DERAKANE™ SIGNIA 411 Epoxy Vinyl Ester Resin

OVERVIEW

DERAKANE SIGNIA 411 epoxy vinyl ester resin is based on bisphenol-A epoxy resin. When fabricated into a composite part it provides resistance to a wide range of acids, alkalis, bleaches, and organic compounds used in chemical processing industry applications.

For **Composite Manufacturers**, DERAKANE SIGNIA resins offers improved shop efficiencies, reduced styrene emissions and improved storage stability.

- Designed to enhance secondary bonding properties and reduce or even eliminate the need for surface preparation between laminate layers during initial production, reducing labor costs and producing a cleaner, employee friendly workplace.
- Formulated for better wet out, reduced gassing and faster composite consolidation.
- Prepared with an innovative styrene suppression system, providing a lower odor environment with up to 35% reduction in emissions based on data generated using the VSE test per 40 CFR Subpart WWWW Appendix A (the US Composites MACT Standard).

For **Asset Owners**, DERAKANE SIGNIA resins offer the proven technology and performance of legacy DERAKANE series resins with the added benefit of a unique, proprietary identification system. This unique, identifiable technology confirms tanks, pipes, etc. are built as specified.

- Extends the service life of equipment designed for corrosive environments, postponing the need for equipment replacement.
- Facilitates design and operation under heavy loads.
- Provides improved toughness and reduced cracking from cyclic temperature and pressure fluctuations or mechanical shocks during shipping, installation and operation.

APPLICATIONS AND USE

This resin is suitable for fabricating FRP storage tanks, vessels, piping, ducts, and on-site maintenance projects, particularly in chemical processing and pulp and paper operations. The product is designed for ease of fabrication using hand lay-up, spray-up and filament winding molding techniques.

- When properly formulated and cured, complies with FDA regulation 21 CFR 177.2420 covering materials intended for repeated use in contact with food.
- Properly made laminates, including laminate build up in multiple steps, have shown good interlaminar adhesion.
- Minimal to no resin excess between laminate layers is required to achieve good secondary bonding. Manufacturers should determine if their practices yield similar results.
- Addition of thixotropic agents and fillers can compromise corrosion resistance. Contact ALTA Performance Materials before using thixotropic agents and fillers.

Recommendations for specific services and environments can be provided by contacting us at derakane@altapm.com.

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TYPICAL LIQUID RESIN PROPERTIES

Property at 25°C (77°F) unless otherwise marked	Value	Unit
Dynamic Viscosity	370	cps (mPa•s)
Kinematic Viscosity	350	cSt
Styrene Content	44	%
Filled Weight Per Gallon at 77°F	1.046	g/ml

EMISSIONS COMPARISON

The table below compares emissions from DERAKANE SIGNIA 411 resin calculated per rules established by the US EPA per Table 1 to Subpart WWWW of Part 63 of the RPC MACT and shows the styrene content of a non-suppressed resin necessary to achieve the same emissions profile.

Resin Application Method	DERAKANE SIGNIA 411 Resin Emissions (lbs/tom)	Equivalent Non-LSE Styrene Content (%)
Manual	106	37.0%
Non-Atomized Mechanical	79	35.7%
Filament Winding	118	32.4%

VAPOR SUPPRESSION EFFECTIVENESS (VSE)

Table 1 Subpart WWWW of Part 63 Emission Calculation Factor	
VSE Factor	0.55
Vapor Suppression Effectiveness (VSE) is per 40 CFR Subpart WWWW Appendix A.	

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ROOM TEMPERATURE CURING

The table below shows typical gel times using MEKP-925H catalyst and Cobalt Naphthenate or Cobalt Octoate-6% (Cobalt6%), Dimethylaniline (DMA) and 4-tert-Butylcatechol (TBC) 10% concentration expressed in parts per hundred resin (phr).

	MEKP-925H (phr)	Cobalt6% (phr)	DMA (phr)	TBC 10% (phr)
Gel time at 16°C (60°F)				
15 minutes +/-5	2.0	0.40	0.10	-
30 minutes +/-10	2.0	0.25	0.05	-
60 minutes +/-15	2.0	0.20	0.05	0.20
Gel time at 22°C (72°F)				
15 minutes +/-5	1.5	0.40	0.05	-
30 minutes +/-10	1.5	0.30	0.05	0.15
60 minutes +/-15	1.5	0.20	-	0.15
Gel time at 28°C (82°F)				
15 minutes +/-5	1.25	0.40	-	-
30 minutes +/-10	1.25	0.25	-	0.05
60 minutes +/-15	1.25	0.15	-	0.15
Gel time at 33°C (92°F)				
15 minutes +/-5	1.0	0.20	-	-
30 minutes +/-10	1.0	0.15	-	0.10
60 minutes +/-15	1.0	0.15	-	0.20
Gel time at 40°C (104°F)				
15 minutes +/-5	1.0	0.15	-	0.05
30 minutes +/-10	1.0	0.15	-	0.20
60 minutes +/-15	1.0	0.10	-	0.30

- Use of cobalt octoate, especially in combination with 2,4-P can result in 20-30% slower gel times
- If faster Barcol hardness development in thin layers is desired, consider adding an accelerator like DMA, Diethylaniline (DEA), or DiEthyl-AcetoAcetamide (DEAA).
- For thicker layers and 30-minute gel time at 22°C (72°F), DMA and TBC 10% may not be needed.
- For pre-acceleration for prolonged storage (e.g. formulation of lining or floor systems) consider DEAA in place of DMA or DEA.
- To avoid problems with water impacting resin cure, lamination work should only be carried out if the ambient temperature is at least 3°C above the dew point (relative humidity <80%). Hot, humid summer conditions may require an adjustment of the above curing formulations (e.g. higher cobalt levels, additional inhibitor, alternate peroxide).

Warning: Using less than 0.05 phr cobalt 6% may cause under-cure in certain conditions. Please contact ALTA Performance Materials Technical Service for further details or if such low levels are being considered.

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BPO CURING

Typical gel times using 50% active Benzoyl Peroxide (BPO-50) and Diethylaniline (DEA). Note: Water based BPO pastes should not be used.

	BPO-50 (phr)	DEA (phr)
Gel time at 16°C (60°F)		
15 minutes +/-5	4.0	0.2
30 minutes +/-10	2.0	0.2
60 minutes +/-15	2.0	0.1
Gel time at 24°C (75°F)		
15 minutes +/-5	3.0	0.16
30 minutes +/-10	2.0	0.12
60 minutes +/-15	2.0	0.05
Gel time at 32°C (90°F)		
15 minutes +/-5	2.0	0.10
30 minutes +/-10	2.0	0.07
60 minutes +/-15	2.0	0.035

TYPICAL CURED CASTING PROPERTIES

Property at 25°C (77°F)	Value	Test Method	Value	Test Method
Tensile Strength	13,000 psi	ASTM D638	86 MPA	ISO 527
Tensile Modulus	450 ksi	ASTM D638	3100 MPa	ISO 527
Tensile Elongation	5-6%	ASTM D638	5-6%	ISO 527
Flexural Strength	21,000 psi	ASTM D790	150 MPa	ISO 178
Flexural Modulus	500 ksi	ASTM D790	3400 MPa	ISO 178
Density	1.13	ASTM D792	1.13	ISO 1183
Volume Shrinkage	8%		8%	
Heat Deflection Temperature	220 °F	ASTM D648	105 °C	ISO 75
Barcol Hardness	30	ASTM D2583	30	EN 59
HDT Maximum stress: 1.8 MPa (264 psi)				

TYPICAL PROPERTIES OF A POST-CURED LAMINATE

Property at 25°C (77°F)	Value	Test Method	Value	Test Method
Tensile Strength	25,800 psi	ASTM D638	178 MPA	ISO 527
Tensile Modulus	1580 ksi	ASTM D638	10,700 MPa	ISO 527
Flexural Strength	32,700 psi	ASTM D790	225 MPa	ISO 178
Flexural Modulus	1170 ksi	ASTM D790	8050 MPa	ISO 178
Glass Content	38.6 %	ASTM D2584	38.6 %	ISO 1172
Laminate construction of 6 mm (1/4") is V/M/M/Wr/M/Wr/M where V=Continuous veil glass, M=Chopped strand mat 450 g/m2 (1.5 oz/ft2) and WR=Woven roving 800 g/m2 (24 oz/yd2).				

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STANDARD PACKAGE
Steel drum with net weight of 205 kgs (452 Lbs).

COMMERCIAL WARRANTY
Eighteen months from date of manufacture, when stored in accordance with the conditions stated below.

STORAGE & MIXING
All other conditions being equal, higher storage temperatures will reduce product stability and lower storage temperatures will extend product stability. Store at temperatures between 15°C and 25°C (60°F – 77°F). Avoid exposure of storage tanks and storage containers to heat such as direct sunlight, steam pipes, and other heating sources.

Hazy resin is indicative of storage below suggested temperatures. Gently warm and mix the resin to normal usage temperatures (typically 20°C) to eliminate haze before use. For additional information on mixing resins, please consult ALTA Performance Materials' "A Guide to Fabricating FRP Composites" and the supplemental document "Mix Room Practices."

Containers: Keep containers sealed to prevent moisture pick-up and monomer loss. Do not store drums and other small containers outdoors. Mild mixing is recommended after prolonged storage. Rotate stock.

Bulk Storage: Consult with your ALTA Performance Materials account representative for a guide to best practices on bulk resin storage and handling.

NOTICE
All information presented herein is believed to be accurate and reliable, and is solely for the user's consideration, investigation, and verification. The information is not to be taken as an express or implied representation or warranty for which ALTA Performance Materials assumes legal responsibility. Any warranties, including warranties of merchantability, fitness for use or non-infringement of intellectual property rights of third parties, are herewith expressly excluded.

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ALTA Performance Materials requests that the user reads, understands, and complies with the information contained herein and the current Material Safety Data Sheet.

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Commercial contacts by region available at:
https://www.ALTAPM.com/contacts/

[i]All properties are typical values. Results may vary. Typical values are not a guaranteed analysis of any specific lot or specification.
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