Q-SUN®

Xenon Test Chambers

Q-LAB

Weathering Basics

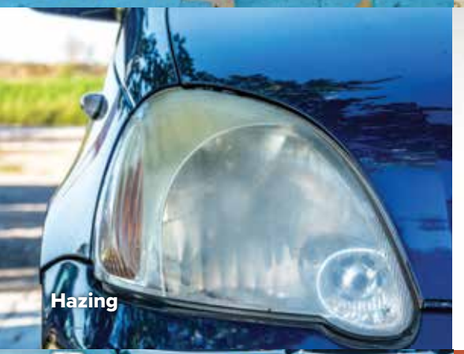
Sunlight, heat and moisture cause millions of dollars in product damage every year. Cracking, crazing, hazing, fading, and yellowing can occur indoors or outdoors. With Q-SUN® xenon test chambers, you can simulate the damage caused by full-spectrum sunlight, temperature, and moisture. In just a few days or weeks, a Q-SUN tester can reproduce the damage that occurs over months or years outdoors.

Will your product last outdoors? Don't guess when you can test!


Adhesion loss


Cracking


Fading


Hazing


Yellowing


Embrittlement

Chalking


Gloss Loss


Strength Loss

Why Q-SUN?

Realistic

Q-SUN xenon test chambers are the ultimate research & development and quality control tool for testing materials that are exposed to direct sunlight, sunlight through window glass or indoor lighting. With a variety of models and options, you can customize your Q-SUN chamber to fit your testing needs.

Three basic models suit the xenon testing needs of any lab: the tabletop Q-SUN Xe-1, the rotating rack Q-SUN Xe-2, and the large flat-array Q-SUN Xe-3. All models are full-featured weathering, lightfastness, and photostability chambers, and meet all major industry standards.

Q-SUN test chambers are used by companies worldwide in dozens of different industries and applications to aid in the selection of new materials, the improvement of existing materials or the evaluation of how changes in formulation affect product durability.

Affordable

Q-SUN xenon arc testers are specifically designed to have the lowest total cost of ownership in the industry. Their low purchase price, low lamp price, and low operating costs set a new standard for lightfastness testing. Now even the smallest lab can afford xenon arc weathering and lightstability testing.

Easy to Operate

The Q-SUN tester's simple yet sophisticated design makes it easy to install, easy to use, and almost maintenance-free.

> Specimen mounting and evaluations are simplified with specially-designed specimen holders.

> All models are completely automated and can operate continuously, 24 hours per day, 7 days per week, without supervision

> Self-diagnostic warnings and service reminders notify users when maintenance and calibration are needed

> Multicolored LED allows tester status to be viewed from a distance

Reliable and Easy to Maintain & Repair

Q-SUN subsystems are modular, easy to troubleshoot, and even easier to replace. This makes typical maintenance and repair of Q-SUN testers simple enough that it doesn't require a field technician (but we're here if you need us).

Q-Lab's Experience

Q-Lab provides the highest-quality weathering test chambers and testing services. Our scientists and engineers participate and offer leadership in ISO, ASTM, IEC, GB, and numerous other professional organizations in creating standardized weathering test methods and procedures.

Q-SUN Models

Features apply to all testers, except as indicated in parentheses below.
For a complete list of Q-SUN chamber capabilities, please go to page 15.

FULL-SPECTRUM XENON LAMPS
The most realistic simulation of full-spectrum sunlight.

SOLAR EYE IRRADIANCE CONTROL
Precise control for repeatable test results.

VERSATILE SPECIMEN MOUNTING
A variety of options for flat specimens and 3D specimens in Xe-1 and Xe-3 models.

CHILLER
Optional chiller for Xe-1 and Xe-3 models enables low chamber air temperatures.

CASTER WHEELS
Increases mobility when lab space is at a premium.

DUAL TOUCHSCREEN DISPLAYS
Full-color interface available in 17 languages.

XENON ARC LAMPS
Q-SUN "E" model testers provide 3000 hour lamp life.

OPTICAL FILTERS
Do not require replacement under normal use.

WATER SPRAY
Operates in light or dark cycles; available for front and back spray.

TEMPERATURE CONTROL
Black panel (insulated or uninsulated) for all models, plus chamber air temperature control for Xe-2 and Xe-3 models.

AUTOCAL CALIBRATION
Fast, easy, reliable temperature and irradiance calibration with the Universal Calibrator system.

USB PORT
Easy data transfer and software updates.

MULTI-COLOR LED LIGHT
Conveniently indicates tester status at a glance.

DURABLE CONSTRUCTION
Painted aluminum construction will not rust.

RELATIVE HUMIDITY CONTROL
Full range of RH conditions to meet test standards (available on Xe-2 and Xe-3 only).

FLAT ARRAY OPTIONS

Q-SUN Xe-1

The Q-SUN Xe-1 is an economical, single-lamp tabletop tester with multiple capabilities. Its small scale is perfect for a lab with a limited budget or only an occasional need for testing. The Q-SUN Xe-1 tester's slide-out specimen tray is 25 × 46 cm (9.9" × 18.0").

Q-SUN Xe-3

The Q-SUN Xe-3 is a full-featured, full-sized tester at a breakthrough price. It utilizes three separate xenon lamps for larger capacity. This 45 × 72 cm (17.8" × 28.3") specimen tray is also useful for exposing large, three-dimensional parts or components.

ROTATING RACK OPTION

Q-SUN Xe-2

The Q-SUN Xe-2 xenon tester offers a large-capacity rotating rack. It is often selected to perform weathering and lightfastness testing of textiles. It supports 31 specimens of 45 × 132 mm (1.8" × 5.2") each. Its single air-cooled lamp is more economical than water-cooled lamps, highly efficient, and very low maintenance. The versatile Q-SUN Xe-2 tester is the simplest, most reliable, and easiest-to-use rotating rack xenon arc tester available.

Xenon Arc Weathering Testing

Xenon arc laboratory weathering tests expose specimens to repetitive cycles of sunlight, heat, and water to simulate the forces of weathering experienced by materials in their service environments. Q-SUN xenon arc weathering testers provide a wide range of conditions to meet the testing needs for materials including plastics, coatings, sealants, textiles, photovoltaics, and more.

FORCES OF WEATHERING

Sunlight, heat, and water are the primary “Forces of Weathering” simulated in xenon arc laboratory testing. Full-spectrum sunlight is reproduced by xenon-arc lamps and modified by optical filters (see pages 8-9). Heat is provided in the form of elevated temperatures and/or temperature cycling to produce thermal shock. Water is delivered in the form of water spray, in addition to controlled relative humidity in Xe-2 and Xe-3 testers.

TEST CYCLE SELECTION

A broad array of international and OEM xenon arc test standards are available, making selection of the “right” standard a challenge. Referring to standards committees in ISO and ASTM can help select the right test designed for your application. The Q-SUN xenon test chambers are capable of running a wide variety of test standards, ranging from simple, historic test cycles like ISO 4892-2, to more complicated modern test cycles designed to better simulate real world environments like ASTM D7869.

WEATHERING TESTING

Three-dimensional (3D) specimens can be tested in Q-SUN Xe-1 and Xe-3 chambers

PRACTICAL CONSIDERATIONS FOR XENON ARC TESTING

Xenon arc laboratory testing can generate valuable data about the relative performance of materials and products when performed correctly. To get the most out of testing, calibration and maintenance of onboard sensors is critical. This includes irradiance, temperature, and relative humidity sensors. Although Q-Lab’s optical filters do not age, all xenon arc lamps do experience aging. Lamps will deliver less UV light over time if not replaced, even if proper calibration is performed. High-purity water is required to avoid specimen spotting and chamber degradation.

RECIPROCITY

The ability to accelerate testing is one of the key benefits of laboratory weathering testing, but this comes with limits. “Reciprocity” is the concept that increasing weathering testing factors, like irradiance or heat, can proportionally decrease the time required for testing. However, weathering degradation features many complex physical and chemical interactions, and reciprocity is typically only observed up to a limited degree of test acceleration.

OUTDOOR TESTING FOR BENCHMARK DATA

Degradation of materials depends strongly on the service environment. Tropical environments like Florida are harsh on materials due to their combination of high temperatures, abundant sunshine, and high humidity. Desert environments like Arizona feature even higher temperatures and sunlight levels but with far less moisture. Combining outdoor testing in benchmark locations with accelerated lab testing helps build a library of data for comparative analysis and ensures that your products will last in the most demanding service environments.

Standards

Q-SUN xenon arc testers meet the specifications in nearly all major international, national, and industry test standards, including tests from ASTM ISO, IEC, and GB. The ability to meet a particular test standard depends on the tester model and configuration. A partial list is provided below; refer to Technical Bulletin LX-5054 for a more comprehensive list.

GENERAL
- ASTM G155
- MIL-STD-810H

AUTOMOTIVE
- ASTM D7869
- ISO 105-B06, -B10
- JASO M346, M351
- SAE J2412, J2527

PAINTS
- ASTM G6695
- ISO 16474-2

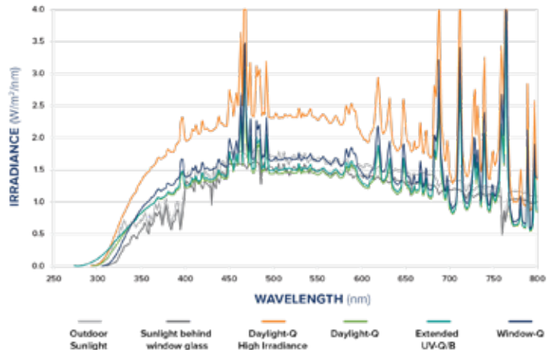
TEXTILES
- AATCC TM 16, 169
- ISO 105-B02, -B04
- Marks & Spencer C9, C9A

PLASTICS
- ASTM D2565
- ISO 4892-2

OTHERS
- IEC 60068-2-5 (Photovoltaics)
- ASTM D7356 (Acid Etch)
- ASTM C1442 (Sealants)
- ICH Guideline Q1B (Pharmaceuticals)

Sunlight Simulation

The Q-SUN testers' xenon arc lamps produce the most realistic reproduction of full spectrum sunlight, including ultraviolet, visible light and infrared radiation. For many materials, exposure to the full spectrum is necessary to provide an accurate simulation, especially when testing for color change and lightfastness.



FULL-SPECTRUM XENON LAMPS

Q-SUN xenon arc test chambers use air-cooled xenon arc lamps to significantly reduce operating and maintenance expenses. Lamp life is guaranteed for most Q-SUN models for 3000 hours at normal irradiance and 1000 hours at high irradiance. Q-SUN models Xe-1 and Xe-2 use one lamp and model Xe-3 uses three.

Changing lamps is quick and easy and does not interfere with the specimen exposure. In the Xe-1 and Xe-3, simply disconnect the plug, release one set screw, and slide out the lamp housing. In the Xe-2, the lamp is easily accessible from the top of the tester. Replacement only requires the user to open an access door, release a set screw, and remove the trigger finger. The lamp and lamp housing can then be easily lifted out of the tester.

HIGH-IRRADIANCE TESTING

Testing at high irradiance is required by several international test standards and can be an effective way to achieve faster results from your accelerated weathering test program. Q-Lab's new X-1800+ and X-1850+ xenon arc lamps enable you to perform high-irradiance testing with improved lamp life to get the most out of your Q-SUN tester.

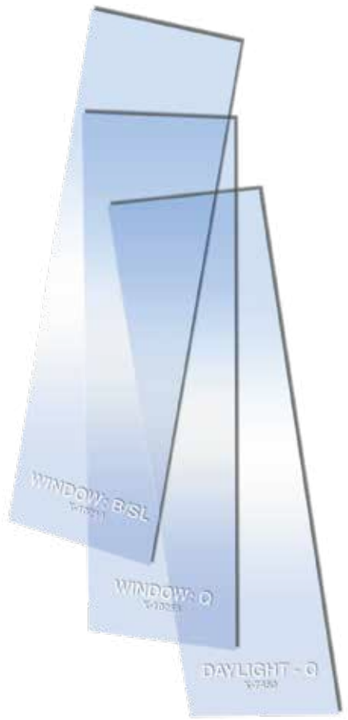
LONG-LIFE OPTICAL FILTERS

Xenon light must be properly filtered to achieve the appropriate spectrum for each particular application. Differences in spectra may affect both the speed and the type of degradation. Three categories of optical filters are available to simulate a variety of service environments. The application or test method dictates which filters should be used.

Q-SUN optical filters are exceptionally durable and maintain the required spectrum indefinitely under normal use. For the Q-SUN Xe-1 and Xe-3, filters consist of a single pane of specially formulated glass. The Q-SUN Xe-2 tester's optical lanterns consist of an outer borosilicate or quartz glass cylinder and two sets of 7 durable inner filters, arranged in a two-tier heptagon.

Daylight Filters

Daylight filters are used to simulate direct sunlight. They provide the best correlation to natural outdoor exposures for most applications. Materials that are typically used outdoors like roofing or exterior coatings should be tested using daylight filters. Three different types of daylight filters are available for Q-SUN xenon test chambers: Daylight-F, Daylight-Q, and Daylight-B/B. These options include both Type I and Type II Daylight filters as defined in ASTM and ISO standards.



Window Glass Filters

Window glass filters produce spectra equivalent to sunlight coming through window glass. This can also simulate other indoor lighting such as the harsh lighting found in a typical commercial or office environment. Window glass filters are used for indoor materials such as printing materials or textiles. Four different window glass filters are available: Window-Q, Window-B/SL, Window SF-5, and Window-IR.

Extended UV Filters

Extended UV filters transmit excess UV, below the normal cut-on of natural sunlight. They are used to produce faster or more severe test results. Extended UV filters are specified in some automotive test methods and are sometimes used for aerospace applications. There are two available Q-SUN filters of this type: Extended UV-Q/B and Extended UV-Quartz.

SOLAR EYE IRRADIANCE CONTROL

All Q-SUN xenon test chambers are equipped with SOLAR EYE irradiance control, a patented, precision light control system. The SOLAR EYE system allows the user to choose the desired level of irradiance. It automatically monitors and maintains the programmed light intensity. Irradiance is monitored and controlled at 340 nm, 420 nm, or TUV (Total UV).

Environmental Simulation

MOISTURE

Moisture in the form of water spray, condensation, and humidity is critical for testing many materials. All Q-SUN models are available with optional water spray and both the Xe-2 and Xe-3 models offer standard control of relative humidity.

WATER SPRAY

The damaging effects of outdoor moisture attack are simulated by direct, pure water spray. The spray can be programmed to operate during either the light or dark periods and can be useful for creating thermal shock and/or mechanical erosion.

RELATIVE HUMIDITY

The Q-SUN Xe-2 and Xe-3 models come standard with relative humidity control. Humidity can affect degradation when the material becomes physically stressed while attempting to maintain moisture equilibrium with its surroundings. Relative humidity also influences the rate at which a specimen dries. Controlled humidity is required in a number of widely used test methods.

WATER PURITY

In Q-SUN testers with water spray, highly-purified deionized water is necessary to prevent water spotting. Suspended silica is the major cause of specimen spotting. Recommended specifications are <0.2 µS conductivity and <0.1 ppm silica. To conserve expensive purified water, an advanced water repurification system is an available option.
See page 14

EXCEPTIONAL REALISM

Specimens exposed in a Q-SUN Xe-1 and Xe-3 are mounted in a near-horizontal orientation. During and after a water spray cycle, a significant amount of water can remain on the surface of the specimen for an extended period of time. This mimics the natural service condition for many products such as automotive coatings and components, wood coatings, plastic lumber, and some roofing materials.

TEMPERATURE

Control of temperature is important because it significantly influences the rate of degradation. Specimen exposure temperature is precisely controlled in all Q-SUN xenon chambers using a black panel temperature sensor.

BLACK PANEL

A black panel thermometer is used to control temperature in the Q-SUN test chamber. Due to its black coating that absorbs all wavelengths uniformly, it provides an estimate of the maximum temperature of specimens in the chamber. Black panel temperatures can be controlled at any point between 25 °C and 120 °C (77 °F to 248 °F) depending upon the irradiance level, lamp age, ambient room temperature, black panel sensor, and specific tester model. Both insulated or uninsulated sensors (black standard or black panel) are available.

CHAMBER AIR TEMPERATURE

In both the Q-SUN Xe-2 and Xe-3 models, chamber air temperature can also be controlled simultaneously with black panel to give the ultimate control of specimen temperature. The low-cost, disposable sensor also monitors and controls relative humidity. In the Xe-1, either chamber air or black panel temperature must be selected.

LOW-TEMPERATURE TESTING

For some interior products such as pharmaceuticals and cosmetics, lower exposure temperatures are necessary to prevent unnatural degradation. An optional chiller is available for these applications.
See page 14

Operation

Q-SUN xenon test chambers are extremely simple to operate. Specimen mounting and evaluations are simplified with specially designed specimen holders. Programming is intuitive. All models are completely automated and can operate continuously, 24 hours per day, 7 days per week.

SPECIMEN MOUNTING

Specimens exposed in a Q-SUN Xe-1 and Xe-3 are mounted in a nearly horizontal orientation. This flat specimen mounting system offers the flexibility to test many sizes, shapes and types of specimens. The Q-SUN Xe-2 rotating rack positions specimens vertically. This configuration is ideal for testing thin, flat specimens such as textiles, paints and coatings. Standard holders are available in a number of sizes to accommodate a variety of different specimens. Bottle holders, textile holders and special mountings for three-dimensional (3D) specimens are also available.

DUAL TOUCH-SCREEN DISPLAYS

Designed to be both functional and easy to use, the Q-SUN controller can be programmed in 17 user-selectable languages (English, French, Spanish, Italian, German, Chinese, Japanese, Korean, Czech, Dutch, Polish, Portuguese, Russian, Swedish, Thai, Turkish, and Vietnamese). Users can program and store up to 10 tests in memory, which has a battery back-up feature.

Calibration & Maintenance

Q-SUN chambers are equipped with a number of on-board sensors to monitor and control the environment inside the chamber. All Q-SUN sensors need to be calibrated or replaced periodically to ensure accurate and consistent results. This process is simple and inexpensive in a Q-SUN tester.

IRRADIANCE

The Q-SUN tester's on-board SOLAR EYE irradiance sensor needs to be calibrated periodically by the user to assure accurate and consistent results. With the patented AUTOCAL system, calibrating the Q-SUN tester is simple using the Universal Calibrator system's UC20 calibration radiometer, and takes only a few minutes. UC20 devices come with a 340 nm, 420 nm, or 300-400 nm TUV (Total UV) sensor and must match the type of sensor actually used in the Q-SUN tester.

Calibration of the UC20 radiometers needs to be performed annually. The UC20 Smart Sensors were designed to be disposable and cost-efficient, and should be replaced annually with a freshly-calibrated UC20. Smart Sensors may also be returned for calibration for users who prefer recalibration to replacement.

Our calibration labs are accredited by A2LA and UKAS for ISO 17025. Additionally, our field calibration is 17025 accredited.

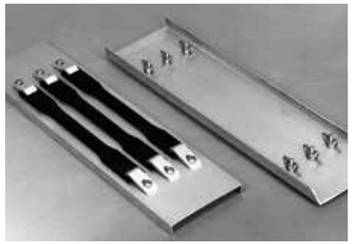
MAINTENANCE

The Q-SUN controller includes complete self-diagnostic error checking. The controller constantly monitors the status and performance of all systems. It also displays simple warning message and routine maintenance reminders and performs safety shutdown, as needed. Typical maintenance items are lamps, sensor calibrations and inexpensive air filters.

TEMPERATURE & RELATIVE HUMIDITY

All Q-SUN black panel temperature sensors need to be calibrated periodically by the user to assure accurate and consistent results. Calibrating the black panel temperature sensor is simple using a the Universal Calibrator system's UC202 calibrated temperature sensor. UC202 thermometers come with either an uninsulated black panel or insulated black panel sensor. The chamber air temperature sensor in an Xe-2 and Xe-3 is inexpensive and requires replacement once per year. An optional Chamber Air Temperature sensor is available for the Xe-1 tester. RH control is standard in Xe-2 and Xe-3 models. These models simultaneously control, monitor, and display relative humidity, black panel temperature, and chamber air temperature.

Accessories & Options



SPECIMEN HOLDERS

Holders are available in a number of sizes to accommodate traditional flat specimens, like panels and plaques. Bottle holders, textile holders, and special mountings are also available for the Q-SUN Xe-1 and Xe-3. 3-D specimens can be placed directly on the specimen tray and in many cases do not require a specimen holder.

CHILLER

A chiller is available for both the Xe-1 and Xe-3. It is used to lower temperatures when testing temperature-sensitive materials. The Xe-1 with chiller is configured so that the chiller is essentially a “permanent stand” for the tester. For an Xe-3, the chiller is a separate unit that requires additional floor space.

WATER PURIFICATION

Unlike competing systems that simply recirculate dirty water, Q-Lab’s repurification system repurifies water in addition to conserving it. Due to the high cost of purified water, the system can pay for itself in a matter of months.

DUAL SPRAY

Dual spray is available for the Xe-3 only. It allows a second liquid solution, such as an acid rain or soap solution, to be sprayed onto test specimens. The system consists of a large external reservoir, centrifugal pump, and a filter.

WATER IMMERSION

The Xe-1-WE xenon test chamber performs weathering testing of specimens immersed in a temperature-controlled water bath, as required by such international standards as ISO 16474-2 and ETAG 002. This tester features an automatically-controlled water fill and drain system, precise temperature control, and an integral water repurification and monitoring system.

BACK SPRAY

Back spray is required by some SAE test methods; it allows water to be sprayed on both the front and back side of specimens simultaneously. A water repurifcaiton system is ideal for back spray configurations.

Summary

● Standard ◑ Optional

Feature	Xe-1	Xe-2	Xe-3
Chamber Type	Flat Array	Rotating Rack	Flat Array
Specimen Capacity	17	31	55
Specimen Orientation	10°	90°	10°
3D Specimen Capability	●	–	●
Dual Touch-Screen Displays in 17 Languages	●	●	●
Full Spectrum Xenon Arc Lamps	1	1	3
Longer Lamp Lifetimes and/or Higher Irradiance	●	●	●
Long-Life Optical Filters	●	●	●
Type I and Type II Daylight Filter Options	●	●	●
SOLAR EYE Irradiance Control (340 nm, 420 nm or TUV)	●	●	●
Black Panel Temperature Control	●	●	●
Chamber Air Temperature Control	◑	●	●
Relative Humidity Control	–	●	●
Programmable Water Spray	◑	◑	◑
AUTOCAL Calibration	●	●	●
UC20 Calibration Radiometer	◑	◑	◑
UC202 Calibration Black Panel Thermometer	◑	◑	◑
Water Repurification System	◑	◑	◑
Chiller	◑	–	◑
Water Immersion	◑	–	–
Dual Spray	–	–	◑
Back Spray	–	◑	◑
USB Port for Software Updates and Tester Data Acquisition	●	●	●

SPECIFICATION BULLETIN LX-5046

Q-SUN Xenon Test Chambers

Overview

Q-SUN® xenon arc chambers reproduce the damage caused by full-spectrum sunlight and rain. In a few days or weeks, Q-SUN testers can reproduce the damage that occurs over months or years outdoors.

Features

Q-SUN xenon arc chambers are available in three different models: the tabletop Xe-1, and full-sized Xe-2 and Xe-3. Each tester is 100% air-cooled, for extreme reliability and simple, low-cost maintenance. All testers have standard datalogging via ethernet, a variety of standard specimen holders, and a remarkably simple user interface available in multiple languages — up to 17 in most models.

	Xe-1	Xe-2	Xe-3
Chamber Type	Flat Array	Rotating Rack	Flat Array
Specimen Capacity	17	31	55
Specimen Orientation (measured from horizontal)	10°	90°	10°
Full Spectrum, Ozone-Free Xenon Arc Lamps - 1800 W	1	1	3
SOLAR EYE® Irradiance Control (340 nm, 420 nm or TUV)	●	●	●
Relative Humidity Control	—	●	●
Water Spray	◑	◑	◑
Heated Water Immersion	◑	—	—

● Standard ◑ Optional — Not Available

Optical Filters and Radiometers

Q-SUN optical filters are very durable and all filters maintain the required spectrum indefinitely, lasting for years under normal use with proper maintenance (except Window-IR). The application or test standard dictates which filter to use. Xe-1 and Xe-3 filters are flat, while the Xe-2 filter lantern consists of an outer borosilicate or quartz cylinder and 14 inner filters.

	Xe-1 & Xe-3 Irradiance Values Typical (& Maximum)[A,B,C]			Xe-2 Irradiance Values Typical (& Maximum)[A,B,C]		
	W/m²/nm @340 nm	W/m²/nm @420 nm	W/m² @TUV (300-400 nm)	W/m²/nm @340 nm	W/m²/nm @420 nm	W/m² @TUV (300-400 nm)
Daylight-F	0.80 (1.30)	1.50 (2.40)	75 (125)	0.80 (0.95)	1.50 (1.70)	75 (85)
Daylight Q	0.68 (1.10)			0.68 (0.80)		
Extended UV (-Q/B, -Quartz[D])						
Daylight-B/B				0.51 (0.61)[E]		55 (65)
Window (-Q, -B/SL)	0.55 (0.85)		70 (108)	0.55 (0.65)		70 (80)
Window (-SF5, -IR, -B04[F])	-		42 (68)	-		42 (62)

Notes:
A: Minimum irradiance 0.25 @340nm, 0.45 @420nm, and 20 @TUV.
B: Typical irradiance that can be obtained by using the X-1800+ or X-1850+ lamp in any "E" configuration with a lamp life of 3000 hours.
C: Maximum irradiance that can be obtained by using the X-1800+ or X-1850+ lamp in any "E" configuration with a lamp life of 1000 hours.
D: Xe-1 and Xe-3 only.
E: In addition to the standard 1,000 and 3,000 hour warranties for Maximum and Typical irradiance values shown, Q-Lab will also guarantee 2000 hours at 0.55 W/m²/nm.
F: Xe-2 only.

Calibration, Temperature and Humidity Control

Q-SUN Xe-2 and Xe-3 testers simultaneously control chamber air tempertaure (CAT) and black panel (uninsulated/BP) or black standard (insulated/IBP/BST) temperature; the Xe-1 controls either, but not both. A disposable electronic relative humidity and CAT sensor provides precise control of relative humidity of the Xe-2 and Xe-3 and should be replaced annually. All Q-SUN testers can be calibrated quickly and easily using Q-Lab's Universal Calibrator system, featuring the patented AUTOCAL® system.

	Xe-1	Xe-2	Xe-3
AUTOCAL UC20 Irradiance Control	●	●	●
UC202 Black Panel Thermometer	●	●	●
Chamber Air Temp (CAT) Sensor	◑	●	●
Relative Humidity (RH) Sensor	—	●	●

● Standard ◑ Optional — Not Available

Operating Specifications

Models[1]	Xe-1-B Xe-1-SE		Xe-1-BCE Xe-1-SCE		Xe-1-WE		Xe-2-HE Xe-2-HSE Xe-2-HBSE		Xe-3-H Xe-3-HSE	Xe-3-HDSE[2] Xe-3-HBSE	Xe-3-HCE Xe-3-HSCE	
Black Panel Temp[3] (°C)	**BP**	**IBP**	**BP**	**IBP**	**BP**	**IBP**	**BP**	**IBP**	**BP**	**IBP**	**BP**	**IBP**
Light Cycle	45-90	50-100	25-90	25-100	45-90	50-100	50-100	55-105	45-110	50-120	35-110	36-120
Light Cycle w/IR Filter	40-70	45-80	20-70	20-80	40-70	45-80	35-85	40-90	40-90	45-100	30-90	31-100
Dark Cycle	25-50	25-50	10-50	10-50	25-50	25-50	25-45	25-45	25-50	25-50	15-50	15-50
Light+Immersion Cycle	—	—	—	—	35-55	35-55	—	—	—	—	—	—
Dark+Immersion Cycle	—	—	—	—	30-50	30-50	—	—	—	—	—	—
Chamber Air Temp[3, 4] (°C)	**CAT**		**CAT**		**CAT**		**CAT**		**CAT**		**CAT**	
Light Cycle (any filter)	35-55		15-55		—		35-65		35-65		25-65	
Dark Cycle	30-45		10-40		—		25-45		25-50		15-50	
Relative Humidity[3]	N/A						20-95%					
Specimen Area	25×46 cm (d×w) (9.9×18.0 in)				22×42 cm (d×w) (8.8×16.5 in)		30×25 cm (h×dia) (11.9×9.8 in)		45×72 cm (d×w) (17.8×28.3 in)			
Specimen Capacity[5] (qty @ size)	17 @ 51×102 mm (2×4 in)				15 @ 51×102 mm (2×4 in)		31 @ 45x132 mm (1.8x5.2 in)		55 @ 51×102 mm (2×4 in)			
Total Specimen Weight (distributed evenly)	14 kg (30 lbs) max						4.5 kg (10 lbs) max		23 kg (50 lbs) max[6]			
Inlet Water Pressure and Purity[7]	All non-"S", non-"W" models[1]: 0.7-6.2 bar (10-90 psi); > 200 kΩ-cm; < 5 µS/cm; < 2.5 ppm TDS All "S" or "W" models: 2,1-6,2 bar (30-90 psi); > 5 MΩ-cm; < 0,2 µS /cm; < 0,1 ppm TDS; < 0,1 ppm colloidal silica											
Water Consumed with Spray On[8]	0.12 L/min		0.12 L/min		0.001 L/min		0.5 L/min (front) 1.0 L/min (front & back)		0.16 L/min (front) 0.4 L/min (front & back)		0.16 L/min	
Water Consumed with Humidifer On[8]	—		—		—		8 L/day		44 L/day		44 L/day	
External Dimensions[9] (w × h × d)	78×52×65 cm (31×21×26 in)		78×138×79 cm (31×55×31 in) *Xe-1 & Chiller*		99×72×65 cm (39×28×26 in)		91×166×69 cm (36×66×27 in)		91×178×99 cm (36×70×39 in)		78×94×94 cm (31×37×37 in) *Chiller Only*	
Weight[10]	50 kg (110 lbs)		124 kg (272 lbs)		88 kg (195 lbs)		172 kg (379 lbs)		190-233 kg (420-512 lbs)		85 kg (186 lbs) *Chiller Only*	
Electrical[11] Requiremts	208V (230V)	1-Φ @ 12A (11A)		1-Φ @ 19A (16A)		1-Φ @ 13A (12A)		1-Φ @ 24A (23A)		3-Φ @ 39A (39A)		3-Φ @ 44A (44A)
	400V	—		—		—		—		3-Φ @ 26A		3-Φ @ 26A

Notes:
1. Nomenclature designations: basic (B), spray (S), humidity (H), dual spray (DS), chiller (C), back spray (BS), water immersion (W). Model (E) Q-SUN testers feature dual touch-screen displays and improved irradiance/lamp efficiency.
2. Model Xe-3-HDSE has a separate water reservoir that requires additional floor space (not shown in picture).
3. Min and max black panel (BP), insulated black panel (IBP; also known as black standard thermometer, or BST), chamber air temperatures (CAT), and relative humidity capabilities are dependent on ambient lab conditions. Interdependencies between these parameters limit achievable operating conditions in the tester.
4. CAT control is optional on Xe-1-B and S models; BP/CAT can only be controlled simultaneously on Xe-2 and Xe-3 models.
5. The Xe-1 and Xe-3 specimen capacity shown is without specimen holders. Xe-2 specimen capacity is shown with specimen holders. Add one additional specimen to Xe-1 specimen capacity if CAT is used in place of BP/IBP.
6. Maximum specimen weight listed is for when the specimen tray is used. If the specimen tray is removed from the Xe-3, the chamber floor can hold evenly distributed specimens with a weight of 90 kg (200 lbs) max.
7. Maintain pH 6-8. For best performance, use a reverse osmosis/deionization (RO/DI) system for all S models.
8. Spray consumption applies to all S models; humidifier consumption applies to all H models. Water consumption values are greatly dependent upon test and lab conditions, and software settings. Values shown are typical for many common standards.
9. Rear Xe-3 vent duct is easily removed to reduce the depth from 99 cm (39 in) to 88 cm (34.5 in) to fit through small doors.
10. Actual shipping weights will be higher, depending upon model and whether the shipment is domestic, ocean or air.
11. Voltages shown are +/-10% and 50/60 Hz.

Warranty

The Q-SUN xenon test chamber is guaranteed against defects in workmanship or materials for one year. Liability is limited to replacing or repairing any part or parts which are defective in materials or workmanship and are returned to our factory, shipping costs prepaid. Liability in all events is limited to the purchase price paid. Damage due to accident or abuse is not covered. Labor and travel costs are not covered. Q-Lab makes no other warranties, including implied warranties of merchantability or fitness for a particular purpose, except as may be expressly provided by Q-Lab in writing. Q-Lab shall not be liable for any incidental, consequential, special, or contingent damages arising out of the sale or use of any product.

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A Choice of Filters for Q-SUN Xenon Test Chambers

There are three general categories of filters which can be used in the Q-SUN® xenon test chamber. The choice of filter depends upon the material tested and its end-use application. Within each general category, there may be several different types of filters. Each filter is a flat piece of specialty glass specifically designed to have a particular transmission.

Because the radiation from an unfiltered xenon arc contains too much short-wave UV to allow useful correlation to natural exposures on the earth's surface, Q-SUN testers employ various types of optical filters to reduce unwanted radiation and achieve an appropriate spectrum. For most of the filter types used, the greatest effect is on the short wavelength portion of the spectrum. Because the damaging effects of UV are inversely proportional to wavelength (i.e., shorter wavelengths = more damaging), it is critical that the cut-on wavelength match the service environment. Nominal cut-on wavelengths are shown below for each filter type.

Daylight Filters

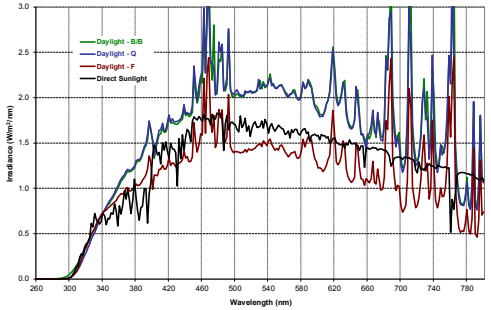
Q-SUN daylight filters produce spectra approximately equivalent to direct sunlight and conform to the spectral requirements of ISO 4892, ISO 11341, ASTM G155, SAE J1960, and SAE J2527. They are recommended for testing materials that are intended for outdoor use.

Daylight - Q. With a nominal cut-on of 295 nm, *Daylight - Q* provides an accurate spectral match with direct sunlight. This filter is often recommended for the best correlation between Q-SUN xenon and natural outdoor exposures.

Daylight - B/B. With a nominal cut-on at 290 nm, *Daylight - B/B* is recommended when correlation to certain rotating-drum style xenon testers is desired.

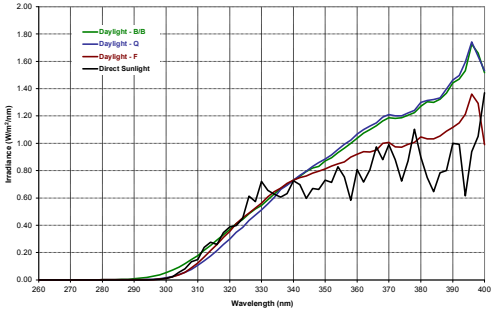
Daylight - F. With a nominal cut-on of 295 nm, *Daylight - F* also provides an accurate spectral match with direct sunlight, particularly in the short-wave UV region. Developed within the automotive industry, this specialty filter has become adopted in some automotive and test standards (e.g. ASTM D7869).

Daylight Filters



Q-SUN daylight filters compared to direct sunlight.

Daylight Filters - UV Region



For the best correlation to direct sunlight, *Daylight - Q* filters are recommended.

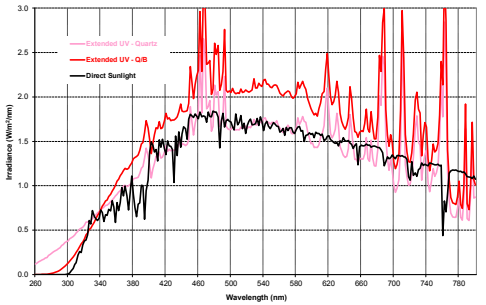
Extended UV Filters

Q-SUN extended UV filters allow significant excess UV below the cut-on of natural sunlight at the earth's surface. Extended UV filters are often used to produce faster degradation than daylight filters. They may also be used to reproduce extraterrestrial spectra for aerospace applications.

Extended UV - Q/B. This filter has a nominal cut-on at 275 nm. For many materials it will produce faster degradation than daylight filters. This filter may be required for certain automotive test methods including SAE J1960, SAE J1885, SAE J2412 and SAE J2527. It is described in ASTM G155.

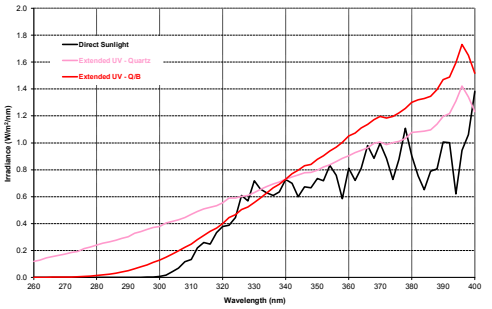
Extended UV - Quartz. Certain special applications require a spectrum with aggressive, very short-wave UV to produce an extraterrestrial exposure condition. The quartz filter has a nominal cut-on at 250 nm. Becuase of its extreme short wave UV cut-on, this filter does not meet the definitional requirements for an "extended UV filter" as defined in SAE or ASTM.

Extended UV Filters



For some materials, extended UV filters may produce faster degradation.

Extended UV Filters - UV Region



Certain automotive test methods call for the spectrum produced by the *Extended UV - Q/B* filter.

Technical Notes

Sunlight Data. As used in this document, the terms "sunlight" and "direct sunlight" refer to sunlight as defined by using the input variables from ASTM G177 in version 2.9.2 of the SMARTS2 model and is approximately equivalent to noon, midsummer sunlight in the northern hemisphere. The term "sunlight through window glass" refers to a calculated value where direct sunlight data from CIE Table 4 is multiplied by the transmission of 1/8 inch glass of the type commonly used in North America.

Q-SUN Data. The data shown in the graphs for Q-SUN filters was measured at the specimen plane in a Q-SUN xenon test chamber. Data for the daylight and extended UV Filters was normalized to 0.73 W/m²/nm @ 340 nm to provide a benchmark comparison with noon midsummer sunlight. Data for the window glass filters was normalized to 1.20 W/m²/nm @ 420 nm to correspond with the calculated CIE/window glass data.

Cut-On. For purposes of this document, the "nominal cut-on wavelength" is defined as 0.2% of the irradiance at 420 nm, rounded to the nearest 5 nm.

Window Glass Filters

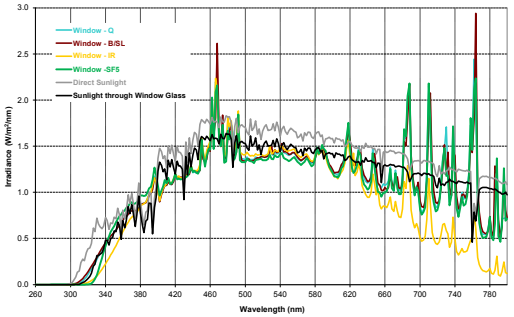
Intended for testing materials that are used indoors, window glass filters produce spectra equivalent to sunlight coming through the window. However, there is no single "standard window glass." Because transmission varies due to thickness, chemical composition, etc., several window glass filters have been developed.

The spectrum produced by the Q-SUN window glass filter also covers most of the wavelengths that would be found from the many artificial light sources used indoors (cool white fluorescent, etc.), so it is appropriate for most indoor applications. For more information on how the spectrum of window glass filtered xenon compares to indoor light sources, see Q-Lab Technical Bulletin LX-5026.

Window - Q. This filter is equivalent to direct sunlight coming through a piece of single-strength, single-pane glass of the type most widely used in North America. This filter meets the requirements for window glass filters in ASTM and most ISO test methods. *Window - Q* has a nominal cut-on of 310 nm.

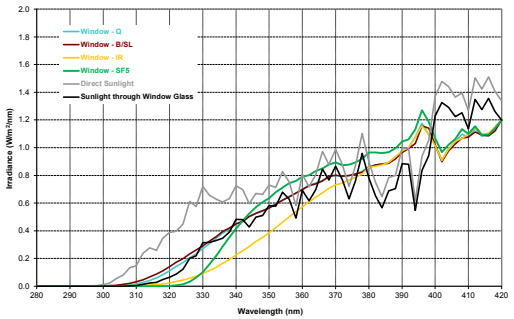
Window - B/SL. This filter is slightly more transmissive and produces a spectrum with slightly more short-wave UV. *Window - B/SL* has a nominal cut-on of 300 nm. This filter meets the requirements for window glass filters in ASTM, ISO and AATCC test methods, including AATCC TM 16-3.

Window Filters



A variety of window glass filters are available to reproduce the spectrum of sunlight that has been filtered by different types of glass.

Window Filters - UV Region



The spectrum produced by the *Window - Q* filters meet the requirements of ASTM and most ISO test methods.

Window - IR. Infrared (IR) filters produce a similar short wavelength cut-on as other window glass filters, but also reduce the amount of long wavelength visible and IR energy that reaches the test specimen. This filter meets certain test specifications that call for "heat reducing filters" (ISO 105 B02). The IR filter has a nominal cut-on of 320 nm.

Window - SF5. This filter is specified for certain automotive interior tests (such as Ford) that require a so-called "335 nm long pass filter." Despite this OEM-designated description, the nominal cut-on for this filter is 325 nm. It is designed to simulate automotive interior conditions.

Filter Application Table

Filter Name	Nominal Cut-On	Recommended Use
Daylight - Q	295 nm	Best for correlation with outdoor exposures
Daylight - B/B	290 nm	Best for correlation to some rotating-drum style testers
Daylight - F	295 nm	Accurate match to the short-wave UV portion of sunlight Used in some ASTM and automotive test standards
Extended UV - Q/B	275 nm	Used for some automotive test methods
Extended UV - Quartz	250 nm	Very aggressive, very short-wave UV, extraterrestrial spectrum
Window - Q	310 nm	Sunlight North American window glass Meets most ISO & ASTM requirements for Window Glass Filters
Window - B/SL	300 nm	Recommended for AATCC procedures like TM 16-3 Meets most ISO & ASTM requirements for Window Glass Filters
Window - IR	320 nm	Reduced heat for lower exposure temperatures Recommended for ISO 105 B02 "European Conditions" Does not meet the requirements for most ISO & ASTM Window Glass Filters
Window - SF5	325 nm	Used for some automotive interior tests (e.g. Ford)

For more information about any of the above test methods, please contact:

AATCC, PO Box 12215 Research Triangle Park, NC 27709 USA
Phone: 919-549-8141; Fax: 919-549-8933; www.aatcc.org

ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA, 19428-2959 USA
Phone: 610-832-9585; Fax: 610-832-9555; www.astm.org

ISO, 1 rue de Varembé, Case postale 56 CH-1211 Geneva 20, Switzerland
Phone: +41 22 749 01 11; Fax: +41 22 733 34 30; www.iso.org

SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001 USA
Phone: 724-776-4841; Fax: 724-776-0790; www.sae.org

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TECHNICAL BULLETIN LX-5054

Partial List of Test Methods & Standards Met by Q-SUN Xenon Test Chambers

	Method	Applicable Model Xe-1	Xe-2	Xe-3
General	ASTM G151	●	●	●
	ASTM G155	●	●	●
	IEC 60068-2-5	●	●	●
	MIL-STD-810G	●	●	●
Automotive	ASTM D7356	–	–	●
	ASTM D7869	–	●	●
	BMW AA-0235 (BMW)	–	–	●
	DBL 5555 (Daimler)	–	●	●
	DBL 7399 (Daimler)	–	●	●
	Fiat 50451	–	●	●
	FLTM BO 116-01 (Ford)	–	●	●
	GMW 3414 (General Motors)	–	–	●
	GMW 14162 (General Motors)	–	●	●
	GMW 14170 (General Motors)	–	●	●
	HES D6601 (Honda)	–	●	●
	ISO 105-B06	–	●	●
	ISO 105-B10	–	●	●
	JASO M346	–	●	●
	JASO M351	–	●	●
	JIS D0205	–	◒	◒
	PV 1303 (Volkswagen)	–	●	◒
	PV 1306 (Volkswagen)	–	◒	●
	PV 3929 (Volkswagen)	–	●	●
	PV 3930 (Volkswagen)	–	●	●
	RNES B-00088 (Renault, Nissan)	–	◒	●
	SAE J2412	–	●	●
	SAE J2527	–	●	●
Roofing	ASTM D1670	●	●	●
	ASTM D4434	–	●	●
	ASTM D4637	–	●	●
	ASTM D4798	●	●	●
	ASTM D4811	–	●	●
	ASTM D6083	–	●	●
	ASTM D6878	–	●	●

● Meets Standard ◒ Conditionally meets; Consult Q-Lab for more information

	Method	Applicable Model Xe-1	Xe-2	Xe-3
Adhesives and Sealants	ASTM C732	●	●	●
	ASTM C734	●	●	●
	ASTM C793	●	●	●
	ASTM C1184	●	●	●
	ASTM C1257	●	●	●
	ASTM C1442	●	●	●
	ASTM C1501	●	●	●
	ASTM C1519	●	●	●
	ASTM D904	–	●	●
	ETAG 002 Part 1	●	–	–
Printing Inks/Artists' Materials/ Paper	ASTM D3424	●	●	●
	ASTM D4303	●	●	●
	ASTM D6901	●	●	●
	ASTM F2366	●	●	●
	GB/T 22771	–	●	●
	ISO 11798	–	●	●
	ISO 12040	●	●	●
	ISO 18909	–	●	●
Textiles	AATCC TM 16	–	●	●
	AATCC TM 169	–	●	●
	Adidas TM 5.11	●	–	–
	GB/T 8427	–	●	●
	GB/T 8430	–	●	–
	GB/T 8431	–	●	●
	GB/T 16991	–	●	●
	IS: 2454	–	●	●
	ISO 105-B02	–	●	●
	ISO 105-B04	–	●	●
	ISO 105-B07	–	●	●
	M & S C9	–	●	●
	M & S C9A	–	●	●
	CPAI-84	–	●	●
Coatings	ASTM D6695	–	●	●
	GB/T 1865	–	●	●
	IRAM 1109-B14:2008	●	●	●
	ISO 15110	●	●	●
	ISO 16474-1	●	●	●
	ISO 16474-2	●	●	●
	JDQ-53.3	●	●	●
	JIS K 5600-7-7	–	●	●
	MIL-A-8625-F	●	●	●
	MIL-P-14105-D	●	●	●

● Meets Standard ◒ Conditionally meets; Consult Q-Lab for more information

Q-LAB

	Method	Applicable Model Xe-1	Xe-2	Xe-3
Plastics	ASTM D1248	●	●	●
	ASTM D2565	●	●	●
	ASTM D4459	–	●	●
	ASTM D5071	●	●	●
	ASTM D6662	●	●	●
	DIN EN 513	–	◒	◒
	EH-438-2	–	◒	◒
	GB/T 16422.1	●	●	●
	GB/T 16422.2	●	●	●
	GB/T 29365	–	●	●
	ISO 29664	–	–	●
	ISO 4892-1	●	●	●
	ISO 4892-2	●	●	●
	JIS K 7350-2	●	●	●
	UL 1581	●	●	●
Rubber and Flooring	ASTM D750	–	●	●
	ASTM D925	–	●	●
	ASTM D1148	●	●	●
	ISO 3865	●	●	●
	ISO 4665	●	●	●
	GB/T 3511	–	●	–
Pharmaceuticals and Cosmetics	Boots	●	●	●
	Colipa Guideline	◒	◒	◒
	ICH Guideline Q1B	●	–	●
Others	ASTM D4355 (Geotextiles)	–	●	●
	ASTM D6551 (Packaging)	–	●	●
	ASTM F1515 (Flooring)	–	●	●
	IEC 62788-7-2 (Photovoltaic)	–	–	●

● Meets Standard ◒ Conditionally meets; Consult Q-Lab for more information

Notes:
1: Many national standards have been superseded by ISO or IEC standards, which are listed on this document.
2: This document is not fully comprehensive. If a standard is not listed here, it may still be met by the Q-SUN.
Contact Q-Lab for more information about a specific test cycle.

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