Review of FAA Guidelines for Fabric Prepreg Material Specification

Toray Composites (America), Inc.

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Major Concerns

- Loss of affordability
- Too specific for a guideline
- Guideline will become strictly enforced
- Timeframe to establish an industry spec
- Shift to supplier responsibility (and thus liability) from end-user

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List of Acronyms

Page #	Questions & Comments
viii	DER & DMIR is repeated twice

1.3 Related Documents

3	Is DOT/FAA/AR-03/19 currently available?

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1.4 Certification Process

Page #	Questions & Comments
4	3rd para., last sentence: "It is critical that the test specimens fabricated through the various levels of building block approach use the same process, which is representative of the one that will be used in the fabrication of production aircraft and rotorcraft" What if there are multiple process cycles used for various parts? What is meant by representative?

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1.5 Recommended Specification Format

Page #	Questions & Comments
5-6	Suggest to include QPL or slash sheets (for industry specifications) at the end of the outline

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2. Development of Material Controls

Page #	Questions & Comments
6	1st para., 1st sentence: "Before the initiation of a qualification program, the sensitivities of the material to variations in the tolerances set on the material chemical and physical properties and processing should be investigated."
	Once the limits are established during a pre-qualification, is it intended that the qualification batches are produced to nominal process conditions? or with the extreme limits incorporated into the qualification batches?

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2.1 Industry Material Specification

Page #	Questions & Comments
7	This section assumes there is already an established industry specification prior to material qualification. How is a qualification handled if there is no established industry specification, and there are multiple customers?
	What do we do in the meantime before an industry specification is released? How long will organizations such as AMS take to release such a industry spec?
	Need some guidance in the short term.

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2.1 Industry Material Specification

Page #	Questions & Comments
7-8	2nd para., last sentence: "...a material specification may contain target values in place of requirements; in this case, following qualification, the target values are updated to requirements based on the evaluation results." 4th para., first sentence: "With this industry specification approach, the traditional process of qualifying a material to an existing material specification (containing either target requirements or requirements from a previously qualified material) is no longer applicable."

Is initial specification prior to qualification needed or not?

Conflicting statements.

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2.1 Industry Material Specification

Page #	Questions & Comments
8	5th para.: "It will be the responsibility of the material supplier to continually test and evaluate the material to populate the database on an ongoing basis to ensure that the material has not changed."

This is accomplished through the supplier's batch acceptance tests and not full testing.

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2.5 Material Qualification Process When Using an End-User Material Specification

Page #	Questions & Comments
11	2nd para.: "In this process, it is anticipated that the material supplier will: 4th bullet: • submit the material and accompanying data, material specification, and allowables to potential end-user"

For an end-user specification, material specification and allowables is not provided by the supplier. Suggest to delete.

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2.5 Material Qualification Process When Using an End-User Material Specification

Page #	Questions & Comments
11	3rd para.: "At this point the end-user will: last bullet: • upon completion of the testing, calculate proposed material batch acceptance limits and B-basis allowables values. Specification limits and allowables will be calculated using procedures documented in DOT/FAA/AR-03/19 and MIL-HDBK-17." Is the end-user limited to only the approaches described in DOT/FAA/AR-03/19 and MIL-HDBK-17?

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3. The Scope Section of the Material Specification

Page #	Questions & Comments
12	2nd para: "It is recommended that for end-user material specifications: 1st bullet: • Form – defines the basic form Suggest to give example 2nd and 4th bullet: • Style - ...fiber tow count... • Class - ... tow count... Tow count appears in both style and class

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4. The Applicable Documents Section of the Material Specification

Page #	Questions & Comments
13-16	Document number listed with and without revision levels. Recommend consistency.

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5.1.1 Batch Definitions

Page #	Questions & Comments
17-18	Suggest that the guideline only state that batch should be defined in each specification. Each specification would be required to define the batch, but may choose how a batch is defined for each process (resin, filming, prepreg). Suggest also that a roll should be defined in each specification.

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5.3.2 Fabric Requirements

Page #	Questions & Comments
22	Table 2A: Recommended Set of Fabric Properties

Recommend to add:

- Selvage Edge
- Thickness (optional)
- Length (optional)

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5.3.3 The Fiber Requirements Section

Page #	Questions & Comments
23	Table 2B: Recommended Set of Carbon Fiber Properties

Recommend to add:

- Yield (mass/unit length)
- Elongation

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5.5.3 Cured Laminate Mechanical Properties

Page #	Questions & Comments
29	2nd para., 1st sentence: "...it is recommended that a second set of tests be run on an ongoing basis to further populate the database"
	Loss of affordability with more testing. Propose to increase database with the batch acceptance tests.
	3rd para., last sentence: "An additional set of open-hole laminate tests is recommended for inclusion in the specifications for materials intended for more general applications."
	Again, possible loss of affordable materials.

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5.5.3 Cured Laminate Mechanical Properties

Page #	Questions & Comments
29	4th para., 1st & 2nd sentence: "Further sets of recommended tests for an expanded database are then presented. These tests are optional with regard to inclusion in the material specification, but may be required for the design and certification of an end-user's product."

Shift from end-user to material supplier's responsibility for possibly design specific testing.

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5.5.4 Recommended Laminate Tests

Page #	Questions & Comments
32	Table 5A: Ply Lay-up Sequences for Recommended Laminate Tests – Prepreg Fabric Materials Recommended Thickness Range for Selecting ‘n’ (in) Thickness recommendation is different from AGATE. Where did these thickness recommendations come from?
33	Table 5B: Recommended Minimum Set of Cured Laminate Mechanical Properties – Prepreg Fabric Materials ±45 Shear Test Type: In-plane Shear ASTM D3518 Recommend to also include ASTM D5379 V-Notch IPS.

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5.5.4 Recommended Laminate Tests

Page #	Questions & Comments
35	1st para. on pg. 35: "It is recommended that fatigue testing of open-hole specimens be conducted to confirm that the parts will be durable over the expected service life. Post-impact residual strength evaluation for damage tolerance is recommended for primary structure applications. Fatigue testing of impact-damaged specimens may also be required for certification of certain primary structures; however, the detailed recommendations for these tests are beyond the scope of this document"

Fatigue testing and damage tolerance, in our opinion, should also be beyond the scope of this document.

Affordability and shift in responsibility issues.

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5.6.1.1 Industry Material Specification

Page #	Questions & Comments
40	2nd para., 2nd sentence: "The organization that will conduct the tests shall submit a test plan, material specification, and process specification prior to the actual qualification."
	What material specification is submitted? The industry specification or an intermediate specification written by the applicant for the qualification?

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5.6.1.3 Minimum Level of Testing

Page #	Questions & Comments
41	3rd para.: "These requirements and acceptance limits are recommended to be established as: 1st bullet: • maximum average, minimum average, and minimum individual values for all strength properties"

What is used to calculate the maximum average?

Should it be $W_n = X + k_n \cdot s$?

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5.6.2 Equivalency Baseline Enhancement

Page #	Questions & Comments
41	1st para., last sentence: "...it is strongly recommended that the material specification contain requirements to test all structural and other properties of interest on each batch, with the test frequency for these tests reduced once the properties are verified to be stable."

Very expensive, this would amount to a continuous qualification. Propose that batch acceptance tests to monitor stability of material.

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6.1.4 Level 3 Changes

Page #	Questions & Comments
46	2nd para., 1st sentence: "Testing to validate level 3 changes should involve a minimum of three batches of prepreg containing a minimum of three batches of resin and two batches of fabric containing a minimum of 2 lots of fiber."
	Level 3 change is an equivalency; therefore, it should be one batch of prepreg.
	4th para., 1st sentence: "A new revision letter for the applicable material specification should be used when the change is incorporated."
	Propose to add "and/or PCD" since some changes may be invisible in the material specification.

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6.5.1 Supplier Certification Testing

Page #	Questions & Comments
49	3rd para., last sentence: "All end-users of a material batch for which retests were performed must be notified at the time of batch shipment."

Recommend to add a provision that only retests that do not have a clear root cause be notified to the end-user. If there is no clear reason why an original set failed, then all tests should be notified.

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6.5.2 End-user (Purchaser) Testing

Page #	Questions & Comments
49	1st para., 2nd sentence: "The material specification should define the number of rolls of each prepreg batch that should be tested by the end-user." What about if one batch is received in multiple shipments? Shouldn't receiving inspection be conducted for each shipment?

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7.1 Material Identification

Page #	Questions & Comments
52	1st para., 1st & 2nd sentence: "The batch and roll number should be on two labels, one on the inside of the core, the other on the outside of the shipping wrapper. The label should include the material designation, name of manufacturer, specification number, and date of manufacture."
	Third label should be added to the outside of the box. Also, amount of material (either in length or area) should be added.

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11 Glossary

Page #	Questions & Comments
55-56	cured ply thickness (CPT) formulas
	? appears in place of ρ
59	glass transition temperature (Tg), n – the approximate midpoint...
	Onset in addition to midpoint can be used to determine Tg