Document No.: NMS 122/3 Revision A, August 1, 2025

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

# Medium Toughness Polyaryletherketone (PAEK) Thermoplastic Toray Advanced Composites Cetex® TC1225 Low Melt (LM) Polyaryletherketone (PAEK) T300JB 3K 5HS 277 gsm 42% RC

Prepared by: Vinsensius Tanoto (NCAMP)

Reviewed by: Erwin Veldman (Toray Advanced Composites), Royal Lovingfoss (NCAMP)

**Distribution Statement A.** Approved for public release; distribution is unlimited.

REVISIONS:

| Rev | By | Date | Pages Revised or Added |
|---|---|---|---|
| - | Vinsensius Tanoto | 9/11/2023 | Document Initial Release |
| A | Vinsensius Tanoto | 8/1/2025 | Cover page: FAW was updated from 280 gsm to 277 gsm.<br>Section 1.3: FAW was updated from 280 gsm to 277 gsm.<br>Section 3: Table 1 was revised. A note was added, RC and FAW are not required for receiving inspection. "2nd Cycle" was added for DSC. Hot Crystallization was removed. Specification limits were added. FAW nominal was updated from 280 gsm to 277 gsm. DSC note was updated, it was computed using material supplier historical data.<br>Section 3.5.2: Table 2 was revised. Void Content was removed. "1st Cycle" was added for DSC. A note for D3171 method 2 was added. Specification limits were added. Resin density was revised from 1.280g/cc to 1.293 g/cc. DSC note was updated, it was computed using material supplier historical data.<br>Section 3.5.3: Table 3 was revised. Flex was replaced with D3518 IPS. Specification limits were added.<br>QPL: Semipreg code was revised from 485 to 479 due to FAW nominal update, no change on the material. Grade was revised from 280 to 277. |
| | | | |
| | | | |
| | | | |
| | | | |

## 1. SCOPE:

### 1.1 Form:

This detail specification along with the base specification NMS 122 establishes the requirements for carbon fiber impregnated with a Polyaryletherketone (PAEK) thermoplastic resin.

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 42, Class 2, Grade 277, Style 3K-5HS

**2.7 Toray Publications**:

PCD-R6071 Toray Advanced Composites Process Control Document NMS 122/3

## 3. TECHNICAL REQUIREMENTS:

Table 1 – Prepreg Physical and Chemical Properties (Class 2)

| Property | Test Method(1) | Number of Replicates | Requirements(4) |
|---|---|---|---|
| Resin (Polymer) Content(6) | NMS 122 | Each Batch(2) | 42±3% ind.<br>42±3% avg. |
| Fiber Areal Weight(6) | NMS 122 | Each Batch(2) | 277±7 gsm ind.<br>277±5 gsm avg. |
| Differential Scanning Calorimetry (DSC) – 2nd Cycle<br>Melt Temp. (Peak) | ASTM D3418 or SACMA SRM 25R-94 | Each Batch(3) | 577 to 593 ºF, avg.(5) |

(1) Specific procedures should be identical to those used in the original material qualification program.
(2) Three specimens minimum should be taken across the width of the prepreg batch.
(3) Three specimens minimum should be taken for each prepreg batch.
(4) “ind.” refers to individual measurements. “avg.” refers to the average measurements per roll.
(5) Limits computed using material supplier historical data.
(6) Not required for receiving inspection.

### 3.2 Constituent Material Requirements:

3.2.2 Reinforcement: Efforts to qualify the carbon fiber to NCAMP carbon fiber material specification, NMS 818, are ongoing. In the meantime, Toray will continue to provide aerospace-grade carbon fiber for this prepreg per the prepregger’s carbon fiber

procurement specification and Toray's internal aerospace-grade PCD. In addition, the following change control is implemented on the carbon fiber:

The carbon fiber tow product manufacturer shall establish control factors which will yield product meeting the technical requirements of this specification. The factors which are used in the production of fiber tow used in the prepreg material qualification shall constitute the approved factors; they shall be used for manufacturing production carbon fiber tow product. 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.

If it is necessary to make any change in the above control factors, the carbon fiber tow 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).

## 3.4 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 Consolidated Laminate Requirements:

### 3.5.2 Consolidated Laminate Physical Properties:

TABLE 2 – Consolidated Laminate Physical Properties (Class 2)

| Property | Test Method(1) | Requirements(2) |
|---|---|---|
| Consolidated Ply Thickness(3) | ASTM D3171 | 0.0115 to 0.0129 inch, avg. |
| Laminate Density(4) | ASTM D792 | 1.52 to 1.54 g/cc, avg. |
| Fiber Volume, by Volume(4)(6) | ASTM D3171 Method II | 47.00 to 55.25 %, avg. |
| Resin Content, by Weight(4)(6) | ASTM D3171 Method II | 36.04 to 45.53 %, avg. |
| Differential Scanning Calorimetry (DSC) – 1st Cycle (4) | ASTM D3418 or SACMA SRM 25R-94 | |
| Melt Temp. (Peak) | | 578.0 to 594.0 ºF, avg. |
| Cold Crystallization Temp. (Peak) | | none(5) |
| Hot Crystallization Temp. (Peak) | | 487.0 to 503.0 ºF, avg. |

(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. Required only on one of the panels listed in Table 3.
(3) Consolidated Ply Thickness of the Laminates in Table 4. Computed from actual qualification panel thicknesses using α=0.01 and modified CV, and theoretical Consolidated Ply Thickness is set as the nominal.
(4) Limits computed using material supplier historical data.
(5) Cold Crystallization should not be observed.
(6) Fiber Density Nominal: 1.77 g/cc and Resin Density Nominal: 1.293 g/cc. Method 1 via acid digestion is not suitable for this material.

3.5.3 Consolidated Laminate Mechanical Properties:

TABLE 3 - Consolidated Laminate Mechanical Properties (Class 2)

| Property | Test Method(1) | Requirements(3) |
|---|---|---|
| 90° Fill Tension Strength and Modulus<br>Room Temperature, Ambient<br>Layup: $[90]_{4S}$ | ASTM D3039 | Strength(2): Min. Ind. ≥ 87.7 ksi<br>Strength(2): Average ≥ 101.5 ksi<br>Modulus(2)(4): 7.76 to 9.22 msi, avg. |
| 90° Fill Compression Strength and Modulus<br>Room Temperature, Ambient<br>Layup: $[90]_{4S}$ | ASTM D6641 | Strength(2): Min. Ind. ≥ 69.1 ksi<br>Strength(2): Average ≥ 80.9 ksi<br>Modulus(2)(4): 7.32 to 8.69 msi, avg. |
| In-Plane Shear 0.2% Offset Strength, 5% Strength and Modulus<br>Room Temperature, Ambient<br>Layup(6): $[+45]_{4S}$ | ASTM D3518 | 0.2% Offset Strength: Min. Ind. ≥ 4.6 ksi<br>0.2% Offset Strength: Average ≥ 5.3 ksi<br>5% Strength: Min. Ind. ≥ 8.1 ksi<br>5% Strength: Average ≥ 9.2 ksi<br>Modulus(5): 0.50 to 0.60 msi, avg. |

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

(2) Normalize the properties to a consolidated ply thickness value of 0.0122 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. Limits computed using Qualification data at α=0.01 and modified CV.

(4) Strain range: 1000-3000 microstrain.

(5) Strain range: 2000-6000 microstrain.

(6) Panels may be built with [0]4s layup and specimens are cut in 45°.

QUALIFIED PRODUCTS LIST

| Supplier Product Designation | Supplier Name and Production Location | Date Qualified | Specification Callout(1) |
|---|---|---|---|
| Toray Advanced Composites Cetex® TC1225 Low Melt (LM) Polyaryletherketone (PAEK) T300JB 3K 5HS<br><br>Semipreg Code:<br>R6071 - CW 0286 127 42 479 Cetex TC1225 | Supplier Name: Toray Advanced Composites<br><br>Production Location:<br>G. v.d. Muelenweg<br>7443 RE Nijverdal<br>Netherlands | 8/1/2025 | NMS 122/3<br><br>Classification callout is optional because Type 42, Class 2, Grade 277, Style 3K-5HS 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 122/3.” This specification is 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.