



Document No.: NMS 323/3

NCAMP Material Specification

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

Low Initial Temperature Vacuum-Bag-Only Cure, Modified Epoxy Prepregs, Type
38, Class 2, Grade 193, Style 3k-70-PW
(Cytac Cycom 5215 T650 3k-70-PW)

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1. SCOPE:

1.1 Form:

This detail specification along with the base material specification NMS 323 establishes the requirements for carbon fiber fabric impregnated with a modified B-staged epoxy resin (“fabric 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 38, Class 2, Grade 193, Style 3k-70-PW

3. TECHNICAL REQUIREMENTS:

Table 1 – Prepreg Physical and Chemical Properties

Property	Test Method ⁽¹⁾	Number of Replicates	Requirements ⁽³⁾
Resin Content	ASTM D 3529	Every roll ⁽²⁾	38±3%, ind 38±2%, avg
Fiber Areal Weight	ASTM D 3776 or SACMA SRM 23R-94	Every roll ⁽²⁾	193±9 gsm, ind 193±8 gsm, avg
Volatile Content	ASTM D 3530	First and last rolls of every batch ⁽²⁾	0.53% max, avg
Flow	ASTM D 3531	First and last rolls of every batch ⁽²⁾	16.6 to 20.8%, avg
Gel Time	ASTM D 3532	Optional ⁽²⁾	8.9 to 15.5 minutes, ind
Tack	See 4.6.1	First and last rolls of every batch	Level IV, ind
Drape	See 4.6.2	First and last rolls of every batch	Pass, ind
HPLC	SACMA SRM 20R-94	First and last rolls of a batch	Specification limits are included in PCD and certificate of conformity
IR	ASTM E 168 ASTM E 1252	Optional	Specification limits are included in PCD and certificate of conformity
Differential Scanning Calorimetry (DSC) exotherm peak temperature total heat of reaction	SACMA SRM 25R-94	Optional	Report only

- (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. Limits computed at $\alpha=0.01$ and modified CV.

3.2 Constituent Material Requirements:

3.2.2 Reinforcement: The carbon fiber tow and fabric products manufacturer shall establish control factors which will yield product meeting the technical requirements of this prepreg specification. The factors which are used in the production of fiber tow and fabric used in the prepreg material qualification shall constitute the approved factors; they shall be used for manufacturing production carbon fiber tow and fabric products. Control factors are Controlled Process Equipment and Controlled Process Parameters for producing the product. Control factors include, but are not limited to, the following:

- a) PAN Precursor formulation (raw ingredients and ratios),
- b) PAN Precursor manufacturing process, equipment, line, or site,
- c) PAN Precursor acceptance requirements,
- d) Carbon fiber tow processing parameters (e.g. temperature and speed),
- e) Carbon fiber tow manufacturing equipment, line, or site,
- f) Carbon fiber tow acceptance requirements,
- g) Carbon fiber tow acceptance test methods,
- h) Carbon fiber tow acceptance sampling plan,
- i) Carbon fiber tow surface treatment methods and levels,
- j) Carbon fiber tow sizing formulation and sizing level, and
- k) Carbon fiber tow sizing application and drying methods, including equipment.
- l) Carbon fiber fabric processing parameters (e.g. speed),
- m) Carbon fiber fabric manufacturing equipment type
- n) Carbon fabric acceptance requirements
- o) Carbon fabric acceptance test methods
- p) Carbon fabric acceptance sampling plan

If it is necessary to make any change in the above control factors, the carbon fiber tow or fabric product manufacturer shall submit for re-approval to NCAMP through the prepreg manufacturer in accordance with NRP 101 Prepreg Process Control Document (PCD) Preparation and Maintenance Guide. NRP 102 Polyacrylonitrile-based Carbon Fiber Process Control Document (PCD) Preparation and Maintenance Guide may be used as a reference. The change shall not be incorporated prior to the receipt of re-approval notice, typically in the form of a signed Advanced Change Notice (ACN).

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⁾	ASTM D 3171	Between 0.00764 and 0.00851 inch, avg
Dry Glass Transition Temperature, T _g by DMA ⁽⁴⁾	SACMA SRM 18R-94	Between 312.8 °F and 348.8 °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. Limits computed at $\alpha=0.01$ and modified CV.

⁽⁴⁾ Limits computed from average qualification data ± 18 °F.

3.5.3 Cured Laminate Mechanical Properties:

TABLE 5 - Required Cured Laminate Tests for Mechanical Properties (Class 2)

Property	Test Method ⁽¹⁾	Requirements ⁽³⁾
0° (warp) Tension Strength and Modulus, Room Temperature Dry Layup: [0] ₁₅	ASTM D3039	Strength ⁽²⁾ : Min. Ind. ≥ 97.49 ksi Strength ⁽²⁾ : Average ≥ 111.3 ksi Modulus ⁽²⁾ : Between 8.34 and 9.86 Msi, avg
90° (fill) Compression Strength and Modulus, Room Temperature Dry Layup: [90] ₁₅	ASTM D6641	Strength ⁽²⁾ : Min. Ind. ≥ 76.24 ksi Strength ⁽²⁾ : Average ≥ 87.89 ksi Modulus ⁽²⁾ ⁽⁴⁾ : Between 7.52 and 8.92 Msi, avg
0° (warp) Short Beam Strength, Room Temperature Dry Layup: [0] ₃₂	ASTM D2344	Strength: Min. Ind. ≥ 8.12 ksi Strength: Average ≥ 9.27 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 0.0081", based on actual qualification panel thicknesses. 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 $\alpha=0.01$ and modified CV.

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

QUALIFIED PRODUCTS LIST

Supplier Product Designation	Supplier Name and Production Location	Date Qualified	Specification Callout ⁽¹⁾
Cytec Cycom 5215 T650 3k-70-PW	Supplier Name: Cytec Engineered Materials Inc. Production Location: 1440 North Kraemer Boulevard Anaheim, CA 92806-1404		NMS 323/3 Classification callout is optional because Type 38, Class 2, Grade 193, Style 3k-70-PW 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 323/3." 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.