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NCAMP Material Specification

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

Autoclave Cure, Prepreg, Type 38, Class 2, Grade 286, Style 8HS

Renegade RM-2014-LDk-Tk Low Dielectric Epoxy Prepreg 4581 8HS Quartz
Fabric

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REVISIONS:

Rev	By	Date	Pages Revised or Added
N/C	Errick Robles, Vinsensius Tanoto, Tom Sutter and Kyle Kershner	07/23/2024	Document Initial Release
A	Vinsensius Tanoto	8/7/2024	Section 3: Table 1, revised FAW test method to align with NMS 201.
B	Vinsensius Tanoto	10/8/2025	Production location was added in QPL.

1. SCOPE:

1.1 Form:

This detail specification along with the base material specification NMS 201 establishes the requirements for quartz yarns fabric impregnated with a modified 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 286, Style 8HS

3. TECHNICAL REQUIREMENTS:

Table 1 – Prepreg Physical and Chemical Properties

Property	Test Method ⁽¹⁾	Number of Replicates	Requirements ⁽³⁾
Resin Content	ASTM D3529-16	Every roll ⁽²⁾	38 ± 4% ind. 38 ± 3% avg.
Fiber Areal Weight	ASTM D3529-16	Every roll ⁽²⁾	286 ± 15 gsm avg
Volatile Content	ASTM D3530-97 (2015)	First and last rolls of every batch ⁽²⁾	1.0% max avg.
Flow ⁽⁴⁾	ASTM D3531-16	First and last rolls of every batch ⁽²⁾	17 to 27 wt %
Gel Time ⁽⁴⁾	ASTM D3532-12	First and last rolls of every batch ⁽²⁾	8 to 17 mins
Tack	See 4.6.1	First and last rolls of every batch	Pass
Drape	See 4.6.2	First and last rolls of every batch	Pass
HPLC	ASTM E682	First and last rolls of a batch	per PCD
IR	ASTM E168-16 ASTM E682-92 ASTM E1252-98 (2013)	First and last rolls of a batch	per PCD

Differential Scanning Calorimetry (DSC) exotherm peak temperature	ISO 11357-1	First and last rolls of every batch	137 to 145 °C
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- (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 mother roll; left, center, right
- (3) "ind." refers to individual measurements. "avg." refers to the average of measurements per roll.
- (4) Limits computed at $\alpha=0.01$ with ModCV.

3.2 Constituent Material Requirements:

- 3.2.2 Reinforcement: Yarns shall be qualified to AMS3846D §3.1.2 quartz. In addition, the following change control is implemented on the quartz yarns:

The quartz yarns 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 yarn shall constitute the approved factors; they shall be used for manufacturing production quartz yarns 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) Quartz yarns processing parameters (e.g. temperature and speed),
- b) Quartz yarns manufacturing equipment, line, or site,
- c) Quartz yarns acceptance requirements,
- d) Quartz yarns acceptance test methods,
- e) Quartz yarns acceptance sampling plan,
- f) Quartz yarns surface treatment methods and levels,
- g) Quartz yarns
- h) Quartz yarns finish application and drying methods.

If it is necessary to make any change in the above control factors, the quartz yarns tow product manufacturer shall submit for re-approval to Renegade in accordance with NRP 101 Prepreg Process Control Document (PCD) Preparation and Maintenance Guide.

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 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, CPT ⁽³⁾⁽⁶⁾	ASTM D3171-15	0.0106 to 0.0118 inch, avg.
Dry Glass Transition Temperature, T _g by DMA ⁽⁴⁾⁽⁵⁾	Single Cantilever per ASTM D7028-07 (2015) ⁽¹⁾	300 to 336 °F, ind.
	3-point bend per ASTM D7028-07 (2015) ⁽¹⁾	276 to 312 °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⁾ Cured Ply Thickness of the Laminates in Table 4. Computed from actual qualification panel thicknesses using $\alpha=0.01$ and modified CV, and theoretical Cured Ply Thickness as the nominal.

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

⁽⁵⁾ Either the single cantilever beam or the 3-point bend methods could be used from this standard.

⁽⁶⁾ Drying at 160°F $\pm$ 5°F for 120 hours minimum prior to testing may be required if specimens are likely to have moisture.

3.5.3 Cured Laminate Mechanical Properties:

TABLE 4 - Required Cured Laminate Tests for Mechanical Properties (Class 2)

Property ⁽⁴⁾	Test Method ⁽¹⁾	Requirements ⁽³⁾
0° (warp) Tension Strength and Modulus Room Temperature, Ambient Layup: [0] ₁₀	ASTM D3039-17	Strength ⁽²⁾ : Min. Ind. $\geq$ 88.2 ksi Strength ⁽²⁾ : Average $\geq$ 100.7 ksi Modulus ⁽²⁾ : 3.00 to 3.56 msi, avg
90° (fill) Compression Strength and Modulus Room Temperature, Ambient Layup: [90] ₁₀	ASTM D6641-22	Strength ⁽²⁾ : Min. Ind. $\geq$ 47.6 ksi Strength ⁽²⁾ : Average $\geq$ 54.3 ksi Modulus ⁽²⁾ : 3.00 to 3.63 msi, avg
0° (warp) Short Beam Strength Room Temperature, Ambient Layup: [0] ₂₀	ASTM D2344-16	Strength: Min. Ind. $\geq$ 7.0 ksi Strength: Average $\geq$ 8.0 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 0.0112 inch, based on theoretical nominal CPT, using the following equation:

$$\text{Normalized_Value} = \text{Measured_Value} \times \text{Measured_CPT} / \text{Nominal_CPT}$$

⁽³⁾ “ind.” refers to individual measurements. “avg.” refers to the average of 5 replicates. Limits computed at $\alpha=0.01$ and modified CV.

⁽⁴⁾ Drying at 160°F±5°F for 120 hours minimum prior to testing may be required if specimens are likely to have moisture.

QUALIFIED PRODUCTS LIST

Supplier Product Designation	Supplier Name and Production Location	Date Qualified	Specification Callout ⁽¹⁾
Renegade RM-2014-LDk-Tk-4581-Z6040-50	Supplier Name: Renegade Materials Corporation Business Location: 3363 South Tech Boulevard Miamisburg, OH 45342 Production Location: 10800 Industry Lane Miamisburg, OH 45342	8/7/2024	NMS 201/1 Classification callout is optional because Type 38, Class 2, Grade 286, Style 8HS 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 201/1." 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.