



WORLDWIDE ENGINEERING STANDARDS

Material Specification

GMW16686

Convertible Fabric

1 Scope

1.1 Material Description. Multi-layer fabric with an inter rubber layer used for convertible soft tops and other exterior trim applications.

1.2 Symbols. This code defines the material construction and will be assigned by the responsible department.

1.3 Applicability. Typical applications for this kind of fabric are convertible soft top covers.

2 References

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

2.1 External Standards/Specifications.

ISO 811	ISO 9001	ISO 105-X12	ISO 14419
ISO 2060	ISO 105-A01	ISO 12219-4	ISO 23910
ISO 2060-C	ISO 105-A02	ISO 12947-1/-2	ISO/IEC 17025
ISO 5084	ISO 105-A03	ISO 13934-1/-2	SAE J2527
ISO 5402	ISO 105-B06	ISO 13937-2	

2.2 GM Standards/Specifications.

GMW3059	GMW3235	GMW4217	GMW14444
GMW3182	GMW3259	GMW4726	GMW14873
GMW3205	GMW3387	GMW6992	GMW15634
GMW3211	GMW3390	GMW14124	GMW15635
GMW3220	GMW3402	GMW14131	GMW16853
GMW3221	GMW3405	GMW14162	
GMW3232	GMW3417	GMW14334	

2.3 Additional References.

- Global Fabric Development Requirements
- Statement of Requirements
- TMC003 Material Safety Data Sheet guidance documents (available at www.gmsupplypower.com).

3 Requirements

3.1 Requirements on Test Specimens. Reference GMW3221.

3.1.1 Standard Conditions (GMW3221-A). All test specimens shall be conditioned to GMW3221-A for a minimum of 24 h, unless the test method indicated that standard conditioning is required or that other conditions apply.

3.1.2 Sampling and Test Specimen Preparation. All test specimens shall be taken from the area beyond the initial 2 m of production and at least 50 mm from either selvage edge. Prepare test specimen as required in the respective test method.

3.1.3 Visual Evaluation of Automotive Trim. (GMW6992). The color, pattern, aesthetics and other related qualities shall be evaluated and approved by the responsible engineering department as an acceptable match to the engineering approval sample when viewed under conditions set forth in GMW6992.

3.1.4 Deviation from Defined Test Methods. Deviations from the conditions of any test method shall be agreed upon between supplier and vehicle manufacturer. All deviations shall be specified on the component drawings, material construction specification form, and Statement of Requirements and shall be indicated as such on test certificates and reports.

3.1.5 Documentation. Samples of components or material released to this specification shall be tested for conformity with the requirements of this specification and approved by the responsible GM department prior to the start of delivery of production level components or materials.

3.1.5.1 Any change to the component or material, e.g., design, function, properties, manufacturing process and/or location of manufacture, requires a new release of the product. It is the sole responsibility of the supplier to provide the customer, unsolicited, with documentation of any change or modification to the product/process, and to apply for a new release.

3.1.5.2 If not otherwise agreed to, the entire verification test shall be repeated and documented by the supplier prior to start of delivery of the modified or changed product. In some cases, a shorter test can be agreed to between the responsible GM department and the supplier.

3.1.6 Laboratory Accreditation. Laboratory testing shall be performed by a laboratory that conforms to ISO/IEC 17025 or ISO 9001 or other third party accreditation and is acceptable to the GM Materials Engineer. Supplier shall submit documentation showing proof of accreditation.

3.1.7 Material Construction Specification. All required information shall be reported on the Convertible Fabric Construction Specification Form (Appendix A). A specification form shall be submitted along with each fabric and fabric composite for engineering construction or laminate approval. Established values for a construction will be reported on and controlled within the limits established on the Convertible Fabric Construction Specification Form. Additional copy of this form is also available at GM Supply Power.

3.1.8 Laboratory Data Forms. All required information shall be reported on the appropriate test data reporting forms per Appendix B1 and Appendix B2. Submit all required test specimens. These forms are available at GM Supply Power.

3.1.8.1 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.

3.1.8.2 Test Specimens. All tested specimens submitted to GM by suppliers shall be stapled to one (1) A4 (8 ½ in × 11 in) white cardstock. On each card, list the test report number, material specification and section number, test date, observations, and disposition.

3.2. Construction Requirements for All Applications. These requirements describe the initial testing to be completed for a new fabric construction. A construction and color approval is valid when the testing in 3.2 and 3.3 is complete.

Note: Part processability may require different construction properties than those listed in 3.2 through 3.2.31. At the approval of the appropriate GM engineer, deviations may be given in order to meet the part processability requirements. Any deviations shall be documented on the Convertible Fabric Construction Specification Form, (Appendix A) as well as in the Appearance Database.

3.2.1 Structure. To be specified by construction (e.g., fabric, flat knit), binding and surface treatment for each layer, if applicable.

3.2.2 Weight per Unit Area to GMW3182. Report the average in grams per square meter (g/m²) for the outer and inner face fabric and the total weight of the laminate.

3.2.3 Total Thickness to ISO 5084. Report the average of five (5) specimens in millimeters (mm) to the nearest 0.01 mm. All readings should be taken after the presser foot has been in contact with the material for at least 5 s.

3.2.4 Composition. To be specified in percent (%) by mass for each layer. Nomenclature according to International Union of Pure and Applied Chemistry (IUPAC).

3.2.5 Yarn Count to ISO 2060. Report the average count to the nearest yarn for the outer and inner fabric, for each direction.

3.2.6 Yarn Density to ISO 2060-C. Report the yarn density for the outer and inner face fabric, for each direction.

3.2.7 Breaking Force and Breaking Force Tension to ISO 13934-1/-2. Test with a velocity of 100 mm/minute and a preload of 5 N. To be tested in as-received condition, after Artificial Weathering, after Heat Ageing, and Humidity Ageing. Test five (5) specimens each from the machine direction (MD), cross machine direction (CMD), and bias left and bias right directions. Report the average tensile strength at break, and average elongation at 25 N, 50 N, and 100 N in each direction. Established values will be reported on and controlled within the limits established on the Convertible Fabric Construction Certification Data Form (Appendix A).

3.2.8 Stretch and Set to GMW3211. Test five (5) specimens from the MD and five (5) from the CMD; report the average of each direction. Load duration 30 minutes.

3.2.9 Stich Tear Out Resistance to ISO 23910. The specimen shall be pulled at a speed of 100 mm/minute $\pm$ 10 mm/minute. The maximum force occurring during the tearing-out of the penetrator (needle) shall be measured. Report the averaged measurements individually for each direction, rounded to the nearest 0.5 N.

3.2.10 Tear Force, Trouser Method to ISO 13937-2. To be tested in as-received condition, after Artificial Weathering, Heat Ageing, and Humidity Ageing. Test both MD and CMD directions. The electronic method of calculation shall be used.

3.2.11 Seam Fatigue to GMW3405. The joining seam of a fabric shall have no slippage (increased distance between rows of yarns), noticeable fiber or yarn breakage, fractures of the sew line, needle hole elongation >2 mm, nor an objectionable seam appearance after 2500 cycles. Seam appearance shall be judged on a sew line when observed from the face side. Seam evaluation may also be conducted on the sewn assembly and disposition made in accordance with these results. Indicate the sewing needle used to sew the test specimens on the test report; use of any other needle than what is recommended in the test procedure shall be approved by the GM Materials Engineer.

3.2.12 Bond Strength to GMW3220. Test three (3) specimens from the MD and three (3) specimens from the CMD, and report the average. Bond strength shall be taken in as-received condition, after Artificial Weathering and Humidity Ageing. To etch the laminate edges before testing, use a solvent (Toluene).

3.2.13 Waterproofness to ISO 811 Test five (5) specimens and report the average water head in centimeters (cm). Waterproofness shall be tested in as-received condition and after Humidity Ageing.

3.2.14 Flexural Stiffness to GMW3390. Five (5) specimens shall be tested from each direction for bending length only. Report the average for MD and CMD, face up only.

3.2.15 Flexibility to ISO 5402. Test in as-received condition and after Artificial Weathering in standard climate and at -10 °C. Specimens shall be visually evaluated for objectionable signs of degradation, including cracking, wrinkling, blistering, yarn breakage or loss of layer adhesion, or other undesirable effects.

3.2.16 Resistance to Wear to ISO 12947-1/-2. To be tested in as-received condition, after Artificial Weathering and Humidity Ageing. Three (3) specimens shall be tested. Pressure applied is 12 kPa. Test for 50 000 cycles. Test outer face to outer face and inner face to inner face material. Blow specimen before rating. No holes are allowed and the rating on the ISO 105-A02 shall be ≥ 3 .

3.2.17 Resistance to Crocking to ISO 105-X12. The results shall be ≥ 4 when compared to ISO 105-A03 after ten (10) strokes to and fro for both wet and dry conditions. For wet testing, use a 65% $\pm$ 5% wet pick-up of the crocking cloth. Test both, outer and inner face fabric.

3.2.18 Impregnation to GMW4726. Report the rating for each test specimen and the average rating of the three (3) test specimens. The requirement is ≥ 8 .

3.2.19 Dimensional Stability to GMW4217 and GMW14124. Dimensional change shall be $\leq 0.3\%$ in the machine direction (MD) and cross machine direction (CMD). The specimen shall exhibit a satisfactory rating, which is no degradation or no delamination of the layers. Color change of the rubber layer that does not affect the appearance of the inner and/or outer face fabric is allowed.

3.2.19.1 Dimensional Stability to GMW4217. Test one (1) specimen using the wet condition. Test another specimen using the dry condition. For both the wet and dry condition, test the specimens twice. Report the dimensional changes for both wet and dry conditions after the first (1st) and second (2nd) test.

3.2.19.1.1 Report curl at completion of the second (2nd) cycle as directed in GMW4217.

3.2.19.2 Resistance to Automotive Environmental Cycling to GMW14124 Cycle C. The specimens shall be exposed to all conditions of the cycle two (2) times. Measure the specimen while it is at each condition (e.g., hot condition, humidity condition, cold and ambient). Report the dimensional change after each condition.

3.2.20 Colorfastness to Artificial Light to SAE J2527. Outer face fabric side shall be exposed to 2500 kJ/m² and 5000 kJ/m². A rating of ≥ 4 per ISO 105-A02 after 5000 kJ/m² is required. Evaluate per ISO 105-A01. A noticeable chroma (saturation) change with minimum hue change is acceptable. Evaluate specimens as specified in GMW6992.

Note: If inner face fabric is not covered when convertible roof is open, test also inner face fabric. The inner face fabric shall be exposed to 2500 kJ/m² only. A rating of ≥ 3 per ISO 105-A02 is required. Evaluate per ISO 105-A01. A noticeable chroma (saturation) change with minimum hue change is acceptable. Evaluate specimens as specified in GMW6992.

Note: Natural Weathering may be used in place of artificial weathering results at the discretion of the materials engineer.

3.2.21 Colorfastness to Artificial Light to GMW14162, Cycle B or ISO 105-B06, Condition 5. For inner face fabric only, choose either test method as available. If using GMW14162, Cycle B, samples prepared shall be exposed to 28 MJ/m². If using ISO 105-B06, condition 5 samples prepared shall be exposed to 225.6 kJ/m². For either test method, a rating of ≥ 3 per ISO 105-A02 is required. Evaluate per ISO 105-A01. A noticeable chroma (saturation) change with minimum hue change is acceptable. Evaluate specimens as specified in GMW6992.

Note: Natural weathering may be used in place of artificial weathering results at the discretion of the materials engineer.

3.2.22 Humidity Ageing to GMW14124, Cycle Q. There shall be no mildew, staining, or discoloration of material after exposure.

3.2.23 Heat Ageing. Age the specimen for 168 h at 115 °C. Evaluate the specimen after it has reached room temperature. There shall be no objectionable degradation or discoloration of material after exposure.

3.2.24 Resistance to Chemicals to GMW14334 B and C. No ring formation, surface, or haptic change is allowed.

3.2.25 Mildew to GMW3259. There shall be no visible growth or odor of mildew.

3.2.26 Emission Testing to GMW16853. For required tests, procedures, and limits, refer to GMW16853: "Overview of Test Procedures" required for the Individual Materials and Part Approvals, and, "Emission Requirements for Interior Material/Parts/Assembly List".

Note: Covered by Emission Testing are the following vehicle interior air quality requirements. Odor, according to GMW3205, fogging, according to GMW3235, volatile organic/semi-volatile organic compound (VOC/SVOC), according to GMW15634, aldehyde and ketone emissions according to GMW15635, amine compatibility according to GMW14131 and for large size components, test according to ISO 12219-4.

• **Application - Code E Parts Only.** See GMW16853 or GMW14444 for explanation.

3.2.27 Soil and Cleaner Resistance to GMW3402. Test only soiling agents A, B, E, H and I. Test both inner and outer face fabric. The requirement is ≥ 6 for any required soil and ≥ 8 for the average of all required soils. No ring formation or haptic change is allowed.

3.2.28 Flammability to GMW3232.

3.2.29 Oil Repellency to ISO 14419. A rating of ≥ 3 is required.

3.2.30 Natural Weathering to GMW14873. A rating of ≥ 4 per ISO 105-A02 after 24 months is required. A rating of ≥ 3 per ISO 105-A02 after 60 months is required. There shall be no other undesirable effects.

Note: For inner face layer test, Natural Weathering to GMW3417 for information only for 100% polyester fabrics.

3.2.30.1 GM is responsible for conducting the natural weathering testing. Suppliers shall submit one (1) A4 (8 ½ in × 11 in) white cardstock sample of material to the responsible engineer at the developing region. This sample must be from the same lot of material that is tested for construction, and shall be submitted along with the construction properties test sample submission package. The sample shall be labeled, "For Natural Weathering Test" and include the supplier's name, piece number, date, and GM Finish Symbol, and color number. GM will perform the specified natural weathering test on this sample and advise the supplier of compliance or lack of compliance to the requirement.

3.2.31 Fiber Degradation to GMW3387 after Artificial Weathering. Test the specimens from 3.2.20 and 3.2.21 for fiber degradation at the required and the highest exposure levels (if higher than the required exposure level). Evaluate per ISO 105-A01. A rating of ≥8 is required. A rating of ≥4 is required for the highest level of exposure if higher than the required level.

3.3 Color Requirements. These requirements describe the testing to be completed for each fabric color once the initial construction has been approved. This testing may be done on a fabric material or on a fabric composite following the initial construction approval. All construction requirements are expected to match the initial construction approval even though these properties are not all retested for each color. Evaluate per ISO 105-A01.

3.3.1 Resistance to Wear to ISO 12947-1/-2. See 3.2.16.

3.3.2 Resistance to Crocking to ISO 105-X12. See 3.2.17.

3.3.3 Colorfastness to Artificial Light. See 3.2.20 and 3.2.21.

3.3.4 Resistance to Chemicals to GMW14334. See 3.2.24.

3.3.5 Soil and Cleaner Resistance to GMW3402. See 3.2.27.

3.3.6 Flammability to GMW3232. See 3.2.28.

3.3.7 Oil Repellency to ISO 14419. See 3.2.29.

3.3.8 Natural Weathering to GMW14873. See 3.2.30.

3.3.9 Fiber Degradation to GMW3387. See 3.2.31.

4 Manufacturing Process

4.1 Part Performance (GMW14444). All fabrics covered by this specification are subject to part performance testing through part validation.

4.2 Processability. Part supplier to evaluate cut, sew and processability and report evaluation to GM Materials Engineering. Successful completion of processability is required for Full Construction Approval of the fabric. Processability to be documented on the proper forms available from GM Supply Power.

4.3 Manufacturer's Identification. See Global Fabric Development Requirements document available from GM Supply Power.

4.4 Quality Control Monitoring. See Global Fabric Development Requirements document available from GM Supply Power.

4.5 Roll Direction. To be specified by the fabric supplier and communicated to all purchasers of their material. Roll direction must also be indicated on the material used for Production Part Approval Process (PPAP) Masters.

4.6 Defect Flagging and Allowance. See Global Fabric Development Requirements document available from GM Supply Power.

5 Rules and Regulations

5.1 Legal Regulations. All materials must satisfy applicable laws, rules, regulations and recommendations valid in the country of usage.

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.

If not otherwise agreed, all release tests shall be repeated and documented by the supplier prior to commencement of delivery of non-conforming bulk supplies. In individual cases, a shorter test can be agreed to between the responsible Engineering department and the supplier.

5.4 Material Safety Data Sheets/Safety Data Sheets (MSDS/SDS). For new product submissions, or when a change in chemical composition of an existing product has occurred, a complete copy of the Material Safety Data Sheet/Safety Data Sheet must be submitted in compliance with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS) requirements or other country-specific MSDS/SDS requirements. In addition, product MSDS/SDS submissions must be in compliance with specific country General Motors TMC003 Material Safety Data Sheet/Safety Data Sheet guidance documents where available.

5.5 All materials supplied to this standard must comply with the requirements of GMW3059, Restricted and Reportable Substances for Parts.

6 Approved Sources

Materials supplied to this specification must be approved by General Motors.

A list of approved materials can be found in the Appearance Database. This GM Material File is provided to third parties to reduce redundant testing of materials. If approved material already listed is used, the part supplier can use 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 the Textiles/Trim Materials Subsystem Leadership Team for details on the approval process. The material approval process must be completed prior to PPAP start date of the part supplied to General Motors.

7 Notes

7.1 Glossary.

Composite: Fabric or fabric laminate that is 100% bonded to a part substrate.

L*: Lightness value according to CIELAB (color scale).

Laminate: Face fabric that is 100% bonded to any combination of foam, scrim, film, nonwoven sheeting.

MATSPC: Global repository of GM approved materials for corresponding GM Engineering Standards.

7.2 Acronyms, Abbreviations, and Symbols.

#	Number
Acc.	According
CMD	Cross Machine Direction
GHS	Globally Harmonized System of Classification and Labeling of Chemicals
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
IUPAC	International Union of Pure and Applied Chemistry
MD	Machine Direction
MSDS	Material Safety Data Sheet
No.	Number
PPAP	Production Part Approval Process
SAE	SAE International