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Ideas for the future.

LAURAMID® - THE PA 12C

Casting without Limits

Melted Lauramid® mass is cast into moulds. There it polymerizes in specific kilns to the desired finished or semi-finished part.
→

LAURAMID® - THE PA 12C

When optimum quality is required

As a part of the innovative Handtmann Group, Handtmann Elteka has established itself as the leading manufacturer of cast polyamide PA 12. This material, developed at the German Headquarters, is now known by its brand name, Lauramid®.

Technological orientation at Handtmann Elteka begins with professional research and development. We perform true pioneering work, such as inventing our PA 12C Lauramid® formula, now a world leader. This polyamide is a highly diverse material that can be applied to numerous fields.

Maintaining an open dialogue with our customers and years of technical experience provide the basis for a multitude of innovative component designs. This equals high economic viability, precision, and reliability.

With our know-how and passion, we work to find the optimum solutions for your requirements – from the production of individual components and complex parts for special mechanical engineering to large-scale production in the automotive sector.

→
Steel hubs, among other things, can be inseparably cast into components made of PA 12C Lauramid®

Due to the casting production Lauramid® can be produced with (LMV) or without steel links
→

LAURAMID® PA 12C CASTING

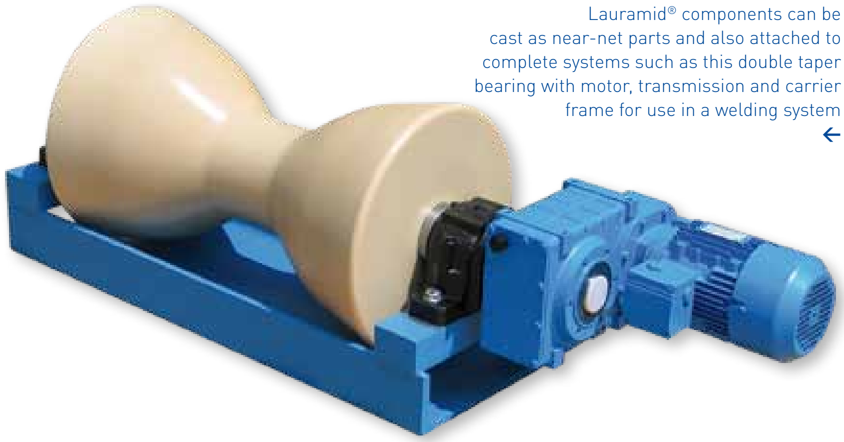
Maximum design options for individual components

Lauramid® is a polyamide 12C, which, as a low-viscosity molten mass, is poured into moulds in a non-pressurized casting process. Unlike other plastics, Lauramid® is neither extruded, injection-moulded, nor deep-drawn. Semi-finished products are produced in Lauramid® casting, such as

• Sheets, cylinders, round bars, tubes
• Lauramid® metal compounds (LMV) = inseparable casting of hubs of all kinds

At the same time, Lauramid® casting is mainly used to directly produce individual, near-net components. Here the advantages of casting technology are revealed. Consequently, innovative solutions for component geometries are generated from Lauramid®. For example, components

• With interior and exterior free-form surfaces and contours
• With wide variations in wall thickness
• With directly-cast hubs



Lauramid® components can be cast as near-net parts and also attached to complete systems such as this double taper bearing with motor, transmission and carrier frame for use in a welding system

LAURAMID® PA 12C CASTING

Minimum “Total Cost of Ownership”

The PA 12C Lauramid® features mechanical and physical advantages which demonstrate their value in sophisticated applications. Due to the extended total cost of ownership and low maintenance, the total lifetime cost for these components and systems made from Lauramid® are in part reduced by more than half. Selected advantages of the material are:

- Lubricant-free use
- Best notch-resistant properties of all polyamides
- Low weight for lightweight constructions (7 x lighter than steel)
- Minimum moisture absorption (0.9 % by weight)
- Chemical resistance (more than 200 tested substances)
- Wide temperature spectrum (-50 to +120 °C)
- Due to mould casting, full working steps (post-processing) or other complex mechanical connections are unnecessary
- Lauramid® is superior to extruded or injection-moulded polyamide 12 with 30% short glass fibres in creep behaviour

The PA 12C Lauramid® is used in applications for a number of different categories. Depending on the requirements profile, the focus is on a variety of properties from the many reliable features available.

Properties / Branches	Dry running	Temperature resistance	Abrasion resistance	UV resistance	Chemical resistance	Food safe	Dimensional stability	Flattening characteristics	Low water absorption	Weight
Mechanical engineering	X		X				X		X	X
Lift and cable railway industry		X	X	X			X	X	X	
Sealing technology, petrochemicals		X			X	X	X		X	
Paper and printing industry		X	X		X		X		X	
Transport (automotive and waggon construction)		X	X	X	X		X	X	X	X
Packaging industry non-food / food	X		X		X	X	X			X
Storage and materials handling	X		X				X	X		
Textile technology	X		X		X		X			X
Medical technology	X		X		X		X	X		

LAURAMID® PA 12C CASTING

Customer-tailored consultation and implementation

Consultation, dimensioning, production and quality assurance.

Decades of experience in the application of PA 12C Lauramid® make it possible for us to provide detailed answers to your questions. In order to expand our specific knowledge of Lauramid® we continue to conduct a range of benchmark trials and support research projects at technical universities.
The results are special calculation programs such as the dimensional analysis of rollers, gear wheels, and material developments for new application fields.

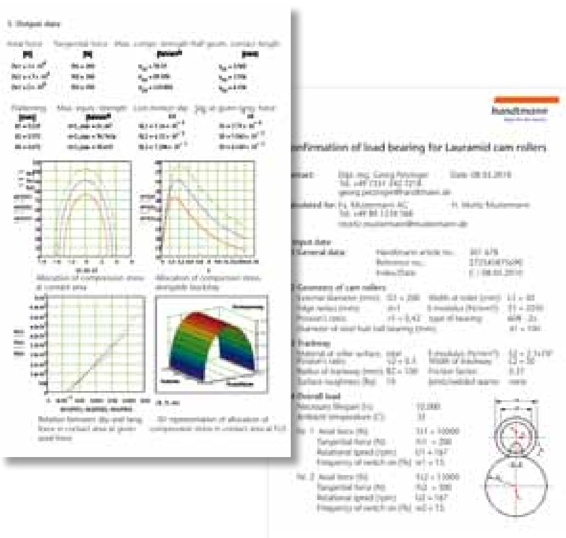
Taking the application conditions into consideration, we optimize all relevant features of your components for you, such as

- Roll resistance
- Gear wheel geometry
- Temperature development
- Composite construction
- Wall thickness

Something to keep in mind: Quality assurance plays a key role at Handtmann Elteka. Among other things, we utilize the following:

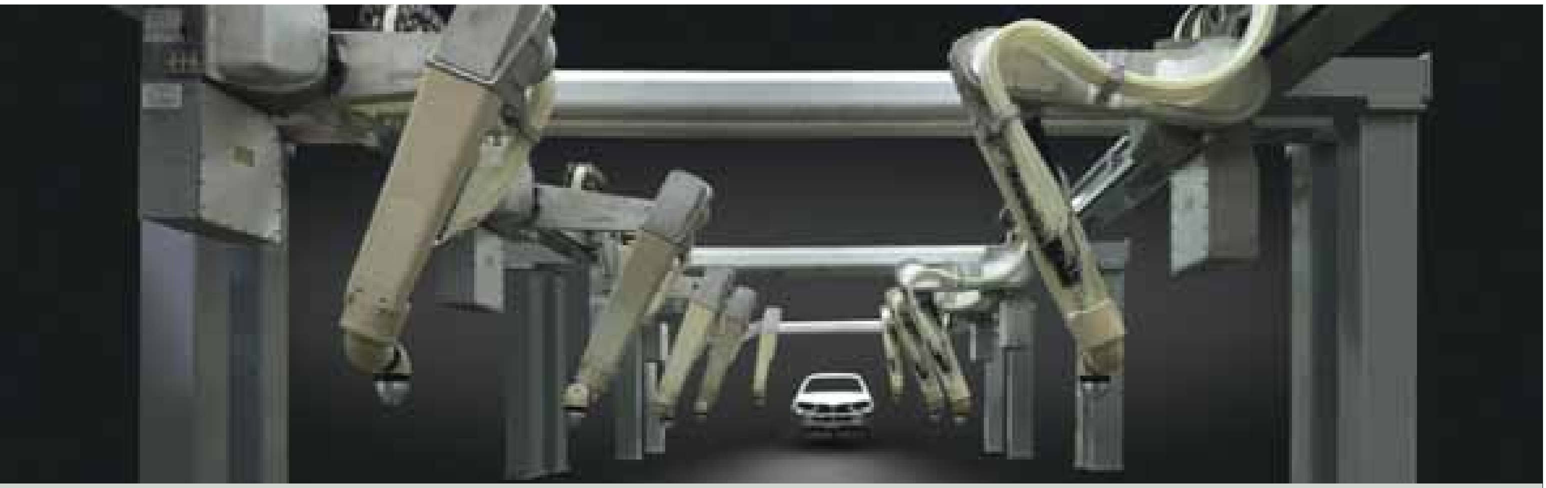
- X-ray inspection of all raw parts
- Measurement of the contours on finished components
- Inspection of complex components on measuring centers

→ In-house calculation programs have been developed for the optimum calculation of components such as rollers and gear wheels



LAURAMID® APPLICATION EXAMPLES

Cable railway construction: Rollers for wind and weather



Robotics: Robotic arms defy the overspray

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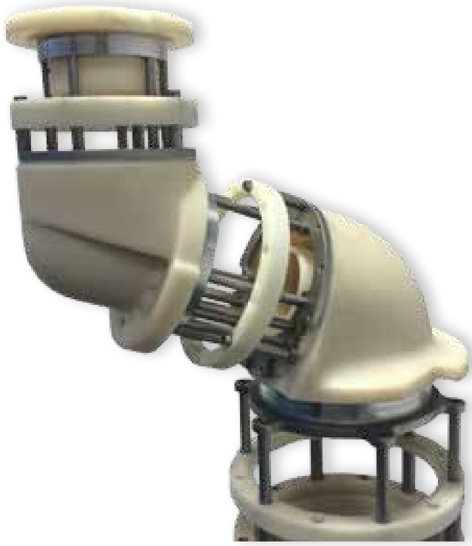
This model of a multi-axis robot arm made of Lauramid® displays the advantages of directly cast free-form surfaces



Fatigue, weather, and chemical resistance

When maximum safety is of primary importance, rollers made of PA 12C Lauramid® are the first choice – for example in cable railways. Coupling, track and carrier rollers must not only be able to withstand very different environmental influences, but also extreme impacts and shocks. Lauramid® rollers prove their endurance by their load capacity, abrasion resistance, extended life and extreme temperature tolerance of -40 to +80 °C.

Completely cast components with cavities and wide variations in wall thickness can also be achieved using Lauramid® casting. For example, our ability to produce thicker walls for robotic arms enables us to avoid the costs of further processing. The low inherent weight of Lauramid® also makes an ideal material for dynamically moved components. The high electrical insulation capability is another important prerequisite for use in the automotive industry paintshops.

←
Amongst other branches, cam disks made of Lauramid® are used in the packaging sector

LAURAMID® APPLICATION EXAMPLES

Packaging technology: For smooth-running gear wheels & cam discs

Food safe.
Durable. Economic.

Low-maintenance and reliable function aspects
are critical if PA 12C Lauramid® is used for components in machines which have to run 24/7. For example, gear wheels or cam disks in the packaging and food industries.
The excellent tribological properties of Lauramid® optimize the sliding characteristics and the noise reduction properties in dry running compared to steel gear wheels. While interacting with cast metal hubs, inexpensive overall solutions can also be achieved with Lauramid® FS, which is food safe.

Dimensionally stable Lauramid® rollers
are also used in the automotive sector. The extremely low flattening characteristics in static condition, the low roller resistance and the dimensional stability on the bearing seats are only some of the reasons for the selection of this unfilled cast polyamide. Fittings rollers made of Lauramid® thus provide high reliability over the entire lifetime of the vehicle.

→
Due to their smooth running properties and durability Lauramid® rollers are also used in vehicle sliding doors

The automotive industry: Rollers for increased dynamics

Further Lauramid® information on
handtmann.de/plastics:

- Material types
- Chemical resistance
- Use of technical consumables
- Comparison to other technical plastics

LAURAMID® PA 12C CASTING

Material characteristics

General properties	Test procedure	Units/data	Lauramid® A / Lauramid® FS with metal composite	Lauramid® B / Lauramid® FS without metal composite
Density	DIN EN ISO 1183	kg/dm³	1.025	1.025
Relative solution viscosity	DIN 53737	rel.	inseparable	inseparable
Water absorption (%) with standard climate	DIN EN ISO 62		0.9	0.9
Water absorption (%) with water storage	DIN EN ISO 62	23 °C/saturated	1.4	1.4
Extract content (ethanol)	Company standard	%	max. 1	max. 1
Melting point	DIN EN 3146	°C	183	190
Mechanical properties				
Ball impression hardness	DIN EN ISO 2039-1	H358	117	122
Shore hardness D	DIN EN ISO 868		76	76
Compressive strength	DIN EN ISO 604	Mpa	54 - 58	54 - 58
Modulus of elasticity (pressure)	DIN EN ISO 604	Mpa	1,400 - 1,800	1,600 - 2,000
Yield stress	DIN EN ISO 527	Mpa	51 - 58	65 - 62
Breaking strength	DIN EN ISO 527	Mpa	30 - 40	37 - 50
Modulus of elasticity (tensile)	DIN EN ISO 527	Mpa	1,800 - 2,000	2,000 - 2,400
Elongation for yield stress	DIN EN ISO 527	%	9 - 13	7 - 11
Elongation for breakage	DIN EN ISO 527	%	>200	15 - 22
Modulus of elasticity (flexion)	DIN EN ISO 178	Mpa	1,550 - 1,900	1,850 - 2,200
Flexural stress with conventional flexion	DIN EN ISO 178	Mpa	57 - 64	64 - 70
Notch resistance (Charpy) +23 °C -30 °C	DIN EN ISO 179	KJ/m²	15 - 28 8 - 18	5 - 12 4 - 9
Coefficient of sliding friction		Lauramid®/metal	0.3	0.3
Electrical properties				
Surface resistance	DIN IEC 93	Ω	$6.6 \cdot 10^{15}$	$6.6 \cdot 10^{15}$
Spec. contact resistance	DIN IEC 93	Ω cm	$3 \cdot 10^{14}$	$3 \cdot 10^{14}$
Dielectric constant	DIN IEC 250		3.5	3.5
Dissipation factor	DIN IEC 250		$3.8 \cdot 10^{-4}$	$3.8 \cdot 10^{-4}$
Tracking Resistance KB Tracking Resistance KC	DIN EN 60112	CTI A	550 600	550 600
Dielectric strength	IEC 243-1	kV / mm	24.4	24.4
Thermal properties				
Lin. expansion coefficient -50 – (-30) °C +30 – (+80) °C	DIN 53752 DIN 53752	10^{-4}/°C 10^{-4}/°C	0.8 - 1.0 1.0 - 1.8	0.8 - 1.0 1.0 - 1.8
Application temperature max. short-term		°C	to 150	to 150
Continuous service temperature (< 10^4 h)	IEC 60216-1 in oil IEC 60216-1 in water IEC 60216-1 in air	°C	140 90 120	140 90 120
Vicat	DIN EN ISO 306/B	°C	172 - 180	185 - 191
Thermal resistance	DIN EN ISO 75/A DIN EN ISO 75/B	°C °C	80 - 115 186	176 - 190 194
Specific heat	DIN EN ISO 11357	kj/kgK	2.4	2.4
Coefficient of thermal conductivity	DIN EN 52612	W/mk	0.27	0.27
Brittleness in cold		°C	-50	-50
Flammability	UL 94		≥10 mm V0 ≥6 mm HB	≥10 mm V0 ≥6 mm HB

Lauramid® A = Lauramid® with metal composite (LMV)
Lauramid® B = Lauramid® without metal composite
Lauramid® FS = Food-safe Lauramid® with and without metal composite

Resistance to chemicals

Chemicals	Concen-tration	Standard types	
	in %	20°C	60°C
Acéton[1]	100	+	+
Ether (s. Diethylether)			
Ethyl acetate (s. Ethanoic acid ethyl ester)			
Ethyl alcohol, undenatured	100	+	Δ
Ethyl alcohol, w., undenatured	96	+	Δ
	50	+	+
	10	+	+
Ethyl hexanol	100	∞	
2- Ethylene chloride	100	Δ	
Alums, all types, w.	jd.	+	+
Aluminium salts, w.	jd.	+	+
Acide formique	98	◊	–
	90	◊	–
	50	◊	–
	10	+	◊
Ammonia, fuming	100	+	+
Ammonia, w.	conc.	+	+
	10	+	+
Ammonium acetate, w.	jd.	+	+
Ammonium carbonate, w.	jd.	+	+
Ammonium chloride, w.	jd.	+	+
Ammonium nitrate, w.	jd.	+	+
Ammonium phosphate, w.	jd.	+	+
Ammonium sulphate, w.	jd.	+	+
Amylalcohol, pure (fermentation alcohol)		+	+
Anilin	100	Δ	
Baryum salts	jd.	+	+
Benzaldehyde	100	–	–
Benzaldehyde. w.	k.g. (0,3)	∞	
Petrol, see fuel			
Benzoic acid	100	+	+
Benzoic acid, w.	k.g.	Δ	
Benzol	100	+	Δ
Ethane dicarbolic acid, w.	k.g.	Δ	
Boric acid	100	+	+

Chemicals	Concen-tration	Standard types	
	in %	20°C	60°C
Boric acid, w.	k.g. (4,9)	+	
Liquid bromine	100	–	
Bromine gas	high	–	–
Bromine solution	k.g.	–	–
Butane liquid	100	+	
Butane gas	100	+	+
Butylacetate (see acetic acid butylester)			
n-Butylalcohol (n-Butanol)		+	+
Calciumchloride, w.		+	+
Calciumnitrate, w.	k.g.	+	
Chlorine, liquid	100	–	
Chlorine, fuming, humid	100	–	–
Chlorine, fuming, dry	100	–	–
Chlorbenzol	100	∞	–
Chloroform	100	∞	–
Chlorosulfuric acid	100	–	–
Chlorine solution		–	–
Chlorine hydroxide, fuming	high	–	–
(cf. also hydrochloric acid)	low	∞	–
Chromium salts [2 and 3], w.	k.g.	+	+
Chromiumtrioxide, w.	k.g.	–	–
(Chromic acid)	20	–	–
Cyclohexane	100	+	+
Cyclohexanol	100	+	+
Cyclohexanone	100	+	∞
Dekahydronaphtalin	100	+	∞
Diethylether [2]	100	+	
Dibutylphthalate (s. plasticiser)			
Dimenthylformamide	100	+	Δ
1,4-Dioxane	100	+	
Iron salts, w.	k.g.	+	+
Acetic acid (glacial)	100	–	–
Acetic acid, w.	50	–	–

Chemicals	Concen-tration in %	Standard types 20°C	60°C
(cf. also vinegar)	10	+	◊
Acetic acid anhydride	100	+	◊
Acetic acid ethyl ester (ethylacetate, acetic ester)	100	+	+
acetic acid butylester (butylacetate)	100	+	+
Hydrofuoric acid	40	Δ	–
Formaldehyde, w.	40	Δ	–
	30	Δ	–
	10	+	Δ
Glycerine	100	+	+
Glycerine, w.	100	+	+
	high	+	+
	low	+	+
Glycol	100	+	+
Glycol, w.	high	+	+
	low	+	+
Urea, w.	k.g.	+	+
Heptane	100	+	+
Hexane	100	+	+
Isooctane	100	+	+
Isoprophylalcohol	100	+	Δ
Potassium hydroxide, w.	50	+	+
	25	+	+
	10	+	+
Potassium carbonate, w. (Potash)	k.g.	+	+
Potassium chlorate, w.	k.g. (7,3)	Δ	∞
Potassium chloride, w.	k.g.	+	+
Potassium dichromate, w.	k.g. (12)	∞	–
Potassium iodide, w.	k.g.	+	+
Potassium nitrate, w.	k.g.	+	+
Potassium permanganate, w.	k.g. (6,4)	◊	–
Potassium sulphate, w.	k.g.	+	+

Chemicals	Concen-tration in %	Standard types 20°C	60°C
Cresol	100	–	–
Cresol, w.	k.g. (0,25)	∞	–
Copper salts, w.	k.g.	+	+
Magnesium salts, w.	k.g.	+	+
Methylalcohol (methanol)	100	+	Δ
Methylalcohol, w.	50	+	+
Methylenchloride [3]	100	◊	
Lactic acid, w.	90	–	–
	50	◊	–
	10	Δ	◊
Mineral oils (see technical consumer goods and drugs)			
Naphthalin	100	+	∞
Sodium carbonate, w. (bicarbonate of soda)	k.g.	+	+
Sodium bisulphate, w.	k.g.	+	∞
Sodium carbonate, w. (Soda)	k.g.	+	+
Sodium chlorate, w.	25	Δ	∞
Sodium chloride, w. (cooking salt)	k.g.	+	+
Sodium chloride, w.	5	Δ	∞
Sodium hydroxide (caustic soda)	100	+	+
Sodium hypochlorite, w.	5	Δ	◊
Sodium nitrate, w.	k.g.	+	+
Sodium nitrite, w.	k.g.	Δ	∞
Sodium perborate, w.	k.g.	+	∞
Sodium phosphate, w.	k.g.	+	+
Sodium sulphate, w. (Glauber salt)	k.g.	+	+
Sodium sulphide, w.	k.g.	+	+
Sodium sulphite, w.	k.g.	+	+
Sodium thiosulphate, w. (hypo)	k.g.	+	+
Sodium carbonate solution, w.	50	+	+
	25	+	+
	10	+	+
Nickel salts, w.	k.g.	+	+
Nitrobenzol	100	Δ	∞

Resistance to chemicals

Chemicals	Concen-tration in %	Standard types 20°C	60°C
Oleic acid	100	Δ	–
Octane (s. Isooctane)			
Oxalic acid w.	k.g.	Δ	◊
Ozone (<0.5ppm)		Δ	
Phenol		–	–
(aqueous phase)	k.g. (ca. 9)	–	–
(phenolic phase)	k.g. (ca. 70)	–	–
Phosphorus pentoxide	100	◊	–
Phosphoric acid	k.g. (85)	–	–
	50	◊	–
	10	+	∞
Propane, liquid	100	+	
Propane, gaseous	10	+	+
Pyridine	100	+	
Mercury	100	+	+
Mercury salts w.	k.g.	+	+
Nitric acid	50	–	–
	25	–	–
	10	–	–
Hydrochloric acid	conc.	–	–
	10	–	–
Sulphur	100	+	+
Sulphur dioxid	low	+	Δ
Sulphur carbonate	100	+	
Sulphuric acid	96	–	–
	50	–	–
	25	◊	–
	10	Δ	∞
Sulphur hydroxide	low	+	+
Silver salts, w.	k.g.	+	+
Steric acid	100	Δ	–
Carbon tetrachloride	100	+	+

Chemicals	Concen-tration in %	Standard types 20°C	60°C
Tetra hydrofuran	100	Δ	◊
Tetrahydronaphthaline	100	+	∞
Tiophen	100	+	∞
Toluol	100	+	∞
Trichloro ethylene	100	Δ	◊
Water	100	+	+
Hydrogen peroxide, w.	30	+	
	10	+	
	3	+	
Tartaric acid, w.	k.g.	+	∞
Xylol	100	+	∞
Zinc salts, w.	k.g.	+	+
Stannic chloride	k.g.	+	+
Citric acid, w.	k.g.	+	∞

Key to symbols:

Resistance:
- stable +
- practically stable Δ
- limited stability ∞
- little stability ◊
- labile –

Concentration:
- w. = white solution
- k.g. = saturated coldly
- jd. = each

Footnotes: 1) kp 56°C; 2) kp 35°C; 3) kp 42°C; 4) kp 46°C; 5) resistance dependent on conditions; 6) Note permeability to odours

Technical Consumer Goods

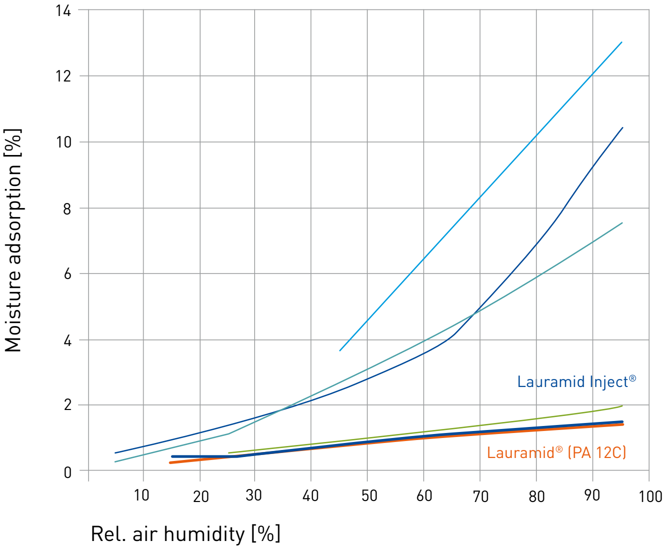
Technical test substances	Concen- tration in %	Standard types 20°C	60°C
Battery acid		∞	–
Alum	k.g.	+	+
Asphalt*		+	+
Petrol (s. fuels)			
Bleach solution (12.5% effective chlorine)		∞	◊
Floor wax [5]		+	Δ
Borax, w.	k.g.	+	∞
Brake fuid[5]		+	+
Calcium chloride (aqueous precipitate)		∞	◊
Chromium plating electrolyte		–	–
Chromo sulphuric acid.		–	–
Diesel oil (see fuel)			
Dixan solution	ready to use	+	+
Spruce needle oil		+	
Hypo (cf. also sodium thiosulphate)	10	+	∞
Formalin		Δ	–
Anti-freeze (motor vehicle)		+	+
Washing up liquid aqueous*		+	+
Heating oil[5]		+	+
Pine needle oil		+	
Neatsfoot oil		+	+
Aqua regia		–	–
Cresol solution		∞	–
Lanolin		+	+
Linseed oil		+	+
LITEX		+	+
Lysol		∞	–
MARLIPAL MG	50	+	+
MARLON, 42% WAS		+	+
MARLOPHEN 83	100	+	+
MARLOPHEN 89	100	+	+
	20	+	+
	5	+	+
MARLOPHEN 810	100	+	+
	20	+	+
	5	+	+
MARLOPHEN 820	100	+	+
	20	+	+
	5	+	+

Technical test substances	Concen- tration in %	Standard types 20°C	60°C
Mineral oils (non aromatic)		+	+
Furniture polish*		+	∞
Engine oils (motor vehicle)		+	+
Moth balls*		+	∞
Oleum	chq.	–	–
Oil No. 3 according to ASTMD 380-59	100	+	+
Paraffin	100	+	+
Paraffin oil	100	+	+
Pectin	k.g.	+	+
Petroleum ether	100	+	+
Petroleum	100	+	+
Photographic developing fuid*	standard	∞	
	ready to use	Δ	
Sagrotan		∞	∞
Soft soap		+	+
Type writer oil		+	+
Shoe cream [5]		+	∞
Sea water		+	+
Silicone grease [5]		+	+
Soda (s. Natriumcarbonat)		+	
Tar*		+	+
Oil of turpentine		+	∞
Test petroleum		+	+
Ink [5]		+	+
Transformer oil [5]		+	+
Fuels normal petrol according to DIN 51635		+	
Petrol regular		+	+
Petrol super		+	+
Diesol oil*		+	+
Washing powder	high	+	+
synth.**	ready to use	+	+
Waterglass			
Hydrogen superoxide (see chemicals)		+	+
Plasticiser dibutylphthalate (VESTINOL C)		+	+
Dibutylsebacate		+	
Dihexylphthalate		+	
Diisononyladipate (VESTINOAL NA)		+	
Diisononylphthalate (VESTINOL N)		+	
Dioctylapidate (VESTINOAL OA)		+	
Dioctylphthalate (VESTINOL AH)		+	+
Tricresolyphosphate		+	
Trioctylphosphate		+	
Two stroke oil		+	+

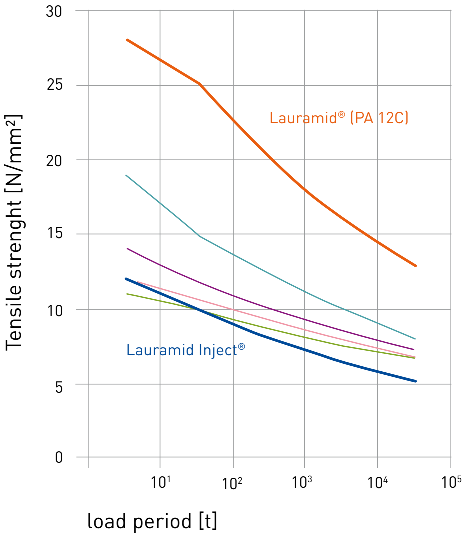
LAURAMID® PA 12C CASTING

Physical characteristics of different polyamides and Lauramid® in comparison

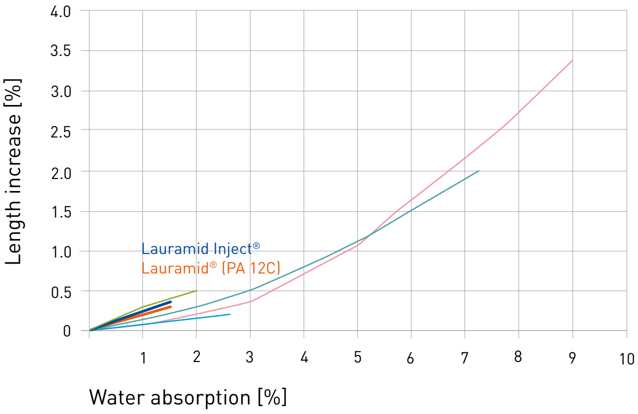
Equilibrium moisture content of different nylons (PA) and Lauramid® as a function of the relative air humidity in case of water retention



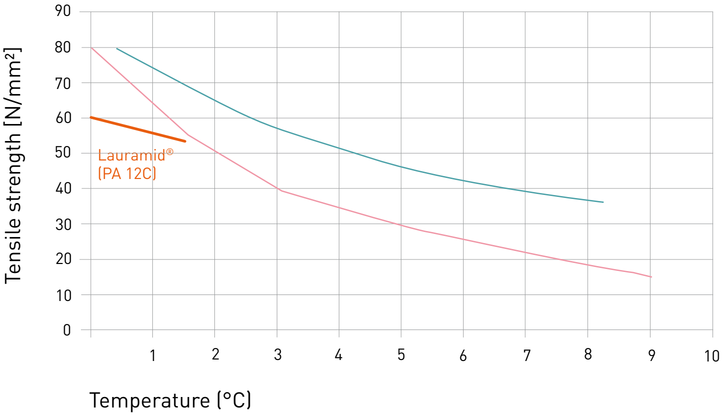
2 % creep limit of nylons (PA) and Lauramid® 23 °C / 50 % relative humidity



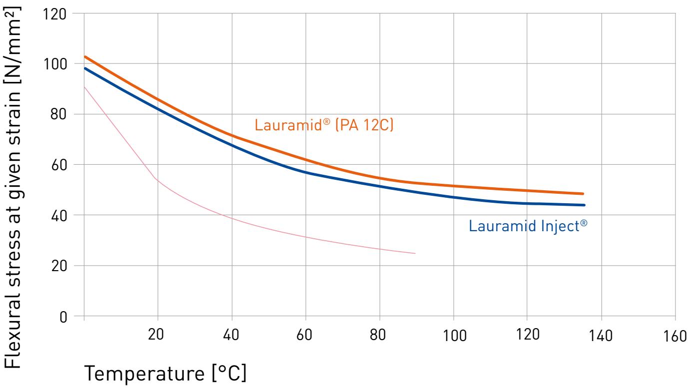
Percental length increase of different nylons (PA) and Lauramid® dependent on the percental water absorption (water at room temperature)



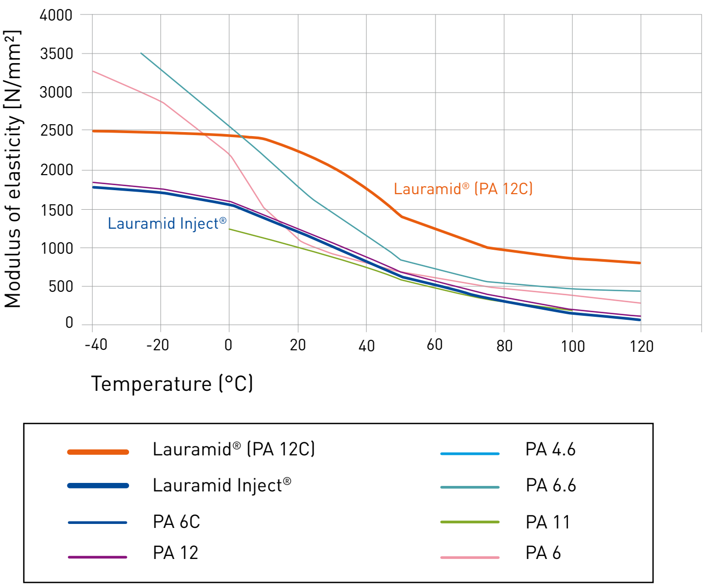
Tensile strength of different nylons (PA) and Lauramid® as a function of the moisture content at 20 °C



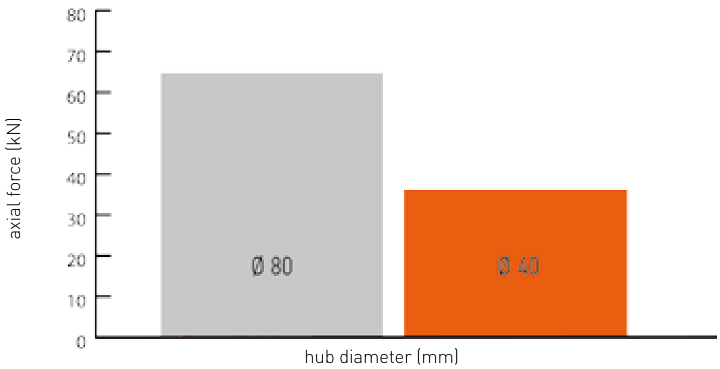
Temperature dependence of the flexural stress at given strain of air-humid PA 6 (nylon) and Lauramid®



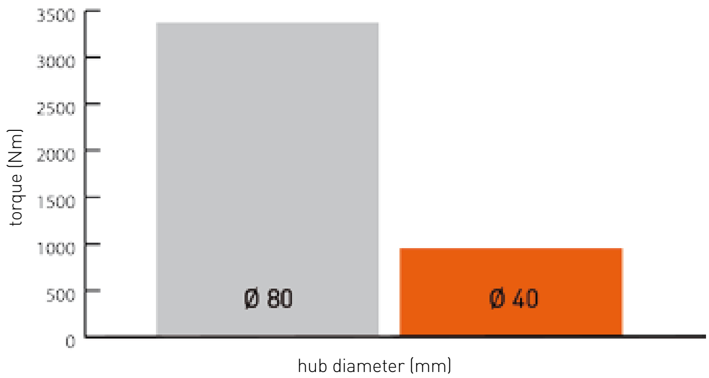
Temperature dependence of the modulus of elasticity of air-humid nylons (PA) and Lauramid®



Experimental determination of the forces required to extrude a cast-in milled hub (DIN 82 RGE, hub length 20 mm, temperature 20 °C) from Lauramid®



Experimental determination of the torque required to turn a cast-in milled hub (DIN 82 RGE, hub length 20 mm, temperature 20 °C) in Lauramid®



Sources material data: In-house testings Handtmann Elteka; campusplastics.com; Becker/Braun: Kunststoff Handbuch 1998 (Munich, Carl Hanser Verlag)

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Ideas for the future.

LAURAMID® - THE PA 12C

by Handtmann Elteka

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