GM	WORLDWIDE ENGINEERING STANDARDS	Material Specification	GMW15932

Epoxy/Epoxide-Carbon Fiber Reinforced Unidirectional Composite Material

1 Scope

1.1 Material Description. This specification covers the properties of epoxy/epoxide resin reinforced with unidirectional carbon fiber.

1.1.1 Adhesive Bonding. The intended production bonding system (substrate and adhesive) shall meet the requirements of the GMW15921 specification when tested in the laboratory. Production representative parts, and/or assemblies, shall meet the requirements of GMW16185 when tested according to the specification.

1.1.2 Paint.

- For painted applications, the material must meet the requirements of GMW16172, Paint Performance Requirements for New Plastic Materials.
- For body or accent color applications, low bake topcoat per 9984901, 9984904 should be used.

1.2 Symbols. Not applicable.

1.3 Applicability. Typical applications include the following: fenders, hoods, roofs, etc.

1.4 Remarks. None.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

ASTM D792	ASTM D3410/D3410M	ASTM D5229	ISO 11359-2
ASTM D2734	ASTM D3518/D3518M	ASTM D5379/D5379M	
ASTM D3039/D3039M	ASTM D4065	ASTM D6641/D6641M	
ASTM D3171	ASTM D4255/D4255M	ASTM E228	

2.2 GM Standards/Specifications.

9984901	GMW3221	GMW15921	GMW16193
9984904	GMW14270	GMW16172	GMW16853
GMW3059	GMW14444	GMW16185	

2.3 Additional References. None.

3 Requirements

3.1 Requirements on Test Specimens. Reference GMW3221, Code A.

3.2 Emissions Testing of Interior Materials and Parts. For all Code E designated parts per GMW14444, reference GMW16853 for emissions testing of interior materials and parts.

3.3 Sampling. Testing should be carried out with laminates molded from three (3) distinct lots (batch) of materials. A lot (batch) is defined as a quantity of material produced at the same time and under the same conditions from a well-defined collection of raw materials. The quantity of material must have minimal variation in properties throughout to be considered a unique lot (batch). For the laminate, a lot (batch) is defined as one (1) lot of fabric and one (1) lot (batch) of resin(s).

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Sampling should be done on the start and end of rolls and should also be conducted across the full width of the rolls during production trials and qualification. This is intended to capture down-the- length and across-the-width variation introduced in the prepregging process steps.

3.4 Baseline Cure Process. It is recommended that the material supplier establish a baseline cure cycle to be used to produce laminates for the batch acceptance testing. The baseline cure cycle should be selected based on the end user applications and requirements for the material. Reasonable tolerances on heat up rates and time at temperature should be established and documented. The cure process shall be capable of producing cured laminates of consistent, high quality. The following process conditions should be documented for each material used:

- Preform thickness
- Preform binder
- Molding technique
- Molding temperatures and molding pressure
- Molding time
- Panel dimensions

The amount of debulking of the preform needs to be documented. Refer to Table 1 for laminate thickness and panel requirements.

Table 1: Cured Laminate Thickness and Panel Requirements – Unidirectional Materials

Layup	Test	Number of Batches X, Number of Panels X, Number of Tests/Batch/Panels			
		Test Temperature/Moisture Condition			
		-40 °C Ambient	23 °C Ambient	85 °C Ambient	85 °C Wet (95% RH 48 hours)
(0)n Note 1	Tensile ASTM D3039	-	3X2X3	1X2X3	1X2X3
(0)n Note 1	Compression ASTM D6641 or ASTM D3410	-	3X2X3	1X2X3	1X2X3
(90)n Note 1	Tensile ASTM D3039	-	3X2X3	1X2X3	1X2X3
(90)n Note 1	Compression ASTM D6641 or ASTM D3410	-	3X2X3	1X2X3	1X2X3
$(0/90)n_s$ Note 1	0/90 Tension ASTM D3039	3X2X3	3X2X3	3X2X3	3X2X3
$(90/0)n_s$ Note 1	90/0 Compression ASTM D6641 or ASTM D3410	3X2X3	3X2X3	3X2X3	3X2X3
$(+45/-45)n_s$ Note 2	In-plane Shear ASTM D3518 or ASTM D5379 or ASTM D4255	3X2X3	3X2X3	3X2X3	3X2X3

Note: RH = Relative Humidity.
Note 1: Select a value of **n** such that the laminate thickness is approximately 2.54 mm (0.100 in) (n_s = symmetrical).
Note 2: Select a value of **n** such that the laminate thickness is approximately 1.27 mm (0.050 in).

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