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

# Autoclave Cure, High Toughness and High Open-Hole Compression Epoxy Prepregs, Type 33, Class 1, Grade 190 (Cytec Cycom EP 2202 IM7G Tape)

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## 1. SCOPE:

### 1.1 Form:

This detail specification along with the base specification NMS 220 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 33, Class 1, Grade 190

## 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) | 33±3% ind<br>33±2% avg |
| Fiber Areal Weight | SACMA SRM 23R-94 | Every roll(2) | 190±7 gsm ind<br>190±5 gsm avg |
| Volatile Content | ASTM D3530 | First and last rolls of every batch(2) | 2% max, avg. |
| Flow | ASTM D3531 | First and last rolls of every batch(2) | 5 to 15% |
| Gel Time | ASTM D3532 | First and last rolls of every batch | 2 to 28(4) |
| 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 | First and last rolls of a batch | See QPL |
| FTIR | ASTM E168<br>ASTM E1252 | One roll per batch | See QPL |
| Differential Scanning Calorimetry (DSC) exotherm peak temperature total heat of reaction, onset temperature, and SubTg | ASTM D3418 | First and last rolls of every batch | See QPL |

(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 α=0.01 and modified CV.
(4) Temporary requirement due to high CV of test results, this is being investigated and final requirement will be processed through ACN.

## 3.2 Constituent Material Requirements:

3.2.2 Reinforcement: The carbon fiber tow shall be qualified to Solvay IM7G-12k-NT PU-P74-06 procurement specification, PRS 87108013 (line 6, 7, 11 only) carbon fiber material specification.

## 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 D3171 | Between 0.0068 and 0.0076 inch, avg. |
| Cured Ply Thickness(4) | ASTM D3171 | Between 0.0067 and 0.0077 inch, avg. |
| Dry Glass Transition Temperature, Tg by DMA(5) | by flexural loading per ASTM D7028 | Between 345 and 385 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. Limits computed at α=0.01 and modified CV.
(4) Theoretical CPT ± 0.0005 inch.
(5) Limits computed from average qualification data ± 18 ºF.

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° Tension Strength and Modulus, Room Temperature, Ambient Layup: $[0]_6$ | ASTM D3039 | Strength[2]: Min. Ind. $\geq$ 295 ksi<br>Strength[2]: Average $\geq$ 377 ksi<br>Modulus[2]: Between 20.7 and 24.5 msi, avg. |
| 90/0° Compression Strength, Room Temperature, Ambient Layup: $[90/0/90]_5$ | ASTM D6641 | Strength[2]: Min. Ind. $\geq$ 72 ksi<br>Strength[2]: Average $\geq$ 84 ksi<br>Modulus[2]: Between 7.1 and 8.4 msi, avg. |
| 0° Short Beam Strength, Room Temperature, Ambient Layup: $[0]_{34}$ | ASTM D2344 | Strength: Min. Ind. $\geq$ 13 ksi<br>Strength: Average $\geq$ 15 ksi |
| Compression After Impact[4] (1500 in-lb/in) $[45/0/-45/90]_{4S}$ | ASTM D7136 & D7137 | Strength: Min. Ind. ≥ 40 ksi<br>Strength: Average ≥ 47 ksi |

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

[2] Normalize the properties to a cured ply thickness value of 0.0072”, based on actual qualification panel thicknesses.

[3] “ind” refers to individual measurements. “avg” refers to the average of 5 replicates. Limits computed at α=0.01 and modified CV.

[4] Required for material supplier only; required on the first five production batches and then once annually.

QUALIFIED PRODUCTS LIST

| Supplier Product Designation | Supplier Name and Production Location | Date Qualified | Specification Callout(1) |
|---|---|---|---|
| Cytec Cycom EP 2202 IM7G Tape | Supplier Name: Solvay Composite GBU (Formerly Cytec Engineered Materials Inc.)<br><br>Production Location:<br>1440 North Kraemer Boulevard<br>Anaheim, CA 92806-1404 | 8/23/2017 | NMS 220/1<br><br>Classification callout is optional because Type 33, Class 1, Grade 190 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 220/1.” 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.