



Document No.: NMS 451/14, Revision B, November 18, 2024

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), Clay Scoggins (Syensqo)

The specification is intended for general distribution to the public, either freely or at a price that does not exceed the cost of reproduction (e.g. printing) and distribution (e.g. postage).

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.
А	Vinsensius Tanoto, Royal Lovingfoss	8/15/2018	 Added Revisions Table on page 2. Revised DSC to 442.4 to 453.2 °F.
В	Vinsensius Tanoto, Royal Lovingfoss	11/18/2024	 All Sections: Formatting. Cover Page: Clay Scoggins (Syensqo) was added as reviewer. Section 3: Table 1, Flow specification limits was revised from "10 to 13%" to "8 to 17%" Section 3.2.2: "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." was removed. Section 3.4.4: Standard width was revised to 24", 50" was a typo. Tulsa, OK produced the material to 12" wide. QUALIFIED PRODUCTS LIST: Supplier Product Designation name was revised from "Formerly MTM45-1/HTS(12K)-145-32%RW" to "MTM45-1-32%-12KHTS40-145-610 (Formerly MTM45-1/HTS(12K)-145-32%RW)". Supplier Name additional information was added, "Cytec Engineered Materials Inc." and "(<i>Cytec Engineered Materials Inc.</i>" and "(<i>Cytec Engineered Materials Inc.</i>" street, Greenville, TX 75402, USA".

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⁾	8 to 17% 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 °F		

- ⁽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.

3.4 Visual and Dimensional Requirements:

3.4.4 Roll characteristics - The standard width for this product is 24 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 - Cureu Laminale Physical Properties			
Property	Test Method ⁽¹⁾	Requirements ⁽²⁾	
Cured Ply Thickness of Laminates in Table 4 ⁽³⁾	SACMA SRM 10R-94	0.0052 and 0.0059 inch, avg.	
Dry Glass Transition Temperature, Tg by DMA	SACMA SRM 18R-94	339.5 and 401.7 °F ind.	
(1) Specific procedures should be identical to these used in the original material			

TABLE 3 - Cured Laminate Physical Properties

⁽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 Prope	ties (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⁾ : 9.25 and 10.97 msi avg.	
90/0° Compression Strength, Room Temperature Dry Layup: [90/0] _{4S}	ASTM D6641	Strength ⁽²⁾ : Min. Ind. \ge 80.68 ksi Strength ⁽²⁾ : Average \ge 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 inch 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.

Supplier Product Designation	Supplier Name and Production Location	Date Qualified	Specification Callout ⁽¹⁾
MTM45-1-32%-12KHTS40-145-610	Supplier Name:	March 24, 2016	NMS 451/14
(Formerly MTM45-1/HTS(12K)-145-32%RW)	Materials Inc.		Classification callout is optional because Type 32, Class 1, Grade 145 is the only classification allowed in this QPL.
	(Cytec Engineered Materials Inc. is wholly owned subsidiary of Solvay)		
	Production Location: 4300 Jackson Street Greenville, TX 75402 USA		
	Cage Code: 0LHZ4		

QUALIFIED PRODUCTS LIST

- ⁽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.