Technical Information

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Resistance of Ultrason® to chemicals

This leaflet contains an overview table and diagrams providing data on the effects of chemicals on Ultrason.

The table summarizes the results of numerous tests. Resistance was assessed on the basis of the stress cracking test on bent strips or the determination of mechanical properties (tensile test, notched impact strength). The data in this brochure relate to uncolored general-purpose grades.

As a general rule this table can serve only as a guide to the suitability of Ultrason for a particular purpose because the effects of exposure to chemicals depend on the design of the part, the manner of its processing and any mechanical stresses in operation. Due to its amorphous nature Ultrason is susceptible to stress cracking when exposed to some media. In many cases tests on moldings under practical conditions are essential.

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Explanatory notes to the table

Ultrason

E Polyethersulfone
EGF Glass-fiber reinforced polyethersulfone
S Polysulfone

Test This specifies which test(s) were carried out.
SC = Stress cracking test using bent strips based on DIN 53449
T T = Tensile test in accordance with ISO 527, notched impact strength based on ISO 179 1eA

Wt.-% The details in this column relate to the concentration (in wt.-%) of an aqueous solution of the chemical in question unless a different solvent is expressly mentioned. If no concentration is specified the data refer to the pure chemical.

°C Specifies the temperature at which the data given were determined. RT stands for “room temperature”.

Resistance was characterized by means of the following symbols

+ = resistant

Drop in rigidity, strength or toughness is ≤ 25 %, no stress crack formation occurs at outer fiber strains of ≤ 1% (bending radius r = 100 mm for test pieces 2 mm thick) for the duration of immersion.
Practical trials under the prevailing conditions recommended

(+) = limited resistance
Drop in rigidity, strength or toughness is ≤ 50 %, no stress crack formation occurs at outer fiber strains of ≤ 0.2 % (bending radius r = 500 mm for test pieces 2 mm thick)
Practical trials under the prevailing conditions necessary

– = not resistant
Material is attacked within a short period of time; stress cracking occurs

○ = soluble

–/○ = not resistant/partly dissolved

Chemical	Test	Wt.-%	°C	Immers-ion time	Ultrason E	Ultrason E GF	Ultrason S	Comments
Acetic acid	SC	3	96	24 h	+			
Acetic acid	SC		RT	< 1h	(+)		(+)	
Acetone	SC		RT	< 1h	–		–	
Acetone/isopropanol	SC	50/50	RT	24 h	(+)		(+)	
Acetone/isopropanol	SC	20/80	RT	24 h	+		(+)	
All-purpose cleaner								see table 5
Ammonia	T T	10	105	196 h	(+)		(+)	
Anesthetics								see table 7
Biodiesel: see fuels								
Break fluid (BASF Hydraulan® DOT 4)	SC		RT, 100	24 h	–	–	–	
Break fluid (BASF Hydraulan® DOT 4)	T T		150	168 h	–/○			
Break fluid (BASF Hydraulan® DOT 4)	T T		120	168 h		(+)		
n-Butanol	T T		70	120 h	+			
2- Butoxyethanol	SC		RT	24 h	+		(+)	
Carbon dioxide	diffusion							see table 8
Carpet cleaners								see table 5
Caustic potash solution: see potassium hydroxide								
Caustic soda solution: see sodium hydroxide								
Chlorobenzene			RT	24 h	–/○		○	
Chloroform			RT	24 h	○		○	
Cinnamon oil	SC		RT	24 h	(+)		(+)	
Citric acid	SC	5	96	24 h	(+)	(+)	(+)	
Cleaner solvent (Ungapon)	SC		RT	168 h	+	+		
Cleaner solvent (Ungapon)	SC		80	24 h	(+)	(+)		
Cleaning agent/disinfectant combination		1	70	240 h			+	see table 5
Cleaning agents, household								see table 5
Cleaning agents, industrial: acidic	T T	1	70	240 h			+	see table 5
Cleaning agents, industrial: alkaline	T T	1	70	240 h	+		+	see table 5
Cleaning agents, industrial: nonionic surfactants	T T	1	70	240 h	+		+	see table 5
Cloves, oil of	SC		RT	24 h	–		–	
Coolant (Freon TF)	SC		RT	24 h	+		+	1,1,2-trichloro-trifluoro ethane
Coolants: Glysantin G 30, G 48	T T	50	130	1000 h	(+)	(+)		
Coolants: Glysantin G 48	SC		80	144 h	(+)		(+)	
Coolants:Ethylene glycol	T T	50	125	2200 h	(+)	(+)	(+)	
Cutting oil	SC		RT	72 h	+			
Cutting oil	SC	5	RT	72 h	+			
Cyclohexanone			RT	24 h	–		○	

Chemical	Test	Wt.-%	°C	Immers-ion time	Ultrason E	Ultrason E GF	Ultrason S	Comments
Damping medium (BASF Glykosafe® 610)	SC		135	24 h	+			
Detergent solution (heavy-duty detergent)								see table 5
1,2 - Dichloroethane			RT	24 h	–/○		○	
Dichloromethane			RT		○		○	
Diesel: see fuels								
Diethyl ether	T T		RT	168 h	+			
Diethyl ether	SC		RT	24 h	(+)		(+)	
Diffusion of gases								see table 8
Dimethoxy ethane			80		–/○	–/○		
Dimethyl acetamide			RT		○		○	
Dimethyl formamide			RT		○		○	
Dinitrogen monoxide (Laughing gas)	SC		RT	24 h	+		+	
Dishwasher detergent								see table 5
Disinfectant								see table 6
Disinfectant: aldehyde-based	T T, SC	</= 5	RT	24 h	+		(+)	see table 6
Disinfectant: chlorine-based	T T, SC	1.5	95	2000 h			(+)	see table 6
Edible fat/Edible oil								see table 3
Ethylene oxide (gaseous)	T T		6	168 h	+		–	
Ethanol	T T		23	3000 h	(+)		–	
Ethanol	SC	15	96	24 h	–		–	
Ethanolamine	SC	</= 30	RT	< 1h	+		+	
Ethanolamine	SC	</= 30	65	< 1h	+		+	
Ethyl acetate	SC		–65	< 1h		–		
Ethyl acetate	SC		RT	24 h	(+)	(+)	–	
Ethylene	diffusion							see table 8
Ethylene glycol	T T		140	1000 h		(+)		
Ethylene glycol	SC		RT	24 h	+		+	
Ethylene glycol	SC	50	105	24 h	(+)		(+)	
Ethylene oxide (gaseous)	SC		6	24 h	+		+	

Chemical	Test	Wt.-%	°C	Immers-ion time	Ultrason E	Ultrason E GF	Ultrason S	Comments
FAM – Test liquids								
FAM A (DIN 51604)	SC		RT	< 1h	(+)	+		50% toluene, 30% isooc-tane, 15% diisobutylene, 5% methanol
FAM B (DIN 51604) test fuel	SC		RT	< 1h	(+)	+		84.5% FAM A, 15% methanol, 0.5 % water
FAM B (DIN 51604) test fuel	T T		RT	500 h	(+)	+		
FAM C (DIN 51604) test fuel	SC		RT	< 1h	+	+		40% FAM A, 58% methanol, 2% water
FAM C (DIN 51604) test fuel	T T		121	1000 h		+		
Fats: see lubricants								
Fats: see edible fats								see table 3
Fluorine (after fluorination)	T T				+	+		
Foods								see tables 3 + 4
Freon TF (coolant)	SC		RT	24 h	+		+	see table 7
Fuels: Diesel	T T		RT	3000 h	+	+		
Fuels: Diesel	T T, SC		100	168 h	+	+		
Fuels: Kerosene	T T		50	672 h	+		+	
Fuels: regular (leaded)	T T		RT	3000 h	(+)	+		
Fuels: Super-Plus	T T		RT	3000 h	+	+		
Fuels: Super-Plus	SC		RT	24 h	(+)	+		
Fuels: Test fuel FAM-B	T T, SC		RT	500 h	(+)	+		
Fuels: Test fuel FAM-C	T T		100	1000 h		+		
Fuels: unleaded	T T		RT	500 h	+	+		
Fuels: Biodiesel (Rapeseed oil, methyl ester)	T T		RT	3000 h	(+)	+		
Fuels: Test fuel M 15 (Super/methanol 85/15)	T T		50	1000 h	(+)	+		
Gas leak test solution (“Gaspruf”)	SC		RT	24 h	(+)			
Gasoline: see fuels								
Gear oil: see lubricants								
Glass cleaner								see table 5
Glycerin	SC		160	24 h	(+)		(+)	
Glysantin® (BASF): see coolants								
Hand cream: see lubricants								
Heat transfer oil (Marlotherm S)	T T		190	< 1h	(+)	+		
Heating bath fluid (Phenylenemethylpolysiloxane)	T T		175	1 h	+	+	+	
Heating bath fluid (Polyglycolether, mod.)	T T		175	1 h	–	–	–	partly dissolved (on surface) after 20 min
Helium	diffusion							see table 8
Household light petroleum								see table 5
Hydraulan® DOT 4: see break fluid								
Hydraulic fluid: based on phosphate ester mixture	T T		70	70 h	+			
Hydrochloric acid	T T	20	85	720 h	(+)	+		
Hydrochloric acid	T T	10	85	1344 h	+		+	
Hydrofluoric acid	T T	1	85	1344 h	+		+	
Hydrogen	diffusion							see table 8
Hypoid oil: see gear oil								

Chemical	Test	Wt.-%	°C	Immers-ion time	Ultrason E	Ultrason E GF	Ultrason S	Comments
Infusion solutions								see table 7
Inhalants								see table 7
Iodine, tincture								see table 6
Isopropanol	SC		RT	24 h	+		+	
Kerosene: see Fuels								
Laughing gas	SC		RT	24 h	+		+	
Lemon oil	SC		RT	24 h	+		(+)	see table 9
Lemon oil	SC	1	100	24 h	(+)		–	
Lubricants: gear oils	T T		150	1000 h	+	+		
Lubricants: gear oils	SC		150	3000 h		(+)		
Lubricants: gear oils	T T		170	1000 h	+	+		
Lubricants: hand cream	SC		RT	350 h	+	+	+	
Lubricants: high pressure grease	T T, SC		RT	168 h	+	+		
Lubricants: mineral oils, general	T T		150	1000 h	+	+		
Lubricants: mineral oils, general	T T		170	1000 h	+	+		
Lubricants: mineral oils, general	T T		190	1000 h	+	+		
Lubricants: mineral oils, general	T T	10	23	168 h	(+)	+	+	
Lubricants: used oil	T T		170	1000 h	+	+		
Methacrylic acid methylester	SC		RT	24 h	–			
Methane	diffusion							see table 8
Methanol	T T		RT	168 h	+			
Methyl ethyl ketone	SC		RT	< 1 h	–		–	
Methylene chloride					○		○	
N-Methylpyrrolidone					○		○	
Mold release agent (without silicone)	SC		150	< 1 h	(+)		(+)	
Narcotics								see table 7
Nitric acid	T T	10	RT	168 h	(+)	+	+	
Nitric acid	T T	10	80	168 h	(+)	+	+	
Nitric acid		65			partly dissolved			
Nitrogen	diffusion							see table 8
n-**O**ctane	SC		RT	24 h	+		+	
n-Octane	SC		125	24 h	(+)		(+)	
Oil: see lubricants								
Oils: animal and vegetable								see table 3
Oxygen	diffusion							see table 8

Chemical	Test	Wt.-%	°C	Immers-ion time	Ultrason E	Ultrason E GF	Ultrason S	Comments
Pepper, oil of	SC		RT	24 h	+		+	
Peracetic acid	T T		RT	48 h	(+)		+	73.3% acetic acid; 18.7 % water; 8% H_2O_2
Peracetic acid	SC		RT	48 h	(+)		(+)	73.3% acetic acid; 18.7 % water; 8% H_2O_2
Perchloroethylene							○	
Phosphoric acid	T T	98	160	168 h	+		+	
Potassium hydroxide	T T	45	70	168 h			(+)	
Potassium hydroxide	T T	25	120	500 h	+			
Potassium hydroxide	T T	45	150	72 h	(+)			
Potassium sulfate	T T	4	96	720 h	+	+	(+)	
Potassium thiocyanate	SC	6 mol/l	RT, 65	24 h	+	+		
Propylene glycol	T T		120	672 h	(+)			
Pyrrolidone-2	SC	7.5	60	24 h	+		+	
Rapeseed oil methyl ester (Biodiesel)	T T		RT	3000 h	(+)	+		
Rapeseed oil methyl ester (Biodiesel)	SC		RT	24 h	+	+		
Refrigerating machine oil KA 22, KC 68	T T, SC		120	168 h	+	+		
Rinsing agent (dish washer)								see table 5
Sanitary cleaning agents								see table 5
Scouring powder								see table 5
Silicone grease	SC		RT	168 h	+		+	
Silicone oil	SC		140	24 h	+	+		
Silicone oil	T T		210	< 1h	+			
Sodium carbonate Na_2CO_3	SC	pH 10.9	RT	24 h	+		+	
Sodium chloride	T T	4	96	720 h	+	+	+	
Sodium chloride	T T	10	70	168 h	+			
Sodium hydrogensulfite $NaHSO_3$	T T	5	96	720 h	+	+	+	
Sodium hydroxide	T T	70	80	168 h	+	+	+	
Sodium hydroxide	T T	10	RT	168 h	+	+	+	
Sodium hydroxide	SC	pH 11.5	RT	24 h	+		+	
Sodium hydroxide	T T	10	80	72 h	+	+	+	
Sodium hypochlorite NaOCl	SC		RT, 95	48 h	+		+	200 ppm active chlorine
Sodium hypochlorite NaOCl	T T		60/95	1000/ 2000 h			(+)	100 ppm NaOCl / 0.5% total chlorine
Sodium hypochlorite NaOCl	T T		45	1000 h	(+)	+		0.1% chlorine
Sodium sulfite Na_2SO_3	SC	pH 9.22	RT	24 h	+		+	
Stain-remover salt								see table 5
Sulfuric acid	T T	10	80	168 h	+	+	+	
Sulfuric acid	T T	10-50	96	720 h	+	+	+	
Sulfuric acid	T T	50	80	720 h	+	+	+	
Sulfuric acid	T T	96			○		○	

Chemical	Test	Wt.-%	°C	Immers-ion time	Ultrason E	Ultrason E GF	Ultrason S	Comments
Tetrachloroethane							○	
Tetrachloroethylene	T T		RT	168 h	(+)			
Tetrachloromethane	SC		RT	< 1h	+		–	
Tetrahydrofuran	SC		RT	< 1h	–/○		–/○	
Tetrahydrothiophene					–			
Thionyl chloride					○		○	dissolved within a couple of days
Thread oil	SC		RT	96 h	+		+	
Titaniumtetrachloride	T T		RT	24 h	+			
Toluene	SC		RT	< 1h	(+)	(+)	–	
Trichlorethylene	SC		RT	< 1h	(+)		–/○	
1.1.1-Trichloroethane	T T		70	70 h	(+)			
1.1.1-Trichloroethane	SC		RT	< 1h	(+)		–	
1.1.2-Trichloroethane	SC		RT	< 1h	–/○		–/○	
1.1.2-Trichlorotrifluoroethane (Freon TF)	SC		RT	24 h	+		+	
Triethylamine	SC		RT	< 1h	(+)		(+)	
Water (demineralized)	T T		95	2000 h	(+)		(+)	see figures 2 + 3
Water (demineralized)	T T		130	1000 h	(+)	(+)		
Water (demineralized)	T T		23, 60, 95	10000 h				tensile creep test, see fig. 4 + 5
Water absorption								see figure 1, table 1
Water vapor	T T		134	500 cycles	(+)		(+)	see figures 6 + 7
Water vapor permeability								see table 2
Xylene	SC		RT	< 1h	+		–	

Water absorption and dimensional stability

Ultrason moldings absorb moisture when they are immersed in water or exposed to air. The amount absorbed depends on the humidity, the duration of exposure, the temperature, the wall thickness of the molding, and the Ultrason product concerned. The rate of absorption is governed by Fick's law of diffusion. The rate of water absorption by Ultrason under various conditions can be seen in Fig. 1.

Moisture absorption increases the ultimate elongation and especially the impact resistance of the unreinforced Ultrason E products in particular.

The tensile strength and the modulus of elasticity in tension are only slightly influenced. The change in dimensions brought about by water absorption is very little (Table 1).

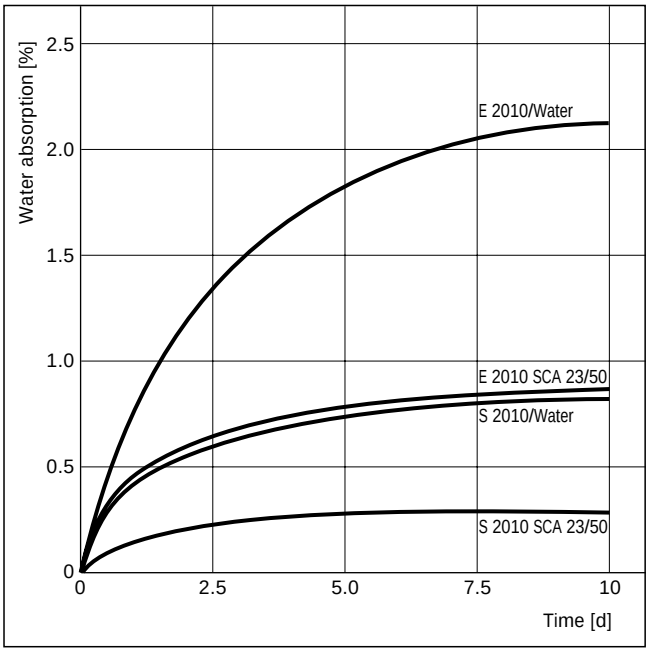

Fig. 1 Water absorption by Ultrason as a function of time under various conditions; wall thickness 2 mm; SCA = Standard conditioning atmosphere (23 °C, 50 % r.h.)

Table 1
Water absorption and changes in dimensions in injection molded tensile bars after immersion in water at 23 °C until saturation

Ultrason	Water absorption (%)	Cross-section change (%)	Change in length (%)
S 2010	0.8	+0.1	+0.1
S 2010 G6	0.5	+0.1	+0.1
E 2010	2.1	+0.3	+0.3
E 2010 G4	1.7	+0.3	+0.2
E 2010 G6	1.5	+0.3	+0.1

Table 2
Permeability to water vapor at 23 °C and transition from an atmosphere of 85 % r.h. to 0 % r.h.

Ultrason E	25–37 g · 100 µm/m^2 · d
Ultrason S	25–40 g · 100 µm/m^2 · d

Heat aging resistance in water

Immersion of Ultrason in water at 95 °C

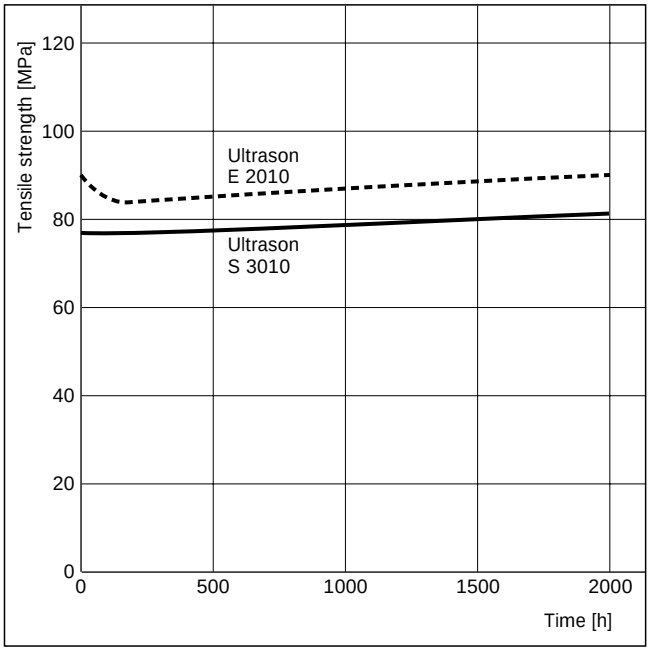

Fig. 2

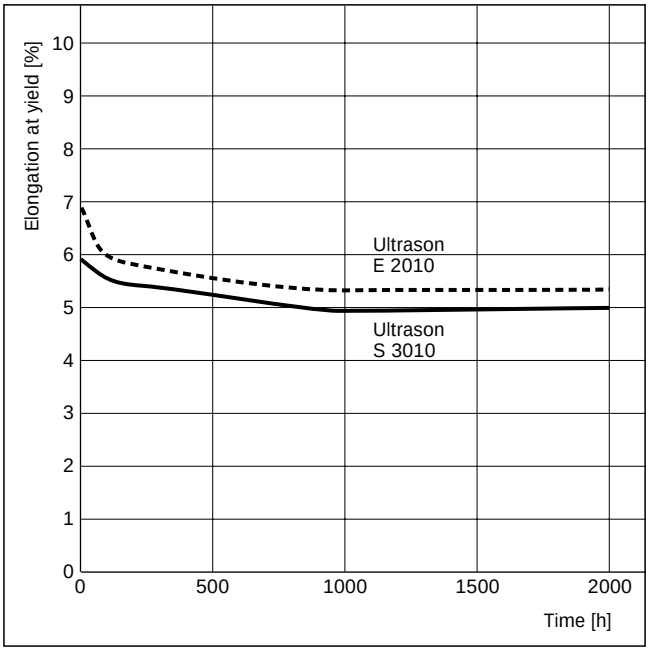

Fig. 3

Tensile strength and elongation at yield measured in accordance with ISO 527

Tensile creep test

The behavior of glass-fiber reinforced Ultrason S and E under static loading in water at 23 °C, 60 °C and 95 °C is illustrated in the following graphs. The time to failure of test specimens subjected to constant tensile stresses was measured in accordance with ISO 899.

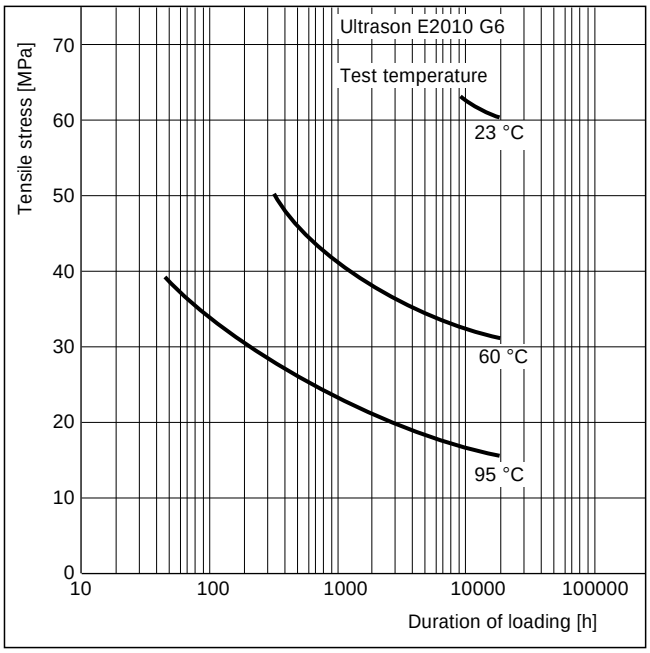

Fig. 4

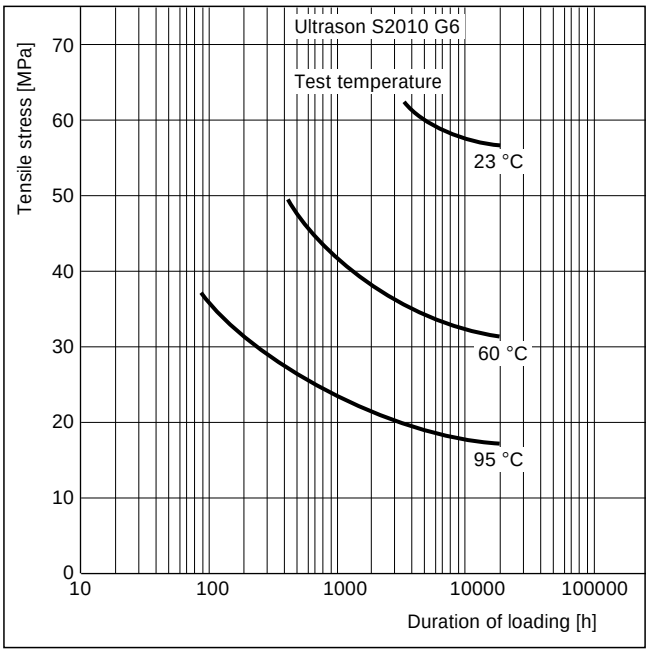

Fig. 5

Ultrason in applications with food contact

Stress cracking test using bent strips based on DIN 53449, Part 3. The test was carried out with standard products. In each case the highest tested outer fiber strain is specified at which no stress cracks appeared under the quoted conditions of concentration and temperature. Outer fiber strains of 0.05, 0.1, 0.2, 0.5, 1.0 and 2.0% were tested.

Table 3
Edible fats and oils

	Temperature °C	Duration	Ultrason E	Ultrason S
Butter	170	50 cycles[1]	0.2	0.1
Butter fat	170	5 cycles[1]	0.2	0.1
Bacon fat	170	5 cycles[1]	0.2	0.1
Chicken fat	170	50 cycles[1]	0.2	0.1
Coconut fat	170	5 cycles[1]	0.2	0.1
Nut-nougat creme	RT, 60	96 h	2.0	1.0
Olive oil	95	24 h	0.5	0.1
Vegetable oil	150	24 h	0.5	0.2
Lard	95	24 h	0.5	0.1

Table 4
Staining by food ingredients

The tests were performed using Ultrason E 2010; assessment after cleaning with standard cleaning agents in a dish washer.

	Temperature °C	Duration h	Assessment
Curry powder, 10% in lard	200	1	no discoloration
Curry powder, 10% in water[3]	200	1	no discoloration
Tomato pulp[3]	200	2.5	no discoloration
Coffee	80	200	no discoloration
Green tea	80	200	no discoloration
Black tea	80	200	no discoloration
Carots, grated	170	5 cycles[2]	no discoloration
Red pepper powder, 10% in coconut fat	180	5 cycles[2]	no discoloration
Red pepper powder, 10% in olive oil	180	5 cycles[2]	no discoloration
Beetroot, pickled	170	5 cycles[2]	no discoloration
Red cabbage, pickled	170	5 cycles[2]	no discoloration
Morello cherries, preserved	170	5 cycles[2]	no discoloration
Wild blueberries, preserved	170	5 cycles[2]	no discoloration
Chocolate pudding	boiling	heated 5 x	no discoloration
Cocoa, 10% in milk	boiling	heated 5 x	no discoloration

[1] Cycle = 45 minutes oven 170 °C, 30 min. cool down
[2] Cycle = 30 minutes oven 170 °C, 30 min. cool down
[3] Evaporated to dryness

Resistance of Ultrason to cleaning agents

Stress cracking test using bent strips based on DIN 53449, Part 3. The test was carried out with standard products. In each case the highest tested outer fiber strain is specified at which no stress cracks appeared after 24 h immersion under the quoted conditions of concentration and temperature. Outer fiber strains of 0.05, 0.1, 0.2, 0.5, 1.0 and 2.0 % were tested.

Table 5

	Volume %	Temperature °C	Ultrason E unreinforced	Ultrason E 20% GF reinforced	Ultrason S unreinforced
Household cleaners					
All-purpose cleaners	1	50	1.0	–	0.5
	100	50	1.0	–	0.5
	1	96	0.5	–	0.2
	5	96	0.5	–	0.2
	100	96	0.2	0.5	0.1
Glass cleaners	100	96	0.5	1.0	0.1
Hand washing agents	5	50	2.0	1.0	1.0
	100	96	1.0	0.5	0.5
Machine washing agents	100	96	0.2	0.5	0.1
Caustic Cleaner (NaOH)	0.5	95	0.5	–	0.5
Water based mixture (KOH, Sodiumhypochlorite, Sodium silicate)	0.5	95	0.5	–	0.5
Clear rinsing agents (acid)	10	96	0.5	–	0.2
Clear rinsing agents (alcohol, nonionic surfactants)	0.05	95	0.2	–	0.2
Sanitary cleaners	100	96	0.5	0.5	0.2
Scouring agents	100	50	1.0	–	1.0
Carpet cleaners	100	RT	1.0	–	–
Household light petroleum	100	RT	1.0	1.0	1.0
Stain remover, salt	15	96	0.2	0.5	0.2
Stain removers, basic	5	96	1.0	–	1.0
Heavy-duty detergents	10	96	0.5	0.5	0.2
Drain cleaners	100	RT	1.0		1.0
Industrial cleaners					
Alkali-based	< 0.5	95	0.2	–	0.2
Acid based (milking systems)	1	60	–	–	0.2
Glycol ether base (degreasers)	100	RT	1.0	–	0.5
Based on nonionic surfactants	< 1	RT	1.0	–	1.0
Cleaner/disinfectant combination	1	RT	2.0	–	1.0
Cleaner/disinfectant combination	1	60	–	–	0.5

– = not tested

Resistance of Ultrason to disinfectants

Stress cracking test using bent strips based on DIN 53449, Part 3. The test was carried out with standard products. In each case the highest tested outer fiber strain is specified at which no stress cracks appeared after 24 h immersion under the quoted conditions of concentration and temperature. Outer fiber strains of 0.05, 0.1, 0.2, 0.5, 1.0 and 2.0 % were tested.

Table 6

		Volume %	Temperature °C	Ultrason E unreinforced	Ultrason S unreinforced
Disinfectant/cleaner combinations					
Incidur spray	Alcohol based	100	RT	1.0	1.0
Tincture of iodine	900 ml ethanol, 100 ml methanol, 3 g iodine, 3,5 g potassium iodide		RT	0.5	0.5
Aldehyd Instrumenten Desinfektion, Alhydex Compact; Alhydex Pre; Buraton 10 F; Gigasept FF; Lysetol V; Nücosept; Tegodor	Aldehyde based	≤ 5	RT	2.0	0.5
Mikrozid Liquid; Gigasept Sporizid	Aldehyde based, wetting agent	≤ 5	RT	1.0	1.0
Circotip AFL	Alkalis, phosphates, silicates based	1	60	–	0.5
Neodisher FA	Alkalis, silicates based	1	95	–	0.2
Alfa Chlortech (milking systems)	Chlorine based	1.5	85	–	0.5
Dismozon pur	Peroxo compound based	1	RT	1.0	1.0
Incidin Perfekt	Phenol, glyoxal based	3	RT	0.5	0.5
Bacillotox	Phenol derivative based	5	RT	0.2	partly dissolved
Acidsan; Circotop SFL (milking systems), Neodisher Z	Acidic, surfactant based	≤ 2	≤ 85	–	0.5
Antifect FF; Terralin	Combination of not ionic surfactants	≤ 1	RT	2.0	1.0
Perform	Persulphate, organic acids	2	RT	2.0	1.0
Sokrena pur	Quaternary ammonium compound	2.5	RT	2.0	0.5

– = not tested

Resistance of Ultrason to media from the field of medicine

Stress cracking test using bent strips based on DIN 53449, Part 3. The test was carried out with standard products. In each case the highest tested outer fiber strain is specified at which no stress cracks appeared after 24 h immersion under the quoted conditions of concentration and temperature. Outer fiber strains of 0.05, 0.1, 0.2, 0.5, 1.0 and 2.0 % were tested.

Table 7

	Volume %	Temperature °C	Ultrason E unreinforced	Ultrason S unreinforced
Anesthetics				
Ethrane (2-chloro-1,1,2-trifluoroethyl difluoromethyl ether)	100	RT	0.5	0.2
Ethrane (saturated vapor)	100	RT	0.5	0.2
Halothane (2-bromo-2-chloro-1,1,1-trifluoroethane)	100	RT	instable	instable
Halothane (saturated vapor)	100	RT	0.2	instable
Diethyl ether	100	RT	2.0	0.5
Laughing gas (nitrogendioxide)	100	RT	1.0	2.0
Infusions/inhalants				
Aminofusin L (10%)	100	RT	2.0	2.0
Combisteril FGX 40	100	RT	2.0	2.0
Dextran 40 E (4%)	100	RT	2.0	2.0
Spitzner aerosol (1:5)	100	RT	2.0	2.0
Terpestrol inhalat	100	RT	2.0	0.5
Lipofundin MTC (20%)	100	RT	2.0	1.0

– = not tested

Sterilization of Ultrason E and S in saturated steam containing 50 ppm of Morpholin (corrosion inhibitor)

Autoclave 35 Company Webeco
Temperature: 134 ºC
Cycle: 5 min. sterilisation, 10 min. vacuum drying

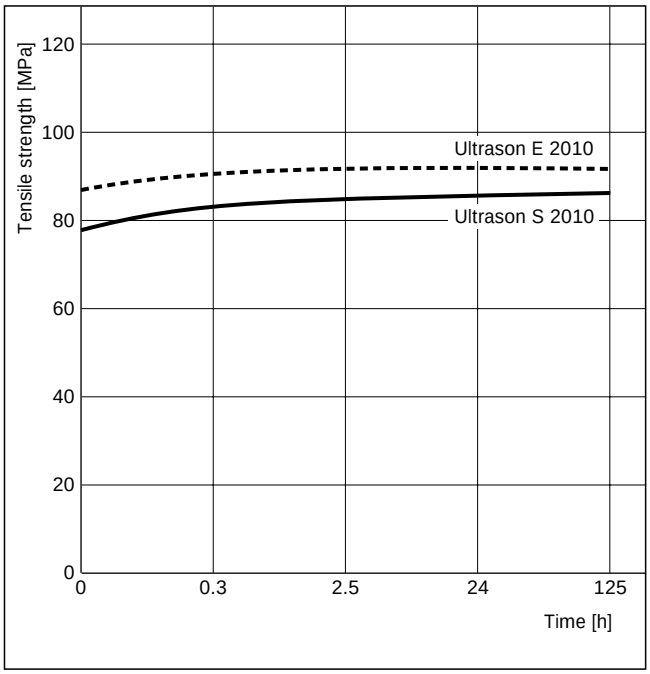

Fig. 6
Tensile strength measured in accordance with ISO 527

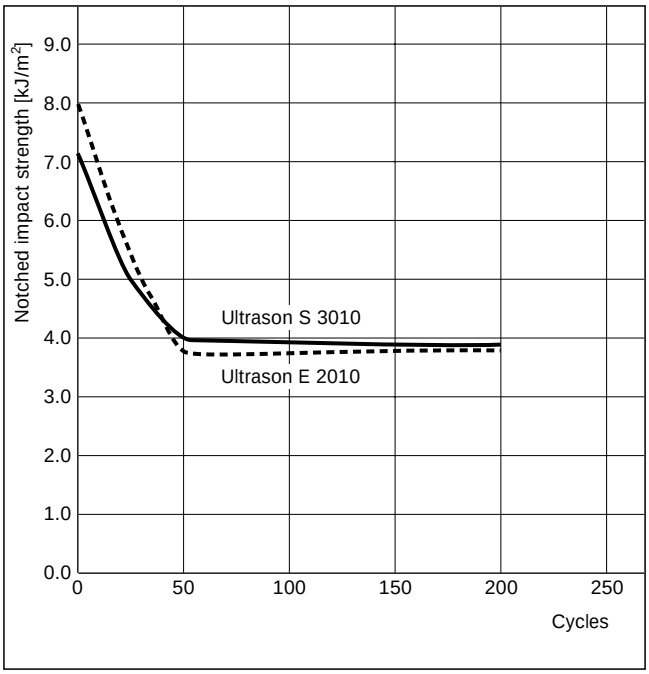

Fig. 7
Charpy notched impact strength ISO 1791eA

Resistance of Ultrason E 2010 G6 after immersion in gear oils at 150 °C

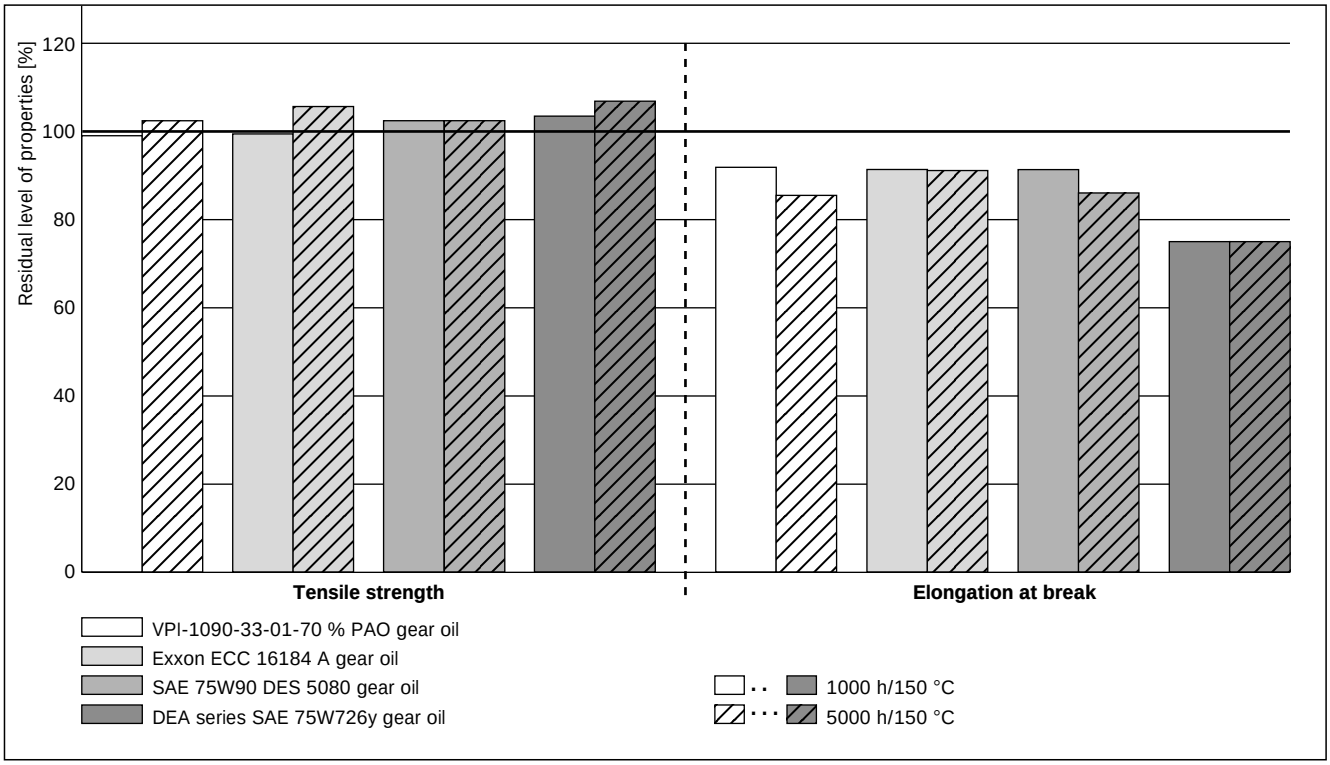

Fig. 8 Tensile strength and rated elongation at break (tensile test in accordance with ISO 527)

Resistance to gear oil at 150 °C

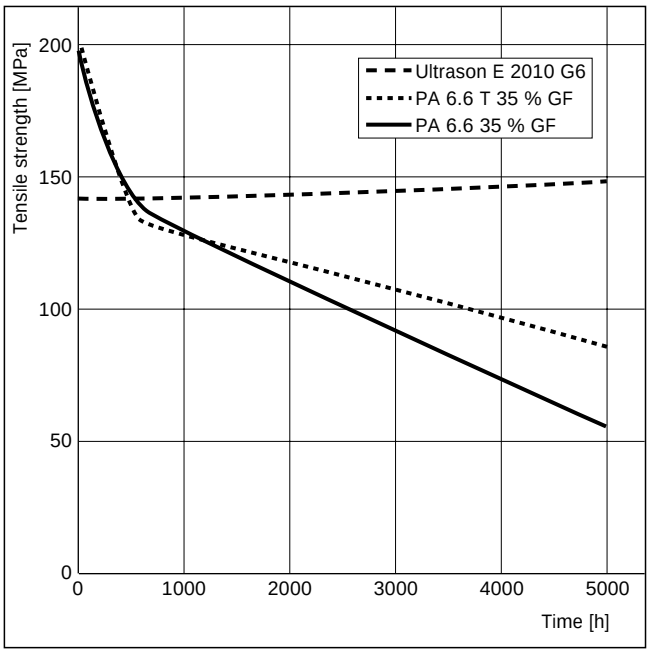

Fig. 9

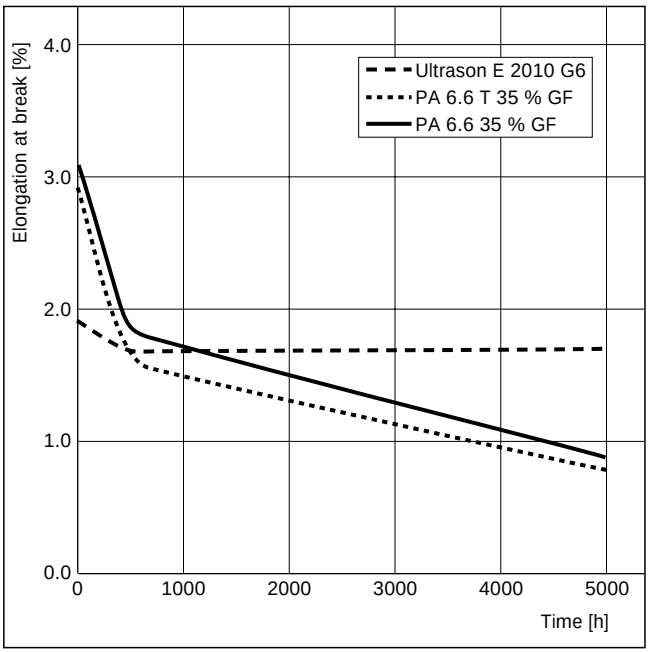

Fig. 10

Tensile strength and elongation at break (tensile test in accordance with ISO 527)

Resistance of Ultrason E 2010 and E 2010 G6 to fuels at RT

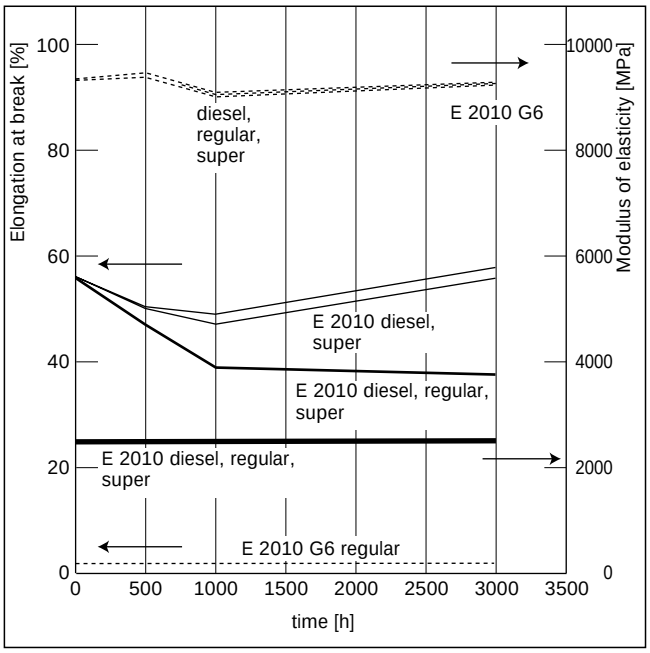

Fig. 11

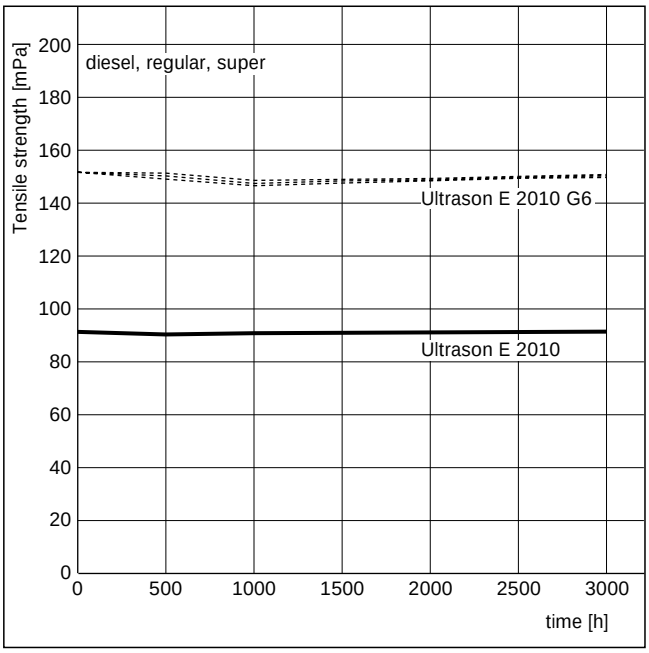

Fig. 12

Tensile strength, elongation at break and modulus of elasticity (tensile test in accordance with ISO 527)

Table 8
Diffusion
Permeability coefficient in $cm^3 \cdot 100\ \mu m/(m^2 \cdot d \cdot bar)$ at 23 °C

	Ultrason E	Ultrason S
Ethylene	20	–
Helium	3800	7100
Carbon dioxide	2600 – 3100	3600
Methane	60	80
Oxagen	320 – 470	710 – 790
Nitrogen	50 – 70	120 – 140
Hydrogen	3800	6500

– = *not tested*

Summary

Ultrason E (PES, polyethersulfone) and Ultrason S (PSU, polysulfone) are high-performance materials having a broad combination of properties. Even at high temperatures both products exhibit outstanding resistance to chemicals, high dimensional stability and mechanical properties of a high order as well as low tendency to creep. The unreinforced materials are transparent.

Due to its outstanding long-term resistance to hot lubricants, fuels and coolants Ultrason E is preferred for use in automotive engineering applications. Ultrason E also provides superior properties for applications in the foods sector in which resistance to fats at high temperatures and low discoloration by food ingredients are required. In the field of medicine Ultrason S is given preference on account of its improved resistance to hydrolysis, sterilizability and lighter intrinsic color.

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