

# Laminating resin MGS® L 235

Hardeners MGS® 233-238

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<b>Approval</b>	German Lloyd
<b>Application</b>	rotor blades for wind turbines, shipbuilding as laminating and adhesive resins (wood-epoxy construction), sporting goods, moulds, tools , hand lay-up and other devices
<b>Operational temperature</b>	-60 °C up to +50 °C (-76 °F up to 122 °F) without heat treatment -60 °C up to +80 °C (-76 °F up to 176 °F) after heat treatment
<b>Processing</b>	at temperatures between 15 °C and 50 °C (59-122 °F) all usual processing methods
<b>Features</b>	pot life of approx. 10 min. up to more than 12 h can be used without heat treatment ( Hardeners 233 - 238) physiologically compatible
<b>Special modifications</b>	on request
<b>Storage</b>	shelf life of 24 months in originally sealed containers

## Characteristics

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**Laminating resin MGS® L 235**

Laminating resin system approved by the **German Lloyd**. It contains no solvents and fillers and has a wide range of pot lives. The system is used for processing of glass, carbon and aramide fibres, featuring high static and dynamic loadability. This system has very good adhesion properties on wood and other materials. In boatbuilding, laminating resin L 235 can be used universally, especially for wood-epoxy constructions.

The range of pot lives is between approx. 10 min. and more than 12 hours. This enables a selection of the optimum system for all processing methods. After precurcuring at room temperature, the manufactured components are workable and demouldable. The final properties, however, will only be reached after postcuring at temperatures of more than 40 °C (104 °F). At room temperature, the fast hardeners 233 - 235 are processable and demouldable after 6 - 12 hours, while the very slow hardeners 236 and 237 have curing periods of 2 - 4 days at room temperature.

Parts produced with L 235 result in high-gloss and non-tacky surfaces, even with unfavourable curing conditions, e. g. lower temperatures and/or high humidities. The mixing viscosity guarantees a fast and complete impregnation of the reinforcement fibres, however, the resin will not spill out of the fabrics on vertical surfaces.

Due to the chemical characteristics of this system we do not expect any problems concerning compatibility (e. g. blistering, tearing or changes in colour), when it is processed with gelcoats. However, comprehensive tests are indispensable.

Although L 235 is very unlikely to crystallize at low temperatures, storage conditions of 15-30 °C and low humidity are recommended. 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.

The materials have a shelf life of minimum 2 years, when stored in their originally sealed containers. Due to selected raw materials, we expect minimal problems concerning skin irritation and allergies during processing.

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

**Application**

**Laminating resin MGS® L 235**
**Specifications**

		Laminating resin L 235
<b>Density</b>	[g/cm <sup>3</sup> ]	1,1 - 1,2
<b>Viscosity</b>	[mPas]	2.300 - 3.000
<b>Epoxy equivalent</b>	[g/equivalent]	170 - 190
<b>Epoxy value</b>	[equivalent /100g]	0,53 - 0,59
<b>Refractory index</b>		1,5640 - 1,5670

**Measuring conditions: measured at 25 °C / 77 °F**

		Hardener 233	Hardener 234	Hardener 235
<b>Density</b>	[g/cm <sup>3</sup> ]	1,04 - 1,08	1,04 - 1,1	0,98 - 1,02
<b>Viscosity</b>	[mPas]	400 - 650	150 - 500	50 - 250
<b>Amine value</b>	[mg KOH/g]	450 - 530	420 - 530	400 - 500
<b>Refractory index</b>		1,5550-1,5605	1,5620 - 1,5670	1,5090-1,5125

		Hardener 236	Hardener 237	Hardener 238	Hardener 239
<b>Density</b>	[g/cm <sup>3</sup> ]	0,95 - 1,02	0,94 - 1,02	0,93 - 0,96	0,92 - 0,98
<b>Viscosity</b>	[mPas]	30 - 150	30 - 150	10 - 50	10 - 50
<b>Amine value</b>	[mg KOH/g]	400 - 500	400 - 550	450 - 550	400 - 500
<b>Refractory index</b>		1,4696 - 1,4716	1,4611 - 1,4626	1,4550 - 1,4900	1,4530 - 1,4580

**Measuring conditions: measured at 25 °C / 77 °F**

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**Laminating resin MGS® L 235**

	Laminating resin L 235	Hardeners 233 - 238
<b>Average EP - Value</b>	0,55	-
<b>Average amine equivalent</b>	-	62

**Processing details**

The optimum processing temperature is in the range between 20 and 40 °C. Higher processing temperatures are possible, but will shorten pot life. An increase in temperature of 10 °C will halve the pot life. Water (for example due to 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.

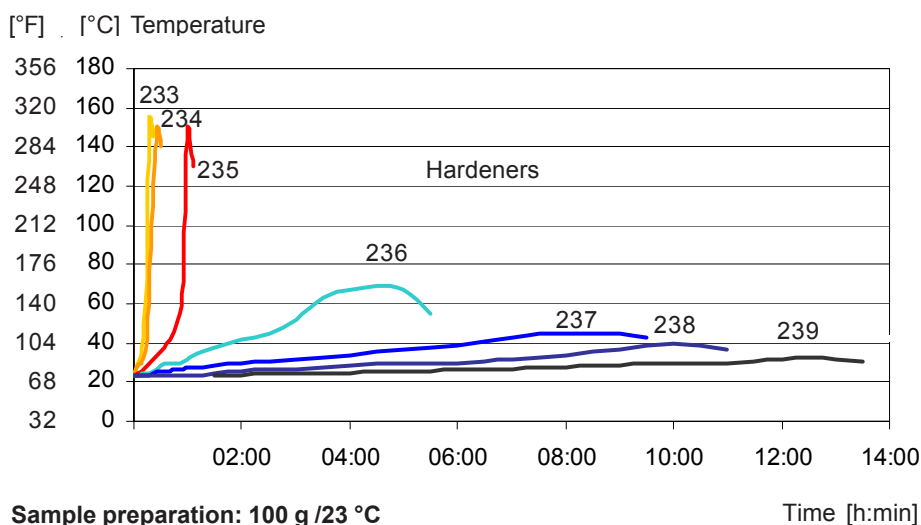
	Laminating resin L 235 : Hardeners 233 - 238
<b>Parts by weight</b>	100 : 35 ± 2
<b>Parts by volume</b>	100 : 41 ± 2

**Mixing ratios**

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.

**Temperature development with Hardener 233 up to Hardener 239**

**Temperature development**



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## Laminating resin MGS® L 235

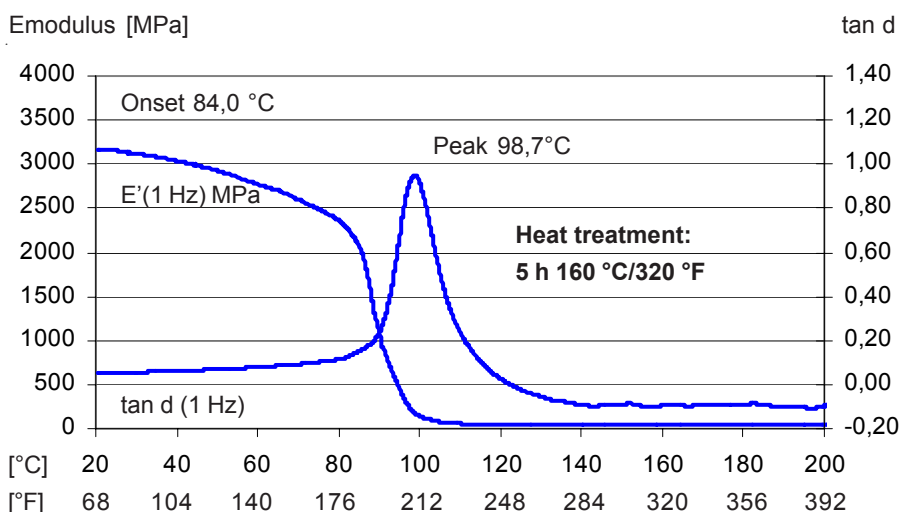
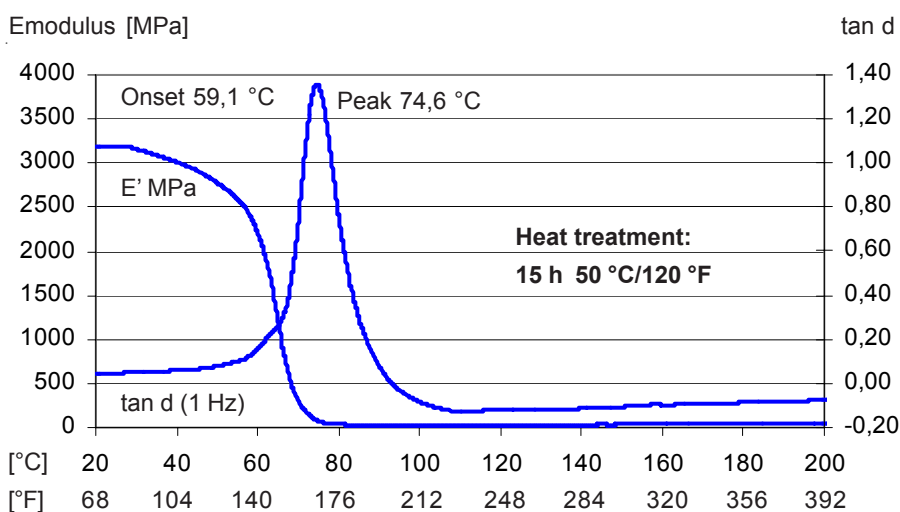
	Laminating resin L 235						
	Hardener 233	Hardener 234	Hardener 235	Hardener 236	Hardener 237	Hardener 238	Hardener 239
<b>20 - 25 °C</b> <b>68 - 77 °F</b>	1-2 h	2-3 h	4-5 h	8-9 h	12-14 h	15-20 h	24-36 h
<b>40 - 45 °C</b> <b>104 - 113 °F</b>	30 min	40 min	50 min	3-4 h	4-6 h	6-7 h	7-10 h

## Gel time

Film thickness 1 mm at different temperatures

### DMA - T<sub>g</sub> (peak) tan delta laminating resin L 235 with hardener 237 measuring after heat treatment

## DMA



### Measurement conditions

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

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## Laminating resin MGS® L 235

	Laminating resin L 235 - Hardener 236
<b>Unconditioned</b>	194 - 203 °F 90 - 95 °C
<b>Conditioned</b>	176 - 194 °F 80 - 90 °C

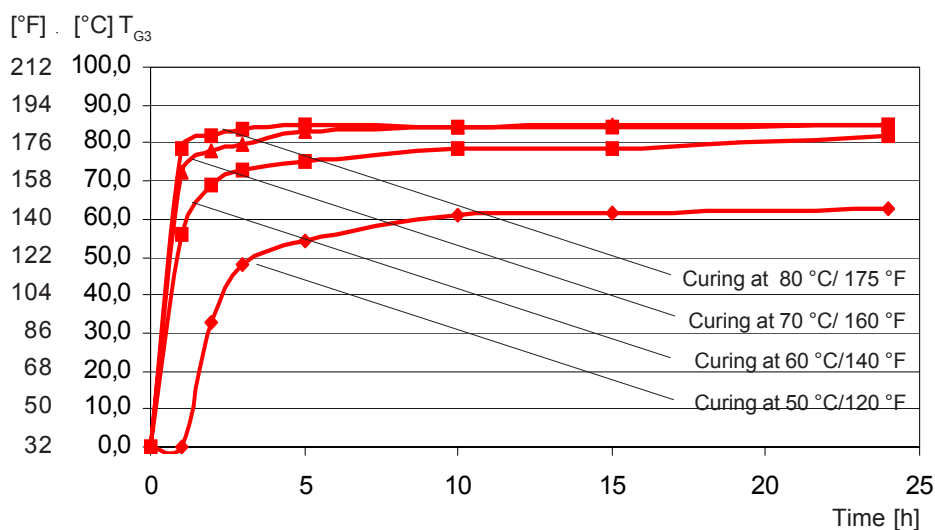
**T<sub>G</sub> conditioned**

### Sample preparation

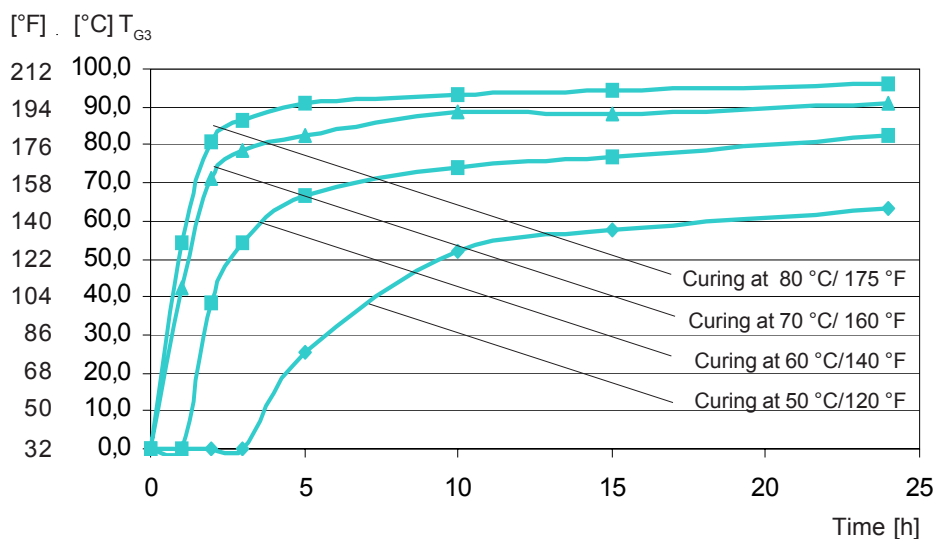
Conditioned at 40 °C (104 °F) 90 % rel. humidity

## Laminating resin L235 Hardener 235

**Development of T<sub>G</sub>**



## Laminating resin L235 Hardener 236



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**Laminating resin MGS® L 235**
**Mechanical data**

Mechanical data of neat resin		
<b>Density</b>	[g/cm <sup>3</sup> ]	1,10 - 1,20
<b>Flexural strength</b>	[N/mm <sup>2</sup> ]	100 - 120
<b>Modulus of elasticity</b>	[kN/mm <sup>2</sup> ]	3,0 - 3,3
<b>Tensile strength</b>	[N/mm <sup>2</sup> ]	70 - 80
<b>Compressive strength</b>	[N/mm <sup>2</sup> ]	90 - 110
<b>Elongation of break</b>	[%]	5 - 9
<b>Impact strength</b>	[KJ/m <sup>2</sup> ]	50 - 80
<b>Water absorption at 23 °C/ 74 °F</b>	24 h [%] 7 d [%]	0,20 - 0,30 0,60 - 0,80
<b>Curing: part cure / full cure</b>		

**Advice:**

Mechanical data are typical for the combination of laminating resin L 235 with hardener H 237. Data can differ in other applications.

## Laminating resin MGS® L 235

### Data of reinforced resin Static tests standard climate

### Mechanical data

Reinforced with		GRC Glass fibre	CRC Carbon fibre	SRC Aramide fibre
<b>Flexural strength</b>	[psi x 10 <sup>3</sup> ] [N/mm <sup>2</sup> ]	70 - 77 480 - 530	94 - 100 650 - 690	42 - 46 290 - 320
<b>Tensile strength</b>	[psi x 10 <sup>3</sup> ] [N/mm <sup>2</sup> ]	64 - 70 440 - 480	65 - 73 450 - 500	55 - 65 380 - 450
<b>Compressive strength</b>	[psi x 10 <sup>3</sup> ] N/mm <sup>2</sup>	55 - 58 380 - 400	58 - 65 400 - 450	19 - 22 130 - 150
<b>Interlaminar shear strength</b>	[psi x 10 <sup>3</sup> ] [N/mm <sup>2</sup> ]	5.5 - 6.1 38 - 42	5.8 - 6.5 40 - 45	3.9 - 4.4 27 - 30
<b>Modulus of elasticity</b>	[psi x 10 <sup>6</sup> ] [kN/mm <sup>2</sup> ]	2.5 - 2.8 17 - 19	5.0 - 5.8 35 - 40	2.0 - 2.5 14 - 17
<p><b>GRC samples:</b> 16 layers of glass fabric, 4H satin, 275 g/m<sup>2</sup> (8.5 oz/sq.yd.), 4 mm (0.16 in) thick</p> <p><b>CRC samples:</b> 8 layers of carbon fabric, plain, 200 g/m<sup>2</sup> (5.9 oz/sq.yd.) 2 mm (0.08 in) thick</p> <p><b>SRC samples:</b> 15 layers of aramide fabric, 4H satin, 170 g/m<sup>2</sup> (5.0 oz/sq.yd.), 4 mm (0.16 in) thick</p> <p>Fibre content of samples during processing/testing: 40 - 45 vol% Data calculated for fibre content of 43 vol%</p> <p>Typical data according to WL 5.3203 Parts 1 and 2 of the GERMAN AVIATION MATERIALS MANUAL</p>				

### Measuring conditions:

Curing: 24 h at 23 °C (74 °F)  
+ 15 h at 80 °C (180 °F)