

Rhino 1411/4111 Epoxy System for Infusion

DESCRIPTION: Multifunctional epoxy resin (1411) and cycloaliphatic-amine based hardener for producing high performance composite parts. Two curing agents (4111 fast and 4111 slow) provide a complete range of working times from 40 minutes to 240 minutes, and by blending the curing agents, any point in between. Rhino 1411 with 4111 provides for ample pot life with fast cure development at standard molding temperatures. Rhino 1411 provides good thermal resistance, excellent fatigue and inter-laminar shear strength with rapid wetting of fiber reinforcements. Rhino 1411 Epoxy Resin is formulated for highly increased E-glass and carbon fiber compatibility. Low toxicity, low odor system. No VOC's, 100% solids.

SUGGESTED USES: Resin infused composite rotor blades, other large fiberglass reinforced structures, and CIPP applications.

SYSTEM LIQUID PROPERTIES:

Viscosity 1411 Resin, 77°F	1000-1500 cps
Viscosity 4111 Slow Hardener, 77°F	10-30 cps
Viscosity of 4111 Fast Hardener	20-40 cps
Mix Ratio, Resin to Hardener	100:30 by weight
Weight Per Gallon, 1411 Resin	9.5 - 9.6 lbs.
Weight Per Gallon, 4111 Hardener	7.9-8.1 lbs.
Weight per Gallon, Mixed	9.2 lbs
Mixed Viscosity, 77°F	250 - 300 cps
Mixed Viscosity, 100°F	150 - 200 cps

GEL TIME RECIPE TABLE: Rhino 1411 Resin, 100 parts, Rhino 4111 (all), 30 parts:

Gel Time, 150 grams @ 77 °F	Percent of 4111 Slow	Percent of 4111 Fast
240 minutes	100% (30 PHR)	-
165 minutes	80% (24 PHR)	20% (6 PHR)
75 minutes	50% (15PHR)	50% (15 PHR)
40 minutes	-	100% (30 PHR)

RESIN INFUSION BASICS: Condition epoxy resin and hardener to between 24°C and 38°C (75°F to 100°F) to ensure proper mixed viscosity. Introduce mixed material into part to be infused keeping mold temperature between 35°C and 40°C (95°F to 104°F). Place or position injection ports to introduce material as needed to ensure injection within two hours. Under moderate vacuum, inject material (within gel time parameters). Cure at 40°C - 85°C to achieve max HDT. **REINFORCEMENT TYPES:** Rhino 1411 Epoxy Resin is specially formulated for highly increased compatibility with fiber reinforcements, such as Carbon, E-Glass and CIPP Felt(s).

ADVANTAGES OF RHINO 1411 EPOXY RESIN: Rhino 1411 Epoxy Resin is formulated to improve the wet-out and bond between the epoxy resin and fiber reinforcements. This formulation technique results in increased physical properties as follows:

- ◆ Fiber Pull-Out Strength
- ◆ Tensile Strength and Modulus
- ◆ Flexural Strength and Modulus
- ◆ Compressive Strength
- ◆ Impact Resistance
- ◆ Inter-Laminar Shear Strength

Of equal, if not greater significance is the retention of the above properties after exposure to heat, cycle fatigue, water, expected adverse environmental reagents such as salt spray, acid rain, etc. The formulation of Rhino 1411 Epoxy Resin System results in minimal degradation of the cured composite's physical properties as compared to epoxy resin systems not containing the proprietary formulation constituents of Rhino 1411 Epoxy Resin. The benefit to the composite fabricator is obvious and clear: Increased product life and confidence!

CURED PHYSICAL PROPERTIES OF COMPOSITE: A-260 unidirectional E-glass (epoxy compatible rovings) with Rhino 1411 Epoxy Resin and 4111 Epoxy Hardener (70:30 glass to resin ratio). Cure schedule – 2 hrs at 35°C (injection) + 4 hrs at 65°C + 2 hours at 85°C.

Property	Result	Test Method
Tensile Strength	83,000 psi	ASTM D 638
Tensile Modulus	5,250,000 psi	ASTM D 638
90° Tensile Strength	6.05 ksi	ASTM D 3039
In-Plane Shear Strength (4 plies +45°)	9.14 ksi	ASTM D 3518
Flexural Strength	86,000 psi	ASTM D 790
Flexural Modulus	2,490,000 psi	ASTM D 790
Izod Impact	44.5 ft/lb/in	ASTM D 256-A
Water Absorption	0.09%	ASTM D 570
Barcol Hardness	64	Rhino Linings

CURED PHYSICAL PROPERTIES OF NEAT RESIN: Rhino 1411 Epoxy Resin, 100 parts, Rhino 4111 Epoxy Hardener, 30 parts. Cured 2 hrs at 35°C + 4 hrs at 65°C + 2 hrs at 85°C.

Property	Result	Test Method
Tg (DSC)	194°F (90°C)	IPC-TM-650, 2.4.25
Shore D Hardness	90D	Rhino Linings
Tensile Strength	10.30 Ksi	ASTM D 638
Ultimate Elongation	7.4 -7.5%	ASTM D 638
Tensile Modulus	465 Ksi	ASTM D638
Ultimate Compressive Strength	14,500 psi	Sandia Labs Method
Flexural Strength	18.65 Ksi	ASTM D 790
Flexural Modulus	430 Ksi	ASTM D 790

Supplied in Gallons, 5 Gallon Pails, 55 Gallon Drums, and 265 Gal IBC's, and Bulk Tanker (4,000 Gals).

SAFETY PRECAUTIONS:

Health Considerations: Consult the Rhino Linings® Material Safety Data Sheets.

This chemical system requires the use of proper safety equipment and procedures. Please follow the Rhino Linings® product MSDS and Safety Manual for detailed information and handling guidelines.

For Your Protection: The information and recommendations in this publication are, to the best of our knowledge, reliable. Suggestions made concerning the products and their uses, applications, storage and handling are only the opinion of Rhino Lining Corporation. Users should conduct their own tests to determine the suitability of these products for their own particular purposes and of the storage and handling methods herein suggested. The toxicity and risk characteristics of products made by Rhino Lining Corporation will necessarily differ from the toxicity and risk characteristics developed when such products are used with other materials during a manufacturing process. The resulting risk characteristics should be determined and made known to ultimate end-users and processors. Because of numerous factors affecting results, **Rhino Linings Corporation makes no warranty of any kind, express or implied**, other than that the material conforms to its applicable current Standard Specifications. Rhino Lining Corporation hereby disclaims any and all other warranties, including but not limited to those of merchantability or fitness for a particular purpose. No statements made herein may be construed as a representation or warranty. The liability of Rhino Lining Corporation for any claims arising from or sounding in breach of warranty, negligence, strict liability, or otherwise shall be limited to the purchase price of the material.