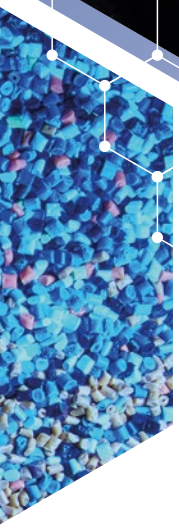
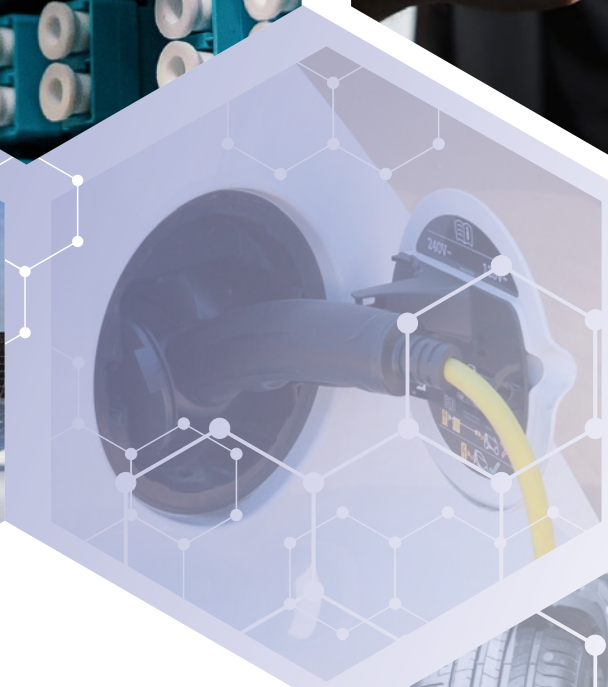
LATI® HIGH PERFORMANCE THERMOPLASTICS





Laramid T

Aromatic polyamide compounds for high temperature applications

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Meeting tomorrow's needs: LARAMID T

To meet the increasingly ambitious demands of the world of industrial design, LATI is enlarging its LARAMID family. The latest member is a highly versatile new polymer named PA9T.

Industrial design trends and requirements

Miniaturisation, integration of functions, connectivity.
These are some of the major trends today seen in practically every area of industrial design. The requirements of environmental sustainability are driving innovation, while the quest for greater energy efficiency is providing the inspiration for new avenues of development. Numerous applications demand materials that offer real and reliable solutions, making it possible to pursue increasingly ambitious challenges in the following sectors:

- automotive,
- electrical and electronics,
- e-mobility,
- power management,
- automation.

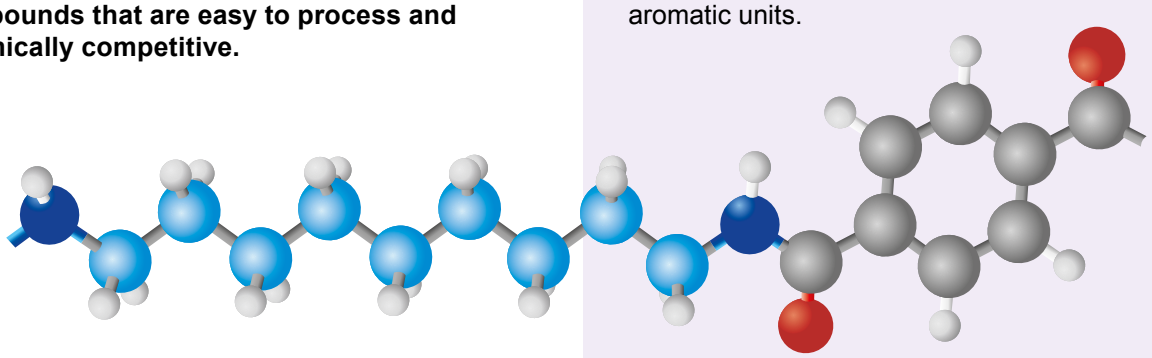
What are the requirements common to these sectors?
Certainly, **resistance to high temperatures**, meaning continuous temperatures of at least **150°C**. Added to this, they have to deliver the **extreme mechanical strength** typically demanded by **metal replacement** applications, and must be able to ensure **superlative performance levels over time**, even in chemically aggressive or high-humidity environments. This amounts to increasingly demanding requirements, even for engineering polymers, and it is a situation that is further complicated by the need to offer all this in the form of **compounds that are easy to process and economically competitive.**

LATI's answer: special compounds for high temperatures

LATI already offers numerous special polymer-based compounds suitable for high-temperature applications: these range from PPS in the LARTON range to LARPEEK and o the polysulphones LASULF and LAPEX. The greatest versatility of use is provided by the **aromatic polyamides** (polyphthalamides, or PPAs) belonging to the LARAMID family, which is made up of materials that are not only heat-resistant, but also ideal for use in formulations that combine mechanical and thermal resistance with excellent electrical characteristics, chemical inertness, flame retardancy and colourability. And the **LARAMID** family is the very one to which LATI has now added a new base polymer, **PA9T**, which boasts excellent characteristics and versatility. Let's look in more detail at the **LARAMID T** family.

The properties of PA9T

The properties of PPAs mainly depend on the monomers from which the polymer is obtained. Indeed, the aliphatic and aromatic parts of the macromolecule help to determine certain characteristics of the final material, such as its moisture absorbency, heat resistance and melting temperature, and therefore also the process parameters for injection moulding. In the case of PA9T, the monomer unit consists of the long aliphatic sequence (in blue in the figure) that separates the aromatic units.



This particular feature makes the resulting polymer **less hygroscopic** than other polyamides and at the same time contributes to the material's **flexibility, resilience**, enhanced **appearance** and greater **dimensional stability**.
Therefore, thanks to its LARAMID T family, LATI is able to offer materials that have the characteristics typical of PPAs, but are tougher, less subject to environmental humidity-related problems, and suitable for moulding **complex** thin-wall **geometries** with **very narrow dimensional tolerances.**

Suitable even for continuous temperatures up to 160°C

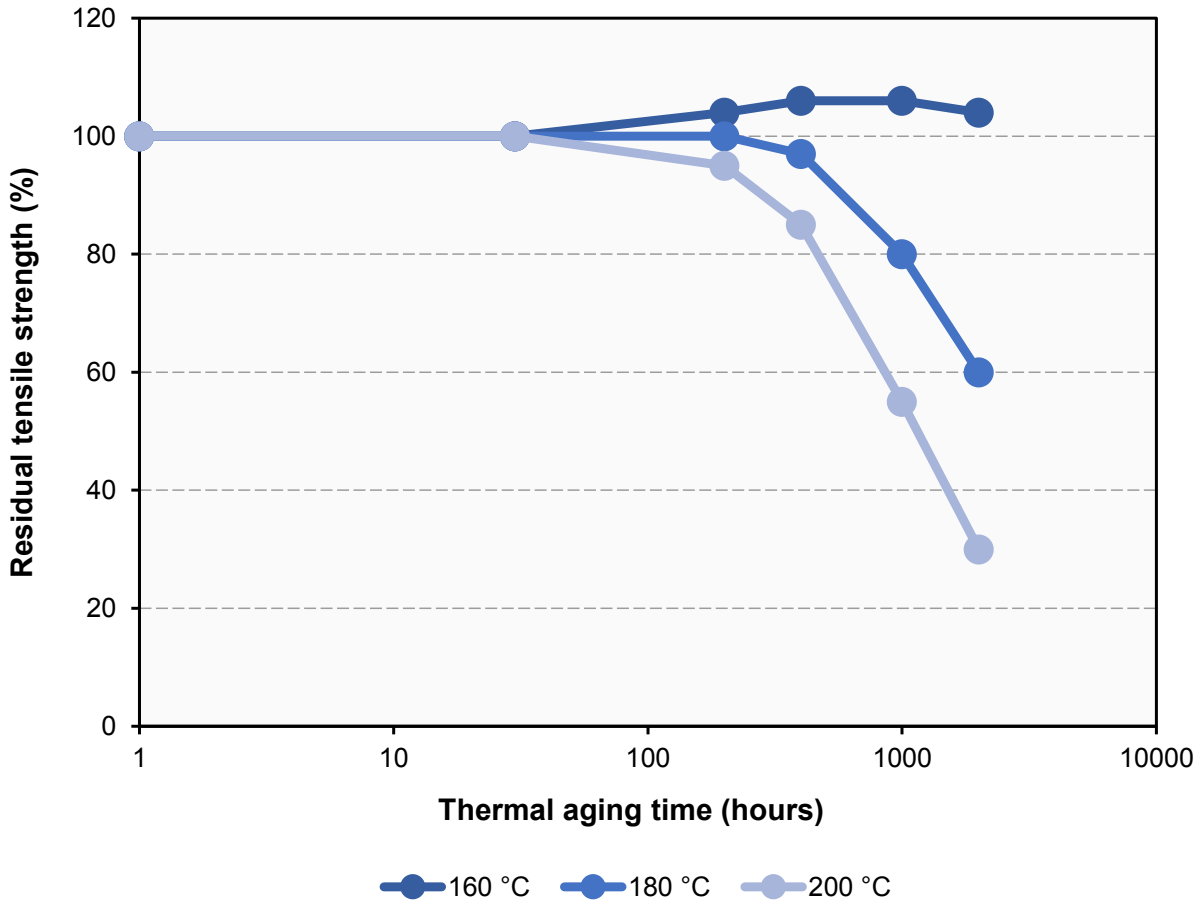
Thanks to the glass transition temperature of the base resin, which is close to 130°C, LARAMID T can immediately be counted among the resins suitable for use in applications where heat accumulation is a real problem. The polymer melts at between 290 and 310°C, meaning that its transition window is similar to those of other PPAs and of PPSs. These important thermal features, added to the stability of the molecule, mean that LARAMID T products remain reliable at continuous use temperatures of up to 160°C; furthermore, up to temperatures of at least 100 °C, they show no real reductions in their mechanical performance.

Effects of thermal aging on the mechanical performance of LARAMID T

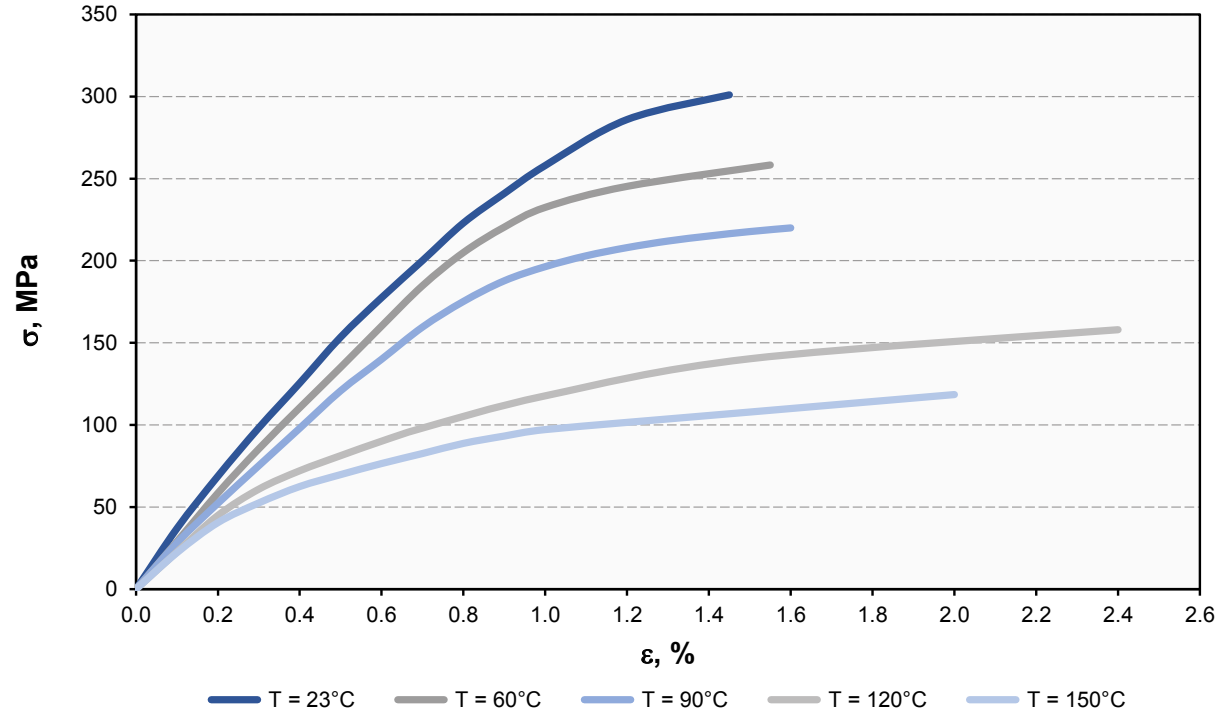
Strength and resilience

Unlike what is seen with other PPAs, the base polymer of LARAMID T displays marked mechanical properties even in non-reinforced formulations. That said, for extreme structural applications, versions reinforced with glass or carbon fibres are designed.
The LARAMID T family includes compounds reinforced with glass fibres, high toughness carbon fibres and high modulus carbon fibres in proportions of up to 60%, 30% and 40%, respectively. It is fundamental to note that its very high modulus of elasticity and stress at break values correspond to a **much higher elongation at break** value than is obtained with similar products.
This advantage is translated into materials that are **not only rigid but also very robust**, i.e., capable of distributing the mechanical stresses to which they are subject, especially in the vicinity of defects; as a result, they increase the life of parts subject, for example, to cyclical or impulsive stress loads.

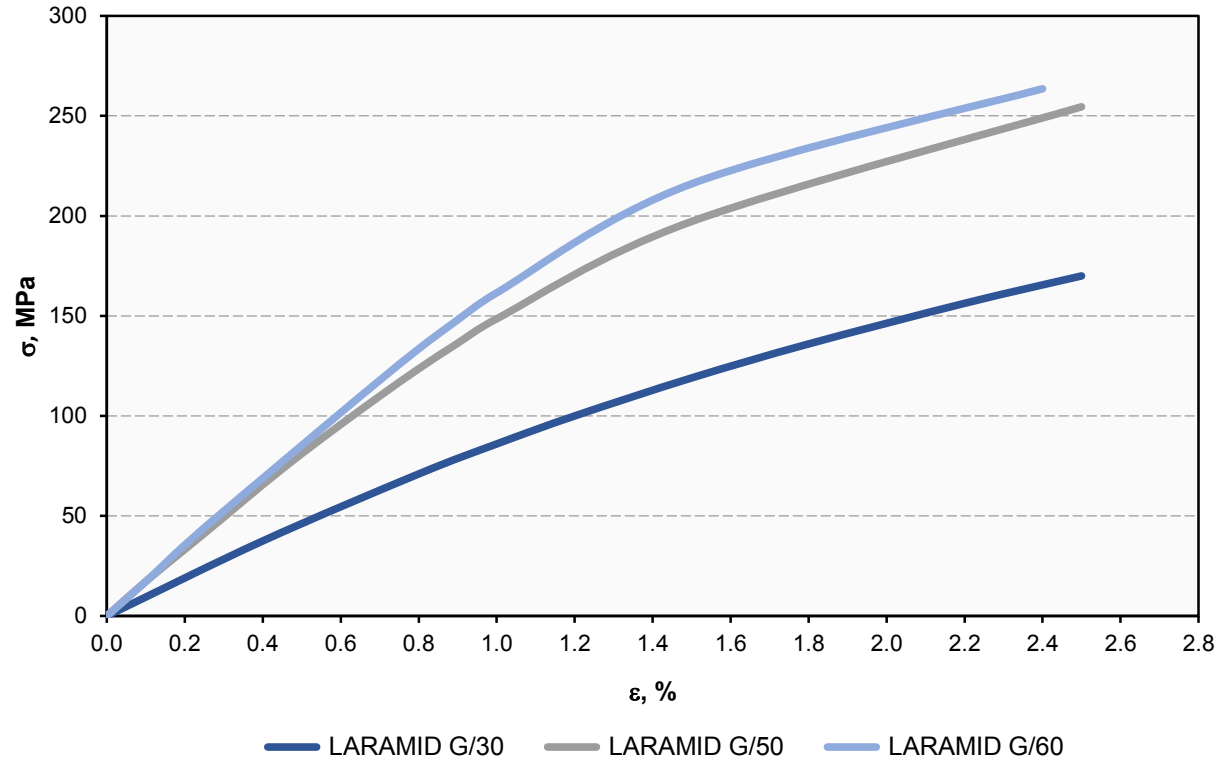
LARAMID T G/50, G/60 and K/35 are therefore materials offering remarkable mechanical performance, even in situations of fatigue, creep and relaxation, shock and vibrations. Thanks to **the high crystallinity of the polymer**, temperature has an only limited effect on the mechanical response of the material, as demonstrated by the stress-strain curves shown on the following pages.



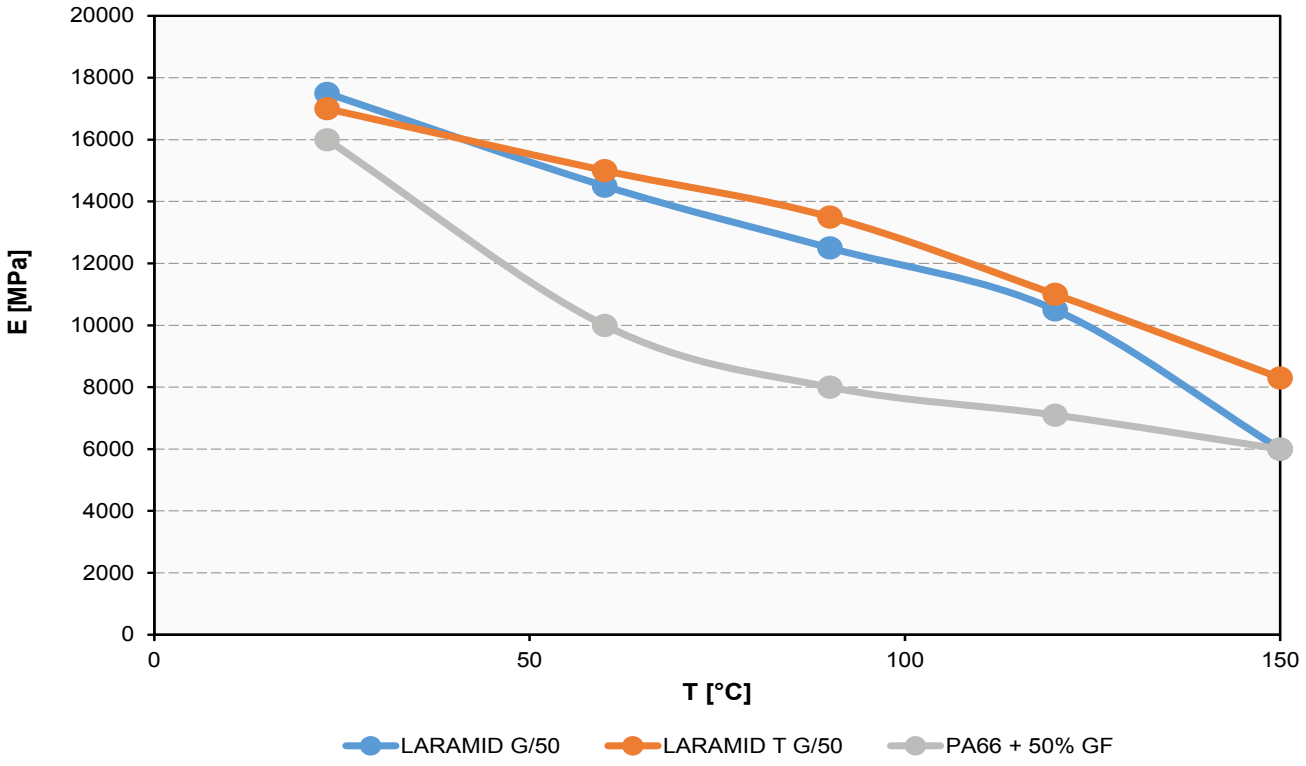
LARAMID T K/40: 30 GPa modulus of elasticity for uncompromising metal replacement



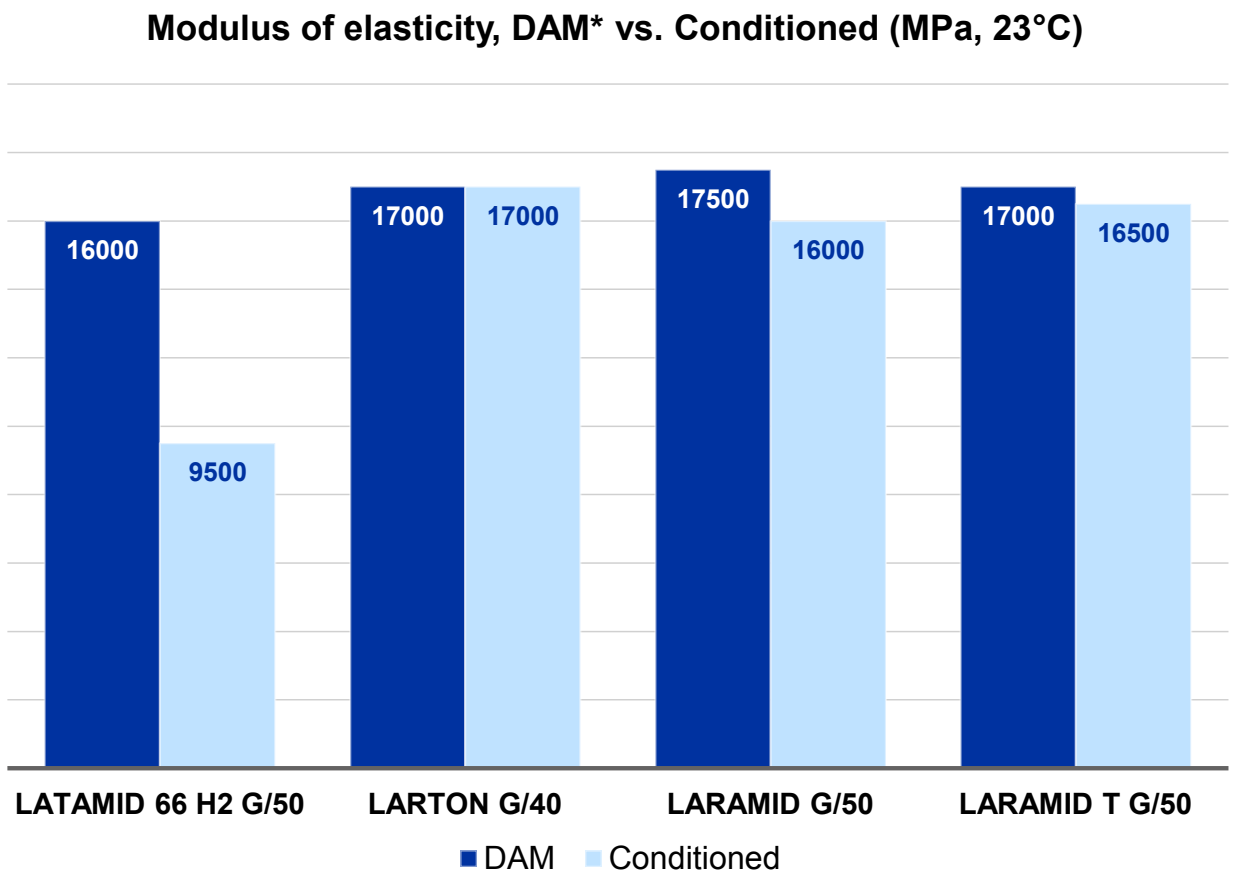
Stress-strain curves at 23°C for LARAMID T G/30-G/50-G/60

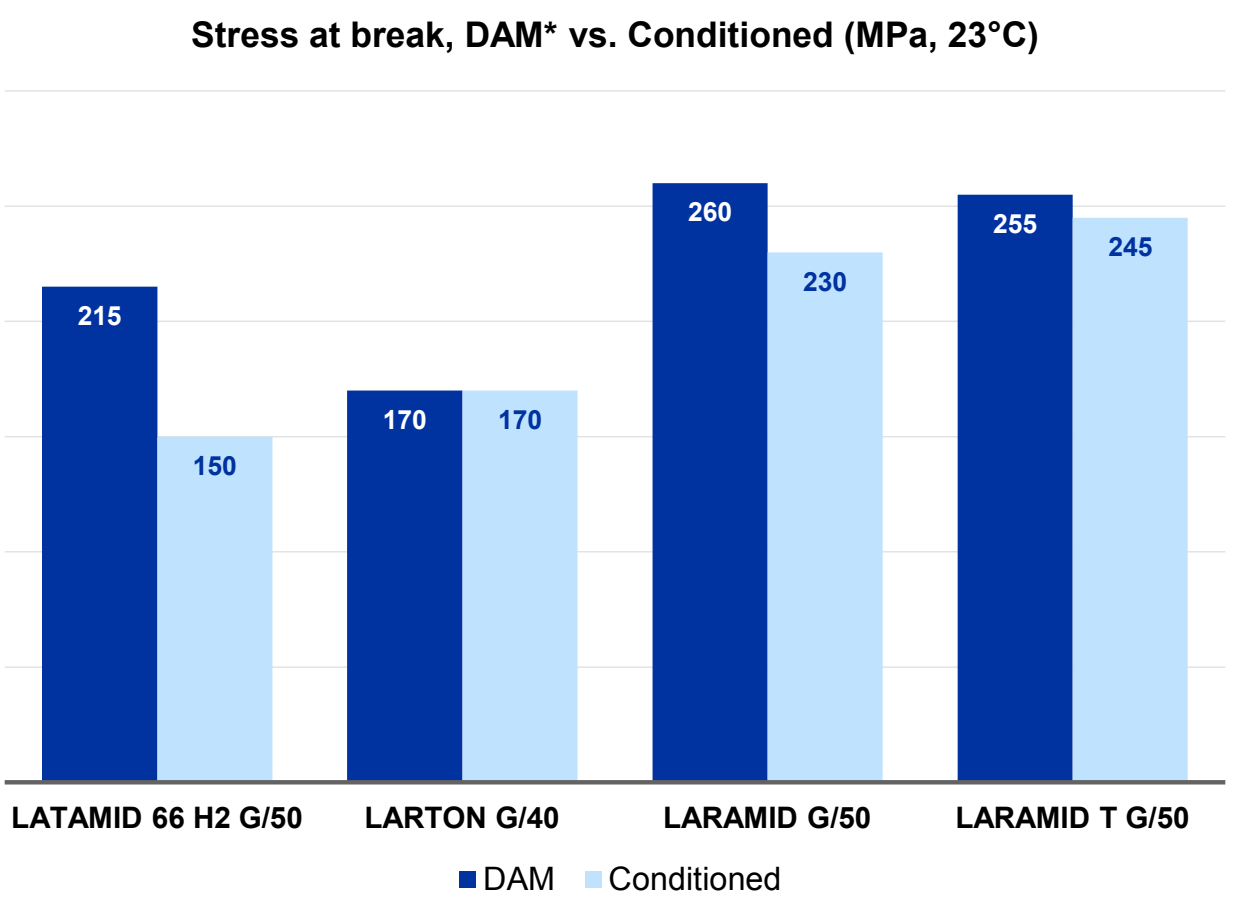


The reduced decay of the modulus of elasticity of LARAMID T G/50 associated with temperature



Negligible effects of humidity on mechanical strength





*Conditioned for 24 hours, 23°C, 50% relative humidity

Choosing your LARAMID compound

See the table to compare the thermal and mechanical properties of LARAMID T compounds for structural applications with similar PA66-, standard PPA- and PPS-based compounds.

Comparison of mechanical features

DESCRIPTION OF THE MATERIAL	TEMP	UNIT	LARAMID T G/50	LATAMID 66 H2 G/50	LARAMID G/50	LARTON G/40
Density in water	°C	g/cm³	1.58	1.58	1.64	1.67
TENSILE STRENGTH						
Tensile modulus	23	MPa	17000	16000	17500	16000
Stress at break		MPa	255	215	260	180
Elongation at break		%	2.5	3	2.1	1.4
Absorbency	ISO 1110 70°C / 62% RH	%	0.36%	1.30%	0.70%	0.10%
Tensile modulus		MPa	16000	10000	14000	16000
Stress at break		MPa	226	150	220	175
Elongation at break		%	2.2	4.3	2.3	1.5
Tensile modulus	60	MPa	15000	10000	14500	15500
Stress at break		MPa	205	170	205	170
Elongation at break		%	2.2	4	2.3	1.5
Tensile modulus	90	MPa	13500	8000	12500	15000
Stress at break		MPa	177	140	185	140
Elongation at break		%	2.1	5	2.4	2
Tensile modulus	120	MPa	11000	7100	10500	9800
Stress at break		MPa	140	120	155	100
Elongation at break		%	3.2	6	3.8	3
Tensile modulus	150	MPa	8300	6000	6000	6800
Stress at break		MPa	90	80	95	75
Elongation at break		%	3.8	6.5	6.5	3.4
CHARPY IMPACT STRENGTH TEST						
Charpy iso c.i		kJ/m²	15.0	15.0	12	9
Charpy iso s.i			80	60	75	30
THERMAL PROPERTIES						
VICAT 49 N		°C	277	255	275	255
HDT 1.82 MPa			279	260	280	270
HDT 0.45 Mpa			288	250	290	280
MOULDING CONDITIONS						
T°. BARREL		°C	320	290	320	310
T°. MOULD			130	90	160	140

The perfect compounds for challenging environments

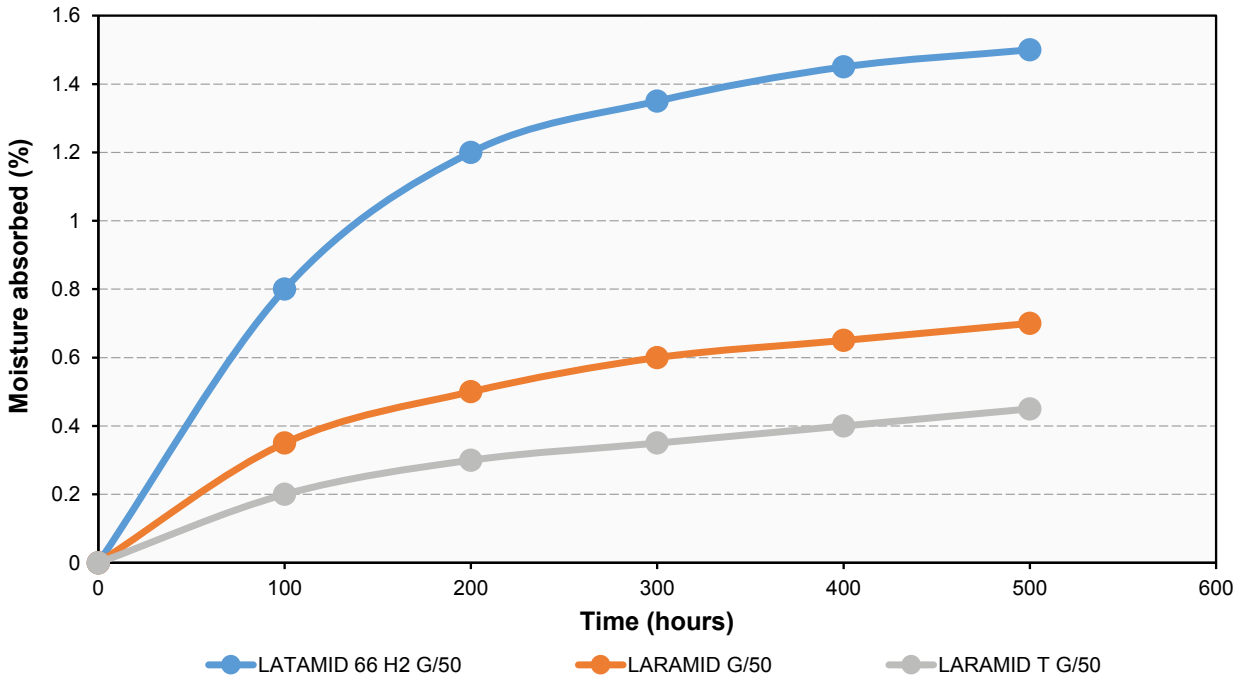
All PPAs show excellent **chemical resistance** against organic compounds, such as oils, solvents, fats and hydrocarbons.
Depending on concentration and temperature, these resins can also cope with most inorganic aggressive substances, such as acids, alkalis and oxidants.
An important feature of LARAMID T compounds, worth underlining, is their **high resistance to hydrolysis**; this, combined with **low moisture absorption** (the lowest among the PPAs), makes the base polymer highly versatile in applications involving direct exposure to hot water, steam, aqueous saline solutions and disinfectants.

Overall, the reduction of mechanical properties that is due to the hydrolytic action of hot water is only slightly greater than what is seen with anhygroscopic resins such as PPS.
The equilibrium moisture content in the air (25°C, rH 50%) is less than 0.5%, and this results in mechanical characteristics that are influenced only negligibly by the effects of the working environment, even when this is characterised by high humidity rates, such as in the Far East countries or in engine compartment applications in the automotive sector.

In terms of chemical resistance, PA9T matches the best engineering polymers

SUBSTANCES	PA9T	PA6T	PA66	PPS
Petrol	86	86	86	98
Motor oil	89	88	81	97
Methanol	72	35	39	98
Toluene	78	77	68	95
Chloroform	87	85	68	87
Water at 80°C	90	63	44	96
Sulphuric acid 10%	81	52	39	98
NaOH (50% water)	85	62	71	92
CaCl2 (50% water)	92	64	73	97
Residual tensile strength (%), immersed for 7 days, 23°C				

Moisture absorption (70°C, rH 62%) - LARAMID T rates among the least hygroscopic PPAs



Precision and aesthetics

Moulding LARAMID T compounds does not require any equipment or measures different from those needed for the processing of other PPAs.

Prior drying will be required as usual, and a plasticising temperature of just over 300°C; it is enough to heat the moulds to 130°C, i.e., a temperature at least 20-30°C lower than that used for similar engineering resins.

The base polymer of LARAMID T displays **very low differential shrinkage**. This is an advantage as it allows complex geometries to be created even using glass fibre- or carbon fibre-reinforced grades. Thanks to the high melt flow index, it is also possible to **fill thin-walled cavities** without needing to force the processing conditions, which is all to the good as regards the integrity of the polymer and therefore also the **aesthetics** of the manufactured products. So, high **dimensional stability**, easy moulding and a great look are further valuable features of this polymer.

	LARAMID T G/50	LATAMID 66 H2 G/50	LARAMID G/50	LARTON G/40
LONGITUDINAL SHRINKAGE %	0.15-0.35	0.3-0.6	0.15-0.4	0.2-0.35
TRANSVERSE SHRINKAGE %	0.55-0.75	0.65-0.95	0.6-0.8	0.45-0.65

PA9T-based compounds from LATI

LATI's PA9T-based product range comprises several compounds already on the market and many others that are under development.

LARAMID T G/30 - G/50 - G/60:
These compounds, **reinforced with glass fibres** in proportions ranging from 30 to 60%, are designed for structural and metal replacement applications in uncompromising settings, e.g., in the electrical, transport and automotive sectors.
The mechanical performance of these materials remains substantially unchanged by exposure to moisture. This, added to their absolute reliability even at temperatures of over 150°C, makes them one of the best choices for applications requiring rigid and robust elements capable of avoiding sudden breaks (this latter feature is attributable to their excellent toughness combined with breaking loads close to 250 MPa).

LARAMID T K/35 – K/40HM:
The grades reinforced with high toughness or high modulus carbon fibres represent traditional solutions for applications in which dimensional stability and mechanical strength need to be combined with electrical conductivity, self-lubrication and maximum stiffness.

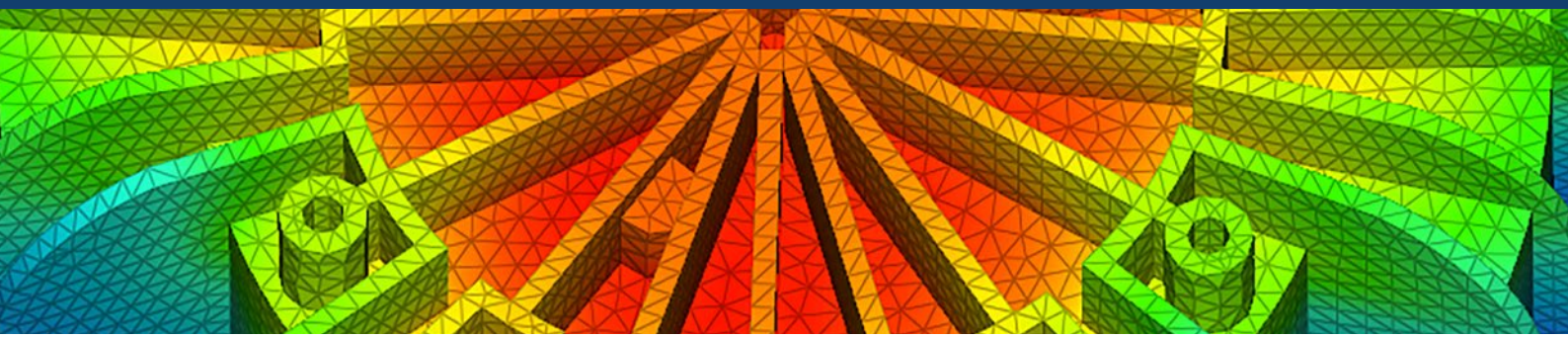
LARAMID T G/30-V0HF1:
This is a reinforced self-extinguishing product without halogens and without red phosphorus. As regards its self-extinguishing properties, it is certified V0 at low thicknesses. It has GWIT and GWFI values suitable for the requirements of the electrical appliances sector, and a CTI> 600V. It is perfect for applications in the electrical, household or industrial sectors, as well as in power management, the world of alternative energy, and electric mobility.

SPECIALS:
The high crystallinity and resulting excellent surface hardness of PA9T are the features that made it possible to create the LATILUB 57T range of self-lubricating compounds reinforced with PTFE, glass fibres or aramid fibres. Thermally conductive grades, named LATICONTHER 57T, are also available. The range of specially formulated compounds is just as large as the range of compounds developed using traditional PPAs.

For further information, samples and technical data sheets, do not hesitate to contact the LATI Customer Service.

About LATI

Founded in Italy in 1945, LATI has, over the decades, earned itself a high-profile position, both in Italy and worldwide, within the field of engineering thermoplastic compounds.
Today, the company is the independent compounder offering the widest range of products in Europe, as well as one of the most qualified suppliers of self-extinguishing compounds internationally. A particular strength is its readiness to develop special grades tailored to its customers' needs.
The company has two plants in Italy with a potential production capacity of 38,000 tons per year.
LATI materials are used in the main application sectors: the automotive industry, precision mechanics, household appliances, electronics, and medical and biobased applications.
LATI distributes its engineering compounds in all the main foreign markets through its own sales network.
The company is committed to ensuring the satisfaction of its partners through a high-tech service that ranges from compound development to assistance with final project development, provided in compliance with the needs of the customer and always with the utmost flexibility.



Support and service

LATI is always ready to support its customers from the very initial design phases, suggesting the most suitable material, carrying out product and moulding performance simulations, and providing on-site assistance to ensure flawless processing.

Co-design support

Thermal, structural and fluid-dynamic FEM calculation is performed by specialists with great experience in numerical simulation, working directly on the geometries provided by the customer and using rheological and mechanical characterisations obtained under real-life conditions of use.

Research & development

LATI supplies compounds designed to meet customer needs. Each formulation is optimised to meet the requirements of the specific application. When necessary, completely new materials are created, thereby increasing the LATI product range.

Moulding assistance

Processing special compounds and optimising their thermal, mechanical and dimensional performance demands specific skills and great care. For this reason, LATI places technicians with great experience of injection moulding (machines and moulds) at the disposal of its customers.

Certifications & compliance

LATI has a team of experts ready to help its customers navigate the process of getting materials certified by globally accredited laboratories and bodies.
In addition, the company itself issues certificates of compliance with all laws relevant to the market segments in which its thermoplastic compounds may be used.

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Find nearest office by visiting our site www.lati.com.

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