

Colorfastness to Light at High Temperatures: Daylight Temperature and Humidity Controlled Apparatus

Adopted in 1996 by AATCC Committee RA50 with permission from the Society of Automotive Engineers, Inc. SAE J2230® 1993; editorially revised and reaffirmed 1997, 2004; revised 2005.

1. Purpose and Scope

1.1 This test method specifies the operating procedures for the exposure of automotive interior trim materials in an outdoor behind-glass apparatus in which the temperature is controlled in a 24 h cycle. The humidity is controlled during the dark(night) portion of the cycle.

1.2 Specimen preparation, test durations and performance evaluation procedures are covered in material specifications of the different automotive manufacturers.

2. Principle

2.1 Samples of the textile material to be tested and the agreed upon comparison standard(s) are exposed simultaneously under specified conditions designed to accelerate the amount of irradiance imposed upon the specimens. The amount of exposure is determined with respect to a specified degree of color change, or alternately to a specific amount of radiant energy. The colorfastness of the specimen is evaluated by comparison of the color change of the exposed portion with the masked control portion of the test specimen or unexposed original material, using the Gray Scale for Color Change or by instrumental color measurement.

3. Terminology

3.1 **black panel thermometer**, n.—a temperature measuring device, the sensing unit of which is coated with black designed to absorb most of the radiant energy encountered in lightfastness testing.

3.2 **blue wool lightfastness standard**, n.—one of a group of dyed wool fabrics which are sensitive to the amount of light, heat, and moisture to which they are exposed.

NOTE: Because of the unstable nature of these materials they are also sensitive to the heat and moisture conditions which exist before exposure testing, after exposure testing and prior to measurement.

3.3 **color change**, n.—as used in colorfastness testing, a change in color of any kind (whether a change in hue, saturation or lightness).

3.4 **irradiation**, n.—the time integral of irradiance expressed in joules per square meter (J/m^2).

3.5 **laboratory sample**, n.—a portion of material taken to represent the lot sample, or the original material, and used in the laboratory as a source of test specimens.

3.6 **radiant exposure**, n.—time integral of irradiance.

3.7 **reference standard**, n.—a homogeneous lot of material having a known or accepted value for one or more physical or chemical properties and selected for use to verify performance of a test apparatus under specified operating conditions.

3.8 **specimen**, n.—a specific portion of a material or laboratory sample upon which a test is performed or which is selected for that purpose.

3.9 **total irradiance**, n.—radiant power integrated over all wavelengths at a point in time expressed in watts per square meter (W/m^2).

3.10 **ultraviolet radiation**, n.—radiant energy for which the wavelengths of the monochromatic components are smaller than those for visible radiation and more than about 100 nm.

NOTE: The limits of the spectral range of ultraviolet radiation are not well defined and may vary according to the user. Committee E-2.1.2 of the CIE distinguishes in the spectral range between 400 and 100 nm:

UV-A	315-400 nm
UV-B	280-315 nm
UV-C	100-280 nm

4. Safety Precautions

NOTE: These safety precautions are for information purposes only. The precautions are ancillary to the testing procedures and are not intended to be all inclusive. It is the user's responsibility to use safe and proper techniques in handling materials in this test method. Manufacturers MUST be consulted on specific details such as material safety data sheets and other manufacturer's recommendations. All OSHA standards and rules must also be consulted and followed.

4.1 Daylight exposure of the skin and eyes for prolonged periods may be hazardous and, therefore, caution should be employed to protect these areas. Under any circumstances, do not look directly at the sun or equipment and materials that

may increase the sun's intensity, such as mirrors.

4.2 Good laboratory practices should be followed. Wear prescribed safety glasses in all laboratory areas.

5. Uses and Limitations

5.1 This test method is designed to simulate extreme environmental conditions encountered inside a vehicle due to sunlight, heat, and humidity for the purpose of predicting the performance of automotive interior trim materials.

5.2 Variations in results may be expected when operating conditions are varied within the accepted limits of this test method, or tests are conducted in different geographical locations. Therefore, no reference shall be made to results from the use of this method unless accompanied by a report detailing the specific operating conditions and location conformance (see Section 12).

6. Apparatus and Materials

6.1 Mounting stand, capable of tracking the sun in elevation and rotation with an accuracy of $\pm 1^\circ$ in order to maintain the front surface of the cabinet normal to the direct beam of the sun (see Fig. 1).

6.2 Test cabinet (see Fig. 1 and 15.1), constructed of corrosion-resistant metal and containing the following:

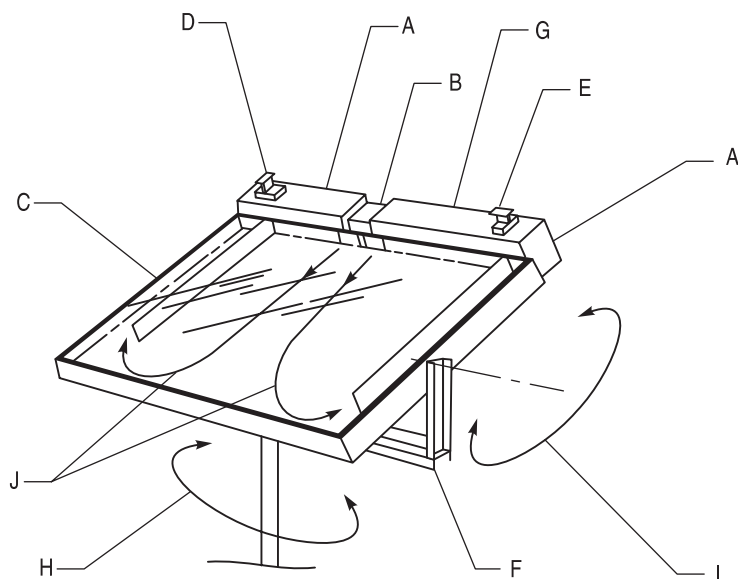
6.2.1 Glass cover, a single piece of 3 mm (1/8 in.) thick clear tempered safety glass, such as Herculite (see 15.2), or equivalent.

6.2.2 Specimen rack, designed and positioned such that the test specimens may be mounted with the plane of the test surface parallel to, and not less than 75 mm (3 in.) below the glass.

6.2.3 Sensor, heater(s), fan(s) and a control system capable of maintaining a specified air temperature to within $\pm 5^\circ C$ ($\pm 9^\circ F$) at any location within the specimen exposure area. An example of such a system is given in Fig. 1.

6.2.4 Sensor, controller, and solenoids, evaporators, or ultrasonic humidifiers capable of controlling the relative humidity to within $\pm 10\%$ of the set humidity during the night portion of the cycle. Optionally, the wet-bulb temperature or dew point may be controlled in order to maintain the required humidity level.

6.3 Radiometer, ultraviolet, to measure irradiance, and connected to an inte-



A - Air Duct
B - Air Blower
C - Glass Cover
D - Solar Cells (Azimuth Control)
E - Solar Cells (Elevation Control)

F - Support Yoke
G - Air Heater (Inside Air Duct)
H - Rotation (Azimuth Direction)
I - Rotation (Elevation Direction)
J - Air Circulation Pattern

Fig. 1—Exposure apparatus.

grator for computing ultraviolet radiant exposure. The ultraviolet radiometer shall be mounted behind glass, such as Herculite (see 15.2), or equivalent, in a ventilated enclosure to avoid overheating the instrument. The enclosure containing the radiometer shall maintain the same orientation as the test cabinet. Two different types of radiometers may be used:

6.3.1 A wide-band ultraviolet radiometer (see 15.3), an instrument which measures irradiance at wavelengths 295-385 nm or 300-400 nm.

6.3.2 A narrow-band ultraviolet radiometer (see 15.4), an instrument which measures irradiance centered at a wavelength of 340 ± 2 nm.

7. Calibration and Verification

7.1 Maintain and calibrate the apparatus described in Appendices A and B. Appendix A contains maintenance and calibration instructions. Appendix B describes the use of reference materials which may assist in determining the performance of the apparatus, and interpreting exposure results when compared to previous tests.

7.2 Use purified water for humidification that is free of silica and has no more than 20 ppm total dissolved solids.

8. Test Specimen Preparation

8.1 Unless otherwise specified, cut test

specimens 75×150 mm (3×6 in.), with a maximum thickness of 25 mm (1 in.). For specimens over 25 mm (1 in.) thick, formed or configured specimens, and large components, specific instructions must be agreed upon between the purchaser and the supplier.

8.2 Replicate specimens are preferred to provide a record of the changes encountered at different radiant exposure levels. Retain an unexposed specimen for comparison to the exposed specimen.

9. Conditioning

9.1 No conditioning is required except for assessment of exposed specimens as described in 11.1.

10. Procedure

10.1 Mount test specimens to the specimen rack. To minimize variations in results caused by non-uniform exposure conditions, the specimen exposure area is restricted to the dimensions provided in Appendix A.

10.2 Ensure the timer and temperature set points are accurate for the test conditions specified below:

Parameters	Day Conditions	Night Conditions
Temperature	$70 \pm 5^\circ\text{C}$ Air ($158 \pm 9^\circ\text{F}$)	$38 \pm 5^\circ\text{C}$ Air ($100 \pm 9^\circ\text{F}$)
Humidity	Not Controlled	$75 \pm 10\%$ R.H.
Hours	8 a.m.-6 p.m.	6 p.m.-8 a.m.

10.2.1 Operate continuously, except for performing maintenance as specified in Appendix A, inspecting specimens, removing specimens or starting new tests.

10.3 Use one of the following procedures for timing the exposure.

10.3.1 Expose specimens for the specified radiant exposure measured in MJ/m^2 total ultraviolet, 295-385 nm or 300-400 nm.

10.3.2 Expose specimens for the specified radiant exposure measured in $\text{kJ}/\text{m}^2/\text{nm}$ at 340 ± 2 nm.

11. Evaluation

11.1 After the test exposure is completed, remove the test specimens and any comparison standards from exposure. Condition in a dark room at standard conditions for testing textiles $21 \pm 1^\circ\text{C}$ ($70 \pm 2^\circ\text{F}$) and RH of $65 \pm 2\%$ for a minimum of 4 h before evaluation.

11.2 Evaluate and report the degree of fade as specified between the contractual parties. Instrumental values are recommended.

11.2.1 Instrumental Measurement.

11.2.1.1 Determine the color difference values in CIELAB units by instrumentally measuring the specimen before and after a specified amount of radiant exposure. The instrument used for specimen measurement shall conform to that specified in Appendix B.2.

11.2.2 Visual Assessment.

11.2.2.1 Assign colorfastness grades using the Gray Scale for Color Change in accordance with AATCC Evaluation Procedure 1 (see 15.6).

11.2.2.2 Using the viewing conditions specified in AATCC Evaluation Procedure 1, quantify the color change using the following terminology:

NONE:	No change in hue, lightness or chroma.
SLIGHT:	A change in lightness and/or chroma which can be determined only upon close examination but no change in hue.
NOTICEABLE:	A change in lightness and/or chroma which can easily be seen and/or a change in hue.
SEVERE:	An extreme change in lightness, chroma, and/or hue.

12. Report

12.1 The final report form shall contain the following:

12.1.1 Laboratory and location.

12.1.2 Type and serial number of exposure apparatus.

12.1.3 Test method.

12.1.4 Specimen exposure area temperature controlled at $xx^\circ\text{C}$ (black panel or air).

12.1.5 Specimen identification.