



SURFACE VEHICLE STANDARD



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Superseding J2019 JAN1994

Accelerated Exposure of Automotive Exterior Materials Using a Controlled Irradiance
Air-Cooled Xenon-Arc Apparatus

RATIONALE

This standard is being balloted for withdrawal as it specifies the use of instruments that have not been manufactured for over 15 years, with no instruments to replace them. The automotive OEMs do specify this standard for materials approvals. This standard is technically replaced by SAE J2527.

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1. Scope

- 1.1 This SAE Standard specifies the operating procedures for a controlled irradiance, air-cooled xenon-arc apparatus used for the accelerated exposure of various automotive exterior materials.
- 1.2 The sample preparation, test durations, and performance evaluation procedures are covered in material specifications of the different automotive manufacturers.

2. References

2.1 **Applicable Publications**—The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATION—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J1545—Instrumental Color Difference Measurement for Exterior Finishes, Textiles and Colored Trim

2.1.2 ASTM PUBLICATIONS—Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM G 26—Standard Practice for Operating Light Exposure Apparatus (Xenon Arc Type) With and Without Water for Exposure of Nonmetallic Materials

ASTM D 859—Test Methods for Silica in Water

ASTM D 4517—Test Method for Low-Level Total Silica in High Purity Water by Flameless Atomic Absorption Spectroscopy

2.1.3 CIE PUBLICATION—Available from Commission International de L'eclairage, 52 Bd Malesherbes, F-75008 Paris, France.

Publication No. 85 (1989): Technical Report — Solar Spectral Irradiance

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3. Definitions

- 3.1 Black Standard Thermometer, N**—A temperature measuring device, which uses a resistance thermometer with good heat-conducting properties, fitted to the reverse side of a metal plate. The metal plate is fixed to a plastic plate so that it is thermally insulated. It is coated with a black layer.
- 3.2 Color Change, N**—As used in fade-weathering testing, a change in color of any kind (whether a change in hue, saturation, or lightness).
- 3.3 Irradiance, N (E)**—The incident radiant flux per unit area of a surface (W/m^2).
- 3.4 Irradiance, Controlled, N**—The maintenance by closed loop feedback of a preselected irradiance throughout a designated exposure interval.
- 3.5 Irradiance, Spectral, N**—The radiant energy within a specified wavelength interval that falls on a unit area of exposed surface ($W/m^2/nm$).
- 3.6 Irradiance, Total, N**—Radiant energy integrated over all wavelengths falling on a unit area of exposure at a point in time expressed in watts per square meter (W/m^2).
- 3.7 Irradiation, N**—See radiant exposure.
- 3.8 Long-arc Xenon, N**—A xenon arc in which the length of the arc between electrodes is greater than the diameter of the envelope enclosing the arc.
- 3.9 Radiant Exposure, N**—The time integral of irradiance (J/m^2).
- 3.10 Radiant Exposure, Spectral, N**—The integration of spectral irradiance with respect to time ($J/m^2/nm$).
- 3.11 Reference Plastic, N**—A clear polystyrene plastic standard selected for exposure as a check on a test apparatus and operating conditions.
- 3.12 Sample, Laboratory, 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.
- 3.13 Specimen, N**—A specific portion of a material or a laboratory sample on which a test is performed or that is selected for that purpose.
- 3.14 Spectral Power Distribution, N**—The variation of energy due to the source over the wavelength span of emitted radiation.
- 3.15 Wavelength Range, N**—The specified wavelength range for bandpass filters; for example, 300 to 400 nm.
- 4. Significance and Use**—This test method is designed to simulate extreme environmental conditions encountered outside a vehicle such as sunlight, heat, and moisture (in the form of humidity, condensation, or rain) for the purpose of predicting the weatherability of automotive materials.

5. Equipment—A more complete description of the apparatuses listed as follows may be found in ASTM G 26.

5.1 Air-Cooled Type¹

The apparatus employed shall use an air-cooled xenon-arc lamp as the source of radiation and should be as follows:

5.1.1 GENERAL—An apparatus using three lamps based on xenon-arc technology that meets the conditions specified in Section 6 is acceptable as long as the filter/optical systems reproduce the spectral distribution of the lamp output and filter system specified in this document. Also, all temperature and humidity must be identical to the conditions specified in Section 6.

5.1.1.1 *Spectral Power Distribution*—The spectral distribution shown in Table 1 (based on CIE Publication No. 85 (1989) Table 4) specifies acceptable ranges within wavebands to describe the lamp output defined in this standard.

TABLE 1—RELATIVE SPECTRAL IRRADIANCE

Wavelength	Relative Spectral Irradiance %
290 to 400	100
below 290	0 ⁽¹⁾
> 290 to 320	5.4 ± 1.8
> 320 to 360	38.2 ± 4.6
> 360 to 400	56.4 ± 9.0

1. Xenon arcs operating according to the method emit a small, but significant, amount of radiation below 295 nm. This radiation can cause degradation reactions which do not occur in actual outdoor exposures.

5.1.1.2 Specimen holders shall revolve around the arc, with the sample plane describing a spherical or cylindrical surface. A slight tilting of the upper and lower sample holders can provide uniformity satisfactory to eliminate the need to reposition specimens in the sample rack and allows use of the complete sample holder.

5.1.1.3 Testing temperatures shall be calibrated using a Black Standard Thermometer unit that is mounted so that the face of the unit is subjected to the same influences as the test specimens.

5.1.1.4 A blower unit in the base of the apparatus shall provide a flow of air through the test chamber and over the test specimens. Control of the specimen, test chamber, and the black standard temperature shall be accomplished by thermostatic control of the chamber temperature and adjustment of the air flow rate to obtain the specified black standard temperature.

5.1.1.5 Relative humidity in the test chamber shall be measured and controlled by a hygrometer. Water should be vaporized and diffused to enrich the air with moisture and produce the required humidity.

1. Model XENOTEST® 1200 CPS or equivalent with chamber air heater and variable fan speed controller meets the requirements of this test method. This apparatus is available from Heraeus DSET Laboratories, Inc., 45601 N. 47th Avenue, Phoenix, AZ 85027-7042. Other similar instruments may be used provided that they (a) can be demonstrated to produce results equivalent to those from the instruments described above, and (b) are mutually agreed to by interested parties.

6. Apparatus Setup

- 6.1** To insure repeatability of tests, maintain and calibrate the apparatus to manufacturer's specifications, and as described in Appendices A and B. Appendix A contains additional maintenance instructions and replacement schedules and Appendix B describes the use of reference plastic to determine if the xenon-arc apparatus is operating within the desired range.
- 6.1.1 The input voltage must be between 200 to 240, 340 to 420, or 400 to 440 V based on manufacturer's specifications.
- 6.1.2 Water used for the specimen spray and humidification system shall leave no objectionable deposits or stains on the exposed specimens. It is strongly recommended that the water contains a maximum of 1 ppm solids and a maximum of 0.2 ppm silica. Silica levels should be determined using ASTM D 859 or ASTM D 4517. A combination of deionization and reverse osmosis treatment can effectively produce water with the desired purity.
- 6.1.3 Install both front panel and sample cooling (back side of specimen) spray nozzles.
- 6.1.4 Install three sections of Suprax filter system, or equivalent to match 5.1.1.1.
- 6.1.5 Program the microprocessor for the test conditions in Table 2. Program other functions to be OFF.

TABLE 2—MICROPROCESSOR PROGRAM

Parameter	Program Dark	Program Light	Program Light	Program Light
Phase No.	1	2	3	4
Phase Time	60 min	40 min	20 min	60 min
Chamber				
Temperature	38°C	47°C	47°C	47°C
Relative Humidity	---	50%	---	50%
Irradiance	OFF	ON	ON	ON
Panel Spray	OFF	OFF	ON	OFF
Sample Cooling	ON	OFF	OFF	OFF
Irradiance Level	0 W/m ²	80 W/m ²	80 W/m ²	80 W/m ²
Number of Filters	Window Glass	0		
Number of Filters	Suprax 1/3	3		
Number of Filters	Suprax 1/6	0		

- 6.1.6 Operate the equipment to maintain the conditions in Table 3. If the actual operating conditions do not agree with the machine settings after the equipment has stabilized, discontinue the test and identify the cause of the disagreement.

TABLE 3—EQUIPMENT OPERATING CONDITIONS

Parameter	Cycle Light	Cycle Dark
Automatic Irradiance	80 W/m ² ± 1 W/m ² @ 300–400 nm	---
Black Standard Temperature	77°C ± 2°C	---
Chamber Temperature	47°C ± 2°C	38°C ± 2°C
Relative Humidity	50% ± 5%	95% ± 5%
Radiant Exposure	See applicable specifications	

NOTE 1—The above tolerances are relative to equipment operation and are not intended to indicate tolerances from absolute calibrations.

NOTE 2—It may be necessary to adjust the blower speed to maintain the temperature difference between the black standard and the chamber temperatures.

- 6.1.7 The tolerances do not apply during the spray portion of the cycle.
- 6.1.8 Adjust the temperature of the core cooling water to provide sufficient cooling but prevent condensation from forming on lamp assembly.

7. Test Procedure

- 7.1 Prepare the specimens to be exposed to fit the specimen holder being used.
- 7.2 Specimen sizes must conform to the size of the specimen holder(s) supplied by the manufacturer for use with the equipment. Specimens that exceed these sizes may not give proper exposure results. Instructions for mounting parts or portions of a part can be obtained from the automotive company for which the material is being tested.
- 7.3 Insert specimen in holder and secure. Under no circumstances should the face side of the sample be closer to the arc than the front side of the specimen holder.
- 7.4 Fill all unused slots in specimen holders with unpolished stainless steel blanks to maintain desired air flow.
- 7.5 Expose specimens, beginning with the dark cycle, for the required radiant exposure (Megajoules per square meter [MJ/m²]) measured in the wavelength range of 300 to 400 nm. See applicable material specification.
- 7.6 Report the degree of fade or other changes as outlined in SAE J1545.

7.7 Exposure Report

- 7.7.1 A copy of the exposure report, Figure 1, must be included with each exposed specimen being submitted for approval.

PREPARED BY THE SAE WEATHERING TEST STANDARDIZATION OF EXTERIOR MATERIALS COMMITTEE

CANCELLED BY THE SAE TEXTILE AND FLEXIBLE PLASTICS COMMITTEE

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APPENDIX A

A.1 Maintenance

A.1.1 Test Chamber—The frequency of cleaning will vary with water quality. However, the chamber must be cleaned at least once a month and flushed with deionized water. Do NOT use cleaning agents containing chlorine.

A.1.2 Conditioning Chamber—The frequency of cleaning will vary with water and air quality in the laboratory. However, the water reservoir must be drained twice a month and flushed with deionized water to remove any deposits.

A.1.3 Optical Assembly—Frequency of cleaning will vary with water quality. However, at least once each week wipe the outer surface of the filter with reagent grade alcohol and a soft cloth. If deposits cannot be removed, the filter should be disassembled and cleaned as necessary.

A.1.4 Black Standard Sensor—Polish monthly using a good quality automotive polish.

A.2 Replacement Schedule

A.2.1 Lamp Assembly and Related Parts—Replace lamps as required by the manufacturer specifications. To adequately control both low wavelength UV and the infrared component of the lamps spectral irradiance, lamps should be replaced so that individual lamps do not exceed manufacturer's recommendations. For systems with more than one lamp, a rotational replacement schedule is recommended.

A.3 Calibration Checks

A.3.1 Check the calibration of the exposure chamber as instructed by the manufacturer, or when the control materials deviate from the specified ranges. (Record these values on the form shown in Figure A1.)

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