EVONIK INDUSTRIES

TROGAMID® T

Amorphous, transparent polyamides with an outstanding combination of properties

Evonik. Power to create.

Evonik is the creative industrial group from Germany, and a global leader in its core business of specialty chemicals. In addition, the group has energy and residential real estate operations.

Together with the Acrylic Monomers and Acrylic Polymers Business Lines, the High Performance Polymers Business Line is part of the Performance Polymers Business Unit, and specializes in customized products and product systems. Our plastics have proven their worth in the automotive, communications and electrical engineering industries, in the engineering, and in medical technology for approximately 40 years.

Evonik. Power to create.

Content

1 Introduction

Nomenclature

The TROGAMID® product range of High Performance Polymers Business Line consists of basic products and resins that are distinguished by their permanent transparency and high chemical resistance. The T grades comprise products based on PA 6-3-T only, while BX grades cover PA 6-3-T blends containing other semi-crystalline or amorphous polyamides. New, specially designed polyamides are designated as CX grades and are followed by a four-digit number.

This four-digit number has no specific meaning, e.g., viscosity number or composition. The table below provides further information about the nomenclature of the TROGAMID® range according to the commonly used ISO standards.

T grades: PA (Nylon) 6-3-T-based polymers and compounds made of trimethyl hexamethylene diamine and terephthalic acid, e.g., TROGAMID® T5000 or TROGAMID® T-GF35.

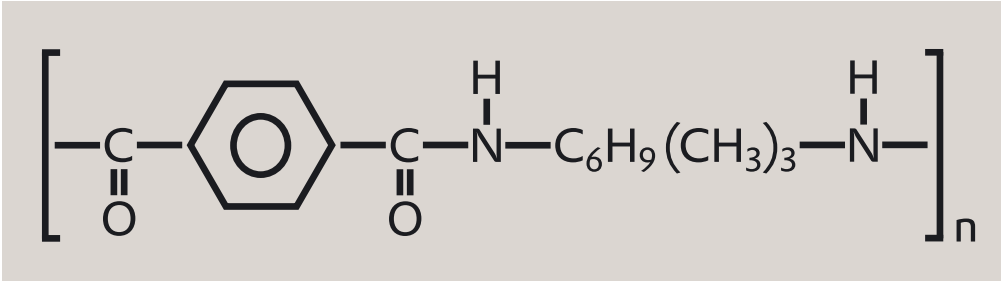
BX grades: PA 6-3-T and semi-crystalline polyamide blends, reinforced and unreinforced, e.g., TROGAMID® BX7304 or TROGAMID® BX9724.

CX grades: Special polyamide grades made of other monomers, e.g., TROGAMID® CX7323 or TROGAMID® CX9704

This brochure covers the TROGAMID® T and BX grades. Two other brochures contain information about the CX grades and about handling and processing TROGAMID® products.

Nomenclature of semi-aromatic / aliphatic amorphous polyamides

TROGAMID®	ISO 1043 nomenclature	ISO 1874 nomenclature	Monomers
T grades	PA 6-3-T	PA NDT/INDT	trimethyl hexamethylene diamine terephthalic acid
BX grades	PA 6-3-T/XX	Not applicable	trimethyl hexamethylene diamine terephthalic acid
CX grades	Not applicable	PA PACM 12	cycloaliphatic diamine dodecanedioic acid



Molecular base of TROGAMID® T

TROGAMID® T

TROGAMID® T and BX consist of terephthalic acid and 2,2,4- /2,4,4-trimethyl hexamethylene diamine, a chemical composition that is responsible for their amorphous structure. This makes TROGAMID® T transparent in contrast to the semi-crystalline high-performance plastics of High Performance Polymers. The amorphous structure also results in low molding shrinkage and low tendency to warp.

In addition to the basic products, a range of specially equipped compounds is also available. The product line fits a wide range of applications and satisfies many requirement profiles.

TROGAMID® T resins are distinguished by the following properties:

- crystal-clear, optical transparency
- high mechanical stability
- high thermostability
- high viscosity
- good chemical resistance compared to other plastics
- good electrical properties
- low mold shrinkage

The special properties of TROGAMID® T have made it useful in many branches of industry:

Electrical industry and electronics

- high-voltage switch casings
- cable glands
- battery seals
- keys and push buttons
- terminal strips
- casings for switches, relays, and counters
- gear wheels and gear racks

Water resource management and filter technology

- filter cups for pneumatic systems
- filter cups for water treatment
- fuel filter cups
- pump casings
- metering devices
- inspection glasses

Machine and apparatus construction

- flowmeters
- liquid-level indicators
- valve blocks and common control blocks for dispensing and metering equipment
- guide rails

2 Product overview

The product line of the TROGAMID® T grades consists of the following products:

Base products

TROGAMID® T5000
Permanently transparent polyamide for injection molding, extrusion, and blow molding; no additives.

Compounds

TROGAMID® T5002
Permanently transparent polyamide with internal mold release agent for injection molding, extrusion, and blow molding.

TROGAMID® T5004
Permanently transparent polyamide with UV stabilizer and improved outdoor weathering behavior for injection molding, extrusion, and blow molding.

TROGAMID® TX7389
Permanently transparent polyamide with internal mold release agent and further improved flow and demolding behavior for injection molding, extrusion, and blow molding.

Reinforced compounds

TROGAMID® T-GF35
Amorphous polyamide, 35% glass fiber reinforced, for the injection molding of stiff, low-warpage moldings; can be mixed with TROGAMID® T5000 to form compounds with a lower glass fiber content whose general properties can be adjusted to fit a particular application.

Blends

TROGAMID® BX7304
Permanently transparent polymer blend consisting of an amorphous and semi-crystalline polyamide for injection molding; improved stress-cracking resistance, low water absorption.

TROGAMID® BX9724
Polymer blend consisting of amorphous and semi-crystalline polyamides, 40% glass fiber reinforced, with high tensile modulus for injection molding, dimensionally stable even while absorbing water; appropriate for substituting cast metal parts with plastic. Moldings exhibit outstanding surface qualities in spite of their high glass fiber content.

Delivery and coloring of TROGAMID®

All products from High Performance Polymers are manufactured, tested, and delivered to our customers in accordance with the ISO 9001:2008 quality management system, and are commonly supplied in their natural color in moisture-proof packaging with a net weight of 25 kg. We can also deliver TROGAMID® resins in larger units upon request. Special colors can be supplied when specific minimum quantities are ordered. Shelf life at room temperature is virtually unlimited, unless the packaging is damaged.

In general, TROGAMID® resins can be colored without problem. The best choice is a coloring agent concentrate based on TROGAMID®. Dry coloring with finely dispersed coloring is also possible, but precludes pneumatic extraction. We do not recommend a "neutral" pigment paste, since it can result in incompatibility. The paste has an adverse effect on the mechanical or optical properties (e.g., a decline of the weld line strength or the loss of transparency because of streaking or clouding). Nonetheless, suitability for use should therefore be tested in each case.

More information about our TROGAMID® products and how they may be modified can be obtained from the stated contacts.

3 Mechanical properties

Mechanical properties of TROGAMID®

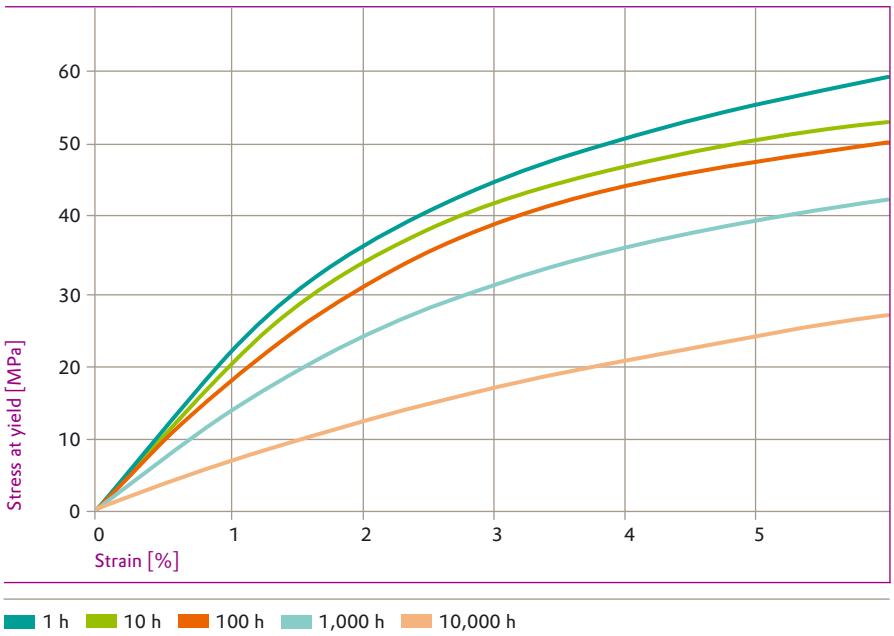
			TROGAMID®						
Property	Test method	Unit	T5000	T5002	T5004	TX7389	BX7304	BX9724	T-GF35
Tensile test 50 mm/min	ISO 527-1/2								
Stress at yield		MPa	90	90	90	88	82	–	–
Strain at yield		%	8	8	8	8	6	–	–
Nominal strain at break		%	> 50	> 50	> 50	> 50	> 50	–	–
Tensile test 5 mm/min	ISO 527-1/2								
Tensile strength		MPa	–	–	–	–	–	220	165
Nominal strain at break		%	–	–	–	–	–	3.2	2.4
Tensile modulus	ISO 527-1/2	MPa	2800	2800	2800	2700	2200	11000	10000
Tensile creep modulus	ISO 899-1								
1 h		MPa	2300	2500	2500	2200	2200	9600	10000
1000 h		%	1100	1300	1300	1600	800	5200	8300
Flexural modulus	ISO 178	MPa	3000	3000	3000	3000	2700	12000	12000
CHARPY impact strength	ISO 179/1eU								
23 °C		kJ/m²	N	N	N	N	N	96 C	77 C
0 °C		kJ/m²	N	N	N	N	N	87 C	70 C
-30 °C		kJ/m²	N	N	N	N	N	80 C	59 C
CHARPY notched impact strength	ISO 179/1eA								
23 °C		kJ/m²	12 C	10 C	10 C	10 C	9 C	14 C	11 C
0 °C		kJ/m²	11 C	9 C	9 C	9 C	–	11 C	10 C
-30 °C		kJ/m²	7 C	6 C	6 C	6 C	8 C	10 C	8 C
Shore hardness D	ISO 868		87	86	86	86	84	90	89
Ball indentation hardness H30	ISO 2039-1	N/mm²	155	155	150	150	130	262	200

N = no break; C = complete break

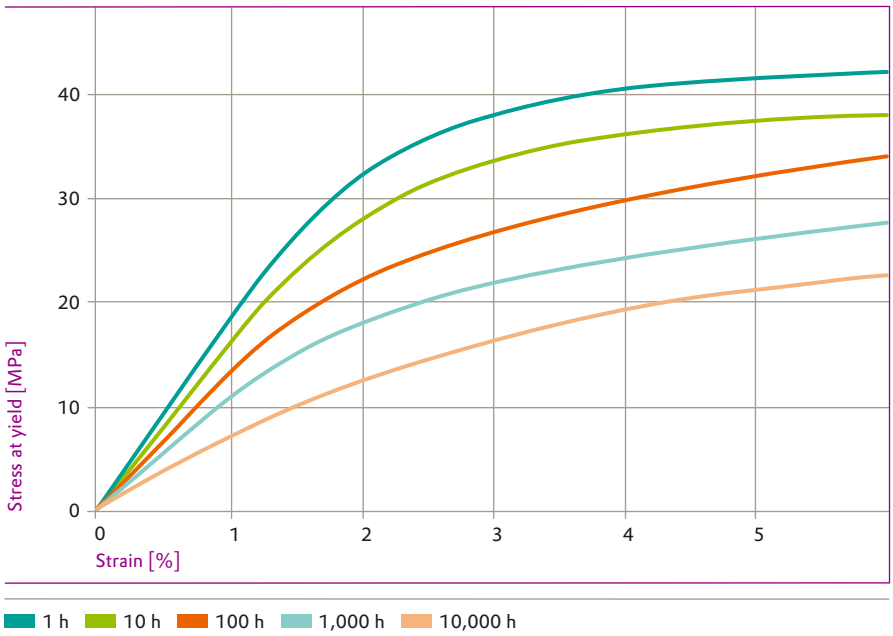
Since the mechanical properties of plastics change as a function of stress level, stress duration, and temperature, it is advisable to use tensile creep strength to calculate and dimension moldings intended for permanent use.

The following diagrams show the isochronous stress-strain plots of TROGAMID® T5000 at 20 °C and 80 °C, respectively, for various stress durations. Due to multiaxial stress, long-term values obtained from internal pressure creep tests must be used for internally stressed parts, such as filter cups, that are utilized in pneumatic systems, water treatment, and the automotive industry.

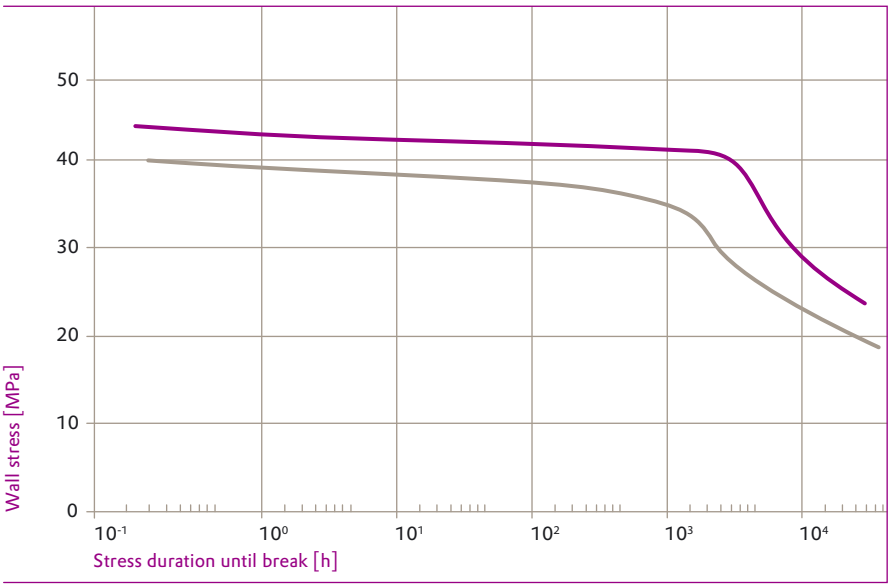
Isochronous stress-strain plots of TROGAMID® T5000 at 20 °C according to ISO 899



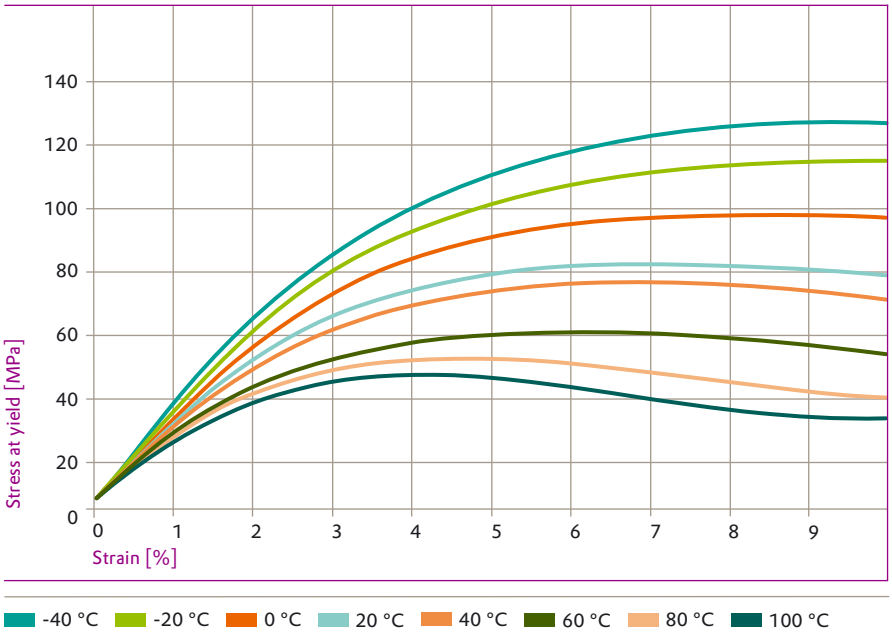
Isochronous stress-strain plots of TROGAMID® T5000 at 80 °C according to ISO 899



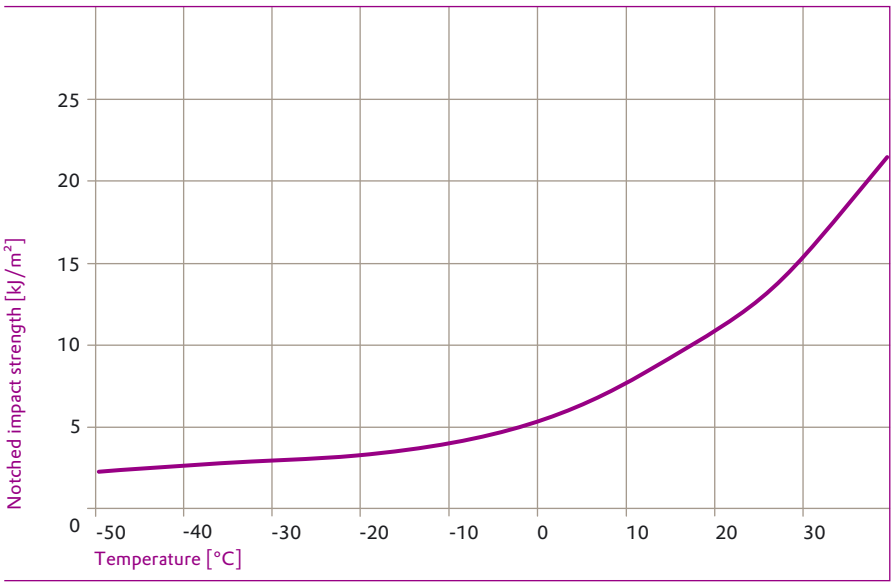
Internal pressure-creep behavior of filter cups consisting of TROGAMID® T5000 (3.5 mm wall thickness)



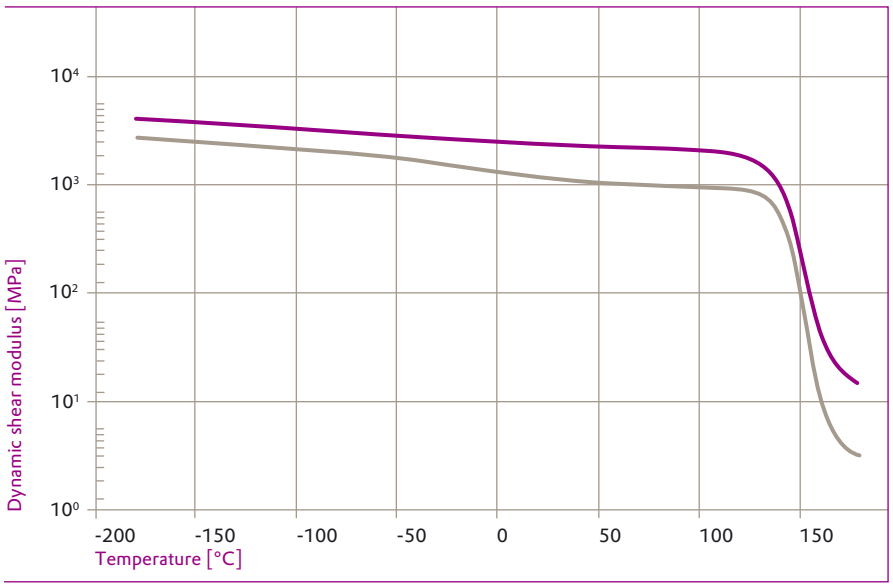
Stress-strain plots of TROGAMID® T5000 from the tensile creep test, according to ISO 899



Notched impact strength of TROGAMID® T5000 depending on temperature, according to ISO 179/1eA



Torsional vibration analysis according to ISO 6721-2



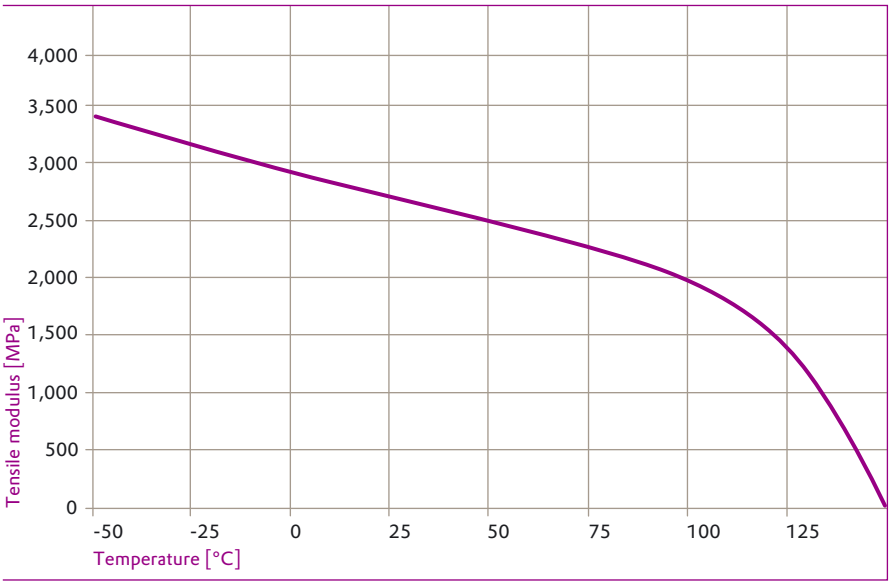
T-GF35 T5000

4 Physical and thermal properties

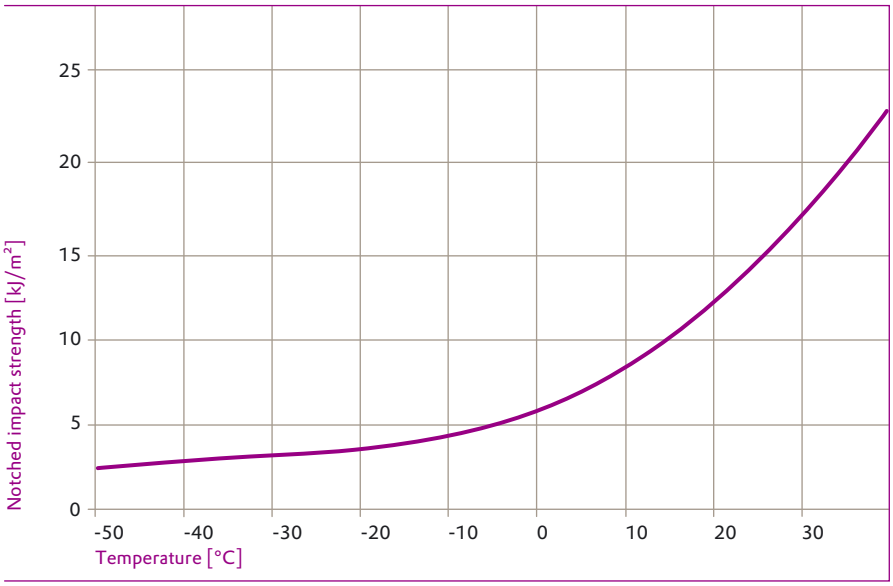
Physical and thermal properties of TROGAMID®

Property		Test method	Unit	TROGAMID® T5000	T5002	T5004	TX7389	BX7304	BX9724	T-GF35
Density	bei 23 °C	ISO 1183	g/cm³	1.12	1.12	1.12	1.12	1.08	1.48	1.40
Viscosity number		ISO 307	cm³/g	132	125	125	115	160	130	100
Vicat softening temperature		ISO 306								
Method A	10 N		°C	155	155	155	155	–	–	158
Method B	50 N		°C	150	150	150	150	99	230	151
Temperature of deflection under load		ISO 75-1/2								
Method A	1.8 MPa		°C	130	130	130	130	75	–	140
Method B	0.45 MPa		°C	145	145	145	145	85	230	150
Linear thermal expansion coefficient	23 °C - 80 °C	ISO 11359								
	longitudinal		10^{-4} K^{-1}	0.55	0.55	0.55	0.55	0.7	0.22	0.32
	transverse		10^{-4} K^{-1}	0.55	0.55	0.55	0.55	0.7	0.38	0.3
Glass transition temperature	10 K/min		°C	150	150	150	150	93	93	150
Melt temperature	10 K/min	ISO 11357	°C	–	–	–	–	–	260	–

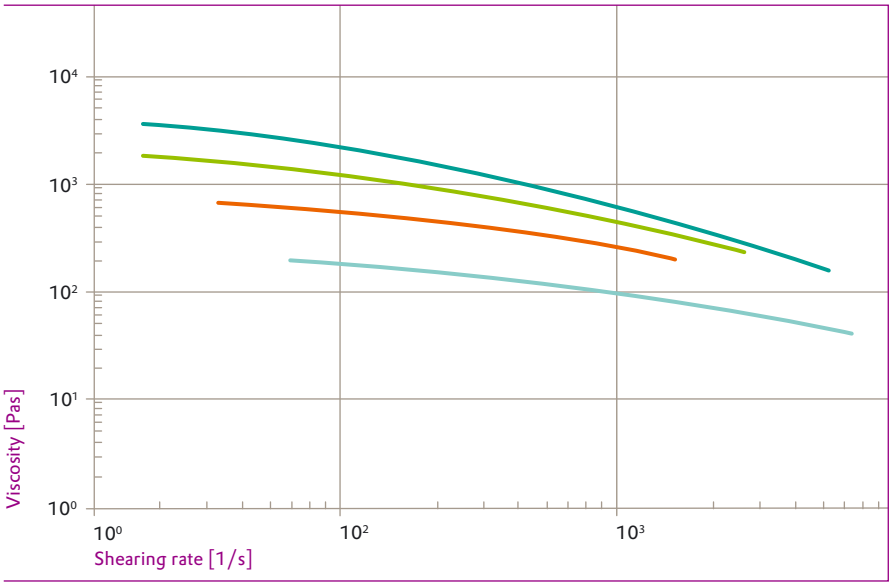
TROGAMID® T5000 tensile modulus depending on temperature, according to ISO 525-1/2



TROGAMID® T5000 notched impact strength depending on temperature, according to ISO 179/1eA

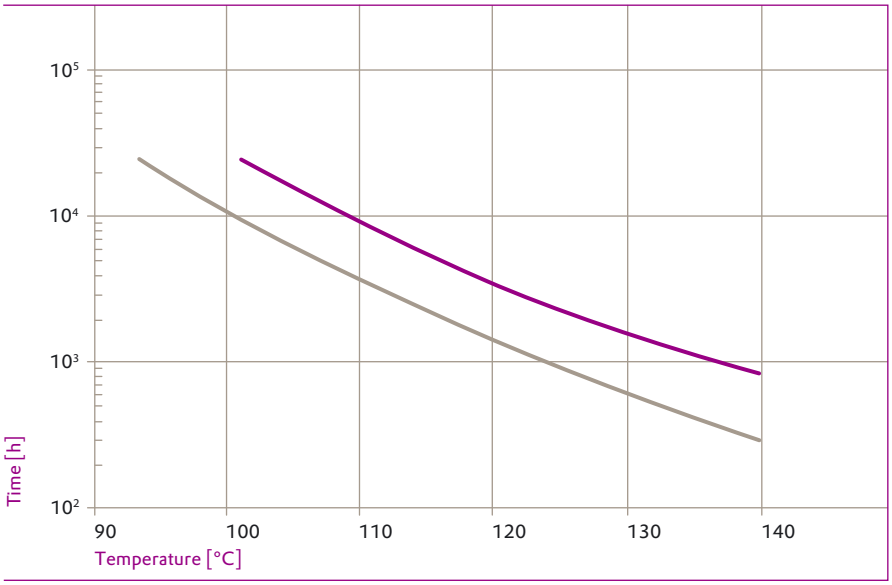


Melt viscosity of TROGAMID® T5000. Results of high pressure capillary viscosimeter (L/D–60/2 mm nozzle geometry)



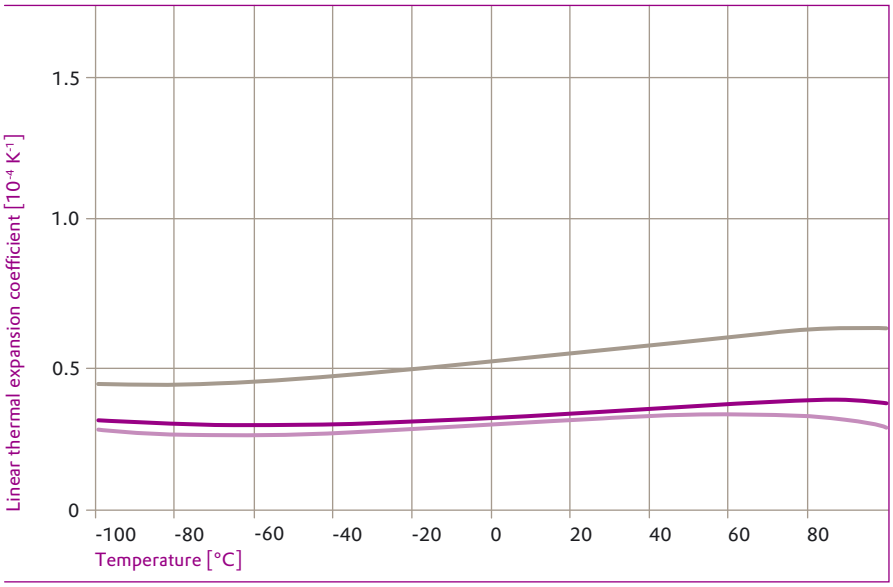
290 °C 300 °C 320 °C 340 °C

Thermal stability of TROGAMID® T compounds according to IEC 216



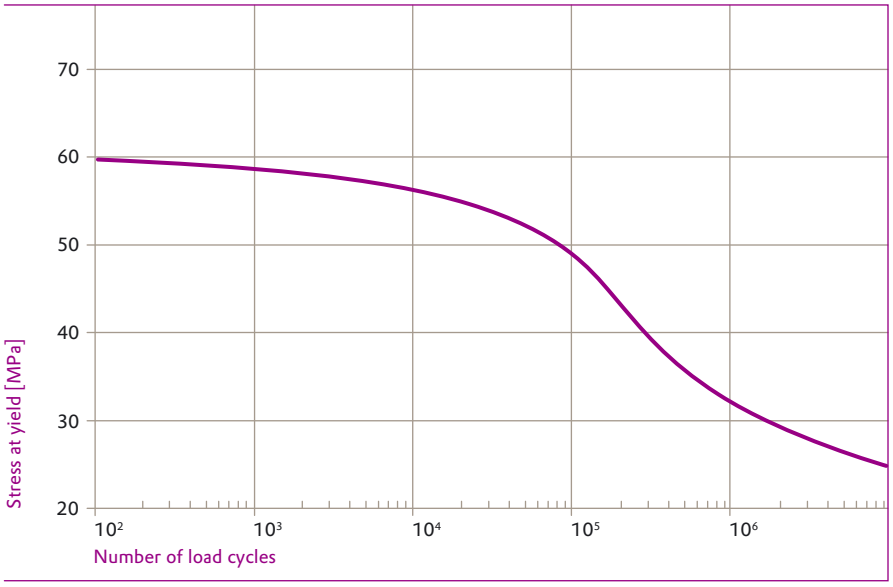
T5000 T5004

Linear thermal expansion coefficient according to ISO 11359 (2 K/min heating rate)



T5000 (longitudinal/transverse) T-GF35 (longitudinal) T-GF35 (transverse)

TROGAMID® T5000 tensile fatigue limit (5 Hz frequency)

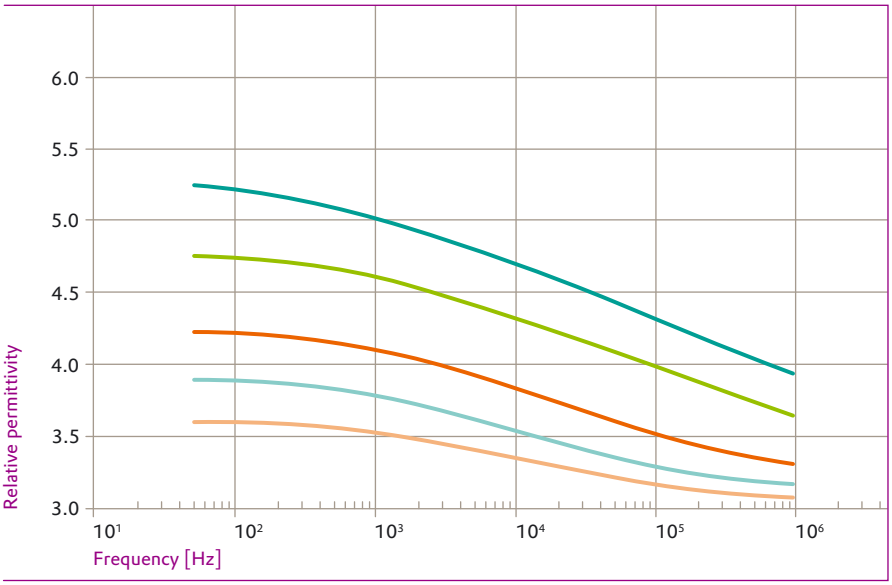


5 Electrical properties

Electrical properties of TROGAMID®

Property		Test method	Unit	TROGAMID® T5000	T5002	T5004	TX7389	BX7304	BX9724	T-GF35
Relative permittivity	50 Hz	IEC 60250		4.2	4	4.2	–	–	–	4.5
23 °C	100 Hz			4.6	4.3	4.6	–	–	–	5
	1 MHz			3.4	3.7	3.3	3.8	–	6.2	3.8
Dissipation factor	50 Hz	IEC 60250		0.021	0.018	0.017	–	–	–	0.016
23 °C	100 Hz			0.025	–	0.024	–	–	–	0.018
	1 MHz			0.028	0.026	0.028	0.028	0.0425	0.025	0.024
Electric strength										
	K20/P50	IEC 60243-1	kV/mm	25	26	24	23	19	27	35
Comparative Tracking Index		IEC 60112								
Test Solution A	CTI			600	600	600	600	600	600	575
	100-drops value			575	575	575	575	575	575	550
Glow wire test	thickness = 1 mm	IEC 60695								
	GWIT	-2 -12/13	°C	900	850	875	850	930	775	750
	GWFI		°C	960	960	800	960	960	750	700
Volume resistivity		IEC 60093	Ohm	10^{13}	10^{13}	10^{13}	10^{13}	10^{13}	10^{13}	10^{13}
Spec. surface resistance		IEC 60093	Ohm	10^{15}	10^{15}	10^{15}	10^{15}	10^{15}	10^{15}	10^{15}
Surface resistance		IEC 60093	Ohm	10^{13}	10^{13}	10^{13}	10^{13}	10^{13}	10^{13}	10^{13}

TROGAMID® T5000 relative permittivity depending on frequency and water content, according to IEC 60250

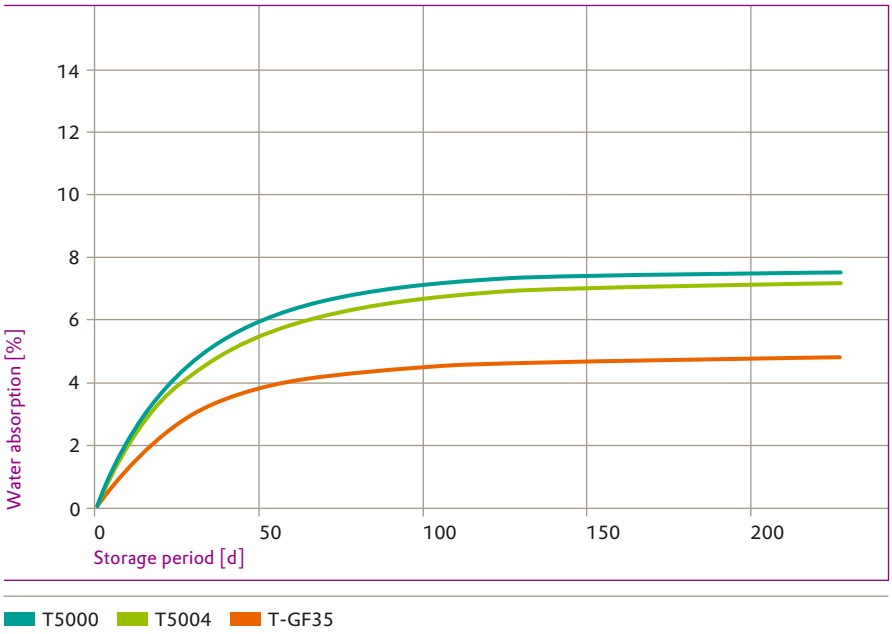


6 Behavior against outside influences

Water absorption/hydrolysis resistance

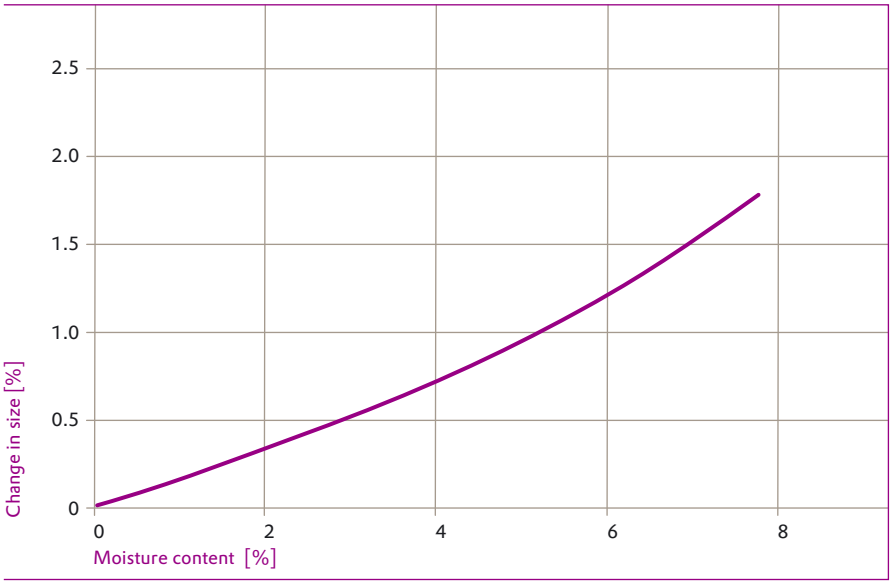
TROGAMID® T compounds, like all other polyamides, absorb water at a rate that depends on the temperature and relative humidity. The water absorption of TROGAMID® T5000 in a saturated state is about 7.5 wt.-%. In contrast to semi-crystalline polyamides PA 6 and PA 66, however, it should be noted that TROGAMID® is not plasticized when it absorbs water. The following diagram indicates the effect of the water that is absorbed.

Water absorption of TROGAMID® T compounds (stored in water at 23 °C) according to ISO 62

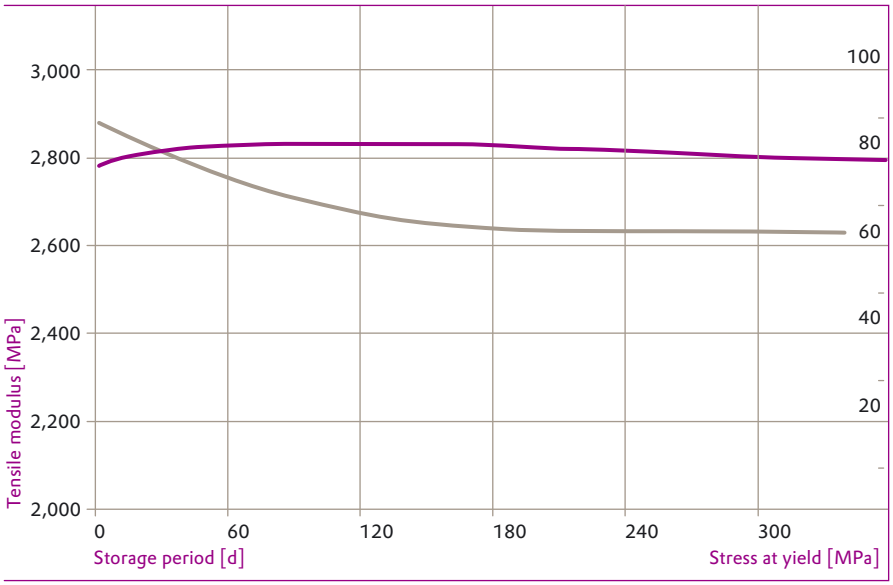


TROGAMID® T5000 moisture absorption as function of atmospheric humidity

Dimensional stability of TROGAMID® T5000 moldings (test specimen 50x50x4 mm)

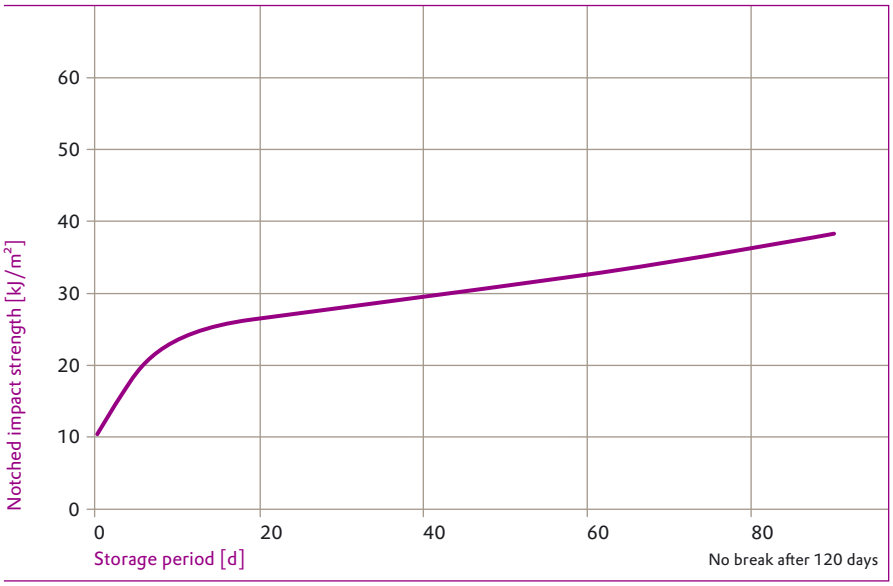


Tensile modulus and stress at yield of TROGAMID® T5000 as a function of storage period in water at 23 °C



Tensile modulus Stress at yield

Notched impact strength of TROGAMID® T5000 as a function of storage period in water at 23 °C according to ISO 179/1eA



Resistance to internal pressure/ dynamic load

Resistance to internal pressure and a high dynamic load are demands typically made by water treatment and filter technology. To conform with common safety regulations, the material must withstand internal pressure at least three times the operation pressure. Furthermore, one distinguishes between short-time stress (burst pressure) and dynamic load (number of load cycles).

The special advantages of TROGAMID® can be seen in the field of water filter cups, as follows. Water filter units prevent corrosion phenomena by restraining the build-up of residue in pipes, especially in building plumbing. Water filters are often used in combination with pressure reducers. Such a control system produces a water pressure that is constant and thus gentle on fittings and pipe systems.

High requirements are placed on the mechanical and dynamic properties of the materials used in filter units to ensure that the units will not break and cause water damage. In this area in particular, TROGAMID® T5000 is the ideal material since it fulfils all the requirements, in short-time stress as well as in the field of dynamic load. In addition, its transparency and its high level of chemical resistance to most oils and greases make TROGAMID® T5000 exceptionally suitable in this field of application.

In addition to the physical properties, it is also essential that TROGAMID® compounds coming into contact with drinking water and food are toxicologically harmless.

Fittings and the top parts of filter cups are not only subject to high internal pressure, but are also exposed to enormous mechanical stresses during both assembly and operation. In many cases, these molded parts are still produced out of metal alloys in the casting process, because thermoplastic constructional materials that possess constant high strengths and good tenacity for the manufacture of dimensionally accurate parts were never previously available. With TROGAMID® BX9724, there now exists a glass-fiber reinforced material that can be used as an alternative to metal. Compared to purely semi-crystalline polyamides, its fundamental mechanical properties hardly change when it comes into contact with water.

Extensive testing of finished parts has confirmed that these resins can be used very successfully for fittings and flanges.

TROGAMID® resins are subject to inspection of the testing agency Deutsche Vereinigung des Gas- und Wasserfaches - Technologiezentrum Wasser [German Association of Gas and Water—Water Technology Center] (DVGW—TZW) in respect of the Guidelines of the German Federal Environment Agency.

Dynamic behavior under load

			TROGAMID®	
Property	Test method	Unit	T5000	BX9724
Burst pressure	DIN EN 53758	bar	150	180
Dynamic load capacity (filter cup)	DIN EN 13443-1	cycles	> $2\text{-}10^5$	> $2\text{-}10^5$

Flammability/thermal properties
TROGAMID® compounds satisfy many of the regulations and directives regarding higher fire safety and lower fire risk without using any flame retardants, halogenated or non-halogenated. Underwriters Laboratories Inc. has classified the fire behavior and maximum continuous working temperature of various TROGAMID® compounds discussed in this brochure in accordance with UL standard 94 (fire behavior) and UL standard 746B (Relative Temperature Index, RTI). The certification listed below relates to the compounds. Moldings and equipment need separate certification.

Flammability/thermal properties

			TROGAMID®						
Property	Test method	Unit	T5000	T5002	T5004	TX7389	BX7304	BX9724	T-GF35
Flammability acc. to UL94	IEC 60695								
0.8 mm			V-2	V-2	V-2	V-2	HB	HB	HB
1.6 mm			V-2	V-2	V-2	V-2	HB	HB	HB
Glow wire test thickness = 1 mm	IEC 60695								
GWIT	-2-12/13	°C	900	850	875	850	930	775	750
GWFI		°C	960	960	800	960	960	750	700

Thermal aging resistance

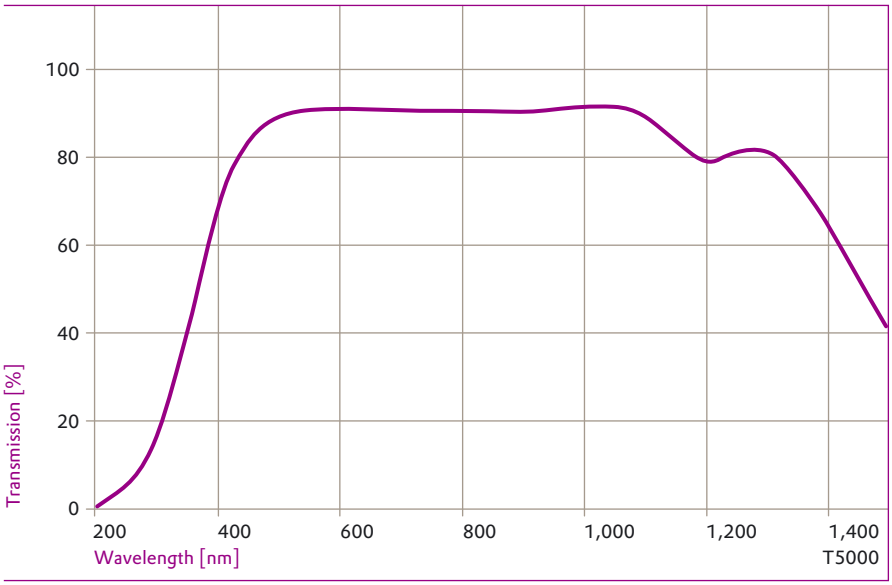
			TROGAMID®		
Property File Number: E47 637	Test method	Unit	T5000	T5002	TX7389
RTI acc. to UL without impact test	UL746 B				
0.8 mm		°C	–	–	65
1.6 mm		°C	85	85	65
3.0 mm		°C	90	90	65
RTI acc. to UL with impact test	UL746 B				
0.8 mm		°C	–	–	65
1.6 mm		°C	80	80	65
3,0 mm		°C	85	85	65
RTI acc. to UL, electrical	UL746 B				
0.8 mm		°C	100	–	65
1.6 mm		°C	100	100	65
3.0 mm		°C	100	100	65

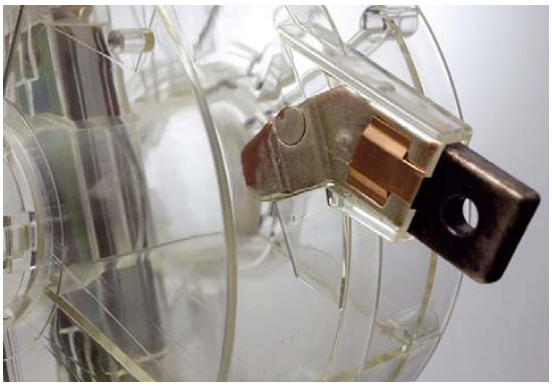
7 Optical properties

Light transmission
TROGAMID® T is amorphous and therefore permanently transparent. It maintains its transparency even at considerable thicknesses. The light transmission in the range of visible light is 90%.

The refraction index of TROGAMID® T5000 is nD^{20}_{D} = 1.566.

Spectral light transmission of TROGAMID® T5000 (3.5 mm wall thickness)





8 Chemical resistance

General remarks
The chemical resistance of TROGAMID® T was measured by storing test specimens in the media to be analyzed for six months at 23 °C. At higher temperatures, both the dissolving capacity and tendency toward stress-crack formation increase. If you are considering applying TROGAMID® at a higher temperature, it is important to first check whether TROGAMID® would be suitable at the planned operating temperature. Testing consists of storing test specimens so that they are strain-free and completely surrounded by the test medium. Internal stresses, which always occur in finished products to a more or less strong extent in practice, have a marked effect on the resistance of TROGAMID® T. Suitability for use should therefore be tested in each case. More information about the durability of TROGAMID® T products in different media can be obtained from the indicated contacts.

Chemical and solvent resistance of TROGAMID® T5000

Medium (23 °C)	Evaluation
A	
Acetone	●
Acrylonitrile	▼ (1)
Adipinic acid, sat.	■
Allyl alcohol	▼ (2)
Aluminum sulfate, sat.	■
Ammonium acetate, sat.	■
Ammonium carbonate, sat.	■
Ammonium iron(II) sulfate, sat.	■
Ammonium iron(III) sulfate, sat.	■
Ammonium nitrate, sat.	■
Ammonium phosphate, sat.	■
Ammonium sulfide, 40%	● (3)
Amyl acetate	■
Amyl alcohol	▼ (2)
Aniline	▼ (2)
Anisole	■
B	
Barium hydroxide, 10%	■
Benzaldehyde	▼ (1)
Benzine	■
Benzine (5% methanol)	▼ (2)
Benzene	■
Benzoic acid, sat.	● (3)
Bromine, liquid	▼ (2)

Medium (23 °C)	Evaluation
1,3-butanediol	▼ (1)
1,4-butanediol	▼ (1)
2,3-butanediol	▼ (1)
Butyl acetate	■
n-butyl alcohol	▼ (2)
t-butyl alcohol	▼ (2)
Butylene glycol	▼
t-butyl methyl ether	■
C	
Carbon disulfide	■
Chloroform	▼ (1)
Chlorosulfuric acid	▼ (2)
Crotonaldehyde	▼ (2)
Cyclohexane	●
D	
Dibutylphthalate	■
1,2-dichloroethane	●
1,2-dichlorobenzene	■
1,2-dichloroethylene	▼ (1)
Difluorodichloromethane	■
Difluoromonochloromethane	●
Diisobutylketone	■
Diisopropyl ether	■
Dimethylformamide	▼ (2)
1,4-dioxane	●

Medium (23 °C)	Evaluation
E	
Ethyl acetate	■
Ethyl alcohol	▼ (1)
Ethylamine, 33%	● (3)
Ethylbenzene	■
Ethylenediamine	▼ (2)
Ethylene glycol	▼ (3)
Ethyl ether	■
F	
Formaldehyde solution	■
Formic acid, conc.	▼ (2)
Furfuralcohol	▼ (2)
G	
Glacial acetic acid	▼ (2)
H	
n-heptane	■
n-hexane	■
Hexantriol	■
Hydrazine hydrate, 80%	● (3)
Hydrochloric acid, 2%	■
Hydrochloric acid, 10%	■
Hydrochloric acid, conc.	▼ (1)
Hydroxylamine, 30%	■
I	
Iron (III) sulfate, sat.	■
Iron (III) sulfate, sat.	■
Isoamyl alcohol	▼ (2)
Isooctane	■
Isopropanol	▼ (1)
M	
Methylene dichloride	▼
Methyl ethyl ketone	▼ (1)
Monofluorodichloromethane	▼
Monofluorotrichloromethane	■

Medium (23 °C)	Evaluation
N	
Nitric acid, 2%	●
Nitric acid, 10%	●
Nitric acid, 30%	▼
Nitrobenzene	■
P	
Paraffin oil	■
Petroleum	■
Potassium hydroxide solution, 50%	■
Potassium chlorate, sat.	●
Potassium chloride, sat.	■
Potassium dichromate, sat.	■
Potassium iodide, sat.	■
Potassium nitrate, sat.	■
Potassium perchlorate, 10%	■
n-Propanol	▼ (2)
Propylene glykol	▼ (1)
S	
Sodium hydroxide solution, 5%	■
Sodium hydroxide solution, 10%	■
Sodium hydroxide solution, 50%	■
Sulfuric acid, 10%	■
Sulfuric acid, 40%	■
Sulfuric acid, conc.	▼ (1)
T	
Tartaric acid, sat.	● (1)
Tetrachloromethane	■
1,1,2,2-tetrafluorodichloroethane	■
Toluene	■
Trichloroethylene	■
1,2,2-trifluorotrichloroethane	■
Trioctyl phosphate	■
X	
Xylene	■

■ = resistant
● = conditionally resistant
▼ = not resistant

Supplementary abbreviations for the chemicals listed:
sat. = saturated solution in water at 23 °C
conc. = concentrated

Supplementary numbers for "conditionally resistant" and "not resistant":
(1) = stress-crack formation
(2) = dissolving
(3) = discoloration, impairment of transparency

9 Registrations and Listings

The Environment, Health & Safety department, which answers to the High Performance Polymers Business Line, provides general information on the toxicological properties of TROGAMID® resins and all evaluations dealing with the resin's contact with foodstuffs. This department is also responsible for providing information on product safety and for compiling EC Safety Data Sheets for TROGAMID®. Please direct all questions on the subject to the indicated contacts.

To date, TROGAMID® has received approval by third-party institutions and has been registered with European authorities, as the following shows:

- Approval in accordance with the Commission Regulation (EU) No 10/2011; the relevant migrations values must be heeded
- KTW Recommendation (German Drinking Water Standard)
- UL Listing, File E47 637
- FDA approval (CFR Title 21, Part 177, § 177.1500 Nylon Resins) for TROGAMID® T5000

10 Ecology and Safety

TROGAMID® resins are non-hazardous substances that are not governed by any particular safety regulations. They are classified under Water Hazard Class 0. They can be disposed of in landfills or incinerated as normal household waste in accordance with local ordinances. Further information can be obtained from the TROGAMID® material safety data sheet that we send upon request. Recycling is, however, preferred and advisable for economic reasons. How reclaimed materials affect the functional properties of a molded part has to be judged in each individual case. Further information about the use of regrind can be obtained from the indicated contacts.

No dangerous by-products are formed if TROGAMID® is processed correctly. Care should be taken, however, to ventilate the working area properly.

TROGAMID® resins contain no halogenated flame retardants, e.g., brominated biphenyls or diphenylethers. No pigments or additives containing cadmium are used.

If the melt is discolored or black specks appear, this is a sign that the material has degraded during processing. Degraded material should be removed quickly from the machine and cooled under water to minimize any offensive odors or fumes. At melt temperatures between 360 and 370 °C, flammable gases are released. Combustion with a sufficient supply of air produces carbon monoxide, carbon dioxide, water, and nitrogen containing compounds as end products. Since the crack and combustion spectrum depends to a great extend on the combustion conditions, it is not possible to make any general statement here.

11 CAE Data of TROGAMID® T5000

With the aim of developing even highly technically sophisticated system solutions jointly with the customer, High Performance Polymers offers comprehensive applications technology services for its products. These include support for the various CAE processes. The costs of optimizations made early on in the development process are only a fraction of those for changes made subsequently or in mass production. Be sure to take advantage of the considerable benefits that comprehensive consulting, including CAE, can offer for the product you use. Contact us if you are planning a new mold or die, or are having problems with existing molds.

Property	Unit	TROGAMID® T5000
Density of melt	g/cm^3	0.90
Spec. heat capacity	$Jkg^{-1}K^{-1}$	2,200
Heat conductivity	$Wm^{-1}K^{-1}$	0.21
Carreau-WLF values		
K1		1,975.9
K2		0.0034126
K3		0.94013
K4		290
K5		205.03
No-flow-temperature	°C	180
Ejection-temperature	°C	130

Campus® material database
The Campus database contains important information on the plastic raw materials available from Evonik. From a given specific profile it is possible to pre-select materials suitable to your application from a multitude of grades. The properties of the thermoplastic raw material are based on ISO-Standard and, therefore are interchangeable.

You will find Campus on the Internet at www.campusplastics.com/campus/producers

Campus® is a registered trademark of CWF GmbH/Frankfurt (Main).

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