ATLAS SUN SPOTS

TECHNICAL ARTICLES AND PRACTICAL INFORMATION ABOUT

VOL. 4 ISSUE 10 TESTING WITH ATLAS WEATHER-OMETERS AND FADE-OMETERS AUTUMN 1975

TECH ARTICLE

WHAT IS A "WEATHER-OMETER"?

By William W. Lane, President, Atlas Electric Devices Co.

Every month we regularly scan a broad range of technical journals and publications looking for articles pertaining to the degradation of products and materials caused by weathering. Abstracts of many of these appear in the SUNopsis section of Sunspots. They may be as general as some simple observations of natural effects or as complex as multi-lab round robin experiments. In the majority, however, a combination of outdoor exposures and laboratory exposures using accelerated weathering techniques are employed. The materials to be tested are often discussed in great detail down to the chemical bonds and atomic structure. Sample preparation is immaculate, parameters of failure are explained thoroughly and the exposed samples may even be examined under an electron microscope to determine cause of failure. We are then told about correlation or lack thereof between laboratory and natural exposures or that material A is vastly superior to material B. But what was the mechanism that caused failure? Were the exposures as carefully controlled as sample preparation and the final evaluation? Too often the article reports: "Samples were exposed for 2 years in South Florida and 2000 hours in a weatherometer". This indicates to me that for 2 years and 2000 hours a technical group had no real idea of what was happening to those samples. Tests run under such completely ambiguous terms cannot hope to be repeated nor can their results be dependable. What is 2 years in South Florida or even more important, what is a weatherometer?

We are using the Atlas registered trademark "Weather-Ometer" generically here to make a point. Just because the lights go on in an accelerated weathering unit, we should not assume that we will automatically get a controlled experiment. Atlas has been designing, building and improving accelerated weathering systems since 1927 when the first Type BW was introduced for paint testing. This unit incorporated an enclosed carbon arc lamp whose radiation is particularly rich in UV at 360, 385 and 415 nanometers. The lamp has been introduced about 10 years earlier to the textile and printing ink industries for color fading. The sample drum of the BW rotated around the lamp at 3 revolutions per hour and water spray wet the specimens on each revolution. No significant attempt was made to control ambient temperature in these units until 1941 when the Model DL-TS was designed. This unit employed 2 enclosed arc lamps to increase light intensity and reduce test time. The 30" diameter sample drum revolved at 1 rpm and a thermoregulated blower gave some very rudimentary temperature control. A cycle meter allowed the operator to program light on and off plus water spray functions with relation to each other. Quite a number of these units continue in regular operation today, the newest of which would now be 25 years old.

National Carbon in the early nineteen thirties developed a new carbon arc lamp and coined the name Sunshine Arc. The spectrum emitted by this lamp reaches further down into the low UV and its intensity generally exceeds that of the enclosed arc at all points. Used with Corex filters, the UV is cut off at about 270 nm. Using this lamp as a base, National built a laboratory weathering device with model designations X-1 and X-1-A. Its controls were equivalent to the DL-TS. A number of these units are still in use nearly 40 years later.

The next major step in developing a laboratory weathering device was taken in 1952 when Atlas took the two basic light sources — enclosed and Sunshine arc — and placed each in a totally enclosed chamber where a continually recirculating air flow could maintain temperature and humidity within a few degrees on a continuous basis. The system incorporated a conditioning chamber and ducting where electric water heaters and a humidifier in conjunction with an air valve regulated conditions in the test chamber. Refrigeration coils were also available for those who wanted extended temperature ranges.

In the late 1950's the first real breakthrough in sunlight simulation came with xenon arc lamps. These lamps still represent the best commercially available source both in the reproduction of the natural sunlight and in flexibility of spectral output. Using selected filters, xenon lamps will produce quantities of low wavelength UV cutting off around 190 nm or a spectrum simulating terrestrial sunlight or sunlight filtered through window glass as found in the home and office. Add to this system gas controls that analyze and maintain concentrations of SO_2, O_3, NO, NO_x with a range of 10 pphm, and a light monitor that virtually guarantees uniform irradiance and you have a highly sophisticated system for laboratory experimentation. Compared with the 1933 DL-TS, the modern Atlas 65-WR123 "Weather-Ometer" is a totally different state of the art.

Our experience indicates that too many users do not realize this. The chemist who has carefully developed a new material, wants it evaluated and sends it down to the test lab with the instructions "Run it in the Weather-Ometer". The lab may have no idea what type of test is appropriate or perhaps the machine is running a given set of conditions because "it has always been run that way". Obviously, in

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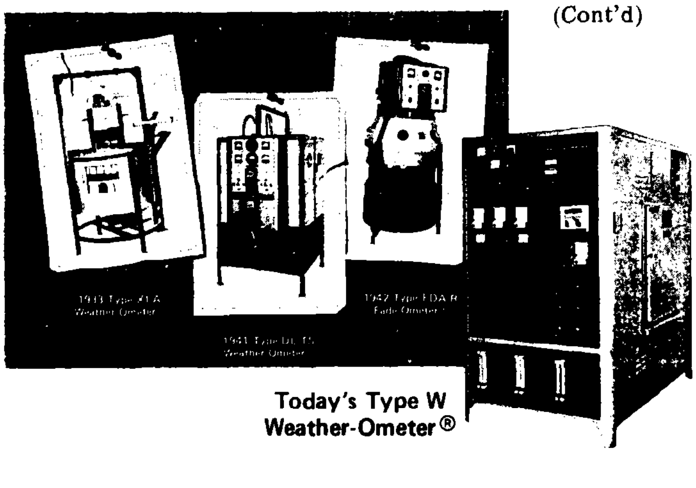

Today's Type W Weather-Ometer®

this case, we need more communication between chemist and lab. Two very important questions should be asked:

1. *What set of test conditions is appropriate for the material?* There are a broad range of association, industrial and governmental specifications currently available. The proper choice here is of paramount importance to the results that will be obtained.
2. *Can the test specifications be run with your equipment?* Light source, temperature and humidity tolerances, water spray and dark cycles are all thoroughly outlined in most test methods. Your unit must be able to comply with all the tolerances if the test is to be meaningful.

What is a "Weather-Ometer"? An Atlas "Weather-Ometer" is a self-contained laboratory system used for accelerated weathering tests. It is identified by specific model designations and capable of meeting certain test specifications. To gather meaningful information from laboratory exposure tests, the wide variety of Atlas "Weather-Ometer" models, and the specifications they meet, must always be kept in mind.

Frank Kelley Jr.

Gerald Albright

APPLIED INSTRUMENTS CORPORATION NEW ATLAS REPRESENTATIVE ON WEST COAST

Effective October 1, 1975, Applied Instruments Corporation of Anaheim and Los Altos, California has been appointed our exclusive sales/service representative for Arizona, California, Oregon, and Washington.

Frank Kelley Jr. is President of the Company and is based in Anaheim. For the past fourteen years, Frank has specialized in the sales, service, and installation of a variety of analytical, bio-medical, laboratory, and scientific instruments. Prior to that, he was associated with Beckman Instruments and the Instrument Division of General Electric Company.

Gerald Albright is the Regional Sales Manager of the Company and directs the activities of their Los Altos office. Before joining Applied Instruments, Jerry was involved in the design and development of electronic test consoles and digital computer circuits. He is also credited with three technical papers and is currently preparing a fourth for the Analytical Chemistry Journal.

The personnel of Applied Instruments are factory trained to provide our customers with complete sales, service, and technical assistance. The areas covered by their two offices are as follows:

Southern California, Arizona
Applied Instruments Corp.
1681 West Broadway
Anaheim, CA 92802
Telephone No. 714-535-6551

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199 First Street, Suite 200
Los Altos, CA 94022
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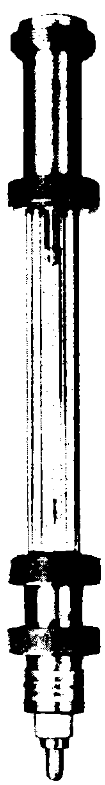
Old & New

New!

1000 HOUR WARRANTY FOR ALL ATLAS XENON BURNER TUBES



As of September 15, 1975, Atlas warrants that our xenon burner tubes will continue to ignite during 1000 hours of normal operation within the 24 month period following the date of sale. This 250 hour extension of the old warranty was predicated on improvements and new developments in the fabrication of the burner. There will be, as indicated above, a 24 month period during which the warranty is effective. Any burner not returned within 24 months from date of shipment will not be covered by the warranty.

Unlike the old warranty, which issued credit, the new policy will apply a warranty adjustment towards the purchase of a replacement burner. We feel this approach will give users added protection; since warranty adjustments will be based on the current replacement price of a new (not preaged) lamp. Currently credits are based on the cost of the burner at the time of original purchase.

This new approach will require the inclusion of a purchase order when returning a defective burner. This order can call for any number of burners, but not less than the number being returned. Purchase orders taking advantage of our quantity discount prices will be accepted. When several replacement lamps are purchased where a quantity discount applies, the warranty adjustment will be calculated on the discounted price for new burners. Again, the warranty adjustment is always based on the present replacement cost of new burners regardless of the original cost.

Warranty adjustments are computed by dividing the number of hours the burner operated by 1000; then multiply by the current selling price of a new burner.

Burner failed at 320 hours ÷ 1000 = .32
New burner price $200.00 x .32 = $64.00

Purchase price of your new replacement burner will be $64.00 plus applicable shipping charges and taxes.

Conditions of the warranty and instructions for returning the burner are detailed on the reverse side of every burner log. So remember, keep accurate records. Also, don't forget burners cannot be accepted if a return authorization number has not been issued. Contact your local Atlas representative or the Atlas plant for this number before making a return.

In summary, a prorated warranty adjustment based on the first 1000 hours of operation will be applied towards the purchase of a replacement burner as long as your replacement request is made within 24 months of the date of original shipment.

An Appraisal Of Artificial Weathering Methods For Assessment Of The Durability Of Paint Films, Correspondence JOCCA Re: SUNopsis 4, #9

With reference to the paper by C. E. Hoey and H. A. Hipwood which appeared in JOCCA, 1974, 57, 151, the following correction should be made:

Table 2, Item 2 on page 152 reported that an Atlas Weather-Ometer XW Type E apparatus was operated for 18 hours a day using 18 minutes radiation and water and 102 minutes radiation alone with 6 hours without light and spray. This was not strictly correct and the apparatus was operated for as long as possible each day, this was frequently longer than 18 hours and usually of the order of 23 hours. The ratio of light to spray is correct, the total running time is correct, but the daily running time was somewhat variable.

In the second column of the same Table under Item 3, the radiation source is stated to be "as above, no filter". This might be taken to imply that the Atlas XW model was used for the "Dew Cycle". In fact, an Atlas XW-R model was used. The information given in the text of the paper is quite clear, but the Table is slightly ambiguous.

Ed. Note: "Dew Cycle" as defined by Stieg and now described in ASTM D3361-74 can be obtained only in unfiltered Type EH units (Models XW-R and XW-WR Weather-Ometers). A proposed ASTM Recommended Practice provides for a "Dew Cycle" using quartz filtered xenon arcs in place of unfiltered carbon arcs. Programmed controlled humidity, rack spray and dark cycles are prerequisites for all "Dew Cycle" instruments.

Predicting Colorfastness to Light in Subtropical Climates, J. E. Norton, R. L. Stone, O. A. Ofjord and J. E. Hemphill, J. of AATCC 7, #8 (1975)

As part of a project conducted by AATCC Committee RA-50, Colorfastness to Light, lightfastness rating for 29 dyed fabrics were compared for daylight exposures in Miami, Fla., and to the xenon-arc lamp. There is better correlation between daylight exposure in a subtropical climate and xenon-arc lamp exposure at high temperature and high humidity than between daylight exposure and xenon-arc exposure with alternate light and darkness. The addition of an "extreme condition" of high temperature with high relative humidity to ISO/R/105/V, Part 2, Colour Fastness to Artificial Light-Xenon-Arc Lamp Test appears justified.

Theories—Laboratory Investigations—Practical Performance, Presented at Scarborough Eng. OCCA Conference, June 1975. Prepared for publication in JOCCA

Some problems concerning the relationship between theoretical aspects and practical performance of painted surfaces are critically examined. In order to correlate theory with practice different laboratory methods and measurements are needed. The selection of realistic and correct methods for this evaluation is very important and the question of correlation is often dependent on the measuring method employed and the criteria chosen. The problems discussed in the text are based upon investigations of the weathering of paint films and the painting of plastics.

Changes in paint film performance during outdoor exposure and in the laboratory have been followed and compared by measuring gloss, weight loss, tensile strength, elongation, micro-indentation hardness, whiteness and by taking photographs with a scanning electron microscope. With regard to the painting of plastics, some theories concerning the relationship between the adhesion and the surface tension of the two components have been studied. The adhesion was measured by the pull-off method and the surface tension by contact angle measurements. The results reveal the complexities and difficulties which arise when endeavouring to obtain correlation between theory and practice.

Ed. Note: Laboratory weathering was conducted in Atlas Weather-Ometers and included modified "Dew Cycles".

Evaluating Colorfastness to Heat, Charles L. Zimmerman, J. Text. Chem. & Col. 6, #11, 1974

The development of AATCC test methods for colorfastness to heat (AATCC Test Methods 117-1973 and 133-1973) is reviewed. Some factors affecting the accuracy of the tests are discussed.

Stability of Vat, Disperse and Sulfur Dyes to Light and Water, John J. Porter, J. of AATCC 7, #7 (1975)

The stability in water of 16 commercial dyes to visible and ultraviolet light from a carbon arc* has been studied. Dyes were selected from three major dye classes – vat, disperse and sulfur. The results are compared to the degradation of two of the dyes in natural sunlight. The dyes degraded at least ten times as fast in artificial light as in sunlight. A significant difference in degradation rate was observed between water soluble dyes and pigment dispersions.

Results show that most commercial colors are resistant to photodegradation and that it would take many weeks before appreciable dye degradation occurred in a natural aquatic environment.

Ed. Note: Clenson U. owns a Model FDA-R Fade-Ometer (1951).

Standard Laboratory Dyeing Procedures for Synthetic Fibers, 1974 Intersectional Tech. Paper Comp. Northern Piedmont Section, J. of AATCC 7, #3 (1975)

A previous study of a synthetic fiber dyeing procedure was extended to standard dyeing procedures for acetate, acrylic, nylon and polyester fibers. A low temperature Launder-Ometer® was chosen as the dyeing equipment.

Normal and "abnormal" combinations of three dyes at various bath ratios were evaluated for each fiber. Repeat dyeings were made by four laboratories to determine repeatability of dyeings between laboratories and within a single laboratory. Color measurements were made by use of the Beckman DBG spectrophotometer. Color differences for total color were determined by the Friele-MacAdam-Chickering II formula.

Standard deviation for precision among laboratories was only slightly worse than the within-laboratory data.

New Gray Scales Simplify Color Assessments, Robert F. Hoban and Robbie L. Stone, J. of AATCC 6, #9 (1974)

ISO Gray Scales for Color Change and for Staining have been widely used for more than 25 years. Now they are available in a new, easier to use fold-out format that is just as accurate and just as reproducible as the old slide rule type.

Poly Semi-esters As Raw Materials For Water Thinnable Finishes, Dr. E. Dhein, Dr. B-W Kaiser and Dr. J. Schoeps, Paint Manufacturer, July/August 1975

Water thinnable stoving finishes based on poly semi-esters are described in detail. Data are presented based upon exposures to a Model XW Weather-Ometer®. A 17:3 water spray cycle was employed (17 minutes-dry, 3 minutes-wet).

Comparison of Reflectance and Related Methods for Studies of Film Surface Deterioration—III. Modification of the Goniophotometer and its Efficiency in Weathering Studies, M. Tahan, J. of Paint Tech., 46, #597, 52 (Oct. 1974)

A Manually operated goniophotometer was successfully automated. A high torque motor was adapted to rotate the photocell. The galvanometer was replaced by a chart recorder, so that the signals were received directly in the form of a goniophotometer curve. A new device to narrow the beam and a new sample mount, capable of accurate setting of the angle of incidence, were used. An integrator was operated to follow the changes in the area of the goniophotometric peaks.

Naturally and artificially weathered samples of pigmented coatings based on polyurethane, epoxy/polyamine, linseed oil modified alkyd resin, vinyl-toluene alkyd, chlorinated rubber and PVC organosol were used to demonstrate the performance of the new prototype.

It was found that the modified machine was much quicker, more informative and capable of better performance.

How Ten Generic Coatings Perform Outdoors For Periods Up To 15 Years, J. A. Mock, Materials Engineering, March 1974

The results of a recently published Navy study on the performance of coatings after 15 years' outdoor exposure show that zinc-rich coatings without topcoats and a modified phenolic coating give long term protection to steel. The study also shows that aluminum pigmentation in the topcoat improves the performance of the protective system.

THE QUESTION AND ANSWER SERIES

Q **Occasionally, a malfunction occurs which after much time spent by our maintenance department is found to be minor in nature. Is there any way in which the down time can be minimized?**

A It has been our experience that many of the problems which occur in the Weather-Ometer, Fade-Ometer and Launder-Ometer could have been avoided by a minimal preventative maintenance program. Like any piece of equipment, whether it be used for production or laboratory research, some type of cleaning, oiling, calibration, etc., is required to assure reliable operation. Atlas equipment is no different. Without some attention, the possibility of a malfunction increases.

Some areas which should be checked periodically are:

1. On units with humidifiers the conditioning chamber should be cleaned periodically. The frequency of cleaning will depend on operation conditions. To begin with, we suggest checking it every month until a convenient cleaning period is developed.
2. The wet bulb wicks should be replaced and the sensing elements cleaned with a *non-chlorinated cleaning compound. Evaporated minerals and salts from the water will cause erratic humidity control and could damage the sensing element.
3. Periodic cleaning of the test chamber with a non-chlorinated cleaning compound will prevent surface corrosion.
   NOTE: The use of demineralized water will not only reduce mineral build up in the aforementioned areas but will reduce the possibility of water stains on the exposed samples.
4. Arc lamp maintenance. The lamp is the heart of the unit and particular care should be given to it. To stress its importance, a detailed maintenance schedule has been outlined on the back side of the arc lamp parts catalog. If your present catalog does not have this schedule, please contact us for a copy.
5. A periodic draining and cleaning of the Launder-Ometer tank is suggested. From time to time impurities could accidentally get into the bath solution which could change its pH to a point where the bath may become corrosive. Once the bath is drained, cleaning with a non-chlorinated cleaning compound is suggested.

When problems exist which can not be solved by your in-plant personnel we suggest that you contact your local representative, or the Atlas Plant in Chicago when local representation is not available, to arrange for additional technical assistance.

To quote an old axiom "an ounce of prevention is worth a pound of cure" or for our metric minded people, ".028 kg of prevention is worth .45 kg of cure."

** Cleaning compounds containing chlorine should never be used on stainless steel. The chloride ion will attack the stainless causing surface corrosion.*

Q **The temperature indicator on my programmed high temperature Launder-Ometer will periodically not keep up with the thermostat indicator during a heating cycle. What is wrong?**

A The inability of the temperature indicator to keep up with the thermostat could result from either a faulty cold water solenoid valve or an erratic heater relay.

To check the solenoid valve may be as easy as observing the drain to see if steam is constantly escaping. This would indicate that some debris has lodged in the solenoid valve orifice. If it is not possible to check the drain, the valve should be taken apart and the orifice checked for debris.

The orifice and plunger assembly may be inspected without disconnecting the solenoid body from the water line. To do this, first turn off the cooling water and the electrical power to the Launder-Ometer. Secondly, remove the solenoid coil. Finally, remove the plunger assembly by grasping its flattened edges near the body with an open end wrench and unscrewing the assembly. The orifice and plunger can now be examined for debris or wear, and cleaned or replaced as necessary.

NOTE: A similar problem could exist on the non-programmed high temperature Launder-Ometers. The hand valve used to regulate the cooling water could have a worn seat which would allow a small amount of water to continuously flow through the cooling coil.

It is a good practice to have an in-line filter on the cooling water inlet. It is particularly important when the tap water contains a large amount of particulate material.

An erratic heater relay can be identified by observing the heater lights to see if one is off when it should be on. Depending on the model and vintage, when the heater selector is in the low heat position one heater will be energized, when in the high position, all heaters will be energized. The heater lights will also indicate a stuck relay, which would result in the temperature indicator exceeding the thermostat indicator setting.

NOTE: The heater lights are standard on current production models and may be added to most older units. Information on the kits will be supplied upon request.

Q **With the introduction of the new 6500 watt lamp, will the 6000 watt lamp still remain available?**

A As pointed out in Volume 3 issue 8 of the Atlas Sun Spots, the development of the 6500 watt lamp was predicated on improving lamp "useful life." It was not our intent, nor is it our intention, to discontinue the fabrication of the 6000 watt lamp. We will continue to supply this lamp.

Research on all of our Xenon lamps (2500, 6000 and 6500 watt) will continue, with particular attention being given to the area of increasing "useful life."

Since the blackening, which is the primary cause of reduced "useful life," occurs in the area of the electrode, it is doubtful, at this time, that the 6000 watt lamp could be improved to the extent of the 6500 watt. As described in the aforementioned "Sun Spots" article the 6500 watt lamp has been increased in length so that this darkened area is now shielded, resulting in it having little effect on the aging of the lamp.

It is our hope that as the state of the art develops, basic improvements will be made in the 6000 watt lamp. When these improvements have proven themselves, they will be routinely incorporated into the production model.

ATLAS ELECTRIC DEVICES COMPANY
4114 N. Ravenswood Ave., Chicago, Ill. 60613
Phone: 312-327-4520 / Cable ATELDECO