

Thermoplastic Polyurethane Elastomers (TPU)

Elastollan® –
Chemical Resistance

Acids



Solvents



Alkalis



Alcohols



Grease, Oils



Water



Technical Information

Introduction

The resistance of plastic materials against chemicals, solvents and other contact substances is an important criterion of selection for many applications.

When contacting such substances, the mechanical properties of plastic materials including Elastollan can be affected.

This Technical Data Sheet provides a survey in tabular form, of the behaviour of selected Elastollan grades towards common contact substances.

The survey is divided into various categories (e. g. weak acids, mineral acids, oxidizing acids, alkaline solutions, solvents). The aim is to simplify the selection of Elastollan types when deciding on their application suitability.

Test Conditions:

Test Specimens

Standard S2 dumb-bells according to DIN 53504. All test pieces pre-tempered for 20 h at 100° C.

Test Temperature

Reagents, 60° C;
Solvents, 23° C

Test Criteria

Reagents: the immersion time to cause a reduction in tensile strength to 20 N/mm².

Solvents: reduction in tensile strength due to swelling after three weeks immersion.

The resistance is indicated roughly in terms of days, weeks, months or years.

According to a general rule of thumb, resistance may be extrapolated to double when reducing temperature by 10° C, and when increasing temperature by 10° C, to half.

Tests were performed with the Elastollan grades S 85 A, C 85 A and 1185 A.

Swelling and solution are primarily affected by the number of hydrogen bonds effective between the linear molecular chains, which increases with hardness. From this, it can be derived that harder products suffer less swelling, and their chemical resistance is higher. Highly polar substances may in part or completely break down the molecular interactions, resulting in severe swelling and in extreme cases complete dissolution of Elastollan materials.

Elastollan – Chemical Resistance

Index

Reagents	Code	Solvents	Code
Acetic Acid	1.	Acetic Ester	15.3
Alcohol	11./16.	Acetone	15.4
Ammonium Chloride Solution	10.	Amyl Acetate	15.3
Ammonium Solution	10.	ASTM-Oils 1, 2 and 3	13./15.7
Anti-freeze	14.	Benzene	15.2
ASTM-Oils 1, 2 and 3	13./15.	Benzyl Alcohol	16.
Battery Acid	5.	Biodiesel Fuel	16.
Benzyl Alcohol	16.	Butane	15.1
Bleach	7.	Butyl Acetate	15.3
Boric Acid	1.	Chlorobenzene	15.6
Brake Fluid	14.	Chloroform	15.5
Butyric Acid	1.	Cyclohexane	15.1
Calcium Hydroxide Solution	9.	Dimethyl Acetamide	15.8
Citric Acid	2.	Dimethyl Formamide = DMF	15.8
Ethanol = Ethyl Alcohol	11./16.	Dimethyl Sulphoxide = DMSO	15.8
Ethyl Acetate	14./15.	Diesel Fuel	16.
FAM Test Fluids A, B and C, according to DIN 51604	12./16.	Ethane	15.1
Formic Acid	1.	Ethanol	16./11.
Gasoline	12./16.	Ethyl Acetate = Acetic Ester	15.3
Diluted Hydrochloric Acid	4.	Ethylene Glycol = Glycol	16.
Hydrogen Peroxide	7.	FAM Test Fluids A, B and C, according to DIN 51604	16./12.
Iso-Propanol = Isopropyl Alcohol	11./16.	Fuel A, B, C and D, according to ASTM D 471	16.
Lactic Acid	1.	Glycol = Ethylene Glycol	16.
Lauric Acid	1.	Glycerine	16.
Methanol = Methyl Alcohol	11./16.	Hexane	15.1
Diluted Nitric Acid	6.	Iso-Octane	15.1
Oleic Acid	1.	Iso-Propanol = Isopropyl Alcohol	16./11.
Phenol Solution	1.	Kerosine	15.1
Diluted Phosphoric Acid	3.	Methane	15.1
Propionic Acid	1.	Methanol	16./11.
Sea Water	0.	Methylen Chloride	15.5
Silicone Oil = Dimethyl Polysiloxane	14.	Methyl Ethyl Ketone = MEK	15.4
Slaked Lime = Calcium Hydroxide Solution	9.	Methyl Isobutyl Ketone = MIBK	15.4
Diluted Soda Lye	9.	N-Methyl Pyrrolidone = NMP	15.8
Soda Solution	9.	Octane	15.1
Sodium Bisulphate Solution	3.	Paraffin Oil	15.1
Sodium Hydroxide Solution	9.	Pentane	15.1
Sodium Hypochlorite Solution	7.	Petroleum Ether	15.1
Sodium Nitrate Solution	7.	Propane	15.1
Sodium Sulphite Solution	8.	Pyridine	15.8
Stearic Acid	1.	Tetrachloroethylene	15.5
Diluted Sulphuric Add	4.	Tetrahydrofurane	15.8
Tap Water	0.	Toluene	15.2
Trichloroethane	14./15.	Trichloroethane	15.5
Triethanolamine Solution	9.	Xylene	15.2
Urea Solution	10.		
Water	0.		

Chemical Resistance of Elastollan

Code	Tested	Elastollan S 85 A		Elastollan C 85 A		Elastollan 1185 A	
		23° C	60° C	23° C	60° C	23° C	60° C
0. Water	Tap Water	Years	Months	Years	Months	Years	Years
	Sea Water	Years	Months	Years	Months	Years	Years
1. Weak Acids, Carbonic Acids	3 % Acetic Acid	Weeks	Days	Weeks	Days	Years	Months
	3 % Lactic Acid	Weeks	Days	Weeks	Days	Years	Months
	3 % Boric Acid	Months	Weeks	Months/ Years	Weeks/ Months	Years	Months
	3 % Phenolic Solution	Weeks/ Months	Days	Months/ Years	Weeks	Years	Months However, tensile strength only 50 % due to swelling
The action of 3 % solutions of formic acid, propionic acid, butyric acid, lauric acid, oleic acid, stearic acid etc., will be comparable.							
2. Chelating Carbon Acids	3 % Citric Acid	Months	Days	Months	Days	Years	Months
3. Weak Mineral Acids	3 % Sodium Bisulphate Solution	Months	Days/ Weeks	Months/ Years	Weeks	Years	Months
	3 % Phosphoric Acid	Months	Days	Months	Weeks	Years	Months
4. Strong Mineral Acids	3 % Hydrochloric Acid	Days	Hours	Days	Hours	Years	Months
The action of 3 % sulphuric acid will be similar.							
5. Battery Acid	Battery Acid	Days	Hours	Days	Hours	Years	Months
6. Oxidizing Mineral Acids	3 % Nitric Acid	Days	Hours	Days	Hours	Days	Hours
7. Oxidizing Solutions, pH-value around 7	Hydrogen Peroxide 35 %	Weeks/ Months		Months		Months	
	Sodium Nitrate, 3 %	Months/ Years	Weeks	Years	Months	Years	Months
	Sodium Hypochlorite= Bleach (Javelle Water), 3 %	Weeks	Days	Weeks	Days	Months	Weeks
	Bleach (Javelle Water), 0.5 %	Months	Weeks	Months	Weeks	Years	Months
Surface becomes tacky							
Surface becomes tacky							

Code	Tested	Elastollan S 85 A		Elastollan C 85 A		Elastollan 1185 A	
		23° C	60° C	23° C	60° C	23° C	60° C
8. Reducing Solutions	Sodium Sulphite, 3 %	Months/ Years	Weeks/ Months	Years	Months	Years	Months
9. Alkaline Solutions	Saturated Calcium Hydroxide (Slaked Lime)	Months/ Years	Weeks	Years	Months	Years	Months
	3 % Soda Solution	Months/ Years	Weeks	Years	Months	Years	Months
	3 % Soda Lye (Caustic Soda)	Weeks	Days	Months	Weeks	Years	Months
	3 % Triethanolamine Solution	Months	Weeks	Months/ Years	Months	Years	Months
10. Basic Solutions	3 % Urea Solution	Months	Weeks	Months/ Years	Weeks	Years	Months
	3 % Ammonium Solution	Days	Hours	Weeks	Days	Years	Months
	3 % Ammonium Chloride Solution	Months/ Years	Weeks/ Months	Years	Months	Years	Months Reduced tensile strength due to swelling
11. Alcohols	Methanol	Days		Weeks/ Months		Months	
	Ethanol	Months		Months		Years	
	Iso-Propanol	Months		Months		Years	
12. FAM Test Fluids acc. to DIN 51604*	Test Fluid A	Months		Years		Years	
	Test Fluid B	Days		Months		Months severe swelling	
	Test Fluid C	Days		Weeks		Months severe swelling	
13. ASTM-Oils acc. to ASTM D 471*	ASTM-Oil 1	Years	Months	Years	Months	Years	Months
	IRM 902	Years	Months	Years	Months	Years	Months
	IRM 903	Years	Months	Years	Months	Years	Months

Code	Tested	Elastollan S 85 A		Elastollan C 85 A		Elastollan 1185 A		
		23° C	60° C	23° C	60° C	23° C	60° C	
14. Miscellaneous	Anti-freeze (Glysantine/Water 1/1.5)	Months	Weeks	Months/ Years	Weeks	Years	Months	
	Silicone Fluid (Dimethyl Polysiloxane)	Years	Months	Years	Months	Years	Months	
	Brake Fluid	Hours	Hours	Hours	Hours	Hours	Hours	
	Brake fluid/many hydraulic oils attack TPU							
	Trichloroethane volume swelling:	Months 39 %		Months 41 %		Months 52 %		
	Ethyl Acetate	Months		Months		Months Reduced tensile strength due to swelling		
	Volume swelling:	75 %		70 %		70 %		

* DIN 51 604, is the standard, established by FAM to assess the resistance of plastic materials to automotive fuels.

(FAM = Fachausschuss Mineral- und Brennstoff-normung-Professional committee for standardization of fuel stuffs)

(ASTM = American Society for Testing and Materials)

Test fluid A consists of:
 50.0 % by volume toluene
 30.0 % by volume iso-octane
 15.0 % by volume di-isobutylene
 5.0 % by volume ethanol

Test fluid B consists of:
 42.0 % by volume toluene
 25.5 % by volume iso-octane
 13.0 % by volume di-isobutylene
 15.0 % by volume methanol
 4.0 % by volume ethanol
 0.5 % by volume water

Test fluid C consists of:
 20.0 % by volume toluene
 12.0 % by volume iso-octane
 6.0 % by volume di-isobutylene
 58.0 % by volume methanol
 2.0 % by volume ethanol
 2.0 % by volume water

Resistance of Elastollan to Solvents

15. Solvents

No degradation of Elastollan products occurs, however, according to the solvent class a variable degree of swelling and consequent reduction in tensile strength (after evaporation of the solvents, the tensile strength recovers approx. its original value). Methanol should be considered more as a chemical reagent than as a solvent! TPU is soluble in some solvents.

As test procedure, S2 dumb-bells **were immersed in the solvent for three weeks at 23° C**, and tested for tensile strength and residual swell 15 minutes after withdrawal. The values of volume swelling and reduction of tensile strength are quoted as an average guide.

Code	Tested	Elastollan S 85 A		Elastollan C 85 A		Elastollan 1185 A		
		% Swelling	% Reduction of Tensile Strength	% Swelling	% Reduction of Tensile Strength	% Swelling	% Reduction of Tensile Strength	
15.1 Aliphatic Hydrocarbons	Pentane	3	2.0	4.5	10	10	20	
	Cyclohexane	4	15	7	10	22	10	
	Iso-Octane	2.5	none	2.5	none	7.5	none	
Elastollan types behave similarly in other aliphatic and cyclo-aliphatic hydrocarbons such as methane, ethane, propane, butane, hexane, octane, petroleum ether, paraffin oil, diesel oil and kerosine (although additives can present problems).								
15.2 Aromatic Hydrocarbons	Toluene	52	55	60	45	65	50	
Other aromatic hydrocarbons such as benzene and xylene have a similar affect.								
15.3 Aliphatic Esters	Ethyl Acetate	75	70	70	65	70	75	
Other short-chained esters such as butyl acetate and amyli acetate have a similar affect.								
15.4 Aliphatic Ketones	Methyl Ethyl Ketone	105	80	110	80	130	90	
Other short-chained aliphatic ketones such as acetone and methyl isobutyl ketone = MIBK have a similar affect.								
15.5 Aliphatic Halogenated Hydrocarbons, 1 C-atom	Methylene Chloride	175	75	155	65	190	95	
	Chloroform	280	75	260	70		practically dissolved	
	2C-atoms	Tetrachloroethylene	20	40	28	35	50	45
	and higher	Trichloroethane	54	39	65	39	75	54
Other aliphatic halogenated hydrocarbons with 2 C-atoms and higher have a similar affect.								

Code	Tested	Elastollan S 85 A		Elastollan C 85 A		Elastollan 1185 A		
		% Swelling	% Reduction of Tensile Strength	% Swelling	% Reduction of Tensile Strength	% Swelling	% Reduction of Tensile Strength	
15.6 Aromatic Halogenated Hydrocarbons	Chlorobenzene	90	60	100	55	110	60	
	Other aromatic halogenated hydrocarbons have a similar affect.							
15.7 ASTM-Oils acc. to ASTM D 471*	ASTM-Oil 1 at 100° C	2	none	none	none	1	none	
	IRM-902 at 100° C	1	none	3	none	12	none	
	IRM-903 at 100° C	3	none	6	none	18	none	
15.8 Agents Dissolving TPU	Tetrahydrofurane	> 450	practically dissolved	> 450	practically dissolved		dissolved	
	Dimethyl Formamide (DMF)		dissolved		dissolved		dissolved	
	Dimethyl Acetamide		dissolved		dissolved		dissolved	
	N-Methyl Pyrrolidone (NMP)		dissolved		dissolved		dissolved	
	Dimethyl Sulphoxide (DMSO)		dissolved		dissolved		dissolved	
	Pyridine		dissolved		dissolved		dissolved	
16. Alcohols and Fuels	Methanol	18	80 poor resistance	18	58 limited resistance for sev. weeks	28	60	
	Ethanol	16	52	18	52	33	64	
	Iso-Propanol	14	44	17	42	30	50	
	Benzyl Alcohol	300	95	270	85	not measurable	partly dissolved	
	Ethylene Glycol	2	poor resistance none	2	poor resistance none	4	poor resistance 15	
	Glycerine	none	none	none	none	none	none	
	FAM Test Fluids acc. to DIN 51 604*	Test Fluid A	39	55	45	50	67	60
		Test Fluid B	38	72 poor resistance	38	55 limited resistance for sev. weeks	68	74
		Test Fluid C	21	60 poor resistance	24	50 limited resistance for sev. weeks	43	70
	Diesel Fuel	Diesel Fuel	3.0	15	5.0	none	11	none
Biodiesel Fuel	RME at 60°C			9	9	27	21	

Code	Tested	Elastollan S 85 A		Elastollan C 85 A		Elastollan 1185 A	
		% Swelling	% Reduction of Tensile Strength	% Swelling	% Reduction of Tensile Strength	% Swelling	% Reduction of Tensile Strength
Fuel Types ASTM D 471	Fuel A = Iso-Octane	2.5	none	2.5	none	7.5	none
	Fuel B = Iso-Octane/ Toluene 70 %/30 %	13	30	18	32	25	36
	Fuel C = Iso-Octane/ Toluene 50 %/50 %	21	40	27	38	38	44
	Fuel D = Iso-Octane/ Toluene 60 %/40 %	17	37	21	36	31	44

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 58.0 % by volume methanol
 2.0 % by volume ethanol
 2.0 % by volume water

Competence in Polyurethanes

With top quality products, a reputation for good customer service and continuous progress and development, Elastollan has secured a firm position in numerous markets.

We want to share our know-how and experience to contribute to your own success: The versatile Elastollan is the ideal material to fulfill your requirements.

For further information, the following detailed brochures are available upon request:

- Thermoplastic Polyurethane Elastomers: Elastollan
- Elastollan – Product Range
- Elastollan – Material Properties
- Elastollan – Processing Recommendations
- Elastollan – Electrical Properties

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