

Starting Formulation

SF 8007

High Temperature Matrix System for Prepreg or Wet Lay-Up Fabrication EPON™ Resin SU-3 and 828

Introduction This solventless epoxy binder is designed for graphite or glass fiber, and boron filament reinforced composites required to withstand extended service temperatures of 177 °C and time periods up to 1,000 hours at 260°C. The formulation is sufficiently fluid at temperatures of 49 to 82 °C to thoroughly impregnate roving tow, or woven fabrics. Impregnated reinforcements are conveniently B-staged to a tacky, drapable consistency for low pressure molding. The binder is also used for wet winding and wet lay-up fabrication of composites.

- Suggested Uses**
- Propeller and turbine blades
 - Trans- and super-sonic aircraft construction
 - MIL-R-9300; Type II uses

- Features**
- Over 70 percent retention of room temperature strength at 177 °C
 - Low weight loss at 204 °C
 - Tack retention life of pre-preg >3 weeks at room temperature is possible
 - Good interlaminar shear strength

Formula	<u>Material</u>	<u>Supplier</u>	<u>Pounds</u>	<u>Gallons</u>
	EPON Resin SU-3	Hexion	75.0	7.50
	EPON Resin 828	Hexion	25.0	2.59
	AC Methyl Anhydride	Anhydrides & Chemicals, Inc.	88.0	8.55
	2-Ethyl-4-methylimidazole	EMI-24, BASF-Wyandotte Corp.	<u>0.3</u>	<u>0.03</u>
		Total	188.3	18.67

Typical Handling Properties Table 1 / Properties of Cast Matrix System¹

	<u>Units</u>	<u>Value</u>
Viscosity, Brookfield		
at 25 °C	cP	8,500
at 49 °C	cP	950
at 82 °C	cP	400
Pot Life		
at 25 °C	hrs	24
at 49 °C	hrs	12
at 82 °C	hrs	4
Density	lbs/gal	10.1

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Compounding and Impregnation EPON Resin SU-3 resin is usually stored at an elevated temperature (typical viscosity of 3,500 cP at 70 °C) for convenient dispensing and handling. Blend the warm EPON Resin SU-3 with EPON Resin 828 and AC Methyl Anhydride at normal room temperature, then add the EMI-24 accelerator and blend to a uniform consistency with power stirring. Although EMI-24 may exhibit a supercooled liquid state, it is usually a solid at room temperature and must be melted prior to weighing and blending into the binder system.

The wetting bath should be maintained at a temperature of 49 to 82 °C in order to facilitate rapid wetting and impregnation of the fibrous reinforcement. To achieve maximum impregnation, heat the guide rollers, squeeze rollers and the mandrel (for filament winding fabrication).

B-Staging The impregnated fiber can be B-staged to a tacky, drapable consistency by heating for approximately 5 minutes in a forced draft oven or drying tower at 121 °C. Store the prepreg, sandwiched between release film at room temperature or below. The tack retention life of the prepreg should be 3 to 4 weeks at 25 °C and in excess of 6 months at -18 °C.

Typical Cured State Properties Table 1 / Properties of Cast Matrix System¹

	<u>Units</u>	<u>Value</u>
Heat Deflection Temperature	°C	275
Tensile Strength	psi	10,400
Tensile Elongation	%	2.4
Tensile Modulus	ksi	560
Flexural Strength		
at 25 °C	psi	11,700
at 177 °C	psi	7,800
Flexural Modulus		
at 25 °C	ksi	520
at 177 °C	ksi	300
Compressive Strength, Yield	psi	19,500
Weight Loss ²		
1,000 hours at 149 °C	%	Nil
200 hours at 204 °C	%	1.4
400 hours at 204 °C	%	1.7
1,000 hours at 204 °C	%	2.7
200 hours at 260 °C	%	5.3
400 hours at 260 °C	%	10.8
800 hours at 260 °C	%	18.4

¹ These values were determined on castings cured for 2 hours at 121 °C followed by 6 hours at 177 °C and an additional 8 hours at 260 °C.

² Weight loss determined on 1/8-inch by 1/2-inch by 4-inch bars aged in a forced draft oven.

Cure Schedules Table 2 / Curing Conditions

Units Pre-Preg Wet Lay-up Laminates

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PreCure at <15psi¹

Time	hrs	< 1
Platen or Autoclave Temperature	°C	93

Pressure Cure

Initial Conditions

Time	hrs	2	2
Temperature	°C	93	121
Pressure	psi	50 – 100	60

Final Conditions

Time	hrs	6	6
Temperature	°C	177	177
Pressure	psi	50 – 100	60

Post Cure

Time	hrs	8	8
Temperature	°C	260	260

¹ The purpose of this step is to polymerize the binder almost to the gel point under contact vacuum bag pressure in order to prevent excessive squeeze-out when higher pressure is applied and to provide back pressure sufficient to expel any entrapped air. Thickening of the binder may be followed by probing an open end of the lay-up. This pre-cure step is usually shortened or eliminated when lower pressure molding techniques such as vacuum bagging are used.

Composite Properties Table 3 / Properties of Graphite and Glass Composites

<u>Composite Description</u>	<u>Units</u>	<u>Unidirectional Graphite</u>	<u>Bidirectional "E"-Glass</u>
Fiber		Morganite II	"E"-Glass
Form		Tow	181 Style Cloth
Surface Treatment or Finish		Heat Treated	1-550 Finish
Orientation		Unidirectional	Bidirectional
Number of Plies		15	12
Resin Content	% by wt	34	33
Fiber Content	% by vol.	58	50
Void Content	% by vol.	<2	<2
Density	grams/cm ³	1.57	1.89

Composite Properties

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Tensile Strength	psi	138,000	48,000
Flexural Strength			
at 25 °C	psi	190,000	76,000
at 82 °C	psi	192,000	73,000
at 177 °C	psi	132,000	–
at 204 °C	psi	–	39,000
at 260 °C	psi	–	23,000
Flexural Modulus			
at 25 °C	ksi	20400	3400
at 82 °C	ksi	19800	3400
at 177 °C	ksi	14200	–
Flexural Strength			
Tested at 204 °C after:			
0 hours	psi	–	39,000
400 hours	psi	–	41,000
1,000 hours	psi	–	41,000
Tested at 260 °C after:			
0 hours	psi	–	23,000
400 hours	psi	–	24,000
1,000 hours	psi	–	20,000
Interlaminar Shear Strength			
Short Beam, 5:1	psi	10,200	–
Torsional	psi	10,800	–
Torsional Shear Modulus	ksi	600	–

Storage Recommendations regarding storage conditions can be obtained by visiting our web site at www.hexion.com

General Information

These are starting formulations and are not proven in the user's particular application but are simply meant to demonstrate the efficacy of the products and to assist in the development of the user's own formulation. It is the user's responsibility to fully-test and qualify the formulation, along with the ingredients, methods, applications or equipment identified herein ("Information"), by the user's knowledgeable formulator or scientist, and to determine the appropriate use conditions and legal restrictions, prior to use of any Information.

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Please refer to the MSDS for the most current Safety and Handling information.

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