



Hytrel[®]

Thermoplastic Polyester Elastomer

Fluid and chemical resistance guide



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Fluid and chemical resistance guide

The data tabulated in this report document the effects of a broad variety of chemicals, solvents, oils and hydraulic fluids on HYTREL[®] thermoplastic polyester elastomer¹. A summary guide to the chemical resistance of HYTREL[®] is presented in Table I. As a general rule, the resistance of HYTREL[®] to fluids and chemicals increases as the hardness of the polymer increases (see Table II). Stress-strain and volume increase data for 40D, 55D and 72D grades of HYTREL[®] following immersion in a variety of fluids are listed in Tables III through V.

Resistance to various classes of fluids

HYTREL[®] has excellent resistance to non-polar materials such as oils and hydraulic fluids, even at elevated temperatures. If necessary, resistance to hot oils can be further enhanced by heat-stabilisation. The superior hot oil ageing resistance of heat-stabilised types such as HYTREL[®] 5555HS² is described in other literature (see bulletin HYT-105).

HYTREL[®] is resistant to most polar fluids – such as acids, bases, amines and glycols at room temperature. However, its resistance to polar fluids is poor at temperatures of 70°C or above. HYTREL[®] should not be used in service that requires continuous exposure to these fluids at elevated temperatures.

Resistance of HYTREL[®] to moist environments is good at room temperature.

Hydrolytic stability can be improved at elevated temperature by incorporating HYTREL[®] 10MS as a stabiliser. Recommendations covering the use of HYTREL[®] 10MS³ are presented in bulletin HYT-114.

HYTREL[®] vs, some other thermoplastics

In general, HYTREL[®] is resistant to the same classes of chemicals and fluids, as are polyurethanes, both ester and ether based. However, HYTREL[®] has better high temperature properties than the polyurethanes, and can be used satisfactorily at higher temperatures in the same fluids. For example, after exposure at 150°C for 7 days in ASTM Oil No. 1, 55D HYTREL[®] swells only about 2%, and retains 60% of its original tensile strength and 90% of its original elongation; polyurethanes of equivalent hardness degrade in less than a week at the same conditions.

HYTREL[®] thermoplastic polyester elastomers do not contain an extractable plasticizer, as do flexible vinyls, certain grades of nylon and many rubber compounds. Many fluids and chemicals will extract the plasticizer from these materials, causing a significant increase in stiffness (modulus) and volume shrinkage. For example, a plasticised nylon of approximately 63D hardness undergoes a two-fold increase in modulus and shrinks about 10% when exposed to ASTM Oil No. 1 for 7 days at 120°C. HYT HYTREL[®] shows no change in modulus and swells approximately 0,3% under the same exposure conditions.

^{1, 2, 3} These superscript numbers refer to the proprietary materials listed on page 9.

Table I Chemical resistance guide for HYTREL®

The data tabulated below summarise the effects of a broad variety of fluids on HYTREL® thermoplastic polyester elastomers. As a general rule the resistance of HYTREL® to fluids and chemicals increases as the polymer hardness increases.

Unless otherwise noted the ratings shown in the table apply to all hardness grades.

Rating Key: A – Fluid has little or no effect
 B – Fluid has minor to moderate effect
 C – Fluid has severe effect
 T – No data – likely to have minor effect
 X – No data – likely to have severe effect

Ratings are at 23°C unless otherwise specified. Concentrations of aqueous solutions are saturated, except where noted.

We emphasise that the data contained herein should be used as a **guide only**. The tabulation is based primarily on laboratory tests but **does not** take into account all variables that can be encountered in actual use. Therefore it is advisable to test the material under actual service conditions before specification. If this is not practical, tests should be devised that simulate service conditions as closely as possible.

Chemical	Rating	Chemical	Rating
Acetic Acid, 20%	A	Boric Acid Solutions	A
Acetic Acid, 30%	A	Bromine, Anhydrous Liquid	X
Acetic Acid, Glacial	A	Butane	A
Acetic Acid, Glacial (38°C)	B	Butyl Acetate	B (40, 55D)
Acetic Anhydride	T	Butyl Acetate	A (72D)
Acetone	B	Calcium Chloride Solutions	A
Acetylene	A	Calcium Hydroxide Solutions	T
Aluminium Chloride Solutions	T	Calcium Hypochlorite, 5%	A
Aluminium Sulphate Solutions	T	Carbon Bisulfide	B (40, 55D)
Ammonium Chloride Solutions	A	Carbon Bisulfide	A (72D)
Ammonium Hydroxide Solutions	T	Carbon Dioxide	A
Ammonium Sulphate Solutions	B (40, 55D)	Carbon Monoxide	A
Ammonium Sulphate Solutions	A (72D)	Carbon Tetrachloride	C (40D)
Amyl Acetate	B	Carbon Tetrachloride	B (55D)
Amyl Alcohol	A	Carbon Tetrachloride	A (72D)
Aniline	C	Castor Oil	B (40, 55D)
ASTM Oil No. 1 (150°C)	A	Castor Oil	A (72D)
ASTM Oil No. 3 (150°C)	A	Chlorine Gas, Dry	X
ASTM Reference Fuel A (70°C)	A	Chlorine Gas, Wet	X
ASTM Reference Fuel B (70°C)	A	Chloroacetic Acid	X
ASTM Reference Fuel C	A	Chlorobenzene	X
ASTM Reference Fuel C (70°C)	B (40, 55D)	Chloroform	C (40, 55D)
ASTM Reference Fuel C (70°C)	A (72D)	Chloroform	B (72D)
Asphalt	T	Chlorosulfonic Acid	C
Atrazine	A	Citric Acid Solutions	A
Barium Hydroxide Solutions	T	Copper Chloride Solutions	A
Beer	A	Copper Sulphate Solutions	A
Benzene	B (40, 55D)	Cottonseed Oil	A
Benzene	A (72D)	Cyclohexane	A
Borax Solutions	A	Dibutyl Phthalate	A

Table I Chemical resistance guide for HVTREL® (continued)

Chemical	Rating	Chemical	Rating
Diethyl Sebacate	A	Mercury	A
Dioctyl Phthalate	A	Methyl Alcohol	A
DUAL ⁵	A	Methyl Ethyl Ketone	B (40, 55D)
Epichlorohydrin	X	Methyl Ethyl Ketone	A (72D)
Ethyl Acetate	B (40, 55D)	Methylene Chloride	C
Ethyl Acetate	A (72D)	Mineral Oil	A
Ethyl Alcohol	A	Naphtha	A
Ethyl Chloride	C (40, 55D)	Naphthalene	B (40, 55D)
Ethyl Chloride	B (72D)	Naphthalene	A (72D)
Ethylene Dichloride	C (40, 55D)	Nitric Acid, 10%	B
Ethylene Dichloride	B (72D)	Nitric Acid, 30%	C
Ethylene Glycol	A	Nitric Acid, 60%	C
Ethylene Oxide	A	Nitric Acid, 70%	C
Ferric Chloride Solutions	T	Nitric Acid, Red Fuming	C
Fluosilicic Acid	T	Nitrobenzen	C
Formaldehyde, 40%	B	Oleic Acid	A
Formic Acid	B	Oleum, 20-25%	C
FREON 11 ⁶	A	Palmitic Acid	A
FREON 12	A	Perchloroethylene	C (40, 55D)
FREON 113 (55°C)	A	Perchloroethylene	B (72D)
FREON 114	A	Petrol	B (55D)
Glue	A	Petrol	A (72D)
Glycerine	A	Phenol	C
n-Hexane	A	Pickling Solution (20% Nitric Acid, 4% HF)	X
Hydrazine	C	Pickling Solution (17% Nitric Acid, 4% HF)	X
Hydrochloric Acid, 20%	B	Potassium Dichromate Solutions	T
Hydrochloric Acid, 37%	C	Potassium Hydroxide Solutions	A
Hydrocyanic Acid	T	PYDRAUL 312 ¹⁰	A
Hydrofluoric Acid, 48%	X	Pyridine	X
Hydrofluoric Acid, 75%	X	SAE 10 Oil	A
Hydrofluoric Acid, Anhydrous	X	Sea Water	A
Hydrogen	A	Silicone Grease	A
Hydrogen Sulphide	A	SKYDROL 500B ¹¹	A
Isooctane	A	Soap Solutions	A
Isopropyl Alcohol	A	Sodium Chloride Solutions	A
JP-4 Jet Fuel	A	Sodium Dichromate, 20%	T
Kerosene	T	Sodium Hydroxide, 20%	A
Lacquer Solvents	B (40, 55D)	Sodium Hydroxide, 46,5%	B
Lacquer Solvents	A (72D)	Sodium Hypochlorite, 5%	A
Lactic Acid	T	Soybean Oil	T
Linseed Oil	T	Stannous Chloride, 15%	T
Lubricating Oils	A	Steam (100°C)	B
Magnesium Chloride Solutions	T	Steam (110°C)	C
Magnesium Hydroxide Solutions	T	Stearic Acid	T
Mercuric Chloride Solutions	T	Styrene	X

Table I Chemical resistance guide for HYTREL® (continued)

Chemical	Rating	Chemical	Rating
Sulphur, Molten	T	Trichloroethylene	B (72D)
Sulphur Dioxide, Liquid	T	Triethanolamine	C
Sulphur Dioxide, Gas	T	Trisodium Phosphate Solution	A
Sulphuric Acid, up to 50%	A	Tung Oil	T
Sulphuric Acid, above 50%	C	Water (70° C)	A
Sulphuric Acid, Fuming (20% Oleum)	C	Water (100° C)	B
Sulphurous Acid	B	Xylene	B (40, 55D)
Tannic Acid, 10%	A	Xylene	A (72D)
Tartaric Acid	T	Zinc Chloride Solutions	A
Tetrahydrofuran	B (40, 55D)		
Tetrahydrofuran	A (72D)		
Toluene	B (40, 55D)		
Toluene	A (72D)		
TREFLAN ¹²	B		
Trichloroethylene	C (40, 55D)		

Table II Effect of hardness on chemical and fluid resistance of HYTREL®

Fluid	Immersion		Volume increase, %		
	Time days	Temperature °C	40D HYTREL®	55D HYTREL®	72D HYTREL®
Oils and Hydraulic Fluids					
ASTM Oil No. 1	7	100	2	2	<1
ASTM Oil No. 3	7	100	23	11	4
Ethylene Glycol	7	23	<1	<1	<1
PYDRAUL 312 ¹⁰	7	100	110	31	15
SKYDROL 500B ¹¹	7	100	–	22	–
Solvent and Fuels					
ASTM Ref. Fuel C	7	23	50	24	9
n-Butyl Alcohol	7	23	18	11	2
CELLOSOLVE Acetate ⁴	7	23	40	19	6
Isooctane	7	23	8	5	<1
Methyl Isobutyl Ketone	7	23	42	19	6
Xylene	7	23	88	36	13
Halocarbons					
FREON 113 ⁶	7	23	19	7	<1
Perchloroethylene	7	23	81	32	10
Trichloroethylene	7	23	Dissolved	67	25
Acids and Bases					
Acetic acid, glacial	7	38	No data	39	16
Acetic acid, 5%	7	38	No data	<1	<1
Formic acid, conc.	7	23	57	31	No data
Formic acid, 50%	7	23	11	8	No data
Sodium Hydroxide, 20%	7	23	<1	<1	<1
Sulphuric acid, 20%	7	23	<1	<1	<1

Table III Fluid and chemical resistance of 40D HYTREL® thermoplastic polyester elastomer

		Original properties at 23°C:		Tensile strength	28,0 MPa		
				Elongation	550%		
Fluid	Immersion		% of original retained after immersion ^a				
	Time days	Temperature °C	Tensile strength	Elongation	Volume increase, %		
Oils and Hydraulic Fluids							
ASTM Oil No. 1	7	23	100	101	<1		
ASTM Oil No. 1	7	100	83	103	2		
ASTM Oil No. 3	7	23	99	107	8		
ASTM Oil No. 3	7	100	78	96	23		
Crude oil, Algerian	3	70	108	101	21		
PYDRAUL 312 ¹⁰	7	23	90	112	40		
PYDRAUL 312 ¹⁰	7	100	50	104	110		
URSA Oil ¹³	7	23	112	110	1		
URSA Oil ¹³	7	100	93	104	5		
Solvents and Fuels							
ASTM Reference Fuel B	7	23	100	104	28		
ASTM Reference Fuel B	7	70	78	96	36		
ASTM Reference Fuel C	7	23	62	110	50		
ASTM Reference Fuel C	7	70	47	89	88		
n-Butyl alcohol	7	23	82	113	18		
CELLOSOLVE Acetate ⁴	7	23	83	110	40		
Isooctane	7	23	106	104	8		
Methyl isobutyl ketone	7	23	57	81	42		
Xylene	7	23	57	74	88		
Halocarbons							
FREON 113 ⁶	7	23	99	107	19		
Perchloroethylene	7	23	73	98	81		
Trichloroethylene	7	23	Dissolved				
Acids and Bases							
Formic acid, conc.	7	23	47	94	57		
Formic acid, 50%	7	23	58	108	11		
Formic acid, 25%	7	23	72	110	5		
Formic acid, 10%	7	23	71	114	2		
Sodium hydroxides 20%	7	23	100	103	<1		
Sulphuric acid, 20%	7	23	91	100	<1		
Miscellaneous							
Dimethyl formamide	7	23	85	111	39		
Ethylene glycol	7	23	76	102	<1		
Nitromethane	7	23	65	103	33		
WESSON oil ¹⁴	7	23	90	102	<1		

^a These properties were measured at room temperature at a strain rate of 50 mm/min on dumbbells die from slabs injection-moulded under standard conditions.

Table IV Fluid and chemical resistance of 55D HYTREL® thermoplastic polyester elastomer

Fluid	Original properties at 23°C:		Tensile strength	40,0 MPa	
			Elongation	500%	
	Immersion		% of original retained after immersion ^a		
	Time days	Temperature °C	Tensile strength	Elongation	Volume increase, %
Oils and Hydraulic Fluids					
ASTM Oil No. 1	7	100	94	100	2
ASTM Oil No. 1	7	121	100	109	2
ASTM Oil No. 1	7	150	97	125	2
ASTM Oil No. 2	7	100	108	105	7
ASTM Oil No. 2	7	121	105	109	8
ASTM Oil No. 2	7	150	95	118	11
ASTM Oil No. 3	7	100	104	107	11
ASTM Oil No. 3	7	121	102	109	13
ASTM Oil No. 3	7	150	61	86	18
Automatic transmission fluid,					
Type A	7	100	109	130	5
Type A	7	121	110	109	6
Type A	7	150	105	123	8
Type A	14	150	60	89	9
Automatic transmission fluid,					
Type F	7	100	104	100	5
Type F	7	121	101	103	6
Type F	7	150	92	131	8
HARMONY Oil No. 41 ⁷	7	100	101	98	3
HARMONY Oil No. 41	7	121	104	103	4
HARMONY Oil No. 41	7	150	35	8	-3
HOUGHTO-SAFE 620 ⁸	7	70	95	96	<1
HOUGHTO-SAFE 620	14	70	95	103	<1
PYDRAUL 312 ¹⁰	7	100	90	91	31
PYDRAUL 312	7	121	77	91	40
PYDRAUL 312	14	121	80	101	41
SKYDROL 500B ¹¹	7	100	72	80	22
SKYDROL 500B	7	121	<10	<10	32
Solvents and Fuels					
ASTM Reference Fuel C	7	23	93	94	24
ASTM Reference Fuel C	7	70	105	102	31
n-Butyl alcohol	7	23	116	100	11
CELLOSOLVE Acetate ⁴	7	23	95	94	19
Isooctane	7	23	106	94	
Methyl isobutyl ketone	7	23	108	97	19
Xylene	7	23	108	97	36
Halocarbons					
Carbon tetrachloride	7	23	94	94	32
FREON 113 ⁶	7	23	102	106	7
Perchloroethylene	7	23	96	100	32
Trichloroethylene	7	23	99	106	67

Table IV Fluid and chemical resistance of 55D HVTREL[®] thermoplastic polyester elastomer (continued)

Fluid	Immersion		% of original retained after immersion ^a		
	Time days	Temperature °C	Tensile strength	Elongation	Volume increase, %
Acids and Bases					
Acetic acid, glacial	7	38	85	88	39
Acetic acid, 5%	7	38	128	112	<1
Formic acid, conc.	7	23	82	89	31
Formic acid, 50%	7	23	84	111	8
Formic acid, 25%	7	23	95	105	4
Formic acid, 10%	7	23	100	109	2
Sodium hydroxide, 20%	7	23	95	106	<1
Sulphuric acid, 20%	7	23	92	106	<1
Miscellaneous					
Aniline	7	23	51	64	93
Dibutyl phthalate	7	23	110	97	12
Diethylene glycol	7	23	101	97	1
Dimethyl formamide	7	23	98	94	19
Dioctyl phthalate	7	23	121	112	3
Ethylene glycol	7	23	101	94	<1
Nitromethane	7	23	100	109	17
Toluene diisocyanate (mixed isomers)	7	23	97	90	41
WESSON Oil ¹⁴	7	23	98	94	<1

b These properties were measured at room temperature at a strain rate of 50 mm/min on dumbbells die from slabs injection-moulded under standard conditions.

c These values are based on unmodified HVTREL[®]; the superior hot oil ageing of heat-stabilised types such as HVTREL[®] 5555HS is covered in other literature.

Table V Fluid and chemical resistance of 72D HYTREL® thermoplastic polyester elastomer

		Original properties at 23°C:		Tensile strength	46,0 MPa		
				Elongation	400%		
Fluid	Immersion		% of original retained after immersion ^a				
	Time days	Temperature °C	Tensile strength	Elongation	Volume increase, %		
Oils and Hydraulic Fluids							
ASTM Oil No. 1	7	121	83	62	<1		
ASTM Oil No. 1	7	150	98	88	1		
ASTM Oil No. 3	7	121	92	62	5		
ASTM Oil No. 3	7	150	83	31	6		
Automatic transmission fluid,							
Type A	7	121	97	70	1		
Type A	7	150	101	96	2		
Automatic transmission fluid,							
Type F	7	121	98	74	2		
Type F	7	150	99	94	2		
PYDRAUL 312 ¹⁰	7	121	97	112	15		
Solvents and Fuels							
ASTM Reference Fuel B	7	23	102	104	4		
ASTM Reference Fuel B	7	50	94	101	9		
ASTM Reference Fuel C	7	23	99	104	9		
ASTM Reference Fuel C	7	50	104	103	12		
n-Butyl alcohol	7	23	108	112	2		
CELLOSOLVE Acetate ⁴	7	23	104	112	6		
Isooctane	7	23	98	112	<1		
J P-4 jet fuel	7	23	107	103	<1		
J P-4 jet fuel	7	38	112	106	<1		
Methyl isobutyl ketone	7	23	109	112	6		
Xylene	7	23	99	101	13		
Halocarbons							
Carbon tetrachloride	7	23	109	109	7		
FREON 113 ⁶	7	23	106	110	<1		
Perchloroethylene	7	23	102	104	10		
Trichloroethylene	7	23	98	93	25		
Acids and Bases							
Acetic acid, glacial	7	38	93	100	16		
Acetic acid, 5%	7	38	107	113	<1		
Sodium hydroxide, 20%	7	23	90	104	<1		
Sodium hydroxide, 10%	7	23	109	110	<1		
Sulphuric acid, 20%	7	23	110	117	<1		
Sulphuric acid, 10%	7	23	102	110	<1		
Miscellaneous							
Aniline	7	23	82	88	31		
Dibutyl phthalate	7	23	98	112	<1		
Ethylene glycol	7	23	100	114	<1		
Toluene diisocyanate (2,4 isomer)	7	23	110	104	6		
WESSON oil ¹⁴	7	23	101	110	<1		

^d These properties were measured at room temperature at a strain rate of 50 mm/min on dumbbells die from slabs injection-moulded under standard conditions.

Proprietary materials

Material	Composition	Supplier
1. HYTREL [®] polyester elastomers – 40, 55 and 72 durometer D hardness	Block copolymers of short-chain diol erephthalate and long-chain polyether diol terephthalate	Du Pont Company Engineering Polymers
2. HYTREL [®] 5555HS	Specially-stabilised 55D HYTREL [®]	
3. HYTREL [®] 10MS	Concentrate of aromatic polycarbodiimide in 40D HYTREL [®] : 20% PCD by weight :	
4. CELLOSOLVE [™] acetate solvent	Ethylene glycol monoethyl ether acetate	Union Carbide Corporation Chemicals and Plastics 270 Park Avenue New York, NY 10017
5. DUAL [™] herbicide	Metolachlor	Ciba Geigy Corp. P.O. Box 18300 Greensboro, N.C. 27419
6. FREON [®] refrigerants FREON 11 FREON 12 FREON 113 FREON 114	Trichlorofluoromethane Dichlorodifluoromethane Trichloroirifluoroethane Dichlorotetrafluoroethane	Du Pont Company FREON Products Division
7. HARMONY [™] Oil No. 41	Hydrocarbon oil	Gulf Oil Company-U.S. 1167 Gulf Building Addition Houston, TX 77002
8. HOUGHTO-SAFE [™] 620 hydraulic fluid	Water/glycol fluid	E. F. Houghton & Company 303 West Lehigh Avenue Department 1 54 Philadelphia, PA 19133
9. ORONITE [™] 8200 hydraulic fluid	Disiloxane fluid	Chevron Chemical Company Oronite Division 200 Bush Street San Francisco, CA 94120
10. PYDRAUL [™] 312 hydraulic fluid	Phosphate ester	Monsanto Company 800 North Lindbergh Boulevard St. Louis, MO 63166
11. SKYDROL [™] 500B	Phosphate ester	
12. TREFLAN [™] trifluralin	α, α, α -trifluoro-2,6-dinitro- N,N-dipropyl-p-toluidine	Elanco Products Co Division of Eli Lilly and Co. 740 Alabama St. Indianapolis, IN 46285
13. URSA [™] oil	Petroleum oil	Texaco, Incorporated 135 East 42nd Street New York, NY 10017
14. WESSON [™] oil	All-vegetable salad oil	Hunt-Wesson Foods, Inc. 1645 West Valencia Drive Fullerton, CA 92634

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