



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.

1.4 Remarks. Not applicable.

2 References

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

2.1 External Standards/Specifications.

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

2.2 GM Standards/Specifications.

GMW3059	GMW3232	GMW3405	GMW14270
GMW3182	GMW3235	GMW4090	GMW14334
GMW3205	GMW3259	GMW4217	GMW14873
GMW3211	GMW3387	GMW4726	GMW15634
GMW3220	GMW3390	GMW6992	GMW15635
GMW3221	GMW3402	GMW14124	GMW16853

2.3 Additional References.

- Global Fabric Development Requirements
- GM SupplyPower can be found at <https://gmsupplypower.covisint.com>
- International Union of Pure and Applied Chemistry (IUPAC) can be found at <https://iupac.org/>

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 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 Modifications. 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 Re-Verification. 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 (see Appendix A, Data Sheet A1). A specification form shall be submitted along with each fabric for engineering construction 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 on GM Supply Power.

3.1.8 Laboratory Data Forms. All required information shall be reported on the appropriate test data reporting forms per Convertible Fabric Construction Certification Appendix B, Data Sheet B1, and Convertible Fabric Color Certification Appendix B, Data Sheet B2. Submit all required test specimens. These forms are available on GM SupplyPower at <https://gmsupplypower.covisint.com>.

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 1/2 in x 11 in) sheet of 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 3.2.30. 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, (see Appendix A, Data Sheet A1) as well as in the GM Materials and 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 construction. Total weight shall be ≥ 800 g/m².

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. Total thickness shall be ≥ 1 mm.

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) (see 2.3).

3.2.5 Yarn Count to GMW4090. 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 Elongation to ISO 13934-1. Test with a velocity of 100 mm/minute and a preload of 5 N. To be tested in as-received condition, after Exterior Thermal Cycling, after Heat Ageing, and Humidity Ageing. Test five (5) specimens each from the Machine Direction (MD) and Cross Machine Direction (CMD). Report the average tensile strength at break and average elongation at 50 N, in each direction. The as-received tensile strength at break shall be ≥ 1800 N/5cm in the MD and ≥ 1300 N/5cm in the CMD. The tensile strength at break shall be a minimum of 70% of the as-received condition after Exterior Thermal Cycling and 95% of the as-received condition after Heat Ageing and Humidity Ageing.

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. See the Construction Specification Form for the individual construction stretch requirements. The set value shall be $\leq$ to 1% in the MD and $\leq$ 2.5% in the CMD.

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. The tear out force shall be $\geq$ to 135 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. The tear force at all conditions shall be a minimum of 50 N.

3.2.11 Seam Fatigue to GMW3405. Test in the MD, CMD, and MD/CMD. 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 Exterior Thermal Cycling, and after Humidity Ageing. To etch the edges before testing, use a solvent (Toluene). The bond strength shall be $\geq$ to 60 N for all conditions.

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. Requirement is ≥ 70 mm in the as-received condition with no degradation 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. See the Construction Specification Form for the individual construction flexural stiffness requirements.

3.2.15 Flexibility to ISO 5402. Test in as-received condition and after Exterior Thermal Cycling, both in standard conditioning (GMW3221-A) and at -10 °C. Tests shall be run in standard conditioning for 25 000 cycles and at -10 °C for 5000 cycles. 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. Outer face fabric to be tested in as-received condition, after Exterior Thermal Cycling, and after Humidity Ageing. Inner face fabric to be tested in as-received condition only. Three (3) specimens shall be tested for each condition, at 1000 cycles, 25 000 cycles, and 50 000 cycles. Pressure applied is 12 kPa. Test outer face fabric to outer face fabric and inner face fabric to inner face fabric. Aged specimen may be cleaned before testing with a soft brush and cleaning solution to eliminate artificial buildup of surface finish. Blow specimen before rating. No holes are allowed and the rating on the ISO 105-A02 shall be ≥ 5 for 1000 cycles, ≥ 4 for 25 000 cycles, and ≥ 3 for 50 000 cycles.

3.2.17 Resistance to Crocking to ISO 105-X12. Test both, outer and inner face fabric. 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.

3.2.18 Impregnation to GMW4726. Test three (3) specimens and 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. The specimen shall exhibit a satisfactory rating, which is no degradation or 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. The requirement is $\leq 0.3\%$ for all conditions.

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

3.2.19.2 Resistance to Automotive Exterior Thermal 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. The requirement is $\leq 0.5\%$ for all conditions.

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

3.2.21 Fiber Degradation to GMW3387 after Artificial Light Exposure. Test the specimens from 3.2.20 for fiber degradation at the required exposure level. A rating of ≥ 6 is required.

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.

- **Application - Code E Parts Only.** See GMW16853 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. For initial approvals and routine quality control, see GMW3232. After completion of the flammability test, record results in millimeter/minute and attach the Flammability Test Report from GMW3232, Appendix B. Requirement is a Maximum Statistical Burn Rate (BStat) value is ≤ 100 mm/minute.

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

3.2.30 Natural Weathering to GMW14873. To be tested by the supplier and submitted separately to the GM materials engineer once complete. 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. This test is to be run for information only. Material approval will be granted based on Color Fastness to Artificial Light results unless otherwise specified by the GM materials engineer.

3.3 Color Requirements. These requirements describe the testing to be completed for each fabric color once the initial construction has been approved. All construction requirements are expected to match the initial construction approval even though these properties are not all retested for each color.

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.

3.3.4 Fiber Degradation to GMW3387. See 3.2.21.

3.3.5 Resistance to Chemicals to GMW14334. See 3.2.24.

3.3.6 Soil and Cleaner Resistance to GMW3402. See 3.2.27.

3.3.7 Flammability to GMW3232. See 3.2.28.

3.3.8 Natural Weathering to GMW14873. See 3.2.30.

3.4 All materials supplied to this standard must comply with GMW3059, **Restricted and Reportable Substances**, including the requirement to obtain a GM-approved International Material Data System (IMDS) submission.

4 Manufacturing Process

4.1 Part Performance. 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. 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.

6 Approved Sources

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

A list of approved materials can be found in the GM Materials Approved Source List. 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,