

EPICOTE™ Resin MGS® LR 385

EPICURE™ Curing Agent MGS® LH 385, 386

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Approval	German Federal Aviation Authority
Application	production of gliders, motor gliders and motor planes, boat and shipbuilding, sports equipment, model airplanes, moulds and tools
Operational temperature	-60 °C up to +95 °C (-76 °F up to 203 °F) after heat treatment
Processing	at temperatures between 10 °C und 50 °C (50 °F - 122 °F), all usual processing methods
Features	extremely good physiological compatibility, good mechanical and thermic properties, pot life of approx. 20 min to approx. 2 hours, not to be declared as toxic
Special modifications	on request
Storage	shelf life of 24 month in originally sealed containers

Characteristics

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Am Ostkai 21/22
70327 Stuttgart
Germany
Phone: +49 (0) 711 - 389 800 0
Fax: +49 (0) 711 - 389 800 11
www.hexion.com

May, 2006

EPICOTE™ Resin MGS® LR 385

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 (129 °F). In order to meet the standards for motor planes (operational temperatures -60°C (-76 °F) to +72 °C (161 °F), heat treatment at 80 °C (176 °F) is necessary.

The range of pot lives is between approx. 20 min and 2 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 precuring 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, hardener LH 385 can also be used without heat treatment afterwards. However, the indicated properties will only be obtained after heat treatment at temperatures over 50 °C (122 °F).

As a matter of experience LR 385 can be combined with suitable gelcoats on UP, PU and EP basis.

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 chemical 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 be removed by warming up. Slow warming up to approx. 50-60 °C (122-140 °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.

Application

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EPICOTE™ Resin MGS® LR 385

Specification

		Laminating resin LR 385
Density	[g/cm³]	1,16 - 1,20
Viscosity	[mPas]	700 - 1050
Epoxy-equivalent	[g/Äquivalent]	160 - 170
Epoxy-value	[Äquivalent/100g]	0,58 - 0,64
Refractory index		1,535 - 1,542

Measuring conditions:

measured at 25 °C / 77 °F

		Hardener LH 385	Hardener LH 386
Density	[g/cm³]	0,95 - 0,99	0,93 - 0,97
Viscosity	[mPas]	90 - 160	40 - 90
Amine value	[mg KOH/g]	480 - 550	480 - 550
Refractory index		1,48 - 1,529	1,462 - 1,51

Measuring conditions:

measured at 25 °C / 77 °F

	Resin LR 385	Hardener LH 385	Hardener LH 386
Average EP-Value	0,61	-	-
Average amine equivalent	-	57	57

Processing details

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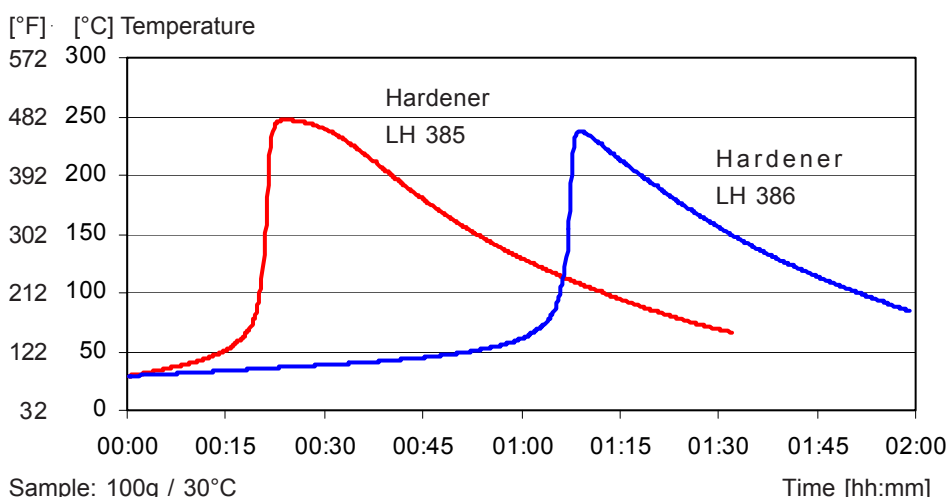
EPICOTE™ Resin MGS® LR 385

	Laminating resin LR 385 : Hardener LH 385, 386
Parts by weight	100 : 35 ± 2
Parts by volume	100 : 43 ± 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

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 during processing have no significant effect on the mechanical properties of the cured product.

	Resin LR 385 Hardener LH 385	Resin LR 385 Hardener LH 386
20 - 25 °C	app. 2-3 h	app. 4-5 h
40 - 45 °C	app. 45-60 min	app. 90-110 min

Gel time

Film thickness 1 mm at different temperatures

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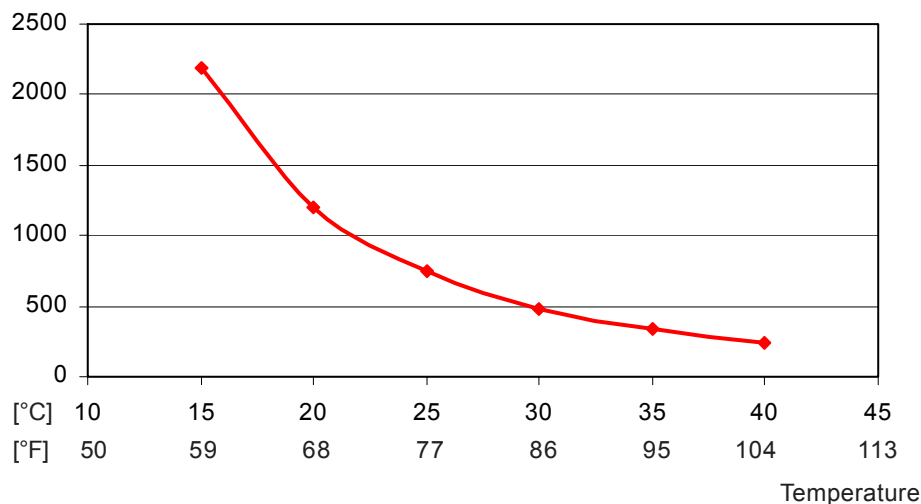
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EPICOTE™ Resin MGS® LR 385

Laminating resin LR 385 / Hardener LH 385

Viscosity of mixture

[mPas] Viscosity



Measuring conditions:

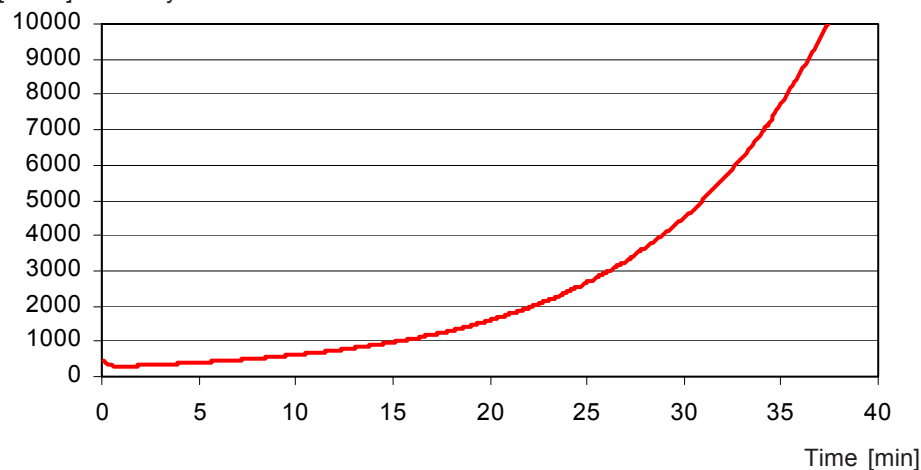
Investigation in rotation viscosimeter, plate-plate configuration

measuring gap: 0,2mm

Laminating resin LR 385 / Hardener LH 385

Viscosity development

[mPas] Viscosity



Measuring conditions:

Investigation in rotation viscosimeter, plate-plate configuration

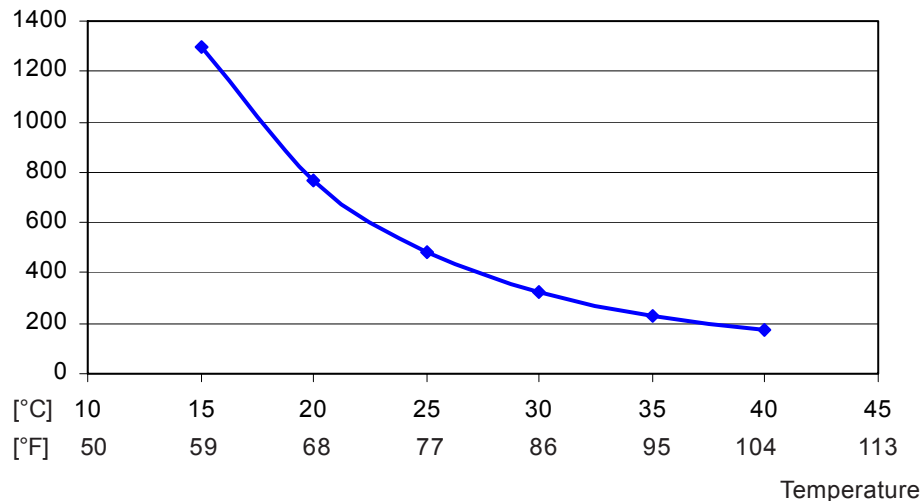
measuring gap: 0,2mm

EPICOTE™ Resin MGS® LR 385

Laminating resin LR 385 / Hardener LH 386

Viscosity of mixture

[mPas] Viscosity



Measuring conditions:

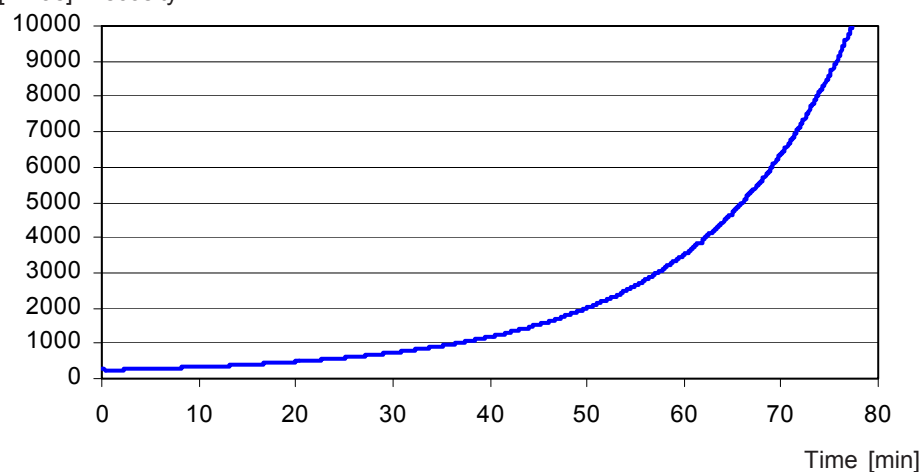
Investigation in rotation viscosimeter, plate-plate configuration

measuring gap: 0,2mm

Laminating resin LR 385 / Hardener LH 386

Viscosity development

[mPas] Viscosity



Measuring conditions:

Investigation in rotation viscosimeter, plate-plate configuration

measuring gap: 0,2mm

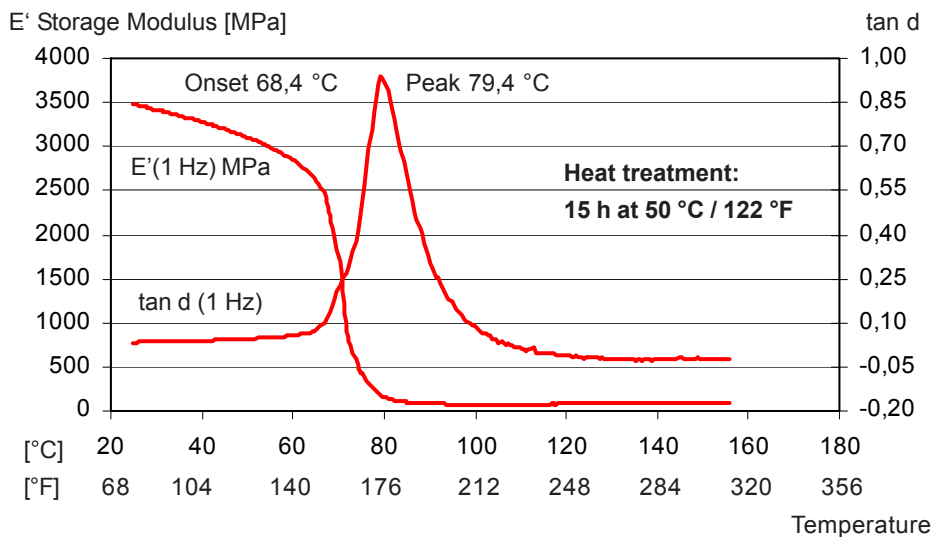
EPICOTE™ Resin MGS® LR 385

DMA Measuring after heat treatment

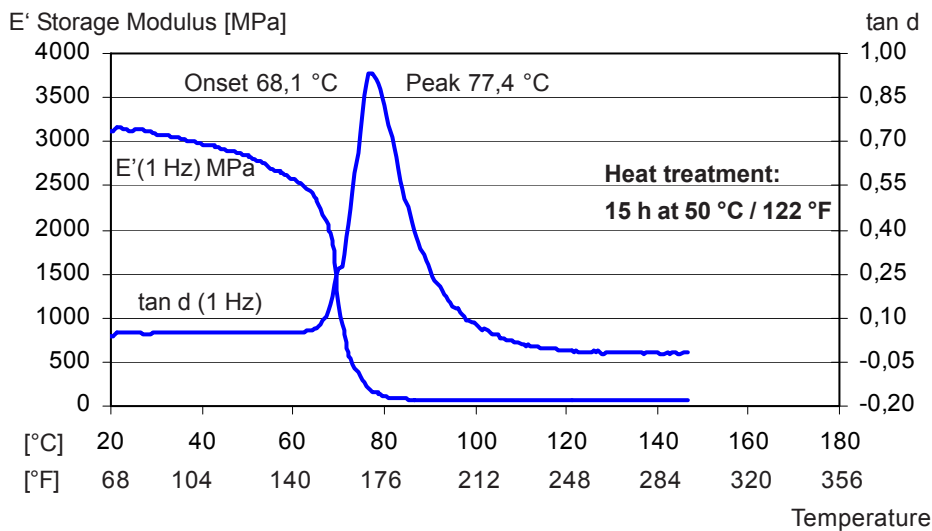
DMA-T_g (peak) tan delta

Laminating resin LR 385 with Hardener LH 385

DMA



Laminating resin LR 385 with Hardener LH 386



Measurement conditions

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

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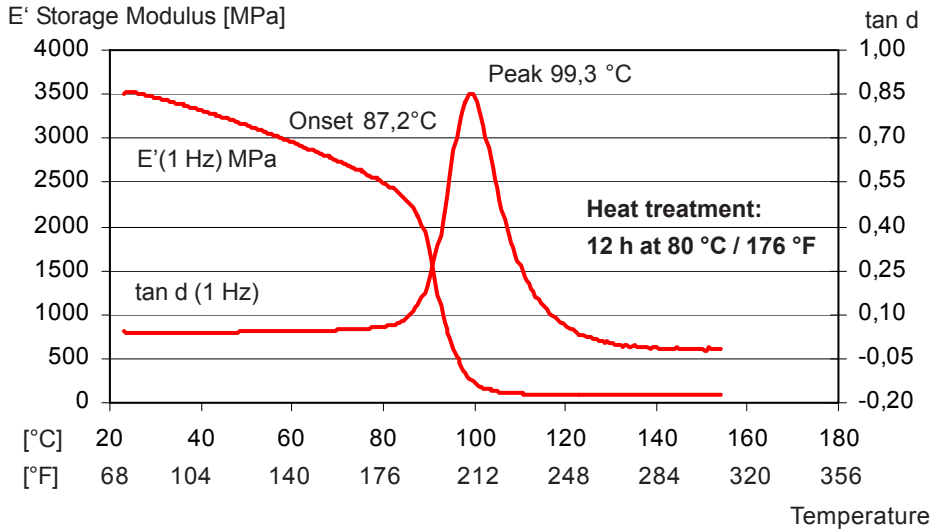
EPICOTE™ Resin MGS® LR 385

DMA Measuring after heat treatment

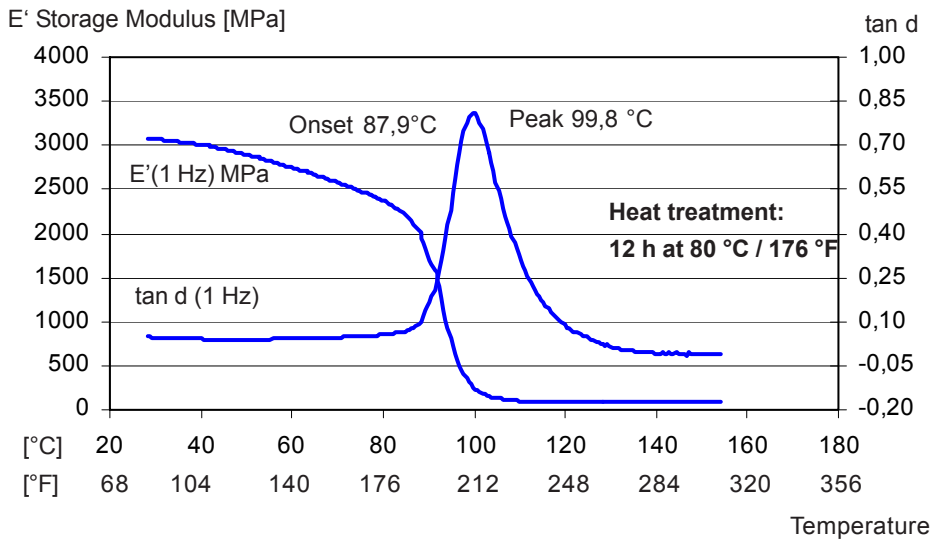
DMA-T_g (peak) tan delta

Laminating resin LR 385 with Hardener LH 385

DMA



Laminating resin LR 385 with Hardener LH 386



Measurement conditions

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

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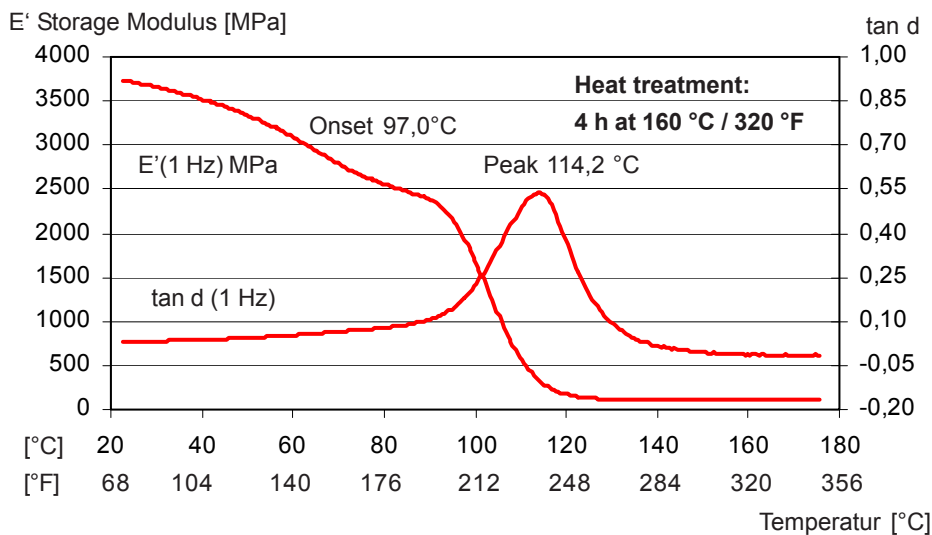
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DMA Measuring after heat treatment

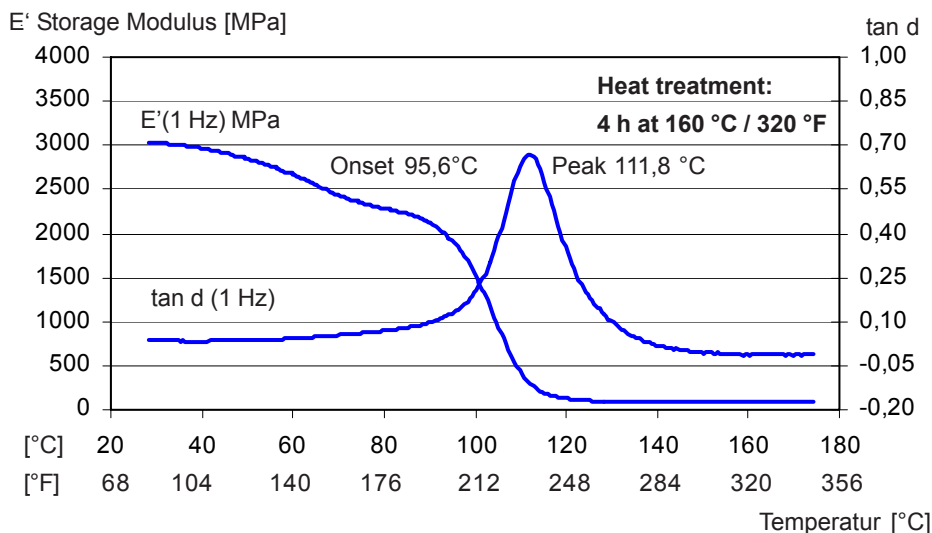
DMA-T_g (peak) tan delta

Laminating resin LR 385 with Hardener LH 385

DMA



Laminating resin LR 385 with Hardener LH 386



Measurement conditions

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

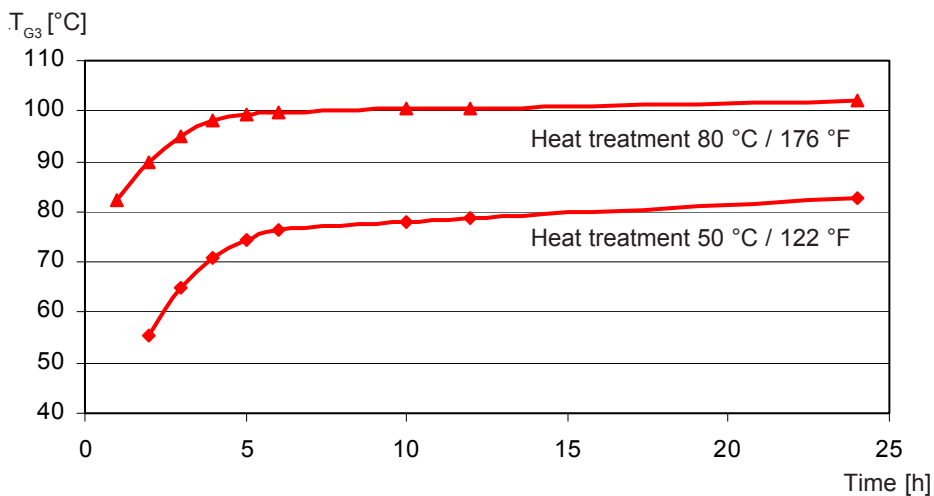
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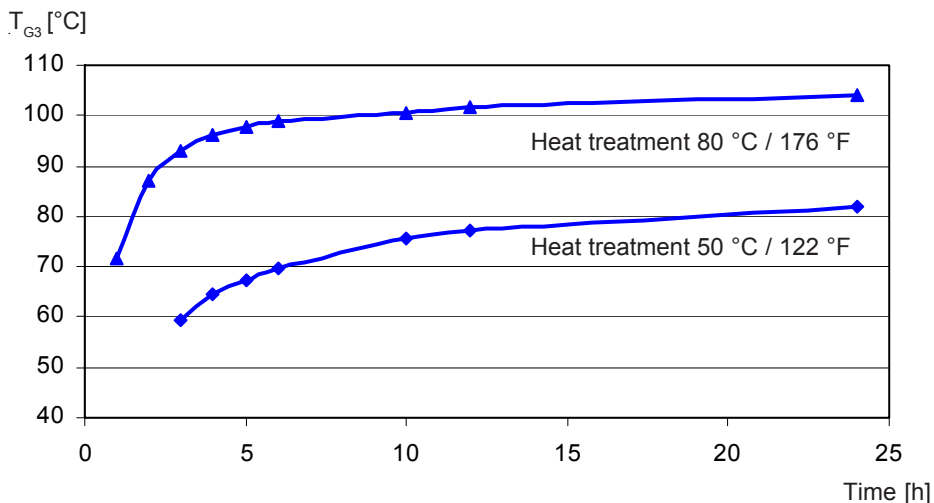
EPICOTE™ Resin MGS® LR 385

Laminating resin LR 385 Hardener LH 385

Development of T_g



Laminating resin LR 385 Hardener LH 386



Sample preparation

DSC, DIN 51007

EPICOTE™ Resin MGS® LR 385
Mechanical data

Mechanical data of neat resin		
Density	[g/cm ³]	1,18 - 1,20
Flexural strength	[N/mm ²]	120 - 130
Modulus of elasticity	[kN/mm ²]	3,3 - 3,6
Tensile strength	[N/mm ²]	75 - 85
Compressive strength	[N/mm ²]	120 - 140
Elongation of break	[%]	6 - 8
Impact strength	[KJ/m ²]	45 - 60
Water absorption at 23°C	24 h [%] 7 d [%]	0,01 0,2 - 0,6
Fatigue strength under reversed bending stresses acc. to BAM Berlin	10 %	2 * 10 ⁴
	90 %	2 * 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 LR 385 with hardener LH 386. Data can differ in other applications.

EPICOTE™ Resin MGS® LR 385**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]	400 - 470	850 - 900	360 - 380
Tensile strength	[N/mm ²]	460 - 500	510 - 550	400 - 480
Compressive strength	[N/mm ²]	300 - 350	450 - 480	130 - 150
Interlaminar shear strength	[N/mm ²]	40 - 45	50 - 55	28 - 33
Modulus of elasticity	[kN/mm ²]	20 - 24	50 - 54	16 - 19
<p>GRC samples: 8 layers of glass fabric, plain, 280 g/m², 2 mm (0.08 in) thick</p> <p>CRC samples: 9 layers of carbon fabric, plain, 200 g/m², 2 mm (0.08 in) thick</p> <p>SRC samples: 7 layers of aramide fabric, 4H satin, 170 g/m², 2 mm (0.08 in) thick</p> <p>Fibre content of samples (GRC, SRC) during processing/testing: 41 - 45 vol% Data calculated for fibre content of 43 vol%</p> <p>Fibre content of samples (CRC) during processing/testing: 48 - 52 vol% Data calculated for fibre content of 50 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 60 °C (140 °F)