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NCAMP Material Specification
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# 265°F Cure High Performance Epoxy Prepregs (Newport 4708)

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# 1. SCOPE:

## 1.1 Form:

This specification and its associated detail specifications establish the requirements for continuous fiber unidirectional and fabric impregnated with a modified B-staged epoxy resin (“unidirectional tape and fabric prepreg”).

## 1.2 Application:

These composite prepreg material systems are intended for use in the fabrication of aerospace structures and components. The materials are designed specifically for vacuum-bag oven cure in accordance with NPS 4708 baseline cure cycle “C” for applications that require a relatively high glass transition temperature, hot/wet performance, toughness, and mechanical properties for a moderate cure temperature thermoset resin system.

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 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 other requirements. The additional requirements are subject to supplier review and approval.

The use of this specification does not guarantee material or structural performance. 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 control, and conducting regular supplier audits.

**1.3 Classification**: Each detail specification has a unique classification. Example specification callout is provided in the qualified products list of every detail specification. Prepregs shall be classified to the following Types, Classes, and Grades or Styles:

1.3.1 Type shall specify nominal prepreg resin content. For example,

Type 33 – Nominal resin content 33% by weight
Type 36 – Nominal resin content 36% by weight
Type 38 – Nominal resin content 38% by weight

1.3.2 Class shall specify prepreg product form. For example,

Class 1 – Unidirectional carbon fiber prepreg tape
Class 2 – Woven carbon fiber fabric prepreg

1.3.3 Grade shall specify nominal fiber areal weight in grams per square meter (gsm). For example,
Grade 145 – 145 gsm fiber areal weight
Grade 193 – 193 gsm fiber areal weight
Grade 300 – 300 gsm fiber areal weight
Grade 370 – 370 gsm fiber areal weight

1.3.4 Style shall specify the woven fabric style (not applicable to Class 1). For example,
Style 3K-70-PW - 3K yarn, 7.0 mil nominal dry fabric thickness, plain weave
Style 6K-135-5HS - 6K yarn, 13.5 mil nominal dry fabric thickness, 5 harness satin weave

**1.4 Safety** – Hazardous Materials:

While the materials, methods, applications, and processes described or referenced in this specification may involve the use of hazardous materials, this specification does not address all the hazards which may be involved in such use. It is the sole responsibility of the user to ensure familiarity with the safe and proper use of any hazardous materials and to take necessary precautionary measures to ensure the health and safety of all personnel involved.

**1.5 Rounding of Values**:

The following applies to all specified limits or requirements in this specification. For purposes of determining conformance with this specification, an observed value or a calculated value shall be rounded “to the nearest unit” in the last right-hand digit used in expressing the specification limit, in accordance with the rounding method of ASTM E29.

**1.6 Qualified Products**:

This specification requires qualified products. Qualified products are listed in the Qualified Products List (QPL) of each detail specification. In accordance with the requirements of this specification, the specific fiber material and source(s), weaver(s), and the specific resin components and source(s) shall be qualified as a prepreg material system. Any other combinations not listed on the QPL of the detail specification are not qualified. In addition, the production of the qualified products is controlled by an NCAMP approved process control document (PCD) as specified in 3.11.

**1.7 Detail Specification**:

This base specification contains basic fiber reinforced epoxy prepreg material requirements that apply to every product. The detail specifications contain additional or superseding properties and requirements that apply to a specific product.

### 1.8 Change Control Approval:

Prepreg product shall be produced in accordance with an NCAMP approved Process Control Document (PCD). Formal change notification and approval is required before a change may be implemented. In general, level 1 through level 3 changes per DOT/FAA/AR-06/10 and DOT/FAA/AR-07/3 are considered major changes. NCAMP approval is required for major changes, and is granted through Advance Change Notices (ACN). Prior to implementing a major change, the material supplier shall contact NCAMP with the following information:

a. A detailed description of the change,
b. A draft test plan to substantiate that the change will not affect the prepreg material properties, and
c. A list of material users

NCAMP staff will communicate the proposed change(s) and obtain necessary suggestions and/or approvals from the material users. In general, DOT/FAA/AR-06/10 and DOT/FAA/AR-07/3 will be used as guidelines. The ACN along with test results will be reviewed by the material users and certification agencies. NCAMP staff will sign the ACN when a consensus is reached.

## 2. APPLICABLE DOCUMENTS

The latest issue of the NCAMP publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order unless otherwise specified. When a referenced document has been canceled and no superseding document has been specified, the last published issue of that document shall apply.

### 2.1 NCAMP Publications:

| | |
|---|---|
| NMS 818 | Carbon Fiber Tow |
| NMS 828 | Carbon Fiber Fabric |
| NRP 101 | Prepreg Process Control Document (PCD) Preparation and Maintenance Guide |
| NPS 4708 | Fabrication of NMS 4708 Qualification, Equivalency, and Acceptance Test Panels |

### 2.2 ASTM Publications (available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, http://www.astm.org)

| | |
|---|---|
| ASTM D 790 | Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials |
| ASTM D 2344 | Standard Test Method for Short-Beam Strength of Polymer Matrix Composite Materials and Their Laminates |
| ASTM D 3039 | Tensile Properties of Polymeric Matrix Composite Materials |
| ASTM D 3529/D 3529M | Standard Test Method for Matrix Solids Content and Matrix Content of Composite Prepreg |

| | |
|---|---|
| ASTM D 3530/D 3530M | Standard Test Method for Volatiles Content of Composite Material Prepreg |
| ASTM D 3531 | Standard Test Method for Resin Flow of Carbon Fiber-Epoxy Prepreg |
| ASTM D 3532 | Standard Test Method for Gel Time of Carbon Fiber-Epoxy Prepreg |
| ASTM D3776 | Standard Test Methods for Mass Per Unit Area (Weight) of Fabric |
| ASTM D 3878 | Standard Terminology Composite Materials |
| ASTM D 6641 | Standard Test Method for Determining the Compressive Properties of Polymer Matrix Composite Laminates Using a Combined Loading Compression (CLC) Test Fixture |
| ASTM D7028 | Standard Test Method for Glass Transition Temperature (DMA Tg) of Polymer Matrix Composites by Dynamic Mechanical Analysis (DMA) |
| ASTM E 29 | Using Significant Digits in Test Data to Determine Conformance with Specifications |
| ASTM E 168 | General Techniques of Infrared Quantitative Analysis |
| ASTM E 1252 | Standard Practice for General Techniques for Obtaining Infrared Spectra for Qualitative Analysis |

**2.3 ISO Publications**:

| | |
|---|---|
| ISO 9000 | Quality Management Systems |

**2.4 SACMA Publications** (available from American Composites Manufacturers Association, 1010 N Glebe Rd., Suite 450, Arlington, VA 22201, http://www.acmanet.org):

| | |
|---|---|
| SACMA SRM 10R-94 | Calculation of Fiber Volume of Composite Test Laminates |
| SACMA SRM 23R-94 | Resin Content and Fiber Areal Weight of Thermoset Prepreg with Destructive Technique |
| SACMA SRM 20R-94 | High Performance Liquid Chromatography of Thermoset Resins |
| SACMA SRM 25R-94 | Onset Temperature and Peak Temperature for Composite System Resins Using Differential Scanning Calorimetry (DSC) |

**2.5 US Government Publications**:

| | |
|---|---|
| 29 CFR 1910.1200 | Hazard Communication, Occupational Safety and Health Standards |
| DOT/FAA/AR-03/19 | Material Qualification and Equivalency for Polymer Matrix Composite Material Systems: Updated Procedure |
| DOT/FAA/AR-06/10 | Guidelines and Recommended Criteria for the Development of a Material Specification for Carbon Fiber/Epoxy Fabric Prepregs |
| DOT/FAA/AR-07/3 | Guidelines and Recommended Criteria for the Development of a Material Specification for Carbon Fiber/Epoxy Unidirectional Prepregs Update |
| MIL–D–3464 | Desiccants, Activated, Bagged, Packaging Use and Static |

| | |
|---|---|
| | Dehumidification |
| MIL-PRF-131 | Barrier Materials, Watervaporproof, Greaseproof, Flexible, Heat-Sealable |
| CMH-17 | Composite Materials Handbook (formerly MIL-HDBK-17) |

## 3. TECHNICAL REQUIREMENTS:

### 3.1 Detail Specification:

The requirements for a specific fiber reinforced unidirectional tape and fabric epoxy prepreg product shall consist of all requirements specified herein in addition to requirements specified in the applicable detail specification. In case of conflict between requirements of this basic specification and an applicable detail specification, requirements of the detail specification shall govern.

### 3.2 Constituent Material Requirements:

Material supplied in accordance with this specification shall consist of epoxy resin and fiber. The definitions of fiber lot, fabric batch, resin batch, and prepreg batch are in accordance 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 one 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.

3.3.2 Tack:

The material shall demonstrate acceptable tack when tested as specified in 4.6.1. Acceptable tack level(s) is defined in the applicable detail specifications.

3.3.3 Drape:

If no evidence of filament breakage can be visually observed, the specimen has met the requirements for drape when tested at ambient temperature as specified in 4.6.2. Report drape level as pass or fail.

Table 1 – Prepreg Physical and Chemical Properties

| Property | Product Form | Test Method[(1)] | Number of Replicates |
|---|---|---|---|
| Resin Content | Prepreg | ASTM D 3529 | Every roll[(2)] |
| Fiber Areal Weight | Prepreg | ASTM D 3776 or SACMA SRM 23R-94 | Every roll[(2)] |
| Volatile Content | Prepreg | ASTM D 3530 | First and last rolls of every batch[(2)] |
| Flow | Prepreg | ASTM D 3531 | First and last rolls of every batch[(2)] |
| Gel Time | Prepreg | ASTM D 3532 | Optional |
| Tack | Prepreg | See 4.6.1 | First and last rolls of every batch |
| Drape | Prepreg | See 4.6.2 | First and last rolls of every batch |
| HPLC | Prepreg | SACMA SRM 20R-94 | First and last rolls of a batch |
| IR | Resin | ASTM E 168 ASTM E 1252 | Optional |
| Differential Scanning Calorimetry (DSC) exotherm peak temperature | Resin | SACMA SRM 25R-94 | Optional |

[(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

**3.4 Visual and Dimensional Requirements**:

3.4.1 General:

The prepreg shall be uniform in quality and shall not contain defects detrimental to handling, layup, cure or structural properties.

3.4.2 Visual Requirements (Class 1):

3.4.2.1 The prepreg material shall be free from foreign material, cut or broken fibers, cured resin, unwetted fibers, wrinkles, resin-rich areas, dry or boardy areas, and indications of moisture visible to the unaided eye.

3.4.2.2 Fuzz balls shall be acceptable provided:

a. The fuzz balls cause no apparent fiber distortion. This shall be determined without removing the fuzz balls.
b. Any fuzz ball shall not exceed 1.5 inches in any direction.
c. The accumulated number of fuzz balls shall not exceed 6 in any 10 square feet of one side of prepreg material.
d. The overall thickness change due to fuzz ball is no more than 50 percent of the prepreg material nominal thickness.

3.4.2.3 The edge of the prepreg tape shall not deviate from a straight line by more than 0.025 inch per foot of length and shall be flush with the separator paper.

3.4.2.4 All fiber tows shall be collimated and parallel, within 0.025 inch per foot of length, to the centerline of the material.

3.4.2.5 The length of fiber gap, parallel to the 0° direction, shall not exceed 10 inches. The width of fiber gap, perpendicular to the 0° direction, shall not exceed 0.030 inch. One gap 0.010 to 0.030 inch wide and not exceeding 10 inches long is acceptable in each 10 square feet of prepreg. Gaps less than 0.010 inch wide and not exceeding 10 inches long are acceptable.

3.4.2.6 The prepreg shall be free from crimped fibers and fiber tow crossovers visible to the unaided eye.

3.4.2.7 The following specifies the acceptance/reject criteria for puckers and/or pimples in the 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):

3.4.3.1 The prepreg material shall be free from foreign material, cut or broken fibers, folded selvages that overlap nonselvage areas, cured resin, unwetted fibers, wrinkles, resin-rich areas, dry or boardy areas, and indications of moisture visible to the unaided eye.

3.4.3.2 The warp yarns shall be parallel to the warp direction within 1.0 inch over any 21.0 inches.

3.4.3.3 The fill yarns shall be perpendicular to the warp direction within 1.0 inch over any 21.0 inches.

3.4.4 Roll characteristics:

The total weight or length of material shall be specified by the purchaser. Unless otherwise specified by the purchaser, individual roll weight shall not exceed 70 pounds and 115 lbs for Class 1 and Class 2 materials, respectively. Width shall be as specified by the purchaser. Unless otherwise specified by the purchaser, tolerances on the width of the prepreg shall be:

| | |
|---|---|
| a. For unidirectional tape widths greater than 12.0 inches: | +/-0.060 inch |
| b. For unidirectional tape widths of 12.0 inches: | +/-0.030 inch |
| c. For unidirectional tape widths less than 12.0 inches: | +/-0.020 inch |
| d. For woven fabric (excluding the selvages): | +/-1.000 inch |

3.4.5 Material not conforming to the visible defect limitations and dimensional requirements:

3.4.5.1 In cases where foreign material or resin rich areas can be removed without causing any apparent deformation of the prepreg surface, they may be removed by spatula or adhesive tape. The spatula or adhesive tape shall not transfer any contaminants to the prepreg product.

3.4.5.2 Areas not conforming to Section 3.4.1, 3.4.2, or 3.4.3 shall be identified along the edge of the prepreg roll by markers. Markers shall be distinguishable from the prepreg and carrier release paper and removable without damaging the prepreg material.

3.4.5.3 For single-point defects, use a single marker.

3.4.5.4 Successive single-point defects 3 feet or less apart shall be considered as one continuous defect. For continuous defective areas, markers shall be placed at the beginning, at each 2-foot maximum interval, and at the end of the continuous defect.

3.4.5.5 Prepreg tape material (Class 1) may be cut and spliced to remove defects. Splices shall be overlapped from 1.0 to 3.0 inches and marked as a single-point defect. Splices shall not be within 50 feet of the beginning or end of a roll. One (1.0) linear foot of additional material shall be supplied for each splice.

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 Ninety percent of a roll shall not contain two successive splices or defects closer than

50 feet. The remaining 10 percent shall not contain two successive splices or defects closer than 15 feet.

3.4.5.8 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.

3.4.5.9 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 cure process shall be in accordance with baseline cure cycle “C” of NCAMP Process Specification NPS 4708 Fabrication of NMS 4708 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.

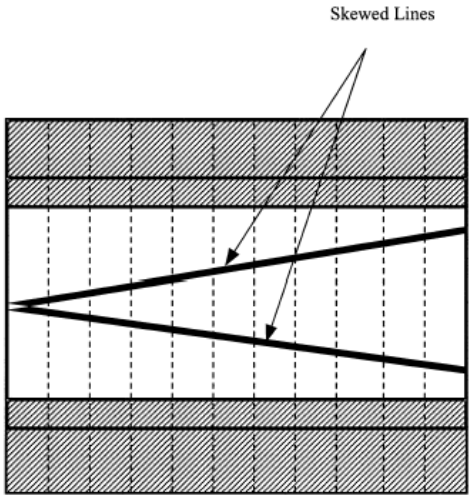


Figure 1 – Specimen Traceability Line

3.5.2 Cured Laminate Physical Properties:

The cured laminate physical properties listed in Table 3 shall conform to the values and limits listed on the corresponding detail specification.

TABLE 3 - Cured Laminate Physical Properties

| Property | Test Method | Number of Replicates |
|---|---|---|
| Cured Ply Thickness | SACMA SRM 10R-94 | 10 measurements per panel |
| Dry Glass Transition Temperature, Tg by DMA | ASTM D7028 | 2 per batch |

3.5.3 Cured Laminate Mechanical Properties:

The cured laminate mechanical properties listed in Table 4 and 5 shall conform to the values and limits listed on the corresponding detail specification.

TABLE 4 - Required Cured Laminate Tests for Mechanical Properties (Class 1 Only)

| Property | Test Temperature | Test Method(1) | Number of Replicates |
|---|---|---|---|
| 0° Tension Strength and Modulus | RT | ASTM D 3039 | 5 |
| 90/0° Compression Strength | RT | ASTM D 6641 | 5 |
| 0° Short Beam Strength | RT | ASTM D 2344 | 5 |
| 0° Flexural Strength and Modulus | RT | ASTM D 790 | 5 |

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

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

| Property | Test Temperature | Test Method(1) | Number of Replicates |
|---|---|---|---|
| 0° (warp) Tension Strength and Modulus | RT | ASTM D 3039 | 5 |
| 90° (fill) Compression Strength and Modulus | RT | ASTM D 6641 | 5 |
| 0° (warp) Short Beam Strength | RT | ASTM D 2344 | 5 |
| 0° (warp) Flexural Strength and Modulus | RT | ASTM D 790 | 5 |

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

**3.6 Storage and Handling Requirements**:

3.6.1 General Requirements:

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 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. Core size shall be defined in detail specifications.

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 the internal fiberboard tube and kept horizontal, and shall not have any objects resting on top of it.

3.6.2.1.1 The prepreg has a storage life of 12 months from the date of manufacture when stored in accordance with the conditions above at a maximum storage temperature of 0 °F. Temperature excursions up to 10ºF, such as during shipping and freezer defrost cycles, for a cumulative maximum 7 days is permitted. The material shall have a minimum of nine months remaining storage life at the time of shipment unless agreed upon by the purchaser.

3.6.2.1.2 For purposes of tracking the storage life, the time shall be measured from the date 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 the user's process specifications.

3.6.2.1.3 Storage Life Extension: There is currently no data to support storage life of more than 12 months beyond the date of manufacture. Storage life extension must be supported by test data and approved by Material Review Board (MRB). It is recommended that the storage life extension, if approved by MRB, is for no more than 6 months only.

3.6.2.2 Handling Life: The handling life of the material at 72+/-5°F and 0-65% relative humidity is 30 days. Handling life begins when the prepreg is removed from the freezer and ends when prepreg is laid onto the tool. The handling life may be extended by 15 days provided that the material passes the gel-time, flow, volatile content, and short beam strength requirements.

3.6.2.3 Staging Life: . Staging life begins at placement of the ply on the tool at 72+/-5°F and 0-65% relative humidity (relative humidity requirement does not apply if kept under vacuum bag) and ends when the cure cycle begins.

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. The total permissible out-time is 45 days. Extension of out-time requires Material Review Board (MRB) action, which should consider the intended application, handling characteristics (tack and drape), and mechanical properties of the material.

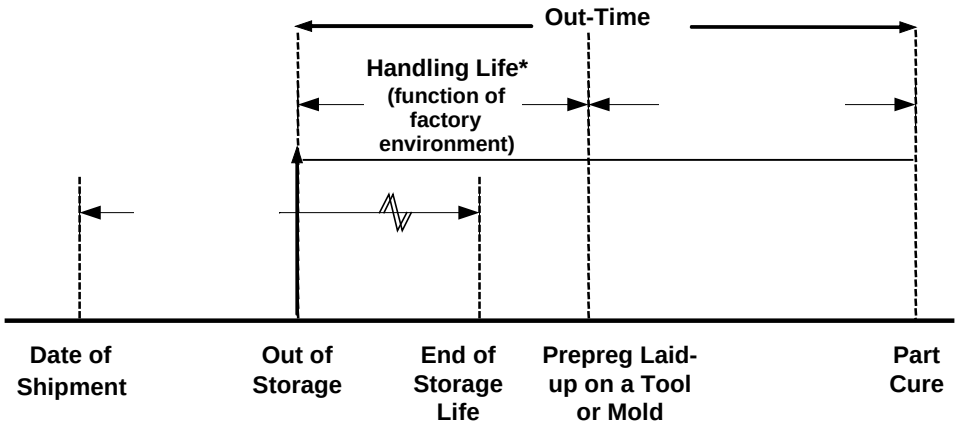


Figure 2. Definitions of Storage, Handling, Staging Life, and Out-Time

3.6.3 Distributors:

A material distributor shall perform the same documentation of storage life and handling life as the material supplier and purchaser. If the original packaging is to be opened to allow for re-spooling into smaller units, the prepreg shall be allowed to warm at ambient temperature in the unopened package until moisture does not condense on the packaging (i.e. prepreg temperature is above dew point). All out-time accumulated during warming, re-spooling, and repackaging shall be subtracted from the total handling life and documented for the purchaser(s). Distributors are not allowed to extend the storage life unless explicitly allowed by the purchaser.

**3.7 Environmental, Health, and Safety**:

3.7.1 Equipment, materials, solutions, and emissions (if applicable) shall be controlled, handled, used, and disposed of in accordance with all local, State, and Federal Government Safety, Health, and Environmental Affairs (SHEA).

3.7.2 The delivered prepreg system shall fulfill the local requirements of the health and safety laws of the country of the purchaser. When processing the prepreg in the composite shop, there shall be no health hazards or emissions that require special measures to be taken to protect the environment.

3.7.3 The manufacturer shall inform the purchaser about the safe handling procedures of the material. The Material Safety Data Sheet (MSDS) shall be made available to the purchaser.

**3.8 Defects During Usage**:

3.8.1 Defects, as defined by this specification, which are not marked by the supplier but found in the prepreg material after acceptance shall be cause for rejection and the defective material may be returned to the supplier. Defects caused by user mishandling, improper storage, or expiration of storage or out-life are not the responsibility of the supplier and shall not be cause for rejection back to the supplier.

**3.9 Qualification Requirements**:

Materials shall be qualified in accordance with an NCAMP test plan.

**3.10 Material Re-Qualification and Equivalency**:

3.10.1 If any change occurs relevant to this specification or the PCD, NCAMP reserves the right to require a re-qualification by the prepreg manufacturer to validate that the changed material is equivalent to the material in the initial qualification. The extent of the re-qualification program will depend on the nature of 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 changes in a material's constituents, 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 and NRP 101) are subject to the written approval of NCAMP. Such changes may require substantial testing.

**3.12 Traceability**:

Each individual material and its constituents as defined by the PCD shall be identifiable at all stages of manufacture and delivery. The material manufacturer shall present evidence of the material traceability upon request.

**3.13 Manufacturer's Responsibility**:

3.13.1 The manufacturer is responsible for the development and manufacture of any material submitted in accordance with this specification. Quality control by the manufacturer shall be in accordance with this specification.

3.13.2 Changes to the prepreg require review and approval by NCAMP in accordance with 1.8. Any testing required to validate the changes or adjustment of manufacturing materials, techniques and/or procedures is the manufacturer's responsibility.

**3.14 Quality Management System**:

The manufacturer's quality system shall be approved as defined in ISO 9000 or equivalent.

**4. QUALITY ASSURANCE**:

**4.1 Responsibility for Inspection**:

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. The purchaser is responsible for the performance of all receiving inspection tests

specified herein, except HPLC. 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:

The purchaser reserves the right to perform additional testing to confirm the supplier's certification data, and to approve incoming material for use in the fabrication of production parts. Each roll of material may be examined by the purchaser for appearance, color uniformity, imperfections which would be detrimental for use in the fabrication of parts, and for quality of workmanship.

4.2.3 Receiving Inspection Tests:

The receiving inspection tests shall be those tests performed by the purchaser or approved test lab on representative samples taken from each production batch of each type of material delivered by the supplier.

## 4.3 Supplier Statistical Process Control:

The supplier shall establish and maintain procedures and requirements for an SPC system based on Key Characteristics (KC) and Controlled Process Parameters (CPP). The KC are the material properties required for batch release per 4.4.1. The KC monitoring, typically using control charts, must be provided to material users, certification agencies, and NCAMP staff upon request. The CPP 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 inclusion in the NCAMP's control charts which 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 Pounds (Net) in Batch | Test Frequency for Batches Shipped |
|---|---|
| 1 to 250 | one roll |
| 250 to 800 | first and last roll |
| 800 + | first, last, and one roll for each additional 800 lbs or part thereof (sampled in the order of production sequence within approximately ±100 lbs of each additional 800 lbs) |

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. Manufacturer's identification.
b. Manufacturer's material designation.
c. Specification number, title, revision.
d. Purchase order number.
e. Date, type, roll numbers and results of batch release tests, including actual individual test data and average values.
f. Results of any retests.
g. Prepreg batch numbers.
h. Lot numbers of fiber, fabric, and resin 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 Conformance is received.
e. Each shipment of prepreg meets the requirements for storage temperature between the point when the purchaser assumes ownership and the point when the material is received.
(1) The purchaser shall document the procedure used to verify temperature exposure.
(2) If any exposure exceeds the maximum handling and mechanical life conditions, the material shall be rejected.
(3) For exposures that exceed the storage temperature and are less than the maximum handling and mechanical life exposure conditions the purchaser may reject the material. If the purchaser accepts the material the time exceeding the storage temperature shall be deducted from the handling life for the material in that shipment.

4.5.2 Testing:

The purchaser shall repeat the supplier batch release test per 4.4.1 (except HPLC) 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 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 aluminum or steel plate with a commercial 2D finish and (2) A squeegee or 1-inch diameter by 1-inch wide roller.

Procedure:
This tack test shall be performed at 70°F±10°F and 0-60% RH.

1. Clean the aluminum or steel plate. Make sure that the plate is dry.
2. Cut two 3-inch by 1-inch specimens from the prepreg. The 3-inch dimension shall be in the 0º or warp direction.
3. Attach one piece of the prepreg specimen to the plate with light pressure using a squeegee or roller over the backing.
4. Remove the backing and apply the next strip to the first one. Tack in a similar manner. Remove the backing from the second strip.
5. Position the plate vertically.
6. Maintain specimens in this position for at least 30 minutes at 70°F±10°F.
7. Determine the tack level as follows:
   a. Tack level I (low tack) - Prepreg is stiff and boardy
   b. Tack level II – Dry but slight drape
   c. Tack level III (slight tack) - Sticks to itself but not to a vertical surface. Unable to adhere to the vertical surface for 30 minutes.
   d. Tack level IV (good tack) - Prepreg sticks to itself and vertical surface. Adhered to the vertical surface for more than 30 minutes.
   e. Tack level V – Sticks to hands or gloves but no resin transfer.
   f. Tack level VI (high tack) - Wet and sloppy with resin transfer.
8. Record the tack level.

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

a. 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.
b. Complete wrapping each specimen separately over a 0.25 inch diameter mandrel within 15 seconds of initiation, with fiber direction transverse to mandrel centerline.
c. 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.

If no evidence of filament breakage can be visually observed, the specimen has met the requirements for drape. Report as pass or fail.

## 5. PREPARATION FOR DELIVERY:

### 5.1 Packaging:

5.1.1 The prepreg shall be rolled onto a core suitable for use at the purchaser. Suppliers uncertain as to core suitability shall direct their inquiries through the purchaser prior to fabrication of material.

5.1.2 Each spool/roll of material shall be wrapped and sealed with a non-adherent, non-contaminating moisture-proof bag to prevent penetration of moisture. The bag material shall conform to MIL-PRF-131, Class 1 or 3, or equivalent.

5.1.3 Place a minimum of four units of MIL–D–3464, Type II desiccant in each bag prior to sealing.

5.1.4 The individual spool or roll shall be packed in a shipping container that will be acceptable for safe transportation by common carriers and shall include a packing list. The core shall be supported on ends to avoid damage to the prepreg. The container shall be of such design as to prevent damage or degradation to the prepreg during shipment.

5.1.5 The outside of each container and the inside of the roll core shall be clearly marked with the following information:

a. Title, number and revision letter of this specification
b. Date of manufacture (or date of shipment if specified by the detail specification)
c. Length of acceptable prepreg
d. Purchase order number and/or sales order number (not required on roll core)
e. Supplier’s name
f. Supplier’s prepreg batch and spool/roll number
g. The number of hours that the material has been exposed to temperatures above the storage temperature (may be documented in packing list instead).
h. A statement (not required on roll core) to indicate that:
    (1) The material shall be shipped at a temperature not to exceed 10°F,
    (2) The material shall be stored at a temperature not to exceed 0°F, and

(3) The container should not stand on end (for Class 2 prepreg only)

i. All material labeling shall comply with OSHA Hazard Communication, 29 CFR 1910.1200.

5.1.6 If spools/rolls are reused, all information not applicable to the current shipment shall be removed.

5.1.7 Storage immediately after manufacture: The prepreg, sealed in a MIL-PRF-131, Class 1 or 3 film, shall be stored at the storage temperature within 6 hours of manufacture.

**5.2 Shipping Requirements:**

5.2.1 The prepreg should be maintained at or below 0°F during shipment by being packed in dry ice or by refrigeration. Temperature excursions up to 10ºF for a cumulative maximum of 7 days are permitted per section 3.6.2.1.1.

5.2.2 Prepreg date of shipment to purchaser shall be within 180 days of the date of prepregging, unless explicitly approved by the purchase for the particular batch to be shipped.

5.2.3 The out-of-storage time between point of manufacture and shipment from the supplier shall be a maximum of 48 hours, unless explicitly approved by the purchaser for the particular batch to be shipped.

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 containers as follows: The “shipping container” shall be defined as a box designated to hold one spool or one roll of prepreg material. Each refrigerated truck shipment requires two recorders, one per each of two randomly selected shipping containers. If the prepreg shipment has only one shipping container per truck, then both temperature recorders shall be placed in that shipping container. Identify each container having a temperature recorder for purposes of expediting receiving inspection.

**5.3 Receipt at Purchaser**:

5.3.1 Store material at or below 0ºF.

5.3.2 If requested by the supplier and documented on the purchase order, retain the shipping container, spools, and temperature recording instruments for return to the supplier.

5.3.3 For personnel safety when receiving shipments with dry ice, carbon dioxide concentration shall be below permissible level (typically 30,000 ppm for short-term exposure) before entering the truck bed. Consult Occupational Safety & Health Administration (OSHA) for more safety information.

## 6. ACKNOWLEDGEMENT:

A vendor shall mention this specification number and the applicable detail specification number and their revision letters, if any, in all quotations and when acknowledging purchase orders.

## 7. REJECTION:

Prepreg rolls not conforming to this specification and the applicable detail specification, or to modifications authorized by purchaser, will be subject to rejection.

## 8. NOTES:

This section of the specifications is reserved for explanatory and other notes.

**8.1 Definitions**:

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.