LATI HIGH PERFORMANCE THERMOPLASTICS

LATILUB

Self lubricant compounds low wear & low friction

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The world of LATILUB

Thermoplastic materials are widely used in the field of mechanics. Reinforcement materials are dispersed within the polymeric matrix, increasing its strength and resilience and allowing it to reach performance levels close to those of metals.

The remarkable design flexibility conferred by polymers has allowed them to be used in geometrically complex kinematic systems, often operating in chemically, thermally and mechanically challenging conditions. Using plastic compounds, it is today possible to manufacture products with the desired dimensional accuracy, without the need for further costly machining processes, as can be necessary for some metal parts. Moreover, injection moulding is a simple process, environmentally friendly and safe for health, as well as cost effective.

In this field, LATI offers LATILUB, a family of self-lubricating thermoplastic compounds designed to limit the friction, wear and noise generated by mechanical and kinematic systems.
LATILUB compounds come in formulas optimised to ensure reliable and noiseless dry operation. In other words, they do not need external lubricants (oils or grease) or, therefore, the maintenance that their use entails. Given the complexity of the phenomena involved, any solutions proposed need to be based on an extensive theoretical and practical understanding not just of the problem to be resolved, but also of the properties of additives and base resins.

The **tribological properties** of a material describe the way it behaves on contact with, and in relative motion with respect to, a body made of a similar or different material. It is crucial to note that the phenomena observed during the interaction, with or without friction, are also linked to factors unrelated to the nature of the material, such as shape and surface roughness, and the operating temperature and conditions.

Pressure, relative velocity and type of motion all play a fundamental role. Given their semiempirical character, however, the tribological properties of an experimentally assessed material cannot be taken as reliable specifications in the design phase.

It is therefore recommended to use the parameters described solely for the purpose of comparing different self-lubricating compounds and not as absolute values. It is also important to perform dedicated tests to support the project development. The characteristics most commonly studied in tribology are:

- **the static and dynamic friction coefficient;**
- **the wear factor.**

A third factor is the PV limit which indicates the material’s ability to withstand increasing combinations of pressure and relative velocity.
Considering the strong empirical character of this factor, it is important to evaluate it carefully and use it with caution.

Friction

Friction force is the force needed to induce relative motion between two interacting bodies, overcoming the resistance generated by the chemical-physical interactions that take place on surfaces in contact with each other. The contact force that opposes relative motion is called **friction** and it is possible to derive a **coefficient** that quantifies it. This coefficient is influenced by surface compressive load, relative sliding velocity, the geometry of the part, as well as the materials involved and the surface roughness.

The **friction coefficient** is therefore defined as the ratio between the force is needed to move the body **F_a** and the normal force acting on the surfaces **W**. If the bodies to be set in motion are at rest, we speak of **static friction**, whereas if they are already in motion, we speak of **dynamic or kinetic friction**.
As already mentioned, the friction coefficient depends on material type, surface roughness and temperature, whereas it is not influenced by surface area.

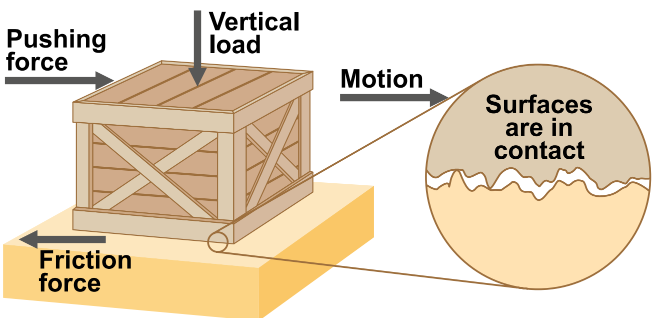
Friction force has different components:

- **adhesion**, linked to the interaction between the surfaces in contact, such as adhesion due to micro-irregularities caused by local plasticisation;
- **deformation**, determined by the mechanical properties of the materials involved, e.g., surface hardness and elastic modulus.

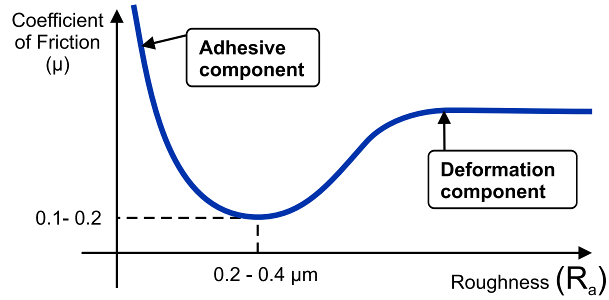
These two components are due to different physical phenomena, therefore they must both be taken into account in the design phase and when **choosing materials**.

Friction and running resistance

$$\frac{F_a}{W} = \mu$$



Effects of metal surface roughness on the friction coefficient



Friction generates a series of local phenomena that have negative effects on elements in relative motion. Metal/polymer, polymer/polymer and polymer/elastomer composites are penalised by adhesion and local micro-deformations favoured by friction-generated heat.
The LATILUB family of compounds is designed to contain these effects by optimising the tribological properties of the materials, thereby opening up a wide range of possible applications for plastics in the field of mechanical engineering.

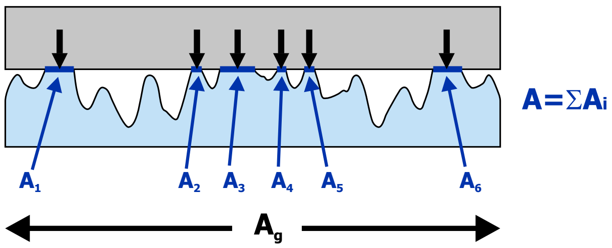
To assess the performance of its compounds, LATI it also uses a test kit based on the **thrust washer** method.
The friction coefficient and wear factor are measured by rotating a washer made from self-lubricating compound on a contact piece in metal, polymer or elastomer, and then applying a given vertical load and relative velocity.
By monitoring the running resistance, the local temperature and the wearing of moving parts, information is obtained on the behaviour of the compound in terms of friction and wear.

Wear

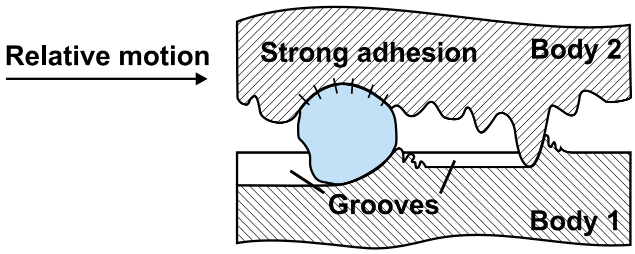
Wear is defined as the **removal of material** from the contact surfaces between two bodies in relative motion. The two main mechanisms involved in wear are very different:

1. adhesive wear is the removal of material due to breaking of the interfacial **bonds** that form on the **area of actual contact** between two bodies.
This phenomenon occurs, for example, in the case of surfaces made of the same material;

The real contact surface is smaller than the geometric one

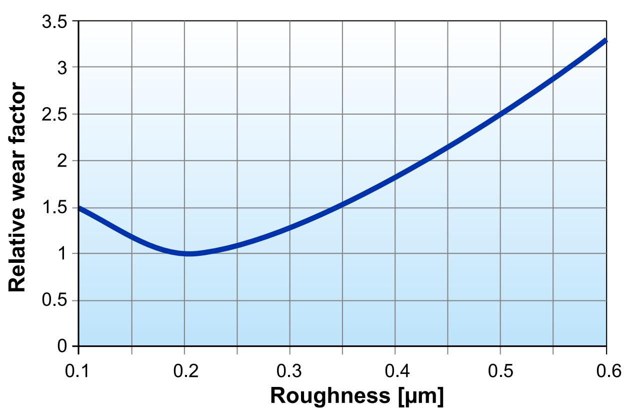


2. abrasive wear, meaning loss of material due to the action of hard particles interposed between surfaces in relative motion, which exert a micro-cutting or ploughing action. Abrasion is a phenomenon typical of compounds reinforced with glass fibres or carbon fibres.



These phenomena lead to the formation of molten polymer and polymer particles (adhesive wear) or debris and grooves (abrasive wear).
It is clear that wear is strongly influenced by the degree of finishing of the surfaces involved, i.e., by their roughness. It is not easy to describe a phenomenon dependent on so many factors.

Wear factor and surface roughness



A widely used parameter, albeit not strictly scientific, is the **wear rate** (WR), which is calculated on the basis of the distance covered:

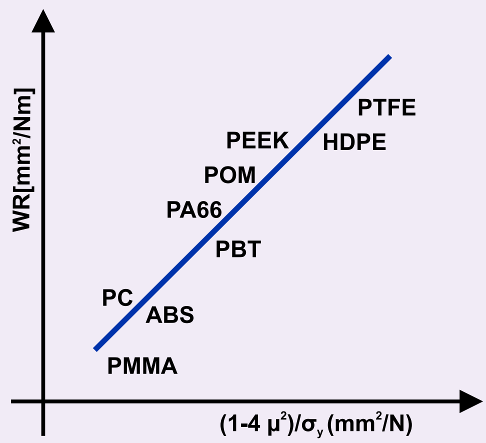
$$WR = \frac{h}{d}$$

where **h** is the thickness removed and **d** the distance covered. Through further mathematical calculations, it is possible to define the most consistent **wear factor**, which is also linked to the surface hardness, the vertical load and the deformation force. The mathematical relationship between the amplitude of motion **(d)**, the volume removed **(V)**, the material hardness **(H)** and the applied load (W), defines the wear factor (K).

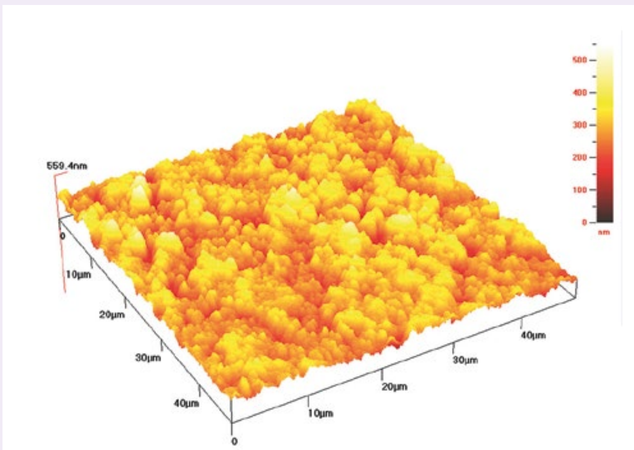
$$K = VH/Wd$$

This value, measured by moving the test specimen at known speed and under known pressure, is often expressed as K/H and measured **in mm³/ Nm**.
The wear factor is strongly influenced by the operating conditions in which it is measured and may vary quite considerably, depending on the situation.
It is interesting to note the responses of the main polymeric resins used in combination with metals having known roughness values: PA66, POM and PEEK all show excellent wear resistance.

Wear resistance of main thermoplastic resins



Surface roughness



Self-lubricating compounds

LATI's long experience in the production of thermoplastic compounds has led it to develop LATILUB, a family of materials engineered to offer exceptional tribological properties. The range includes grades optimised for the injection moulding of parts subject to friction and wear, which can be used irrespective of geometrical complexity and in any application sector. The advantages offered by LATILUB compounds improve the performance and cost efficiency of the parts produced:

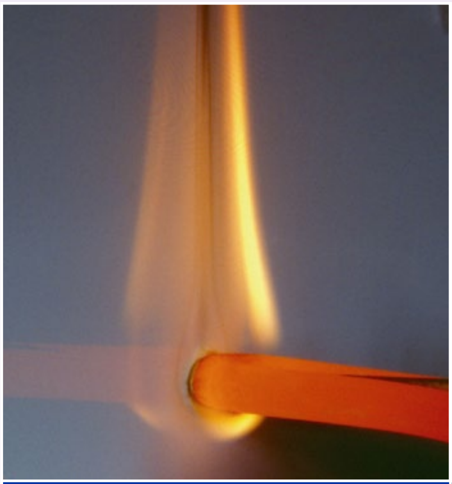
- lighter weight compared with metals and greater resistance to environmental corrosion;
- smaller moving masses compared with metal, and therefore advantages in terms of kinematics and energy efficiency;
- easier mass production without the need for secondary processes (deflashing, washing, etc.);
- freedom of design and easy combination of functions;
- less noise during operation;
- elimination of external lubricants, grease and oils, which has clear advantages:
  1. no trapping of dust or dirt in the friction zone;
  2. no need for maintenance;
  3. constant performance over time.

These developments have been made possible by careful selection of the best thermoplastic resins and the introduction of various functional additives which, used individually or by exploiting the synergy that exists between some of them, make it possible to improve the tribological behaviour of the base polymers.
The following combinations, for example, are highly effective:

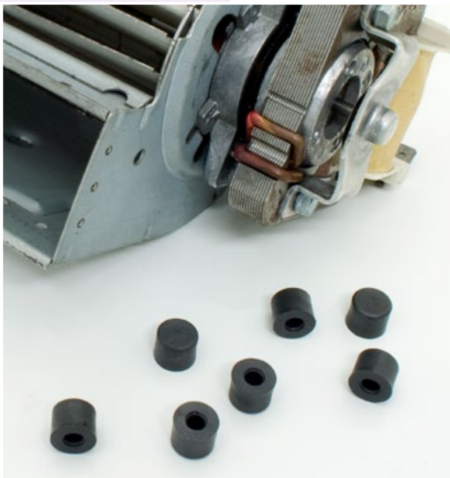
- **PTFE and aramid fibre**, to simultaneously limit friction and wear;
- **MoS_2 and glass fibre**, for structural parts with a low friction coefficient;
- **PTFE and silicone** to reduce start-up and running resistance;
- **Grafite and PTFE** to reduce friction and ensure maximum dimensional stability.

Correctly identifying the grade that best meets the requirements of a certain project remains a complex task, especially when **combining different materials**.
Indeed, numerous factors can alter the behaviour of a material, however well engineered it is.
In addition to these issues, we must also consider the **relative significance** of numerical values, i.e., the friction coefficient, wear factor and PV limit, whose reliability in the design stage must be carefully evaluated.
Tribology in the field of polymers is a very much an evolving science, and adopting an empirical approach to real problems, which means performing **tests** on the product in real conditions of use, is still the safest way to obtain satisfactory results.

The additives used in LATILUB are often also compatible with formulations designed to respond effectively to other needs.

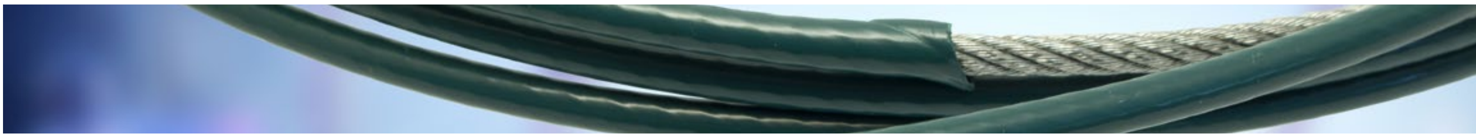


SELF-EXTINGUISHING
Improved wear resistance and low friction factor are available even on **flame resistant** polymer matrix as PA, PBT and PPS.



STRUCTURAL
Structural and self-extinguishing parts are obtained using PA, PBT, PPS and PPA matrices containing up to 50% glass fiber.

ANTISTATIC
Graphite and carbon fiber ensure high **electrical conductivity** as well as ecellent self-lubrication.



PROPERTIES (typical values)	TESTING CONDITIONS	STANDARDS	UNITS (SI)	LATILUB 87/24UV-20T	LATILUB 87/28-12T G/20	LATILUB 87/28-20T	LATILUB 87/28-15T K/20	LATILUB 87/28-17ST K/15	LATILUB 95-15T	LATILUB 95-25GR CE/10
				AMORPHOUS						
				PC	PC	PC	PC	PC	PSU	PSU
PHYSICAL										
Density	23°C	ISO 1183	g/cm³	1.34	1.43	1.32	1.37	1.33	1.35	1.49
Linear shrinkage at moulding* (60x60x2mm - 60MPa)	along flow	ISO 294-4	%	0.55 ÷ 0.75	0.25 ÷ 0.45	0.55 ÷ 0.75	0.15 ÷ 0.25	0.20 ÷ 0.30	1.05 ÷ 1.30	0.40 ÷ 0.60
	across flow			0.60 ÷ 0.75	0.45 ÷ 0.65	0.60 ÷ 0.75	0.25 ÷ 0.40	0.35 ÷ 0.50	1.15 ÷ 1.35	0.55 ÷ 0.80
MECHANICAL										
Charpy - Impact strength notched (specimen 80 x 10 x 4 mm)	23°C	ISO 179-1eA	kJ/m²	12	15	12	8	8	7	2
Charpy - Impact strength unnotched (specimen 80 x 10 x 4 mm)	23°C	ISO 179-1eU	kJ/m²	50	60	50	30	30	70	10
Tensile modulus	23°C	ISO 527-1	MPa	2200	5700	2200	15300	10500	1800	8500
Tensile strength	23°C	ISO 527-1	MPa	55	85	55	130	105	90	65
Elongation at yield	23°C	ISO 527-1	%	3		3			5	
Elongation at break	23°C	ISO 527-1	%	10	2.5	8	1.5	2	8	1.2
THERMAL										
Vicat - Softening point (heating rate 50°C/h)	49 N - 50°C/h	ISO 306	°C	140	150	145	150	150	180	180
HDT – Heat Distortion Temperature	0.45 MPa	ISO 75	°C	140	145	140	145	145	180	175
	1.82 MPa			125	140	130	140	140	170	170
TRIBOLOGICAL										
Static and dynamic coefficient of friction	load 6.1Kg speed 15m/min	ASTM D-1894	μ static	0.18	0.26	0.18	0.24	0.22	0.20	0.23
			μ dynamic	0.14	0.20	0.14	0.17	0.16	0.17	0.18
Wear Factor (K)	pressure 20 Kg/cm² speed 3 m/min - 40 h	Thrust Washer	(10^{-10} m³/h)/(N m h)	3.5	15	3.5	9	7	4.5	12
PROCESSING CONDITIONS										
Pre-drying temperature	(at least 3 hours at…)		°C	110 ÷ 130	110 ÷ 130	110 ÷ 130	110 ÷ 130	110 ÷ 130	110 ÷ 130	110 ÷ 130
Melt temperature			°C	265 ÷ 300	275 ÷ 320	265 ÷ 300	275 ÷ 320	275 ÷ 320	290 ÷ 320	300 ÷ 330
Mould temperature			°C	80 ÷ 100	80 ÷ 110	80 ÷ 100	80 ÷ 110	80 ÷ 110	90 ÷ 110	100 ÷ 120
SELF-EXTINGUISHING										
				UL	UL	UL				
COLORABILITY										
				☑	☑	☑	☑	☒	☑	☑

UL — UL approved grade

Intrinsically self-extinguishing base resin

	SEMICRYSTALLINE												
LATILUB 85-10T G/30	LATILUB 45/7-20T	LATILUB 52/30-15T G/30	LATILUB 73/13-01M	LATILUB 73/13-10ST	LATILUB 73/13-20T	LATILUB 73/13 Y/20	LATILUB 73/13-10T Y/15	LATILUB 73/13-15T G/15	LATILUB 75/4-05T G/30-V0	LATILUB 75/4-20T	LATILUB 62-01M G/30	LATILUB 62-10T	LATILUB 62-15ST
PES	**HDPE**	**PPh**	**POM**	**POM**	**POM**	**POM**	**POM**	**POM**	**PBT**	**PBT**	**PA 6**	**PA 6**	**PA 6**
1.66	1.06	1.25	1.44	1.43	1.50	1.40	1.46	1.60	1.64	1.41	1.36	1.18	1.20
0.35 ÷ 0.50	1.10 ÷ 1.50	0.40 ÷ 0.65	2.00 ÷ 2.30	2.10 ÷ 2.40	2.15 ÷ 2.50	1.65 ÷ 1.95	1.55 ÷ 1.90	0.70 ÷ 1.00	0.40 ÷ 0.65	1.80 ÷ 2.10	0.40 ÷ 0.55	0.95 ÷ 1.25	0.90 ÷ 1.20
0.65 ÷ 0.80	1.10 ÷ 1.50	1.00 ÷ 1.30	2.05 ÷ 2.25	2.15 ÷ 2.35	2.20 ÷ 2.45	1.75 ÷ 2.10	1.65 ÷ 2.00	1.30 ÷ 1.60	1.10 ÷ 1.40	1.80 ÷ 2.05	0.75 ÷ 1.00	1.00 ÷ 1.35	0.95 ÷ 1.30
8	20	7	5.8	5.2	4.5	4.5	5	4	8	1.5	9	3	5
35	NB	40	50	50	45	25	35	20	40	25	70	NB	NB
8600	1400	6700	2600	2600	2700	2900	3300	5600	9700	2300	8800	2700	2400
60	20	80	65	50	50	45	60	65	110	40	160	65	55
	10		5	12	5	5.5	4.5			4		4	5
1.8	20	2.8	20	40	16	7.5	6	1.8	2.8	8	3	20	45
220	70	130	130	130	135	140	140	150	205	170	210	195	200
215	75	160	110	150	145	160	120	160	220	160	220	170	155
210	45	145	85	100	90	120	85	155	200	70	200	65	55
0.28	0.17	0.16	0.18	0.15	0.15	0.18	0.18	0.23	0.22	0.15	0.45	0.25	0.21
0.20	0.12	0.1	0.16	0.13	0.09	0.14	0.13	0.2	0.18	0.12	0.38	0.22	0.16
18	6	12	11	1.8	2.2	4.5	3.9	5.5	22	4	31	9.3	8.1
150 ÷ 180	80 ÷ 90	80 ÷ 90	80 ÷ 90	80 ÷ 90	80 ÷ 90	80 ÷ 90	80 ÷ 90	80 ÷ 90	100 ÷ 120	100 ÷ 120	90 ÷ 100	90 ÷ 100	90 ÷ 100
350 ÷ 390	180 ÷ 230	220 ÷ 250	175 ÷ 200	175 ÷ 200	175 ÷ 200	175 ÷ 200	175 ÷ 200	175 ÷ 200	240 ÷ 250	230 ÷ 245	240 ÷ 280	230 ÷ 250	230 ÷ 250
150 ÷ 190	20 ÷ 40	40 ÷ 60	70 ÷ 90	70 ÷ 90	70 ÷ 90	70 ÷ 90	70 ÷ 90	70 ÷ 90	70 ÷ 90	70 ÷ 90	70 ÷ 100	70 ÷ 90	70 ÷ 90
					UL			UL	UL		UL		
☑	☑	☑	☒	☑	☑	☑	☑	☑	☑	☑	☒	☑	☑

Molybdenum disulphide

Molybdenum disulphide (MoS_2) has a **nucleating** effect on PA and POM, i.e., it favours the formation of crystalline regions in the moulded part, especially in areas that cool quickly such as the external ones in contact with the mould. Friction surfaces with good crystallinity perform better mechanically and are more resistant to wear than those with a higher amorphous resin content.

Molybdenum disulphide has a **crystalline structure with mobile layers**, similar to that of graphite. In fact, the lubricating power of this mineral stems from the relative mobility of the adjacent layers.

Furthermore, MoS_2 can **fill the microcavities** present on the surface of moulded pieces and their contact parts, reducing friction and abrasion caused by roughness

Molybdenum disulphide also greatly improves the PV limit, especially in structural compounds **reinforced with glass fibre**. Excellent results are achieved, in particular, in situations where there are plastic parts sliding against metal.

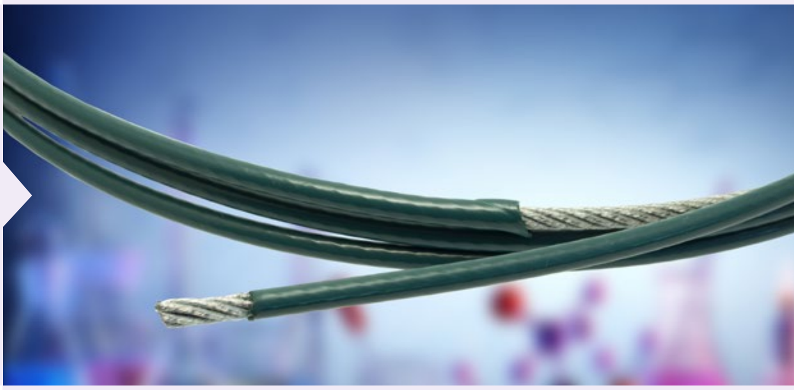
LATILUB products containing MoS_2 are suitable for applications with operating conditions characterised by low specific pressure and relative velocity.

Having an **excellent price/performance** ratio, they can be considered the first step in improving the self-lubrication properties of standard grades for structural use, e.g., PA66 **reinforced with 30 and 50% glass fibre**.

LATILUB 62-02M

SAFETY CABLE

PA6 for extrusion, 2% molybdenum disulphide. Cable-coating compound, anti-abrasion formula, minimum running resistance.



LATILUB 66-01M G/30

DRIVE ELEMENT

PA66, 30% glass fibre, **molybdenum disulphide**. High mechanical resistance, low friction coefficient, noiseless and economical. Ideal for parts subjected to significant mechanical stress.

LATILUB 66-01M G/50

HIGH-VOLTAGE SWITCH CAM

PA66, 50% glass fibre, molybdenum disulphide. Maximum structural strength. Resistance to creep and fatigue. Low friction coefficient to minimise the drive force.

PTFE and UHMWPE

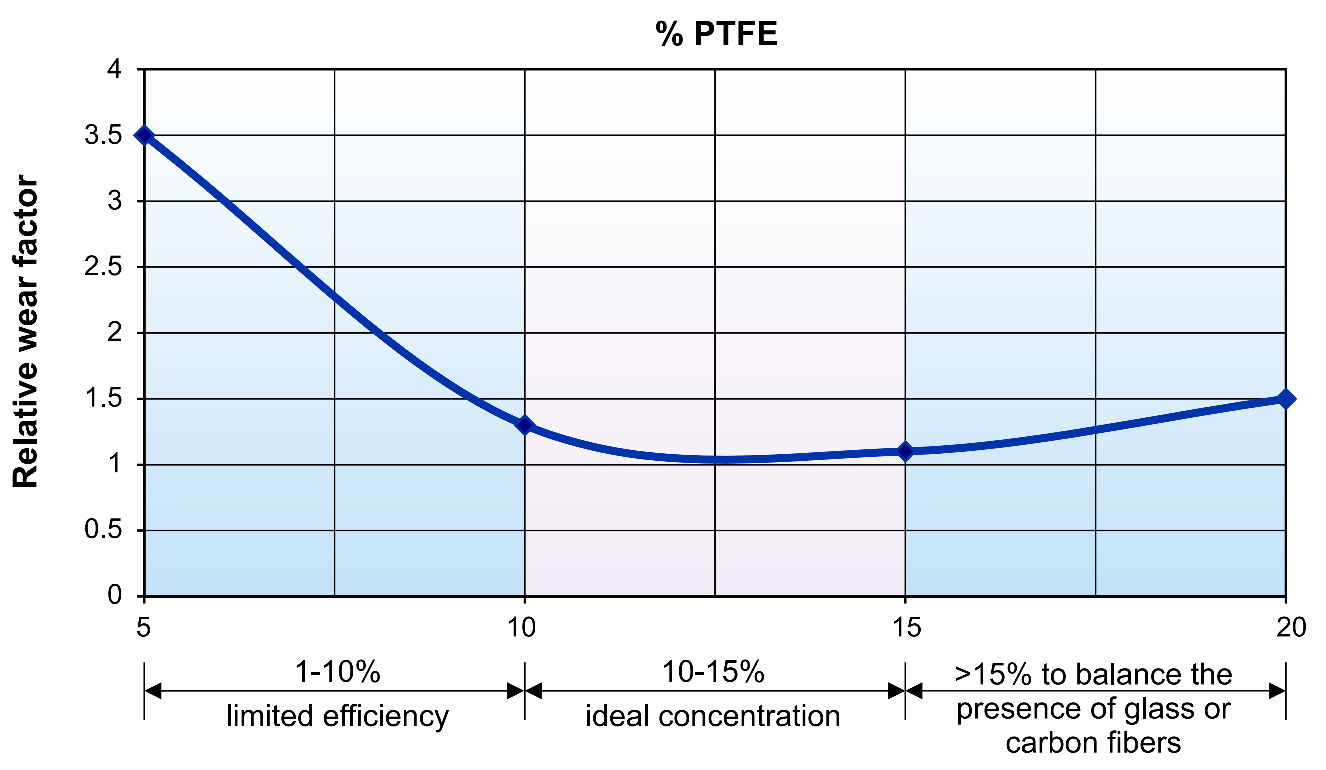
PTFE is a polymer with a particular macromolecular structure and chemical composition. Although it offers only moderate wear resistance, it has a **very low friction coefficient**, among the lowest known. In self-lubricating compounds, PTFE, dispersed in the plastic matrix as a powder, is somehow «laminated» by the stresses that arise at the interface between surfaces in relative motion. In this way, the polymer fills the pores in the surface and reduces its roughness; it is then transferred to the contact part **(film transfer)**, thus improving the relative sliding. This mechanism requires a minimum **burn-in time** to allow the self-lubricating surface layer to form.
PTFE has a higher dynamic than static friction coefficient, which may lead to **stick-slip** problems, meaning instability during motion of the contact parts. To avoid this, PTFE is often used in combination with a **silicone oil**. The distribution and content of PTFE are crucial factors determining self-lubrication efficiency. The best results are achieved with PTFE concentrations of around 10% in amorphous polymers and 20% in reinforced semi-crystalline polymers, respectively.

LATILUB compounds containing PTFE can combine lower friction coefficients with a higher PV limit.
The LATILUB products offering these characteristics are the ones most widely used in mechanical applications, particularly ones involving:

- high pressure;
- high velocity (and possibly unidirectional motion).

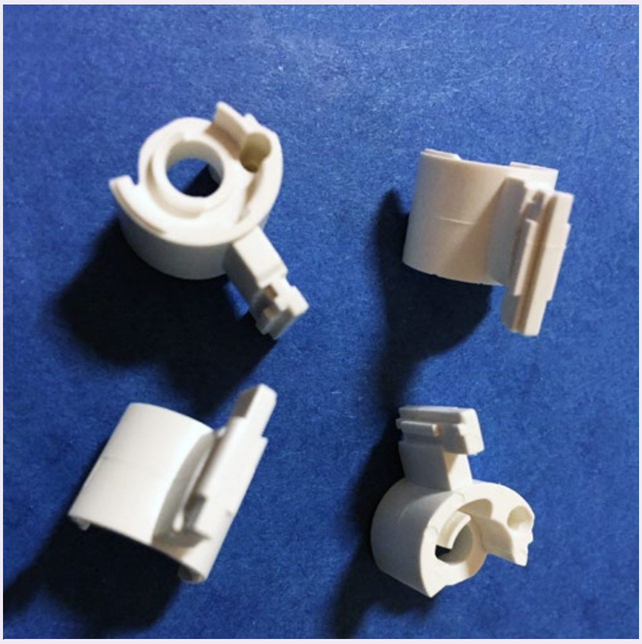
UHMWPE (ultra-high molecular weight polyethylene) is a polymer with tribological properties similar to those of PTFE, and it can be an acceptable replacement for PTFE in applications where absence of halogens is essential and it is desirable to ensure safe processing free of phenomena related to the presence of fluorinated polymers, e.g., corrosion and in-mould deposit. Very interesting results are obtained with polymers that can be processed below 300°C, e.g., PA and PC.

Diagram of PTFE efficiency in selflubricating compounds



LATILUB 75-20T

SAFETY BUSHING
PBT, 20% PTFE
Maximum smoothness, no dimensional variation in hot or humid environments.



LATILUB 66-20T G/20

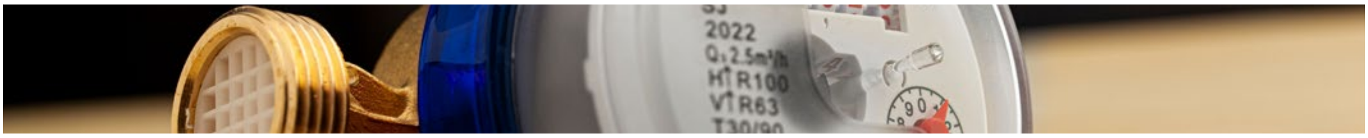
CAM FOR SWITCH
PA66, 20% PTFE, 20% glass fibre
Mechanical strength combined with smooth and noiseless operation.
PTFE minimises friction and running resistance..

LATILUB 62-10E G/35

WIRING SYSTEM COMPONENTS
PA6, 35% glass fibre, 10% UHMWPE
Halogen-free structural and self-lubricating solutions for minimum environmental impact.
Maximum smoothness and noiselessness.

LATILUB 73/13-20T

SOLAR PANEL ORIENTATION SYSTEM
POM, 20% PTFE
Outdoor use, resistance to sunlight and bad weather conditions. Minimum running resistance, accurate and noiseless operation.



				SEMICRYSTALLINE						
PROPERTIES (typical values)	**TESTING CONDITIONS**	**STANDARDS**	**UNITS (SI)**	**LATILUB 66-01M**	**LATILUB 66-01M G/15**	**LATILUB 66-01M G/30**	**LATILUB 66-01M G/50**	**LATILUB 66-02S**	**LATILUB 66-10T G/10**	**LATILUB 66-10T G/30-V0KB1**
				PA 66	**PA 66**	**PA 66**	**PA 66**	**PA 66**	**PA 66**	**PA 66**
PHYSICAL										
Density	23°C	ISO 1183	g/cm³	1.14	1.24	1.38	1.59	1.13	1.26	1.49
Linear shrinkage at moulding* (60x60x2mm - 60MPa)	along flow	ISO 294-4	%	1.20 ÷ 1.50	0.45 ÷ 0.75	0.35 ÷ 0.65	0.30 ÷ 0.60	1.20 ÷ 1.50	0.60 ÷ 0.80	0.35 ÷ 0.60
	across flow			1.25 ÷ 1.55	0.95 ÷ 1.25	0.75 ÷ 1.05	0.65 ÷ 0.95	1.25 ÷ 1.55	1.10 ÷ 1.40	0.75 ÷ 1.00
MECHANICAL										
Charpy - Impact strength notched (specimen 80 x 10 x 4 mm)	23°C	ISO 179-1eA	kJ/m²	4	4	9	10	9	4	12
Charpy - Impact strength unnotched (specimen 80 x 10 x 4 mm)	23°C	ISO 179-1eU	kJ/m²	NB	30	65	65	NB	30	50
Tensile modulus	23°C	ISO 527-1	MPa	3700	6000	9400	15500	3000	4800	9900
Tensile strength	23°C	ISO 527-1	MPa	85	110	165	220	70	95	165
Elongation at yield	23°C	ISO 527-1	%	9				5		
Elongation at break	23°C	ISO 527-1	%	11	3.8	3.1	2.5	30	4.2	2.9
THERMAL										
Vicat - Softening point (heating rate 50°C/h)	49 N - 50°C/h	ISO 306	°C	240	250	255	260	240	245	250
HDT – Heat Distortion Temperature	0.45 MPa	ISO 75	°C	235	250	260	265	215	255	265
	1.82 MPa			90	235	255	260	65	235	255
TRIBOLOGICAL										
Static and dynamic coefficient of friction	load 6.1Kg speed 15m/min	ASTM D-1894	μ static	0.29	0.36	0.42	0.46	0.27	0.29	0.35
			μ dynamic	0.27	0.32	0.36	0.39	0.25	0.24	0.30
Wear Factor (K)	pressure 20 Kg/cm² speed 3 m/min - 40 h	Thrust Washer	$(10^{-10}$ m³/h)/(N m h)	70	44	30	24	44	23	21
PROCESSING CONDITIONS										
Pre-drying temperature	(at least 3 hours at…)		°C	90 ÷ 100	90 ÷ 100	90 ÷ 100	90 ÷ 100	90 ÷ 100	90 ÷ 100	90 ÷ 100
Melt temperature			°C	260 ÷ 290	270 ÷ 300	275 ÷ 300	280 ÷ 310	260 ÷ 290	275 ÷ 300	270 ÷ 290
Mould temperature			°C	70 ÷ 90	70 ÷ 100	70 ÷ 100	70 ÷ 100	70 ÷ 90	70 ÷ 100	70 ÷ 100
SELF-EXTINGUISHING										
				UL	UL	UL				LATI
COLORABILITY										
				☒	☒	☒	☒	☑	☑	☒

UL — UL approved grade

Intrinsically self-extinguishing base resin

Silicone

Silicone oil is a lubricant that tends to **migrate towards the surface** from inside the polymer in which it is dispersed. This has the effect of reducing the friction between moving parts during use.
The use of high-viscosity silicone oils is preferred as these more easily form a **persistent layer** over the entire surface of the part. Silicone-based additives have the advantage of moderately reducing the friction coefficient and wear factor.

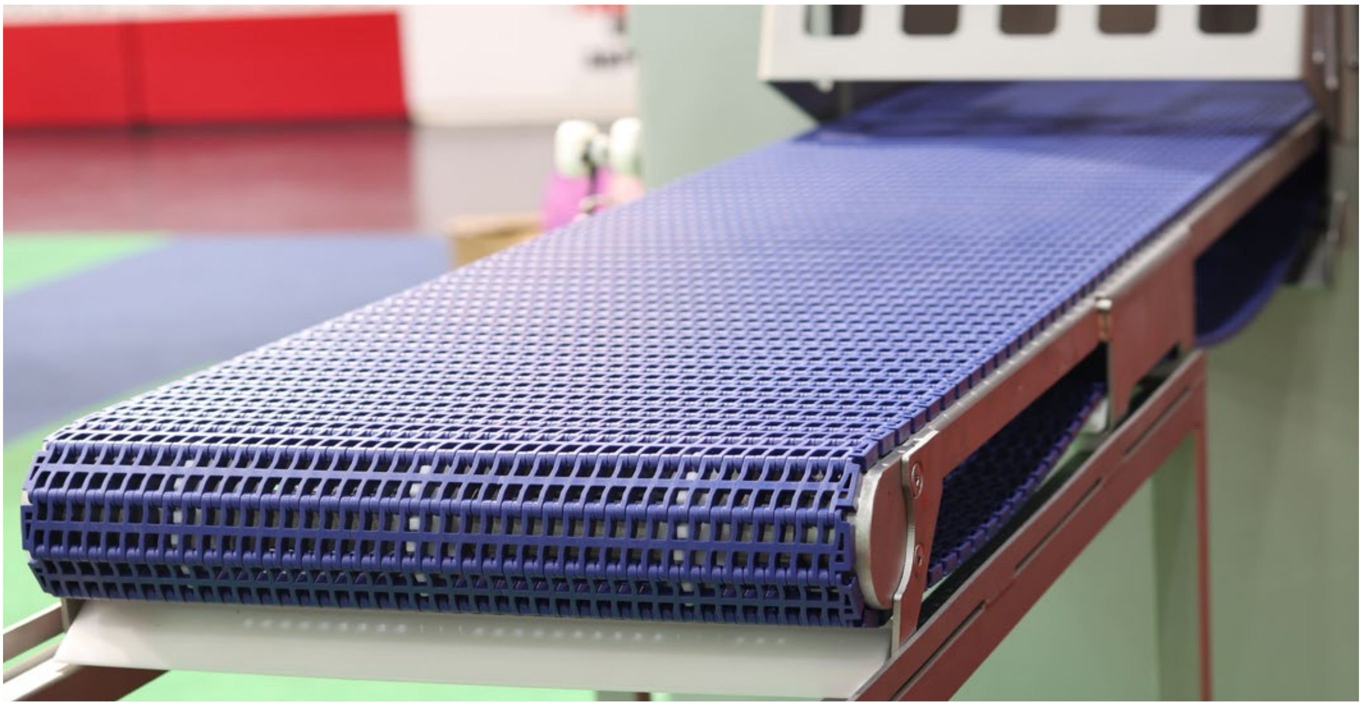
The combination of **silicone and PTFE creates synergistic** effects due to the capacity of the oil to reduce the repeated stick-slip effect during motion that typically occurs with PTFE.

Significant improvements are also obtained on base **resins exposed** to adhesive wear and abrasive micro-cutting wear, e.g., PBT.

Precisely because of its tendency to migrate, silicone oil cannot be used in electrical or electronic devices. It is also not recommended for products requiring excellent surface aesthetics.

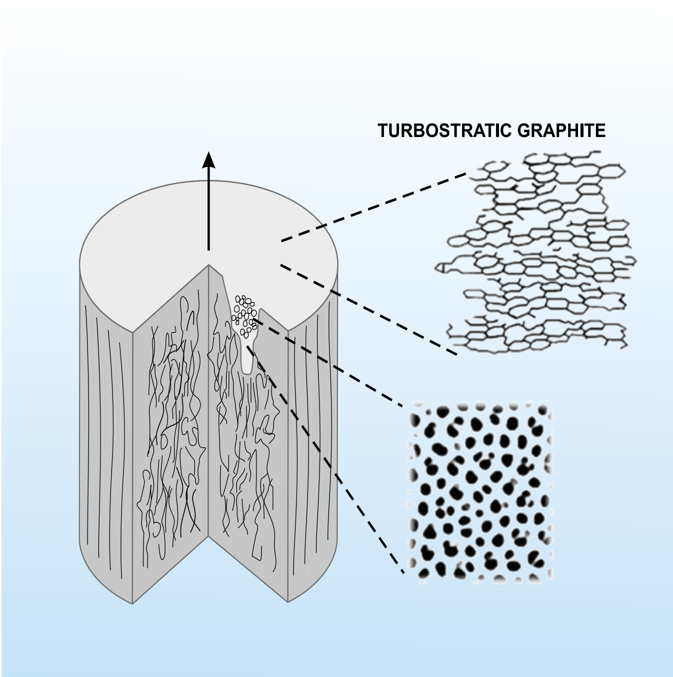
The use of silicone oil is recommended for parts operating at:

- low pressure;
- high velocity.



Carbon fibres

Carbon fibres have for many years been used as a highly efficient **mechanical reinforcement**, but their chemical nature and morphology mean that they also feature interesting tribological properties.
By exploiting the arrangement and mobility of the **graphitic planes** of which they are composed, carbon fibres in fact allow a significant increase in the PV limit and a reduction in the friction coefficient of the compound.
Carbon fibres improve the **surface hardness** of a material and may therefore entail contact-related problems, e.g., **unexpected wear phenomena** such as third-body abrasion. The synergistic use of carbon fibres in combination with PTFE leads to significant advantages both from a mechanical and a purely tribological point of view.
Like graphite, carbon fibres confer **electrical** and thermal **conductivity** on the compound.
LATILUB carbon fibre-filled compounds are recommended for challenging applications, in which mechanical performance, hardness and antistatic properties are priority requirements.
Care is needed when using carbon fibres in combination with metals such as aluminium and steel.



PROPERTIES (typical values)	TESTING CONDITIONS	STANDARDS	UNITS (SI)	LATILUB 66-10T K/10	LATILUB 66-10T Y/15	LATILUB 66-15ST G/30	LATILUB 66-15T G/30	LATILUB 66-15T K/30	LATILUB 66-20T	LATILUB 66-20T G/20
				SEMICRYSTALLINE						
				PA 66	**PA 66**	**PA 66**	**PA 66**	**PA 66**	**PA 66**	**PA 66**
PHYSICAL										
Density	23°C	ISO 1183	g/cm³	1.23	1.23	1.45	1.48	1.38	1.25	1.44
Linear shrinkage at moulding* (60x60x2mm - 60MPa)	along flow	ISO 294-4	%	0.35 ÷ 0.55	1.25 ÷ 1.45	0.40 ÷ 0.60	0.40 ÷ 0.60	0.25 ÷ 0.45	1.30 ÷ 1.60	0.50 ÷ 0.70
	across flow			0.80 ÷ 1.10	1.35 ÷ 1.65	0.90 ÷ 1.20	0.90 ÷ 1.20	0.65 ÷ 0.95	1.40 ÷ 1.70	0.95 ÷ 1.25
MECHANICAL										
Charpy - Impact strength notched (specimen 80 x 10 x 4 mm)	23°C	ISO 179-1eA	kJ/m²	5	4	8	10	8	2.8	10
Charpy - Impact strength unnotched (specimen 80 x 10 x 4 mm)	23°C	ISO 179-1eU	kJ/m²	35	45	45	50	40	55	40
Tensile modulus	23°C	ISO 527-1	MPa	9100	3800	9400	9500	18500	2800	6300
Tensile strength	23°C	ISO 527-1	MPa	145	85	150	160	180	65	120
Elongation at yield	23°C	ISO 527-1	%						9	
Elongation at break	23°C	ISO 527-1	%	2.8	5	2.5	2.5	1.5	10	2.5
THERMAL										
Vicat - Softening point (heating rate 50°C/h)	49 N - 50°C/h	ISO 306	°C	250	245	250	250	250	245	250
HDT – Heat Distortion Temperature	0.45 MPa	ISO 75	°C	270	240	260	260	260	250	265
	1.82 MPa			250	120	250	250	245	100	250
TRIBOLOGICAL										
Static and dynamic coefficient of friction	load 6.1Kg speed 15m/min	ASTM D-1894	μ static	0.24	0.25	0.28	0.30	0.25	0.26	0.30
			μ dynamic	0.21	0.21	0.25	0.25	0.19	0.22	0.22
Wear Factor (K)	pressure 20 Kg/cm² speed 3 m/min - 40 h	Thrust Washer	(10^{-10} m³/h)/(N m h)	13	7.5	17	19	15	6.2	5.5
PROCESSING CONDITIONS										
Pre-drying temperature	(at least 3 hours at…)		°C	90 ÷ 100	90 ÷ 100	90 ÷ 100	90 ÷ 100	90 ÷ 100	90 ÷ 100	90 ÷ 100
Melt temperature			°C	275 ÷ 300	270 ÷ 300	275 ÷ 300	275 ÷ 300	275 ÷ 300	270 ÷ 300	275 ÷ 300
Mould temperature			°C	70 ÷ 100	70 ÷ 90	70 ÷ 100	70 ÷ 100	70 ÷ 100	70 ÷ 90	70 ÷ 100
SELF-EXTINGUISHING										
										(UL)
COLORABILITY										
				☒	☑	☑	☑	☒	☑	☑

(UL) UL approved grade

(icon) Intrinsically self-extinguishing base resin

Aramid fibres

Aramid fibres are made up of a polymer that is essentially a fully aromatic polyamide. The chemical nature and structure of these fibres make them extremely resistant to heat, mechanical stress and abrasion caused, for example, by free particles of removed material or other debris. The main feature of aramid fibre-reinforced LATILUB compounds is therefore the **extremely reduced wear of the moving parts** and relative contact parts, in the case of both polymer against metal and polymer against polymer.

Combination with plastics is a valid option in fibre-reinforced compounds, too, and in applications involving high operating speeds and pressure, e.g., bushings, washers, slide guides and gears. Combining **PTFE with aramid fibres** also allows a significant reduction of the friction coefficient.

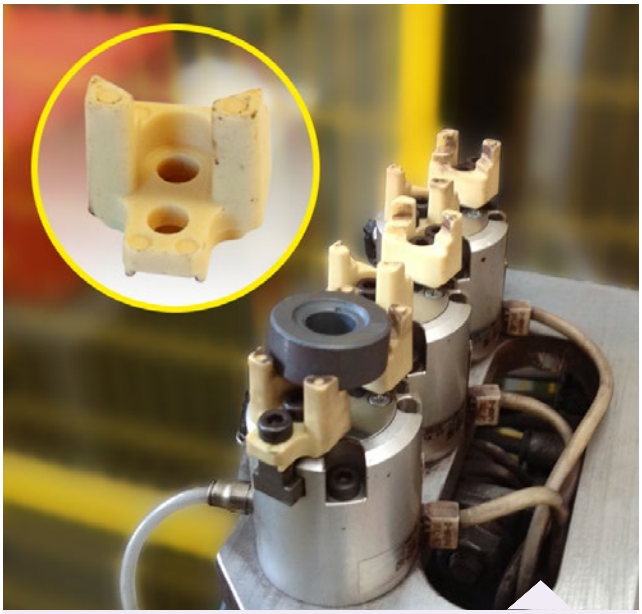
Therefore, compounds containing both these additives are particularly effective, especially in all situations requiring resistance to wear and very low resistance to sliding (e.g., automation systems, automotive applications and so on). In this regard, grades made from intrinsically self-lubricating resins, such as PA, POM and PEEK, are particularly interesting.
Unlike carbon fibres, the aramid fibres used in LATILUB compounds do not significantly improve the mechanical properties or surface hardness of the material.

LATILUB 80-10T Y/15

HIGH-PERFORMANCE AUTOMOTIVE BUSHING
PPS, 10% PTFE, 15% aramid fibre
Resistance to heat, wear, and chemicals.
Maximum dimensional stability and surface hardness. For uncompromising applications.

LATILUB 66-10T Y/15

POWER GEARS FOR TEXTILE MACHINERY
PA66, 10% PTFE, 15% aramid fibre
Minimum wear even in the presence of high specific pressure and relative velocity.
The ultimate LATILUB solution for applications where friction and wear are the main issues. Also with POM, PPS, PPA and PEEK.



LATILUB 66 Y/20

ROBOT AND AUTOMATION COMPONENTS
PA66, 20% aramid fibre
For maintenance-free elements/parts destined for numerous cyclic applications.
Maximum resistance to abrasive wear.

				SEMICRYSTALLINE						
PROPERTIES (typical values)	**TESTING CONDITIONS**	**STANDARDS**	**UNITS (SI)**	**LATILUB 66-20T G/20-V1**	**LATILUB 66-20T G/40**	**LATILUB 67-10STE21 G/20**	**LATILUB 57D-15T G/30**	**LATILUB 57-10T Y/15**	**LATILUB 57-30GRTS G/20**	**LATILUB 80-10T K/15**
				PA 66	**PA 66**	**PA 66**	**PPA**	**PPA**	**PPA**	**PPS**
PHYSICAL										
Density	23°C	ISO 1183	g/cm³	1.46	1.65	1.26	1.55	1.28	1.54	1.45
Linear shrinkage at moulding* (60x60x2mm - 60MPa)	along flow	ISO 294-4	%	0.50 ÷ 0.65	0.35 ÷ 0.60	0.50 ÷ 0.70	0.35 ÷ 0.65	1.10 ÷ 1.40	0.50 ÷ 0.80	0.20 ÷ 0.35
	across flow			0.90 ÷ 1.20	0.75 ÷ 1.05	1.00 ÷ 1.30	0.75 ÷ 1.05	1.20 ÷ 1.50	1.20 ÷ 1.60	0.30 ÷ 0.50
MECHANICAL										
Charpy - Impact strength notched (specimen 80 x 10 x 4 mm)	23°C	ISO 179-1eA	kJ/m²	8	12	15	8	1	6.5	4
Charpy - Impact strength unnotched (specimen 80 x 10 x 4 mm)	23°C	ISO 179-1eU	kJ/m²	35	50	65	60	10	20	20
Tensile modulus	23°C	ISO 527-1	MPa	6400	13000	6000	10000	3500	11000	16000
Tensile strength	23°C	ISO 527-1	MPa	115	170	90	170	60	115	130
Elongation at yield	23°C	ISO 527-1	%			2.5				
Elongation at break	23°C	ISO 527-1	%	2.5	2	3.5	2.2	2	1.5	0.7
THERMAL										
Vicat - Softening point (heating rate 50°C/h)	49 N - 50°C/h	ISO 306	°C	250	250	230	250	215	245	255
HDT – Heat Distortion Temperature	0.45 MPa	ISO 75	°C	265	270	245	280	240	295	280
	1.82 MPa			250	260	205	255	135	275	265
TRIBOLOGICAL										
Static and dynamic coefficient of friction	load 6.1Kg speed 15m/min	ASTM D-1894	μ static	0.30	0.35	0.25	0.33	0.27	0.24	0.26
			μ dynamic	0.24	0.29	0.21	0.29	0.24	0.22	0.21
Wear Factor (K)	pressure 20 Kg/cm² speed 3 m/min - 40 h	Thrust Washer	(10^{-10} m³/h)/(N m h)	6.2	5.1	24	15	5.5	8	8
PROCESSING CONDITIONS										
Pre-drying temperature	(at least 3 hours at…)		°C	90 ÷ 100	90 ÷ 100	90 ÷ 100	90 ÷ 100	120 ÷ 130	120 ÷ 130	110 ÷ 130
Melt temperature			°C	270 ÷ 290	275 ÷ 300	270 ÷ 300	320 ÷ 340	310 ÷ 330	310 ÷ 330	290 ÷ 310
Mould temperature			°C	70 ÷ 100	70 ÷ 100	60 ÷ 80	130 ÷ 160	130 ÷ 160	150 ÷ 170	130 ÷ 150
SELF-EXTINGUISHING										
				LATI						
COLORABILITY										
				☑	☑	☑	☑	☑	☒	☒

UL approved grade

Intrinsically self-extinguishing base resin

SEMICRYSTALLINE											
LATILUB 80-15T G/30	LATILUB 80-10T G/40	LATILUB 80-15T K/30	LATILUB 80-17ST G/30	LATILUB 80-40GRT	LATILUB 80-10T Y/15	LATILUB 88/10-15T K/30	LATILUB 88/10-15T G/30	LATILUB 88/50-20GRT K/10	LATILUB 88/50-20T	LATILUB 88/50-30GRT	LATILUB 88/10-10T Y/10
PPS	PPS	PPS	PPS	PPS	PPS	PEEK	PEEK	PEEK	PEEK	PEEK	PEEK
1.62	1.72	1.50	1.67	1.60	1.42	1.47	1.62	1.45	1.40	1.48	1.37
0.25 ÷ 0.40	0.10 ÷ 0.25	0.15 ÷ 0.35	0.25 ÷ 0.40	0.45 ÷ 0.75	0.45 ÷ 0.75	0.10 ÷ 0.30	0.30 ÷ 0.55	0.25 ÷ 0.40	0.90 ÷ 1.30	0.65 ÷ 1.05	0.75 ÷ 1.15
0.60 ÷ 0.75	0.40 ÷ 0.60	0.25 ÷ 0.45	0.60 ÷ 0.75	0.50 ÷ 0.80	0.50 ÷ 0.80	0.35 ÷ 0.55	0.60 ÷ 0.90	0.60 ÷ 0.90	1.00 ÷ 1.40	0.90 ÷ 1.30	0.85 ÷ 1.25
8	8.5	4	6	1.5	1.5	5	9	5	7	6	5
35	45	20	25	10	5	27	38	36	NB	35	55
13500	14500	24000	11000	6800	3800	22700	12400	12500	3900	5600	4000
120	160	170	135	50	45	170	110	145	75	85	75
									7		
1.4	1.5	0.5	1.7	1	1.2	1	2	2.3	30	2.5	6
255	260	255	255	245	245	350	350	350	270	280	285
275	280	280	275	250	250	350	295	350	190	220	240
265	265	270	265	150	110	350	255	295	155	165	165
0.21	0.26	0.18	0.19	0.16	0.19	0.30	0.35	0.26	0.26	0.26	0.25
0.17	0.23	0.14	0.16	0.09	0.15	0.24	0.28	0.20	0.23	0.18	0.20
8.7	10	8.8	8.5	4.7	4.30	6	6.8	6.3	4.4	4.7	6.7
110 ÷ 130	110 ÷ 130	110 ÷ 130	110 ÷ 130	110 ÷ 130	110 ÷ 130	120 ÷ 150	120 ÷ 150	120 ÷ 150	120 ÷ 150	120 ÷ 150	120 ÷ 150
290 ÷ 310	290 ÷ 310	290 ÷ 310	290 ÷ 310	290 ÷ 310	290 ÷ 310	370 ÷ 400	370 ÷ 400	370 ÷ 400	360 ÷ 390	360 ÷ 390	360 ÷ 390
130 ÷ 150	130 ÷ 150	130 ÷ 150	130 ÷ 150	130 ÷ 150	130 ÷ 150	170 ÷ 200	170 ÷ 200	170 ÷ 200	170 ÷ 200	170 ÷ 200	170 ÷ 200
UL, flame	UL, flame	flame	flame	flame	UL, flame	flame	flame	flame	flame	flame	flame
✓	✓	✗	✓	✗	✓	✗	✓	✗	✓	✗	✓

Graphite

Graphite has a crystalline structure arranged in parallel free layers. This structure allows **relative sliding** between the free layers. This property is significantly enhanced in water thanks to the interaction of the latter with the graphite layers.

In water, in fact, compounds containing this additive display excellent tribological properties thanks to reduction of the friction coefficient and wear factor.

Thanks to its high intrinsic electrical conductivity, graphite confers **antistatic** properties on compounds.

This additive has a natural black colour, an aspect that must be taken into account when moulding parts with specific aesthetic requirements, since graphite-based compounds cannot be coloured.

Being similar to a mineral filler, graphite is suitable for manufacturing items with **high dimensional stability** that do not require excellent mechanical properties.
Ideal for use in case of:

- low velocities;
- high pressures;
- contact with water.

LATILUB 88/50-20GRT K/10

PROFESSIONAL PRUNING MACHINE GEARS
PEEK, 20% graphite and PTFE, 10% carbon fibre
Resistance to high temperatures.
Safe power transmission without particle formation.
Minimum abrasion and reduced friction even at high specific pressures and rotation speeds.

LATILUB 80-40GRT

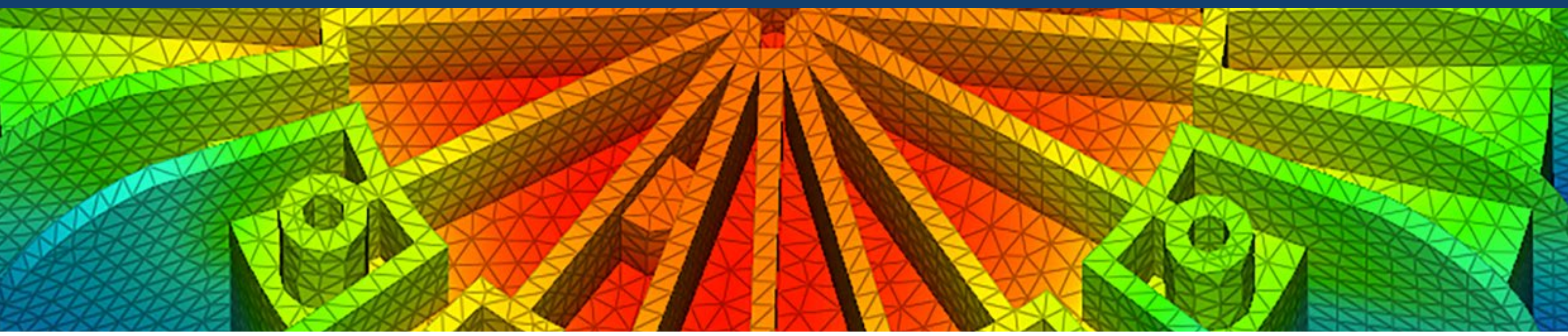
BUSHING FOR PYROLYTIC OVEN FAN
PPS, 40% graphite and PTFE
Substantial friction reduction, maximum dimensional stability.
Perfect for precision elements resistant to temperatures and harsh environmental conditions.

LATILUB 95-25GR CE/10

WATER METER INTERNAL JACKET
PSU, 25% graphite, 10% ceramic filler
Maximum dimensional stability, suitable for contact with drinking water even when hot.

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.

LATI HIGH PERFORMANCE THERMOPLASTICS

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

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CERTIFIED MANAGEMENT SYSTEMS
CERTIQUALITY
UNI EN ISO 9001:2015
UNI EN ISO 14001:2015
UNI ISO 45001:2018

CERTIQUALITY È MEMBRO DELLA FEDERAZIONE CISQ

GOLD 2022 ecovadis Sustainability Rating

FAI CORPORATE GOLDEN DONOR
Noi sosteniamo il FAI