



Colorfastness to Artificial Weathering

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. This test method shall be used to determine the effects of weathering using a xenon-arc lamp source (artificial sunlight) to simulate extreme environmental conditions encountered inside a vehicle due to sunlight, heat and humidity. This method shall be used to evaluate the colorfastness, as well as being the artificial weathering method to evaluate degradation.

This method describes four possible exposure cycles:

Method A. Light and Dark Exposure Cycle (100 °C, 420 nm). The cycle alternates between light and dark periods. This cycle is based on ISO 105-B06 exposure condition Number Three.

Method B. Light Only Exposure Cycle (100 °C, 300 to 400 nm). This cycle is based on ISO 105-B06 exposure condition Number Three.

Method C. Light Only Exposure Cycle (115 °C, 300 to 400 nm). This cycle is based on ISO 105-B06 exposure condition Number One.

Method D. Light and Dark Exposure (89 °C, 340 nm). The cycle alternates between light and dark periods. This cycle is based on ISO 105-B06 exposure condition Number Five (SAE J1885/SAE J2412 equivalent with SAE J2413 as the companion document).

1.2 Foreword. This test method was developed by the Global Textile Team to create a common method for evaluating colorfastness to artificial weathering.

1.3 Applicability. Not applicable.

2 References

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

2.1 External Standards/Specifications.

ISO 105-A02	SAE J2412
ISO 105-B06	SAE J2413
ISO 4892-1	SAE J2414
SAE J1885	

2.2 GM Standards/Specifications.

GMW6992

2.3 Additional References. None.

3 Resources

3.1 Facilities. Not applicable.

3.2 Equipment.

3.2.1 Method A. Test equipment, according to ISO 105-B06, with the following machine setup shall be used:

3.2.1.1 Filters.

- Inner filter: Type S Borosilicate
- Outer filter: Soda Lime

Appendix A defines the Spectral Power distribution for Type "S" Borosilicate/Soda Lime filter combination for Method A.

3.2.1.2 Temperature Sensor. Black Standard Temperature (BST).

3.2.1.3 Chamber (Dry Bulb) Temperature. Active.

3.2.1.4 Rack Panel Temperature. Active.

3.2.1.5 Radiation. Controlled at 420 nm.

3.2.2 Method B. Test equipment according to ISO 105-B06 with exposure apparatus B or C shall be used.

3.2.3 Method C. Test equipment according to ISO 105-B06 with exposure apparatus B with 4IR+3WG or 10 WG filter system shall be used.

3.2.4 Method D. Test equipment according to ISO 105-B06 for exposure condition Number Five or SAE J2414/SAE J2413.

3.2.5 White-Standard Thermometer. The White Standard thermometer is in accordance with the Black Standard thermometer of ISO 105-B06. However, the metal plate is provided with a white cover according to ISO 4892-1.

3.3 Test Vehicle/Test Piece. Test material according to ISO 105-B06 shall be used.

3.4 Test Time. The timing will be set based on the material specification requirement.

3.5 Test Required Information. Not applicable.

3.6 Personnel/Skills. Not applicable.

4 Procedure

Test specimens are exposed in a xenon-arc weathering device to artificial weathering conditions which simulate extreme environmental conditions encountered inside a vehicle due to sunlight, heat, and/or humidity. Test specimens are then evaluated for colorfastness (fade) or other modes of degradation.

4.1 Preparation. Test samples shall be prepared according to ISO 105-B06.

A conditioning to GMW3221 **Standard Conditioning of Organic Materials** is not required.

4.2 Conditions.

4.2.1 Environmental Conditions. See 4.3.1.

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 Exposure Conditions.

4.3.1.1 Method A. Exposure conditions according to ISO 105-B06 Condition Three, but with parameters according to Table 1. Exposure begins in the Dark Period. The Dark and Light Periods are alternated until the required exposure level of kilojoules per square meter (kJ/m^2) is met. The timing for the Light Period only is calculated from the required radiant exposure as:

$$t = \frac{Q}{E \times 3.6}$$

Where:

Q is the radiant exposure expressed in kilojoules per square meter

E is the irradiance expressed in watts per square meter (or joules per square meter second)

t is the time expressed in hours

3.6 is the conversion factor expressed in kiloseconds per hour

Appendix B identifies timing for typical required irradiation values.

Table 1: Exposure Conditions for Method A

	Dark Period ("Light Off" Period) <small>Note 1</small>	Light Period ("Light on" Period) <small>Note 1</small>
Duration = (Time/Irradiation)	1 h	3.8 h at 1.2 W/m^2 at 420 nm
Test chamber temperature, °C	38 ± 2 °C	65 ± 3 °C
Black Standard Temperature, °C	38 ± 2 °C	100 ± 3 °C
Relative humidity in test chamber, %	$95 \pm 2\%$	$20 \pm 10\%$
Specimen spray	Off	Off
Rack spray	Off	Off
Conditioning water temperature, °C. (This will be for some models or weatherometer only.)	40 ± 4 °C	66 ± 4 °C

Note 1: Method A consists of five alternating Dark Periods (1 h per each period) and five Light Periods (3.8 h per each period) in a 24 h duration with the test beginning in the Dark Period.

4.3.1.2 Method B. Exposure conditions shall be according to ISO 105-B06 Condition Three but with humidity of 0 to 20% relative humidity (RH).

In addition to the Black Standard Temperature of +100 °C, a White Standard Temperature of $+76 \pm 1$ °C is observed for information only.

The timing (number of cycles) for the wide band exposure is calculated per the equation in 4.3.1.1. Appendix B displays timing for typical required radiant exposure values.

4.3.1.3 Method C. Exposure conditions shall be according to ISO 105-B06 Condition One but with humidity of 0 to 20% RH.

In addition to the Black Standard Temperature of +115 °C, a White Standard Temperature of 75 ± 1 °C is observed for information only.

The timing (number of cycles) for the wide band exposure is calculated per the equation in 4.3.1.1. Appendix B displays timing for typical required radiant exposure values.

4.3.1.4 Method D. Exposure conditions shall be according to ISO 105-B06 Condition Five or SAE J2412/SAE J2413.

4.3.2 Exposure. Exposure shall be according to ISO 105-B06. The exposure shall be continued until the required radiant exposure value as specified in the relevant material specification has been reached. The time until the required radiant exposure value has been reached is noted.

5 Data

5.1 Calculations. Visual assessment for colorfastness shall be made by a person with a trained eye. Compare the test specimen to a control sample and the gray scale (refer to ISO 105-A02) under standard lighting defined in GMW6992. All comparisons shall be made with like sized evaluation areas.

Perform color and gloss measurements, if applicable.

Calculate the differences between the unexposed control sample of the start of test values of the unexposed sample and the exposed test specimen.

Degradation evaluations to be completed and reported according to the methods defined in the relevant material specification.

5.2 Interpretation of Results.

5.2.1 Report the color change rating from visual assessment at required exposure level. Note any appearance or degradation changes seen that are not included on the color change rating scale.

5.2.2 If required, report the color machine measurements for color change using the CIELAB D65/10° measurements for DE*, DL*, DC*, DH*, Da*, Db* at each required exposure level.

5.2.3 If required, for information only, provide Standard Reference Manual (SRM) data for the days the test specimen was being tested.

5.2.4 Report all test parameters according to material specification.

5.3 Test Documentation. The results of the tests will be recorded in the Test Report.

6 Safety

This standard may involve hazardous materials, operations, and equipment. This standard does not propose to address all the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

7 Notes

7.1 Glossary. Not applicable.

7.2 Acronyms, Abbreviations, and Symbols.

BST	Black Standard Temperature
RH	Relative Humidity
SPD	Spectral Power Distribution
SRM	Standard Reference Manual

8 Coding System

This standard shall be referenced in other documents, drawings, etc., as follows:

Test to GMW14162/A/640 kJ/m²/Rating 4 minimum

Where:

GMW	= Validation area (GM Worldwide)
14162	= Sequential number
A	= Method
640 kJ/m²	= Required radiant exposure value
Rating 4 minimum	= Required minimal gray scale rating to ISO 105-A02.

9 Release and Revisions

This standard was originated in June 2005. It was first approved by the Global Textile Team in October 2006. It was first published in October 2006.

Issue	Publication Date	Description (Organization)
1	OCT 2006	Initial publication.
2	JUN 2011	Five year refresh of standard – updated in current template. (Global Textiles Team)

Appendix A

Type "S" Borosilicate/Soda Lime

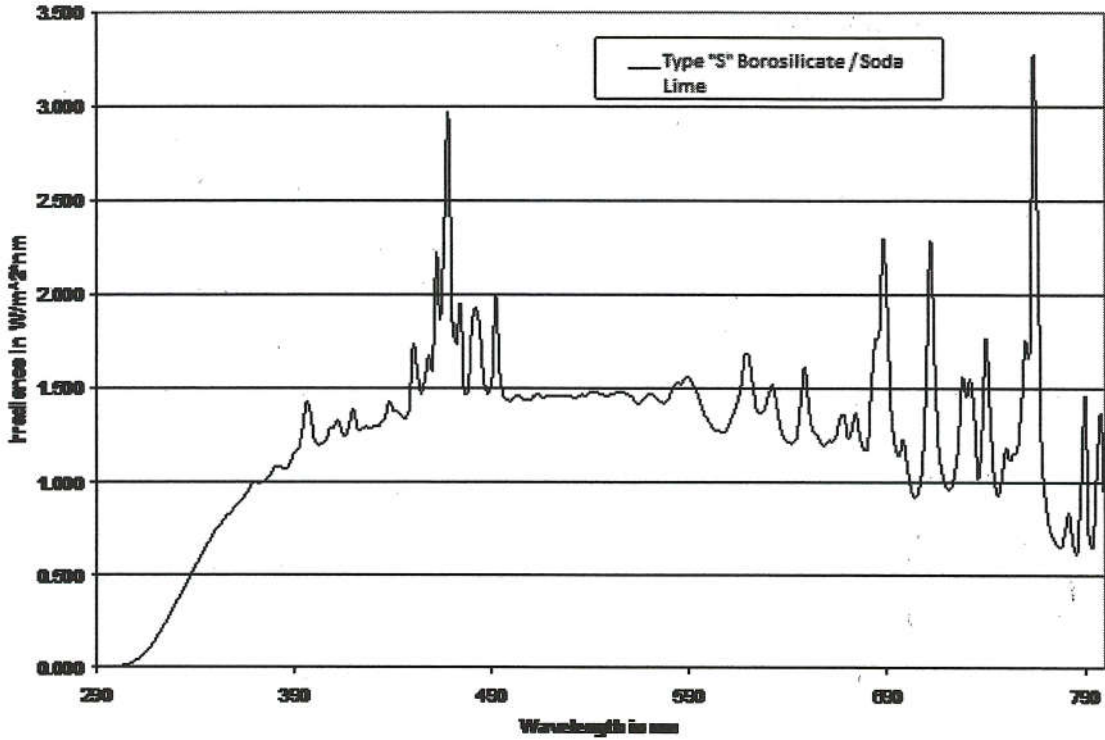


Figure A1: Spectral Power Distribution (SPD) for Filter Combination of Method A

Appendix B

Table B1: Timing for Typical Exposures using Method A

Required Radiant Exposure Q (Irradiance Value)	Time for Radiant Exposure (Q) in kJ/m ²		5 Dark Periods + 5 Light Periods = 24 h
kJ/m ²	Light Period Hours	Dark Period Hours	Total Test Time in Hours
320	74.0	19.5	93.5
640	148.0	38.9	186.9
960	222.0	58.4	280.4

Table B2: Typical Timing for Method B

Required Radiant Exposure Q (Irradiance Value)	Irradiance: 45 W/m ² Wide Band: (300 to 400) nm		Irradiance: 60 W/m ² Wide Band: (300 to 400) nm	
	Hours	= Days	Hours	= Days
MJ/m ²				
14	86	3.6	65	2.7
19	117	4.9	88	3.7
28	173	7.2	130	5.4
38	235	9.8	176	7.3
42	259	10.8	194	8.1

Table B3: Typical Timing for Method C

Required Radiant Exposure Q (Irradiance Value)	Irradiance: 70 W/m ² Wide Band: (300 to 400) nm		Irradiance: 90 W/m ² Wide Band: (300 to 400) nm	
	Hours	= Days	Hours	= Days
MJ/m ²				
14	56	2.3	43	1.8
19	75	3.1	59	2.4
28	111	4.6	86	3.6
38	151	6.3	117	4.9
42	167	6.9	130	5.4