



Epoxy-Carbon Fiber Reinforced Exposed Weave Resin Transfer Mold (RTM) Composite Material

1 Scope

Note: Nothing in this standard supercedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose/Material Description. This specification covers the properties of a Class A (exposed weave) epoxy resin matrix that is reinforced with carbon fiber (CF) fabric preforms in the form of either a woven, a non-crimped fabric, a chopped fiber mat, or a combination thereof. Such composites may be produced via resin transfer molding (RTM), or other similar processes.

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

1.1.2 Paint. Follow paint testing procedures listed in GMW16172 (for test Plaques) and GMW14797 (for painted parts), these standards detail exterior plastic and engine compartment painted parts performance requirements. Approved painting materials that can be used on the Epoxy/Epoxide substrate are listed in the GM Materials Approved Source List (GMMASL):

Use paint materials approved as follows:

- Primer per 9984804
- Primer surfacer per 9984121 (if required at target plant)
- Topcoat per 9984836, 9984901, 9984904, or GMW15703
- Paint panels both per GMW17981

1.2 Symbols. Not applicable.

1.3 Applicability. Typical applications include the following: exterior body panels, with particular application to exposed weave carbon fiber (CF) components.

1.4 Remarks. None.

2 References

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

2.1 External Standards/Specifications.

ASTM D3039	ASTM D6856	ISO 1403-1	ISO 11359-2
ASTM D3171	ISO 62	ISO 1403-2	ISO 11469
ASTM D3410	ISO 75	ISO 2577	ISO 14125
ASTM D3518	ISO 180	ISO 3795	
ASTM D4065	ISO 1183	ISO 6603-2	

2.2 GM Standards/Specifications.

9984121	GMW3221	GMW14729	GMW16172
9984804	GMW14124	GMW14797	GMW16534
9984836	GMW14270	GMW14829	GMW16535
9984901	GMW14333	GMW15703	GMW16853
9984904	GMW14444	GMW15891	GMW17981
GMW3059	GMW14700	GMW15921	

2.3 Additional References. Not applicable.**3 Requirements**

3.1 Requirements on Test Specimens. Reference GMW3221, GMW14124, GMW14333.

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 All materials supplied to this standard must comply with GMW3059, Restricted and Reportable Substances. For raw materials, non-dimensional materials (e.g., fluids, greases) and/or bulk materials that require approval into the GM Materials Approved Source List (GMMASL), an International Material Data System (IMDS) submission must be made by the material supplier as a material Material Data Sheet (mMDS). After the mMDS is approved by the GM IMDS team, the materials supplier is to provide a "Header only report" to the responsible GM Materials Engineer. Further guidance can be found in the GM-specific instructions on the IMDS website.

3.4 Test Procedures. Only the latest approved standards are applicable unless otherwise specified. Suitable precautions should be taken to ensure that applicable safe limits are not exceeded when conducting test procedures, processes, and/or handling the materials required by this specification. Reference GMW14700, GMW14729, GMW14829 and GMW15891.

3.4.1 Properties shall be determined using test specimen's waterjet cut from compression molded test plaques. Plaques shall be molded as shown in Appendix A, Figure A1. Plaques shall be molded using the mold temperatures, mold pressure and cure cycle that will be used to mold production parts. The standard fabric layup for testing purposes is [(0 degrees/90 degrees)/(± 45 degrees)] s, as indicated in Appendix B, Figure B1.

3.4.2 Raw materials used for molding shall be within their vendor-defined shelf life. Plaques shall be uniform in appearance and free from blisters, pregels, knit lines, cracks, and surface contamination.

3.4.3 Textile composites have a repeating geometrical pattern. This repeating pattern is referred to as the unit cell. A unit cell is defined as the smallest section of the textile architecture required to replicate the textile pattern by using only in-plane translation (and no rotations) of the unit cell. Refer to ASTM D6856 for further definition. The recommended ratio of specimen width to unit cell width for a textile composite is 2:1. The larger of, (1) the specimen width dictated by this recommended ratio and, (2) the specimen width recommended in the corresponding standard for the measured property should be used to ensure that at least two (2) unit cells are included within the specimen gage section.

3.4.4 An equal number of specimens shall be cut from both the longitudinal (0 degrees) and transverse (90 degrees) plaque directions for each mechanical property. The specimens shall be tested, and the results averaged. The average value is the material property value. Tests shall also be performed on specimens in the 45 degree orientation and these average values shall be reported separately. These values are compared to the required values shown in Appendix A, Table A1, which apply to the standard fabric layup unless otherwise indicated (Appendix B, Tables B2 thru B4).

3.4.5 Tests shall be conducted 40 h minimum after molding and immediately following a conditioning period of 24 h minimum at (23 ± 2) C and (50 ± 5)% relative humidity (RH), unless otherwise specified. All testing shall be done on un-annealed samples.

4 Manufacturing Process

All shipments of material or parts under contract or purchase order manufactured to this specification shall be equivalent in every respect to the initial samples approved by Engineering. There shall be no changes in raw material composition or source, formulation, construction, manufacturing or test methods, or location of manufacture without prior notification and approval by the appropriate GM Material Specialist Team. Lack of notification by the supplier constitutes grounds for rejection of any shipment and/or forfeiture of approval. While samples may be taken from incoming shipments and checked for conformance to this specification, the supplier shall accept the responsibility for incoming shipments meeting this specification without dependence upon purchaser's inspection.

5 Rules and Regulations

5.1 Legal Regulations. All materials must satisfy applicable laws, rules, regulations and recommendations.

5.2 Language. In the event of conflict between the English and domestic language, the English language shall take precedence.

5.3 Inspection and Rejection. Samples of components or materials released to a GM material specification shall be tested for conformity with the requirements of this material specification and approved by the responsible Engineering department prior to commencement of delivery of bulk supplies.

A new approval must be received for any changes, e.g., properties, manufacturing process, location of manufacture, etc. If not otherwise agreed, all testing and documentation normally required for initial release must be completed.

It is the responsibility of the supplier to inform the customer in a timely manner, without solicitation, and to include documentation of all modifications of materials and/or processes and to apply for a new release.

5.4 Safety Data Sheets. Safety Data Sheets (SDS) for chemicals supplied to GM for internal production processes, must be submitted to GM Manufacturing in compliance with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS) requirements or other country-specific SDS requirements.

5.5 Identification. The composite material shall be identified by the specification code, the manufacturer's identification code and lot number, along with any additional vehicle group and component division requirements.

5.6 Material Identification for Recycling Purposes. The material identification code defined per ISO 11469 using symbols and abbreviations given in ISO 1403-1 and ISO 1403-2 is: >EP-(CW+CK+CM)50<.

6 Approved Sources

Materials supplied to this specification must be approved by GM Materials Engineering.

A list of approved materials can be found in the GM Materials Approved Source List (GMMASL). To access this list, reference GMW14270 for latest location. This GM material file is provided to third parties to reduce redundant testing of materials. If an approved material is used, the part supplier can use the GM material file reference for Production Part Approval Process (PPAP) material approval. If the decision is made to use a not yet approved material, contact Materials – Composites Global Subsystem Leadership Team (GSSLT) for details on the approval process. The material approval process must be completed prior to PPAP start date of the part supplied to GM.