# Q-SUN®

Xenon Arc 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 arc 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 arc 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. For labs who require very high specimen capacity, the large format rotating rack Q-SUN Xe-8 is available, as presented in a separate brochure.

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, SAE, 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 ARC LAMPS**
*The most realistic simulation of natural 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**
*3000 hour lamp life at typical irradiance levels*

**OPTICAL FILTERS**
*Do not require replacement under normal use*

**WATER SPRAY**
*Operates in light or dark cycles; available for both front and back*

**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 arc lamps for larger capacity. The 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 rotating rack geometry. 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.

Q-Lab's newest rotating rack xenon arc offering, the large capacity Q-SUN Xe-8, is available to support high specimen throughput and is described in a separate brochure.

# 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, ASTM, SAE, and others can help select a test designed for your application. 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. This includes proper water and electrical supply, calibration of onboard sensors, and basic maintenance of lamps and filters.

Rank-ordered data from xenon testing can be a powerful tool for directional decision making, both for quality control and research and development. Correlation between laboratory and actual outdoor results does not adhere to one general acceleration factor, but varies significantly depending on the material, test type, and failure mode. Proper correlation for a given product and degradation type needs to be established by comparison with actual outdoor test data.

## 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. Q-Lab offers both types of benchmark testing.

*Florida*

*Arizona*

# Standards

Q-SUN xenon arc testers meet the specifications in nearly all major international, national, and industry test standards, including tests from ASTM, ISO, SAE, AATCC, 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 Q-Lab’s Standards Search tool 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 D6695
- ISO 16474-2

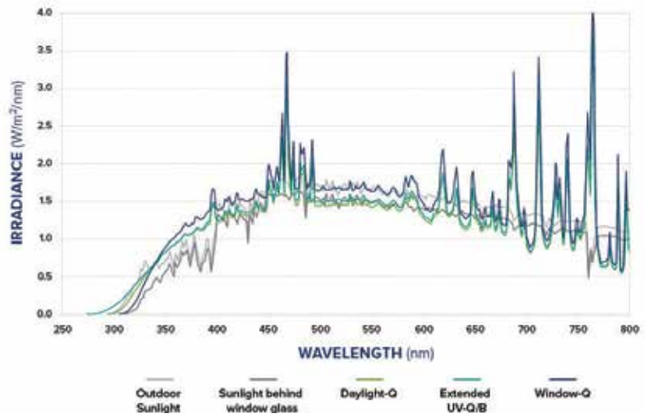
### TEXTILES
- AATCC TM 16, 169
- ISO 105-B02, -B04
- Marks & Spencer C9, C9A

### PLASTICS
- ASTM D2565
- ISO 4892-2

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

# Sunlight Simulation

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 all Q-SUN models for 3,000 hours at normal irradiance and 1,000 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 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.

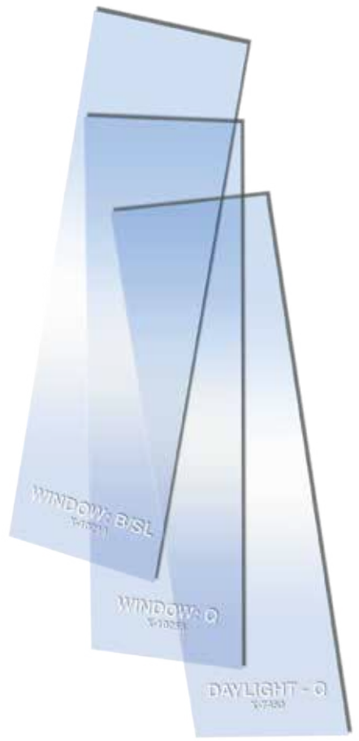
## LONG-LIFE OPTICAL FILTERS

Light from xenon arc lamps 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 per lamp. 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-Q and Daylight-F filters meet the requirements of Type I Daylight filters as defined in ASTM and ISO standards. Daylight-B/B filters are classified as Type II Daylight filters.




### Window Glass Filters

Window glass filters produce spectra equivalent to sunlight passing through window glass. This can also simulate other indoor 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, 300-400 nm).

# 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

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. To conserve expensive purified water, an advanced water repurification system is an available option.
**See page 14**

### EXCEPTIONAL REALISM

Specimens exposed in Q-SUN Xe-1 and Xe-3 testers 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

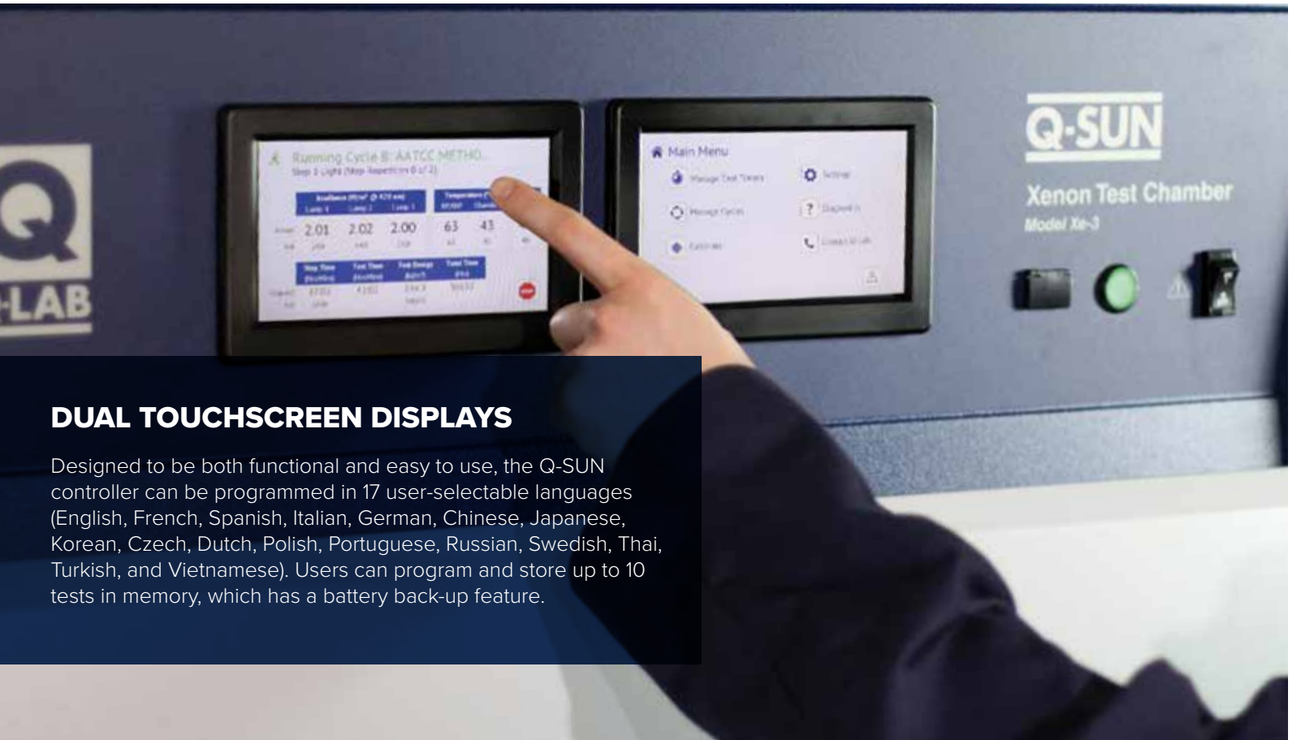
For some interior products such as pharmaceuticals and cosmetics, lower exposure temperatures are necessary to prevent unnatural degradation. An optional chiller is available for these applications.
**See page 14**

# 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 TOUCHSCREEN 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 UC20 radiometers needs to be performed annually. UC20 Smart Sensors can either be returned to Q-Lab for recalibration or replaced annually; both options are cost-effective.

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

## MAINTENANCE

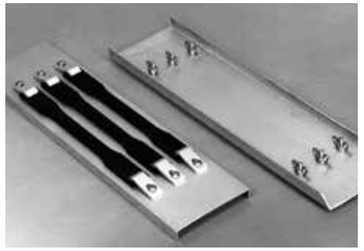
The Q-SUN controller includes complete self-diagnostic error checking. The controller constantly monitors the status and performance of all systems. It also displays simple warning message and routine maintenance reminders and performs safety shutdown, as needed. Typical maintenance items are lamps, 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 black panel thermometers are available in insulated and uninsulated versions. UC202 Smart Sensors require yearly, inexpensive recalibration or replacement.

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. Three-dimensional 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 REPURIFICATION

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

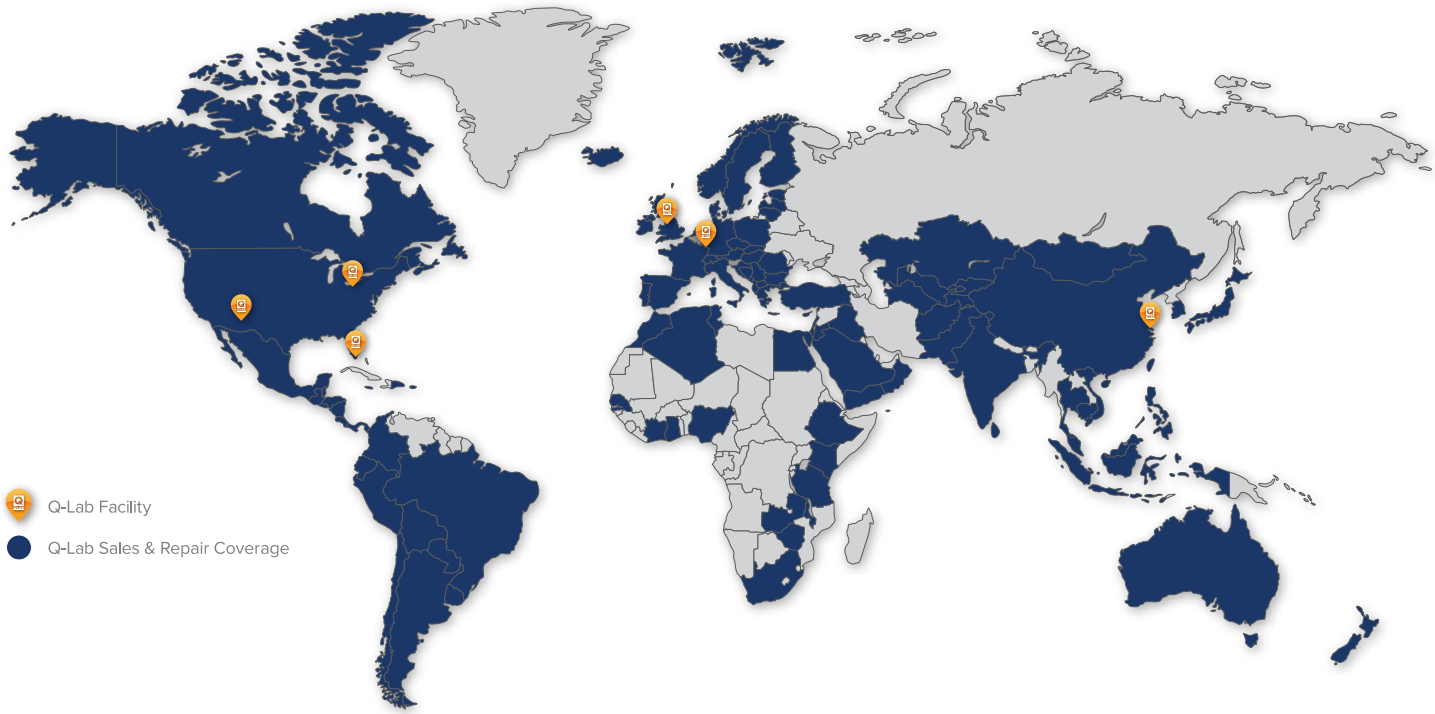
Back spray is required by SAE J2527; it allows water to be sprayed on both the front and back side of specimens simultaneously.
A water repurifcaiton system is ideal for back spray configurations.
Back Spray is available for Xe-2 and Xe-3 models, and is standard for Xe-8 models.



# 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 from Horizontal | 10° | 90° | 10° |
| 3D Specimen Capability | ● | – | ● |
| Dual Touchscreen 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 | ● | ● | ● |




Q-LAB

## OUR GLOBAL NETWORK

We are committed to provide world-class technical, sales, and repair support in over 80 countries in which we operate. Visit **Q-Lab.com/support** for contact information specific to your location and inquiry type.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