

Material Properties

Chemical Resistance

Acid and Alkaline

TPU products are readily attacked by concentrated acid and alkaline solutions. Any contact with this type of chemical medium should be avoided. Elastollan® products are resistant to dilute acid and alkaline solutions. After immersion at R.T. for 105 days in 1 and 10% ammonium solution and 1 and 10% sulfuric acid solution, a reduction in tensile strength of 20-25% and about 10% respectively was observed, and a swelling of 0.5-2.0%. Elastollan® 1100 Series, polyether based, is better suited in this environment than the "S" or "C" Series.

Gasoline and Other Hydrocarbons

Elastollan® "C" and "S" Series products are resistant to cyclohexane, diesel fuel, isooctane, petroleum ether, kerosene and bitumen. A completely reversible swelling is observed with a 1-3% increase in volume at R.T. and a tolerable drop in tensile strength of only 20%. In regular grade gasoline a 15% increase in volume is observed with a 30% reduction in tensile strength.

Premium Gasoline and Aromatic Hydrocarbons

When immersed in benzene and toluene at R.T. Elastollan® products swell to about 50%. This can create about a 10 point reduction in Shore A hardness and up to 22 points in Shore D hardness. In premium gasoline the affect on Elastollan® products increases with the aromatic content of the gasoline

(i.e. the higher the grade of gasoline, the more effect it has on Elastollan® products). A maximum reduction of 3 points on the A scale and 8 points on the D scale is observed and a 20% increase in volume due to swelling.

ASTM Oils and Fuels

The affect of ASTM oils and fuels on Elastollan® products lie between those of saturated and aromatic hydrocarbons. Tests were made at 23°C (73°F) using ASTM 1, 2, 3 oils and ASTM A, B and C fuels.

Lubricating Oils and Greases

Elastollan® was immersed in the standard gear oils, SAE-80 and SAE-90, at 23°C. And also in the standard motor oils, SAE 20W50, SAE 20W40 and HD-20 at 23°C. The lubricating greases used were BP Energrease HT-EP-00 (calcium based), BP Energrease GP 3-G (calcium based), BP Energrease LS-2 (lithium based), BP Energrease HTO (sodium based) and BP Energrease RBB-2 (sodium based). All were evaluated at 23°C. Elastollan® "C" and "S" grades are relatively resistant to these materials even up to 80°C, with a very low percentage in swell.

Solvents

When immersed in aliphatic alcohols such as methanol, ethanol and isopropyl alcohols, Elastollan® "C" and "S" series products swell to a maximum of 13% volume, with a corresponding drop in tensile strength. This effect is

accelerated at higher temperatures. The loss in properties however, is reversible when the solvent has evaporated from the Elastollan® parts.

Elastollan® grades swell when immersed in chlorinated solvents. The lower the molecular weight of the solvent, the stronger the swelling effect. Because of the extent of swelling in methylene chloride, ethylene chloride and perchlorethylene, it is suggested that these materials not come in contact with Elastollan® parts, or, if they must, only for very short-term contact. The swelling, as mentioned above, is reversible. This is also true with respect to mechanical properties.

Ketones, such as acetone, methyl ethyl ketone and especially cyclohexanone are actually good solvents for TPU compounds. For this reason, TPU products are also not suitable in applications requiring contact with aliphatic ester, such as ethylene acetate and butylene acetate. These solvents also have a strong swelling affect on TPU products. Tetrahydrofuran and aniline also readily dissolve or severely swell parts made from TPU products.

Table VI summarizes the performance of Elastollan® grades exposed to various chemicals at 23°C (78°F).

Note: This information is provided as a guideline only. We recommend that you test the Elastollan® products to your application requirements.

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Chemical Resistance

Table VI - Chemical Resistance Chart

	Swell rating*		Recommended Usage**	
	1100	C & S 600	1100	C & S 600
Acids				
Acetic, 3n	⊕	⊕	S	N
Boric, 4%	⊕	∅	S	N
Chromic, 3n	-	-	N	N
Citronic, 3n	⊕	⊕	S	N
Formic, 3n	-	-	N	N
HCl, 3n	+	+	S	S
Lactic, 3n	∅	∅	S	N
Nitric, 3n	-	○	N	N
Phosphoric, 3n	-	∅	N	N
Sulfuric, <20%	+	+	S	S
Sulfuric, >20%	⊕	⊕	S	N
Alkalines				
Ammonia, 3n	+	+	S	S
Potassium Hydroxide, 3n	+	+	S	S
Sodium Hydroxide, <20%	+	+	S	S
Sodium Hydroxide, >20%	∅	∅	N	N
Aqueous Solution				
Aluminum Chloride, 10%	⊕	+	S	S
Ammonium Chloride, 10%	⊕	+	S	S
Bleaching Agent, 40%	+	+	S	S
Bleaching Agent, 100%	⊕	⊕	N	S
Calcium Chloride, 40%	⊕	+	S	S
Caustic Soda, 10%	+	+	C	S
Ferric Chloride, 10%	⊕	⊕	S	S
Hydrogen Peroxide, 3%	+	+	C	S
Magnesium Chloride, 30%	⊕	+	S	S
Potassium Chloride, 40%	⊕	+	S	S
Potassium Dichromate, 10%	⊕	+	S	S
Potassium Permanganate, 5%	-	∅	N	N
Sea Water	+	+	C	S
Sodium Bisulfate, 10%	⊕	⊕	S	S
Sodium Chloride, 10%	⊕	+	S	S
Sodium Hypochlorite, PH 13	+	+	C	S

*Swell Rating

- + Excellent 0-3%
- ⊕ Good 4-15%
- ∅ Fair 16-30%
- Poor > 30%
- Dissolves

	Swell rating*		Recommended Usage	
	1100	C & S 600	1100	C & S 600
Fuels				
ASTM Fuel A	+	+	S	C
ASTM Fuel B	∅	∅	S	S
ASTM Fuel C	∅	∅	S	S
Diesel Fuel	⊕	+	S	C
Gasohol (10-15% Methanol)	-	∅	N	S
High-test (Super) Gasoline	-	∅	N	S
Kerosene	+	+	S	C
Oils				
ASTM Oil #1	+	+	S	C
ASTM Oil #2	+	+	S	C
ASTM Oil #3	+	+	S	C
Break Fluid (ATE or ATS)	-	-	N	N
Gear Box Oil (SAE 90)	+	+	S	C
Hydraulic Fluid	⊕	+	S	C
Hydraulic/Water Emulsion	⊕	+	S	S
Mineral Oil	+	+	S	C
Motor Oil	+	+	S	C
Paraffin Oil	+	+	S	C
Power Steering Fluid	⊕	+	S	C
Skydrol 500 Oil	-	-	N	N
Greases				
Calcium Grease	+	+	C	S
Sodium Grease	+	+	C	S
Teflon Grease	+	+	C	C
Miscellaneous				
Diocetyl Phthalate (DOP)	+	+	C	C
Ethylene Chloride	⊕	⊕	S	S
Ethylene Glycol/Water 50/50	⊕	⊕	S	S
Household Cleaner	⊕	+	S	C
Naptha	+	+	C	C
Silage (Silo) Juice	⊕	⊕	S	S
Natural Perspiration	+	⊕	C	S
Tincture of Iodine	-	-	N	N
Tricresyl Phosphate	-	-	N	N

**Recommended usage

- C = Continuous/dynamic use
- S = Intermit/static use
- N = Not recommended

	Swell rating*		Recommended Usage	
	1100	C & S 600	1100	C & S 600
Solvents				
Acetone	-	-	N	N
Aniline	-	-	N	N
Benzene	-	-	N	N
Benzyl Alcohol	○	○	N	N
Butane	⊕	⊕	S	S
Butyl Acetate	-	-	N	N
Butyl Alcohol	-	∅	N	S
Carbon Tetrachloride	-	∅	N	S
Chlorobenzene	-	-	N	N
Chloroform	-	-	N	N
Cyclohexane	∅	⊕	N	S
Ethanol	∅	∅	N	S
Ether	∅	∅	N	S
Ethyl Acetate	-	-	N	N
Freon 11, 12, 22	∅	∅	N	S
Glycerin & Glycol	+	+	C	C
Heptane	⊕	+	S	C
Hexane	⊕	⊕	S	S
Isopropyl Alcohol	∅	∅	N	S
Methanol	∅	⊕	N	S
Methyl Acetate	-	-	N	N
Methyl Ethyl Ketone	∅	-	N	N
Methyl Glycol	-	-	N	N
Methylene Chloride	-	-	N	N
N-Methyl Pyrrolidone	○	○	N	N
Perchloroethylene	-	-	N	N
Petroleum	⊕	+	S	C
Pyridine	○	○	N	N
Turpentine (Pine Oil)	⊕	⊕	S	S
Tetrachloroethylene	-	-	N	N
Tetrahydrofuran	-	-	N	N
Toluene	-	-	N	N
Trichloroethylene	-	-	N	N
Xylene	-	-	N	N