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NCAMP Material Specification

*This specification is generated and maintained in accordance with NCAMP
Standard Operating Procedures, NSP 100*

Medium Temperature, Out-of-Autoclave, Oven-Vacuum-Bag Cure Epoxy Resin
Impregnated Fiber Reinforced Composite Materials, Type 35, Class 4, Grade 293,
Style 7781

Solvay (Formerly Cytec, Umeco Structural Materials (USM-OK), The Advanced
Composites Group (ACG)) MTM45-1 7781

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Scoggins (Solvay)

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REVISIONS:

Rev	By	Date	Pages Revised or Added
N/C	Yeow Ng and John Tomblin		Document DRAFT REVISION
A	Yeow Ng and John Tomblin	9/26/2012	Document Initial Release
B	Vinsensius Tanoto, Royal Lovingfoss	8/28/2018	<ul style="list-style-type: none"> Updated Cover Page. Revised DSC specification limits to 442.4 to 453.2 °F. Revised FC specification limits based on Qualification retest data.
C	Vinsensius Tanoto, Royal Lovingfoss	11/29/2018	<ul style="list-style-type: none"> Revised Flow specification limits to 21.0% to 26.6%. Revised DMA specification limits to 357.8F to 388.4F.
D	Vinsensius Tanoto and Royal Lovingfoss	8/18/2021	<p>All Sections:</p> <ul style="list-style-type: none"> Formatting. <p>Cover Page:</p> <ul style="list-style-type: none"> Clay Scoggins (Solvay) was added as reviewer. <p>Section 3.2.2:</p> <ul style="list-style-type: none"> Revised Fabric Warp Break Strength requirement from 180 lb/in minimum to 150 lbf/in minimum to match supplier's COA. Removed Fabric Fill Break Strength requirement to match supplier's COA. Revised Fabric Yarn Count/Inch, warp x fill requirement from 60 ± 3 x 55 ± 3 to 57 ± 2 x 54 ± 2 to match supplier's COA. <p>Section 3.5.3:</p> <ul style="list-style-type: none"> Table 5, SBS layup was revised from “[0]_{6S}” to “[90]_{6S}”. Table 5 Note 2, “theoretical nominal CPT” was revised to “calculated theoretical nominal CPT”. <p>QUALIFIED PRODUCTS LIST:</p> <ul style="list-style-type: none"> Supplier Product Designation name was revised from “MTM45-1/GF0103-35%RW” to “MTM45-1-35%-EGLASS-8H-293-1270 (Formerly MTM45-1/GF0103-35%RW)”. Supplier Name additional information was added, “Cytec Engineered Materials Inc.” and “(Cytec Engineered Materials Inc. is wholly owned subsidiary of Solvay)”. Production Location was revised from “5350 South 129th East Avenue, Tulsa, OK 74134, USA” to “4300 Jackson Street, Greenville, TX 75402, USA”.

1. SCOPE:

1.1 Form:

This detail specification along with the base material specification NMS 451 establishes the requirements for E glass fiber fabric impregnated with a modified B-staged epoxy resin ("fabric prepreg"). The prepreg is produced using one side coated (one side tacky) hot-melt process.

This detail specification follows the section and table numbering scheme of the base specification. It contains additional or superseding requirements. The base specification shall govern where no additional requirement is specified; in such cases, the applicable sections are omitted from this detail specification.

1.3 Classification: All products qualified to this detail specification have the following classification: Type 35, Class 4, Grade 293, Style 7781.

3. TECHNICAL REQUIREMENTS:

Table 1 – Prepreg Physical and Chemical Properties

Property	Test Method ⁽¹⁾	Number of Replicates	Requirements ⁽³⁾
Resin Content	ASTM D3529	Every roll ⁽²⁾	35±3% ind. 35±2% avg.
Fiber Areal Weight	ASTM D3776 or SACMA SRM 23R-94	Every roll ⁽²⁾	293±20 gsm ind. 293±18 gsm avg.
Volatile Content	ASTM D3530	First and last rolls of every batch ⁽²⁾	1.0% max ind. 0.71% max. avg.
Flow	ASTM D3531	First and last rolls of every batch ⁽²⁾	21.0% to 26.6% avg.
Gel Time	ASTM D3532	Optional	54.5 to 66.4 minutes avg.
Tack	See 4.6.1	First and last rolls of every batch	Level IV
Drape	See 4.6.2	First and last rolls of every batch	Pass
HPLC	SACMA SRM 20R-94	One roll per batch ⁽⁴⁾	P1/P2 = 0.75 to 1.35 P1/P3 = 1.0 to 2.25 P1/P4 = 0.5 to 0.95
IR	ASTM E168 ASTM E1252	One roll per batch ⁽⁴⁾	A798/A1481 = 0.9 to 1.15
Differential Scanning Calorimetry (DSC) exotherm peak temperature	SACMA SRM 25R-94	Every resin batch	442.4 to 453.2 °F

- (1) Specific procedures should be identical to those used in the original material qualification program.
- (2) Three specimens should be taken across the width of the prepreg; left, center, right.
- (3) "ind." refers to individual measurements. "avg" refers to the average measurements per roll.
- (4) Optional to perform either HPLC or IR.

3.2 Constituent Material Requirements:

3.2.2 Reinforcement: Specific glass fiber yarn producer and production location is controlled by the prepreg process control document (PCD) and NRP 101. The fabric shall meet the requirements in the table below. In addition, the fabric weaver and weaving location is controlled through prepreg PCD and NRP 101. This product does not contain tracer yarn. Tracer yarn may be included only if it is specifically requested by the purchaser. The inclusion of tracer yarn might alter the material properties.

Property	Requirement
Specification	AMS-C-9084, Class 2, Type VIIIB (BGF Industries, Inc., E-Glass, 497A finish)
Fabric Warp Break Strength	150 lbf/in minimum
Fabric Thickness	0.010 ± 0.002 inches
Fabric Yarn Count/Inch, warp x fill	57 ± 2 x 54 ± 2
Fabric Areal Weight	293 ± 18 g/m ²

3.4 Visual and Dimensional Requirements:

3.4.4 Roll characteristics - The standard width for this product is 50 inches. Other widths may be supplied only if it is specifically requested by the purchaser.

3.5 Laminate (Cured Prepreg) Requirements:

3.5.2 Cured Laminate Physical Properties:

TABLE 3 - Cured Laminate Physical Properties

Property	Test Method ⁽¹⁾	Requirements ⁽²⁾
Cured Ply Thickness ⁽³⁾	SACMA SRM 10R-94	0.00930 to 0.0105 inch avg.
Dry Glass Transition Temperature, Tg by DMA	SACMA SRM 18R-94	357.8 to 388.4°F ind.

- (1) Specific procedures should be identical to those used in the original material qualification program.
- (2) "ind." refers to individual measurements. "avg" refers to the average measurements per panel.
- (3) Computed from actual qualification panel thicknesses and theoretical nominal CPT. Limits computed at α=0.01 and modified CV.

3.5.3 Cured Laminate Mechanical Properties:

TABLE 5 - Required Cured Laminate Tests for Mechanical Properties (Class 4)

Property	Test Method ⁽¹⁾	Requirements ⁽³⁾
0° (warp) Tension Strength and Modulus, Room Temperature Dry Layup ⁽⁶⁾ : [0] _{6S}	ASTM D3039	Strength ⁽²⁾ : Min. Ind. ≥ 55.40 ksi Strength ⁽²⁾ : Average ≥ 63.41 ksi Modulus ⁽²⁾ : 3.30 to 3.92 msi avg.
90° (fill) Compression Strength and Modulus, Room Temperature Dry Layup ⁽⁶⁾ : [90] _{6S}	ASTM D6641	Strength ⁽²⁾⁽⁵⁾ : Min. Ind. ≥ 54.44 ksi Strength ⁽²⁾⁽⁵⁾ : Average ≥ 64.33 ksi Modulus ⁽²⁾⁽⁴⁾⁽⁵⁾ : 3.15 to 3.75 msi avg.
90° (fill) Short Beam Strength, Room Temperature Dry Layup ⁽⁶⁾ : [90] _{6S}	ASTM D2344	Strength: Min. Ind. ≥ 8.518 ksi Strength: Average ≥ 9.727 ksi

⁽¹⁾ Specific procedures should be identical to those used in the original material qualification program.

⁽²⁾ Normalize the properties to a nominal cured ply thickness (CPT) value of 0.0100 inch based on calculated theoretical nominal CPT, using the following equation:
Normalized_Value = Measured_Value x Measured_CPT / Nominal_CPT

⁽³⁾ "ind." refers to individual measurements. "avg." refers to the average of 5 replicates. Limits computed at α=0.01 and modified CV.

⁽⁴⁾ Permissible to use a minimum of one specimen with strain gage.

⁽⁵⁾ Computed based on Qualification re-test data.

⁽⁶⁾ This material is 8HS reinforced with resin impregnation on the fill face only. It is recommended for potential users to use the same layup configuration as the Qualification which is Warp-Face-In (WFI), dry to dry mid-plane. Warp face is the dry side of the prepreg.

QUALIFIED PRODUCTS LIST

Supplier Product Designation	Supplier Name and Production Location	Date Qualified	Specification Callout ⁽¹⁾
MTM45-1-35%-EGLASS-8H-293-1270 (Formerly MTM45-1/GF0103-35%RW)	Supplier Name: Cytec Engineered Materials Inc. <i>(Cytec Engineered Materials Inc. is wholly owned subsidiary of Solvay)</i> Production Location: 4300 Jackson Street Greenville, TX 75402 USA Cage Code: 0LHZ4	9/27/2012	NMS 451/4 Classification callout is optional because Type 35, Class 4, Grade 293, Style 7781 is the only classification allowed in this QPL.

- (1) In accordance with NCAMP Standard Operating Procedures, NSP 100, this QPL shall not contain alternate materials/products. Additional production location may be included in the QPL only after successful equivalency demonstration and approval per NCAMP Prepreg Process Control Document (PCD) Preparation and Maintenance Guide, NRP 101.
- (1) The proper specification callout for material procurement purpose is “NMS 451/4.” This specification was developed based on the material properties that are available publicly. The purchaser may specify additional requirements beyond those specified in this specification, especially when the purchaser has generated additional material properties beyond those available publicly or when the application requires additional requirements. The additional requirements are subject to supplier review and approval.