



Automotive Environmental Cycles

1 Introduction

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. This procedure documents various environmental cycles and aging conditions that may be performed prior to testing or as a complete test. This specification does not include standard conditions for testing or preconditioning prior to testing. Those requirements may either be found in the material specification or in GMW3221.

1.2 Applicability. Refer to Table 1 for applicability.

Note: Some of the test cycles in this specification are best used as a quality control test and are not meant to validate potential field performance. See the platform materials engineer for additional details.

1.3 Remarks. This procedure documents several cycles that have been globally agreed upon for material specifications. Only those cycles shall be selected to create requirements for GMW material specifications. The globally agreed upon cycles for material specifications are: Cycles M, Q, R, S, T, U, V and W. For test cycle uses, see 4.1.2.

1.3.1 Exposure environments, cycle durations, and the applicable tolerances are generally defined in the sections and tables that follow. However, prior to the initiation of testing these variables should be confirmed by reviewing the applicable material specification, test procedure, or by verifying the test cycle with the requesting engineer.

2 References

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

2.1 External Standards/Specifications.

ISO 9227 VDA 621-415

2.2 GM Standards/Specifications.

GMW3221 GMW14444 GMW15288
GMW3286 GMW14729

3 Resources

3.1 Facilities.

3.1.1 Calibration. The test facilities and equipment shall be in good working order and shall have a valid calibration label.

3.1.2 Alternatives. Alternative test facilities and equipment may also be used. However, all measuring variables as specified in this standard shall be determined correctly with respect to their physical definition.

3.2 Equipment.

3.2.1 Mechanical Convection Oven capable of maintaining the required temperature from the material specification to a tolerance of $\pm 3^\circ\text{C}$.

3.2.2 Humidity Chamber capable of maintaining the required humidity from the material specification to a tolerance of $\pm 3\%$.

3.2.3 Salt Spray Cabinet consisting of a fog chamber, salt solution reservoir, a supply of suitably conditioned compressed air, one or more atomizing nozzles, specimen supports, provisions for heating the chamber and

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necessary means of control. The size and detailed construction of the salt spray cabinet are optional provided the conditions obtained meet the requirement of this method. A suitable apparatus is described in ISO 9227.

3.2.4 Cold Room or Cold Chamber with port holes capable of maintaining the required temperature from the material specification to a tolerance of $\pm 3^\circ\text{C}$.

3.2.5 Rack or Fixture required supporting the test specimens between 15 and 30 degrees from the vertical position in such a manner as to prevent contact between the test specimens or any metallic material capable of creating a galvanic couple.

3.2.6 Steam Autoclave capable of maintaining the required temperature to within $\pm 2^\circ\text{C}$ and able to withstand pressures of up to 1.5 bars (150 kPa) above atmospheric (i.e., 2.5 bar absolute). The autoclave must be capable of venting at the completion of the test to prevent undue frothing of water upon opening the chamber.

3.3 Test Vehicle/Test Piece. Not applicable.

3.4 Test Time. See Section 4 for test times of various test cycles.

3.5 Test Required Information. Not applicable.

3.6 Personnel/Skills. Not applicable.

4 Procedure

This document is not a specific test procedure. It provides various aging conditions and cycles that may be referenced from other specifications. These cycles shall be performed as required in the applicable specification. Some aging cycles may require that the material be tested at the temperature specified. When this procedure is referenced, always follow all applicable instructions for cycles, combinations of cycles, or aging and cycle combinations from the source document.

4.1 Preparation.

4.1.1 Cut the required number of specimens from the sample to the dimensions specified in the material specification.

Note: The material specification may require specimens that have been exposed to cycling or aging be conditioned for a minimum of 24 h to the requirements of GMW3221 prior to testing.

Note: Gloves shall be worn while handling specimens in the cold chamber to prevent heat transfer to the specimens. If testing is not done in a cold room, it must be done in a cold chamber using port holes. Testing in a cold chamber with the door open will not maintain the required temperature.

4.1.2 Test Cycle and Applicability.

Table 1: Test Cycle Uses Note 1, Note 2, Note 3

Test Cycle	QC Test	Validation Test	Use
A	X	X	Coating evaluation - stress before adhesion test
B			There is no Cycle B test
C	X	X	Exterior above beltline humidity/temperature test
D	X		Interior above beltline humidity/temperature test
E	X		Interior below beltline humidity/temperature test
F	X	X	Exterior below beltline humidity/temperature test
G	X		Corrosion Resistance
H	X		Dimensional stability of headliners and interior components
I	X	X	Glass bonding/paint material test
J		X	Corrosion resistance
K	X		Exterior sealant, substrate and/or coating test
L			Sealant resistance to gasoline

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Test Cycle	QC Test	Validation Test	Use
M		X	Dimensional stability of interior trim - finished
N	X		Dimensional stability of interior trim - textiles
O	X	X	Paint layer cracking
P	X	X	Delamination/dimensional stability of covered door trim-unsupported plastic rolled goods
Q	X	X	Delamination/yellowing, grin through of headliner and laminated fabrics
R	X	X	Shrinkage of upholstery materials used for wrapping instrument panel (IP) and rear window trim (RWT)
S	X	X	Accelerated aging for physical change of leather/plastic rolled goods
T	X	X	Delamination/yellowing, grin through of headliner and laminated fabrics
U	X	X	Corrosion resistance and creepback/edge corrosion for organic coatings
V	X	X	Corrosion resistance and creepback/edge corrosion for organic coatings
W	X		Exterior/Interior adhesive/sealant humidity/high temperature test
X	X	X	Shrinkage of IPs with genuine leather trim

Note 1: Quality Control (QC) Test - No defined correlation to field performance.

Note 2: Validation Test - Field relevant test, cyclic environments represent severe field exposure.

Note 3: Some of the test cycles in this specification are best used as a quality control test and are not meant to validate potential field performance. See the platform materials engineer for additional details.

4.2 Conditions.

4.2.1 Environmental Conditions.

4.2.2 Test Conditions. Deviations from the requirements of this standard shall have been agreed upon. Such requirements shall be specified on component drawings, test certificates, reports, etc.

4.3 Instructions.

4.3.1 When this specification appears on an engineering drawing, actual parts coated with the representative paint system shall be used.

4.3.2 If not on an engineering drawing, the test specimens can be parts or panels. If test panels are used, the recommended panel size is 100 × 300 mm.

4.3.3 Support panels or specimens on a rack so that they will be held in a position of 15 degrees to 30 degrees from the vertical position avoiding contact between each other during the test. Test panel/part orientation shall be such that it is not shingled or shielded by another test specimen or test equipment. Test specimens that are to be evaluated for warpage and dimensional stability shall be mounted in a production intent manner.

4.3.4 Expose the test specimens to one or more cycles designated by the appropriate material specification or engineering drawing.

4.4 Procedure.

4.4.1 Mount the component in an appropriate test fixture (production intent orientation) using production fastening techniques.

4.4.2 Subject the component to applicable cycle (refer to paragraph 4.5 for cycles and application).

4.4.3 Evaluation.

4.4.3.1 Evaluate component per engineering drawing or material specification.

4.4.4 Results. Requirements to be specified on engineering drawing or material specification.

4.5 Cycles and Application.

4.5.1 Environmental Cycles A and C through W (there is no Cycle B) are illustrated in Tables 2 through Table 20.

4.5.2 Cycle A, Moisture and Cold Cycle. This cycle is used to evaluate the coatings or to stress the surface before adhesion test, unless otherwise specified. This test requires 15 cycles be run and then test results evaluated. Evaluate periodically prior to the completion of test during the ambient conditions exposure (See Table 2).

4.5.3 Cycle C, Exterior Humidity Thermal Cycle. To be used for exterior components above beltline (See Table 3). Unless otherwise specified two complete cycles shall be run for evaluation.

4.5.4 Cycle D, Interior Humidity Thermal Cycle. To be used for interior components above beltline (See Table 4). Run one cycle for evaluation unless otherwise specified.

4.5.5 Cycle E, Interior Humidity Thermal Cycle. To be used for interior components below beltline (See Table 5). Run one cycle for evaluation unless otherwise specified.

4.5.6 Cycle F, Exterior Humidity Thermal Cycle. To be used for exterior component below beltline (See Table 6). Material specification shall specify the number of cycles to be run to evaluate.

4.5.7 Cycle G, Environmental Corrosion Cycle. To be used to evaluate environmental corrosion resistance of materials. Unless otherwise specified, run 30 cycles to evaluate (See Table 7).

4.5.8 Cycle H, Dimensional Stability Test Cycle. To be used to test the dimensional stability of headliners and other interior components including attaching mechanism (See Table 8). Unless otherwise stated, 7 complete cycles shall be run to evaluate along with 168 h at 85 °C on a separate part.

4.5.9 Cycle I, Glass Bonding/Paint Test Cycle. To be used to evaluate stationary glass bonding and paint materials. Unless otherwise specified, run 5 cycles to evaluate (See Table 9).

4.5.10 Cycle J, Environmental Corrosion Cycle. This is combination of GMW14124, Cycle G and Scab Corrosion Cycle, GMW15288 to be used for accelerated corrosion resistance test. Unless otherwise specified, repeat the cycle 5 times (10 weeks total) to evaluate (See Table 10).

4.5.11 Cycle K, Exterior Sealant, Substrate and/or Coating Test Cycle. To be used to evaluate exterior sealant and/or coatings. Unless otherwise specified, run 13 cycles to evaluate (See Table 11).

4.5.12 Cycle L, Gasoline Dip Test Cycle. To be used for sealants exposed on an intermittent basis. Unless otherwise specified, run 5 cycles to evaluate (See Table 12).

4.5.13 Cycle M, Interior Trim Dimensional Stability Cycle. To be used to evaluate the dimensional stability of finished interior trim panels. Unless otherwise specified, run 2 cycles to evaluate (See Table 13).

4.5.14 Cycle N, Interior Trim Dimensional Stability Cycle. To be used to evaluate the dimensional stability of textile materials on interior trim panels. Unless otherwise specified, run 1 cycle (See Table 14). Evaluate parts after exposure to each environment.

4.5.15 Cycle O, Paint Crack Cycle. To be used to evaluate the potential for paint layering systems to crack. Unless otherwise specified, run 10 cycles (See Table 15). Evaluate panels for cracking after each cycle.

4.5.16 Cycle P, Covered Door Panel Delamination/Dimensional Stability Cycle. To be used to evaluate the potential for delamination and the dimensional stability of door trim covered with unsupported rolled goods. Unless otherwise specified, run 2 cycles (See Table 16). Parts should be full assemblies, mounted on the metal outer panel with all seals, etc., in place. Test in car position. Evaluate parts after exposure to each environment.

4.5.17 Cycle Q, Aging Condition for Bond Strength and Hydrolytic Stability of Laminated Textile Materials (this cycle is an option to Cycle T). To be used as an aging cycle to compare original bond strength to after aging; also used as a method to test hydrolytic stability of laminated textile materials (See Table 17).

4.5.18 Cycle R, Shrinkage of Upholstery Materials used for Wrapping Instrument Panels (IP) and Rear Window Trim (RWT). To be used to monitor the dimensional changes as permanent shrinkage or other effects from the cycle (See Table 18).

4.5.19 Cycle S, Accelerated Aging of Leather and Plastic Rolled Goods. To be used to evaluate leather or plastic rolled goods after exposure to heat; humidity and cold (See Table 19).