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NCAMP Material Specification

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

Autoclave Cure, Low Dielectric Epoxy Prepreg (Renegade RM-2014-LDk-Tk)

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1. SCOPE:

1.1 Form:

This specification and its associated detail specifications establish the requirements for quartz fabric impregnated with a modified low-dielectric epoxy resin.

1.2 Application:

These composite prepreg material systems are intended for use in the fabrication of aerospace structures and specifically radomes. The materials are designed specifically for vacuum-bag autoclave cure in accordance with NPS 82014 [illegible] Alternate out-of-autoclave cures are available, but not qualified herein. They are typically used in radome applications requiring tuned dielectric properties.

Material property data including statistically based material allowables are available publicly for the materials covered by this specification. Part fabricators that wish to utilize the material property data, allowables, and specifications may be able to do so by demonstrating the capability to reproduce the original material properties; a process known as equivalency. More information about this equivalency process including the test statistics and its limitations can be found in Section 6 of DOT/FAA/AR-03/19 and Section 8.4.1 of CMH-17-1G.

This specification is developed based on the material properties that are available publicly. The purchaser may specify a[illegible] this specification, especially when the purchaser has generated additional material properties beyond those available publicly or when the application requires other requirements. The additional requirements are subject to supplier review and approval.

The use of this spe[illegible] Material users should be actively involved in evaluating material performance and quality including, but not limited to, performing regular purchaser quality control tests, performing periodic equivalency/additional testing, participating in material change management activities, conducting statistical process [illegible]

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with DOT/FAA/AR-06/10 and DOT/FAA/AR-07/3.

3.2.1 Epoxy Resin System:

The resin system shall be an epoxy-based resin that is capable of meeting the requirements of this specification; no separate specification exists for the resin system. Any changes to the epoxy resin system since qualification shall be re-approved by NCAMP. No more than five resin batch shall be included in any single prepreg batch unless allowed by the detail specification or accepted by the purchaser in the purchase order.

3.2.2 Reinforcement: The reinforcement requirements shall be specified in the applicable detail specifications.

3.3 Prepreg Physical and Chemical Property Requirements:

3.3.1 Uncured prepreg physical and chemical properties:

The uncured prepreg material shall meet the physical and chemical property requirements of Table 1 and as specified below. The material shall be capable of being cut without disarray of the filaments and without other visible damage.

Table 1

exotherm peak temperature

unrolled condition.

TABLE 2 Acceptance/Rejection Criteria for Puckers and/or Pimples

Largest Dimension	Frequency	Criteria
Greater than 0.50 inch	Any	Rejectable
0.25 to 0.50 inch	3 or less per 1 sq. ft	Acceptable
Less than 0.25 inch	All	Acceptable

3.4.3 Visual Requirements (Class 2 Woven fabric prepreg):

3.4.3.1

3.4.5.5 Prepreg material (Class 1 & 2) may be cut and spliced to remove defects. Splices shall be overlapped from 0.0 to 3.0 inches and marked as a single-point defect. The splicing technique must be easily identified by the end-user. Splices shall not be within 15 feet of the beginning or end of a roll. No two splices shall be closer than 3 feet.

3.4.5.6 Prepreg material roll shall have a maximum defect content of 15 percent by weight or length. The defect weight limit shall be based on full-width weight.

3.4.5.7 The type, location, and length (for continuous defect) of each marked defect, and the location of the splices shall be indicated on a defect log accompanying each roll of prepreg material. Defect and splice locations shall be identified by markers on the prepreg roll edge.

3.4.5.8 Defective areas, considered as the length of the defect multiplied by the width of the roll, shall not be counted toward the amount of material purchased.

3.5 Laminate (Cured Prepreg) Requirements:

3.5.1 Test Laminate Fabrication and Baseline Cure Process:

The test laminate fabrication and baseline cure process shall be in accordance with NCAMP Process Specification NPS 82014 Fabrication of NMS 201 Qualification, Equivalency, and Acceptance Test Panels. In order to facilitate individual specimen traceability, individual specimen numbering and/or skewed lines must be written or drawn across each sub-panel as shown in Figure 1.

Figure 1 Specimen Traceability Line

3.5.2 Cured Laminate Physical Properties:

The cured laminate physical properties listed in Table 3

Note: Experiment to establish material out-time and storage-life is ongoing.

3.6.1.1 Release Paper/poly Film:

A non-transferring separator paper with differential release may be used on the inside of the roll. Paper or release film shall be used to permit easy removal of the preimpregnated material from the roll without loss of resin, tearing, shredding, fiber realignment, or other damage. The material shall be capable of being cut cleanly without other visible damage. The release paper shall not contaminate the prepreg.

3.6.1.2 Material Handling:

All rolled material greater than 12 inches wide shall be supported at all times by the ends of the internal fiberboard tube and kept horizontal. Unless otherwise specified by the purchaser, the fiberboard tube of prepreg wider than 12 inches shall extend a minimum of 2 inches past the separator film for this purpose. The material shall not be allowed to rest against any surface, and except for rolls of 12.0 inches or less in width, shall not be allowed to rest in a vertical position. Wider width rolled material may be momentarily rested against a surface or in a vertical position only while being transferred to or from storage or packaging. The fiberboard tube of prepreg 12 inches or narrower shall extend a minimum of 1 inch past the separator film.

3.6.1.3 Thawing Rolled Materials:

Preimpregnated materials shall be allowed to warm at ambient temperature until moisture does not condense on the packaging (i.e. prepreg temperature is above dew point). The material out-time shall be recorded by the distributor and purchaser. The material out-time between manufacture and shipment at supplier location shall be in accordance with 5.2.3.
NOTE - No form of applied or direct heat shall be used to accelerate the thawing process.

3.6.2 Prepreg Life Requirements:

Definitions for storage life, handling life, staging life, and out-time are shown in Figure 2.

3.6.2.1 Storage Life: The prepreg rolls shall be stored in sealed moisture-proof bags in a clean and dry area. The prepreg rolls shall be supported at all times by the ends of

manufacture, unless otherwise specified in the purchase order. Material that has been stored for a time period longer than the maximum storage life shall not be used until tests have been performed to extend the storage life as defined by 3.6.2.1.3 or

3.6.2.1.3 Storage Life Extension: Storage life may be extended by the purchaser. Storage life extension requirement is similar to receiving inspection requirement in 4.5. Each extension is for 6 months only. Storage life may be extended a maximum of one time only (subject to change depending on storage shelf life verification). Rolls must be unopened in original packaging at the time of expiration to be eligible for extension. Samples and out time logs must be made available to the material manufacturer for extension testing.

3.6.2.2 Handling Life: The handling life of the material at 62-77°F and 0-65% relative humidity is 28 days (unverified). Handling life begins when the prepreg is removed from the freezer and ends when prepreg is laid onto the tool. Extension of handling life requires Material Review Board (MRB) approval, which should consider the intended application, handling characteristics (tack and drape), and mechanical properties of the material.

3.6.2.3 Staging Life: The staging life (or mechanical life) of the material when covered with vacuum bagging materials at 72+/-5°F and 0-65% relative humidity is 10 days (unverified). Staging life begins at placement of the ply on the tool and ends when the cure cycle begins. Extension of staging life requires MRB approval, which should consider the intended application and mechanical properties of the material.

3.6.2.4 Out-time: Out-time begins when the prepreg is removed from freezer storage and ends when the cure cycle begins. Total out-time is the summation of handling life and staging life.

Figure 2. Definitions of Storage, Handling, Staging Life, and Out-Time

the change of the material or the material processing. DOT/FAA/AR-06/10 and DOT/FAA/AR-07/3 provide guidance in this area.

3.10.2 Equivalency is limited to the evaluation of minor manufacturing process, or fabrication (e.g. curing) process used with a material. Significant changes to the prepreg material will require a full qualification program and a separate specification.

3.10.3 It is the responsibility of the material supplier to conduct testing to demonstrate that the current material, when processed to the baseline process specification, will generate composite properties statistically equivalent to the properties of the original materials.

3.11 Process Control Document:

3.11.1 The supplier shall prepare and control a Process Control Document (PCD) in accordance with NRP 101. The PCD shall be considered proprietary and shall be protected in accordance with disclosure agreements signed by the supplier and NCAMP. The established Process Control Document (PCD) shall be presented to NCAMP upon request. NCAMP shall treat any information contained in the PCD as proprietary.

3.11.2 Changes to the PCD of a qualified material (as defined by DOT/FAA/AR-06/10, DOT/FAA/AR-07/3,

Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all batch release inspection and test requirements specified herein and the purchaser is responsible for the performance of all receiving inspection tests specified herein, except HPLC and IR. The purchaser may perform reduced receiving inspection testing if the reduced sampling plan is specifically approved by the original equipment manufacturer or the certifying agency (see section 4.5.2). The supplier may use their own facilities or any commercial laboratory acceptable to NCAMP. The purchaser or NCAMP reserves the right to perform additional tests to assure that the material furnished conforms to the prescribed requirements.

4.2 Classification of Tests and Inspections:

4.2.1 Qualification Tests:

The preproduction tests performed for material qualification are those tests performed on representative samples of each specific form of material to establish a qualified product in accordance with this specification. Qualification testing shall be in accordance with an NCAMP test plan.

4.2.2 Batch Release Tests:

Batch release tests shall be those tests performed by the supplier on representative samples taken from each production batch of each type of material submitted by the supplier for acceptance under contract or purchase order. Specification limits are specified in the detail specification. Data and certification of data generated shall accompany each shipment of material.

4.2.2.1 Additional Testing:

and NCAMP staff upon request. The KPP monitoring must also be provided to material users, certification agencies, and NCAMP staff upon request, but proprietary information may be coded or normalized. Alternatively, supplier may send the KC data to NCAMP for are available to the public.

4.4 Product Certification:

4.4.1 Batch Release Tests:

The supplier shall perform batch release tests on each batch of prepreg as specified in this section and the detail specification.

4.4.1.1 Prepreg Physical and Chemical Properties: Test in accordance with the requirements of Table 1 and the detail specification.

4.4.1.2 Laminate Physical Properties: Test in accordance with the requirements of Table 3 and the detail specification.

4.4.1.3 Laminate Mechanical Properties: Each batch of prepreg shall be tested to verify compliance with the mechanical property requirements in Table 4 or 5 of the applicable detail specification, in accordance with Table 6 sampling plan.

TABLE 6 - Supplier Quality Control Sampling Plan for Laminate Mechanical Properties

Number of Linear Yards (LY) (Net) in Batch	Test Frequency for Batches Shipped
1 to 1000	one roll
1001 to 2000	first and last roll
2000 +	first, last, and one roll for each additional 1000 LY or part thereof (sampled in the order of production sequence within approximately ±200 LY of each additional 1000 LY)

4.4.2 Certification of Conformance

The supplier shall furnish with each shipment one copy of a Certification of Conformance including certified test reports, confirming that all the material in the shipment complies with the requirements of this specification. The Certificate of Conformance shall include the following information:

a.
b.
c. Specification number, title, revision.
d. Purchase order number.
e. T

h. Lot numbers of fiber, fabric used in the manufacturer of the prepreg materials.
i. Date of manufacture (date of impregnation).
j. Fiber lot certification test data and certificate of conformance.
k. List of roll numbers for each batch and the quantity (length or weight) of each roll.
l. Roll defect logs.

4.4.3 Records: The following records shall be available for inspection by NCAMP and purchasers

4.4.3.1 The supplier shall keep on permanent file all records pertaining to the qualification of the candidate material.

4.4.3.2 The supplier shall keep the following records on file, for each prepreg batch, for a minimum period of 7 years:
a. Full prepreg batch traceability. This traceability shall extend to the particular resin and resin component batches, and fiber yarn lot(s) employed, where applicable.
b. All records pertaining to raw material receiving inspection and certification, in process records, and product testing specified in the supplier PCD.
c. All records pertaining to the SPC.

4.5 Receiving Inspection: Before the prepreg material is accepted, the purchaser shall perform the following:

4.5.1 Verification: Material shall be inspected to assure that:
a. The material identification is correct.
b. The quantity is correct.
c. The required test data is received and meet the requirements of this specification.
d. The Certificate of Confo912 0 61sH 612 792 reW*nBT/F2 12 Tf1 0 0 1 270.8 329.54 Tm

The purchaser shall repeat the supplier batch release test per 4.4.1 (except HPLC, IR, gel time) as part of the receiving inspection tests on each batch of prepreg. As use and confidence increase, the receiving inspection testing may be modified based on proven performance in cooperation with the material supplier, customer (if purchaser is supplying composite parts to another aircraft company), and appropriate certification agency.

4.5.3 Re-Testing:

One retest is allowed for each test property. Additional re-test(s) is allowed only when one or more of the following conditions exist:

a. The initial test was performed in significant deviation to the appropriate procedure. Significant deviations are those expected to affect the measured response.
b. In the course of layup, cure, machining, or testing, there was an occurrence known to cause or contribute to the observed test result(s).
c. Standard statistical analysis procedures establish the suspect individual data point(s) as an outlier and there is a probable, if not provable, relationship to a deviation from required procedure.

4.6 Test Methods:

4.6.1 Determination of Prepreg Tack: The purpose of this test method is to determine the level of prepreg tack through its ability to adhere to itself and to a vertical surface. Equipment needed are (1) A corrosion resistant steel plate with a commercial 2D finish, (2) A squeegee or 1-inch diameter by 1-inch-wide roller, (3) A utility knife, (4) A temperature and RH monitor, (5) A chlorine-free scouring powder, (6) An oven capable of 150 ºF, and (7) A timer.

Procedure:

1. Cut two (2) 3-inch +/- -inch +/- ruler and a utility knife. The 1-inch dimension shall be in the 0º or warp direction. The specimens shall be conditioned at 75°F maximum for 30 minutes before proceeding with the tests. Record lab temperature and relative humidity (RH) on Form #0046.

2. steel panel by cleaning with chlorine-free scouring powder and clean water. Rinse with distilled water to obtain a NO water-break surface and dry in air oven in 130-150°F. Cool to RT for 30 minutes.
3. Position the first ply of test sample on the prepared surface of the panel, using a

oriented vertically on the panel as shown below. Tv(e42.1 201.74how)4(n)24(be)-2(los.s[3.)]TJE

4. Position the panel vertically on edge against a wall or in a holder and observe.
5. Set the timer for thirty (30) minutes.
6. To pass, the sample must adhere to the panel and to the second ply without any indication of release, buckling, slippage, or other adhesive failure for at least 30 minutes at 75°F maximum. Document results on Form #0046.
7. Make sure to clean the stainless-steel plate with appropriate solvent after all testing is complete and store it in its protective sleeve that will minimize surface scratching.

4.6.2 Determination of Drape: The drape of the prepreg shall be determined at 70°F±10°F and 0-60% RH as follows:

1. Cut sufficient material to obtain three specimens that are a minimum of 2-inches long by a minimum of 3-inches wide and remove any release paper or film.
2. Complete wrapping each specimen separately over a 0.25-inch diameter mandrel within 15 seconds of initiation, with fiber direction transverse to mandrel centerline.
3. Remove each specimen from the mandrel and inspect for evidence of cracks, wrinkles, folds, or tears on the surface of the material. Evidence of these defects in cut edges extending less than 0.13-inch inward maximum from the edge shall not be considered rejectable.
4. If no evidence of filament breakage can be visually observed, the specimen has met the requirements for drape.
5. Report the results as pass or fail on certification as required by specification or work instructions.

5.

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5.2.4 Temperature Recorders: Temperature recorders shall be used as required herein to verify that the material was maintained at or below 10 F during the entire time of shipping. If the material has been exposed to temperature between 10 F and 77 F, the material handling life and staging life must be subtracted accordingly. For shipping containers not large enough to hold the prepreg material and a temperature recorder, a separate container shall be used exclusively to contain the temperature recorder in a manner similar to the prepreg it represents.

5.2.5 For dry ice shipments, at least one temperature recorder shall be positioned within at least one shipping container. The shipping container shall be of such a construction to allow enough room for the prepreg, temperature recorder and dry ice. There shall be enough dry ice or additional dry ice shall be added during shipment to maintain the prepreg at the required shipping temperature. The shipping container shall also be insulated and have a partition of suitable material to separate the temperature recorder and packaged prepreg from direct contact with the dry ice.

5.2.6 For refrigerated shipments, temperature recorders shall be positioned within the shipping

8. NOTES:

8.1 Definitions:

Mother Roll - A quantity of prepreg sharing a single fabric roll
Daughter Roll - Daughter rolls are individually packaged with unique labeling. Daughter rolls are usually split from a mother roll for customer handling.
Note: A roll can be both a mother and a daughter roll if it does not require splitting.

For definitions that are not provided in this specification or other applicable NCAMP specifications, the definitions in DOT/FAA/AR-06/10 and DOT/FAA/AR-07/3 shall apply. For definitions not provided in DOT/FAA/AR-06/10 and DOT/FAA/AR-07/3, the definitions in ASTM D3878 shall apply. For definitions not provided in ASTM D3878, the definitions in CMH-17 (formerly MIL-HDBK-17) shall apply.