

Laminating resin MGS[®] L 335

Hardeners MGS[®] 335, 340

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Approval	German Federal Aviation Authority
Application	production of gliders, motor gliders, sports equipment, model airplanes, moulds and tools
Operational temperature	-60 °C up to +40 °C (-76 °F up to 104 °F) without heat treatment -60 °C up to +60 °C (-76 °F up to 140 °F) after heat treatment
Processing	at temperatures between 10 °C and 50 °C (50 -122 °F) all usual processing methods
Features	good physiological compatibility good mechanic properties pot life from approx. 10 min. to approx. 6 hours
Spacial modifications	L 335 T: thixotropic L 335 W: white
Storage	shelf life of 24 months in originally sealed containers

Characteristics

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Am Ostkai 21/22
70327 Stuttgart
Germany
Phone: +49 (0) 711 - 3 89 80 00
Fax: +49 (0) 711 - 3 89 80 011
www.hexionchem.com

Laminating resin MGS® L 335

Laminating resin system approved by the **German Federal Aviation Authority** with different pot lives for processing of glass, carbon and aramide fibres, featuring high static and dynamic loadability.

After heat treatment at 50-55 °C (122-131°F), the system meets the standards for gliders and motor gliders (operational temperatures -60 °C (-76 °F) to +54 °C (130°F). Heat treatment at higher temperatures is possible and will reduce the necessary heat treatment period; however, a considerable rise of the glass transition temperature will not be obtained.

The range of pot lives is between approx. 10 min and 6-7 h. The hardeners have the same mixing ratio and can be mixed among themselves in any ratio. This permits a selection of the optimum system for all processing methods. After initial curing at room temperature, the components manufactured are workable and demouldable. You will receive high-gloss and non-tacky surfaces, even with unfavourable initial curing conditions, e. g. lower temperatures or high humidities.

The mixing viscosity guarantees fast and complete impregnation of the reinforcement fibres; however, the resin will not spill out of the fabrics on vertical surfaces. In order to obtain special properties, it is also possible to add fillers to the mixture of resin/hardener, such as Aerosil, microballoons, cotton flakes, metal powder, etc.

If high heat resistance or aircraft approval are not necessary, the system can also be used without heat treatment. However, the indicated properties will only be obtained after heat treatment at temperatures over 50 °C (122 °F).

No problems are to be expected if L 335 is being processed in combination with suitable gelcoats or topcoats (UP, PU, ...). However, comprehensive tests are indispensable.

Due to its special formulation, crystallisation of resin or hardener is unlikely, even when stored at cold temperatures. Yet optimum storage conditions are at 15-30 °C (60-85 °F) and low humidity. After dispensing material, the containers must again be closed carefully, to avoid contamination or absorption of water. All amine hardeners show a chemical reaction when exposed to air, known as „blushing“. This reaction is visible as white carbamide crystals, which could make the materials unusable.

Crystallization, even though unlikely to occur, would be visible as a clouding or solidification of the contents of the container. If crystallisation of either component should be observed, it can be removed by warming up. Slow warming up to approx. 50 °C-60°C (122 °F-140 °F) in a water bath or oven and stirring or shaking will clarify the contents of the container without any loss of quality. Use only completely transparent products. Before warming up, open containers slightly to permit equalization of pressure. Caution during warm-up! Do not warm up over an open flame! While stirring up use safety equipment (gloves, eyeglasses, respirator).

The relevant industrial safety regulations for the handling of epoxy resins and hardeners and our instructions for safe processing are to be observed

Application

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Laminating resin MGS® L 335

		Laminating resin L 335
Density	[g/cm³]	1,14 - 1,18
Viscosity	[mPas]	2.300 - 2.900
Epoxy-equivalent	[g/equivalent]	170 - 189
Epoxy-value	[equivalent /100g]	0,53 - 0,59
Refractory index		1,5620 - 1,5640

Specifications

		Hardener 335	Hardener 340
Density	[g/cm³]	1,01 - 1,07	0,93 - 0,98
Viscosity	[mPas]	100 - 250	10 - 60
Amine value	[mg KOH/g]	360 - 450	350 - 450
Refractory index		1,5429 - 1,5440	1,4570 - 1,4600

Measuring conditions:

measured at 25 °C / 77 °F

	Laminating resin L 335	Hardeners 335-340
Average EP - Value	0,56	-
Average amine equivalent	-	68

Processing details

	L 335 + Hardener 335	L 335 + Hardener 335:340 (1:1)	L 335 + Hardener 340
68 - 77 °F 20 - 25 °C	app. 2-3hours	app. 3-4 hours	app. 8-9 hours
104 - 113 °F 40 - 45 °C	app. 45-60 min	app. 60-90 min	app. 80-120 min

Gel time

Film thickness: 1 mm at different temperatures

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Laminating resin MGS® L 335

Composition		Processing time	Mixture ratio +/- 2 parts		Minimal curing time at room temperature until workable
Hardener 335 Parts by weight	Hardener 340 Parts by weight		Parts by weight	Parts by volume	
100	0	10-15 min	100:38	100:45	app. 8-10 h
50	50	60-90 min	100:38	100:45	app. 16-20 h
20	80	app. 4 h	100:38	100:45	app. 24-30 h
0	100	app. 6 h (*)	100:38	100:45	app. 2-3 days

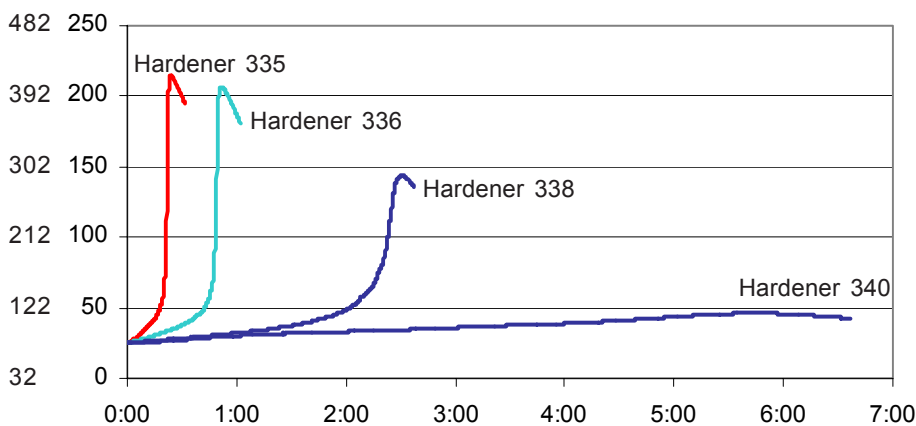
Mixing ratios

*) Gel point not clearly defined. Time to reach 5.000 mPas.

The mixing ratio stated must be observed carefully. Adding more or less hardener will not result in a faster or slower cure, but in incomplete curing with limited performance, that can not be corrected in any way.

Resin and hardener must be mixed carefully. Mix until no clouding is visible in the mixing container. Special attention must be paid to the walls and bottom of the mixing container.

[°F] [°C] Temperature



Sample: 100 g / 20 °C (68 °F)

Time [h]

Temperature development

The optimum processing temperature is in the range between 20 °C (68 °F) and 40°C (104 °F). Higher processing temperatures are possible, but will shorten pot life. An increase in temperature of 10 °C (50 °F) will halve the pot life. Water (for example very high humidity or contained in fabrics or fillers) causes an acceleration of the resin/hardener reaction. Different temperatures and humidities during processing have no significant effect on the mechanical properties of the cured product.

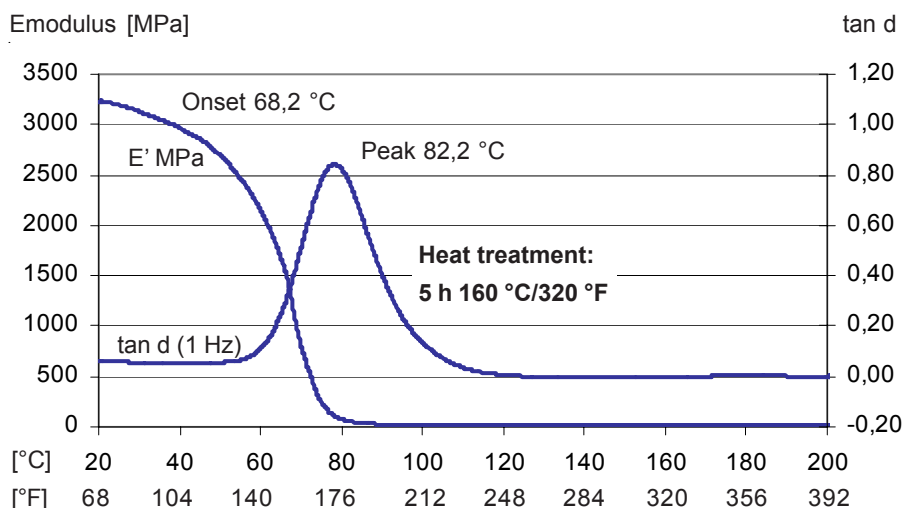
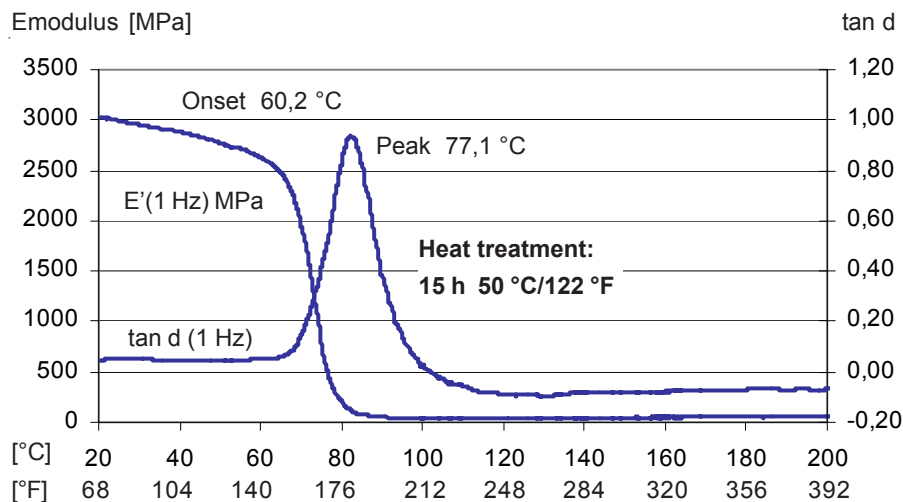
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Laminating resin MGS® L 335

DMA - T_g (peak) tan delta laminating resin L 335 with hardener 340 measuring after heat treatment

DMA



Measurement conditions

Coupon thickness: 2 mm
Heating rate: 2 K/min
Frequency: 1 Hz

	Hardener 335	Hardener 335-340 /1:1	Hardener 340
unconditioned	70-75 °C 158-167 °F	70-75 °C 158-167 °F	70-75 °C 158-167 °F
conditioned	55-60 °C 131-140 °F	55-60 °C 131-140 °F	55-60 °C 131-140 °F

T_g conditioned

Sample preparation

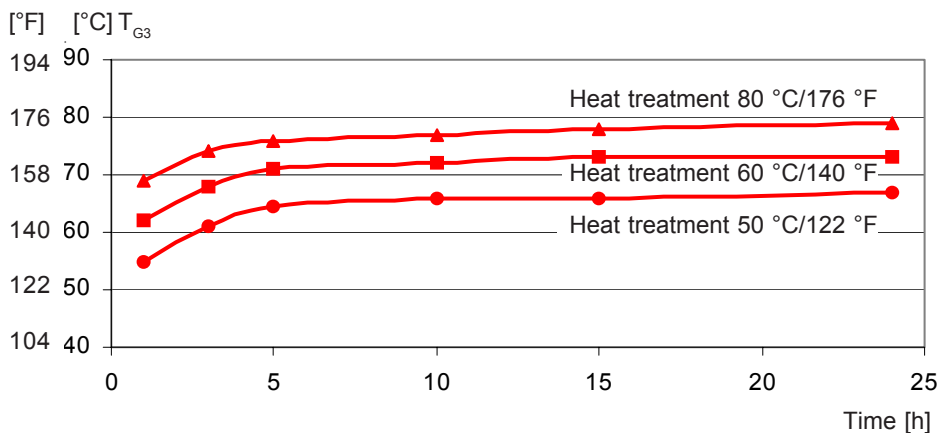
Conditioned at 40 °C (104 °F) 90 % rel. humidity

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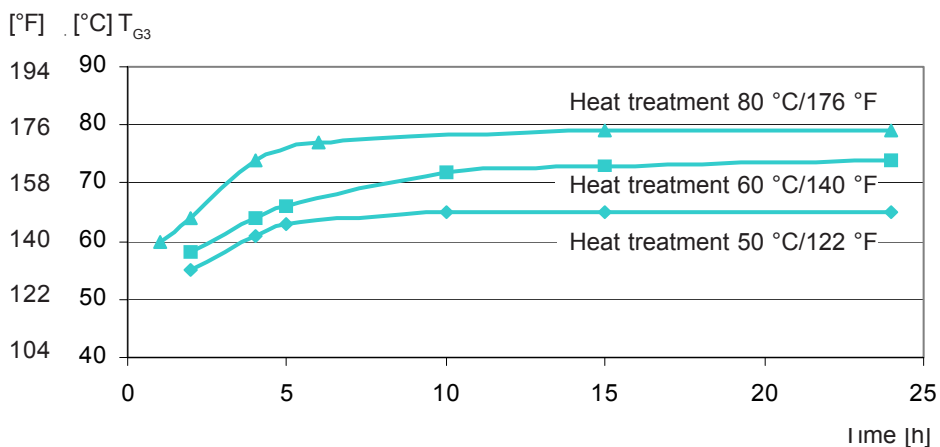
Laminating resin MGS® L 335

Laminating resin L 335 - Hardener 335

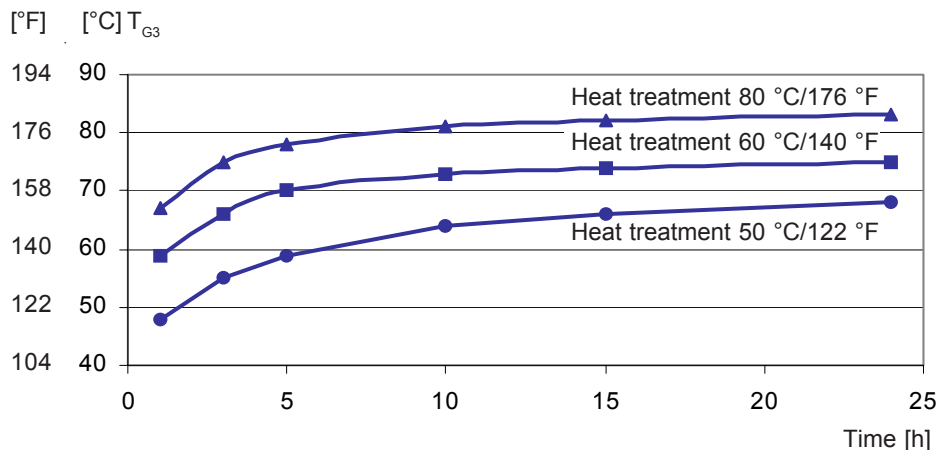
Development of T_G



Laminating resin L 335 - Hardener 336



Laminating resin L 335 - Hardener 340



Sample preparation

Initial curing before heat treatment 24 h at room temperature

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Laminating resin MGS® L 335
Mechanical data

Mechanical data of neat resin		
Density	[g/cm ³]	1,18 - 1,20
Flexural strength	[N/mm ²]	110 - 120
Modulus of elasticity	[kN/mm ²]	3,0- 3,3
Tensile strength	[N/mm ²]	70 - 80
Compressive strength	[N/mm ²]	120 - 140
Elongation at break	[%]	5,0 - 6,5
Impact strength	[KJ/m ²]	45 - 55
Water absorption at 23°C	24 h [%]	0,20 - 0,30
	7 d [%]	0,60 - 0,80
Fatigue strength under reversed bending stresses acc. to DLR Brunsw.	10 %	erw > 2 x 10 ⁶
	90 %	erw > 2 x 10 ⁶
Curing: 24 h at 23 °C (74°F) + 15 h at 60 °C (140 °F)		
Typical data according to WL 5.3203 Parts 1 and 2 of the German Aviation Materials Manual.		

Advice:

Mechanical data are typical for the combination of laminating resin L 335 with hardener 335. Data can differ in other applications.

Laminating resin MGS® L 335

Data of reinforced resin Static tests in standard climate

Mechanical data

Reinforced with		GRC Glass fibre	CRC Carbon fibre	SRC Aramide fibre
Flexural strength	[N/mm ²]	490 - 540	680 - 700	300 - 350
Tensile strength	[N/mm ²]	450 - 500	460 - 520	400 - 480
Compressive strength	[N/mm ²]	390 - 420	430 - 490	130 - 160
Interlaminar shear strength	[N/mm ²]	39 - 44	44 - 50	28 - 32
Modulus of elasticity	[kN/mm ²]	17 - 21	38 - 43	15 - 17

GRC samples:
16 layers of glass fabric, 8H satin, 296 g/m² (8.5 oz/sq.yd.), 4 mm (0.16 in) thick

CRC samples:
8 layers of carbon fabric, plain, 200 g/m² (5.9 oz/sq.yd.) 2 mm (0.08 in) thick

SRC samples:
15 layers of aramide fabric, 4H satin, 170 g/m² (5.0 oz/sq.yd.), 4 mm (0.16 in) thick

Fibre content of samples during processing/testing: 40 - 45 vol%
Data calculated for fibre content of 43 vol%

Typical data according to WL 5.3203 Parts 1 and 2
of the GERMAN AVIATION MATERIALS MANUAL

Measuring conditions:

Curing: 24 h at 23 °C (74°F)
+ 15 h at 60°C (140°F)