GM	WORLDWIDE ENGINEERING STANDARDS	Material Specification	GMW16381

Light Weight Reinforced Thermoplastic Underbody Panel Materials

1 Scope

1.1 Material Description. The material shall be supplied in sheet form with a thickness of 4 mm to 6 mm. The sheet is expandable upon heating and formed to final shape in a compression mold. The material shall be suitable for use in exterior underbody vehicle environments.

1.2 Symbols. Not applicable.

1.3 Applicability. Components made from this material are used to close-off open areas on the underside of the vehicle. They are intended to provide improved aerodynamic performance of the vehicle. The material can be attached to body and frame components with standard mechanical fasteners such as push pins, threaded fasteners, etc.

1.3.1 Limitations on Usage. The materials described in this specification are designed for use in applications where the component will not exceed temperatures of 120 °C. Above this temperature additional insulators or reflectors can be applied and shall be tested in vehicle.

1.4 Remarks. Acoustic grade material shall be designated as GMW16381 Type A. This standard describes the requirements for Light Weight Reinforced Thermoplastic (LWRT) materials used to make panels that are attached to the underside of the vehicle and used to improve the aerodynamics of the vehicle.

2 References

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

2.1 External Standards/Specifications.

ISO 178	ISO 1183	ISO 5084	ISO 9053
ISO 527	ISO 4577	ISO 6603-2	ISO 17025
ISO 1172			

2.2 GM Standards/Specifications.

GMW3059	GMW3221	GMW14124	GMW14700
GMW3182	GMW14093	GMW14270	GMW15725

3 Requirements

3.1 Requirements on Test Specimens. Reference GMW3221.

3.1.1 Test Data. The supplier is responsible for all testing required by this specification. Lab testing is to be performed by a laboratory that conforms to ISO 17025 and is acceptable to the customer (GM). Test reports must conform to ISO 17025 Test Reports and Calibration Certificates.

3.1.2 Data Reporting. If all individual readings of a specific test meet or exceed the specified requirements, report the average. Unless otherwise stated, any individual reading outside the specified limit does not meet the requirement. Report all individual test results that do not meet the requirements.

Any additional test requirements shall be provided to GM upon request (i.e., high speed stress strain and compression curves for use in Computer Aided Engineering analysis).

3.1.3 Samples for Test. All testing shall be conducted on production representative formed parts when possible. Flat panels can be used when required for specific tests and must be representative of production materials and process. All tests on flat panels must be approved in advance by GM Engineering.

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3.1.4 The material used for producing the part shall be tested to the requirements listed in Table 1 and approved in the GM Materials Approved Source List. Each increment of areal weight of the material shall be tested to the requirements of Table 1.

3.1.5 The production part shall meet the performance requirements as listed in Table 2 or as indicated on engineering drawings.

3.2 Areal Weight. Use the procedure described in GMW3182. Test three (3) specimens minimum and report the average in grams per meter squared (g/m^2). Specimens shall be taken from significant areas of the part, especially deep draw or high strain areas. Acceptable production tolerances shall be ± 10%. Any deviation must be agreed to by GM Engineering. Refer to the part drawing for weight specifications.

3.3 Thickness. For fibrous materials use the procedure described in ISO 5084. For solid materials use calipers, micrometers or similar measurement tools. Thickness measurements shall be made from designated areas of the part as shown on the drawing or as defined by GM Engineering. Report the average of three (3) measurements taken from the defined areas. Report the values in millimeters to the nearest 0.1 mm.

3.4 Environmental Cycle. Test an entire part in "vehicle position" mounted in a rack or fixture. Test the part to GMW14124 Cycle F, seven (7) cycles.

The part shall exhibit no objectionable degradation after the test such as; wrinkling, distortion, delaminating, expansion, shrinkage or other change that will interfere with normal function.

3.5 Heat Aging. Test an entire part in "vehicle position" mounted in a rack or fixture in an oven at 120 °C for 400 h. The part shall exhibit no objectionable degradation after the test such as; wrinkling, distortion, delaminating, expansion, shrinkage, or other changes that will interfere with normal function.

3.6 Impact Resistance. Perform impact testing using GMW14093 apparatus B or C codes 1 through 3. Impact a minimum of three (3) points on the part. Impact zones shall include the leading edge of the part and other significant impact susceptible areas or areas as defined by GM Engineering. The impact energy shall be 10 J. Impact testing shall also be conducted at -30 °C, with an impact energy of 5 J. After completion of the test the component shall show no breakage, or cracks or other defects that will interfere with normal function.

3.7 Impact Resistance (Gravelometer). Use the procedure described in GMW14700 Method B. Specimens shall be taken from significant stone impact areas of the part. Specimens shall be subjected to 100 kg of gravel impingement at 90° impact angle, following the conditions listed below:

- As received = after 16 h at 23 °C, 50% Relative Humidity (RH)
- Following 3.5 Heat Aging

The part shall exhibit no objectionable degradation after the test such as; wrinkling, distortion, delamination, shrinkage, folding, cracking or other changes that will interfere with normal function.

3.8 Water and Splash Resistance. Weigh a production part. Completely immerse the part in water for 1 hr. Remove from the water and let the part sit in vehicle position for 24 h. Re-weigh the part. The part weight shall not have increased more than 10% from the original dry weight.

3.9 Laminate Peel Strength. For sandwich or laminated constructions, all layers must meet the minimum peel strength of 750 Nm with cohesive failure of the core. Breaks in the laminate skin are acceptable provided the load at break is 750 Nm minimum. Run the peel tests of the laminated face skins or films at an angle of 90° on a power driven machine with a constant rate of 300 mm/minute jaw separation. Report results for regions of the part designated by GM Engineering. Run the peel test as received, following 3.4 Environmental Cycle, 3.5 Heat Aging, and 3.7 Impact Resistance. Test a minimum of three (3) specimens for each condition**.**

Table 1: Material Requirements (All Tests Performed on Samples 4 mm Thick)

Property	Test Method	Requirement
Fiber Reinforcement, percent (%)	ISO 1172	± 2% absolute
Specific Gravity (s.g.)	ISO 1183	Report
Areal Weight. gram per meter squared (g/m^2)	GMW3182	Target Value 1400 gm/m^2
Flexural Modulus	ISO 178 Method 1	3000 MPa × (s.g.) minimum

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