Quick Links

Drawing on decades of weathering leadership and expertise, the Atlas Consulting Group provides in-depth consulting services that assist you in developing and applying the best weathering test methods and strategies for your products. ***Atlas Weathering Consulting Insights*** offers interesting and valuable information on a variety of topics relevant to long-term durability testing.

Weathering and Lightfastness Standards An Often Complex Maze of Information

The purpose of standards in weathering is not necessarily to define realistic test methods, rather they are a means to establish a common basis for repeatable and reproducible test comparisons. Modern standards are primarily performance based. This means that the standards define the test conditions, but do not necessarily define the ways to achieve them. Each instrument which fulfills these requirements can be used to perform the corresponding test. This allows the operator to select the appropriate test instrument to meet their requirements, as long as the specifications are fulfilled.

Standards also allow instrument manufacturers the flexibility to evolve their products within the standards specifications. However, on an international level, performance based standards also have their downsides. While they need to be open to alternative methods of controlling parameters, this can inherently result in varied test implementations.

An example, which very often causes confusion and misunderstanding, regards the reference sensors used to measure and control "worst case" specimen surface temperatures under radiation: black painted metal sheets with an attached thermo couple which should absorb at least 90% to 95% of incoming radiation (ISO 4892-1 (1999)). In America and Asia, black panel sensors which do not have insulation on the back side, are primarily used and referred to as the black panel surface temperature (BPT). In Europe, black standard temperature sensors (BST) are primarily used. These have the sensor directly attached to the metal sheet from the back side and then they are covered by a PTFE insulator. The BST is usually higher than the BPT but the difference is not fixed and, within common test conditions, usually ranges from 0 to 12 Kelvin and will vary depending on the instrument, irradiance, air velocity, environmental conditions, etc. (Fig. 1).

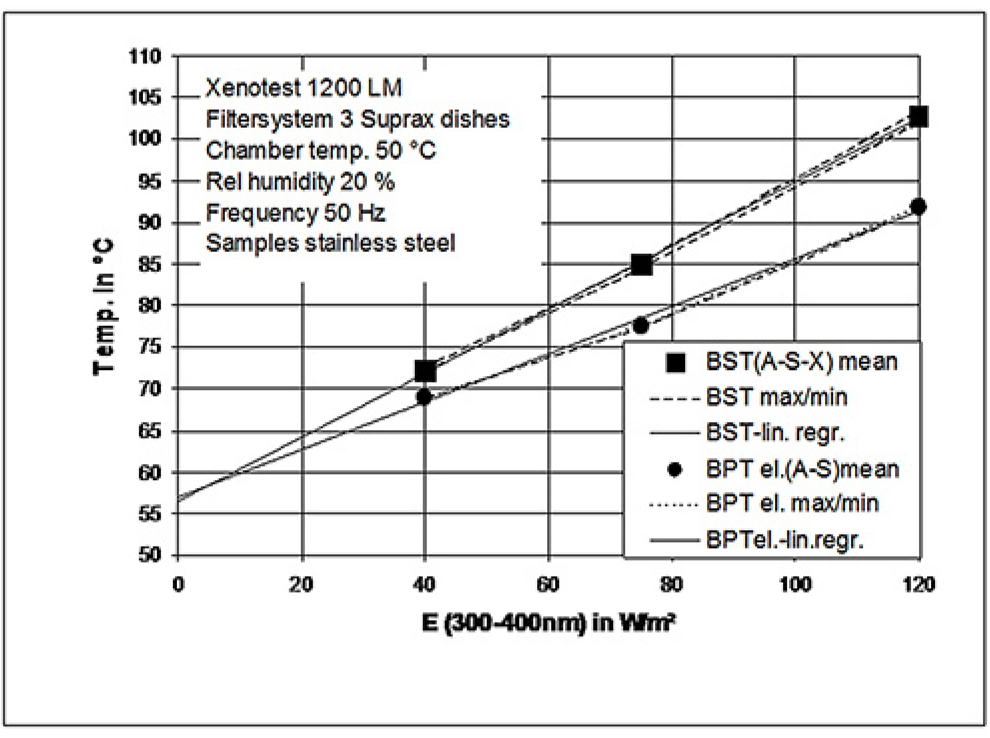

Fig. 1. BPT and BST in dependency of the irradiance in an Atlas Xenotest® instrument

Most modern standards (ISO and ASTM) allow operators to run typical lightfastness and weathering test cycles using either BPT or BST control sensors. For example, ISO 105-B10 (2011) allows running the test cycles A and B with a BST of 65 °C (recommended) or with a BPT of 63 °C (or as agreed between the interested parties). For cycles C and D (BST = 82 °C and BPT = 77 °C) the difference is larger, showing that it is hard to estimate the relation between those temperatures. However, running these tests with different temperature control options will lead to different test specimen temperature profiles. Since surface temperature is often a critical aging factor, just a few degrees difference will most likely lead to different results and therefore, cycles using different temperature control sensors cannot be directly compared.

ISO 4892-2 (2013) takes this issue one step further by defining separate test cycles for weathering, lightfastness and hot-lightfastness using BST control (Cycle 1,2,3) or BPT control (Cycle 4,5,6). Note: ISO 4892-2 is not restricted to instruments with relative humidity and chamber air temperature control. Additional cycles are described in the Annex. This leads to a total of twelve different test cycles for just three test scenarios. This indicates how difficult it sometimes can be to compare test results which have been tested according to the same standard, but with different settings.

Another source of confusion is the selection of the radiometer to control irradiance. Here you can either use broadband control, 300 – 400 nm, also called total UV (Europe), or narrow band control at 340 nm for outdoor daylight or 420 nm for daylight through window glass (America and Asia). However, the exact ratio between narrow band and broadband control depends on the spectral power distribution, thus the specific light source and optical filters used. This becomes most obvious when similar settings of ISO 105-B02 (normal conditions) and AATCC TM16 Option 3 are compared. Both cycles specify 1.1 W/(m² x nm) at 420 nm. However, the corresponding broadband setting for B02 would be 42 W/m² and the TM16 setting would be 48 W/m². So, which one is the correct broadband value?

This confusing occurrence can be easily explained by looking at the UV cut-on of the spectral power distribution according to the specification in the standards (Fig.2). The AATCC TM16 spectral power distribution has more UV. The 420 nm sensor is blind to that difference, while it is recognized by the broadband sensor. However, as long as the spectral power distribution of the radiation source is within the specification of the standard, the ratio should be in a limited range.

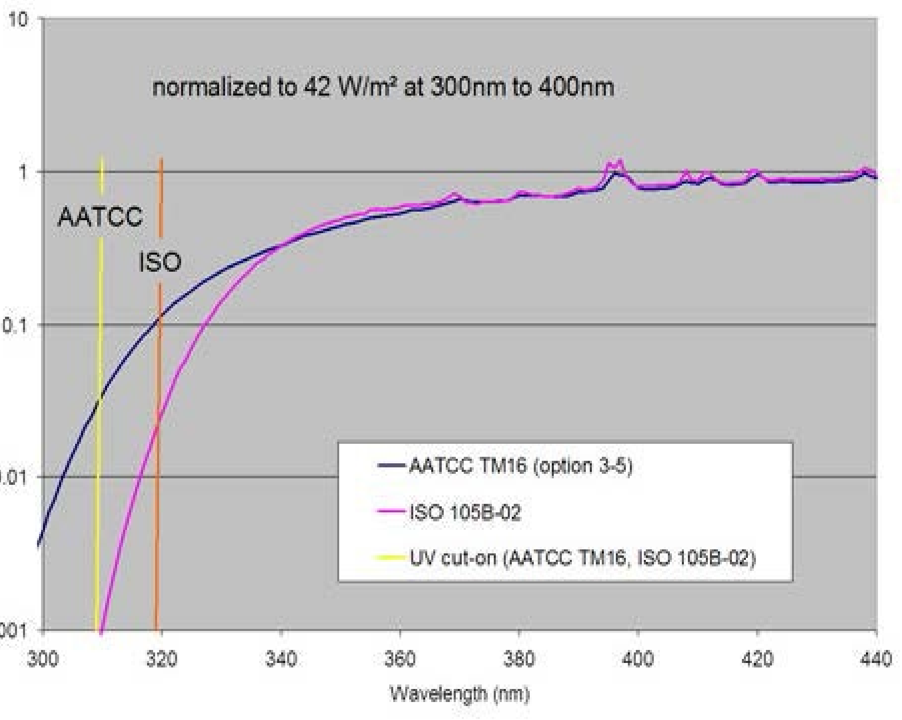

Fig. 2. Spectrum comparison: ISO vs. AATCC (Source: Artur Schönlein "Light Fastness Standards", Symposium at the 100th anniversary of the German Colour Fastness Committee DEK, 2011, Erding, Germany).

This example shows how difficult it can be to compare different radiometers. These small deviations in irradiance mainly affect the test times to reach a radiant energy endpoint, while deviation in temperature might also change the degradation rate or pathway. Therefore, most often, the choice is given to use narrow or broadband control in the same test cycle. When the test times are related to standard reference materials such as blue wools, this should not cause a difference in the quality of the test. However, if different test scenario results are compared, these differences should be considered as well.

If you are not sure about the proper settings of your Atlas instruments for specific standards or specifications, or if you need guidance through the maze of standards, please contact Atlas Consulting. Atlas Consulting can also help you select the appropriate standards or develop the test cycles, test methods and complete test programs that are appropriate for both the products you are testing and their intended end-use climates.

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AMETEK® MEASUREMENT & CALIBRATION TECHNOLOGIES

Atlas Material Testing Technology LLC | Phone: +1-773-327-4520 | Fax: +1-773-327-5787 | Email: atlas.info@ametek.com
Atlas Material Testing Technology GmbH | Phone: +49-6051-707140 | Fax: +49-6051-707149 | Email: atlas.info@ametek.de