



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



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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 (T_g) > 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 developed 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/cm ³	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



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 (T_g) > 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 developed 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/cm ³	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



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)

	<i>Norm</i>	<i>Unit</i>	<i>Result</i>	<i>Requirement GL</i>
<i>Tensile strength</i>	<i>DIN EN ISO 527-2</i>	<i>MPa</i>	79,1	≥ 55
<i>Elongation at break</i>	<i>DIN EN ISO 527-2</i>	<i>%</i>	4,8	≥ 2,5
<i>Tensile modulus</i>	<i>DIN EN ISO 527-2</i>	<i>MPa</i>	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/cm ³	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



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/cm ³	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/cm ³	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



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/cm ³	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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TYPE APPROVAL CERTIFICATE

Certificate no.:
TAK000015C
Revision No:
2

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.

Product(s) approved by this certificate is/are accepted for installation on all vessels classed by DNV.

Issued at **Hamburg** on **2024-04-08**

This Certificate is valid until **2029-04-07**.

DNV local unit: **Augsburg**

Approval Engineer: **Joachim Rehbein**

for **DNV**



Digitally Signed By:
Stefan Röhr
Location: **DNV Hamburg,**
Germany

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.

LEGAL DISCLAIMER: Unless otherwise stated in the applicable contract with the holder of this document, or following from mandatory law, the liability of DNV AS, its parent companies and their subsidiaries as well as their officers, directors and employees ("DNV") arising from or in connection with the services rendered for the purpose of the issuance of this document or reliance thereon, whether in contract or in tort (including negligence), shall be limited to direct losses and under any circumstance be limited to 300,000 USD.



Form code: TA 251

Revision: 2023-09

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Job ID: 262.1-027992-3
Certificate no.: TAK000015C
Revision No: 2

Product description

Two component epoxy resin system.

Approved variants

Epoxy Resin L with following hardeners:

- 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. 2 – renewal 2024:

- Application for type approval TAA 901 dated 2020-05-26;
- TDS Epoxy Resin L of 06/2023;
- SDS Epoxy Resin L rev. 1.19 of 2023-01-05;
- Type approval assessment report TA 401 R&G Faserverbundwerkstoffe Waldenbuch, Germany, issued 2023-04-27;
- Type approval assessment report TA 401 Bohrmann, Klein-Winterheim, Germany, issued 2023-05-22;
- Certificate of analysis EN10204 3.1 issued by Bohrmann GmbH, dated 2021-09-14;
- Test reports issued by polymerphys IK of 2023-11-09;
- Report issued by Bohrmann GmbH of 2023-11-13.

TAK000015C Rev. 1 – 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/cm ³
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 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