Laminating resin MGS® L 160

Hardeners MGS® 160, 163, 260 S

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Characteristics

Approval	German Federal Aviation Authority
Application	manufacturing of gliders, motor gliders and motor planes, boat and shipbuilding, sports equipment, model airplanes, moulds and tools
Operational temperature	-60 °C up to +50 °C (-76 °F up to 122 °F) without heat treatment -60 °C bis +80 °C (-76 °F up to 176 °F) after heat treatment
Processing	at temperatures between 10 °C and 50 °C (50 - 122 °F)
Features	low mixed viscosity pot life from approx. 45 min. to approx. 5 h good mechanic properties high heat resistance
Storage	shelf life of 24 months in originally sealed containers

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Laminating resin MGS® L 160

Application

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). In order to meet the standards for motor planes (operational temperatures -60 °C (-76 °F) to +72 °C (162 °F), heat treatment at 80 °C (176 °F) is necessary.

The range of pot lives is between approx. 45 min. and 4 - 5 h. After initial curing at room temperature, the components manufactured with hardener 160 are workable and demouldable.

Hardeners 163 and 260 S stay brittle after initial curing at room temperature. Before processing or demoulding it is necessary to postcure in the mould 1-2 hours at 40-50°C (104-122 °F).
You will receive high-gloss and non-tacky surfaces, even with unfavourable initial curing conditions, such as lower temperatures or high humidities.

The mixing viscosity is very low - for this reason these combinations are also applicable for injection and pultrusion. When laminating manually at vertical surfaces, the resin can spill out of the fabrics, especially when using wide-mesh fabrics. For such cases we would recommend the application of laminating resin L 160 T.

The laminating resin system does not contain any unreactive components. All raw materials and additives feature a very low vapour pressure, therefore the material can be processed under vacuum even at elevated temperatures.
In connection with these properties, we do not expect any problems concerning compatibility in case of combination with polyester gelcoats, diverse paints (e. g. on the basis of PUR etc.) However, comprehensive tests are indispensable.

Although our resin systems are very unlikely to crystallize at low temperatures, storage conditions of 15 - 30 °C (59-86 °F) 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 chemial reaction when exposed to air, known as „blushing“. This reaction is visible as white carbamide crystals, which could make the materials unusable.

Crystallization is visible as a clouding or solidification of the contents of the container. If crystallisation of either component should be observed, it can 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, gas mask).

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

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Specifications

		Laminating resin L 160
Density	[g/cm³]	1,13 - 1,17
Viscosity	[mPas]	700 - 900
Epoxy-equivalent	[g/equivalent]	166 - 182
Epoxy-value	[equivalent /100g]	0,55 - 0,60
Refractory index		1,5480 - 1,5530

		Hardener 160	Hardener 163	Hardener 260 S
Density	[g/cm³]	0,96 - 1,00	0,94 - 0,97	0,93 - 0,97
Viscosity	[mPas]	10 - 50	10 - 60	80 - 100
Amine value	[mg KOH/g]	550 - 650	520 - 580	450 - 500
Refrectory index		1,5200 - 1,5210	1,5108 - 1,5115	1,4980 - 1,4985

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

Processing details

	Laminating resin L 160
Average EP - Value	0,57

	Hardener 160	Hardener 161	Hardener 162	Hardener 163	Hardener 260 S
Average amine equivalent	44	47	48	49	62

	Hardener 160 A	Hardener 161 A	Hardener 162 A	Hardener 163 A
average amine equivalent	49	52	52	61

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Laminating resin MGS® L 160

Mixing ratios

Hardener	Processing time 100g/20 °C (68 °F)	Mixture ratio		Workable after initial curing at room temperature	Composition weight %	
		Parts by weight	Parts by volume		Hardener 160	Hardener 260 S
160	app.1 h	100:25	100:30	yes	100	0
161	app.1,5-2 h	100:26	100:31	yes	80	20
162	app.2-2,5 h	100:27	100:33	yes	70	30
163	app.3-3,5 h	100:28	100:34	brittle	60	40
260 S	app. 5 h	100:36	100:43	no	0	100
160 A	app. 1 h	100:28	100:32	yes	on request	on request
161 A	app.1,5-2 h	100:30	100:35	yes	on request	on request
162 A	app.2-2,5 h	100:30	100:35	yes	on request	on request
163 A	app.3-3,5 h	100:35	100:40	no	on request	on request

Other prereacted hardeners can be supplied as well as mixtures of Hardeners 160 and 260 S. They are labeled with an A (e. g. Hardener 160 A) These hardeners are characterized by a higher viscosity and are therefore especially suited to the lamination of vertical surfaces.

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.

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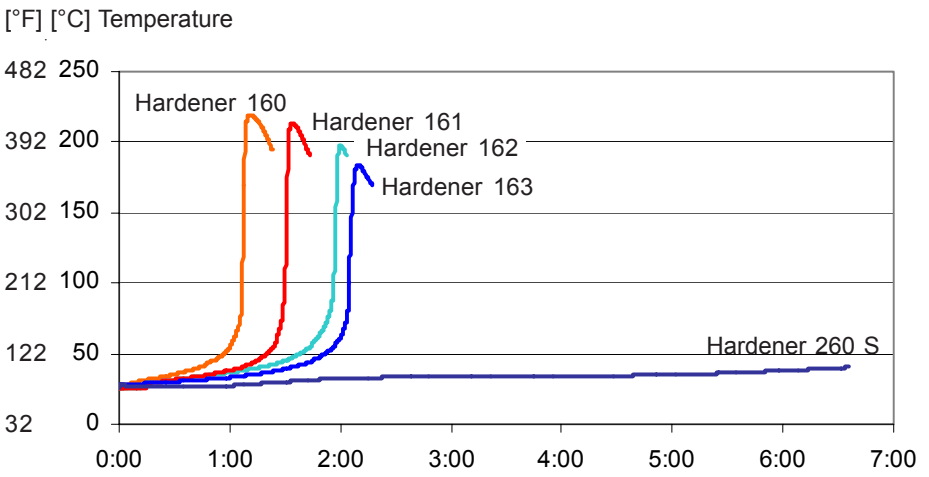
Laminating resin MGS® L 160

Temperature development



Sample preparation
100 g / 20 °C (68 °F)

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 very high humidity or contained in fabrics or fillers) causes an acceleration of the resin / hardener reaction. Different temperatures and humidities dring processing have no significant effect on the mechanical properties of the cured product.

Gel time

	Laminating resin L 160		
	Hardener 160	Hardener 163	Hardener 260 S
68 - 77 °F 20 - 25 °C	app. 3 - 4 h	app. 5 - 6 h	app. 6 - 7 h
104 - 113 °F 40 - 45 °C	app. 1 h	app. 1 h /40 min	app. 2 h

Film thickness 1 mm at different temperatures

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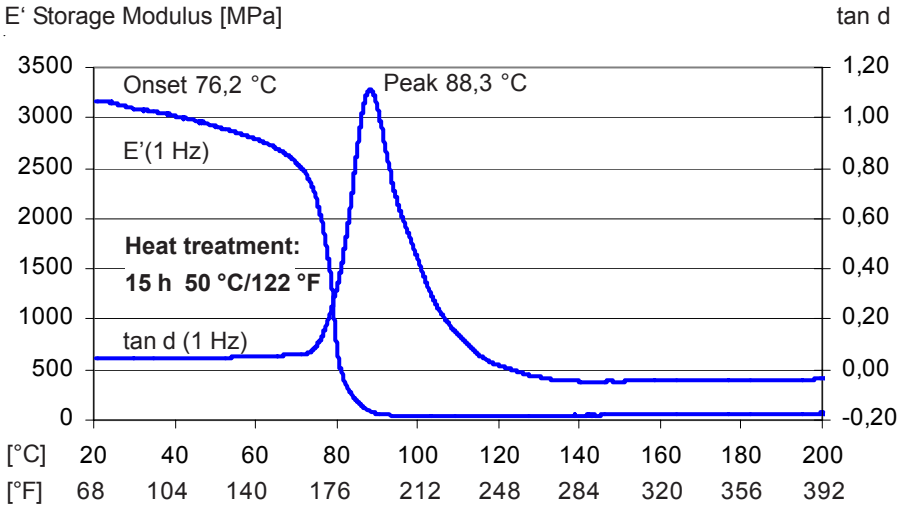
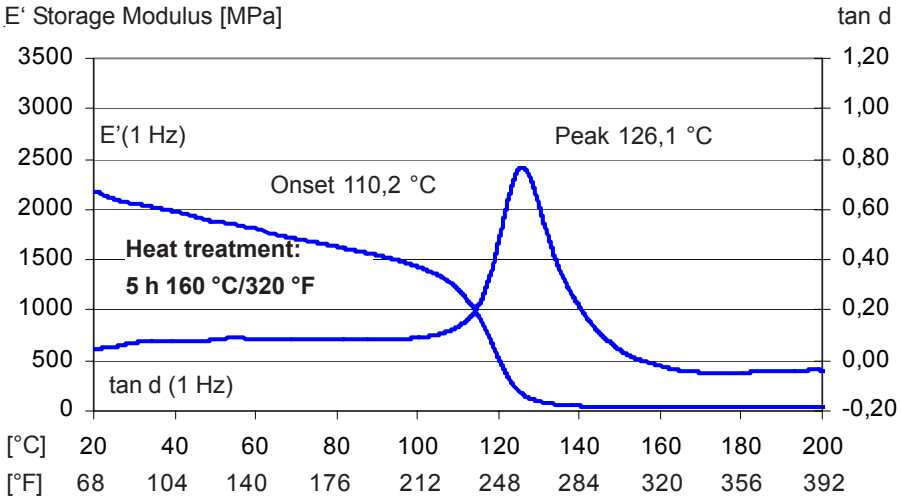
Laminating resin MGS® L 160

DMA

DMA - T_G (peak) tan delta laminating resin L 160 with hardener 163 measuring after heat treatment





Measurment conditions

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

Glass transition temperature (T_G) DSC

	L 160 with Hardener 160	L 160 with Hardener 163	L 160 with Hardener 260 S
unconditioned	75 - 80 °C 167-176 °F	85 - 90 °C 185-194 °F	90 - 95 °C 194-203 °F
conditioned	65 - 70 °C 149-158 °F	80 - 85 °C 176-185 °F	85 - 95 °C 185-203 °F

Sample preparation

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

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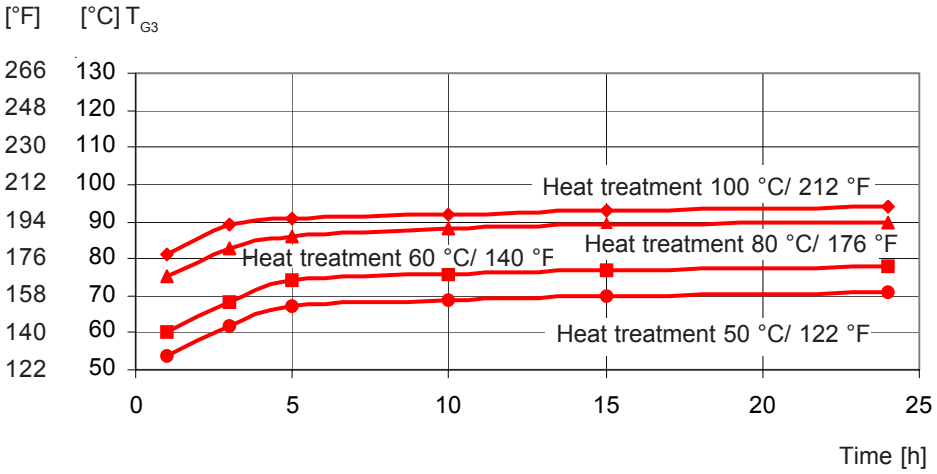
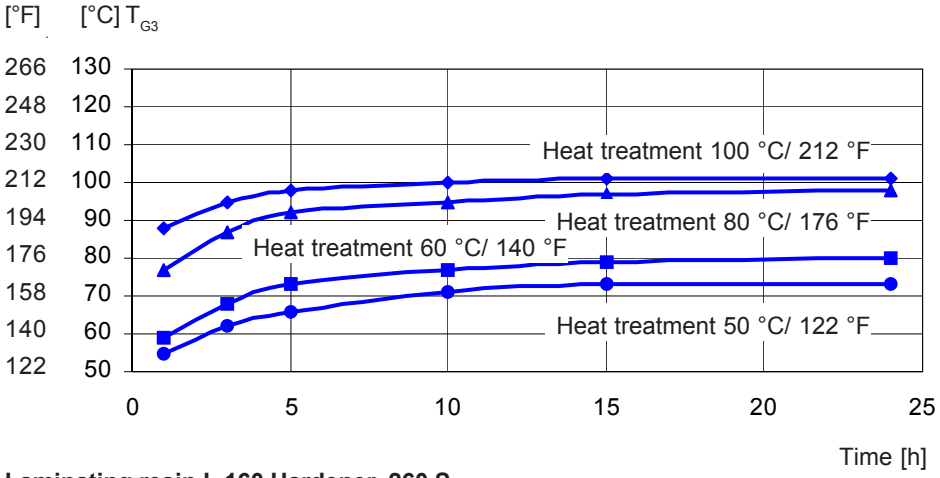
Laminating resin L 160 Hardener 160

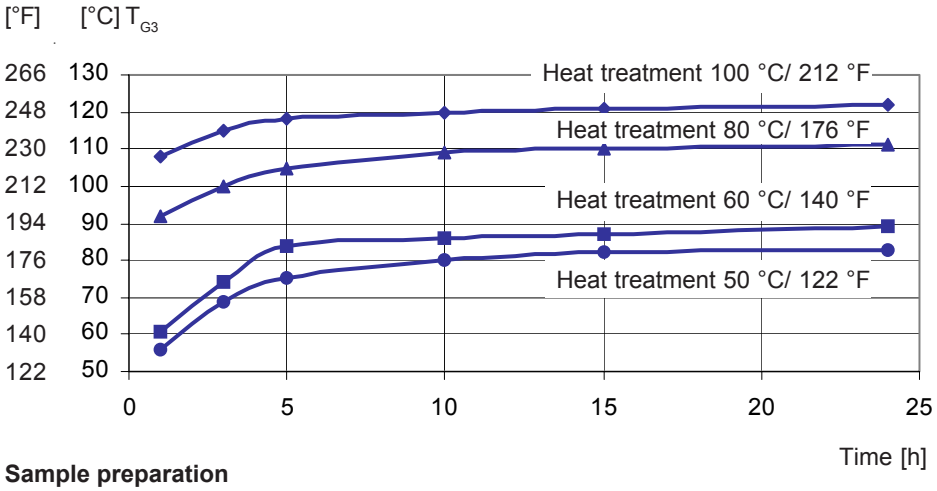
Development of T_G



Laminating resin L 160 Hardener 163



Laminating resin L 160 Hardener 260 S



Sample preparation

Initial curing before heat treatment 24 h at room temperature

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Mechanical data

Mechanical data of neat resin		
Density	[g/cm³]	1,18 - 1,20
Flexural strength	[N/mm²]	110 - 140
Modulus of elasticity	[kN/mm²]	3,2 - 3,5
Tensile strength	[N/mm²]	70 - 80
Compressive strength	[N/mm²]	80 - 100
Elongation at break	[%]	5,0 - 6,5
Impact strength	[KJ/m²]	40 - 50
Water absorption at 23°C	24 h [%] 7 d [%]	0,10 - 0,20 0,20 - 0,50
Fatigue strength under reversed bending stresses acc. to DLR Brunsw.	10 % 90 %	> 1 X 10^6 > 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 160 with hardener 160. Data can differ in other applications.

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Laminating resin MGS® L 160

Mechanical data

Data of reinforced resin
Static tests in standard climate

Reinforced with		**GRC** Glass fibre	**CRC** Carbon fibre	**SRC** Aramide fibre
Flexural strength	[N/mm²]	510 - 560	720 - 770	350 - 380
Tensile strength	[N/mm²]	460 - 500	510 - 550	400 - 480
Compressive strength	[N/mm²]	410 - 440	460 - 510	140 - 160
Interlaminar shear strength	[N/mm²]	42 - 46	47 - 55	29 - 34
Modulus of elasticity	[kN/mm²]	20 - 24	40 - 45	16 - 19

GRC samples:
16 layers of glass fabric, 8H satin, 296 g/m² (8.7 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 80 °C (176 °F)

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