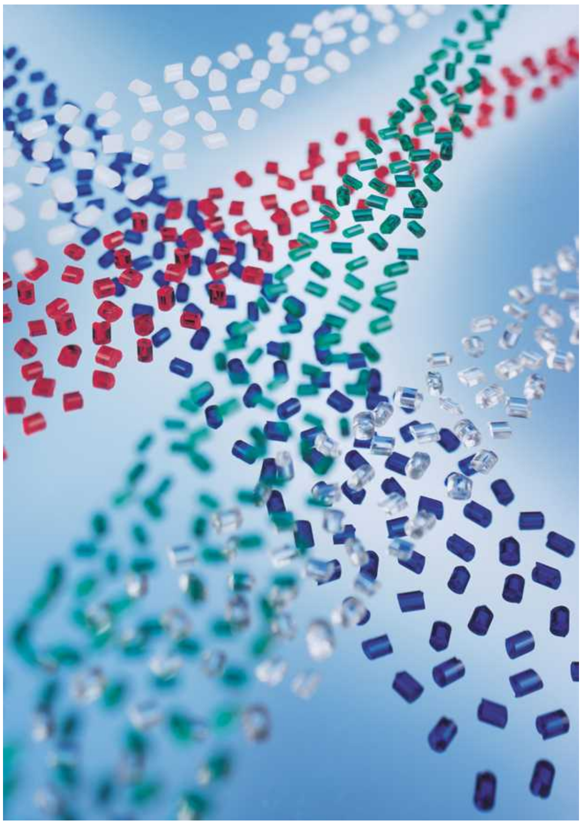
VESTAMID® L
Polyamide 12 compounds

Starting from butadiene, Evonik manufactures laurolactam, the monomer for PA 12, which is then converted by means of a polycondensation reaction into PA 12 and marketed under the name VESTAMID® L.

Outstanding cold impact strength

The (carbon)amide groups (-CO-NH-) in polyamides are responsible for the formation of hydrogen bonds between the macromolecular chains. The hydrogen bonds contribute to the crystallinity, increase the strength, the melting point and the chemical resistance.
The concentration of amide groups is the lowest in PA 12 compared to any other commercially available polyamide, and this determines the specific properties of PA 12:

- the lowest water absorption of all commercially available polyamides, resulting in properties which vary little with changing humidity, and in moldings with virtually unchanged dimensions
- exceptional impact and notched impact strengths, in both dry as molded state, and at temperatures well below the freezing point
- good to excellent resistance against greases, oils, fuels, hydraulic fluids, various solvents, salt solutions and etc.
- exceptional resistance to stress cracking including metal parts encapsulated by injection molding or embedded
- exceptional abrasion resistance
- low coefficient of sliding friction, in dry running against steel, polybutylene terephthalate, polyacetal and other materials
- noise and vibration damping properties
- superb fatigue resistance under high frequency cyclical loading condition
- high processability



Customized product range

The properties of PA 12 compounds can be modified to suit the requirements of many applications by incorporating various additives such as stabilizers, plasticizers, reinforcements, and fillers.

The VESTAMID® L compounds of Evonik comprise a range of various products that are customized to the requirements of processors and users. Many of the PA 12 compounds are suitable especially for the injection molding of precision parts; others have been developed specifically for the extrusion process.

Unfilled PA 12 compounds

Property		Test method	Unit	VESTAMID® L1670	VESTAMID® L1940	VESTAMID® X7373
Physical, thermal, and mechanical properties, and flammability						
Density		ISO 1183	g/cm^3	1.01	1.01	1.01
Melting temperature		ISO 11357				
DSC	2nd heating		°C	178	178	178
Temp. of deflection under load						
Method A	1.8 MPa	ISO 75	°C	50	50	50
Method B	0.45 MPa		°C	120	110	130
VICAT softening temperature		ISO 306				
Method A	10 N		°C	170	170	170
Method B	50 N		°C	140	140	150
Linear thermal expansion	23-55°C	ISO 11359	10^{-4} K^{-1}	1.5	1.5	1.5
Flammability acc. UL94	1.6 mm	IEC 60695		HB	HB	HB
	3.2 mm			HB	HB	HB
Water absorption	23 °C, saturation*	ISO 62	%	1.4	1.5	1.4
	23°C, 50% rel. humidity		%	0.7	0.8	0.7
Mold shrinkage		ISO 294-4,				
in flow direction		processing acc.	%	0.9	0.85	0.95
in transverse direction		ISO 1874-2	%	1.1	1.15	1.15
Tensile test		ISO 527-1/-2				
Stress at yield			MPa	46	45	47
Strain at yield			%	6	5	5
Stress at break			MPa			
Strain at break			%	>50	>50	>50
Tensile modulus		ISO 527-1/-2	MPa	1400	1350	1500
CHARPY impact strength	23 °C	ISO 179/1eU	kJ/m^2	N	N	N
	-30 °C		kJ/m^2	N	N	N
CHARPY notched impact strength	23 °C	ISO 179/1eA	kJ/m^2	4 C	6 C	6 C
	-30 °C		kJ/m^2	5 C	6 C	6 C
Electrical properties						
Relative permittivity	23°C, 100 HZ	IEC 60250		3.8	3.8	4.2
	23 °C, 1 MHz			2.2	2.5	3.8
Dissipation factor	23°C, 100 HZ	IEC 60250	10^{-4}	450450	450	750
	23 °C, 1 MHz		10^{-4}	280280	310	520
Electric strength		IEC 60243-1	kV/mm	27	27	30
Comparative tracking index		IEC 60112				
Test solution A	50 drops value			>600	>600	>600
	CTI			600	600	600
Volume resistivity		IEC 60093	Ω cm	10^{15}	10^{15}	10^{15}
Electrolytic corrosion		IEC 60426	Stage	A1	A1	A1

N = no break, P = partial break, C = complete break

* Plasticized compounds were not stored in water because of slight plasticizer migration.

**ISO 294-4, specimen 60x60x2 mm

VESTAMID® L2101F	VESTAMID® L2106F	VESTAMID® L2140 L2170	VESTAMID® L2141black	VESTAMID® LX9008	VESTAMID® LX9012	VESTAMID® LX9016
1.01	1.01	1.01	1.01	1.01	1.01	1.01
178	175	178	178	176	176	180
50 110	40 80	50 110	50 110	45 125	45 120	45 105
170 140	170 130	170 140	170 140	175 145	170 130	170 130
1.5	1.5	1.4	1.5	1.4	1.3	1.2
HB HB	HB HB	HB HB	HB HB	HB HB	HB HB	HB HB
1.6 0.8	1.8 0.8	1.6 0.7	1.5 0.7	1.4 0.7	1.5 0.8	1.6 0.8
0.7 1.25	0.7 1.2	0.65. 1.25	0.7 1.3	** 0.25 1.9	** 1.0 1.4	** 1.2 1.2
45 5 >50	45 5 >50	47 5 >50	46 5 >50	42 5 48 >50	37 5 46 >50	36 5 47 >50
1400	1300	1400	1500	1450	1100	1070
N N	N N	N N	N N	N N	N N	N N
32 C 9 C	7 C 7 C	16 C 9 C	10 C 8 C	45 P/ C 22 C	19 C 15 C	33 C 17 C
3.7 3.0	3.7 3.0	3.7 3.0	9.7 4.0	3.7 2.9	3.8 3.0	3.8 3.0
450 280	450 280	450 260	2100 1100	520 320	530 280	470 260
29	27	26	35	26	24	22
>600 600	>600 600	>600 600	>600 600			
10^{15}	10^{15}	10^{15}	10^{12}	10^{14}	10^{14}	10^{14}
A1	A1	A1	A1			

Plasticized PA 12 compounds

Property		Test method	Unit	VESTAMID® L1723	VESTAMID® L2121	VESTAMID® L2122
Physical, thermal, and mechanical properties, and flammability						
Density		ISO 1183	g/cm^3	1.03	1.02	1.03
Melting temperature DSC	 2nd heating	ISO 11357	 °C	 173	 176	 173
Temp. of deflection under load Method A Method B	 1.8 MPa 0.45 MPa	ISO 75	°C °C	 45 95	 45 110	 45 95
VICAT softening temperature Method A Method B	 10 N 50 N	ISO 306	 °C °C	 165 130	 170 130	 165 125
Linear thermal expansion	23–55°C	ISO 11359	$10^{-4}\ K^{-1}$	1.8	1.6	1.7
Flammability acc. UL94	1.6 mm 3.2 mm	IEC 60695		HB HB	HB HB	HB HB
Water absorption 23 °C	saturation* 23°C, 50% rel. humidity	ISO 62	% %	 0.5	 0.6	 0.5
Mold shrinkage in flow direction in transverse direction		ISO 294-4, processing acc. ISO 1874-2	 % %	 1.65 1.5	 0.6 1.65	 0.6 1.6
Tensile test Stress at yield Strain at yield Stress at break Strain at break		ISO 527-1/-2	 MPa % MPa %	 30 27 >50	 35 20 >50	 30 26 >50
Tensile modulus		ISO 527-1/-2	MPa	480	700	490
CHARPY impact strength	23 °C -30 °C	ISO 179/1eU	kJ/m^2 kJ/m^2	N N	N N	N N
CHARPY notched impact strength	23 °C -30 °C	ISO 179/1eA	kJ/m^2 kJ/m^2	24 C 5 C	40 C 7 C	68 P 6 C
Electrical properties						
Relative permittivity	23°C, 100 HZ 23 °C, 1 MHz	IEC 60250		10 3.7	6.5 3.4	10 3.3
Dissipation factor	23°C, 100 HZ 23 °C, 1 MHz	IEC 60250	10^{-4} 10^{-4}	1600 1200	1900 550	1900 1000
Electric strength		IEC 60243-1	kV/mm	33	34	32
Comparative tracking index Test solution A	 50 drops value CTI	IEC 60112		 >600 600	 >600 600	 >600 600
Volume resistivity		IEC 60093	Ω cm	10^{12}	10^{14}	10^{13}
Electrolytic corrosion		IEC 60426	Stage	A1	A1	A1

N = no break, P = partial break, C = complete break

* Plasticized compounds were not stored in water because of slight plasticizer migration.

VESTAMID® X7393	VESTAMID® L2124	VESTAMID® L2123	VESTAMID® X7293	VESTAMID® L2128	VESTAMID® LX9013
1.02	1.03	1.03	1.02	1.05	1.02
173	171	171	172	164	172
45 115	45 90	45 80	45 100	40 70	55 130
170 130	165 125	165 120	165 130	145 100	165 130
1.4	1.8	1.8	1.8	1.8	1.6
HB HB	HB HB	HB HB	HB HB	HB HB	HB HB
0.6	0.5	0.6	0.5	0.5	0.6
0.8 1.35	0.7 1.55	0.65 1.4	0.65 1.35	0.65 1.2	0.35 1.45
31 28 >50	26 31 >50	24 32 >50	27 32 >50	18 45 >50	– – 43 >50
580	400	370	400	230	410
N N	N N	N N	N N	N N	N N
115 P 8 C	150 P 6 C	115 P 13 C	130 P 7 C	N 6 C	140 P 7 C
7 4.2	12 3.8	10 3.6	11 4.6	17 3.8	12 3.4
1900 1100	1600 1500	2000 1100	2000 1900	3000 2400	5000 1000
27	32	29	30	31	22
>600 600	>600 600	>600 600	>600 600	>600 600	>600 600
10^{12}	10^{12}	10^{12}	10^{12}	10^{10}	10^{10}
	A1	A1		A1	

Reinforced, filled and flame retardant PA 12 compounds

Property		Test method	Unit	VESTAMID® L-GF15	VESTAMID® L1833	VESTAMID® L-GF30
Physical, thermal, and mechanical properties, and flammability						
Density		ISO 1183	g/cm^3	1.12	1.17	1.24
Melting temperature		ISO 11357				
DSC	2nd heating		°C	178	178	178
Temp. of deflection under load						
Method A	1.8 MPa	ISO 75	°C	160	160	165
Method B	0.45 MPa		°C	175	175	175
VICAT softening temperature		ISO 306				
Method A	10 N		°C	175	175	175
Method B	50 N		°C	170	175	175
Linear thermal expansion 23–55°C		ISO 11359	10^{-4} K^{-1}	0.8	0.7	0.6
Flammability acc. UL94	1.6 mm	IEC 60695		HB	HB	HB
	3.2 mm			V-2	V-2	HB
Water absorption	23 °C, saturation*	ISO 62	%	1.3	1.2	1.1
	23°C, 50% rel. humidity		%	0.6	0.6	0.5
Mold shrinkage		ISO 294-4,				
in flow direction		processing acc.	%	0.35	0.2	0.15
in transverse direction		ISO 1874-2	%	0.65	0.65	0.65
Tensile test		ISO 527-1/-2				
Stress at yield			MPa			
Strain at yield			%			
Stress at break			MPa	95	105	120
Strain at break			%	6	6	5
Tensile modulus		ISO 527-1/-2	MPa	3900	5000	6500
CHARPY impact strength	23 °C	ISO 179/1eU	kJ/m^2	75 C	90 C	85 C
	-30 °C		kJ/m^2	80 C	95 C	100 C
CHARPY notched impact strength	23 °C	ISO 179/1eA	kJ/m^2	17 C	25 C	23 C
	-30 °C		kJ/m^2	11 C	16 C	21 C
Electrical properties						
Relative permittivity	23°C, 100 HZ	IEC 60250		4.0	4.1	4.1
	23 °C, 1 MHz			3.4	3.4	3.4
Dissipation factor	23°C, 100 HZ	IEC 60250	10^{-4}	380	370	310
	23 °C, 1 MHz		10^{-4}	260	260	330
Electric strength		IEC 60243-1	kV/mm	44	41	44
Comparative tracking index		IEC 60112				
Test solution A	50 drops value			>600	>600	>600
	CTI			600	600	600
Volume resistivity		IEC 60093	Ω cm	10^{15}	10^{15}	10^{15}
Electrolytic corrosion		IEC 60426	Stage	A1	A1	A1

N = no break, P = partial break, C = complete break

* Test specimen 127x12.7x3.2 mm

VESTAMID® L1930	VESTAMID® L-GB30	VESTAMID® L-CF15	VESTAMID® X7166	VESTAMID® X7167	VESTAMID® X7229
1.24	1.25	1.08	1.06	1.05	1.06
178	178	178	178	178	175
130 170	55 150	170 175	50 140	50 130	40 130
175 170	175 155	175 175	175 150	175 150	170 150
0.5	1.3	1.5	–	–	0.8
HB HB	HB HB	HB HB	V-0 V-0	V-2 V-2	V-2 V-2
1.1 0.5	1.1 0.5	1.3 0.5	1.3 0.6	1.5 0.6	1.5 0.6
0.7 0.6	1.2* 1.2*	0.15 0.4	0.65 0.75	0.6 0.95	0.55 0.8
69 4 60 10	47 5 38 37	 120 5	47 5 >50	48 5 >50	36 17 >50
4000	2000	8000	1800	1700	1000
70 C 65 C	160 C 160 C	60 C 70 C	65 C 80 C	N N	N N
10 C 11 C	6 C 6 C	14 C 13 C	3 C 5 C	9 C 6 C	11 C 5 C
4.1 3.4	4.1 3.5		3.6	3.6	5
310 240	310 230		340	380	1700
40	31		28	28	27
>600 600	>600 600	100	>600 600	>600 600	>600 600
10^{15}	10^{15}		10^{14}	10^{14}	10^{13}
	A1	A1		A1	

Permanently antistatic and conductive, black PA 12 compounds

Property		Test method	Unit	VESTAMID® L-R1-MHI	VESTAMID® L-R3-MHI	VESTAMID® L-R4-MHI
Physical, thermal, and mechanical properties, and flammability						
Density		ISO 1183	g/cm^3	1.11	1.10	1.06
Melting temperature		ISO 11357				
DSC	2nd heating		°C	178	178	178
Temp. of deflection under load						
Method A	1.8 MPa	ISO 75	°C	50	50	50
Method B	0.45 MPa		°C	130	130	130
VICAT softening temperature		ISO 306				
Method A	10 N		°C	175	175	175
Method B	50 N		°C	140	140	140
Linear thermal expansion	23–55°C	ISO 11359	10^{-4} K^{-1}		1.8	1.8
Flammability acc. UL94	1.6 mm	IEC 60695		HB	HB	HB
	3.2 mm			HB	HB	HB
Water absorption	23 °C, saturation*	ISO 62	%	1.4	1.5	1.5
	23°C, 50% rel. humidity		%	0.5	0.8	0.5
Mold shrinkage		ISO 294-4,				
in flow direction		processing acc.	%	1.7	1.45	1.75
in transverse direction		ISO 1874-2	%	1.7	1.55	1.65
Tensile test		ISO 527-1/-2				
Stress at yield			MPa	37	38	36
Strain at yield			%	5	5	8
Stress at break			MPa	35		33
Strain at break			%	45	>50	42
Tensile modulus		ISO 527-1/-2	MPa	1600	1600	1250
CHARPY impact strength	23 °C	ISO 179/1eU	kJ/m^2	N	N	N
	-30 °C		kJ/m^2	80 C	N	N
CHARPY notched impact strength	23 °C	ISO 179/1eA	kJ/m^2	60 C	55 P	55 P
	-30 °C		kJ/m^2	8 C	15 C	12 C
Electrical properties						
Isolation resistance		IEC 60167	Ω	10^1	10^4	10^5
Volume resistivity		IEC 60093	Ω cm	10^1	10^4	10^5

N = no break, P = partial break, C = complete break

* Plasticized compounds were not stored in water because of slight plasticizer migration.

VESTAMID® L-R7-MHI	VESTAMID® L-R9-MHI	VESTAMID® L-R3-EP	VESTAMID® L-R3-EI	VESTAMID® LX9102	VESTAMID® L-R2-GF25	VESTAMID® X7380	VESTAMID® L-CF15
1.08	1.08	1.17	1.06	1.12	1.27	1.21	1.08
178	178	176	178	171	178	178	178
50 130	50 130	60 120	60 130	55 120	170 175	160 175	170 175
175 140	175 140	170 140	175 140	169 136	175 170	175 170	175 175
1.7	1.7	1.5	1.5	1.5	1	0.4	1.5
HB HB	HB HB	HB HB	HB HB	HB HB	HB HB	HB HB	HB HB
1.5 0.7	1.5 0.7	 0.5	1.2 0.5	1.5 0.5	1.2 0.5	1.2 0.6	1.3 0.5
1.4 1.45	1.4 1.45	1.3 1.3	1.55 1.6	1.35 1.5	0.3 0.85	0.25 0.75	0.15 0.4
36 6 >50	37 6 >50	 46 >50	42 9 36 44	32 37 39 >50	 120 5	 100 6	 120 5
1400	1400	800	1500	640	6500	5400	8000
N N	N N	N N C	N N	N N	75 C 70 C	80 C 60 C	60 C 70 C
60 P 12 C	60 P 12 C	38 C 4 C	21 C 9 C	90 P 5 C	12 C 11C	17 C 8 C	14 C 13 C
10^7	10^9	10^3	10^3	10^4	10^2	10^7	10^4
10^7	10^9	10^3	10^3	10^4	10^2	10^7	10^4

Resistance against heat, radiation, and chemical attack

For thermoplastics to perform optimally over long periods within aggressive environments (UV radiation, hot air, etc.), it is necessary to incorporate the appropriate stabilizers.

Heat aging

Appropriate heat stabilizers improve the long-term performance of polyamides when used in air under higher temperatures. Except for some special products, all VESTAMID® L compounds are usually equipped with an optimal stabilizer package.

Hydrolysis resistance

Polycondensation products, to which polyamides also belong, have a limited resistance against hot water or moist air at higher temperatures. However, compared with other polyamides, PA 12 exhibits good hydrolysis resistance. PA 12 is gradually degraded by hot water. Compounds with a higher molecular mass will last longer than grades with a lower molecular mass. Hydrolysis occurs more rapidly in acid media than in neutral or alkaline ones. Up to temperatures of 70 to 80°C standard grades can be regarded as practically stable against pure water attack.

UV resistance

Exposure to short wave light of wavelengths less than 400 nm causes an accelerated decrease in molecular mass, leading to the embrittlement of moldings or semi-finished products. The deterioration can be reduced substantially by adding light stabilizers. UV absorbers and radical scavengers improve weathering performance remarkably. The best protection against irradiation, however, is obtained by using suitable grades of carbon black if blackening can be done. The addition of pigments can have either a stabilizing or sensitizing effect. Additionally, mechanical properties can be affected by carbon black or pigments.

Resistance against ionizing radiation

PA 12 has a high resistance to ionizing radiation.

Chemical resistance

PA 12 is highly resistant against chemically induced stress cracking. For details please contact the indicated persons.

Abrasion and frictional properties

Polyamides are characterized by a very high abrasion resistance. Harder compounds have a higher abrasion than softer materials. The abrasion increases again only in the case of very soft compounds.

For bearings or sliding parts the abrasion is of less importance than the coefficient of sliding friction. The coefficient depends on the bearing load, rotational speed, surface structure, or hardness of the mating surface, and the temperature. The coefficient of friction of polyamide against metal is lower than of metal against metal.

Whenever the application of lubricants may cause problems, PA 12 should be the first choice for the manufacture of bearings. Nevertheless, it should be mentioned that the optimum solution is offered by the use of bearings which were lubricated in assembly (maintenance free bearings). The high chemical resistance of PA 12 allows the use of practically all lubricants. As a result of lubrication, the coefficient of friction is considerably reduced and wear is practically eliminated.

On a final note, we would like to point out one special advantage that VESTAMID L2101 has at very low temperature. Under cryogenic conditions, it serves excellently as shot granules for deburring rubber parts.

Physiological and toxicological evaluation of VESTAMID® compounds

Please direct all questions on the toxicological properties of VESTAMID® compounds and relevant analysis pertaining their contact with foodstuffs to the indicated contact address. Here you will also receive the up-to-date safety data sheets of VESTAMID®.

Food contact
Uniform regulations for plastics that come into contact with foodstuffs exist at the European level. The consolidated EU Directive 2002/72/EC and its amendments apply. It lists approved monomers and plastic additives as positive. In other words, in Europe only approved monomers and additives on the EU positive lists may come into contact with food.

The basic VESTAMID® grades of the PA 12 range have been approved by the European Union for direct contact with foodstuffs, since laurolactam, the fundamental monomer of VESTAMID®, was positively listed. A migration value limit for laurolactam of 5 mg per kilogram was imposed, which must be tested on the finished article itself and be kept within limits there.

In accordance with 21 CFR, § 177.1500, „Nylon Resins“, US FDA (Food and Drug Administration) approval for nylon-12 is only valid for films up to a thickness of 0.0016 inches (i.e.,40 μm). This approval covers the basic products VESTAMID® L1600, L1700, L1901 und L2101F. However, the restrictions exclude the contact with alcohol containing food or beverages. It has to be observed that heat sterilization of these non-stabilized compounds does not exceed 120°C for 30 minutes. If a stabilization or the use of special additives should be essential, we provide information on request.

Environment and ecological safety

VESTAMID® compounds are non-hazardous and not harmful to water. They are not subject to any particular safety regulations. Disposal can be done by land filling or incinerating together with normal household rubbish, provided that local ordinances permit this. Reprocessing is however preferable and is also of interest for economic reasons.

No dangerous by-products are formed if VESTAMID® is processed properly. Care should be taken, however, to ventilate the working area properly as it is required when processing thermoplastics – especially for compounds containing flame retardants or plasticizers.

Compounds containing flame retardants do not contain any brominated biphenyls or diphenylethers. In addition, grades with flame retardants free of halogen or phosphorous compounds can be supplied.

No pigments or additives containing cadmium are used.

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