ATLAS MATERIAL TESTING SOLUTIONS
AMETEK MEASUREMENT & CALIBRATION TECHNOLOGIES

Material Testing Product and Technology News

Volume 43
Issue 94

SunSpots®

Fall 2013

High Irradiance Weathering Testing

Excerpted from a July 2013 white paper by Allen Zielnik, Senior Consultant-Weathering Science, Atlas Material Testing Technology LLC

Accelerated weathering testing can speed time to market and reduce the indirect costs associated with long term outdoor exposures. However, many of these routine tests are based on standards and methods that were developed decades ago and have not kept pace with advances in weathering technology or scientific knowledge. And most of them only provide accelerations over real time outdoor testing on the order of four- to six-fold (actual values are highly material specific, however).

For this reason, much of weathering research has been focused on two key objectives:

- Improving correlation of accelerated tests with real world performance
- Increasing test acceleration rates

The correlation effort has mainly focused on two separate fronts:

- On the hardware side, there have been major advances in optical and control technologies
- On the applications side, new test methods have demonstrated both improved test correlation and acceleration [1]

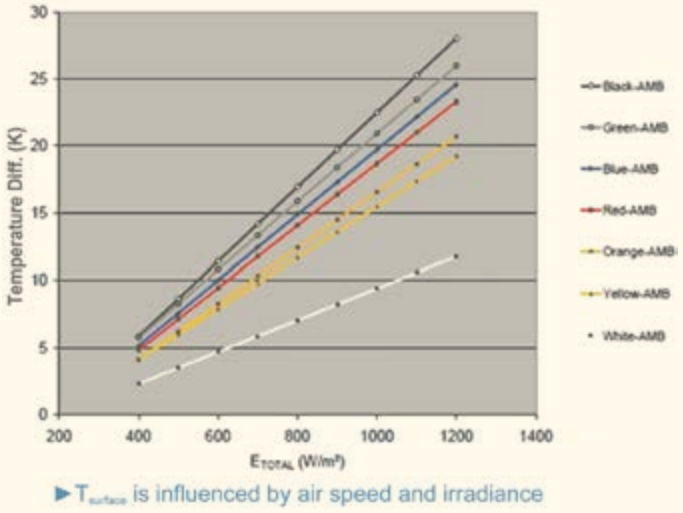

Figure 1. *Excellent linearity of color coated panel surface temperature control achieved with increasing irradiance in Xenotest® Beta [4]*

Atlas introduces new Xenon Weathering Instrument – Xenotest® 440 *Page 12*

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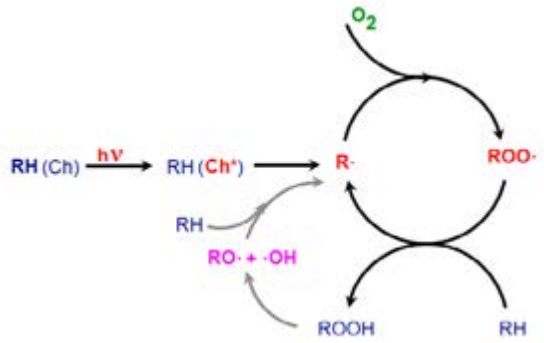

Figure 2. *Photolysis is an initiating step in polymer auto-oxidative degradation, but subsequent reactions may be influenced by secondary factors independent of irradiance.*

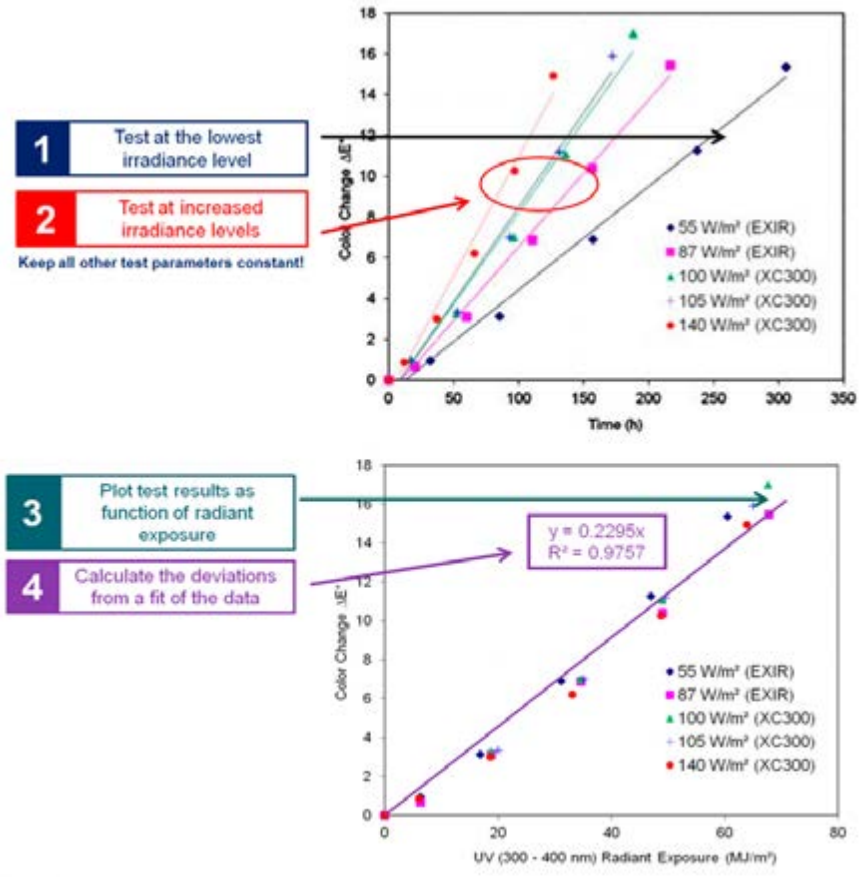

Figure 3. *Simplified reciprocity validation method using ORWET [11] orange lacquer coating standard reference material; ISO 4892-2 xenon test method (no water spray). Note that the property change (ΔE) is very linear with radiant exposure for this material [12].*

High irradiance is one tool that may further increase test acceleration. It provides an opportunity for "accelerating the accelerated test." Two key advantages are:

- Shortening test times over natural and traditional accelerated weathering testing
- Providing a longer equivalent service life exposure in the same timeframe as conventional accelerated weathering

Primary Weather Factors

The main external environmental stresses are heat, light and moisture. The distortion of any of these from natural conditions can lead to erroneous test results and interpretation. The more an accelerated test alters the natural balance of these stresses from that of outdoors, the more likely the results will also differ. This disparity is often the basis for accelerated tests resulting in poor correlation with natural outdoor exposures. Nevertheless, increasing test irradiance often provides greater opportunity for true, undistorted acceleration than do the other primary weather factors.

What Is High Irradiance Testing?

The term "high irradiance" refers to any irradiance higher than that of natural sunlight. Therefore, a sunlight reference value is required. CIE Publications No. 20 [2] and 85 [3] have traditionally served as a "definition" of standard reference sunlight. For testing purposes, CIE No. 20 specifies spectral irradiance values of:

- 60 W/m^2 between 300 and 400 nm
- 1000 W/m^2 between 300 and 3000 nm

Later, international standards added a similar irradiance level for daylight behind 3mm window glass:

- 50 W/m^2 between 300 and 400 nm

Atlas uses these CIE values to establish a "1-sun" baseline. For consistency, Atlas will reserve the term "high irradiance" to refer to ≥2-sun based on the CIE references.

Thermal and Moisture Effects in Weathering

As noted, light, heat and moisture stresses are linked in weathering, and it is important to properly regulate the temperature and moisture stresses as irradiance is increased. Temperatures, from an equipment engineering perspective, become more difficult to manage at high irradiances. Therefore, high irradiance technologies need to be more rigorously optimized for temperature management than their "conventional" 1-sun counterparts. The Xenotest® Alpha+, for example, allows for a wide irradiance range while keeping the temperatures (both black panel/black standard and chamber) constant (Figure 1).

Weathering Test Acceleration and Correlation

An acceleration factor (AF) is commonly used to describe the relative degree of acceleration of a test. The AF is a simple equation that indicates how much faster an accelerated test produces an equivalent amount of property change as compared to a natural outdoor exposure, whether at a test site or in-use service condition.

$$AF_{(\text{light, heat, moisture, etc.})} = \frac{t_{outdoor}}{t_{accelerated}}$$

Although AF is a simple concept, there are several important tenets:

- It is valid only for a specific combination of a natural exposure and an accelerated test
- Correlation must be maintained; i.e., the degradation chemistry and resulting property changes must be faithfully reproduced
- It applies to the times (or time-dependent variable such as radiant exposure) to reach a specific and equal amount of a property change — e.g., chemical, appearance, physical, etc. — and not to the increased level of any stress

Sometimes the ratio of times to equal radiant exposure of two tests is used to calculate an AF. However, this factor is not based on a measured material-specific property change and should strictly be considered as a theoretical AF for relative purposes only.

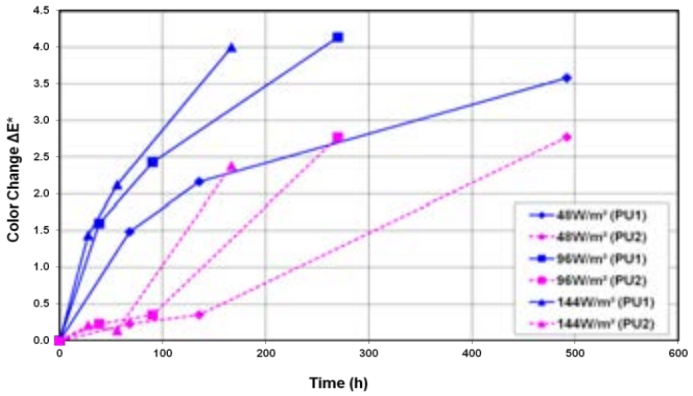

Figure 4. *When the ΔE is plotted as a function of radiant energy, it is easier to visualize the correlation at the three irradiance levels for each specimen type.*

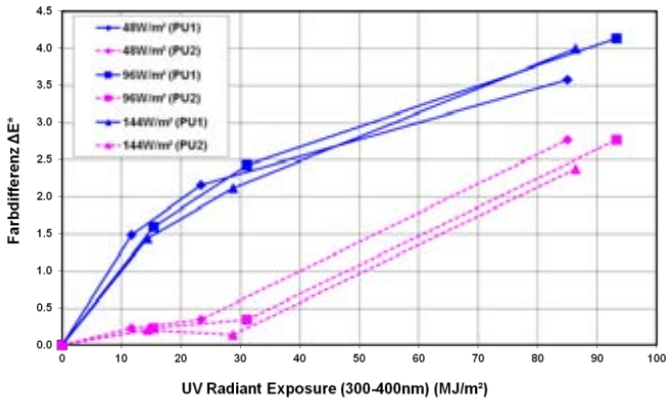

Figure 5. *Although the property change is not linear with radiant exposure, the amount of the change at equal radiant exposures, but different irradiances, was similar; this is an indication that reciprocity was obeyed. A curve fit showed excellent R^2 values (R^2 is the square of the Pearson correlation coefficient, r).*

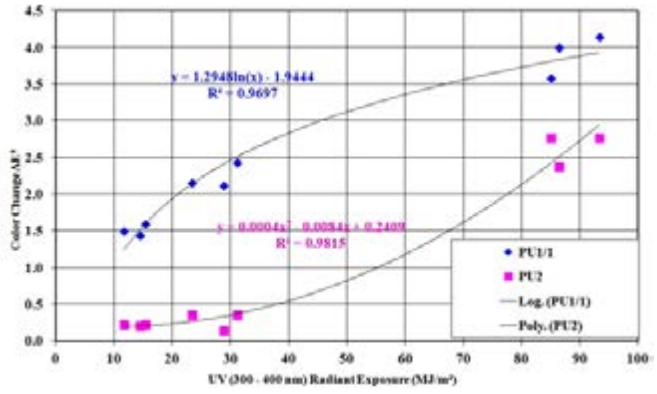

Figure 6. *A fit of the data at three irradiances for two polyurethanes, ΔE versus radiant exposure shows good reciprocity.*

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High Irradiance Weathering Testing, from previous page

APPLICATION	IRRADIANCE (UV)	INSTRUMENT / TECHNOLOGY	REFERENCE
Textiles	up to 3-sun	Xenotest® Alpha	1), 2)
Automotive Interior Materials	up to 3-sun	Xenotest® Alpha	1), 3)
Automotive Coatings	up to 3-sun acceleration factor to South Florida up to 63	Xenotest® Alpha Ultra Accelerated Weathering System (UAWS)	1) 4)
Polymers	up to 2-sun up to 4-sun	Ci35, Ci4000, Ci5000 Weather-Ometer® EMMAQUA®	5) 6) 7)
Solar Materials/ CPV Encapsulants	up to 32-sun	Modified Ci4000 Weather-Ometer®	8)

Table 1. *Published examples using high irradiance*

Table 1 References:

1) Artur Schönlein et al. GUS-Jahrestagung, Stutensee (2013)
2) Jochen-Wilfried Stuck, DEK Fachtagung "Echtheitsprüfungen in der Textilindustrie," Gelnhausen (1996)
3) Jörg Boxhammer, Polymer Testing 20 (2001), 719 ff
4) Henry K. Hardcastle et al. SunSpots Volume 40, Issue 88 (2010)
5) James Pickett et al. Polym. Degrad. Stab. 93 (2008), 1597 ff
6) Kurt Scott et al. Service Life Prediction of Polymeric Materials (2009), 83 ff
7) Henry K. Hardcastle et al. 2nd European Weathering Symposium, Gothenburg (2005)
8) Michael Kempe et al. SunSpots Volume 39, Issue 85 (2009)

XENON WEATHERING STANDARD	SCOPE	ALLOWED IRRADIANCE LEVELS UP TO 3 SUN (i.e. 180 W/m2 (UV) for daylight filters)	COUNTRY
ISO 4892-2	Plastics	Daylight and window glass	International
ISO 11341	Coatings	Daylight and window glass	International
ISO 105-B06	Automotive interior	Window glass, set of exp. cond. no. 6	International
ISO 105-B10	Textiles	Daylight	International
ASTM G155	Non-metallic materials	Daylight (cycle 9), window glass (cycle 10)	USA
ASTM D6695	Coatings	Daylight (cycle 1)	USA
VDA 75202	Automotive interior	Window glass, option A	Germany
JASO M346	Automotive interior	Window glass	Japan
JASO M351	Automotive exterior	Daylight	Japan

Table 2. *Representative high irradiance xenon arc weathering standards*

The Principle of Reciprocity

In film photography, reciprocity is the inverse relationship between the intensity (irradiance) and exposure time that determines the reaction of a light-sensitive material. The principle states that if reciprocity is observed, equivalent radiant exposures (radiant exposure = irradiance x time) will produce the same amount of photochemical change for different combinations of time and light intensity. If reciprocity applies, a short exposure at higher irradiance would be exactly equivalent to that of a longer test at low irradiance, provided they delivered the same radiant exposure and produced identical results [5].

For photographic film, it was found that for very short or very long exposures, or both, reciprocity fails — i.e., was not linear. However, the effect was repeatable and could be accounted for and exposures corrected. This finding was used to modernize and expand the concept of reciprocity beyond the simple linear model used in photography.

This "Schwarzschild effect" [6] can be described by a modern power law equation:

$$K = AI^p$$

where K is the rate of reaction, A is a proportionality constant, I is intensity, and p is the experimentally derived Schwartzschild coefficient (slope of line of log (K) v. log (I) plot). The Schwarzschild coefficient is sometimes referred to as a reciprocity factor.

When $p = 1$, for photochemical reactions, reciprocity is obeyed. In this case, reciprocity is a specific subset of the larger Schwarzschild equation. For $p < 1$, the rate of property change increases less than expected from the increased light intensity. However, even here the effect may be repeatable for a given material. In such cases, high irradiance testing may still be used for materials with low p values, provided an equation can be fitted to the data. As p values decrease, the test acceleration factor also decreases, thus limiting the usefulness of the high irradiance test.

Researchers at 3M Corporation's Weathering Resource Center experimentally determined p values for over 50 different materials [7]; values ranged from 0.2 to 1.12 with a mean of 0.64. Gary

Jorgensen [8], from the U.S. National Renewable Energy Laboratory, examined polyvinyl chloride (PVC) and UV-stabilized polycarbonate (PC) polymers at irradiances up to 50-sun using a solar concentrator. Values for ***p*** were 0.67 for the PVC and 1.1 for the PC over a very wide irradiance range. National Institute for Standards and Technology (USA) researchers have experimented and extensively reported on weathering photo-reciprocity [9] values for ***p***.

Non-photon degradation mechanisms (Figure 2) are a likely source of reciprocity "failure" — i.e., low ***p*** values. For example, moisture hydrolysis, oxygen diffusion and thermally influenced free radical and oxidative reactions are frequently involved in the weathering of polymeric materials.

If accelerated test data is to be used to estimate a property change under normal exposure, the mathematical relationship must be determined by correlating the results at the higher test irradiance(s). Where a mathematical relationship cannot be established, high irradiance testing will not be predictive. Therefore, determining the relationship and validating reciprocity through correlation studies should be considered a necessary step in high irradiance testing. The consequence of ignoring reciprocity effects for low values of ***p*** is to underestimate material degradation and to overestimate service life based on the accelerated test.

EMMAQUA® STANDARD	SCOPE	COUNTRY
ISO 877-3	Plastics	International
ASTM D3841	Glass-fiber reinforced polyester	USA
ASTM D4364	Plastics	USA
ASTM D4141	Coatings	USA
ASTM D5722	Coated hardboard	USA
ASTM E1596	PV modules	USA
ASTM G90	Non-metallic materials	USA
SAE J576	Optical automotive plastics	USA
SAE J1961	Automotive exterior	USA
SAE-AMS-T-22085	Preservation sealing tape	USA
JIS Z2381	General	Japan

Table 3. *Representative Fresnel solar concentrator weathering standards*

Determining Reciprocity

A harmonized method is currently being developed as a new ISO Technical Report [10] to validate reciprocity in weathering tests. In summary, exposures are conducted at the standard and increased irradiance(s). To help isolate irradiance effects from any complicating effects from heat and moisture, these are held constant as the irradiance is increased. The measured property changes are then plotted as a function of radiant exposure (the time-dependent parameter). A curve is then fitted to the graph to determine the degree of deviation (shown in Figure 3 as R^2 in a linear regression analysis where R^2 is the square of the Pearson's correlation coefficient, r).

The Pearson correlation coefficients [13] can also be calculated; a good correlation, for example, would be a Pearson correlation coefficient >0.9 per the draft ISO standard.

Note that a non-linear change to a property with radiant exposure, which is common, is not the same as a reciprocity failure. For example, Figures 4 and 5 illustrate xenon testing of two polyurethane automotive seating materials (backed by foam or fabric), and show a non-linear ΔE color change with exposure time at three irradiance levels [14].

A curve fit of the data (Figure 6) at the three irradiances for each polyurethane (ΔE versus radiant exposure) shows excellent R^2 values (Pearson correlation coefficients r >0.9) showing a high (although non-linear) degree of reciprocity; these are examples of materials validated for high irradiance testing.

The important point is that the material property change does not need to be linear with radiant exposure for the sample to obey reciprocity. These are separate concepts. Note there are other, more thorough methods for testing reciprocity than used in the simplified draft ISO approach. Deriving a comprehensive material weathering equation may require individual terms for the separate effects of irradiance, heat and moisture, etc.

Continued on next page

High Irradiance Weathering Testing, from previous page

Current Application of High Irradiance

Testing at irradiances >1-sun has been common for decades. For example, there is 20 years of experience with the Xenotest® Alpha HE and 50 years with EMMAQUA® weathering. There are many applications (Table 1) where the effectiveness of high irradiance testing has been successfully demonstrated.

As weathering technology has evolved, test standards have been trending to higher irradiance levels. There are industry and OEM proprietary tests in the automotive industry specifying up to 3-sun levels, and many standards either specify or permit high irradiance (Tables 2 and 3).

Conclusion

The true promise of high irradiance tests — quicker time to determine results, faster time to determine a material's suitability for use, shorter time to market, or higher outdoor equivalents in the same test time — may be fully realized with the application of established and straightforward techniques to establish reciprocity. While some materials may prove unsuitable for the technique, high irradiance has already proven applicable to reliably increase test acceleration for many products. ■

» To download this white paper in its entirety, go to ***http://atlasmtt.com/highirradiancepaper.***

References/Citations

[1] ASTM D7869 - 13 Standard Practice for Xenon Arc Exposure Test with Enhanced Light and Water Exposure for Transportation Coatings

[2] CIE Publication No. 20-1972 "Recommendations for the integrated spectral irradiance and the spectral distribution of simulated solar radiation for testing purposes"

[3] CIE Publication No. 85-1989 "Technical report – Solar spectral irradiance": ISBN 3 900 734 22 4

[4] Schonlein, A; Gesellschaft fuer. Umweltsimulation. (GUS)

[5] Bunsen, R.W. and Roscoe, H.E., Ann. Phys., 108, 193, 1859

[6] Rudolph Seck and Dennis H. Laney (1983). Leica Darkroom Practice. MBI Publishing Company. p183. ISBN 978-0-906447-24-6

[7] Ketola, W.; "Weathering Testing for Retroreflective Sheetings: a retro-perspective after 25 years of research," CORM 2007 Annual Conference: Optical Radiation Consensus Standards and Industry, May 8-11, 2007

[8] Jorgensen, G; et al., "Use of Uniformly Distributed Concentrated Sunlight for Highly Accelerated Testing of Coatings," in Service Life Prediction, Methodology and Metrologies, J.W. Martin and D.R. Bauer, eds., ACS Symposium Series 802, American Chemical Society, Washington, D.C. p. 11, 2002

[9] Martin, J; Chin, J; Nguyen, T; National Institute of Standards and Technology, "Reciprocity law experiments in polymeric photodegradation: a critical review," Prog. In Org. Coating 47, p. 292-311, 2003

[10] ISO/TC 61/SC 6 N 1339 Plastics – Deterministic acceleration of laboratory weathering (draft, 2013)

[11] Schulz, U.; "Accelerated Testing: Nature and Artificial Weathering in the Coatings Industry, p. 91, ISBN 3-86630-908-2, 2009

[12] Schönlein, S.; et al; GUS-Jahrestagung, Stutensee, 2013

[13] Schulz, U.; "Accelerated Testing: Nature and Artificial Weathering in the Coatings Industry, p. 162, ISBN 3-86630-908-2, 2009

[14] Jörg Boxhammer, Polymer Testing 20 (2001) 719 ff

ATLAS • SHOWS

testXpo
October 14–17, 2013
Ulm, Germany

K-Show
October 16–23, 2013
Düsseldorf, Germany
Hall 10, Booth D51

CHINACOAT
November 20–22, 2013
Shanghai, China
Hall E2, Zone 3, Booth No. 2G22

Wind Turbine Blade Manufacture 2013
December 3–5, 2013
Düsseldorf, Germany
Booth #25

in-cosmetics
April 1–3, 2014
Hamburg, Germany
Booth #G14, Hall 4

Visit Atlas' booth at these shows to learn about the latest weathering developments and how we can help advance your testing program.

For a complete list of Atlas shows, visit www.atlas-mts.com.

ATLAS • SPEAKS

testXpo – 22nd Annual International Forum for Materials Testing
October 15, 2013
Ulm, Germany

"Accelerated and High Irradiance Weathering Testing"

Presenter: Uwe Wendt, Atlas Material Testing Technology GmbH

2nd Atlas/NIST Workshop on Photovoltaic Materials Durability
November 13–14, 2013
NIST Campus
Gaithersburg, Maryland, USA

"Weather Durability Testing and Failures in Terrestrial Flat Plate PV Modules"

Presenter: Allen Zielnik, Atlas Material Testing Technology LLC

SSPC 2014
February 11, 2014
Coronado Springs Resort
Lake Buena Vista, Florida, USA

"Increasing Weathering Test Acceleration Through Higher Irradiance"

Presenter: Allen Zielnik, Atlas Material Testing Technology LLC

AMI Ltd. Conference – Polymers in Photovoltaics 2014
April 8–10, 2014
Maritim Hotel
Cologne, Germany

"The Principles of Weathering and How They Apply to Environmental Durability Testing of PV Backsheets"

Presenter: Andreas Riedl, Atlas Material Testing Technology GmbH

Atlas/NIST Workshop to Explore PV Materials Durability

Gaithersburg, MD » November 13–14, 2013

Plan now to join Atlas Material Testing Technology and the National Institute of Standards and Technology (NIST) for the 2nd Atlas/NIST Workshop on Photovoltaic Materials Durability. Scheduled for November 13–14, the event will be held at the NIST campus in Gaithersburg, Maryland.

The two-day event will focus on measurement science for assessing the durability and service lives of polymers used in photovoltaic applications. It will feature technical presentations by industry experts, a poster session, a standards discussion, and a tour of the NIST facility.

Participants will have the chance to hear from and interact with experts representing material suppliers, module manufacturers, and testing and certification companies, as well as universities and national laboratories. The workshop is a great opportunity to engage in open discussions and contribute recommendations as the industry works toward incorporating advanced research into consensus standards development efforts.

Organizing Committee

- **David Burns,** 3M
  » dmburns@mmm.com
- **Joannie Chin,** NIST
  » joannie.chin@nist.gov
- **Xiaohong Gu,** NIST
  » xiaohong.gu@nist.gov (co-chair)
- **Kurt Scott,** Atlas
  » kurt.scott@ametek.com (co-chair)
- **John Wohlgemuth,** NREL
  » John.Wohlgemuth@nrel.gov

Who should attend:

- PV module producers faced with product longevity issues
- R&D staff interested in new materials and systems for PV
- Technical standards participants engaged in transitioning R&D into PV standards
- Reliability and QA personnel tasked with maximizing longevity and durability of their products (suppliers and module manufacturers)
- Financial managers and industry executives interested in warranty considerations and return on investment calculations in their business models
- Anyone interested in understanding long-term performance issues in the PV market

To register for the workshop please visit **www.atlasmtt.com/pvworkshop.** Note: Online registration ends at 5:00 p.m. EST on November 7, 2013. This workshop will be held in English. ■

Atlas Introduces New UVTest Workshop

One-Day Sessions to Be Offered in European Locations

Responding to client requests, Atlas has developed a new one-day workshop focusing on the Atlas UVTest Fluorescent/UV instrument. This hands-on training course is designed for instrument operators, quality assurance and control personnel, laboratory technicians, and anyone who is responsible for equipment operation, calibration, and maintenance.

Instructors will guide workshop participants through the fundamentals of operation, calibration, and maintenance of the UVTest instrument. Whether you are a new or experienced operator, this course will give you the skills to keep your test equipment operating longer and in specification.

The workshop combines hands-on training and theory to replicate a real-world experience as closely as possible, including providing valuable information on standards and addressing frequently asked questions.

Program » The UVTest Workshop builds in a considerable amount of time for working on the instrument. This hands-on format encourages participation and ensures that each student becomes comfortable with the UVTest, its components, and its operation.

Theory » Detailed lectures will provide participants with the basics needed to optimize the reliability of the test equipment and the reproducibility of test results: installation requirements, control circuits of the test parameters and fluorescent lamps, calibration procedures, and trouble-shooting.

Course Locations and Tuition » The UVTest Workshop will be offered in various European locations, including Atlas laboratory facilities. Courses will be conducted in different languages, depending on the location. Tuition for the workshop includes refreshments and lunch as well as all course materials. Hotel accommodations are not included, but Atlas can assist with reservations if needed. Due to limited space for each seminar, advance registration is required. ■

For details on this workshop and other Atlas course offerings, visit ***http://atlasmtt.com/courses*** *or contact us at atlas.info@ametek.com.*

Keep Your Team Up to Date!

Atlas' education and training solutions will help you and your staff master the skills now needed to develop long-lived products in shortened development cycles. Our programs are designed for all levels to ensure that everyone on your team understands the fundamentals of weathering and how to operate our instruments. For the latest schedules and locations, visit www.atlas-mts.com or e-mail atlas.info@ametek.com.

Fundamentals of Weathering I	October 29, 2013	Borås, Sweden	Presented in English
	November 13, 2013	Magdeburg, Germany	Presented in German
	November 14, 2013	Paris, France	Presented in French
Fundamentals of Weathering II	October 30, 2013	Borås, Sweden	Presented in English
	November 14, 2013	Magdeburg, Germany	Presented in German
	November 15, 2013	Paris, France	Presented in French
SUNTEST® Workshop	November 7, 2013	Linsengericht, Germany	Presented in German
Xenotest® Workshop	November 5–6, 2013	Linsengericht, Germany	Presented in German
UVTest Workshop	December 11, 2013	Linsengericht, Germany	Presented in German

Right Light™ Technology: A Better Match to Sunlight

Inside view of Ci Weather-Ometer®

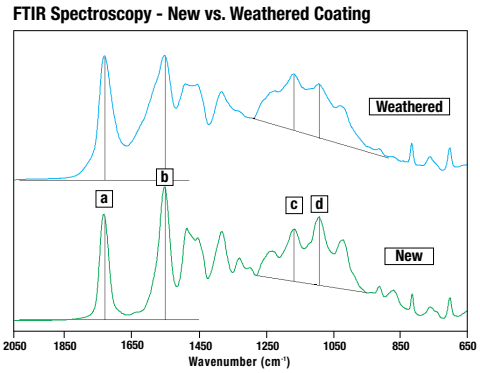

Figure 1

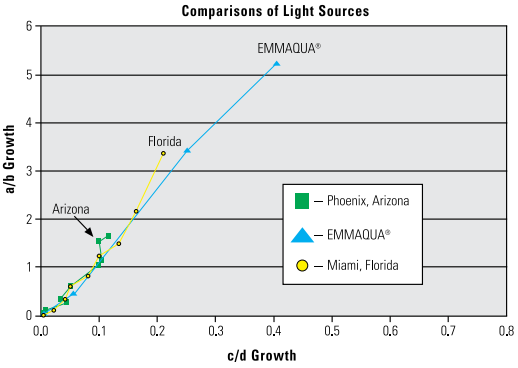

Figure 2

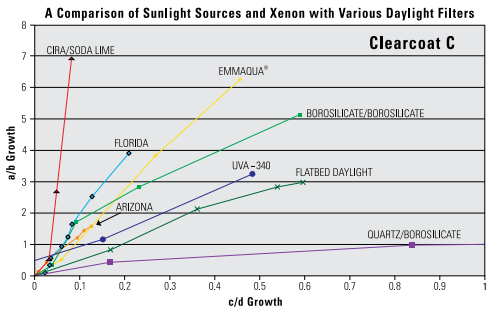

Figure 3

Introduction

Since its commercialization, the Atlas Right Light™ xenon filter system has been mentioned in a number of different media that describe its basic concept and attributes for laboratory weathering tests. The features detail how Right Light provides a very close match to natural sunlight in the short wavelength UV, which is very important in obtaining good test results and which have led to its adoption in at least one major international automotive weathering standard, ASTM7869-13, "Standard Practice for Xenon Arc Exposure Test with Enhanced Light and Water Exposure for Transportation Coatings."

This may be the beginning of a trend, because the full merits of the Right Light can be equally applied to other products and in other international standards. To that end, it may be helpful to briefly recap the Right Light story:

Motivation and Method

Ford Motor Company's challenge to Atlas to "get the light right" began an effort that led to an unprecedented three-way development partnership between Ford, Atlas, and Atlas' technical glass supplier, Schott. The mission: To develop the "perfect" xenon lamp filter for matching laboratory instrumental and outdoor weathering test results.

To objectively identify the "right light," Ford proposed the use of a method it had developed that uses Fourier Transform Infrared (FTIR) spectroscopic measurements to describe the chemical changes occurring in an automobile coating being weathered. The coating used was thoroughly evaluated and selected for its sensitivity to UV spectral distribution.

As photo-degradation of the coating occurs, the shifts in values at the critical FTIR peaks — identified as a, b, c, and d in Figure 1 — are used to chart the quality and quantity of chemical changes that occur. Plotting the ratio of the values of the ordinate and abscissa, as shown in Figure 2, gives a quick visual indication of whether any compared exposures are similar. Based on the premise that similar chemical changes can only be induced by similar photo-degradation, and by extension similar UV light, the procedure consequently may be used to identify similar light exposures — or, even more useful, to identify laboratory light sources used in weathering tests that are sufficiently close to sunlight.

The method was vetted by correctly demonstrating that Miami, Arizona, and EMMAQUA® (concentrated sunlight) — basically small variations of sunlight (Figure 2) — are similar enough in the UV cut-on range, for the purposes of weathering tests, and conversely showing with impressive sensitivity that a number of laboratory light sources commonly used to simulate daylight are, in fact, significantly different from sunlight (Figure 3).

Utilizing the Method as a Development Tool

This Ford method was used by the three-way partnership mentioned above as a tool in the development of the Right Light. When compared to other

commonly used daylight filters, Right Light produced by far the closest results to those obtained with real sunlight (Figure 4; compare to Figure 3). A semi-log plot of spectral power distribution (SPD) of xenon filtered by conventional daylight filters, and Right Light versus sunlight, confirms the excellent match of Right Light and sunlight indicated by the method's results (Figure 5). The Right Light by itself produces the appropriate xenon filtering to provide a sunlight match, thus, it is used in combination with the neutral (non-selective) quartz filter.

Additional Benefits

The Right Light/Quartz filter combination has sharp and steep UV transmittance cut-on. This high UV transmittance efficiency produces 15% greater throughput at 340 nm than a new Type S Borosilicate/Type S Borosilicate combination. This greater efficiency is beneficial in a number of ways:

- Fifteen percent less power is required to run the same irradiance level, reducing overall operating costs. Since Right Light ages negligibly, this cost savings increases over time, compared with other conventional filters that decline with age.
- Lower lamp power means less near-infrared output to the test chamber, expanding the available temperature operating range and lowering the fan speeds needed to maintain BPT/BST temperatures.
- Lower fan speeds exhaust less warm air from the instrument, resulting in lower laboratory air-conditioning costs.
- Higher irradiance may be achieved at an instrument's power limit, resulting in the extension of the instrument's operating range.

The Sealed Lamp Opportunity

An important additional benefit of the Right Light is its non-solarizing property. Numerous aging studies show that it remains virtually unchanged with use (Figure 6), lasting at least as long as the xenon lamp itself and eliminating the need to change out filters after some usage. Atlas now has the ability to provide the combination of lamp and filter into one maintenance-free sealed lamp assembly (Figure 7). ■

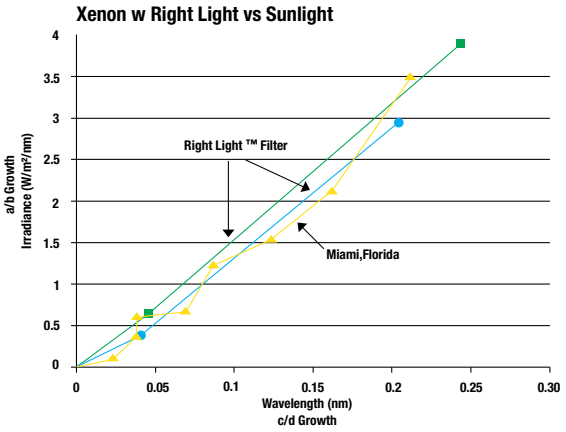

Figure 4

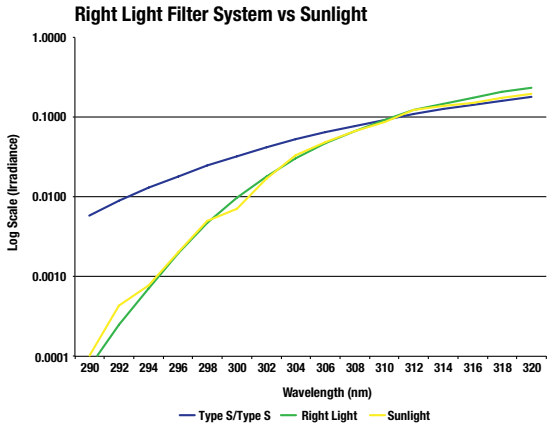

Figure 5

Figure 7: Atlas Sealed Lamp

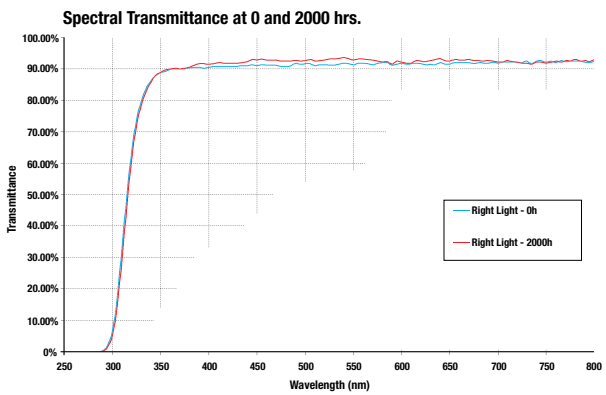

Figure 6

Atlas Launches Xenotest® 440 — Fast, Economical, Versatile

The new Xenotest 440 can reduce lamp operating costs by 30% or more

XenoLOGIC™

Only companies that can quickly bring superior products to market are able to survive today's globally competitive environment. For this reason, accelerated weathering testing using high irradiance levels has become an important need in product development. The new Xenotest 440, Atlas' latest air-cooled xenon test chamber for accelerated weathering, addresses this need.

Designed for fast and economical testing, the Xenotest 440 utilizes XenoLogic™, a revolutionary new twin-lamp operating technology that enables the instrument to achieve high irradiance levels of 120 W/m^2 of total UV radiation. By testing at higher irradiance levels, test times can be significantly reduced compared to standard weathering tests.

In addition to its high irradiance functionality, XenoLogic provides another significant advantage — extended lamp service life. How does it work?

XenoLogic continuously synchronizes the two 2200W xenon lamps inside the chamber at the lowest possible stress level, which leads to optimized lamp service life and maximized light efficiency. With this new technology, the two xenon lamps combined can last over 4000 hours under standard testing levels of 40-60 W/m2. This increases instrument uptime and reduces lamp operating costs by 30% or more.

The Xenotest 440 test chamber provides exceptional capacity for an array of materials and sizes:

- 38 narrow (13.5 x 4.5 cm) test positions suitable for textiles, leather, or paper specimens
- 33 wide (10 x 6.8 cm) test positions suitable for plastics, paints, and coatings specimens
- 22 wide & long (13.5 x 5.5 cm) test positions suitable for technical textile/automotive interior specimens
- 19 or 11 extra long test positions suitable for technical textiles/plastics specimens

With wide-ranging testing capabilities as well as material-specific specimen handling, the Xenotest 440 is designed to cover the most commonly used industry standards (e.g., ISO, ASTM), making it one of the most versatile instruments available.

The Xenotest 440 sets a new standard for economical, mid-sized air-cooled xenon devices by combining new XenoLogic lamp operating technology for extended lamp service life with efficient design including ultrasonic humidifiers to reduce water consumption. ■

For more information about the new Xenotest 440, please visit www.atlas-mts.com or contact us at atlas.info@ametek.com.

Accredited LS-200 Full Spectrum Monitoring Service Now Available

About a year after launching the LS-200 Full Spectrum Monitoring device, Atlas has expanded its technical support offerings to include LS-200 monitoring services.

The LS-200 is specifically designed for use in Ci Series Weather-Ometers, to precisely measure the spectral power distribution (SPD) output of the xenon lamp. The LS-200 enables customers to verify that their Weather-Ometers meet the SPD requirements of their test standards at a fraction of the cost of a fully equipped spectroradiometer.

While indirect methods of judging aging characteristics exist (such as wattage increases, ratio of different wavelength monitoring points, and evaluating standard reference materials), the only way to accurately verify the SPD is to take a direct measurement.

Once calibrated by Atlas, this device has excellent correlation to the spectroradiometers used in our Calibration Laboratory. The LS200 can be used in multiple units and in any generation Weather-Ometer.

Since smaller laboratories may not want to commit to the purchase of an LS-200 for just a few measurements per year, Atlas' Technical Service team now offers LS-200 measurements as a service. They can inspect and verify the spectral power distribution of your Weather-Ometer as a part of a scheduled maintenance or repair visit. This LS-200 measurement has been added to our ISO 17025 scope of accreditation.

The results of the measurements can be provided in two ways:

- Standard – Data is supplied from the measurement. The customer is required to perform the analysis to determine compliance to the relevant test method.
- Deluxe – Data is supplied from the measurement and input to a table that analyzes compliance to the relevant test method. A certificate of conformance is provided.

For more information on acquiring the LS-200 for your lab, or if you are interested in the LS-200 measurement service, please contact us at atlas.info@ametek.com. ■

Atlas UK Lab Receives ISO 17025 Re-Accreditation

Atlas' laboratory in Leicester, UK — which conducts performance and load testing — recently received re-accreditation to ISO 17025 by the United Kingdom Accreditation Service.

The Leicester laboratory specializes in accelerated weathering and lightfastness testing of plastics, paints and coatings, sealings, rubber, automotive exterior and interior materials and components, printing inks, glues, anodized aluminum, and non-metallic materials. The lab features a variety of xenon, fluorescent and carbon-arc weathering devices that meet most accelerated test methods from corporate, national, and international standards organizations.

Having a flexible accreditation, the facility is able to perform all related tests based on parameters in its scope of accreditation. The lab also provides evaluation services that include gloss measurements, instrumental color, and visual evaluations. With more than 20 different weathering devices and a highly skilled staff, the Atlas laboratory in Leicester provides the highest level of service and quality.

Please contact Jo Snow-Tyler at +44 (0) 116 2462930 or jo.snow-tyler@ametek.com with any questions or to request a quotation. ■

SunPower Solar Panels Earn Unprecedented Reliability Rating with Atlas 25+® Program

Tests Show Less than 2 Percent Power Loss

SunPower Corp., a leading solar technology and energy services company, received confirmation of its product quality recently after its high-efficiency SunPower® E20/327 Solar Panel underwent the rigorous Atlas 25+ Comprehensive PV Durability Testing program. Upon completion, the SunPower panel showed less than 2 percent power degradation — an outstanding result. A certificate was issued by Atlas' partner, SGS, the world's leading inspection, verification, testing and certification company.

> "Our Atlas 25+ third-party testing program replicates the harsh weather conditions that solar panels will undergo during their lifetime."
>
> » *Richard Slomko*
> *Global Testing Manager*
> *Atlas Testing Services*

The Atlas 25+ testing protocol includes long-term environmental exposure that requires modules to have less than 8 percent degradation over the testing period in order to receive SGS certification. In addition to achieving less than 2 percent power loss, the SunPower E20/327 Solar Panel also passed two additional criteria: no visual aesthetic changes and no change in electro-luminescence.

"Our Atlas 25+ third-party testing program replicates the harsh weather conditions that solar panels will undergo during their lifetime," said Richard Slomko, global testing manager at Atlas Testing Services. "We are pleased that SunPower's solar panels not only withstood these conditions, but well exceeded the power degradation criteria in addition to testing well on all criteria."

Atlas 25+ is a proprietary multi-dimensional durability test program designed to subject photovoltaic modules to the environmental degradation stresses that can be expected over long-term service. It provides manufacturers with the data they need to demonstrate long-term durability and to support warranty and performance claims while reducing the costs associated with aftermarket product failure.

The program exposes solar panels to a series of stresses, including UV-A/UV-B exposure, salt spray corrosion, condensing humidity, solar/thermal humidity cycle, solar/thermal humidity freeze cycle, Arizona and Florida solar tracking — including peak summer — and initial, final and multiple interval measurements.

"SunPower produces the most reliable solar panels. The results of the demanding Atlas 25+ testing criteria confirm our position," said Tom Werner, SunPower president and CEO. "We want to provide our customers with third-party validation of the efficiency and reliability of our solar technology. We are pleased and honored to be the only solar company to date to receive this test's highest rating." ■

Atlas Website Now Offered in Chinese

Visitors to the Atlas website can now view site information in Chinese. The translated content is available either by selecting the newly added language on the home page or by going directly to the Chinese language site at www.atlas-mts.cn.

Through its parent company AMETEK, Atlas now has offices in Shanghai, Beijing, Guangzhou, and Chengdu, along with several remote locations throughout China for both sales and technical support.

By taking the step to translate its website into Chinese, Atlas aims to provide the Chinese market easier access to the innovative weathering testing products and services the company provides.

For local support in China, please contact Stephanie Wang at atlas.sales@ametek.com.cn.

Atlas' HVFAA and HMV Chambers

Atlas Launches Flammability Landing Page

Atlas' new Flammability Landing Page is now live at **www.flammability.atlas-mts.com**. The page focuses exclusively on Atlas flammability chambers — the HVUL2, the HVFAA, and the HMV.

The risk of uncontrolled flammability must be avoided for a variety of products and materials across numerous industries. Atlas' flammability instruments provide unmatched accuracy, repeatability, and safety when performing qualification testing to determine the burn rates and resistance of products.

The landing page offers visitors:

- A brief overview of flammability testing products and solutions
- A convenient contact form to request further information
- A quick link to Atlas' corporate website

For more information about Atlas flammability testing equipment, visit www.flammability.atlas-mts.com or contact us at atlas.info@ametek.com.

New Accelerated Weathering Page Goes Live

Atlas is happy to announce that our Accelerated Weathering Landing Page — at **www.accelerated-weathering.com** — is now live.

The new page helps visitors understand the meaning of "weathering" as well as the various types of weathering testing that can be performed. It also emphasizes the importance of weathering and offers key reasons for testing, regardless of the industry.

The landing page offers:

- Detailed, easy-to-understand descriptions of various types of weathering testing available for those new to the field
- A convenient contact form for requesting further information on Atlas weathering testing instruments and services
- A quick link to the Atlas corporate website, where more detailed product and service information can be found

For more information about Atlas weathering testing equipment and services, visit www.accelerated-weathering.com or contact Atlas directly at atlas.info@ametek.com.

SKZ Uses Atlas Weather-Ometer® to Measure Impact of Surface Temperature on Plastics

SKZ, one of Europe's leading accredited and certified quality assurance institutes, has launched a research project to better predict the impact of surface temperature on the weathering behavior of plastics.

A critical factor in the project is the differing surface temperatures of plastic specimens in natural weathering compared with accelerated laboratory weathering. To better understand this, SKZ has enlisted Atlas Material Testing Technology.

To improve the comparison of laboratory and outdoor exposures, specimen surface temperatures need to be measured and taken into account during laboratory weathering. To accomplish this, SKZ has incorporated the Ci4000 Weather-Ometer® with its new Specific Specimen Surface Temperature System™ (S^3T) from Atlas into its project. The Ci4000 Weather-Ometer continuously reads specimen surface temperatures with a pyrometer and assigns a measurement to the respective specimen via an RFID tag. Each specimen's weathering behavior is characterized by color and physical properties.

By including surface temperature measurement into the predictive model, artificial laboratory weathering is better correlated with natural, outside weathering. The weathering sequences are then analyzed and described with a modified Arrhenius model.

The S3T system provides users with the specimen temperature information that is critical to determining a material's service life. The new system can be used in a wide range of test standards with different temperature, irradiance, and humidity set points. ■

For more information on S^3T technology, please contact us at ***atlas.info@ametek.com****.*

Atlas/KHS Announces Partnership with MESSRING

Lighting Technology Collaboration to Better Serve Customers

The Atlas company KHS Technical Lighting, a leader in the development of technical lighting solutions for over 35 years, has entered into an exclusive alliance with MESSRING Systembau GmbH. The partnership will offer existing and new customers more comprehensive lighting system solutions from a single source — and guarantee the highest quality service worldwide.

Atlas/KHS has many years of experience in the custom design and manufacture of high-speed lighting systems with a special focus on hydrargyrum medium-arc iodide (HMI) lighting technology. MESSRING brings more than 40 years of experience in the design and development of crash-test facilities, components, and data-acquisition systems. Since the introduction of MESSRING LED floodlights in 2012, Bavaria-based MESSRING has established itself as a leader in developing lighting for crash-test scenarios.

Accurate lighting equipment plays a key role in precisely recording and reproducing crash-test scenarios, especially those meeting stringent international testing regulations. The Atlas/KHS-MESSRING partnership will greatly increase the availability of high-efficiency lighting systems tailored to the specific requirements of the latest active and passive safety testing scenarios. From proven and tested HMI lighting to the latest LED technology, the partnership will offer solutions tailored to each customer's individual spatial conditions, testing requirements, and budget.

The addition of the latest LED technology enables Atlas/KHS to expand its product offerings, while MESSRING broadens its spectrum of reliable crash-test facilities, components, data-acquisition systems, and control technology.

"We are extremely pleased about this new partnership agreement," says Martin Welling, division vice president at Atlas/KHS. "It fully meets the needs of our existing customers and will surely attract new joint customers."

"Experience and customized solutions are critical in our industry," adds MESSRING CEO Dierk Arp. "One of the best things about this partnership is that each company will continue to focus on its core strengths, yet, when a project demands, each can transfer specific aspects of the project to the other partner, offering technical and economic benefits to each partner and its respective customers." ■

KHS high-speed lighting system

MESSRING's new M=LIGHT LED floodlight technology

For more information about KHS Technical Lighting products, visit ***www.khslight.com*** *or contact us at atlas.info-khs@ametek.de.*

To contact Messring Systembau GmbH, visit ***www.messring.de***.

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