ATLAS
MATERIAL TESTING SOLUTIONS

SunSpots

Material Testing Product
and Technology News

Volume 33
Issue 70

Fall 2003

What Makes a Xenon Weathering Instrument High-end?

by Dipl.-Phys. Andreas Riedl
Product Manager, Weathering Instrumentation Products
Atlas Material Testing Technology GmbH

Causality and Precision

Equal causes have equal effects.
Similar causes have similar effects.

The first sentence is known as the principle of weak causality. Its nature is theoretical because it is very unlikely that you'd find two identical sets of causes in the universe. More interesting for testing technology is the second one, the principle of strong causality. As long as a system does not show chaotic behavior, this principle is valid and is the prerequisite for all experimental science and classical statistics. It leads to the basic requirement for any sophisticated test method: **Keep all influencing factors under control as tightly as possible!**

Continued on page 5

Colour Fastness Tests

by Diplom Ingenieur (FH) Hermann Ulshöfer
Head of Product/Analysis Testing, Business Unit Textile Dyes
Clariant (Switzerland) Ltd.

Colour fastness means the resistance of the colour of dyeings or prints on textiles to various types of influences to which they are subjected during production or in use. In December 2002, Clariant (Switzerland) Ltd. dedicated a publication to this topic, titled "Colour Fastness Tests," which I wrote.Colour fastness is not necessarily a favourite topic of textile processors, but is quite often an essential part of their daily business. Therefore, this publication intends to provide an overview of existing test methods and their application from a user's standpoint. It is divided into four sections, dealing with General Principles (ISO 105-A series, etc.), Light and Weather Fastness Properties (ISO 105-B series, etc.), Washing Fastness Properties (ISO 105-C series, etc.), and Other Fastness Properties (ISO 105—C to Z series, etc.).

Continued on page 10

Weiss Technik partnership to expand Atlas' product offerings, page 18

In This Issue

Atlas Test Instruments Group

XenoCal Coming to a Ci Model Near You

Atlas is pleased to announce that a XenoCal will be available for the Ci3000+, Ci4000, and Ci5000 Weather-Ometers. The XenoCal has successfully been used in Atlas Xenotest air-cooled instruments for years, and after an in-depth study, Atlas Controlled Irradiance (Ci) water-cooled instruments will also be able to use this completely independent calibration device.

XenoCal Consists of the Following:

- The sensor face, a quartz dome housing a white diffusion disk, a filter, and a photodiode behind the disk;
- The battery compartment housing a very special lithium battery for supplying power;
- An RS232C interface port for transmitting accumulated data to a PC; and
- A rugged, aluminum exterior and stainless steel covering for protecting the XenoCal during operation inside an instrument.

The XenoCal is installed on the rack inside the instrument. The instrument is then turned on, and radiation begins to fall on the diffusion disk. The wavelengths specified by the type of XenoCal pass through the filter and are converted to electrical current. These time specific current values are stored in the XenoCal's memory. When the calibration cycle is completed, the XenoCal is removed and the data is downloaded to a PC. Using XenoSoft user software, the calibration data is displayed in a chart that shows the continuous irradiance values at the time the readings were taken.

The new XenoCals will be available for order in the first quarter of 2004.

Each XenoCal is lightweight, easy to handle, and stored in a rugged, shock-resistant carrying case. Atlas will begin offering 300–400 nm and 340 nm XenoCals in the first quarter of 2004. For more information regarding the XenoCal, please contact your local sales representative.

Touch Me!

Programming and making changes to your weathering test program now requires only the light touch of a fingertip!

Atlas is pleased to introduce a new, even more user-friendly face for the Xenotest® Beta:

- A modern touch screen makes operation simple
- The large color display not only presents the status of your test program, but graphically displays the process of your test parameters as well
- Using memory chip interface, you may upload data directly to your test equipment or download instrument or test data for further processing on your computer (unless you do not want to use the RS232 or USB interface)
- Transmitting the measured values of modern sensors digitally—in the XenoCal, for example—makes the data transfer “immune” against possible sources of interference in the lab, like electromagnetic radiation or radio signals

The new user-friendly touch screen uses the latest state-of-the-art technology. Try it for yourself at the FAKUMA 2003 show in Germany, October 14–18: Hall A6, Booth # 6207.

Mark Your Calendar for PPS’04

The Photostability of Drugs Interest Group and the Academy of Pharmaceutical Sciences invite you to attend the 5th International Conference on Photostability of Drugs and Drug Products (PPS’04), sponsored by Atlas Material Testing Technology LLC.

Papers will be presented on photochemistry and photophysics of drugs, photostability, light protection of drugs, formulation of photosensitive drugs, the ICH Guideline (experience and status), and related topics such as photobiological tests and sunscreen preparations.

The meeting will start with a one-day short course on the basic principles of photostability testing, where Atlas will take an active part, and it will be followed by a two-day scientific conference with presentations and poster exhibits. Vendor exhibitions will also be offered throughout the entire conference.

The meeting will be held at the Royal Pharmaceutical Society of Great Britain, London, England, on **June 14–16, 2004.** Please visit www.photostability.org or e-mail info@photostability.org for a complete packet of information.

The Atlas SUNTEST XLS+

ITMA 2003

Birmingham will be this year’s host for the biggest textile machinery exhibition in the world, ITMA. Over the past 30 years this show rotated among Hannover, Milan, and Paris, respectively.

The textile industry has always been a major market for Atlas; the history of lightfastness is linked to dyes and textiles starting with the Carbon Arc instruments in the U.S. during the ’20s, and with Xenon Arc in Europe in the ’50s.

The textile industry has grown tremendously during the last decades. Manmade fibers have been developed, sophisticated production technologies have been supported by fully automated machines, and high-level quality standards have been reached. From the beginning, Atlas was involved in the standardization of testing procedures developing the corresponding instruments. For example, today many AATCC test procedures are based on Atlas equipment like AATCC Launder-Ometer® and the AATCC Crockmeter.

In the field of accelerated light- and weatherfastness of textiles, Atlas is the industry leader offering a variety of different instruments like Ci Series Weather-Ometers and Xenotest products. Atlas instruments have helped textile manufacturers achieve a high level of stability in technical textiles and automotive textiles.

Atlas is proud to be exhibiting at ITMA 2003. We can be located in Hall #5, Booth #T5-34M. ITMA will be the first international showcase of the newly formed SDL Atlas, the single source for all of your textile needs.

AtlasShows

2003

IFAI 2003
October 1–3
Las Vegas, Nevada, USA

FAKUMA
October 14–18
Friedrichshafen, Germany

ITMA 2003
October 22–29
NEC
Birmingham, England
Hall 5,
Booth #T5-19D

Test Expo 2003 North America
October 29–31
Novi Convention Center
Novi, Michigan, USA
Booth #5016

FSCT ICE 2003
November 12–14
Philadelphia, Pennsylvania, USA
Booth #602

RICH-MAC
November 25–28
Milan, Italy

2004

Maquitex
February 12–15
Porto, Portugal

SAE 2004
March 8–11
Cobo Hall
Detroit, Michigan
Booth #711

Surface Technology
April 19–24
Hannover, Germany

Eurocoat
May 11–13
Rimini, Italy

ANTEC
May 16–20
Navy Pier
Chicago, Illinois

ITM 2004
June 1–6
Istanbul, Turkey

Quality Expo
June 9–10
Novi Convention Center
Novi, Michigan

PPS'04
June 14–16
London, United Kingdom

K' Show
October 20–27
Duesseldorf, Germany

Pack Expo
November 7–11
McCormick Place
Chicago, Illinois

*For the latest on Atlas shows and presentations, visit **www.atlas-mts.com.***

AtlasCommitment to Education

2003

Fundamentals of Weathering I*
November 5
Oensingen, Switzerland

November 14
Research Triangle Park, North Carolina, USA

November 18
Germany

Weather-Ometer® Workshops

Atlas Weathering Services Group South Florida Test Service, Miami, Florida, USA:
October 20
Ci4000/Ci5000 Weather-Ometer® Workshop

October 21–22
Ci35/Ci65 Weather-Ometer® Workshop

October 23
Advanced Ci35/Ci65 Weather-Ometer® Workshop

Duisburg, Germany:
November 12–13
Ci Weather-Ometer® Workshop

Fundamentals of Weathering II*
November 6
Oensingen, Switzerland

November 19
Germany

Xenotest Workshop
November 24–25
Linsengericht, Germany
(German language)

Registration information and workshop/seminar brochures are available online at www.atlas-mts.com or from Theresa Schultz, Client Education USA, +1-773-327-4520, tschultz@atlas-mts.com, or Bruno Bentjerodt, Client Education Europe, 0049-(0)6051-707-245, bbentjerodt@atlasmtt.de.

* *Effective immediately, if you attend any Fundamentals of Weathering course and purchase an Atlas Weather-Ometer® within 12 months, Atlas will reimburse you for the full value of the seminar. Offer good on all Atlas Ci models and Xenotest Alphas, Betas, and 150 S+ models.*

For more information, please contact your local Atlas representative.

AtlasSpeaks

2003–04

2003 LASCT PIC Conference PAINT * INK * Coatings
October 2, Los Angeles, California USA

Allen Zielnik, Atlas Material Testing Technology LLC, will present "Key Concepts in Coatings Weatherability."

Machine/Media Match Tiara Group December Meeting
December 7–9, San Diego, California USA

Mark Chomiczewski, Atlas Material Testing Technology LLC, will speak on testing standards and test equipment for image permanence.

3rd International Symposium on Service Life Prediction
February 1–6, Sedona, Arizona USA

Kurt Scott, Atlas Material Testing Technology LLC, will present a paper titled "Next Generation Light Controls for Weathering Devices." Kelly Hardcastle, Atlas Weathering Services Group, will present a paper on "A New Approach to Characterizing Weathering Reciprocity."

Weathering Instrument, from page 1

The **quality** of a given test method, here any *weathering test method,* is generally described by the term "precision," which includes the following two elements, often shortened to R&R:

Repeatability: "Ability of a single test to produce the same result in replicate specimens of a material exposed simultaneously in a single device"

Reproducibility: "Ability of a test to produce the same result in replicate specimens exposed in identical devices in separate laboratories each running the same test

Sometimes "Reproducibility" is extended to different types of instruments in separate laboratories.

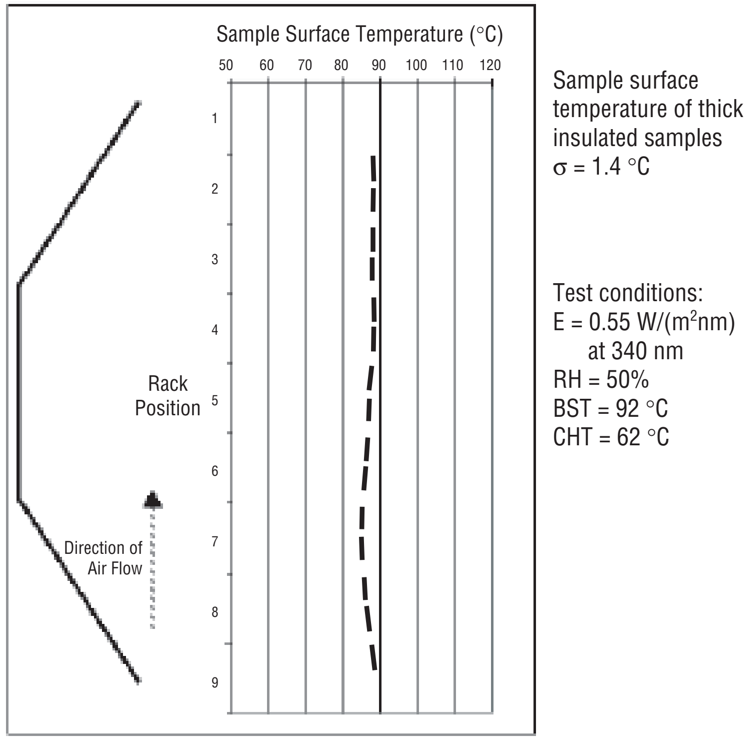


Figure 1: Uniformity of parameters on inclined three-tier rack

Test Method: Weathering Instrument

Today, weathering test methods are described by so-called performance-based standards. These documents have to cover a variety of different instruments, often including old or technically inferior types of devices. Very often this leads to different sets of exposure conditions—e.g., one with and one without control of a specific weathering parameter. Sometimes the tolerances are so wide that two users are able to meet the same performance-based standard by using two different types of instruments and selecting different set points for several test parameters. Although both are meeting the same standard, they are actually performing different tests.

In weathering technology, a test method is closely connected to the instrument in which the exposure is performed. Therefore the quality of a test method cannot be separated from the quality of the weathering instrument that is used. Later on we will define quality criteria for weathering testing, and we will see that R&R are not the only relevant aspects.

But let's get back to the basics. What is weathering testing? Looking at the variety of light sources, the huge number of different exposure conditions, and the various devices that are called weathering instruments, we should start by defining the goal of weathering testing: "To investigate the response of a material, component, or product to the influence of weather either directly or indirectly (the latter means through glass, e.g., in a car, house, or store)."

In dealing with a well-known and pure chemical substance, a researcher might use analytical methods that employ mercury lamps, lasers, or other equipment to excite certain molecules for subsequent analysis of reaction kinetics or chemical reaction products. But in general, a researcher does not know the whole complexity of his material including all impurities, not to mention their interaction. Therefore we have to take the **experimental approach:** Simulate and control the main weathering parameters as well as possible and rely on the principle of strong causality. The better a weathering instrument does this, the more sophisticated the test method—and the higher the value of this test for the user. This shows in a very simple way that the quality of the weathering instrument is the crucial factor.

Continued on next page

Weathering Instrument, from previous page

Xenon High-end Versus Xenon Low-end

Many different exposure instruments are used within the global weathering community with significant variations in capability and quality. Now, imagine arranging all available types of instruments on a linear vertical scale. Put the very simple instruments at the bottom (the "low end" of the scale) and proceed with increasing capability upward until you reach the most sophisticated types. Let's call the upper region of our scale "high-end." You might argue that this model is too simple, and that we need three, four, or five more dimensions—e.g., price, sample capacity, etc. However, as "quality" is in most cases expressed as a one-dimensional—or "scalar"—quantity, we should be allowed here to restrict ourselves to one dimension.

Our goal is to define a high-end weathering test or high-end weathering instrument. This does not mean that high-end is required for each and every application.

Some technologies are undoubtedly low-end because they are violating the basic principle of the experimental approach as explained earlier. This applies to all carbon-arc, mercury lamp, and fluorescent bulb testing. These light sources deviate too much from the photochemically active ultraviolet (UV) and visible (VIS) solar spectral power distribution (SPD) to be accepted as a proper simulation.

The xenon long-arc, when properly filtered, simulates UV and VIS solar radiation more closely than any other artificial light source. Therefore, we will confine our considerations to this kind of light source.

What Makes a High-end Weathering Test?

It goes without saying that R&R are important. But what else has to be added to our list of criteria to characterize a sophisticated weathering test? Certainly, the test should provide acceleration compared to end-use conditions, as one of the experimenter's goals is to receive information about the long-term weathering behavior of his samples as quickly as possible. In addition, the aging behavior of the samples in an accelerated test should correlate to the effects that are observed in real-world exposure. We end up with the following essential requirements for advanced weathering testing:

- **C**orrelation
- **A**cceleration
- **R**epeatability
- **R**eproducibility

All four of these criteria, which we will call **CARR** criteria, must be satisfied in a balanced way. That implies that raising one of the four might lead to a decrease of another. For instance, the possibility for accelerating a test is in general limited by the need for good correlation to end-use exposure, and vice versa.

What Makes a High-end Weathering Instrument?

A high-end weathering instrument must ensure that all four **CARR** criteria are fulfilled as completely as possible, i.e., "according to the present state-of-the-art." Fifty years of experience in xenon testing has shown that the following requirements are essential for a present high-end instrument to fulfill the CARR criteria:

1) Simulation of all main weathering parameters
2) Uniformity on sample level
3) Control of all main weathering parameters
4) Calibration of all controlled parameters

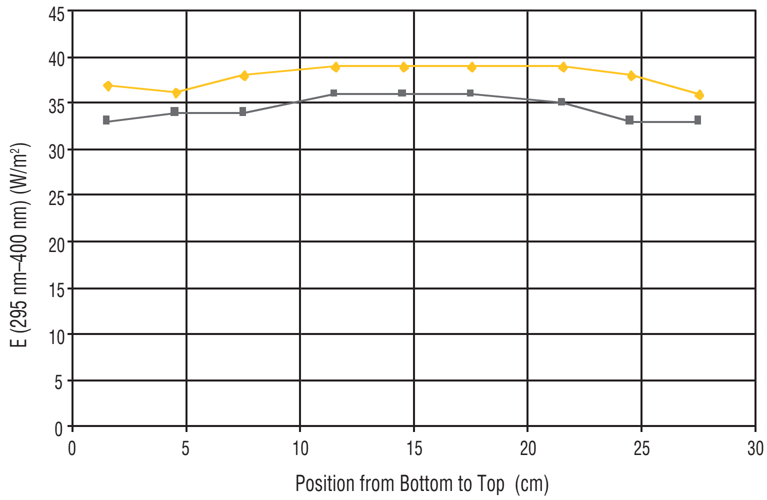
The main weathering parameters are radiation (spectral power distribution and irradiance), heat (surface temperature and air temperature), and moisture (humidity, rain, or dew).

State-of-the-art high-end instruments simulate solar radiation using advanced, stable filter systems and specially designed xenon lamps. Of course, all lamp types for Atlas xenon instruments have been developed exclusively for this application and are meeting high performance criteria with regard to their spectral power distribution, long-term stability (lifetime), and lot-to-lot uniformity. In contrast, there are low-end xenon instruments on the market that merely use commercial lamps sold for mass applications, such as photocopy devices. Using a simple photocopier lamp in a weathering instrument is like using heavy fuel oil in a racing car—no chance for a pole position.

Besides an advanced lamp-filter system, high-end xenon instruments are equipped with sophisticated sensors to measure and control irradiance (E). State-of-the-art humidification systems, capacitive humidity sensors, and smart hardware and software for control of relative humidity (RH) of the chamber air are also employed.

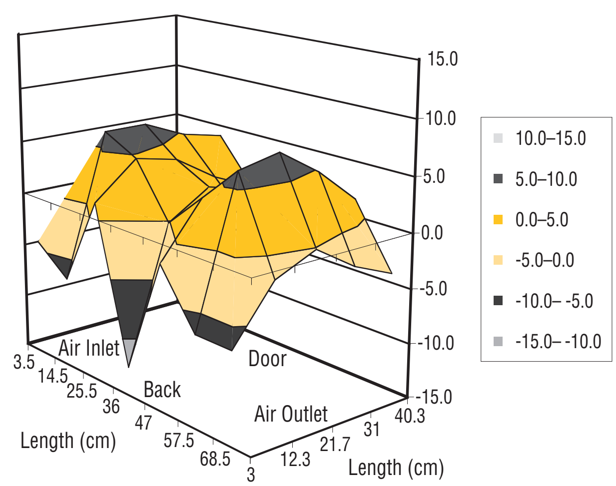
Temperature is the second most important weathering parameter besides radiation. For best R&R, it is essential to measure and control both black standard or black panel temperature (BST/BPT) *and* chamber air temperature (CHT). Some types of low-end instruments on the market ask the operator to select one of the two temperatures for control and do not provide any means to adjust the other one—e.g., by variation of the air speed. The absence of this important feature automatically excludes these devices from the premier league.

The necessity of calibrating all sensors in a weathering instrument to measure and control exposure parameters goes without saying, although there is potential for improvement in certain state-of-the-art calibration procedures.



Rotating rack (90° shifted)
E (300 nm–400 nm) = 38 W/m^2
Maximum deviation: - 5%; + 3%
Standard deviation: 3.3%

Pos. 1
Pos. 2



Static flatbed with 3 lamps
E = 0.68 W/(m^2nm) at 340 nm
Maximum deviation: ±10%

Figure 2: Uniformity of irradiance (E) in a rotating rack instrument compared to a flatbed device

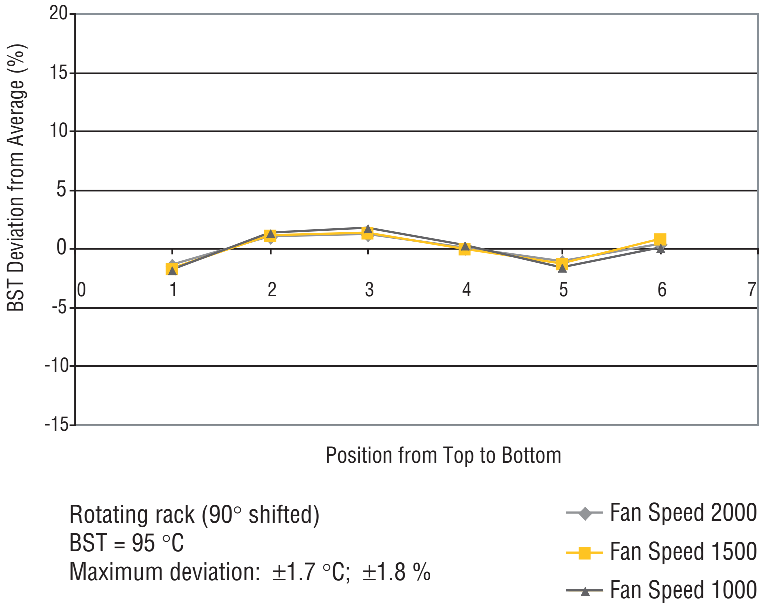
Why is Rotating Rack Better Than Flatbed?

There are two fundamentally different concepts in weathering instrument technology with regard to the exposure geometry: rotating rack and flatbed exposure.

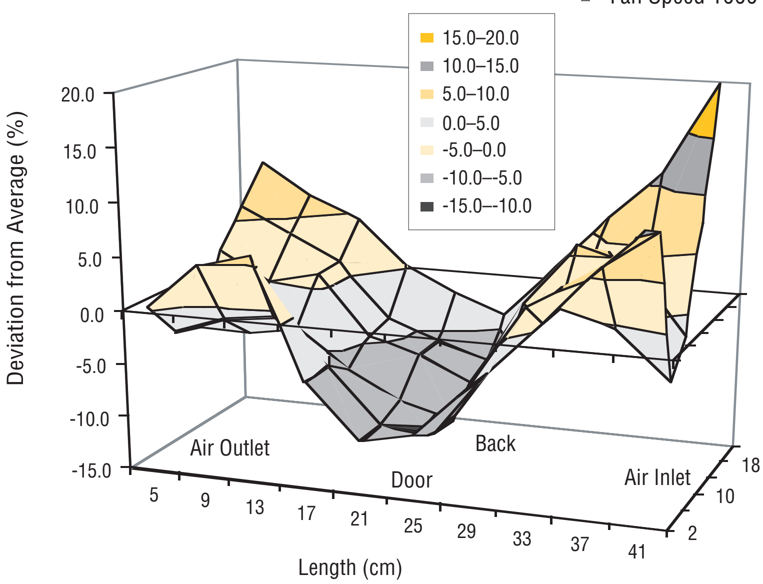
It has been mistakenly suggested that the concept of a sample rack that rotates around the xenon burner has been taken from old carbon-arc instruments without any thought. The truth is that many years ago, several manufacturers, some of them never having been active in the carbon-arc business, started to use rotating racks independently from each other with one common technical goal: **to achieve the best possible uniformity of the weathering parameters on sample level.** By automatically rotating the samples around the xenon lamp, all receive the same relative spectral power distribution (SDP), irradiance (E),

Continued on next page

Weathering Instrument, from previous page



Rotating rack (90° shifted)
BST = 95 °C
Maximum deviation: ±1.7 °C; ±1.8 %



Static flatbed with 1 lamp
BST = 70°C
Maximum deviation: ±7 °C; +10 °C

Figure 3: Uniformity of black standard temperature (BST) in a rotating rack instrument compared to a flatbed device

and radiant exposure (H). Additionally, the airflow within the chamber is designed to ensure best possible uniformity of BST/BPT, CHT, and RH on sample level. Since physics has not changed during the last several decades, this concept is still valid. Taking into account the technological effort that is required to achieve best uniformity using *all three dimensions* (e.g., two-tier or three-tier racks in instruments with large sample capacity), the drawback of being confined to a *two-dimensional* sample tray becomes obvious. Figure 1 (page 5) shows the uniformity of the sample surface temperature in a three-tier Atlas Ci5000 Weather-Ometer® [1].

Another aspect to examine is the simulation of rain by spraying water on the samples. Although they have not been studied in detail, one can surely expect differences in the results of spraying on vertical mounted, automatically rotating samples, and horizontal static samples. The main problems for flatbed devices will probably be the uniformity of the spray pattern and the disturbing effects of long-lasting droplets that slowly dry on the samples.

Nevertheless, more than 25 years ago, the first flatbed devices were introduced into the market under the name SUNTEST. With thousands of SUNTESTs sold, Atlas knows the exact strengths and limitations of this technology. These low-end devices have found their place in many applications, including the pharmaceutical and cosmetic industries. Flatbed devices are especially useful for "go/no go" tests and routine quality control. Naturally, this type of low-end device is not able to meet the needs of sophisticated weathering and lightfastness testing. For flatbed devices, manual periodic repositioning of specimens is often recommended to compensate for inhomogeneous exposure conditions. This practice (alternating harsh and smooth conditions) is different from rotating rack exposure (constant conditions).

Figure 2 (page 7) and Figure 3 illustrate the difference between the two types of instruments. Obviously, the variations of BST/BPT (Figure 3) and E (Figure 2) over the exposure area in flatbed devices are at least three to five times larger than in rotating rack instruments. Knowing that increasing the temperature by 10 °C approximately doubles the speed of chemical reactions, the deviations in flatbed devices are not at all acceptable for sophisticated testing needs.

Improvement of Testing Technology

Eventually, what is a high-end test or a high-end instrument today might become low-end tomorrow. The technical and scientific state-of-the-art is progressing steadily, and so is the instrument technology.

The quality of a weathering instrument is characterized by its ability to measure and control not only the main exposure parameters but also the fluctuation around the set point in the equilibrium state as well as the behavior during and after a phase change (e.g., between wet and dry phase). Figure 4 shows how the actual control tolerances of BPT, CHT, and RH have been constantly narrowed down during three generations of Atlas weathering instruments [1].

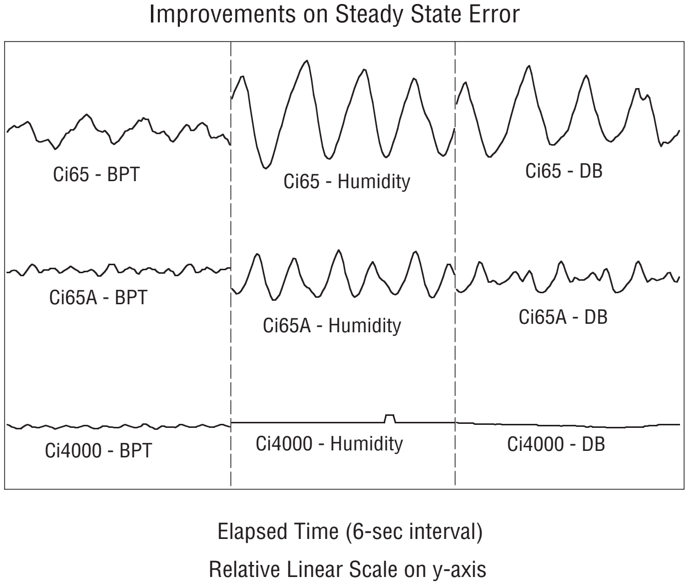


Figure 4: Actual tolerance of black panel temperature (BPT), relative humidity (RH), and chamber air temperature (CHT = DB) through three generations of weathering instruments

Summary

The requirements for state-of-the-art **high-end xenon weathering instruments** can be summarized as follows:

- Specially designed xenon lamp
- Variety of advanced filter systems
- Capability to measure and control E
- Capability to measure and control RH
- Capability to measure and control both BST/BPT and CHT, or at least control one and adjust the other manually
- Rotating rack to ensure best uniformity of SPD, E, H, CHT, BST/BPT, and RH
- Stable control of all parameters with tight tolerances
- Calibration of all controlled parameters

Meeting all of the above requirements is essential for a weathering instrument to fulfill the CARR criteria—correlation, acceleration, repeatability, and reproducibility—in the best way that is currently technically achievable.

All current flatbed devices on the market have to be characterized as low-end xenon instruments, although they are useful in many applications, e.g., for simple “go/no go” tests or routine quality control.

[1] Kurt Scott, “Advances in Accelerated Weathering Instrumentation Tests Using Advanced Control Systems,” ASTM Symposium Durability 2000 on Accelerated and Outdoor Weathering Testing, January 25–26, 2000, New Orleans, USA

Colour Fastness, from page 1

The following article is an excerpt of the Light and Weather Fastness Properties section (Part 1), providing an overview and brief descriptions of current textile standards.

Part 1: Standards/Brief Descriptions

ISO 105-B01: Colour Fastness to Light: Daylight

B01 describes a test method for determining the resistance of the colour of textiles to the influence of daylight in an exposure rack. Depending on the testing site and time of year—i.e., depending on climatic influences—very different, poorly reproducible results may be obtained. Furthermore, the tests are long and troublesome. CSA Testing hardly uses this test method anymore because ISO 105-B02 is much quicker and produces far more reproducible results.

Brief description: Expose the test specimen and ISO lightfastness references 1–8 until the contrast (change in colour) on the test specimen corresponds to grey scale grade 4 and then until it corresponds to grey scale grade 3 but at maximum until the blue wool reference 7 shows a contrast corresponding to grey scale grade 4.

Assessment: The rating corresponds to the number of the blue lightfastness reference which shows a similar contrast to the test specimen.

ISO 105-B02: Colour Fastness to Artificial Light: Xenon Arc Lamp

B02 describes a test method for determining the resistance of the colour of textiles to the influence of an artificial xenon light source that corresponds to natural daylight (D65).

Brief description: Expose test specimen and ISO lightfastness scale 1–8 in a suitable apparatus with a xenon lamp at least until a contrast (change in colour) corresponding to grey scale grade 4 and later to grey scale grade 3 is visible on the test sample, but at most until the blue wool reference 7 shows a contrast corresponding to grey scale grade 4 (in CSA Testing: blue wool reference 6 to grey scale grade 3).

Assessment: The lightfastness rating corresponds to the number of the blue wool reference on the lightfastness scale which shows a similar contrast. It is also possible to expose until a certain stage is reached and then assess with the grey scale.

Remark: The stages of contrast have been selected sensibly. An attack weaker than grey scale grade 4, regardless of when it occurs, is unlikely to lead to complaints. However, if the attack is greater than grey scale grade 3 it will probably no longer be of interest whether it corresponds to rating 2 or 1.

M&S C9: Xenon Arc Lamp

Corresponds largely to the procedure in ISO 105-B02 on testing devices as defined by M&S.

AATCC Test Method 16 (E: Xenon Arc Lamp)

AATCC TM 16 Option E describes a test method for determining the resistance of the colour of textiles to the influence of an artificial light source that corresponds to natural daylight (D65). In Option A, the test is carried out with a carbon arc lamp. The method Option A is used less and less frequently because the light spectrum differs too much from natural daylight, particularly in the UV region.

Brief description: Expose test sample and AATCC lightfastness scale in a suitable apparatus at least until a contrast (change in colour) corresponding to grey scale grade 4 and later to grey scale grade 3 is visible on the test sample, but at most until the blue wool reference L6 shows a contrast corresponding to grey scale grade 4.

Assessment: The lightfastness rating corresponds to the number of the blue wool reference on the L lightfastness scale which shows a similar contrast. An "L" is placed in front of the rating.

It is also possible to expose until a certain stage is reached and then assess with the grey scale. In the USA it is often asked how stable the sample is after a particular stage of exposure, e.g., after 40 AFU* (* = instead of the correct term AFU it is often asked after 40 hours).

ISO 105-B03: Colour Fastness to Weathering: Outdoor Exposure

B03 describes a method of determining the resistance of the colour of textiles to weather carried out outdoors on an exposure rack.

Depending on the testing site and time of year—i.e., depending on climatic influences, very different, poorly reproducible results may be obtained. Furthermore, the tests are long and troublesome. CSA Testing has not used this test method for many years because ISO 105-B04 is much quicker and produces far more reproducible results.

ISO 105-B04: Colour Fastness to Artificial Weathering and Wet Lightfastness: Xenon Arc Fading Lamp

B04 describes a test method for determining the resistance of the colour of textiles to artificial weathering conditions that can be achieved in an apparatus fitted with a xenon arc lamp. The test method can also be used to determine the wet light sensitivity of textiles.

Brief description: The test specimens are exposed to a weathering cycle in an apparatus fitted with a xenon arc lamp. The test specimen is sewn in loops onto a hanger and exposed to light while spraying for 1 min with demineralized water and then drying for 29 min. The drying speed depends on the substrate so that heavy materials are not quite dry at the end of the cycle; a drying time of 29 min is maintained anyway.

For weather fastness: The blue wool references 1–8 are exposed at the same time and in the same place, protected by window glass from spraying, until the blue wool reference 6 shows a contrast corresponding to grade 4 and later grade 3 of the grey scale "change in colour."

Assessment: The lightfastness rating corresponds to the number of the blue wool reference on the lightfastness scale which shows a similar contrast.

For wet lightfastness: The specimens are treated for 16 h (32 spraying cycles). When this test was developed, only the Xenotest 150 (S) was available and for that reason an exposure time of 16 h was fixed. As all testing parameters are fixed, a fixed number of hours is permissible here.

Assessment: The change in colour is assessed compared to an unexposed reference using the grey scale.

Remark (for weather and wet light): The fastness of a single dye may change significantly in combination with other dyes.

ISO 4892-2A (formerly DIN 53387-1-A-X) Weather, Wet Light (= part of Draft Proposal ISO 105-B10)

This standard was originally developed for plastics. Recently it has been adapted for use for textiles in order to determine the resistance of the colour to weather.

Brief description: The test specimens are exposed to a weathering cycle in an apparatus fitted with a xenon arc lamp.

Continued on next page

Colour Fastness, from previous page

The test specimen is sewn in loops onto a hanger and exposed to light while spraying for 18 min with demineralized water and then drying for 102 min. Compared to the former weather fastness test, better wetting out and complete drying are achieved. At present, treatment is usually carried out for 44 h (22 spraying cycles). Provided the test is carried out under the previously fixed test conditions, a fixed number of hours is permissible here. Up to now there was no fixed variant for wet lightfastness (see ISO 105-B04).

Assessment: The change in colour is assessed compared to an unexposed reference using the grey scale.

Remark: The fastness of a single dye may change significantly in combination with other dyes.

M&S C9A: Wet Alkali Light

Brief description: Wet out the test specimen with the test solution (4 g/l ECE phosphate-containing Test Detergent (B) and 1 g/l sodium perborate tetrahydrate) (200–250% pickup), wrap the wet specimen immediately in polyethylene film tube. Expose in a suitable apparatus (as defined by M&S) with a xenon arc lamp until the blue wool reference 1 (not wrapped in film) corresponds to rating 4 "change in colour."

Assessment: Change in colour compared to an unexposed original with the grey scale.

Remarks: The fastness of a single dye may change significantly in combination with other dyes.

During exposure of the wrapped sample, part of the evaporated test solution condenses on the inside of the PE tube and drops unevenly back onto the surface of the sample. Unlevelness can result, making assessment of this fastness test more difficult.

CSA-internal: Sportswear Wet Light

Brief description: Wet out the test specimen in the desired test solution (a, b, or c) (pickup 200–250%) and wrap the specimen immediately in polyethylene film tube. Expose in a suitable apparatus with a xenon arc lamp until the blue wool reference 3 (not wrapped in film) corresponds to rating 3 "change in colour."

Test solutions:

a) demineralized water

b) 4 g/l ECE phosphate-containing Test Detergent (B)
1 g/1 sodium perborate tetrahydrate

c) perspiration solution containing
1 g/l 1-histidine monohydrochloride monohydrate
5 g/l sodium chloride
2.5 g/l disodium hydrogen phosphate dihydrate adjust to pH 8 with 1 n caustic soda.

Remark: b) corresponds to M&S C9A but is exposed for 15 h.

Assessment: Change in colour compared to an unexposed original with the grey scale.

Remarks: The fastness of a single dye may change significantly in combination with other dyes.

During exposure of the wrapped sample, part of the evaporated test solution condenses on the inside of the PE tube and drops unevenly back onto the surface of the sample. Unlevelness can result, making assessment of this fastness test more difficult.

ISO 105-B05: Detection and Assessment of Photochromism

B05 describes a test method for detecting and assessing the temporary change in colour of textiles under brief exposure to light. This change in colour returns to the original shade during storage in the dark.

Brief description: Expose reference 1 of the ISO lightfastness scale to a xenon arc lamp at moderate effective humidity until the contrast between the exposed and unexposed parts corresponds to the contrast of grey scale grade 4 "change in colour." Expose the test specimen for a quarter of this time under the same conditions.

Assessment: At the end of the exposure time, immediately assess any contrast in colour with "change in colour."

According to ISO 105-B05: Contrast less than rating 4: colour of the test specimen is not photochromic. Contrast stronger than rating 4: store test specimen for 3 h in the dark. If there is still a contrast, store the test specimen for another 21 h in the dark. If the contrast disappears to a remainder of 4–5 or less, the colour is photochromic according to ISO. If the contrast remains stronger than 4–5, the test specimen is not photochromic, but the colour has poor lightfastness.

Assessment of photochromism is particularly difficult, mainly because the change in colour of photochromic dyeings reverts fairly quickly. For this reason, CSA Testing has a test method in which all relevant influences are fixed exactly and the change in colour is determined simultaneously with the aid of a colour measuring device.

According to the CSA internal test, the change rating immediately after the end of the exposure time is assessed with greater differentiation:

4.8–5.0 not photochromic
4.5–4.7 tendency to photochromism
4.2–4.4 slightly photochromic
3.9–4.1 photochromic
3.6–3.8 severely photochromic
1.0–3.5 very severely photochromic

If the contrast disappears to a remainder of 4.7 or less, the colour is photochromic. If the contrast remains stronger than 4.7, the test specimen is not photochromic, but the colour has poor lightfastness.

ISO 105-B06: Colour Fastness and Aging to Artificial Light at High Temperatures: Xenon Arc Lamp

In CSA Testing, test conditions No. 3 and 5 of ISO 105-B06 are mainly used. As these terms are less common than those in the original national standards it is in case of test condition No. 3 often spoken of as VDA Recommendation 75202 or DIN 75202 or not quite correctly of FAKRA and for test condition No. 5 of SAE J 1885.

Automotive lightfastness VDA Recommendation 75202, ex DIN 75202

Brief description: Backing of the test specimen is prescribed, as in ISO 105-B06, in which 75202 is integrated. Through the insulating effect this produces a slightly higher temperature of the test specimen is achieved, but in particular a reproducible temperature.

Expose the test specimen and ISO lightfastness references 1–8 in a suitable apparatus at a black standard temperature (BST) of 100 °C and a relative humidity of 20% until blue wool reference 6 shows a contrast (change in colour) corresponding to grey scale grade 3. The end point of exposure is preferably determined colorimetrically as is always the case in CSA Testing. The blue wool reference 6 must show an attack of DE* = 4.3, which corresponds to rating 3 of the ISO 105-A05 formula. This is regarded as 1 cycle/period. 1 cycle/period on the Atlas Ci4000 corresponds to ca. 260–280 kJ/m^2nm at 420 nm.

Exposures of only **one** *cycle:* Correct name: VDA 75202-2A. 2 stands for the test method (determination of colour fastness, only one cycle/period) and A for the exposure conditions.

Continued on next page

Colorfastness, from previous page

Assessment: The lightfastness rating corresponds to the number of the blue wool reference on the lightfastness scale, which shows a similar contrast to the test specimen. Assessment with grey scale ratings is possible by the standard and is recommended by CSA Testing.

Exposures of several cycles: Correct name: VDA 75202-3A x. 3 stands for the test method (determination of ageing behaviour, several cycles/periods), A for the exposure conditions, and x for the number of test cycles/periods. When testing several cycles/periods, assessment with grey scale ratings is prescribed.

Automotive Lightfastness SAE J 1885

Brief description: In SAE J 1885, backing of the test specimen is not prescribed, but it is not forbidden either. In ISO 105-B06, in which SAE J 1885 is integrated as test condition 5, backing of the test specimen is prescribed.

The sample is exposed in an exposure apparatus equipped with a xenon arc lamp. An exposure cycle consists of 2 phases:

3.8 h light, black panel temperature (BPT) 89 °C, relative humidity 50%, exposure intensity 0.55 W/m^2 nm at 340 nm

1 h dark, black panel temperature 38 °C, relative humidity 95%

Assessment: This is done with grey scale ratings.

- **ISO 105-B07: perspiration wet lightfastness, in discussion at present**
- **ISO 105-B08: checking of blue lightfastness references on wool fabric 1–7**
- **ISO 105-B09: does not exist at present**
- **ISO 105-B10: weather fastness, in discussion at present** ■

Explanation of abbreviations and some internet addresses (a selection from the list in “Colour Fastness Tests”):

- **AATCC** American Association of Textile Chemists and Colorists, www.aatcc.org
- **AFU** AATCC Fading Unit
- **CSA** Clariant (Switzerland) Ltd., www.clariant-textiles.com
- **DIN** German Institute for Standardization, www.din.de
- **FAKRA** Standardization Committee Automotives within DIN
- **ISO** International Organization for Standardization, www.iso.ch
- **M&S** Marks&Spencer, London (U.K.), www.marksandspencer.com
- **SAE** Society of Automotive Engineers, www.sae.org
- **VDA** German Association of the Automotive Industry, www.vda.de

Author Hermann Ulshöfer entered the field of textile colour fastness in the early ’80s, having worked with screening textile dyes. With this publication, he aims to provide a better understanding of colour fastness testing by sharing tips and information acquired during his 20 years of work in this area.

For a complete copy of the 75-page “Colour Fastness Tests” (No. 1087383), featuring beautiful watercolour paintings by the author, please contact Clariant (Switzerland) Ltd. – BU Textile Dyes, Rothausstrasse 61, CH-4132 Muttenz; +41/61 469 67 43; www.clariant-textiles.com.

Need Energy Star® Solar Measurements? Call on Atlas

The Energy Star® program is a government-backed program that was started in 1992 and expanded in 1995 to help businesses and individuals protect the environment through superior energy efficiency. Roofing products and materials are just one of many products that require specific evaluations to obtain the Energy Star® certification.

Atlas Weathering Services Group is listed on the "approved" list for laboratories that are qualified to perform measurements per ASTM E903: Solar Absorptance, Reflectance and Transmittance of Materials Using Integrating Spheres, a requirement for Energy Star® approval of roofing products. Additionally, our laboratories are ISO/IEC 17025-accredited and, therefore, "approved labs" for the real-time outdoor exposures per ASTM G7 of roofing products.

The busy Evaluations Lab at Atlas' South Florida Test Service

Requirements as to the "climate of the outdoor exposure sites" are not mentioned in the Energy Star® document, but the client is encouraged to choose an environment (or environments) that reflects the area(s) where they sell their products. The two most popular AWSG test sites are located in central Arizona, DSET Laboratories (hot, dry, high UV) and southern Florida, South Florida Test Service (warm, humid, high UV). Both test sites are approved for the exposure of materials.

Our technicians in charge of providing the measurements and/or testing of your samples to the above Energy Star® requirements have a combined 70+ years of experience and are highly qualified in their specific fields.

The experienced and knowledgeable AWSG client services representatives are very familiar with the Energy Star® program and can give you the assistance you need. For more information regarding Energy Star® visit the Energy Star® web site at www.energystar.gov or contact an AWSG client services representative at info@atlaswsg.com.

New EMMAQUA® Service Unveiled

Atlas Weathering Services Group is pleased to announce a new temperature-controlled test methodology for the EMMAQUA® outdoor accelerated test device. Using the Atlas pioneered EMMAQUA® and EMMA®, 10 mirror solar concentrator technology, and an Atlas-patented temperature control system, the target sample temperature is maintained essentially constant despite variations in ambient daytime temperature and solar radiation intensity.

A temperature sensor mounted to the EMMAQUA® target board is interfaced with a controller capable of controlling the power to the blower motor which is used to circulate cooling ambient air across the test specimens. The black-panel temperature set point can be maintained between 70 and 130 °C.

Atlas' pioneering EMMAQUA field in Phoenix, Arizona

Research and development groups, material design teams, applications engineers, and others concerned with the effects of solar radiation and elevated temperatures on their products now have a new tool to analyze material behavior. This new temperature control methodology, along with the proven benefits and correlation of the EMMAQUA® test method, make this a very valuable research tool—one that only AWSG can offer!

Please contact your client services representative at 1-800-255-3738 or info@atlaswsg.com for more information.

Atlas Weathering Services Group

AWSG Introduces Specimen Bar Coding

Once again, Atlas Weathering Services Group is leading the commercial weathering industry by introducing another great customer service feature—specimen bar coding! This pioneering opportunity is the latest example of our commitment to provide our clients with superior service through state-of-the-art technology. AWSG is the **only** commercial weathering lab to offer this specimen tracking, automation, and quality enhancement feature.

AWSG is rolling out this service at our South Florida Test Service location in Miami in October, then at DSET Laboratories in Arizona early next year. The new system will have many great benefits for our clients as well as AWSG, including:

- Accurate and durable specimen identification
- Real-time specimen tracking
- Automated processes—no more manual inputs of test codes
- A "history" of each specimen as it is recalled and re-exposed
- Enhanced hurricane/severe weather preparation

Atlas' new specimen bar coding service—the first in the industry—will mean even better quality and faster turnaround.

If requested, AWSG can send preprinted AWSG bar code labels to clients who wish to track their samples with their own bar code equipment. A common and universal bar code format will allow AWSG bar code labels to be used with most commercially available bar code systems.

In addition to sample bar coding, every test rack in our field is also bar coded. This automates the recording of the location of each and every specimen in the field and increases accuracy and quality. Evaluation services will be greatly enhanced by scanning each specimen prior to measurement to ensure the proper evaluations are being performed. Improved quality and turnaround time are obvious benefits of this bar code system!

This new feature is one of the most significant enhancements in the weathering industry in years. As the recognized global leader in weathering and operator of the largest and best-maintained exposure fields in the world, AWSG continues to implement new services that "raise the bar" on weathering services and testing. Stay tuned for more news about this new customer service feature. Contact your client services representative at 1-800-255-3738 or info@atlaswsg.com for more information.

Weathering Experimenter's Toolbox: Deltas vs. Delta of Deltas

Modern measurement instruments offer superior long-term stability over instruments of only a few years ago. For example, filter wheel colorimetry, which was susceptible to long-term drift, has been largely replaced by spectrophotometry using stable holographic gratings. Still, variation in measurement systems affects a weathering researcher's ability to discern small differences in test groups (especially important for early predictions).

Among the most popular tools for reducing the effects of these variations are the central limit theorem, the increase in sample numbers or measurement numbers, and the reporting of means and grand means. Another tool, however, utilizes blocking with control specimens. In this approach, each material specimen is cut in half. The first half is measured and then exposed. The second half is also measured but retained in a controlled environment archive. The delta between the halves' initial measurement is recorded. At the conclusion of the exposure, the exposed half is re-measured along with the archived half. A delta between the two pieces is again calculated. The two delta values are then compared and a "delta of deltas" is obtained. This delta of deltas blocks a variety of instrument variations and may improve gage capability over very long exposures.

Atlas Receives ISO 9001:2000 Blessing

Atlas is proud to announce that our Chicago operation has been accredited by TUV Rheinland of North America to the ISO 9001:2000. Our facilities in Linsengericht/Altenhaßlau, Germany will be accredited to this standard by year-end.

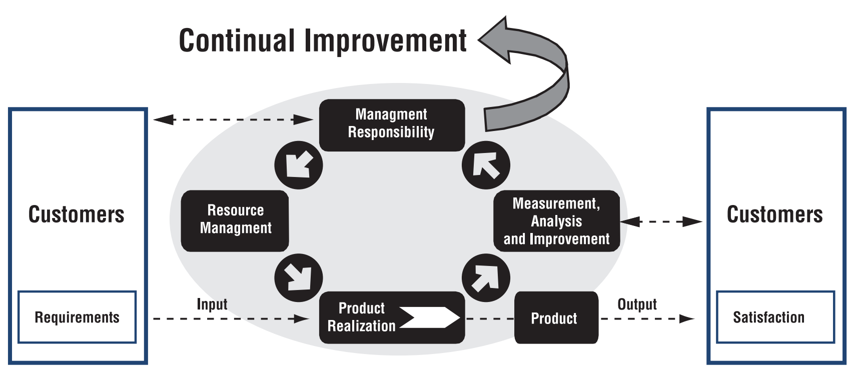
"Accreditation to the new revision of this standard was one of our goals for the year, and an important step in fully implementing a total quality management system," said Matt McGreer, Director of Quality Systems for Atlas. "The 2000 revision of the standard contains much more definition and emphasis on the responsibility of management and the interaction of all business processes. Therefore, our accreditation is really a team effort."

The process model concept of the ISO 9001:2000 standard is based on eight quality management principles:

- Customer focus
- Leadership
- Involvement of people
- Process approach
- System approach to management
- Continual improvement
- Factual approach to decision making
- Mutually beneficial supplier relationships

McGreer went on to say that accreditation to the standard was not considered a final achievement. "This is just one facet of our quality system implementation. Continual improvement, and the Plan-Do-Check-Act methodology are keys to our business performance and meeting our customers' requirements."

Based on a recent survey in "Quality Digest," only 53 percent of companies previously registered to the 1994 version of the ISO standard have completed the transition to the new requirements. The deadline for this transition is December 14, 2003.



Atlas' continual improvement process

Atlas Commitment to Growth

Atlas Partners with Weiss Technik

Atlas has entered into an exclusive partnership with Weiss Umwelttechnik GmbH (Weiss Technik). Under this agreement, Atlas becomes Weiss Technik's exclusive partner for marketing and production of standard climatic test chambers in the United States and Canada. The partnership is expected to further enhance the range of technology offered by Atlas and to increase the depth of Atlas' commitment to excellence in materials durability testing. The expanded offering will provide added convenience to Atlas customers in automotive and other associated industries as Atlas becomes the single source for material durability testing instruments and services.

Based in Reiskirchen-Lindenstruth, Germany, Weiss Technik is the world's largest manufacturer of environmental test chambers with annual revenue of $190 million, and is a member of the Schunk Group with annual revenue of $790 million. Weiss Technik, which dominates the European market and has a strong presence in the Asian-Pacific region, has been seeking a strong industrial partner to enter North America which has an estimated annual market of $400 million in environmental test chambers. They selected Atlas due to our established sales and service network and our strong reputation in the industry.

Atlas will begin production of the environmental chambers in the fourth quarter of 2003. As with all Atlas products, these chambers will receive field service support from Atlas' highly trained, experienced technical service staff.

For more information regarding the Atlas-Weiss partnership, contact Jamie Chesler at jchesler@atlas-mts.com; for more information regarding the environmental chambers, contact Larry Bond at lbond@atlaswsg.com.

AWSG Earns CRRC Accreditation

Atlas Weathering Services Group (AWSG) has received accreditation as an independent testing laboratory by the Cool Roof Rating Council (CRRC). AWSG is the only commercial weathering laboratory approved by CRRC to perform the reflectance (ASTM E903) and emittance (ASTM E408) measurements required by this organization. Please visit the CRRC web site for "Participating Accredited Independent Testing Laboratory" at www.coolroofs.org/productratingprogram_laboratories.html.

This accreditation has been granted as a result of our participation in the CRRC training program recently held at Lawrence Berkeley National Laboratory. Kathy Eoff, Senior Technician in the Optics Lab at our DSET Laboratories site, was the AWSG representative for this training and is a recognized optics measurement expert.

The Cool Roof Rating Council was created in 1998 to develop accurate and credible methods for evaluating and labeling the solar reflectance and thermal emittance of roofing products and to disseminate that information to all interested parties. CRRC is an independent and non-biased organization and joining the program is voluntary.

Participants in the CRRC program are required to have initial reflectance and emittance measurements performed on their roofing product(s). After initial measurements are made, samples will be exposed for three years of weathering/aging. At the end of the three-year program, final reflectance and emittance measurements will again be required.

For more information on this program, go to www.atlaswsg.com and click on the CRRC link (www.coolroofs.org) or call 1-800-255-3738 and speak with a client services representative or Kathy Eoff.

Atlas-SDL Union to Streamline Textile Testing

Atlas Material Testing Technology LLC entered into an agreement on May 15, 2003 to acquire SDL International Ltd., a U.K.-based testing instrument supplier recognized as the most complete global supplier of textile testing instruments.

The union will provide textile manufacturers with a single source for instrumentation to meet all of their global testing requirements. SDL, Atlas Textile Test Products, Raitech, and Textile Innovators will form the newly created SDL Atlas Textile Testing Solutions LLC, which will be headed by Charles S. Lane. The restructuring will strengthen Atlas' focus in both textile testing instruments and its core weathering test instruments and services, known as the *Network of Weathering.*

"We have brought together Atlas, with its leadership in lightfastness and colorfastness, and SDL, with its expansive product offering, to form a company that will provide the textile industry with a single source for their textile testing solutions," Lane said. "SDL Atlas is clearly the largest, most complete global source of textile testing equipment."

Shirley Development Limited (SDL) was founded in 1951 by the Shirley Institute to commercialize inventions from the Institute. Prior to 1920, the Institute was named the British Cotton Industry Research Association. In 1984, Russell Crompton and Steven Combes purchased SDL from the Institute. SDL sales of approximately $10 million are currently comprised of 50% as a manufacturer and 50% as a distributor of other manufacturers' instruments.

Atlas, founded in 1919 in Chicago, has its roots in the textile industry. Atlas Textile Test Products is best known for its lightfastness testing instruments: the Atlas Fade-Ometer® and Xenotest 150 S+. Other mainstays in this line are the AATCC Launder-Ometer® and AATCC Crockmeter, which test the colorfastness of a fabric. A recent acquisition of Raitech, developer of the Quickwash®, has increased Atlas' resources for textile testing product innovation.

SDL customers will benefit from this expanded offering of products and services in addition to an increased global customer service network. The new entity will also provide growth opportunities for both organizations.

For more information about the acquisition, please contact Robert Lattie, Director, Product Management, at rlattie@atlas-mts.com.

Sedona Symposium to Explore Service Life Prediction

The 3rd International Symposium on Service Life Prediction—"Challenging the Status Quo"— will be held **February 1–6, 2004** at the Radisson Poco Diablo Resort in Sedona, Arizona. This international symposium is designed to provide a forum for presenting and discussing the latest scientific and technical advances leading to more reliable and quantitative predictions of the weathering performance of polymeric materials. The intended audience includes public and private organizations involved in the production, supply, research, and use of polymeric materials and products. Presentation and discussion topics include problem definition, testing mindset, correlation and prediction, field exposures, accelerated aging, measurements and mechanisms, and implementation. The technical contact for this symposium is Jonathan W. Martin: +1-301-975-6707 (telephone), +1-301-990-6891 (fax), jonathan.martin@nist.gov. Registration forms can be found at http://www.ebiks.com/slpsymposium.

Visit us at FSCT ICE 2003 November 12–14 in Philadelphia! Booth #602

Atlas Material Testing Solutions

Atlas Material Testing Technology LLC
4114 North Ravenswood Avenue
Chicago, Illinois 60613, USA
Phone: +1-773-327-4520
Fax: +1-773-327-5787
www.atlas-mts.com

Atlas Material Testing Technology BV
Aalsvoort 69
7241 MA Lochem
The Netherlands
Phone: +31-573-256465
Fax: +31-573-253368

Atlas Material Testing Technology GmbH
Vogelsbergstrasse 22
D-63589 Linsengericht/Altenhaßlau
Phone: +49-6051-707-140
Fax: +49-6051-707-149

Atlas Weathering Services Group
South Florida Test Service
17301 Okeechobee Road
Miami, Florida 33018, USA
Phone: +1-305-824-3900
Fax: +1-305-362-6276

DSET Laboratories
45601 North 47th Avenue
Phoenix, Arizona 85087, USA
Phone: +1-623-465-7356
Fax: +1-623-465-9409
Toll Free: 1-800-255-3738
www.atlaswsg.com

KHS US Office
4114 North Ravenswood Avenue
Chicago, Illinois 60613, USA
Phone: +1-773-327-4520
Fax: +1-773-327-4023

Experience. The Atlas Difference.

www.atlas-mts.com

ATLAS

ATLAS MATERIAL TESTING TECHNOLOGY LLC
4114 North Ravenswood Avenue
Chicago, Illinois 60613, USA

Presorted Standard
US Postage
PAID
Evanston, IL
Permit No. 198