

EPIKOTE™ Resin MGS™ LR 135 and EPIKURE™ Curing Agent MGS™ LH 133-138

CHARACTERISTICS

Approval	DNV-GL SE (Germanischer Lloyd)
Application	Rotor blades for wind turbines, boatbuilding, as laminating and adhesive resins (wood-epoxy construction), sporting goods, moulds, tools and other devices
Operational temperature	-60 °C up to +50 °C without heat treatment -60 °C up to +80 °C after heat treatment
Processing	Generally at temperatures between 15°C and 50°C, all common processing methods
Features	Pot life from approx. 10 min to 10hrs Limited irritation potential
Special modifications	LR 135 LV: low viscosity LR 135 T: thixotropic
Storage	Shelf life of 24 months in originally sealed containers

APPLICATION

EPIKOTE™ Resin MGS™ LR135 laminating resin system approved by the German Lloyd. It contains no solvents and fillers and is available for different 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 adhesive properties with wood and other materials.

The range of pot lives is between approx. 10 min. and more than 10 hours. This enables a selection of the optimum system for all processing methods. After precuring at room temperature, the manufactured components are workable and demouldable. The final properties, however, will only be obtained after postcuring at temperatures of more than 40°C. At room temperature, the fast hardeners LH 133 - 135 are processable and demouldable after 6 - 12 hours, while the very slow hardeners LH 136 - 138 have curing periods of 2 - 4 days at room temperature.

Laminates produced with this system 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 drain out of the fabrics on vertical surfaces.

Due to the chemical characteristics of this system we do not expect any problems concerning compatibility

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(e.g. blisters, tearing or changes in colour), when it is processed with gelcoats. However, comprehensive tests are indispensable.

Epoxy resins are super cooled liquids, therefore crystallisation is immanently possible. In an early stage, crystallisation is visible as a clouding, and can progress to a stage, where the resin becomes a wax-like solid. Crystallisation can be reversed by slow heating of the product to approx. 40°C - 60°C. This physical phenomenon is reversible and is no restriction to quality. In fact a high purity of material will increase a tendency for crystallisation.

Although LR135 is 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 only minor 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.

SPECIFICATIONS

Laminating resin LR135		
Density ¹⁾	[g/cm ³]	1,14 – 1,18
Viscosity ¹⁾	[mPa·s]	2.300 – 2.900
Refractory index ¹⁾		1,558 – 1,562

Curing agent				
		LH133	LH134	LH135
Density ¹⁾	[g/cm ³]	1,04 – 1,08	1,03 – 1,07	0,98 – 1,02
Viscosity ¹⁾	[mPa·s]	400 – 650	150 – 300	50 – 150
Refractory index ¹⁾		1,555 – 1,565	1,564 – 1,570	1,509 – 1,513
Potlife ²⁾	[min]	app. 15 min.	app. 15 min.	app. 30 min.
T _{g pot}	[°C]	80 – 90 °C unconditioned 65 – 75°C conditioned ³⁾		

Curing agent					
		LH136	LH1364	LH137	LH138
Density ¹⁾	[g/cm ³]	0,94 – 0,98	0,94 – 0,98	0,94 – 0,98	0,93 – 0,96
Viscosity ¹⁾	[mPa·s]	20 – 100	10 – 50	10 – 50	10 – 50
Refractory index ¹⁾		1,470 – 1,480	1,460 – 1,470	1,450 – 1,470	1,457 – 1,459
Potlife ²⁾	[min]	app. 2 h	app. 2,5 h	app. 7 h	app. 10 h
T _{g pot}	[°C]	80 – 90 °C unconditioned 65 – 75°C conditioned ³⁾			

Measuring conditions:

- 1) measured at 25°C
- 2) measured at 20°C
- 3) conditioned at 40 °C / 90% r.H.

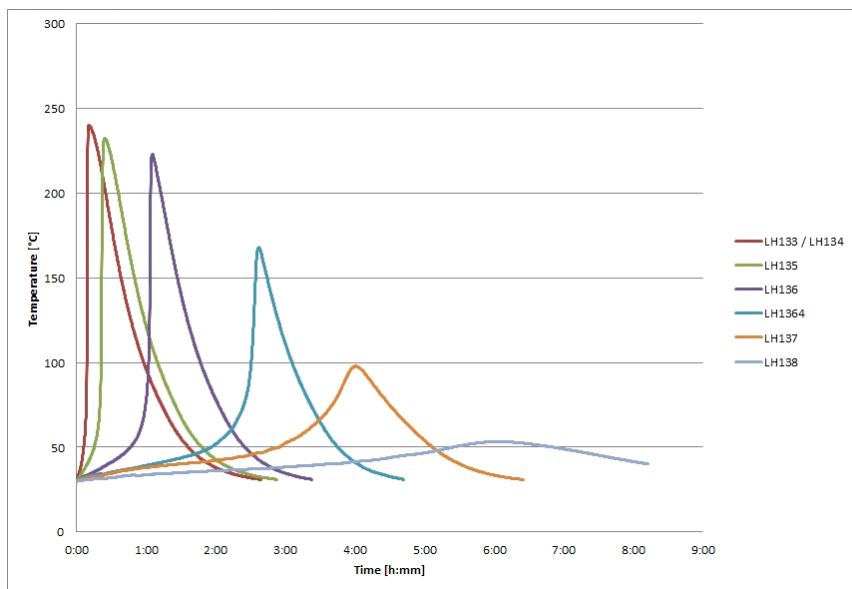
MIXING RATIOS

LR135 : All curing agents	
Parts by weight	100 : 35 ± 2
Parts by volume	100 : 41 ± 2

The mixing ratio stated must be observed very carefully. Adding more or less curing agent will not result in a faster or slower reaction – but in incomplete curing which cannot be corrected in any way. Resin and curing agent must be mixed very thoroughly. Mix until no clouding is visible in the mixing container. Pay special attention to the walls and bottom of the mixing container.

All curing agents have blue colour to distinguish between resin and curing agents, and for easier identification of a correct mixing process. Although unlikely, deviations in colour are possible (e.g. due to UV radiation after longer exposure to sun light), but however have no effect on the processing and final properties of the material

TEMPERATURE DEVELOPMENT



Measuring conditions: 100g / 30°C

Optimum processing temperature is in the range of 20°C to 35°C. Higher temperatures are possible, but will shorten pot life. A temperature increase of 10°C will halve the pot life. Water (e.g. high humidity or contained in additional fillers) causes an acceleration of the resin/ curing agent reaction. Different temperatures during processing are not known to have significant impact on the mechanical properties of the cured product.

Do not mix large quantities – particularly of highly reactive systems – at elevated processing temperatures. As the heat dissipation in the mixing container is very slow, the contents will be heated up by the reaction heat (exothermic resin-curing agent reaction) rapidly. This can result in temperatures of more than 200°C in the mixing container, which may cause smoke-intensive burning of the resin mass.

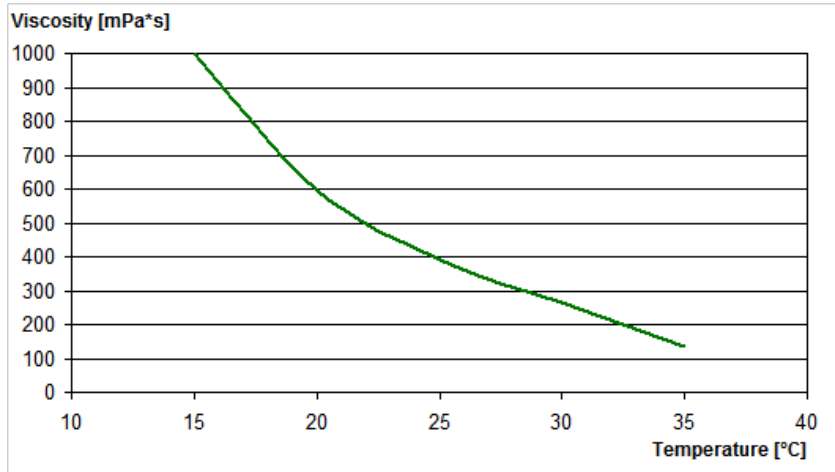
GEL TIME

	Curing agent		
	LH133	LH134	LH135
20 – 25°C	app. 1 – 2 hours	app. 2 – 3 hours	app. 4 – 5 hours
40 – 45°C	app. 30 min.	app. 40 min.	app. 50 min.

	Curing agent		
	LH136	LH137	LH138
20 – 25°C	app. 6 – 7 hours	app. 10 – 12 hours	app. 15 – 20 hours
40 – 45°C	app. 1 – 2 hours	app. 3 – 4 hours	app. 6 – 7 hours

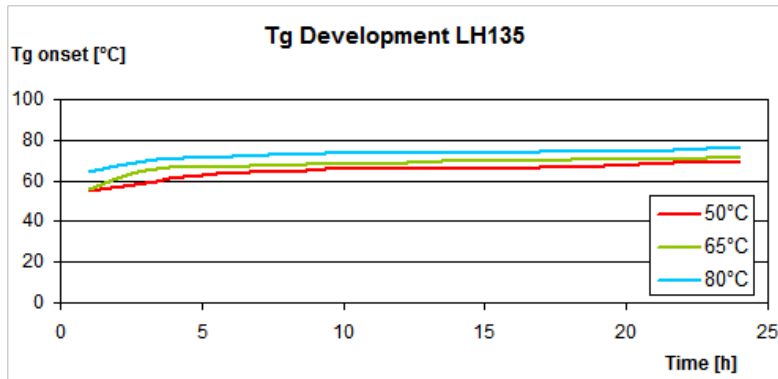
Measuring conditions: Film thickness 1 mm at different temperatures

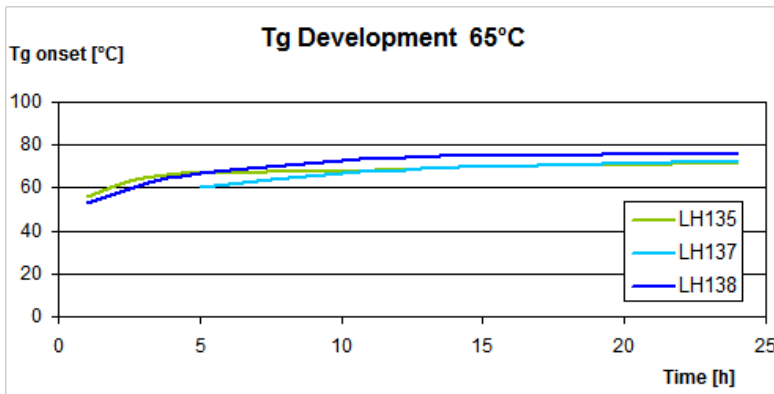
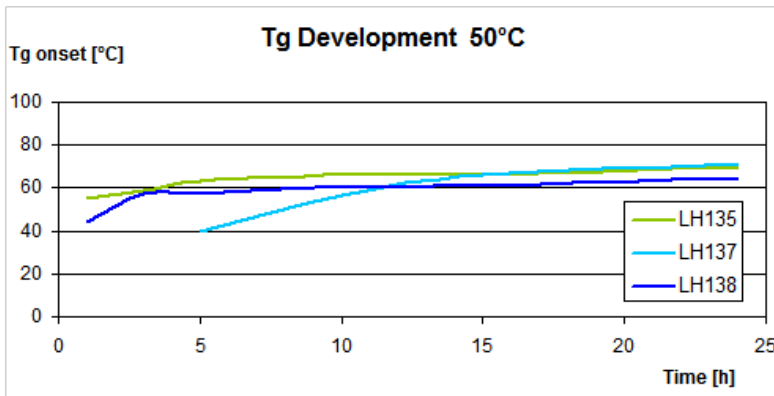
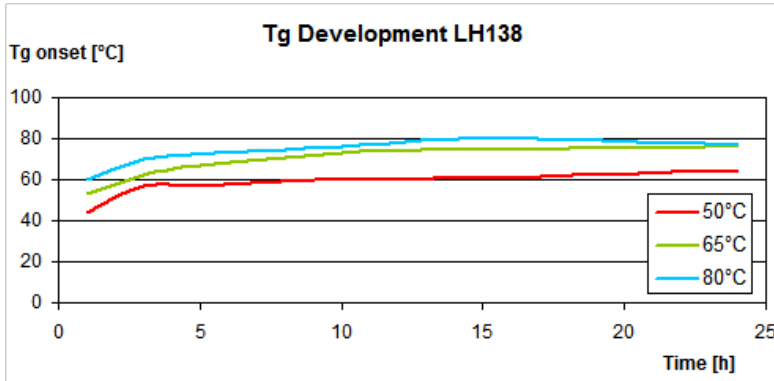
VISCOSITY OF MIXTURE



Measuring conditions: rotation viscosimeter, plate-plate configuration, measuring gap 0.2 mm

T_g DEVELOPMENT





Measuring conditions for all Tg measurements: DSC, DIN 51007

MECHANICAL DATA OF NEAT RESIN

Mechanical data		
Density DIN EN ISO 1183-1	[g/cm ³]	1,10 – 1,20
Flexural strength DIN EN ISO 178	[MPa]	110 – 130
Modulus of elasticity DIN EN ISO 178	[GPa]	2,9 – 3,2
Tensile strength DIN EN ISO 527-2	[MPa]	68 – 80
Compressive strength DIN EN ISO 604	[MPa]	80 – 100
Elongation at break DIN EN ISO 527-2	[%]	7,0 – 10,0
Impact strength ISO 179-1	[kJ/m ²]	30 – 50
Water absorption at 23°C DIN EN ISO 175	24h [%]	0,10 – 0,50
	7d [%]	0,20 – 0,80
Curing: 24h at 23°C + 15h at 60°C		

Advice:

Mechanical data are typical for the combination of laminating resin LR135 with curing agent LH135. Data can differ in other applications.

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