



# A Choice of Filters for Q-SUN Xenon Test Chambers

There are three general categories of filters that can be used in Q-SUN® xenon arc test chambers. 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 consists 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 (shorter wavelengths are 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.

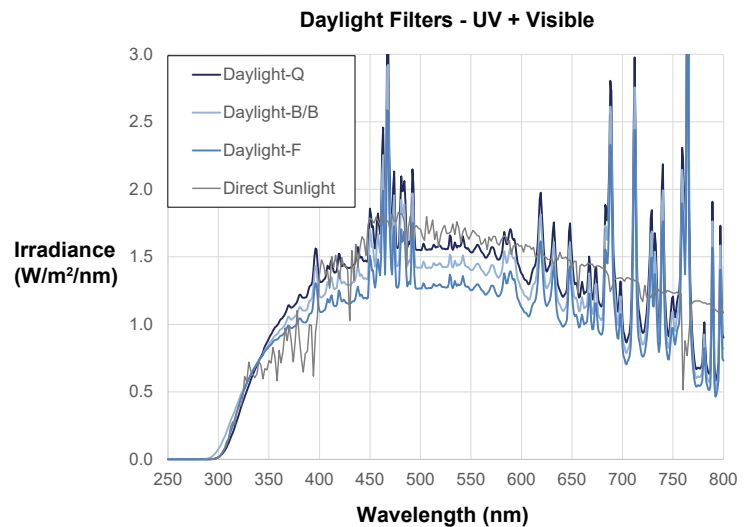
## Daylight Filters

Q-SUN daylight filters produce spectra approximately equivalent to direct sunlight and conform to the spectral requirements of ISO 4892, ISO 11341, ASTM G155, ASTM D7869, and SAE J2527. They are recommended for testing materials that are intended for outdoor use.

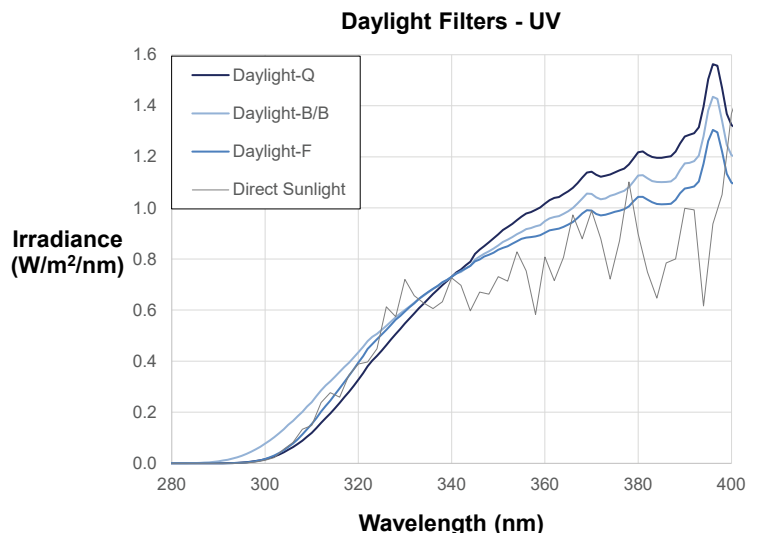
**Daylight-Q** With a nominal cut-on of 295 nm, *Daylight-Q* provides an accurate spectral match with direct sunlight. This filter is often recommended for the best correlation between Q-SUN xenon and natural outdoor exposures. Daylight-Q meets the requirements of a Type I optical filter in ASTM G155 and ISO 4892-2.

**Daylight-B/B** With a nominal cut-on at 290 nm, *Daylight-B/B* is recommended when correlation to some historical test results is desired. Daylight-B/B meets the requirements of a Type II optical filter in ASTM G155 and ISO 4892-2.

**Daylight-F** With a nominal cut-on of 295 nm (Type 1), *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 (notably ASTM D7869).



Q-SUN daylight filters compared to direct sunlight



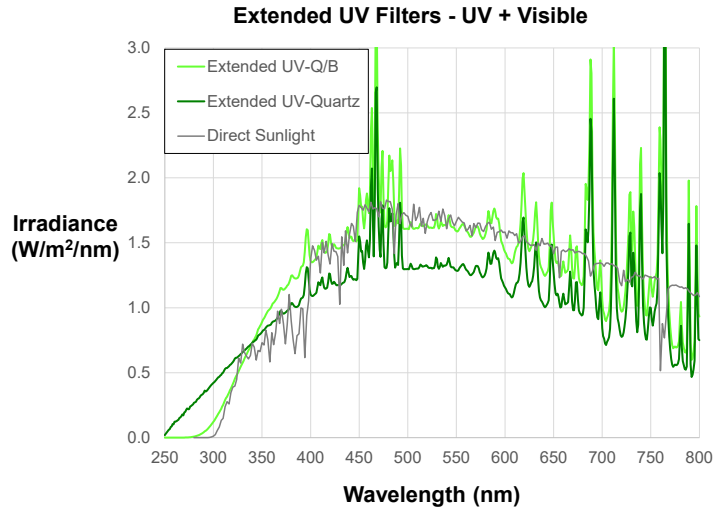
Daylight filters have small yet significant differences in the short-wave UV region

## Extended UV Filters

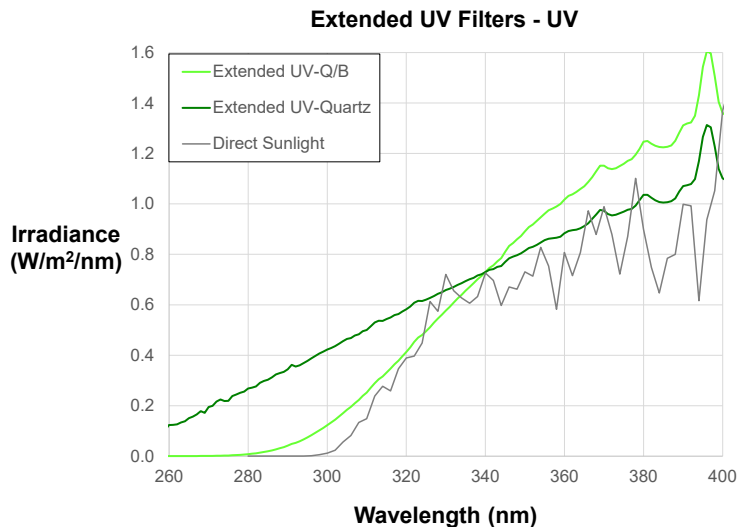
Q-SUN extended UV filters allow significant excess UV below the cut-on of natural sunlight at the earth's surface. Extended UV filters are often used to produce faster degradation than daylight filters. They may also be used to reproduce extraterrestrial spectra for aerospace applications.

**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 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. Because 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.



For some materials, extended UV filters may produce faster degradation



Extended UV-Q/B filters transmit short-wave UV not seen on Earth's surface; Extended UV-Quartz filters offer almost no filtering

### 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-241 Table CIE-H1 is multiplied by the transmission of 3 mm (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.

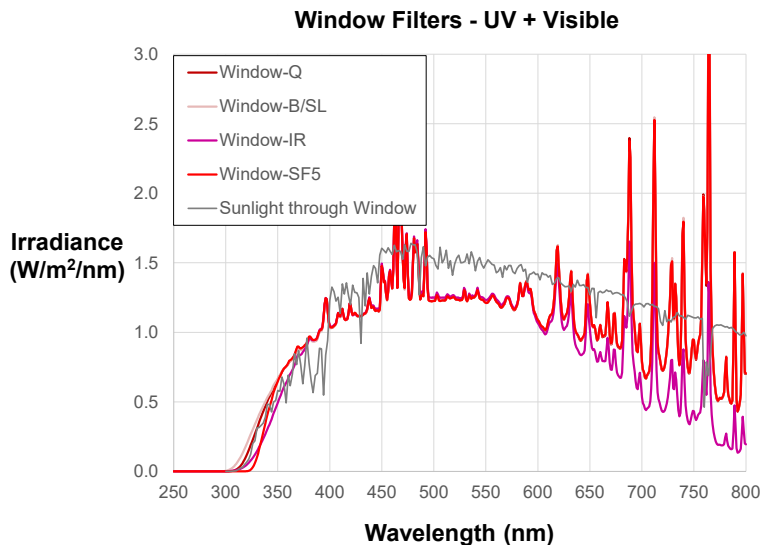
## Window Glass Filters

Window glass filters produce spectra equivalent to sunlight passing through windows, and are intended for testing materials that are used indoors. However, there is no single "standard window glass." Because transmission varies due to thickness, chemical composition, tint, and other factors, several window glass filters have been developed.

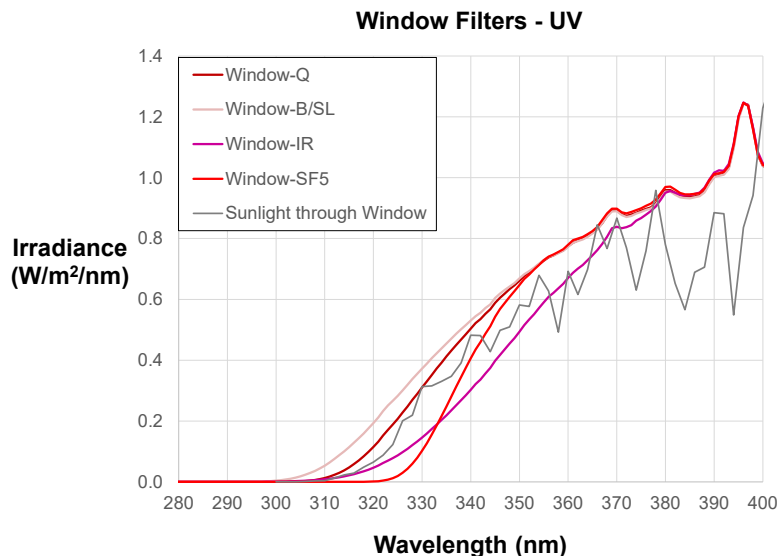
The spectrum produced by the Q-SUN Window glass filters also covers most of the wavelengths that would be found from the many artificial light sources used indoors, so it is appropriate for most indoor applications. For more information on how the spectrum of window glass filtered xenon compares to indoor light sources, see Q-Lab Technical Bulletin [LX-5026 Quantifying the Indoor Light Environment](#).

**Window-Q** This filter is equivalent to direct sunlight passing 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 TM16.3.



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



The spectrum produced by the *Window-Q* filters meets 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. Meets definition of Type I Daylight Filter in ASTM G155 and ISO 4892-2.
Daylight-B/B	290 nm	Best for correlation to some rotating-drum style testers. Meets definition of Type II Daylight Filter in ASTM G155 and ISO 4892-2.
Daylight-F	295 nm	Accurate match to the short-wave UV portion of sunlight (Type I Daylight). 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 passing through clear, 3 mm window glass. Meets most ISO & ASTM requirements for Window Glass Filters.
Window-B/SL	300 nm	Recommended for AATCC procedures like TM16.3. Meets most ISO & ASTM requirements for Window Glass Filters.
Window-IR	320 nm	Reduced heat for lower exposure temperatures. Recommended for ISO 105-B02. Does not meet requirements for most ISO & ASTM Window Glass Filters.
Window-SF5	325 nm	Used for some automotive interior tests, including Ford.

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

**AATCC**

[www.aatcc.org](http://www.aatcc.org)

**ASTM International**

[www.astm.org](http://www.astm.org)

**ISO**

[www.iso.org](http://www.iso.org)

**SAE**

[www.sae.org](http://www.sae.org)



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