Technical Datasheet

INEOS Composites

DERAKANE™ SIGNIA 441 Epoxy Vinyl Ester Resin

DERAKANE SIGNIA 441 epoxy vinyl ester resin is a lower styrene-content resin based on an optimized epoxy resin backbone. This optimized structure yields superior thermal and corrosion resistance performance,which place it as a resin type between DERAKANE SIGNIA 411 and DERAKANE SIGNIA 470 RESINS. It provides resistance to a wide range of acids, alkalis, and organic compounds used in chemical processing industry applications. DERAKANE SIGNIA 441 resin

- 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 reduce cracking from cyclic temperature and pressure fluctuations or mechanical shocks during shipping, installation and operation.
- When properly formulated and cured, complies with FDA regulation 21 CFR 177.2420 covering materials intended for repeated use in contact with food.

For **Composite Manufacturers**, DERAKANE SIGNIA resins incorporate the best of INEOS Composites's corrosion resistant resin technologies, offering improved shop efficiencies, reduced laminate exotherms, 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 work place.
- 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 10% 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 same proven INEOS Composites resin technology and peformance as with legacy DERAKANE series resins, now with the added benefit of a unique, proprietary identification system. This unique, identifiable technology confirms tanks, pipes, etc. are built as specified.

Note: Contact us before using thixotropic agents and fillers. Addition of thixotropic agents and fillers can compromise corrosion resistance.

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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. DERAKANE SIGNIA 441 resin is designed for ease of fabrication using hand lay-up, spray-up and filament winding molding techniques. Properly made laminates including laminate build up in multiple steps have shown good interlaminar adhesion. Necessary practices to achieve good secondary bonding include minimal to no resin excess between laminate layers. Manufacturers should determine if their practices yield similar characteristics. 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. Recommendations for specific services and environments can be provided by contacting us at derakane@ineos.com.

TYPICAL LIQUID RESIN PROPERTIES

Property(1) at 25°C (77°F)	Value	Unit
Dynamic Viscosity	420	mPa·s (cps)
Kinematic Viscosity	450	cSt
Styrene Content	32	%
Density	1.08	g/ml

(1) Properties are typical values based on material tested in our laboratories. Results may vary from sample to sample. Typical values should not be construed as a guaranteed analysis of any specific lot or as specification items.

VAPOR SUPPRESSION EFFECTIVENESS (VSE) per 40 CFR Subpart WWWW Appendix A

Table 1 Subpart WWWW of Part 63 Emission Calculation Factor	
VSE Factor	0.2

Table 1 to Subpart WWWW of Part 63 provides equations to calculate HAP Emission Factors for specific processes with and without vapor suppression additives.

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TYPICAL CURING CHARACTERISTICS

The following tables provide typical gel times for Methyl Ethyl Ketone Peroxide (MEKP) and Benzyl Peroxide (BPO).

MEKP Cure System

Typical gel times(2) using Norox(3) (ME)KP-925H(4) catalyst (MEKP) and Cobalt Naphthenate or Octoate-6%(5) (Cobalt6%), and 4-tert-Butylcatechol (TBC) 10% concentration expressed in phr(6).

Warning: Using less than 0.05 phr cobalt 6% may cause undercure under certain conditions. Please contact INEOS Composites Technical Service for further details or if such low levels are envisaged.

Gel time at 16°C (60°F)	MEKP (phr)	Cobalt6% (phr)	TBC 10% (phr)
25 +/- 10 minutes	2.5	0.4	-
45+/- 10 minutes	1.5	0.3	-

Gel time at 22°C (72°F)	MEKP (phr)	Cobalt6% (phr)	TBC 10% (phr)
15 +/- 5 minutes	2.5	0.3	-
30 +/- 10 minutes	1.5	0.2	(+)
60 +/- 15 minutes	1.0	0.2	-

Gel time at 28°C (82°F)	MEKP (phr)	Cobalt6% (phr)	TBC 10% (phr)
15 +/- 5 minutes	1.5	0.3	-
30 +/- 10 minutes	1.0	0.2	-
60 +/- 15 minutes	1.0	0.1	0.05

Gel time at 33°C (92°F)	MEKP (phr)	Cobalt6% (phr)	TBC 10% (phr)
15 +/- 5 minutes	1.5	0.1	0.05
30 +/- 10 minutes	1.0	0.1	0.05
60 +/- 15 minutes	1.0	0.1	0.20

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

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levels, additional inhibitor, alternate peroxide). Please contact INEOS Composites Technical Service for specific recommendations.

(+) If faster Barcol Hardness development in thin layers is desired, please consider adding an accelerator like dimethylaniline (DMA), diethylaniline (DEA) or diethyl acetoacetamide (DEAA). For thicker layers and 30 minute gel times at 22°C (72°F), DMA and TBC 10% may not be needed.

(2) Thoroughly test any other materials in your applications before full-scale use. Gel times may vary due to the reactive nature of these materials. Always test a small quantity before formulating large quantities.
(3) Registered trademark of United Initiators.
(4) Norox (ME)KP-925H; (ME) used only in NA name, but not elsewhere. MEKP or equivalent low hydrogen peroxide content MEKP. Use of other MEKP catalysts or additives may result in different gel times.
(5) Use of cobalt octoate, especially in combination with 2,4-pentanedione can result in 20-30% slower gel times.
(6) phr = parts per hundred resin molding compound

BPO Cure System

Typical gel times(2) using 50% active BPO paste catalyst and DEA(7). Concentration expressed in phr(6).

Gel time at 16°C (60°F)	50% BPO Paste (phr)	DEA(7) (phr)
15 +/- 5 minutes	2.0	0.5
30 +/- 10 minutes	2.0	0.3
60 +/- 15 minutes	2.0	0.2

Gel time at 24°C (75°F)	50% BPO Paste (phr)	DEA (phr)
15 +/- 5 minutes	2.0	0.4
30 +/- 10 minutes	2.0	0.2
60 +/- 15 minutes	2.0	0.12

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Gel time at 32°C (90°F)	50% BPO Paste (phr)	DEA (phr)
15 +/- 5 minutes	2.0	0.2
30 +/- 10 minutes	2.0	0.12
60 +/- 15 minutes	2.0	0.07

(7) For pre-acceleration for prolonged storage (e.g. formulation of lining or flooring systems) consider DEAA in place of DMA or DEA. For further information, please contact INEOS Composites.

TYPICAL MECHANICAL PROPERTIES

Typical properties(1) of a cured casting at 25°C (77°F).

Property of casting	Value (SI)	Method	Value (US)	Method
Tensile Strength	76 MPa	ISO 527	11,000 psi	ASTM D638
Tensile Modulus	3.5 GPa	ISO 527	500 ksi	ASTM D638
Tensile Elongation	4-5%	ISO 527	4-5%	ASTM D638
Flexural Strength	120 MPa	ISO 178	18,000 psi	ASTM D790
Flexural Modulus	3.4 GPa	ISO 178	500 ksi	ASTM D790
Heat Distortion Temperature(8)	120°C	ISO 75	248°F	ASTM D648
Barcol Hardness	35	EN 59	35	ASTM D2583

(8) Maximum stress: 1.8 MPa (264 psi)

Typical properties(1) of a postcured 6 mm (1/4") laminate(9) at 25°C (77°F).

Property of laminate	Value (SI)	Method	Value (US)	Method
Tensile Strength	160 MPa	ISO 527	23,000 psi	ASTM D638
Tensile Modulus	11,000 MPa	ISO 527	1600 kpsi	ASTM D638
Flexural Strength	190 MPa	ISO 178	27,000 psi	ASTM D790

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Flexural Modulus	8300 MPa	ISO 178	1200 kpsi	ASTM D790
Glass Content	43%	ISO 1172	43%	ASTM D2584

(9) 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/m^2 (1.5 oz/ft^2) and Wr=Woven roving 800 g/m^2 (24 oz/yd^2).

CERTIFICATES AND APPROVALS

The manufacturing, quality control and distribution of products, by INEOS Composites, comply with one or more of the following programs or standards: ISO 9001, ISO 14001 and OHSAS 18001 .

STANDARD PACKAGE

208 Liter (55 Gallon) Non-Returnable Drum
Net Wt. 205 Kgs (452 Lbs.)
DOT Label Required: Flammable Liquid

STORAGE

This resin contains ingredients which could be harmful if mishandled. Contact with skin and eyes should be avoided and necessary protective equipment and clothing should be worn.

Drums - It is highly recommended that all material is stored at stable temperatures between 15° - 25°C (60° - 77°F). Avoid exposure to heat sources such as direct sunlight or steam pipes. To avoid contamination of product with water, do not store outdoors. Keep sealed to prevent moisture pick-up and monomer loss. Rotate stock.

Bulk - See INEOS Composites's Bulk Storage and Handling Manual for Polyesters and Vinyl Esters. A copy of this may be obtained from INEOS Composites at +1.614.790.3333 or 800.523.6963.

All things being equal, higher storage temperature will reduce product stability.

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

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 INEOS Composites 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.

Since the user's product formulations, specific use applications and conditions of use are beyond the control of INEOS Composites, INEOS Composites makes no warranty or representation regarding the results which may be obtained by the user. It shall be the sole responsibility of the user to determine the suitability of any of the products mentioned for the user's specific application.

INEOS Composites requests that the user reads, understands and complies with the information contained herein and the current Material Safety Data Sheet.

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