseed oil methyl ester)	100	1 min	0
	100	24 h	0
Fuel: Diesel RF 06-03	100	1 min	0
	100	24 h	0
Fuel: FAM B [(DIN 51604) Testing fuel]	100	1 min	0
	100	24 h	0
Glycerol	100	1 min	0
	100	24 h	0
Heat transfer medium: Glythermin P82 (i-Propylene glycol)	100	1 min	0
	100	24 h	0
Heat transfer medium: Glythermin P44 (1,2-Propylene glycol)	100	1 min	0
	100	24 h	0
Heat transfer medium: H Galden ZT 130 (Hydrofluoropolyether)	100	1 min	0
	100	24 h	0

Chemical Resistance (based on raw material information)			
Media	Conc. [wt-%]	Time	Rating
Hydraulic fluid: Brake Fluid DOT 4 (Polyglycolcompounds)	100	1 min	1
Hydraulic fluid: Pentosin CHF 202	100	1 min	0
	100	24 h	0
Hydraulic fluid [Skydrol LD 4 (aviation, fire resistant)]	100	1 min	0
	100	24 h	4
Hydraulic fluid [Skydrol PE 5 (aviation, fire resistant)]	100	1 min	0
	100	24 h	0
Hydraulic fluid (Tributyl phosphate)	100	1 min	0
	100	24 h	4
Hydrochloric acid	10	1 min	0
	10	24 h	0
Isopropanol	100	1 min	0
	100	24 h	0
Lubricant: Gear oil (Shell Donax TX)	100	1 min	0
	100	24 h	0
Lubricant: Motor oil (Shell Helix 5 W 40)	100	1 min	0
	100	24 h	0
Lubricant: Motor oil (OS 206 304)	100	1 min	0
	100	24 h	0
Methanol	100	1 min	0
	100	24 h	0
Methyl ethyl ketone	100	1 min	4
Mold cleaner (Lusin Clean L 21)	100	1 min	4
n-Octane	97	1 min	0
	97	24 h	0
Olive oil	100	1 min	0
	100	24 h	0
Petroleum ether	100	1 min	0
	100	24 h	0
Phosphoric acid	85	1 min	0
	85	24 h	0
Rapeseed oil	100	1 min	0
	100	24 h	0
Soldering fluid: Soldering Flux (Zinc chloride, Ammonium chloride)	100	1 min	0
	100	24 h	0
Sodium carbonate	2	24 h	0
	20	24 h	0
Sodium chloride	10	24 h	0
Sodium hydroxide	1	1 min	0
	1	24 h	0
	35	1 min	0
	35	24 h	0
Sodium hypochlorite	10	1 min	0
	10	24 h	0

Chemical Resistance (based on raw material information)

Media	Conc. [wt-%]	Time	Rating
Sulfuric acid	20	1 min	0
	20	24 h	0
	96	> 48 h	partially soluble
Tenside [Lutensol A7N (fatty alcohol ethoxylate)]	20	24 h	0
Tenside: Sodium dodecylbenzene sulphonate	12.5	24 h	0
tert. Butylethylether	100	1 min	0
Tetrahydrofurane	100	1 min	3
	100	24 h	partially soluble
Triacetine	100	1 min	0
Tributyl phosphate	100	1 min	0
	100	24 h	4
Trichloro ethylene	100	1 min	4*
	100	> 24 h	unsoluble
Triethanolamine	100	1 min	0
	100	24 h	0
Water (demineralized)	100	1 min	0
	100	24 h	0
Xylene	100	1 min	1
	100	24 h	3

* tested with a bending block diameter of 400mm

Resistance against adhesives and sealants (based on raw material information)

Media	Hardening	Conc. [wt-%]	Time	Rating
Single-component adhesive: Loctite 401 (Ethyl-cyanoacrylat)	moisture	100	1 min	3
Single-component adhesive: Loctite 431 (Ethyl cyanoacrylate)	moisture	100	1 min	2
Single-component adhesive: Loctite 572 (Dimethacrylate ester)	anaerobic	100	1 min	0
		100	24 h	3
Single-component adhesive: Loctite 3211 (Acrylated urethane)	UV/visible light	100	1 min	0
		100	24 h	0
Contact adhesive: Armaflex adhesive 520 (Polychloroprene-based)	At 20 °C 36 h bonding time	100	1 min	2
Thread sealant: Loctite 5331 (Acetoxy silicone)	moisture	100	1 min	0
		100	24 h	0
Thread sealant, secure: Loctite 243 (Dimethacrylat ester)	anaerobic	100	1 min	0
		100	24 h	4
Pipe thread sealant: Loctite 55 (Polyamide fiber with chemically inert paste)	moisture	100	1 min	0
		100	24 h	0

Resistance against animal and vegetable fats (based on raw material information)

Media	Conc. [wt-%]	Time [h]	Temperature [°C]	Rating
Butter	100	24	150	0
Clarified butter	100	24	150	0
Peanut Oil	100	24	150	0
Vinegar	5	24	RT	0
Coconut fat	100	24	150	0
Margarine	100	24	150	0
Olive oil	100	24	95	0
Vegetable Oil	100	24	150	0
Beef Tallow	100	24	150	0
Bacon	100	4	170	0

Resistance against dishwasher detergents (based on raw material information)

Media	Conc. [wt-%]	Time [h]	Temperature [°C]	Rating
Rinse aid (Somat, Domol)	100	1	65	0
Dishwasher cleaner (finish)	100	1	65	0
Dishwasher salt (finish)	100	1	65	0
Dishwasher Tabs (finish Powerball All in 1)	7.5	1	80	0
	7.5	24	80	0
Dishwasher Tabs (finish Quantum)	7.5	1	80	0
	7.5	24	80	0