Automotive Interior and Exterior Weathering Testing
汽车内外饰老化测试

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Q-Lab's Weathering Webinar Series近期讲座预告

- 今天是近期汽车系列讲座的第一讲
- 系列讲座相关内容将在我们的网页上发布: q-lab.com/webinars

Date	Topic
5/12/2022	Automotive Interior and Exterior Weathering Testing 汽车的内外饰老化测试
6/9/2022	Relative Humidity and Wet/Dry Transitions in Salt Spray Corrosion Tests 盐雾测试中的相对湿度和干湿交替
6/23/2022	Modern Automotive Weathering Test: ASTM D7869 ASTM D7869-新的汽车老化测试方法
6/30/2022	Water Delivery in Accelerated Weathering Testing 加速老化测试中水的施加
7/14/2022	Correlation in Accelerated Weathering and Corrosion Testing 加速老化和腐蚀测试的相关性

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Today‘s Agenda日程

- Weathering of automotive components汽车零部件的老化
- Weathering science basics老化的基本概念
- Natural outdoor testing自然户外测试
- Accelerated laboratory testing实验室加速测试
- Automotive test methods汽车测试方法

Problem – Automotive Weathering Testing

汽车老化测试-问题

- 实验室的测试合格的产品，在实际使用的条件下，为什么会出现老化/腐蚀失效的情况?
- 现有的实验室测试时间和评判标准，是否足够严格，能否保证产品的使用条件下几年不出问题？
- 以前的产品和工艺合适的老化/腐蚀质量控制方法，对新的材料和工艺是否同样适用？

测试的类别

测试类别	结果	测试时长	结果比较
QC	Pass / fail	• Defined确定 • Short短	Material specification 指标
Qualification / validation 验证	Pass / fail	• Defined确定 • Medium-long中长	Reference material or specification 对比样/指标
Correlative 相关	Rank-ordered data 排序	• Open-ended不固定 • Medium中	Natural exposure 自然曝露 (Benchmark site)
Predictive 预测	Service life使用寿命 Acceleration factor加速因子	• Open-ended不固定 • Long长	Natural exposure 自然曝露 (Service environment)

Weathering of Automotive Components
汽车零部件的老化

Why is it worthwhile to conduct weathering testing?

为什么有必要做老化测试？

Weathering of Auto Exteriors汽车外饰的老化

Color change and gloss loss变色和失光

Weathering of Auto Exteriors汽车外饰的老化

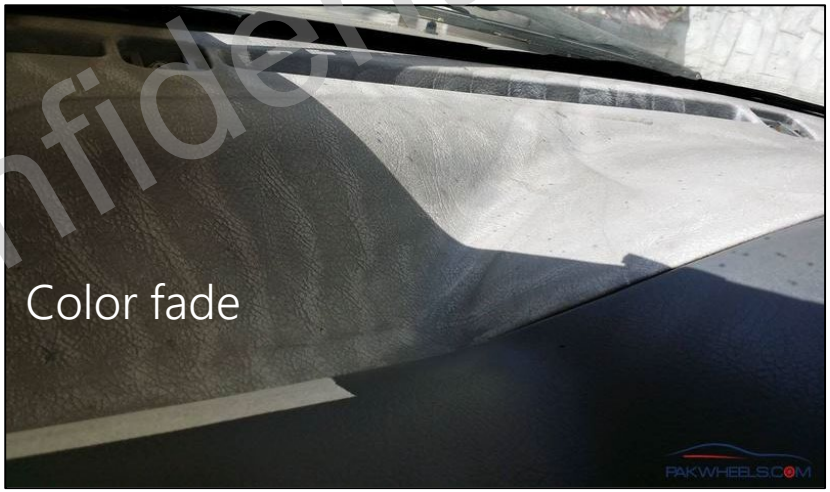
Physical and Chemical failures物理和化学失效

Weathering of Auto Exteriors汽车外饰的老化

Physical and Chemical failures物理和化学失效

Weathering of Auto Interiors汽车内饰的老化

Physical and Appearance failures物理和表观失效



Why Do Weathering Testing?为什么要做老化测试？

High gloss and color integrity
完好的高光泽和颜色

OR

Fading, cracking, peeling
褪色、开裂、起皮

Weathering testing can mean the difference between happy customers and … the customer on the right 客户的感官差异巨大

Weathering science basics
老化的基本概念

Why do interior and exterior automotive components fail in service?

为什么汽车内外饰件使用中会失效/老化？

What is Weathering?什么是老化？

Changes in material properties resulting from exposure to the radiant energy present in sunlight in combination with heat (including temperature cycling) and water in its various states, predominately as humidity, dew, and rain.

因阳光、热和不同形态水的共同作用，材料性能的变化。

Forces of Weathering老化的要素

Know Your Enemy!

- Sunlight光
- Heat热
- Water水

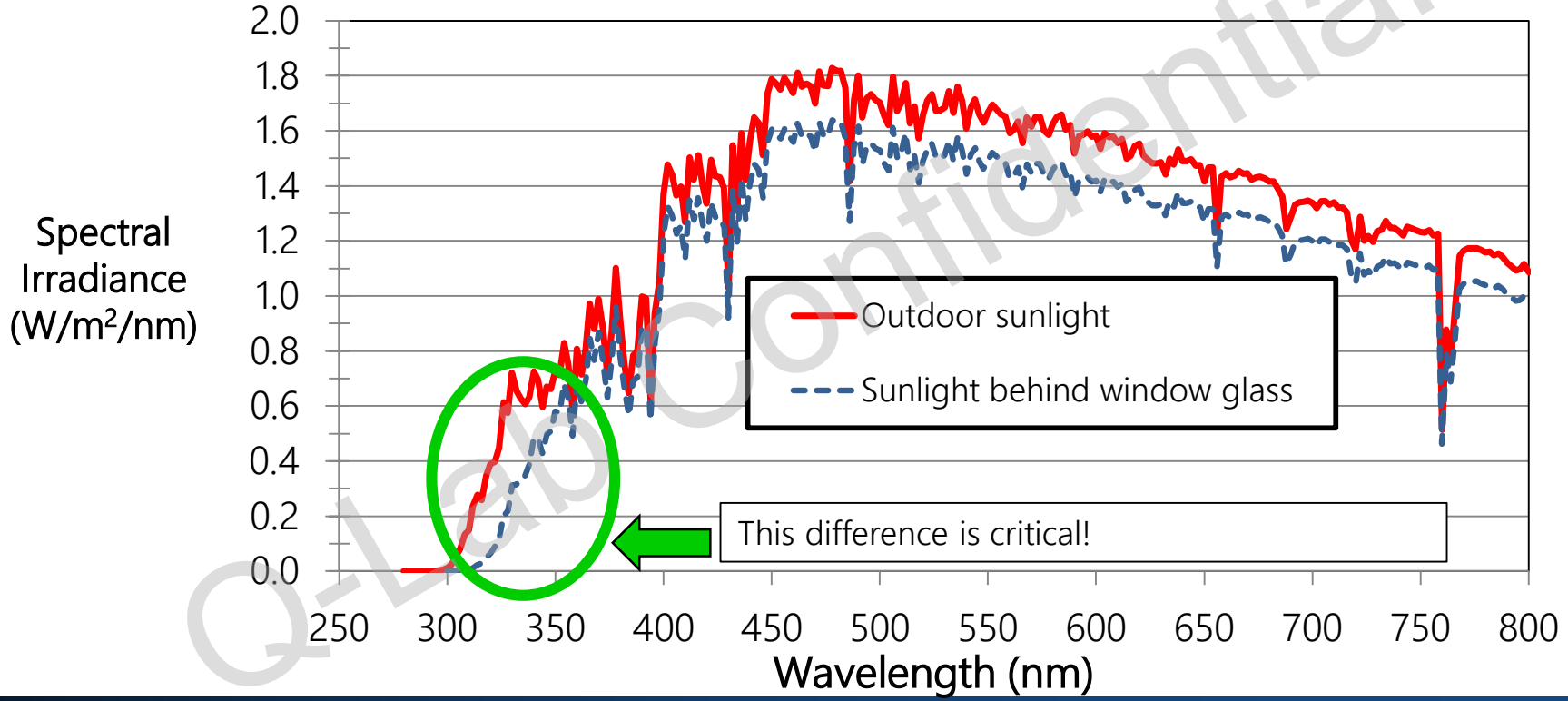
**Other factors can impact weathering as well but we will not focus on those today*

Ultraviolet (UV) light is responsible for most weathering degradation 紫外线是造成老化的主要原因

UV is only 7% of the sunlight spectrum but it causes virtually all polymer degradation!

太阳光中的7%的紫外线是所有聚合物降解的主要原因！

Sunlight Exterior vs Sunlight Interior车内外阳光光谱



Factors Affecting Automobile Glass Light Filtering

对光透过率有影响的汽车玻璃的参数

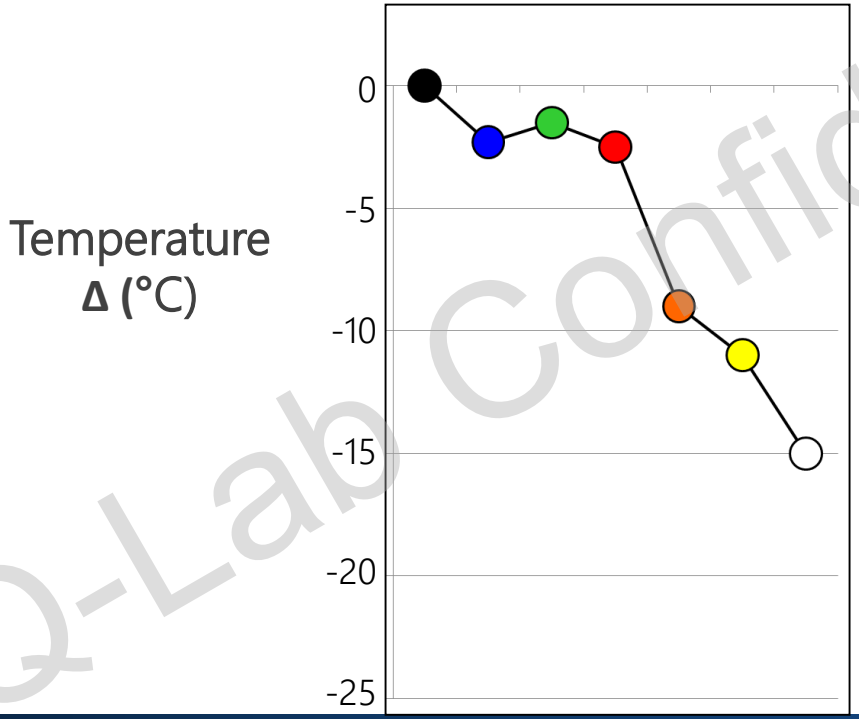
- Tint着色
- Thickness厚度
- Lamination层压

Heat Effects热效应

- Dimensional change尺寸变化
- Evaporation蒸发
- Thermal aging热老化
- Thermal cycling热循环

Temperature and Color温度和颜色

Darker Colors Have Higher Temperatures!深色的样品温度更高!



Heat behind Window Glass玻璃窗后的热

Temperature of automobile interior components behind window glass can exceed 100 °C
玻璃窗后的内饰件的温度会超过100度

Major Effects of Water水的主要影响

- Chemical Reactions化学反应
  - Reactions in solution溶解
  - Facilitates reaction via increase in oxygen transport促进氧的反应

- Physical Effects物理效应
  - Erosion侵蚀
  - Absorption/freeze-thaw吸收/冻融
  - Thermal shock热冲击
  - Impact (material loss)冲刷

Water in Service Environments使用环境中的水

Humidity湿度

- Affects time of wetness
- Exterior and interior

Rainfall降雨

- Washing of surfaces
- Chalking
- Thermal shock

Dew露水

- High O_2 content
- Long dwell time

PRIMARY SOURCE OF OUTDOOR WETNESS

Natural Outdoor Weathering Testing
户外老化测试

Benchmark test data from realistic exposures

测试的基准数据来自真实环境曝露

45° south-facing exposure45度朝南

0° Exposure Angle0度角曝晒

Mesh backing for three-dimensional components网状背板

Black Box Testing黑箱测试

- Imitates auto trunk and hood conditions
  模拟车箱环境
- Developed by GM in 1950's通用汽车
  1950年代开发
- High temperature高温
- SAE J1976

Under-Glass Exposures for Interior Components

玻璃窗下的内饰件曝露

Whole Car Testing 整车曝露

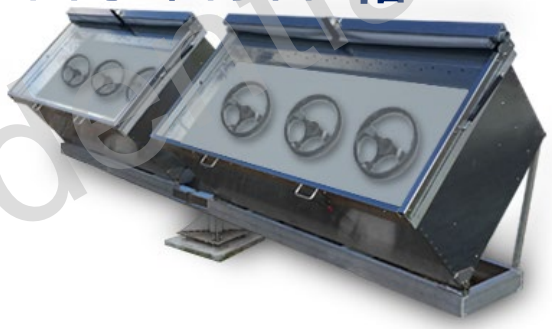
- Testing of entire vehicle整车测试
- Best simulation of the end use – includes exterior and interior weathering最佳模拟-包含内外饰件老化
- All parts, materials and components interact during the weathering process 所有材料和部件的老化过程中的相互影响
- Thermal radiation studies commonly performed 通常包含热辐射研究

Accelerated Outdoor Weathering Testing
户外加速老化测试

Realistic exposures done faster 真实曝露、快速测试

AIM Box

“Automotive Interior Materials” Box “汽车内饰材料”箱



- Reproduces extreme heat from automotive interior再现车内的高温环境
- Can test entire instrument panel可以测试整个仪表板
- Different plastics experience different thermal expansion不同塑料的膨胀系数不同
- Generates differential stresses between different interior plastics不同塑料间的内应力

Natural Sunlight Concentrator: Q-TRAC

太阳跟踪反射聚能装置：Q-TRAC

Natural Sunlight Concentrator: Q-TRAC

太阳跟踪反射聚能装置：Q-TRAC

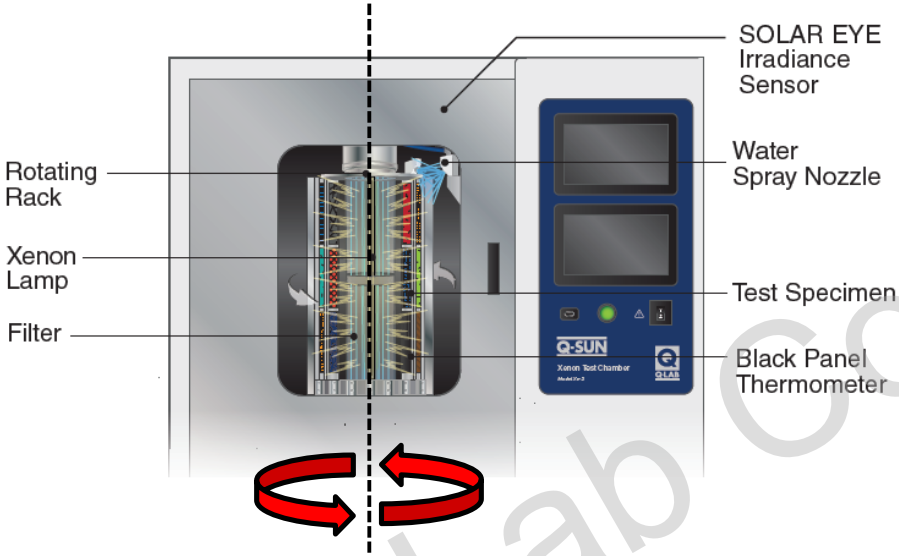
- Tracks the sun during the day白天跟踪太阳
- Delivers 5 × as much UV as a natural exposure5倍的紫外光照
- Fast results with natural solar spectrum基于自然太阳光照的快速测试

Laboratory Weathering Testing
实验室加速老化

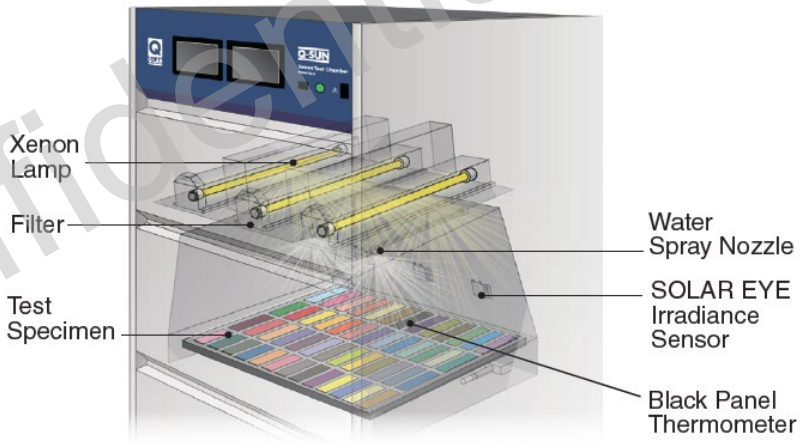
Accelerating testing for faster results than outdoor

加速测试，比户外更快得到结果

Xenon Arc Test Apparatus氙灯装置



Rotating Drum
转鼓



Flat Array
平板

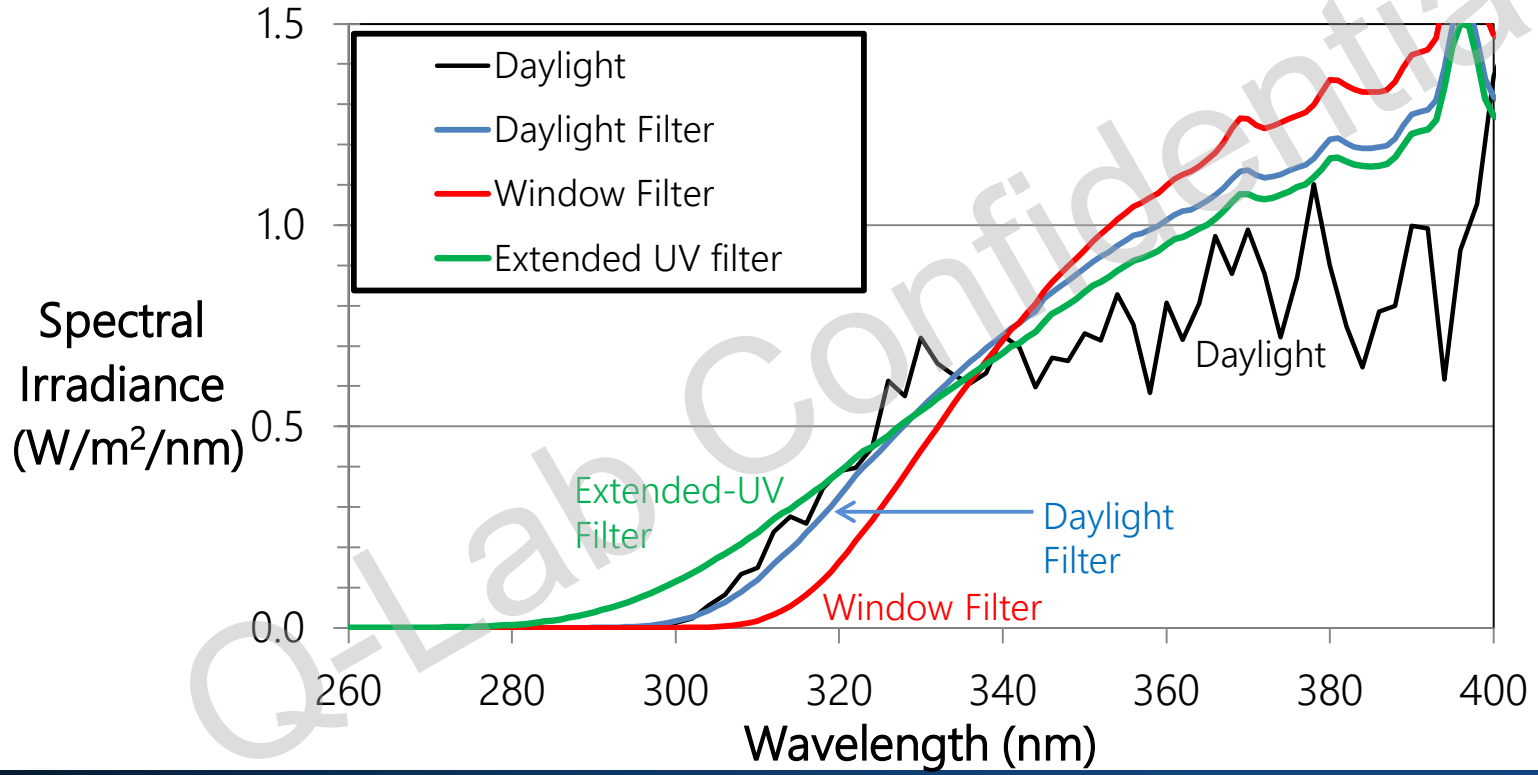
Optical Filters过滤片

- **Daylight** (for exterior components)日光过滤片（用于外饰件）
- **Window** (for behind-glass interior components)窗玻璃过滤片（用于内饰件）
- **Extended UV** (for harsh testing, quality control)紫外延展过滤片（用于QC快速测试）

Rotating drum
"lantern" filter
转鼓式
"灯笼"滤片

Flat array
filter
平板滤片

Xenon and Sunlight Spectra氙灯及太阳光谱

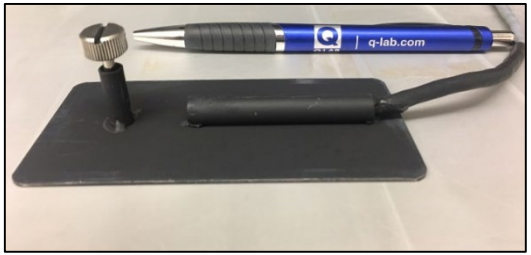


Black Panel Temperature Control

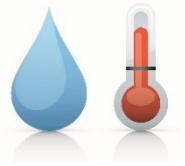
黑板温度控制

- Most common in test standards测试标准的通常要求
- Approximates maximum specimen surface temperature相当于样品的最高温度
- Can be used in combination with chamber air temp sensor and control可以和空气温度控制配合使用

Black Panel Temperature Sensors黑板温度计

Panel探头	ASTM (ISO) Designation设计	Typical use用途
	Uninsulated Black Panel (Black Panel) 非绝缘黑板（黑板)	Metallic substrates (painted metal) 金属基材（如钢板涂层）
	Insulated Black Panel (Black Standard) 绝缘黑板（黑标)	Insulating substrates (polymers) 绝缘基材（聚合物）

Environmental Control 测试环境条件的控制

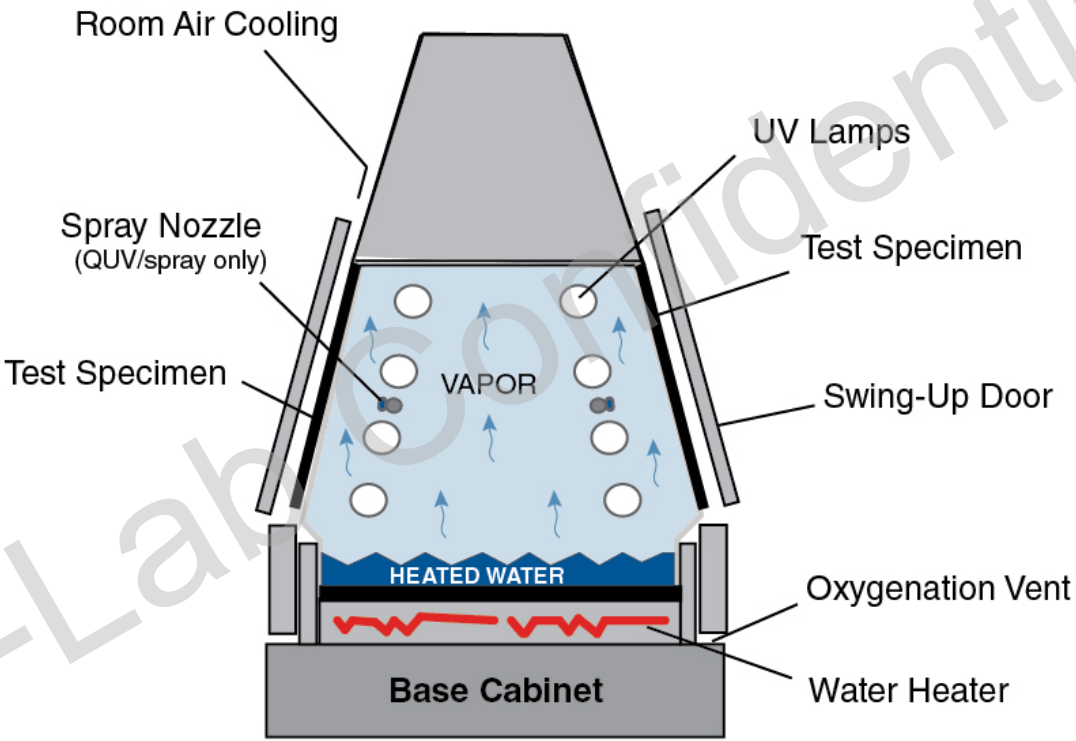


- CAT and RH control Required by certain test methods有些标准要求空气温度和相对湿度控制
- CAT spec necessary for control of RH控制相对湿度须控制空气温度
- BP temp always hotter than chamber air temp from absorbing radiant heat因吸收热辐射，黑板温度总高于空气温度
- For many durable materials, RH makes very little difference compared to spray and condensation对于高耐候材料，相对湿度的影响远小于水喷淋和冷凝

Xenon Arc Water Spray氙灯水喷淋

- Front spray前喷
  - Primary method of water delivery
  - Calibration technique for front spray recently developed (ASTM D7869)
- Back spray后喷
  - Result of a failed experiment intended to generate condensation; persists in some standards
- Dual spray双喷
  - For delivering a 2nd solution, e.g. acid rain, soap
- Immersion (Ponding)浸润
  - Alternative to front spray called out in some standards

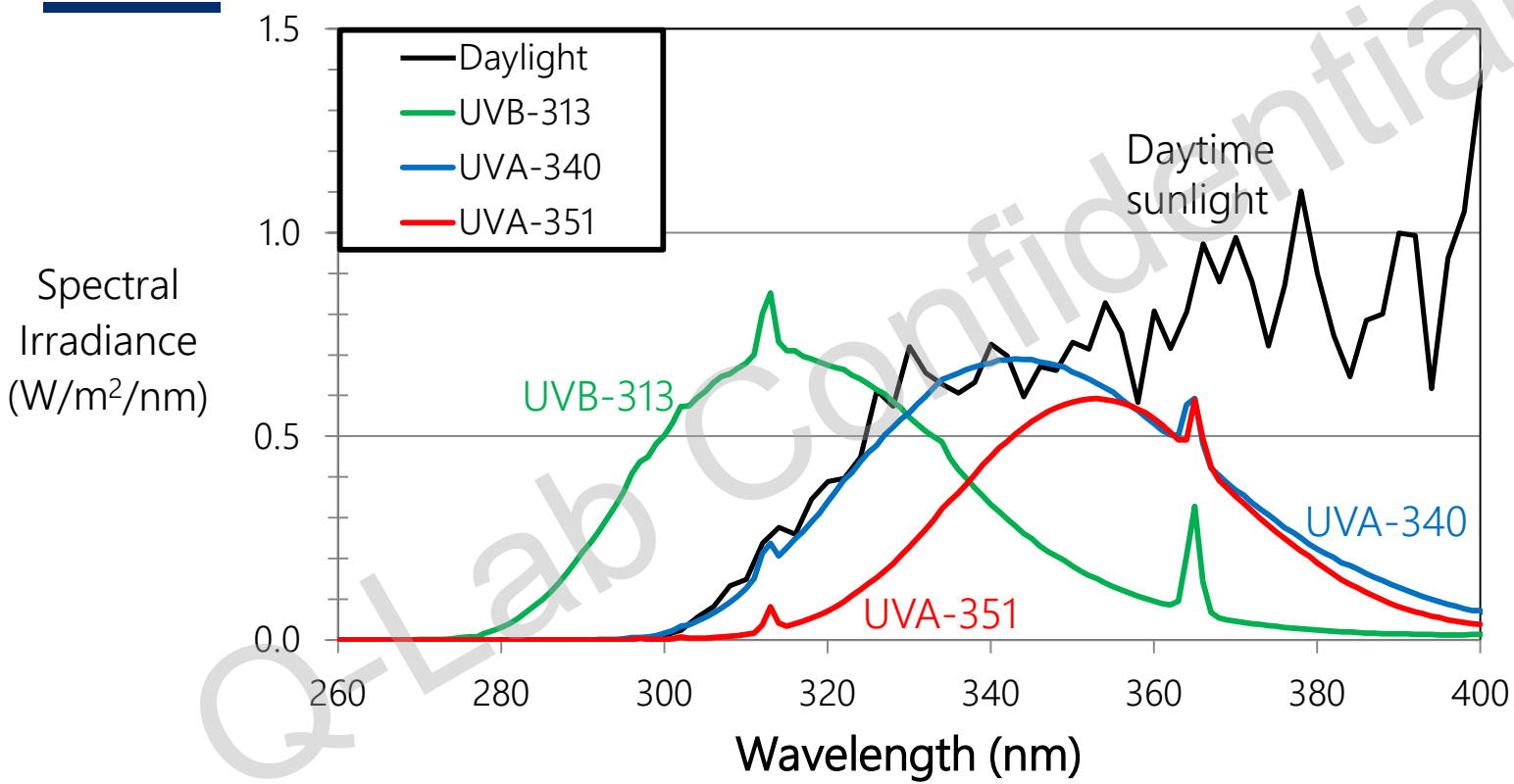
Fluorescent UV Test Apparatus紫外测试设备



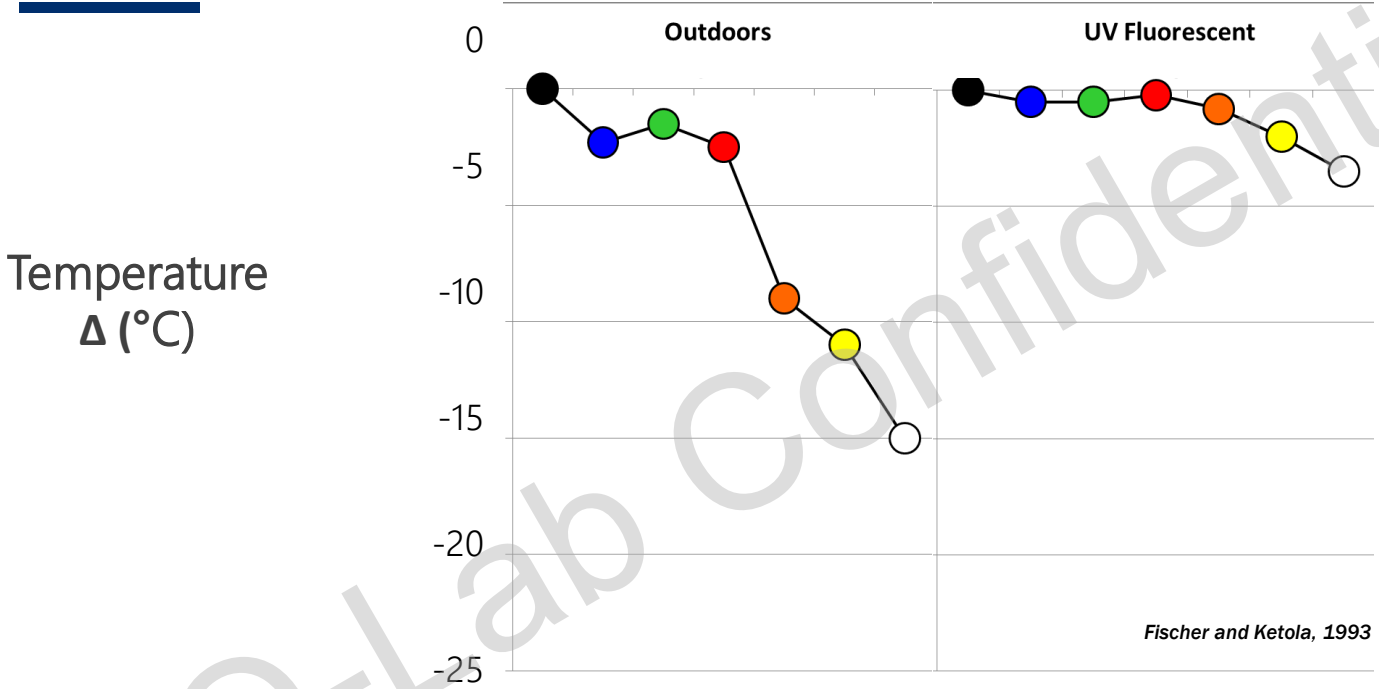
QUV Lamps紫外灯管

- UVA-340 (for exterior components外饰)
- UVA-351 (for interior components内饰)
- UVB-313EL (for harsh testing, quality control 快速QC测试)

QUV Lamp and Sunlight Spectra紫外灯和阳光光谱



QUV Color Temperature颜色对温度的影响



- Xenon testers generate IR heat and reproduce outdoor color temp. differences
- UV fluorescent testers do not

QUV Condensation冷凝

- Closest match to natural wetness最接近自然的潮湿模拟
- Best way to accelerate water in an laboratory tester 最佳的实验室水加速
- Elevated temperature可升温
- High O_2 content氧含量高
- Tester performs distilling – you cannot deposit debris on specimens! Water is guaranteed to be clean.使用蒸馏水，避免污染

Creating condensation in the QUV is easy and does not require expensive, pure water

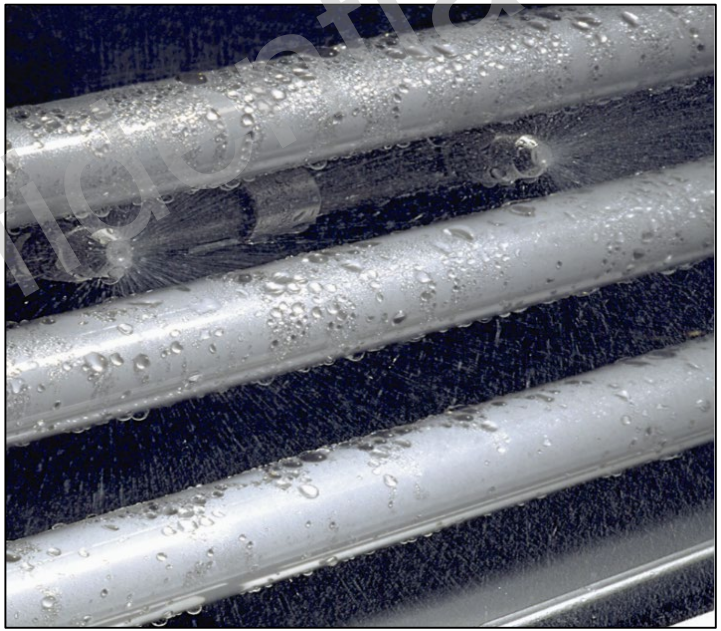
QUV Water Spray 水喷淋

- Ensures that parts get fully saturated

确保湿透

- Creates erosion & thermal shock

产生侵蚀和热冲击



Automotive Accelerated Laboratory Testing
汽车实验室加速测试

Driving towards better correlation with outdoor weathering

驶向与户外老化更好相关性的目标

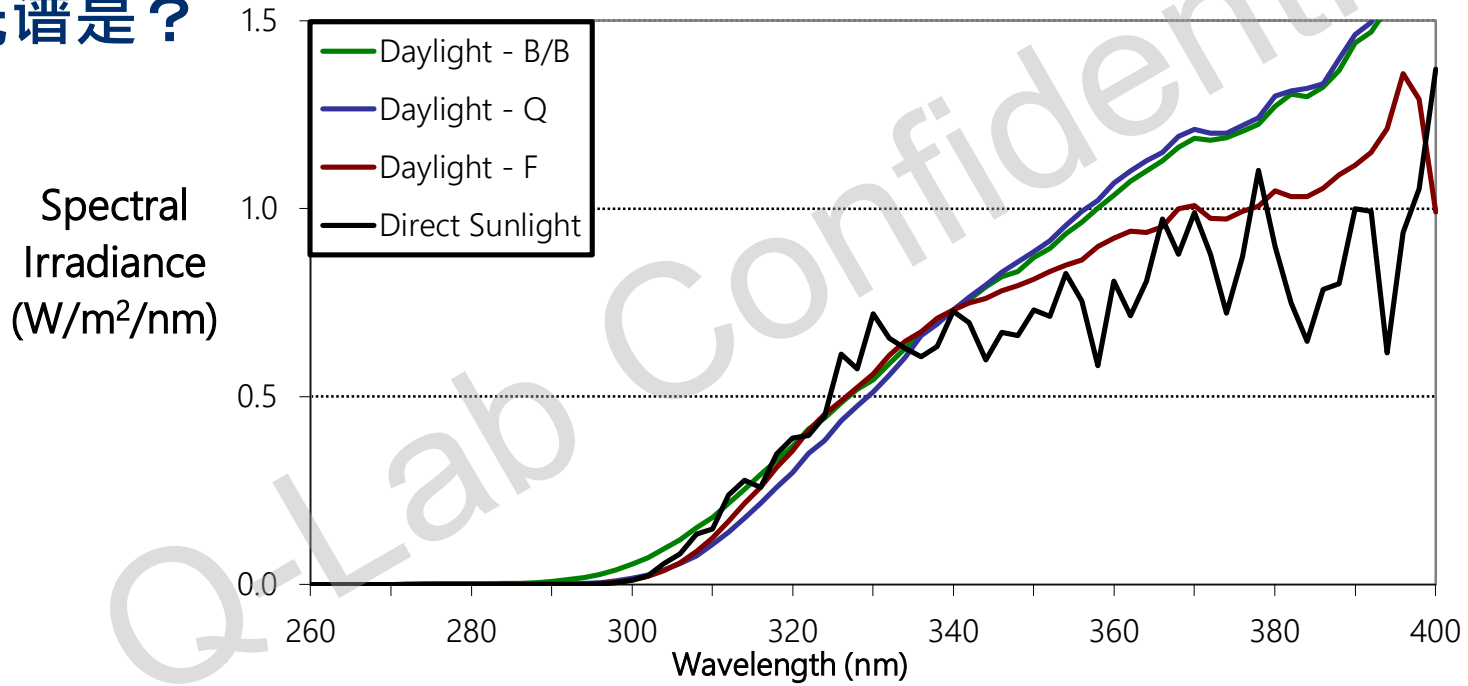
Automotive Weathering Testing 汽车老化测试

Exterior and Interior Test Conditions Summary内外饰测试条件汇总

Property条件	Exterior外饰	Interior内饰
Light spectrum光谱	Daylight / Extended-UV filters日光玻璃 UVA-340 lamps紫外灯管	Window filters窗玻璃 UVA-351 lamps紫外灯管
Heat热	Elevated temperature升温	Very high temperature高温
Water水	Condensation冷凝 Water Spray水喷淋	None无
Humidity湿度	Can be controlled;可控 affects time of wetness影响潮湿时间	Can be controlled;可控 not often critical 次要作用

Automotive Weathering Testing汽车老化测试

Exterior Light Spectra: Which best represents the sun?最佳光谱是？



Automotive Weathering Testing汽车老化测试

Basic Exterior Tests (ASTM)

ASTM INTERNATIONAL

ASTM G154

TABLE X2.1 Common Exposure Conditions

Cycle	Lamp	Typical Irradiance	Approximate Wavelength	Exposure Cycle
1	UVA-340	0.89 W/m²/nm	340 nm	8 h UV at 60 (±3) °C Black Panel Temperature; 4 h Condensation at 50 (±3) °C Black Panel Temperature

Decades of data collected with these tests

ASTM G155

TABLE X3.1 Some Historical Exposure Conditions

Cycle	Filter	Irradiance and Wavelength	Exposure Cycle	Black Panel Temperature (BPT) (°C)	Relative Humidity (RH) (%)	Chamber Air Temperature (CAT) (°C)
1	Daylight	0.35 W/(m²· nm) @ 340 nm	102 min light	63	*50*[A]	*44*[A]
			18 min light and water spray[B]	Uncontrolled		*44*[A]

- **Advantages:** history, general applicability and compatibility历史悠久
- **Disadvantages:** not scientifically designed, may lack correlation 相关性存疑

Automotive Weathering Testing 汽车老化测试

Basic Exterior Tests (ISO)

ISO 4892-3, 16474-3

Used around the world

Method A: Artificial accelerated weathering with UVA-340 lamps				
Cycle No.	Exposure period	Lamp type	Irradiance	Black-panel temperature
1	8 h dry 4 h condensation	UVA-340 (type 1A)	0,76 $W \cdot m^{-2} \times nm^{-1}$ at 340 nm UV lamps off	60 °C ± 3 °C 50 °C ± 3 °C

ISO 4892-2, 16474-2

Method A — Exposures using daylight filters (artificial weathering)						
Cycle No.	Exposure period	Irradiance[b]		Black-standard temperature °C	Chamber temperature °C	Relative humidity %
		Broadband (300 nm to 400 nm) W/m^2	Narrowband (340 nm) $W/(m^2 \cdot nm)$			
1	102 min dry 18 min water spray	60 ± 2 60 ± 2	0,51 ± 0,02 0,51 ± 0,02	65 ± 3 —	38 ± 3 —	50 ± 10[c] —

- Advantages: history, general applicability and compatibility历史悠久
- Disadvantages: not scientifically designed, may lack correlation 相关性存疑

Automotive Weathering Testing汽车老化测试

Basic Exterior Tests: SAE J2020 外饰标准基本

Program the Cycle Timer to achieve the following test conditions: 8 h UV light exposure at 70 °C, alternating with 4 hours condensation exposure at 50 °C.

Allows for UVA or UVB lamps

- **Advantages:** history, general applicability, includes water & dark包含黑暗条件和水侵蚀
- **Disadvantages:** still water-deficient; optical filters with excess UV 水侵蚀不充分

Automotive Weathering Testing汽车老化测试

Popular Exterior Tests: SAE J2527外饰标准-常用

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

Not really needed

One of the few tests to define exposure by energy instead of power

- **Advantages:** history, general applicability, includes water & dark历史悠久
- **Disadvantages:** still water-deficient; optical filters with excess UV 紫外过强，水侵蚀不充分

Automotive Weathering Testing汽车老化测试

High Irradiance Exterior Tests外饰标准-高光强

ASTM G154

TABLE X2.1 Common Exposure Conditions

Cycle	Lamp	Typical Irradiance	Approximate Wavelength	Exposure Cycle
6	UVA-340	1.55 W/m²/nm	340 nm	8 h UV at 60 (±3) °C Black Panel Temperature; 4 h Condensation at 50 (±3) °C Black Panel Temperature.
2	UVB-313	0.71 W/m²/nm	310 nm	4 h UV at 60 (±3) °C Black Panel Temperature; 4 h Condensation at 50 (±3) °C Black Panel Temperature

Harsh spectrum

High intensity

ASTM G155

This is called a "3 sun" test, popular with Japanese automakers

TABLE X3.1 Some Historical Exposure Conditions

Cycle	Filter	Irradiance and Wavelength	Exposure Cycle	Black Panel Temperature (BPT) (°C)	Relative Humidity (RH) (%)	Chamber Air Temperature (CAT) (°C)
9	Daylight	180 W/m² @ 300 - 400 nm	102 min light	63	50	28[A]
			18 min light and water spray[B]	Uncontrolled		28[A]

- Advantages: *Speed!!! 快速！*
- Disadvantages: Correlation 相关性？

Automotive Weathering Testing汽车老化测试

Scientific Exterior Test: ASTM D7869 外饰标准

TABLE 1 Exposure Cycle

Step Number	Step Minutes	Function	Irradiance Set Point[A] at 340 nm W/(m²·nm)	Black Panel Temperature Set Point[A]	Chamber Air Temperature Set Point[A]	Relative Humidity Set Point[A]
1	240	dark + spray	—	—	40°C	95 %
2	30	light	0.40	50°C	42°C	50 %
3	270	light	0.80	70°C	50°C	50 %
4	30	light	0.40	50°C	42°C	50 %
5	150	dark + spray	—	—	40°C	95 %
6	30	dark + spray	—	—	40°C	95 %
7	20	light	0.40	50°C	42°C	50 %
8	120	light	0.80	70°C	50°C	50 %
9	10	dark	—	—	40°C	50 %
10	Repeat subcycle steps 6 to 9 (shown in bold) an additional 3 times (for a total or 24 h = 1 cycle).					

Long water

A solar day

Thermal shock

More on this next week …

- **Advantages:** scientific design, light spectrum, temps, water delivery **科学**设计
- **Disadvantages:** newer, less history, precise control required **新，要求严格**

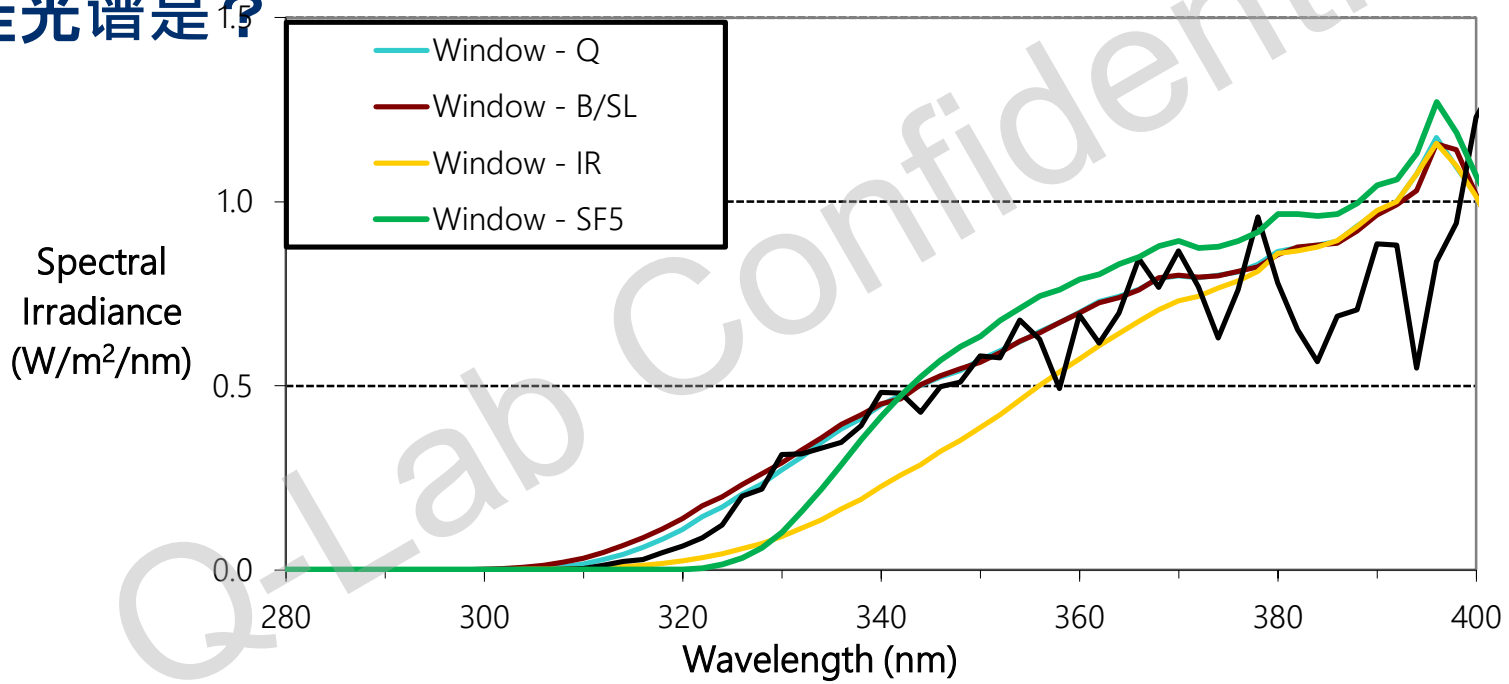
Automotive Weathering Testing汽车老化测试

Exterior Test Summary 外饰测试总结

- Exterior automotive weathering tests intended to simulate outdoor sunlight, heat, and water experienced by autos用于模拟汽车外饰的光、热、水的模拟
- Wide variety of test conditions多种测试标准，差异大
  - Selection depends on equipment, goals, time 根据测试目的和时间来选择标准
  - Material type can influence choice as well 根据材料来选择标准

Automotive Weathering Testing汽车老化测试

Interior Light Spectra: Which best simulates auto glass?最佳光谱是？

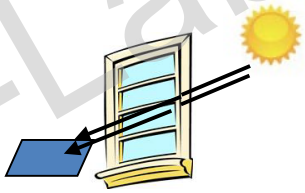
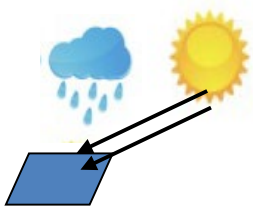
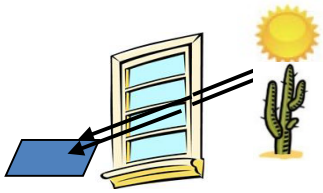
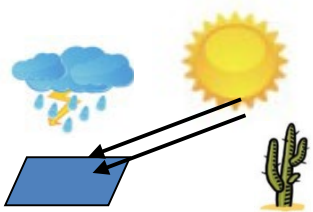


Products and Interior Test Standards产品和标准

Product产品	Test type测试项目	Major test standards主要标准
Apparel and Design Fabrics织物	Lightfastness日晒	• ISO 105:B02 • ISO 105:B04 (like B02 but with water) • AATCC TM 16 (Option 3) • Other derivatives like Marks & Spencer
Automotive and high-temp汽车与高温	Lightfastness日晒	• ISO 105:B06 • VDA (DIN) 75202 • SAE J2412 • IUF 402 – Int'l Union of Leather Technologists and Chemists Societies
Outdoor and Industrial Textiles 户外和工业织物	Weathering耐候	• AATCC TM 169 (xenon) • AATCC TM 186 (fluorescent UV) • ISO 105:B03 (outdoor)

ISO 105-B02, -B04, B06 & -B10

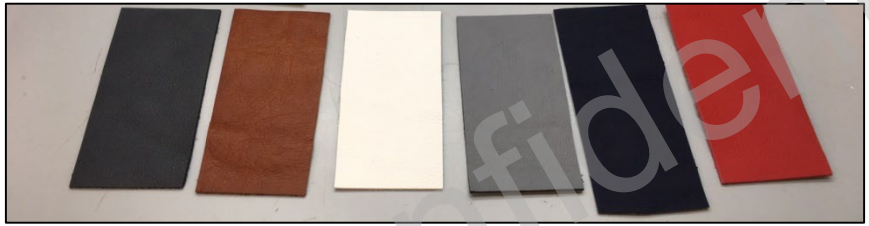
A variety of exterior and interior test protocols多种内外饰测试标准

Aspect指标	B02	B04	B06	B10
Environment环境	Interior	Exterior	Interior	Exterior
Irradiance (W/m² TUV)光强	42	42	45	60
Cut-on wavelength (nm)截止点	315	300	310	290
UV light紫外光	Low	Medium	Low	High
IR light红外光	Suppressed	Suppressed	High	High
Water cycle水	Dry only	Cyclic dry/spray	Dry only	Cyclic dry/spray option
Graphic				

Interior Material Testing 内饰材料老化测试

Testing of Leather Specimens per SAE J2412

As-received



440 kJ

1015 kJ

Automotive Weathering Testing 汽车老化测试

Basic Interior Tests (ASTM) 内饰-基础标准

ASTM INTERNATIONAL

ASTM G155

Cycle	Filter	Irradiance and Wavelength	Exposure Cycle	Black Panel Temperature (BPT) (°C)	Relative Humidity (RH) (%)	Chamber Air Temperature (CAT) (°C)
6	Window Glass	1.10 W/(m^2· nm) @ 420 nm	228 min light	63	35	*47*[A]
			60 min dark[D]	43	90	*43*[A]

Very popular test

- **Advantages:** history, general applicability 历史久、通用标准
- **Disadvantages:** not scientifically designed, may lack correlation 相关性存疑

Automotive Weathering Testing 汽车老化测试

Basic Interior Tests (ISO) 内饰-基础标准

ISO 4892-3, 16474-3

Used around the world

Cycle No.	Exposure period	Lamp type	Irradiance	Black-panel temperature
Method B: Artificial accelerated weathering with UVA-351 lamps				
5	24 h dry (no moisture)	UVA-351 (type 1B)	0,76 W·m^{-2} × nm^{-1} at 340 nm	50 °C ± 3 °C

ISO 4892-2, 16474-2

Method B — Exposures using window glass filters						
Cycle No.	Exposure period	Irradiance		Black-standard temperature °C	Chamber temperature °C	Relative humidity %
		Broadband (300 nm to 400 nm) W/m^2	Narrowband (420 nm) W/(m^2·nm)			
2	Continuously dry	50 ± 2	1,10 ± 0,02	65 ± 3	38 ± 3	50 ± 10[c]
3	Continuously dry	50 ± 2	1,10 ± 0,02	100 ± 3	65 ± 3	20 ± 10

- **Advantages:** history, general applicability历史久、通用标准
- **Disadvantages:** not scientifically designed, may lack correlation相关性存疑

Automotive Weathering Testing 汽车老化测试

Popular Interior Test: SAE J2412 内饰-常用标准

Controls	Dark Cycle		Light Cycle	
	Target	Tolerance	Target	Tolerance
Automatic Irradiance	None		Contractual Agreement (See Note 1)	± 0.02 Wm^2 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	Not applicable		Contractual Agreement	
Cycle Duration	1 hour (See Note 2)	± 6 minutes	3.8 hours (See Note 2)	± 6 minutes

High T

Seems easy

- Advantages: history, general applicability, includes dark历史久、通用标准、包含黑暗条件
- Disadvantages: UV optical filter totally and wildly inappropriate 紫外滤片不合理

Automotive Weathering Testing 汽车老化测试

High Irradiance Interior Tests 内饰-高辐照

ASTM INTERNATIONAL

ASTM G155

Cycle	Filter	Irradiance and Wavelength	Exposure Cycle	Black Panel Temperature (BPT) (°C)	Relative Humidity (RH) (%)	Chamber Air Temperature (CAT) (°C)
10	Window Glass	162 W/m^2 @ 300 - 400 nm	Continuous Light	89	50	Uncontrolled

This is the interior "3 sun" test

- Advantages: *Speed!!! 快速测试！*
- Disadvantages: Correlation 相关性差

OEM Interior Test Standards 内饰-主机厂标准

Standard	Name	Who
PV1303	Non-Metallic Materials: Exposure Test of Passenger Compartment Components	Volkswagen
GMW 14162	Colorfastness to Artificial Weathering	General Motors
FLTM BO 116-01	Exposure of Interior Trim Materials using a controlled irradiance water cooled xenon-arc	Ford
D47 1431	Materials and Passenger Compartment Parts Behaviour of the Appearance to Artificial Light at High and Medium Temperatures	Renault
DBL 5555	Finished Parts and Semi-Finished Products Made of Organic Polymer Materials General Conditions and Test Methods	Daimler

Automotive Weathering Testing 汽车老化测试

Interior Test Summary 内饰-总结

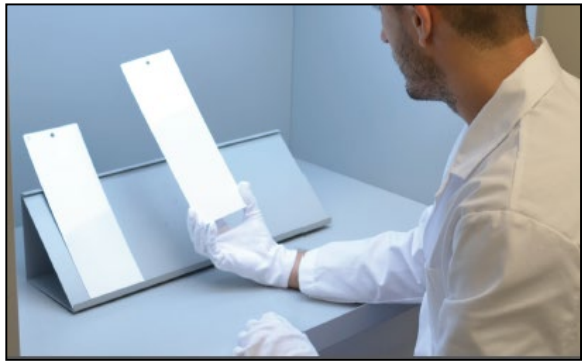
- Interior automotive weathering tests intended to simulate sunlight behind glass and trapped heat experienced by auto cabin components 模拟玻璃后，内饰高温条件
- Wide variety of test conditions 多种测试标准，差异大
  - Selection depends on equipment, goals, time 根据测试目的和时间来选择标准
  - Material type can influence choice as well 根据材料来选择标准

Automotive Weathering Testing 汽车老化测试

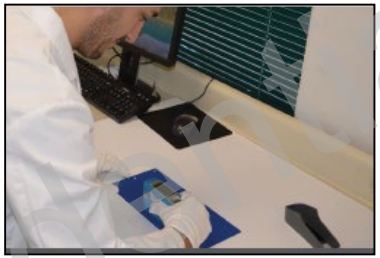
Test Guidelines 测试指南

- Length of test depends on test conditions, failure mode, and durability of material 根据失效模式和材料耐久性选择测试时长
  - 2000-3000 hour tests are common for automotive coatings 汽车涂料一般测试2-3千小时
  - Test to failure测到失效为止
- Critical to determine failure mode of interest 确定失效模式很重要
  - Gloss, color, tensile strength, adhesion 光泽、颜色、强度、附着力

Evaluations



Visual目测



Color and gloss
颜色和光泽

Mechanical力学

Evaluation measurements performed to ASTM, ISO, other standards

Summary – Automotive Weathering Testing

汽车老化测试-总结

- Automotive exterior and interior materials experience a wide range of physical and chemical degradation from sunlight, heat, and water in service environments汽车内外饰材料因使用环境中的光、热、水，产生物理、化学老化
- Natural outdoor test methods like Black Box, Under-glass, and whole car can simulate automotive conditions户外自然曝晒可以用黑箱、玻璃箱和整车来模拟
- Accelerated outdoor tests like AIM Box and natural solar concentrator provide enhanced testing outdoors可以用AIM Box箱和太阳跟踪装置进行户外加速曝露
- Xenon arc and fluorescent UV accelerated test chambers can provide results in a shorter timeframe 氙灯和紫外加速设备可以提供快速测试
- Wide variety of tests for interior and exterior materials to select from 内外饰测试有大量测试条件可供选择

Summary – Automotive Weathering Testing

汽车老化测试-后续合作

- 实验室的测试合格的产品，在实际使用的条件下，往往会出现老化/腐蚀投诉的情况?
- 现有的实验室测试时间和评判标准，是否足够严格，能否保证产品的使用条件下几年不出问题？
- 以前的产品和工艺合适的老化/腐蚀质量控制方法，对新的材料和工艺是否同样适用？

张恒（13701620302/微信-测试咨询）

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