How to run SAE J2412 and J2527

Xenon arc testing for automotive interior and exterior materials

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Q-Lab's Corrosion Standards Webinar Series

- Today is the third of our four-part webinar series on automotive testing standards.
- Our upcoming and complete archive of past webinars, available on demand, are hosted at: q-lab.com/webinars

Date	Topic
23 Apr	CATCH
30 Apr	SAE J2334
21 May	SAE J2412 / J2527
28 May	ASTM D7869

Presentation materials, Q&A

- You'll receive a follow-up email from info@email.q-lab.com with links to a survey, registration for future webinars, and to download the slides
- Use the Q&A feature in Zoom to ask us questions today! We'll stay on after the presentation is completed to answer all questions

Outline

- History and goals of SAE J2412 and J2527
- Interpretation of standards requirements
  - SAE J2412 – Interior automotive materials
  - SAE J2527 – Exterior automotive materials
- Specimen preparation and test setup
- Test performance, evaluation, and reporting

SAE J1885 and J1960: The Predecessors

- Introduced in the late 1980's as:
  - SAE J1885 *Accelerated Exposure of Automotive Interior Trim Components Using a Controlled Irradiance* ***Water Cooled*** *Xenon-Arc Apparatus*
  - SAE J1960 *Accelerated Exposure of Automotive Exterior Materials Using a Controlled Irradiance* ***Water-Cooled*** *Xenon Arc Apparatus*
- These are **hardware-specific**, requiring water-cooled xenon lamps
- When first introduced, these standards provided the best methods for screening and qualifying materials
  - In particular, SAE J1960 *at the time* correlated well to outdoor testing of coatings
  - This was at the beginning of the clear-coat / base-coat era

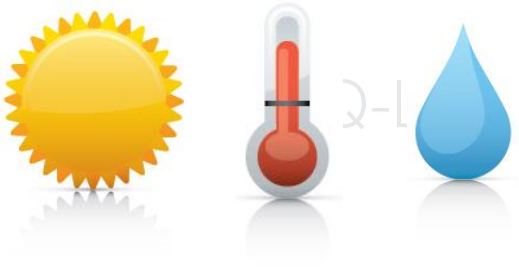
SAE J2412 and J2527: The Successors

- SAE J1885 and J1960 were replaced in 2003-04 by:
  - SAE J2412 ***Performance Based*** *Standard for Accelerated Exposure of Automotive Exterior Materials Using a Controlled Irradiance Xenon-Arc Apparatus*
  - SAE J2527 ***Performance Based*** *Standard for Accelerated Exposure of Automotive Exterior Materials Using a Controlled Irradiance Xenon-Arc Apparatus*
- These are **performance-based**, meaning that any instrument that meets the test conditions can be used
- SAE J1885 and SAE J1960 remain "Current" with 2008 revision dates but are **Canceled**
  - Notes state they are being canceled and superseded in 2008
  - Use is restricted to certain old models specified in the documents

Forces of Weathering

- Sunlight
  - Light source
  - Optical filter
  - Irradiance Control point and setting
- Heat
  - Black Panel or Insulated Black Panel
  - Chamber Air Temperature
- Moisture
  - Relative Humidity
  - Spray

SAE Test Conditions



Standard	Light	Heat	Water
SAE J2412 Interior	Xenon arc lamp 0.55 W/m^2/nm @340 nm Extended UV Filter	Very high 89 °C BP, 63 °C CAT (Light) 38 °C Dark	Humidity only 50% RH (Light) 95% RH (Dark)
SAE J2527 Exterior	Xenon arc lamp 0.55 W/m^2/nm @340 nm Extended UV or Daylight Filter	High 70 °C BP, 47 °C CAT (Light) 38 °C in Dark	Humidity and spray Spray for nearly ½ the cycle Front and back spray 50% RH in dry steps

Test Goals in SAE Standards

Accelerated Test Type	Result	Test Time	Results compared to
Quality Control	Pass / fail	• Defined • Short	Material specification
Qualification / validation	Pass / fail	• Defined • Medium-long	Reference material or specification
Correlative	Rank-ordered data	• Open-ended • Medium	Natural exposure (Benchmark site)
Predictive	Service life Acceleration factor	• Open-ended • Long	Natural exposure (Service environment)

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SAE 2412

SURFACE VEHICLE STANDARD	J2412™	FEB2024
	Issued 2003-11 Revised 2024-02 Superseding J2412 NOV2023	
Accelerated Exposure of Automotive Interior Trim Components Using a Controlled Irradiance Xenon-Arc Apparatus		

SAE J2412

- Originally published in 2003
- Revised in 2004, 2015, 2023, and **2024**
- Basic cycle and content largely unchanged
- Today's presentation will reference only the 2024 version

SAE J2412 Test Cycle and Conditions

Controls	Dark Step		Light Step	
	Target	Tolerance	Target	Tolerance
Automatic Irradiance	None	N/A	0.55 $W \cdot m^{-2} \cdot nm^{-1}$ (see Note 1)	±0.02 $W \cdot m^{-2} \cdot nm^{-1}$
Black Panel Temperature	38 °C	±2.5 °C	89 °C	±2.5 °C
Dry Bulb Temperature	38 °C	±3 °C	62 °C	±2 °C
Relative Humidity	95%	±10%	50%	±10%
Radiant Exposure	N/A	N/A	Contractual Agreement	N/A
Step Duration	1 hour (see Note 2)	±6 minutes	3.8 hours (see Note 2)	±6 minutes

Cycle alternates between 1:00 Dark and 3:48 Light

No water spray (appropriate for interior)

Xenon-Arc Light Source

- Conveniently, the light source, xenon-arc, is mentioned directly in the title

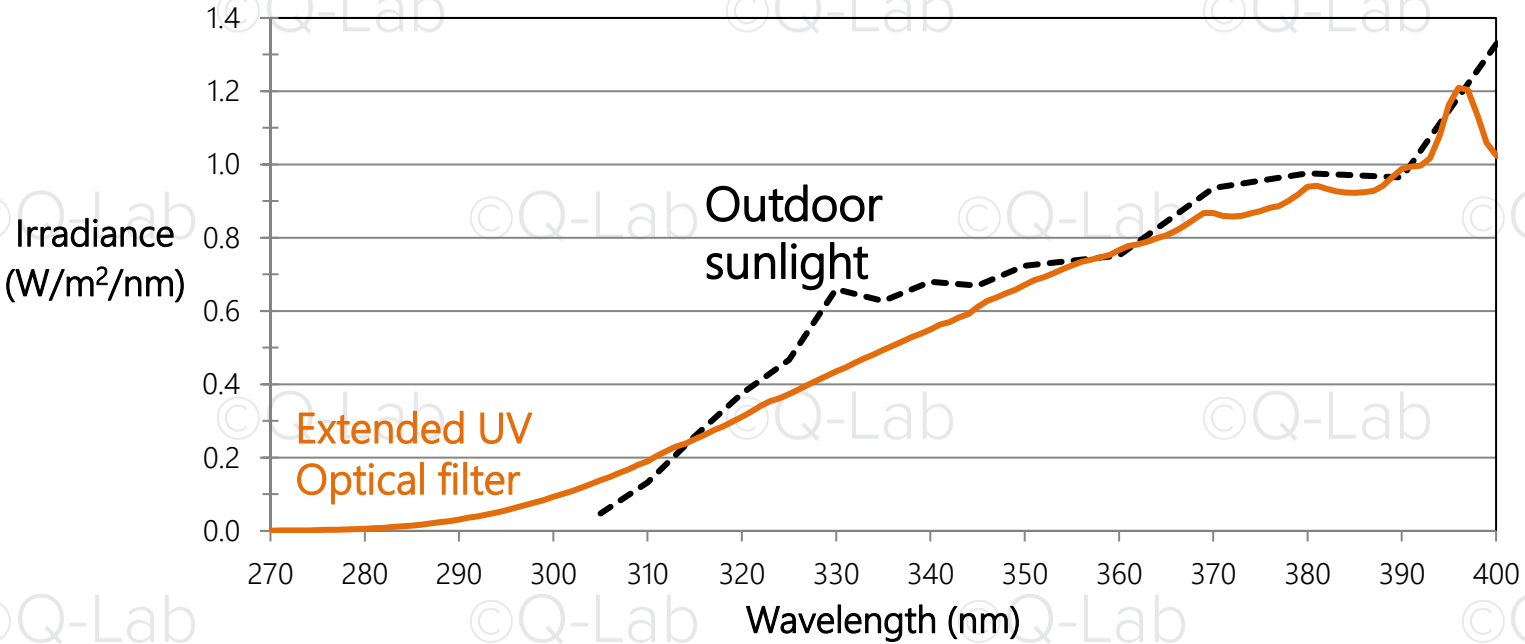
- In case there are any doubts, additional notes are included in the standard, giving users clear instruction:

  § 5.2 The apparatus employed utilizes a xenon-arc lamp(s) as the source of radiation…

  § 5.2.1 A more complete description of the apparatus can be found in ASTM G151 and ASTM G155

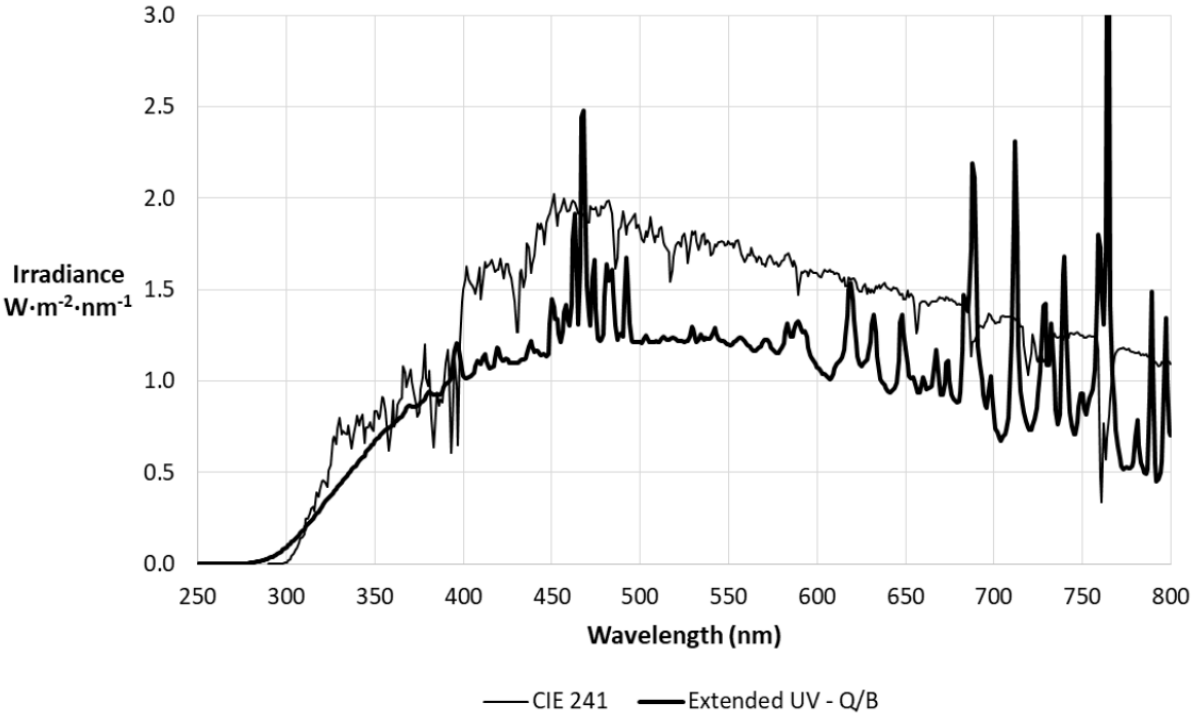
Optical Filter Requirements

SAE J2412 specifies an ***Extended UV*** optical filter, which has shorter-wavelength cut-on than natural sunlight



Spectral Irradiance: Graphical

Extended UV filter vs. sunlight spectral irradiance graph shown for reference



Spectral Irradiance: Tables

The spectral charts shown are a great visual representation of the optical filter **intent**, but the real **requirement** is given in Table A1

Table A1 (Part 1) - Irradiance in W/m² based on 81 SPD's for Xenon-Arcs with extended UV filters normalized to exactly 0.55 W.m⁻² at 340 nm

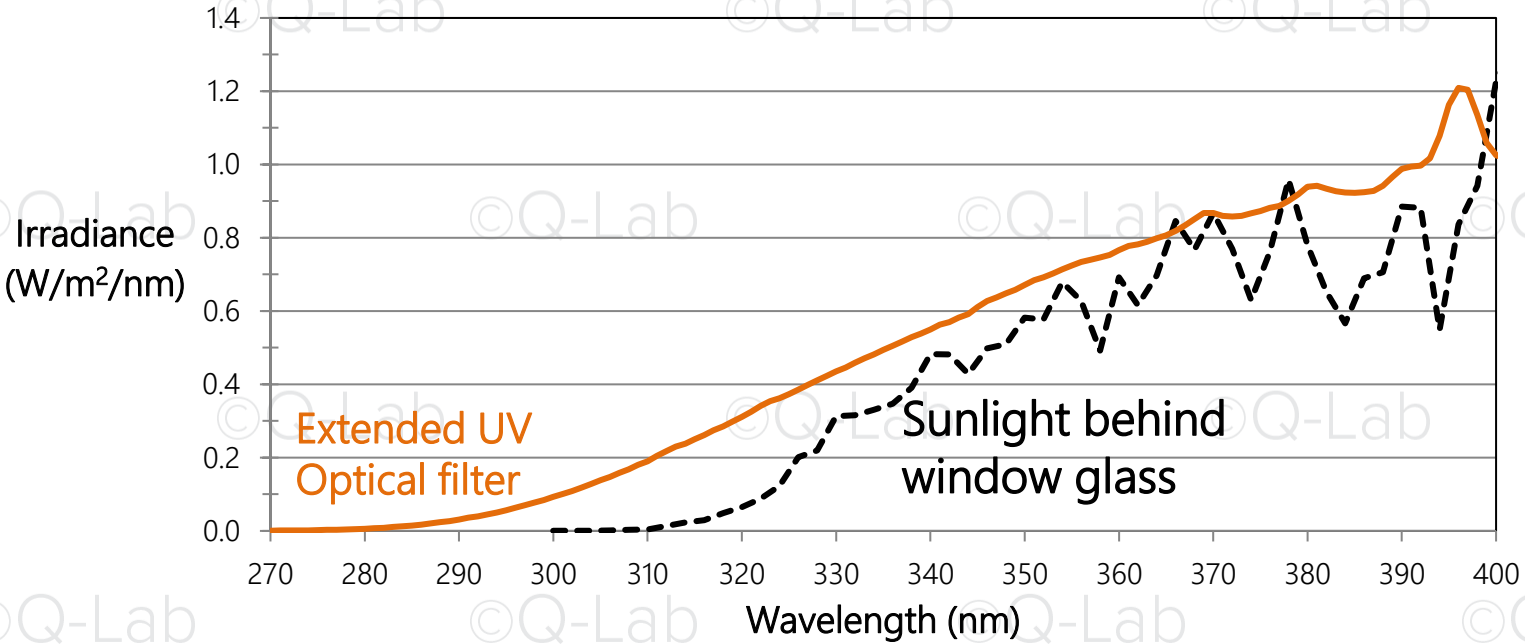
bandpass	average	standard deviation	min	max
250-260	0.00	0.00	0.00	0.02
261-270	0.00	0.00	0.00	0.03
271-280	0.04	0.02	0.01	0.10
281-290	0.22	0.08	0.09	0.42
291-300	0.73	0.16	0.36	1.16
301-310	1.60	0.20	1.04	2.19
311-320	2.72	0.19	2.13	3.26
321-330	3.91	0.14	3.48	4.29
331-340	5.06	0.04	4.95	5.18
341-350	6.10	0.10	5.91	6.33
351-360	7.06	0.22	6.48	7.67
361-370	7.97	0.33	7.19	8.83
371-380	8.65	0.48	7.55	9.77
381-390	9.17	0.59	7.99	10.57
391-400	10.67	0.70	9.17	13.29
300-400	63.10	1.97	58.30	68.17

Table A1 (Part 2) - SPD table for xenon-arc lamps from 400-800 nm at 50 nm bandpasses based on 37 SPDs

Bandpass	Average	Standard Deviation	Min	Max
400-450	57.47	5.13	47.20	67.74
451-500	73.71	6.22	61.28	86.15
501-550	66.26	7.40	51.46	81.06
551-600	67.61	7.43	52.75	82.48
601-650	64.85	7.69	49.46	80.24
651-700	60.52	6.14	48.25	72.80
701-750	57.06	6.17	44.72	69.40
751-800	48.44	7.39	33.66	63.22

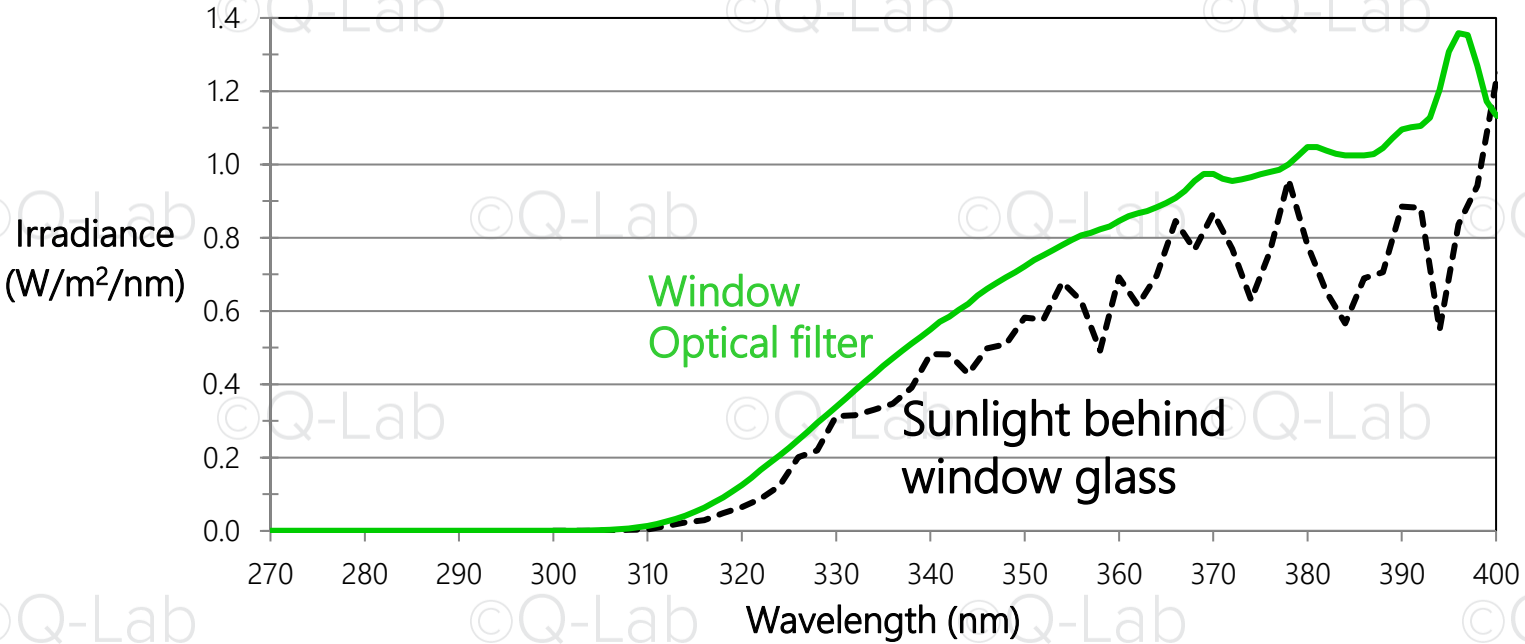
Optical Filter Suitability

Extended UV is even less of a match for **interior** sunlight



Optical Filter Suitability

Extended UV is even less of a match for interior sunlight
2024 version *suggests* users consider a **Window glass** filter



Optical Filter Requirements

- The device manufacturer (Q-Lab!) has responsibility to ensure that a particular filter satisfies the standard.
  - *§ 5.1 The equipment manufacturer is responsible for the approval of the equipment and for providing the proof of compliance of the critical test parameters, including the different spectral irradiances (also known as spectral power distributions, or SPDs) that are required by contractual parties.*
  - *§ 6.1.3 Fit the xenon-arc lamp with an Extended UV Filter to provide a spectral power distribution (SPD) indicated in Appendix A, Table A1 and Figure A1.*
- We can provide documentation for this

Automatic Test Parameter Control

- These important parameters are to be controlled automatically in SAE J2412:
  - Irradiance
  - Panel Temperature
  - Chamber Air Temperature
  - Relative Humidity
- § 5.2 *The instrument shall have the means to automatically control irradiance, Black Panel temperature, chamber temperature and relative humidity.*

Irradiance

Controls	Dark Step		Light Step	
	Target	Tolerance	Target	Tolerance
Automatic Irradiance	None	N/A	0.55 $W \cdot m^{-2} \cdot nm^{-1}$ (see Note 1)	±0.02 $W \cdot m^{-2} \cdot nm^{-1}$
Black Panel Temperature	38 °C	±2.5 °C	89 °C	±2.5 °C
Dry Bulb Temperature	38 °C	±3 °C	62 °C	±2 °C
Relative Humidity	95%	±10%	50%	±10%
Radiant Exposure	N/A	N/A	Contractual Agreement	N/A
Step Duration	1 hour (see Note 2)	±6 minutes	3.8 hours (see Note 2)	±6 minutes

Note 1: 0.55 $W \cdot m^{-2} \cdot nm^{-1}$ at 340 nm is the historic preferred irradiance for this test. Equipment monitoring a broad band rather than the narrow band will have different target values than those listed in Table 1. Other values, higher or lower, agreed upon by contractual parties can be used, but they invalidate the values listed for the blue wools in Appendix B and polystyrene reference material shown in Appendix C.

SAE J2412 used to provide no irradiance target and simply *recommend* 0.55 in a note

Now it is a formal requirement in the table

Black Panel Temperature Sensor

Controls	Dark Step		Light Step	
	Target	Tolerance	Target	Tolerance
Automatic Irradiance	None	N/A	0.55 $W \cdot m^{-2} \cdot nm^{-1}$ (see Note 1)	±0.02 $W \cdot m^{-2} \cdot nm^{-1}$
Black Panel Temperature	38 °C	±2.5 °C	89 °C	±2.5 °C
Dry Bulb Temperature	38 °C	±3 °C	62 °C	±2 °C
Relative Humidity	95%	±10%	50%	±10%
Radiant Exposure	N/A	N/A	Contractual Agreement	N/A
Step Duration	1 hour (see Note 2)	±6 minutes	3.8 hours (see Note 2)	±6 minutes

§ 5.3 The apparatus shall have an uninsulated black panel thermometer, as described in ASTM G151

Air Temperature and Relative Humidity

Controls	Dark Step		Light Step	
	Target	Tolerance	Target	Tolerance
Automatic Irradiance	None	N/A	0.55 $W \cdot m^{-2} \cdot nm^{-1}$ (see Note 1)	±0.02 $W \cdot m^{-2} \cdot nm^{-1}$
Black Panel Temperature	38 °C	±2.5 °C	89 °C	±2.5 °C
Dry Bulb Temperature	38 °C	±3 °C	62 °C	±2 °C
Relative Humidity	95%	±10%	50%	±10%
Radiant Exposure	N/A	N/A	Contractual Agreement	N/A
Step Duration	1 hour (see Note 2)	±6 minutes	3.8 hours (see Note 2)	±6 minutes

§ 5.2 The instrument shall have the means to automatically control irradiance, Black Panel temperature, chamber temperature and relative humidity.

Cycle Duration

Controls	Dark Step		Light Step	
	Target	Tolerance	Target	Tolerance
Automatic Irradiance	None	N/A	0.55 $W \cdot m^{-2} \cdot nm^{-1}$ (see Note 1)	±0.02 $W \cdot m^{-2} \cdot nm^{-1}$
Black Panel Temperature	38 °C	±2.5 °C	89 °C	±2.5 °C
Dry Bulb Temperature	38 °C	±3 °C	62 °C	±2 °C
Relative Humidity	95%	±10%	50%	±10%
Radiant Exposure	N/A	N/A	Contractual Agreement	N/A
Step Duration	1 hour (see Note 2)	±6 minutes	3.8 hours (see Note 2)	±6 minutes

Note 2: Other cycle times may be used upon contractual agreement, if, for example, an irradiance different than the specified default value is specified

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SAE 2527

SURFACE VEHICLE STANDARD	J2527™	SEP2017
	Issued 2004-02 Revised 2017-09 Superseding J2527 FEB2004	
(R) Performance Based Standard for Accelerated Exposure of Automotive Exterior Materials Using a Controlled Irradiance Xenon-Arc Apparatus		

SAE J2527

- Originally published in 2004
- Revised in 2017
- Currently under revision, expected 2026 publication
- Basic cycle and content largely unchanged
- Today's presentation will mostly reference 2017 version

SAE J2527 Test Cycle

Step	Light	Dark	Spray
1	None.	60 min.	Front and back
2	40 min/ 1.32 kJ•m^{-2}•nm^{-1}	Not applicable	None
3	20 min/ 0.66 kJ•m^{-2}•nm^{-1}	Not applicable	Front
4	60 min./1.98 kJ•m^{-2}•nm^{-1}	Not applicable	None

Cycle is 3:00 total

Light steps can be timed in minutes or in radiant dose, assuming a control value of 0.55 W/m^2/nm @340 nm

We will replace those giant dots with normal-sized dots ☺

Xenon-Arc Light Source

- As with SAE J2412, the light source is included directly in the title of SAE J2527
- Additional criteria give users instruction:
  - *§ 5.2 The apparatus employed utilizes a xenon-arc lamp(s) as the source of radiation.*
  - *§ 5.2.1 A more detailed description of the apparatus can be found in ASTM G151 and ASTM G155*

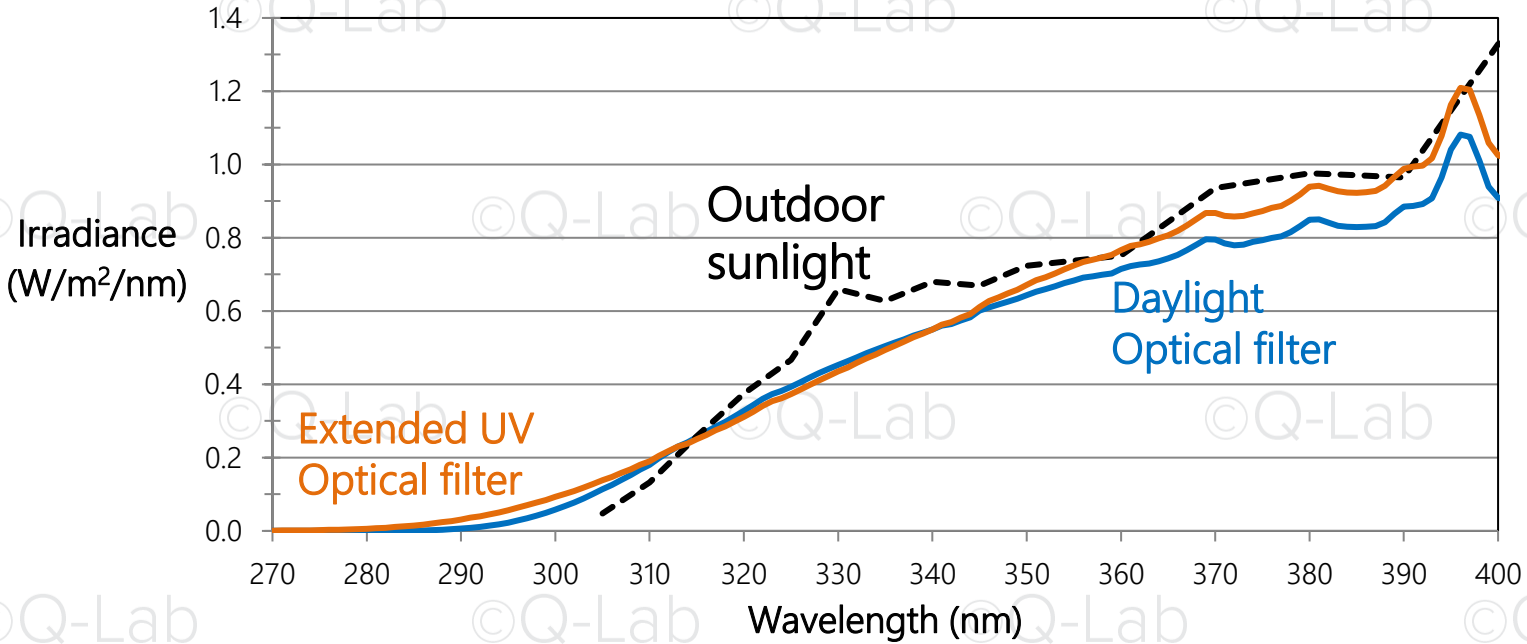
Optical Filter Requirements

SAE J2527 allows for either **Extended-UV** or **Daylight** optical filters to be used for exposure.

> *§ 6.3 Fit the xenon-arc lamp with the appropriate optical filters to meet the intended spectral power distribution (SPD). The filters shall provide an SPD that falls within the respective ranges shown in Tables C1 or C2 in Appendix C. Refer to Figure C1 or C2 in Appendix C for representative spectral power distributions*

Optical Filter Requirements

Daylight is a better match; **Extended UV** has historical data
Next revision will discuss Type I and Type II Daylight



Spectral Irradiance: Graphical

Extended UV

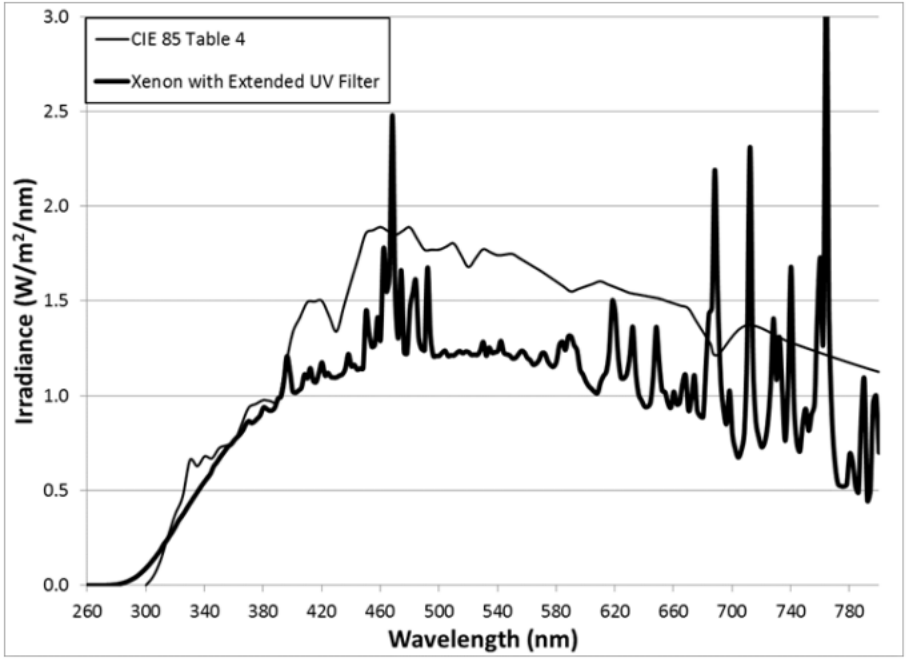


Figure C1 – Example of extended UV and sunlight SPD

Daylight

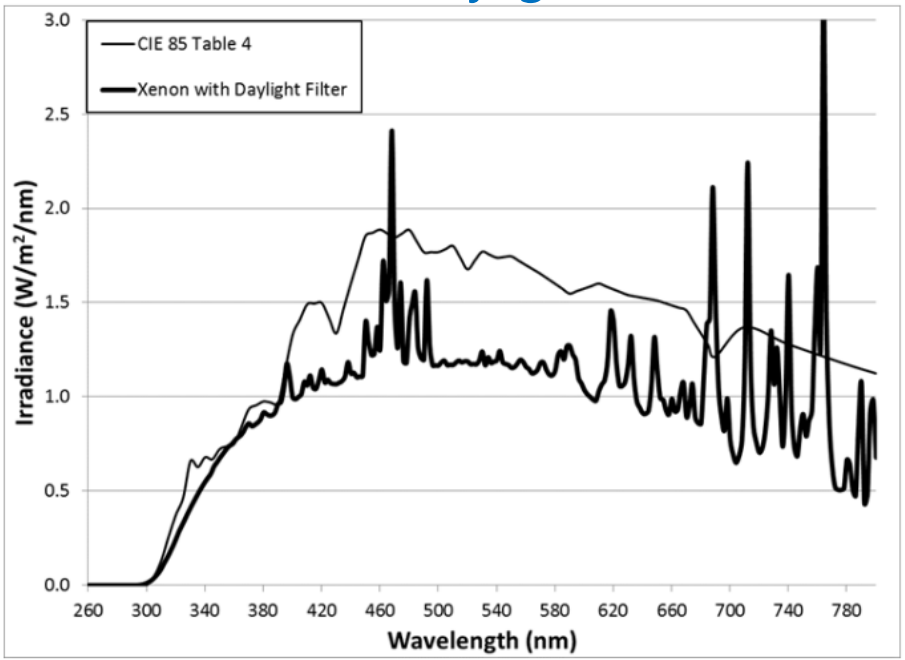


Figure C2 – Example of daylight filter vs. sunlight spectral power distribution

Spectral Irradiance: Tables

Extended UV

Table C1 - Extended UV filters

Irradiance in W/m² based on 81 SPD'S for Xenon-Arcs with Extended UV Filters Normalized to Exactly 0.55 $Wm^{-2}nm^{-1}$" at 340 NM

Bandpass	Mean	Std. Dev	Min	Max	Lower 95%	Upper 95%
250-260	0.00	0.00	0.00	0.02	0.00	0.01
261-270	0.00	0.00	0.00	0.03	0.00	0.01
271-280	0.04	0.02	0.01	0.10	0.00	0.08
281-290	0.22	0.08	0.09	0.42	0.07	0.38
291-300	0.73	0.16	0.36	1.16	0.41	1.04
301-310	1.60	0.20	1.04	2.19	1.19	2.00
311-320	2.72	0.19	2.13	3.26	2.34	3.10
321-330	3.91	0.14	3.48	4.29	3.63	4.18
331-340	5.06	0.04	4.95	5.18	4.97	5.15
341-350	6.10	0.10	5.91	6.33	5.90	6.30
351-360	7.06	0.22	6.48	7.67	6.61	7.51
361-370	7.97	0.33	7.19	8.83	7.32	8.62
371-380	8.65	0.48	7.55	9.77	768	9.62
381-390	9.17	0.59	7.99	10.57	8.00	10.34
391-400	10.67	0.70	9.17	13.29	9.26	12.08
300-400	63.10	1.97	58.30	68.17	59.16	67.04

SPD table for 400-800 nm at 50 nm bandpasses

			Suggested Spec			
Bandpass	Average	Std dev	Min	Max	Lower 95%	Upper 95%
400-450	57.47	5.13	47.20	67.74	47.20	67.74
451-500	73.71	6.22	61.28	86.15	61.28	86.15
501-550	66.26	7.40	51.46	81.06	51.46	81.06
551-600	67.61	7.43	52.75	82.48	52.75	82.48
601-650	64.85	7.69	49.46	80.24	49.46	80.24
651-700	60.52	6.14	48.25	72.80	48.25	72.80
701-750	57.06	6.17	44.72	69.40	44.72	69.40
751-800	48.44	7.39	33.66	63.22	33.66	63.22

Daylight

Table C2 - Daylight filters

Irradiance in W/m² based on 111 SPD'S for Xenon-Arcs with Daylight Filters Normalized to Exactly 0.55 $Wm^{-2}nm^{-1}$" at 340 NM

Bandpass	Mean	Std. Dev	Min	Max	Lower 95%	Upper 95%
250-260	0.00	0.00	0.00	0.00	0.00	0.00
261-270	0.00	0.00	0.00	0.00	0.00	0.00
271-280	0.00	0.00	0.00	0.01	0.00	0.00
281-290	0.02	0.02	0.00	0.11	0.00	0.06
291-300	0.19	0.10	0.03	0.55	0.00	0.38
301-310	0.77	0.21	0.32	1.46	0.35	1.18
311-320	1.91	0.21	1.31	2.68	1.49	2.33
321-330	3.39	0.13	2.96	3.97	3.12	3.65
331-340	4.92	0.06	4.68	5.11	4.80	5.03
341-350	6.24	0.09	5.80	6.40	6.06	6.43
351-360	7.40	0.22	6.66	7.82	6.97	7.84
361-370	8.58	0.41	7.56	9.82	7.76	9.39
371-380	9.25	0.60	8.09	11.36	8.04	10.45
381-390	9.92	0.89	8.39	13.71	8.15	11.69
391-400	11.88	1.44	9.64	18.57	8.99	14.76
300-400	64.31	3.57	57.79	78.96	57.16	71.45

SPD table for 400 to 800 nm in 50 nm bandpasses

			suggested spec			
bandpass	average	std dev	min	max	lower 95%	upper 95%
400-450	64.3	8.4	47.5	81.0	47.5	81.0
451-500	86.3	16.4	53.4	119.2	53.4	119.2
501-550	74.4	12.5	49.4	99.5	49.4	99.5
551-600	73.5	10.3	52.9	94.2	52.9	94.2
601-650	68.0	8.1	51.9	84.2	51.9	84.2
651-700	63.8	9.4	44.9	82.6	44.9	82.6
701-750	58.2	11.8	34.6	81.7	34.6	81.7
751-800	55.6	9.9	35.8	75.4	35.8	75.5

Automatic Test Parameter Control

- These important parameters are to be controlled automatically in SAE J2527:
  - Irradiance
  - Panel Temperature
  - Chamber Air Temperature
  - Relative Humidity
- § 5.2 *The instrument shall have the means to automatically control irradiance, Black Panel temperature, chamber temperature and relative humidity.*

Irradiance

Controls	Dark+Spray Step 1 Target	Dark+Spray Step 1 Operational Fluctuation	Light Step 2,3,4 Target	Light Step 2,3,4 Operational Fluctuation
Automatic irradiance	None		0.55 $Wm^{-2}nm^{-1}$ at 340 nm *	
Black panel temp.	None		70 °C	± 3 °C
Chamber air temp. (Dry bulb)	38 °C	Not Applicable	47 °C	± 3 °C
Relative humidity	95%	Not Applicable	50%	± 10%
Radiant exposure	None		See applicable specification	

Note 1: 0.55 $W \cdot m^{-2} \cdot nm^{-1}$ at 340 nm is the historic preferred irradiance for this test. Equipment monitoring a broad band rather than the narrow band will have different target values than those listed in Table 1. Other values that are higher or lower and agreed upon by contractual parties can be used, but they change the target values for any weathering reference materials used and the radiant energy dosages used in Table 1.

Black Panel Temperature Sensor

Controls	Dark+Spray Step 1 Target	Dark+Spray Step 1 Operational Fluctuation	Light Step 2,3,4 Target	Light Step 2,3,4 Operational Fluctuation
Automatic irradiance	None		0.55 $Wm^{-2}nm^{-1}$ at 340 nm *	
Black panel temp.	None		70 °C	± 3 °C
Chamber air temp. (Dry bulb)	38 °C	Not Applicable	47 °C	± 3 °C
Relative humidity	95%	Not Applicable	50%	± 10%
Radiant exposure	None		See applicable specification	

§ 5.3 The apparatus shall have an uninsulated black panel thermometer, as described in ASTM G151

Air Temperature and Relative Humidity

Controls	Dark+Spray Step 1 Target	Dark+Spray Step 1 Operational Fluctuation	Light Step 2,3,4 Target	Light Step 2,3,4 Operational Fluctuation
Automatic irradiance	None		0.55 $Wm^{-2}nm^{-1}$ at 340 nm *	
Black panel temp.	None		70 °C	± 3 °C
Chamber air temp. (Dry bulb)	38 °C	Not Applicable	47 °C	± 3 °C
Relative humidity	95%	Not Applicable	50%	± 10%
Radiant exposure	None		See applicable specification	

§ 5.2 The instrument shall have the means to automatically control irradiance, Black Panel temperature, chamber temperature and relative humidity.

Water Spray

Step	Light	Dark	Spray
1	None.	60 min.	Front and back
2	40 min/ 1.32 kJ•m^{-2}•nm^{-1}	Not applicable	None
3	20 min/ 0.66 kJ•m^{-2}•nm^{-1}	Not applicable	Front
4	60 min./1.98 kJ•m^{-2}•nm^{-1}	Not applicable	None

Step 1 requires Front + Back spray in Dark conditions

- Pioneering use of longer water steps in the Dark, for better realism
- Back spray intended to cool specimen backs to form condensation on front; however …
  - Water temp is uncontrolled
  - Specimen edges can't be sealed easily (spray reaches the front, moist air reaches the back)
- Original intent was back spray only. but original devices were doing front and back.
- Updated to "Front and Back"; better approach would be to remove back spray entirely

Water Spray

Step	Light	Dark	Spray
1	None.	60 min.	Front and back
2	40 min/ 1.32 kJ•m^{-2}•nm^{-1}	Not applicable	None
3	20 min/ 0.66 kJ•m^{-2}•nm^{-1}	Not applicable	Front
4	60 min./1.98 kJ•m^{-2}•nm^{-1}	Not applicable	None

- Step 3 requires Front spray in Light
  - This is common in xenon standards, but does not produce sufficient water uptake for coatings testing
- High-purity water is required for water spray, as in every xenon arc standard, to avoid spotting

Operational Fluctuation

- Operational fluctuation refers to the allowed variance in the **measured value** of any given parameter, **at the location where it is being measured**
  - It IS a tester performance stability requirement
  - It is NOT a uniformity requirement
  - Is does NOT allow you to choose any setpoint within the specified range
- For example, consider a requirement of **CAT = 47 ± 3 °C**
  - This doesn't mean the air has to be between 44-50 °C everywhere in the test chamber. It means the CAT sensor must always measure between 44-50 °C
  - It also doesn't mean you can program any CAT setpoint from 44-50 °C that you like. You have to program 47 °C.

Operational Fluctuation

Controls	Dark+Spray Step 1 Target	Dark+Spray Step 1 Operational Fluctuation	Light Step 2,3,4 Target	Light Step 2,3,4 Operational Fluctuation
Automatic irradiance	None		0.55 $Wm^{-2}nm^{-1}$ at 340 nm *	
Black panel temp.	None		70 °C	± 3 °C
Chamber air temp. (Dry bulb)	38 °C	Not Applicable	47 °C	± 3 °C
Relative humidity	95%	Not Applicable	50%	± 10%
Radiant exposure	None		See applicable specification	

NOTE: The operational fluctuations do not apply during the spray portion of the segments

Cycle Timing

Step	Light	Dark	Spray
1	None.	60 min.	Front and back
2	40 min/ 1.32 kJ•m^{-2}•nm^{-1}	Not applicable	None
3	20 min/ 0.66 kJ•m^{-2}•nm^{-1}	Not applicable	Front
4	60 min./1.98 kJ•m^{-2}•nm^{-1}	Not applicable	None

* The radiant dosages (kJ•m^{-2}•nm^{-1}) listed are based on an irradiance level of 0.55 Wm^{-2} nm^{-1} at 340 nm. An apparatus that monitors irradiance using a broadband rather than a narrowband or operated at higher irradiance levels will have a different radiant energy dosage for the time intervals shown.

§ 6.4 Choose the program cycle which provides 120 minutes of light and 60 minutes of dark in the following cycle: 60 minutes of dark with both back and front spray, 40 minutes of light followed by 20 minutes of light and front specimen spray, followed by 60 minutes of light, and repeating. The test sequence shall follow the condition set up in Table 1

Outline

- History and goals of SAE J2412 and J2527
- Interpretation of standards requirements
  - SAE J2412 – Interior automotive materials
  - SAE J2527 – Exterior automotive materials
- Specimen preparation and test setup
- Test performance, evaluation, and reporting

How to Program SAE J2412

- Q-SUN Xe-2, Xe-3, or Xe-8
- Extended UV-Q/B Filter (!)
- Narrowband 340 nm Sensor
- Uninsulated Black Panel
- Start in Light step

Step	Function	Relative Humidity	Irradiance	Black Panel Temp	Chamber Air Temp	Step Time (hh:mm)
1	Light	50 %	0.55 W/m^2/nm	89 °C	62 °C	3:48
2	Dark	95 %	-	-	38 °C	1:00

How to Program SAE J2527

- Q-SUN Xe-2, Xe-3, or Xe-8
- Extended UV-Q/B or Daylight-B/B Filter (!)
- Narrowband 340 nm Sensor
- Uninsulated Black Panel
- Start in Dark step

Step	Function	Relative Humidity	Irradiance	Black Panel Temp	Chamber Air Temp	Step Time (hh:mm)
1	Dark + Front/Back Spray	95 %	-		38 °C	1:00
2	Light	50 %	0.55 W/m²/nm	70 °C	47 °C	0:40
3	Light + Spray	50 %	0.55 W/m²/nm	70 °C	47 °C	0:20
4	Light	50 %	0.55 W/m²/nm	70 °C	47 °C	1:00

Chamber Sensor Calibration

Sensor	Device
Irradiance	UC20/340
Black Panel	UC202/BP
Chamber Air Temperature Relative Humidity	Chamber Air Temperature / Relative Humidity Sensor

UC20/340 Smart Sensor

UC202/BP Smart Sensor

Specimen Mounting

- In order for water delivery during SAE J2527's back spray, a mesh tray is required in an Xe-3.
- Open-back specimen holders are needed for a Q-SUN Xe-2
- Mesh tray may be used for SAE J2412 in order to meet polystyrene limits

Xe-3 Mesh Tray

Xe-2 Open-backed holders

Specimen Preparation

- SAE J2412 & SAE J2527 Specimen Preparation and Conditioning
  § 7.1 Prepare the specimens to be exposed to fit the specimen holder being used. Refer to ASTM G147 for conditioning and handling of specimens.
- SAE J2412 Back textiles with cardboard
  § 7.3 Interiors textiles (body cloth, carpet, vinyl coated fabrics, etc.) shall always be backed with white cardboard. In all cases the white cardboard shall be the size of the specimen holder to eliminate any gaps.
- SAE J2412 Fill unused slots and gaps with cardboard
  § 7.4 Fill all unused slots with an inert non-reflective material (e.g., white cardboard panels) to maintain desired air flow.

Textile Specimens on cardstock in Xe-2 holder

Outline

- History and goals of SAE J2412 and J2527
- Interpretation of standards requirements
  - SAE J2412 – Interior automotive materials
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Additional Requirements

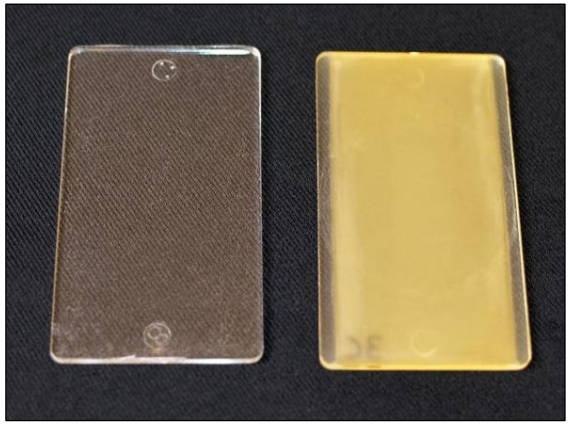
- Specimen Repositioning
  - SAE J2412 & SAE J2527 *§5.4.1*
- DI Water Supply (< 1 ppm solids and < 0.2 ppm silica)
  - SAE J2412 *§6.1.1*
  - SAE J2527 *§6.2*
- Test duration to be reported by total radiant exposure ($kJ/m^2/nm$)
  - SAE J2412 & SAE J2527 *§9.2.6*

Specimen Repositioning

- Ensures best repeatability and reproducibility
- Perform at least 4 times per test
- Not *required* for Q-Lab testers (>90% uniformity) but *recommended*
- Required for both flat array and rotating rack

Polystyrene Weathering Reference Material

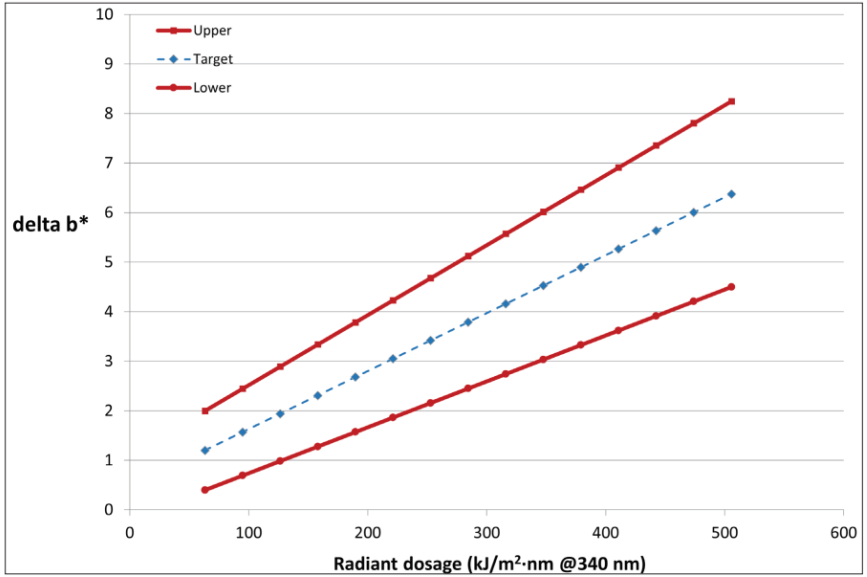
- Polystyrene is a polymer with known sensitivity to light and heat
- Its yellowing behavior is used in SAE J2412 and J2527 to validate chamber performance
- PS use is **optional** as of the 2016-2017 revisions, but still widely-used
- Useful as a comparison tool for reproducibility and reliability. Limits are established for these SAE standards, but PS can be used in any test



Polystyrene Tolerances

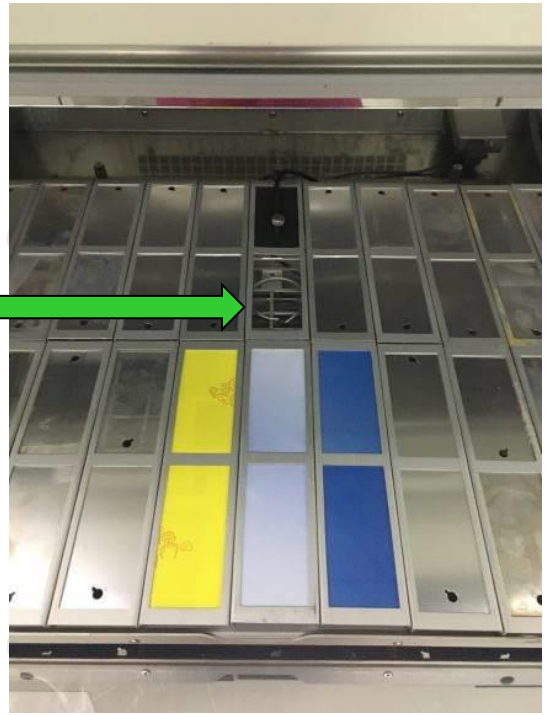
Each test and PS Lot has its own published max/min

Radiant Dosage (kJ/m²·nm @ 340 nm)	95% Tolerance Interval for Reflectance Δb*, SAE J1960 and J2527 Table C1 Spectra Extended UV Filter		
	Low	Target	High
31.6			
63.2	0.40	1.20	2.00
94.8	0.69	1.57	2.45
126.4	0.99	1.94	2.89
158	1.28	2.31	3.34
189.6	1.57	2.68	3.79
221.2	1.86	3.05	4.23
252.8	2.16	3.42	4.68
284.4	2.45	3.79	5.13
316	2.74	4.16	5.57
347.6	3.04	4.53	6.02
379.2	3.33	4.90	6.46
410.8	3.62	5.27	6.91
442.4	3.91	5.64	7.36
474	4.21	6.01	7.80
505.6	4.50	6.38	8.25



Polystyrene Procedures

- During the test
  - Mount polystyrene in specimen holder
  - Place close or directly next to the black panel
  - Use a mesh tray for proper airflow
- Following the test
  - Instrumental Color Measurement
    - CIELAB, D65 illuminant, 10° observer
  - Back with white calibration tile
    - Do not back with paper, which may include optical brighteners



Evaluating and Reporting

- Visual Assessment
- Grey Scale Fade
- Instrumental Color Assessment
- Gloss retention
- Blistering
- Adhesion
- Test Duration (radiant exposure, $kJ/m^2/nm$)

Conclusions

- SAE J2527 and SAE J2412 have been instrumental in the development of automotive material reliability and performance. The majority of the performance of these standards is for Qualification and Validation.
- Though new standards like ASTM D7869 (see you next week!) have better correlation to service environment or more accurate representation of light exposure, the standards are still very popular
- The Q-SUN Xe-2, Xe-3, and Xe-8 are qualified to run either standard with the proper configuration and setup.

Thank you for your time.

Questions?

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We make testing simple.

Q-LAB