Document No.: NMS 451/14, Revision A, August 15, 2018

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 32, Class 1, Grade 145

Solvay (Formerly Cytec, Umeco Structural Materials (USM-OK), The Advanced Composites Group (ACG)) MTM 45-1 HTS40 F13 Tape

Prepared by: Michelle Man, Vinsensius Tanoto, Yeow Ng, John Tomblin

Reviewed by: Dusty Penn (Cytec), Royal Lovingfoss (NCAMP), Chris Ridgard (Cytec)

National Center for Advanced Materials Performance
Wichita State University – NIAR
1845 Fairmount Ave., Wichita, KS 67260-0093, USA

REVISIONS:

Rev	By	Date	Pages Revised or Added
N/C	Yeow Ng and John Tomblin	3/24/2016	Document Initial Release.
A	Vinsensius Tanoto, Royal Lovingfoss	8/15/2018	• Added Revisions Table on page 2. • Revised DSC to 442.4 to 453.2 ºF.

1. SCOPE:

1.1 Form:

This detail specification along with the base specification NMS 451 establishes the requirements for continuous unidirectional carbon fiber impregnated with a modified B-staged epoxy resin ("unidirectional tape prepreg"). The prepreg is produced using a 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 32, Class 1, Grade 145

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)	32±3% ind. 32±2% avg.
Fiber Areal Weight	SACMA SRM 23R-94	Every roll(2)	145±7 gsm ind. 145±5 gsm avg.
Volatile Content	ASTM D3530	First and last rolls of every batch(2)	2.0% max ind. 0.8% max avg.
Flow	ASTM D3531	First and last rolls of every batch(2)	10 to 13% avg.
Gel Time	ASTM D3532	Optional	60±5 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 (neat resin sample)	442.4 to 453.2 ºF

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

3.2 Constituent Material Requirements:

3.2.2 Reinforcement: The carbon fiber tow shall be qualified to NCAMP carbon fiber material specification NMS 818/11. The fabric weaving 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.

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 of Laminates in Table 4(3)	SACMA SRM 10R-94	Between 0.0052 and 0.0059 inch, avg.
Dry Glass Transition Temperature, Tg by DMA	SACMA SRM 18R-94	Between 339.5 and 401.7 ºF 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 4 - Required Cured Laminate Tests for Mechanical Properties (Class 1)

Property	Test Method[1]	Requirements[3]
0/90° Tension Strength and Modulus, Room Temperature Dry Layup: $[0/90]_{4S}$	ASTM D3039	Strength[2]: Min. Ind. $\geq$ 134.9 ksi Strength[2]: Average $\geq$ 154.0 ksi Modulus[2]: Between 9.25 and 10.97 msi avg.
90/0° Compression Strength, Room Temperature Dry Layup: $[90/0]_{4S}$	ASTM D6641	Strength[2]: Min. Ind. $\geq$ 80.68 ksi Strength[2]: Average $\geq$ 97.55 ksi
0° Short Beam Strength, Room Temperature Dry Layup: $[0]_{16}$	ASTM D2344	Strength: Min. Ind. $\geq$ 11.85 ksi Strength: Average $\geq$ 13.53 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 0.0055" based on 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.

QUALIFIED PRODUCTS LIST

Supplier Product Designation	Supplier Name and Production Location	Date Qualified	Specification Callout(1)
MTM45-1/HTS(12K)-145-32%RW	Supplier Name: Solvay (Formerly Umeco Structural Materials) Production Location: 5350 South 129th East Avenue, Tulsa, OK 74134 USA	March 24, 2016	NMS 451/14 Classification callout is optional because Type 32, Class 1, Grade 145 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 451/14.” 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.