Faserverbundwerkstoffe®

Composite Technology

Epoxy Resin L + Hardener GL 1/GL 2

Laminating and infusion resin for processing in boat construction and for wind turbine blades

TYPE APPROVED PRODUCT
DNV
DNV.COM/AF

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EK997214 Ausgabe 07/2023

Epoxy resin system

Epoxy Resin L + Hardener GL 1

The well-proven R&G Epoxy Resin L in combination with Hardener GL 1 offers an approval by the Germanische Lloyd for the construction of boats and rotor blades for wind turbines.

Properties:

- Fully cures at 10 °C
- Color slightly yellowish after mixing
- Glass transition temperature (Tg) > 85 °C (post-curing at 70 °C / 15 h)
- Ambient curing does not result in brittleness (at 20 °C)
- **Pot life: approx. 30 minutes**
- High static and dynamic strength
- Also for acceleration of Hardener GL 2

This newly delevoped resin system is ideal for wetting-out glass, aramid and carbon fibres. It exhibits a very good price/performance ratio and is suitable for the following processing procedures:

- Resin infusion (RI)
- RTM (resin transfer moulding)
- Press moulding
- Vacuum moulding
- Filament winding
- Hand laminating

The resin component itself is absolutely free of crystallization due to its Bisphenol A/F base! The resin system is ambient curing and develops no distinctive brittleness even at curing temperatures below 20 °C.

Overview of characteristics Epoxy Resin L + Hardener GL 1

	Norm	Unit	Result	Requirement GL
Density	DIN EN ISO 1183-1	g/cm³	1,171	none
Tensile strength	DIN EN ISO 527-2	MPa	74	≥ 55
Elongation at break	DIN EN ISO 527-2	%	3,5	≥ 2,5
Tensile modulus	DIN EN ISO 527-2	MPa	3490	≥ 2700
Flexural strength	DIN EN ISO 178	MPa	135	≥ 100
Heat deflection temperature (HDT)*	DIN EN ISO 75-2	°C	74	≥ 70
Water resumption (after 168 h)	according to DIN EN ISO 175	mg	31	≤ 50

* 24 h at 23 °C + 16 h at 80 °C

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Epoxy resin system

Epoxy Resin L + Hardener GL 2

The well-proven R&G Epoxy Resin L in combination with Hardener GL 2 offers an approval by the Germanische Lloyd for the construction of boats and rotor blades for wind turbines.

Properties:

- Extremely low-viscous (Mixing viscosity 250 mPas at 25 °C)
- Highly transparent (Colour index < 1 Gardner)
- Fully cures at 15 °C
- Glass transition temperature (Tg) > 85 °C (post-curing at 70 °C / 15 h)
- Ambient curing does not result in brittleness (at 20 °C)
- **Pot life: approx. 210 minutes (**Gelnorm®-Geltimer 23 °C/100 g)
- High static and dynamic strength

This newly delevoped resin system is ideal for wetting-out glass, aramid and carbon fibres. It exhibits a very good price/performance ratio and is suitable for the following processing procedures:

- Resin infusion (RI)
- RTM (resin transfer moulding)
- Press moulding
- Vacuum moulding
- Filament winding
- Hand laminating

The resin component itself is absolutely free of crystallization due to its Bisphenol A/F base! The resin system is ambient curing and develops no distinctive brittleness even at curing temperatures below 20 °C.

Overview of characteristics Epoxy Resin L + Hardener GL 2

	Norm	*Unit*	*Result*	*Requirement GL*
Density	*DIN EN ISO 1183-1*	*g/cm³*	*1,151*	*none*
Tensile strength	*DIN EN ISO 527-2*	*MPa*	*74,8*	*≥ 55*
Elongation at break	*DIN EN ISO 527-2*	*%*	*4,5*	*≥ 2,5*
Tensile modulus	*DIN EN ISO 527-2*	*MPa*	*3057*	*≥ 2700*
Flexural strength	*DIN EN ISO 178*	*MPa*	*119*	*≥ 100*
Heat deflection temperature (HDT)*	*DIN EN ISO 75*	*°C*	*73*	*≥ 70*
Water resumption	*according to DIN EN ISO 175*	*mg*	*43*	*≤ 50*

* 1 h at 23 °C + 5 h at 70 °C + 5 h at 80 °C

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Epoxy resin system

Epoxy Resin L + mixture Hardener GL 1 + Hardener GL 2

(50 % Hardener GL 1 + 50 % Hardener GL 2)

Processing and properties
The hardeners GL1 and GL 2 can be mixed with each other at all mixing ratios for individual pot lives within their processing times. **The mixing ratio for the standard resin constituent Epoxy Resin L is identical for both curing agents, so this resin constituent can be mixed at the constant ratio of 100:30 parts by weight.**

Overview of characteristics Epoxy Resin L + mixture Hardener GL 1 + Hardener GL 2 *(50 % Hardener GL 1 + 50 % Hardener GL 2)*

	Norm	Unit	Result	Requirement GL
Tensile strength	*DIN EN ISO 527-2*	*MPa*	***79,1***	*≥ 55*
Elongation at break	*DIN EN ISO 527-2*	*%*	***4,8***	*≥ 2,5*
Tensile modulus	*DIN EN ISO 527-2*	*MPa*	***3450***	*≥ 2700*

Technical information

Mixture of Hardener GL 1 + Hardener GL 2

(50 % Hardener GL 1 + 50 % Hardener GL 2)

Specification	Property	Value	Unit	Testing method
	Viscosity at 25 °C	32	mPas	ISO 3219
	Amine index	529	mgKOH/g	CTP-TS 31-97
	Density at 23 °C	0,971	g/cm³	ISO 2811-2
	Gardner colour index	3,2		Gardner, ISO 4630-2
	Refractive index	1,5012		DIN 51 423-2
	Appearance	yellowish		visual
	Active-H-Equiv. weight	52	g/Eq.	calculated
	Solid content	100	%	
System properties with Epoxy Resin L	rec. amount hardener	30	g	per 100 g
	Viscosity at 25 °C	387	mPas	ISO 3219
	Pot life	20	min	v. 23 -> 40 °C with 100 ml*
	Time to T_{max}	40	min	
	min. curing temperature	12	°C	
	Shore D a. 7 d r.t.	84		ISO 868
	Glass transition temp. (Tg)	80	°C	

*Temperature increase from 23 °C to 40 °C with 100 ml: approx. 20 minutes

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Technical information

Epoxy Resin L

Characteristics	Modified, low-viscosity bisphenol A/F-Epoxy resin
Processing and properties	Epoxy Resin L is a modified, low-viscosity epoxy resin based on bisphenol A and F. Range of applications are laminates from glass-, aramid- and carbon fibres for wind turbine blades and boat building. Epoxy Resin L is resistant to crystallisation.

Specifications

Property	Value	Unit	Testing method
Viscosity at 25 °C	710 ± 70	mPas	ISO 3219
Density at 23 °C	1,15 ± 0,01	g/cm³	ISO 2811-2
Gardner colour index	< 2		Gardner, ISO 4630-2
EP-Equiv. weight	178	g/Eq.	CTP-TS 33/34-00
Solid content	100	%	
Flash point	> 150	°C	DIN-ISO 3679

Storage: At room temperature in originally packed units the shelf life is at least 36 months.

Hardener GL 1

Characteristics	Modified cycloaliphatic polyamine free of alkylphenol and benzyl alcohol
Processing and properties	Hardener GL 1 is an epoxy hardener, which can be used in combination with suitable epoxy resin formulas in a wide range of applications e.g. composite materials and provides cured very good mechanical properties.

Specifications

Property	Value	Unit	Testing method
Viscosity at 25 °C	100 ± 50	mPas	ISO 3219
Amine index	515 ± 50	mgKOH/g	CTP-TS 31-97
Density at 23 °C	1.00± 0.01	g/cm³	ISO 2811-2
Gardner colour index	< 5		Gardner, ISO 4630-2
Refractive index	1.536 ± 0.001		DIN 51 423-2
Appearance	yellowish, clear		visual
Active-H-Equiv. weight	53	g/Eq.	calculated
Solid content	100	%	

System properties with Epoxy Resin L

rec. amount hardener	30	g	per 100 g
Viscosity at 25 °C	820	mPas	ISO 3219
Pot life	approx. 13	min	v. 23 -> 40 °C with 100 ml *
Time to T_{max}	27	min	
min. curing temperature	10	°C	
Shore D a. 7 d r.t.	80		ISO 868
Glass transition temp. (Tg)	85 - 87	°C	

Storage: At room temperature in originally packed units the shelf life is at least 24 months.

*Temperature increase from 23 °C to 40 °C with 100 ml: approx. 13 minutes

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Technical information

Hardener GL 2

Characteristics	Modified cycloaliphatic polyamine free of alkylphenol and benzyl alcohol
Processing and properties	Hardener GL 2 is an epoxy hardener with very low viscosity, which can be used in combination with suitable epoxy resin formulas in a wide range of applications e.g. composite materials and provides cured very good mechanical properties.

Specification

Property	Value	Unit	Testing method
Viscosity at 25 °C	14 ± 2	mPas	ISO 3219
Amine index	565 ± 10	mgKOH/g	CTP-TS 31-97
Density at 23 °C	0,94 ± 0,01	g/cm³	ISO 2811-2
Gardner colour index	< 1		Gardner, ISO 4630-2
Refractive index	1,4681 ± 0,0008		DIN 51 423-2
Appearance	colourless, clear		visual
Active-H-Equiv. weight	50	g/Eq.	calculated
Solid content	100	%	

System properties with Epoxy Resin L

rec. amount hardener	30	g	per 100 g
Viscosity at 25 °C	248	mPas	ISO 3219
Pot life	approx. 109	min	v. 23 -> 40 °C with 100 ml *
Time to T_{max}	150	min	
min. curing temperature	15	°C	
Shore D a. 7 d r.t.	83		ISO 868
Glass transition temp. (Tg)	85-87	°C	

Storage: At room temperature in originally packed units the shelf life is at least 24 months.

*Temperature increase from 23 °C to 40 °C with 100 ml: approx. 109 minutes

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DNV

TYPE APPROVAL CERTIFICATE

Certificate No:
TAK000015C
Revision No:
1

This is to certify:

That the Epoxy Systems

with type designation(s)
Epoxy Resin L - Series

Issued to
R&G Faserverbundwerkstoffe GmbH
Waldenbuch, Germany

is found to comply with
DNV class programme DNV-CP-0089 – Type approval – Epoxy resin systems

Application :

Laminating resin for construction of laminates made of fibre reinforced plastics.

Issued at **Hamburg** on **2022-01-10**

This Certificate is valid until **2023-02-23**.
DNV local station: **Hamburg Materials & Welding**

Approval Engineer: **Joachim Rehbein**

for **DNV**
Digitally Signed By: Wildhagen, Christian
Location: DNV GL Hamburg, Germany
Signing Date: 10.01.2022, on behalf of

Thorsten Lohmann
Head of Section

This Certificate is subject to terms and conditions overleaf. Any significant change in design or construction may render this Certificate invalid.
The validity date relates to the Type Approval Certificate and not to the approval of equipment/systems installed.

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Job Id: **262.1-027992-2**
Certificate No: **TAK000015C**
Revision No: **1**

Product description

Two component epoxy resin system.

Approved variants

Epoxy Resin L with following hardener
- GL 1
- GL 2

Type Approval documentation

- Technical Data Sheet
- Material Safety Data Sheet
- Test Report No. P 8602-1 and P 8602-2 issued by KIWA Polymer Institut GmbH
- Workshop Inspection Report issued by DNV GL Hamburg, dated on 2017-12-20.
- Quality assurance/control documentation

TAK000015C rev. 01 – change of production site:
- Application for type approval TAA 901 & change request 90.01a, dated 2020-05-26;
- Type approval assessment report TA 401, issued 2021-11-16;
- Certificate of analysis EN10204 3.1 issued by Bohrmann GmbH, dated 2021-09-14;
- Test reports issued by polymerphys IK GmbH, Industriepark Hoechst - G 830, 65926 Frankfurt am Main, Germany;
- Assessed production site:
  Bohrmann GmbH
  Raiffeisenstr. 45
  55270 Klein-Winternheim
  Germany

Material Properties

Properties	Test Method	Epoxy Resin L	GL 1	GL 2	Unit
Density at 23°C	ISO 2811-2	1.13 – 1.15	0.99 – 1.01	0.93 – 0.95	g/cm³
Amine Value	CTP-TS 31-97	N/A	465 – 565	555 - 575	mgKOH/g
Viscosity at 25°C	ISO 3219	670 – 760	50 – 150	12 - 16	mPa·s

Limitation

The resin complies with the applicable requirements of DNV GL and is compatible to the fibres, adhesives and core materials. Any significant changes in design and / or quality of the material will render the approval invalid.

Periodical assessment

A production site with a valid Approval of Manufacturer (AoM) certificate for material in question is exempted from the obligation concerning retention and renewal assessments.
For a manufacturer without a valid AoM certificate, periodical assessments are required after two years and after 3.5 years (retention survey) and for renewal after 5 years (renewal survey). Refer to DNV-CP-0338, Sec.4.

To check the validity of this certificate, please look it up in https://approvalfinder.dnv.com

END OF CERTIFICATE