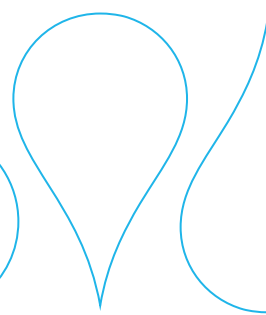
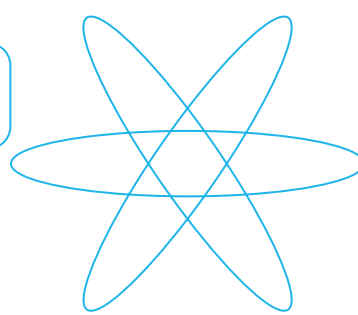
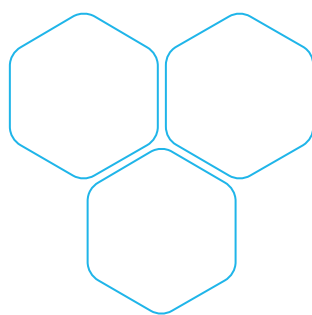
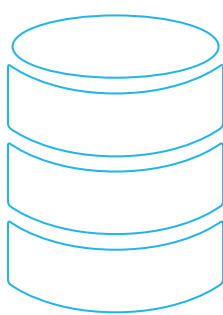
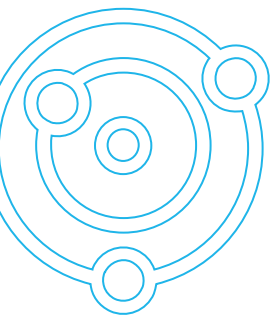
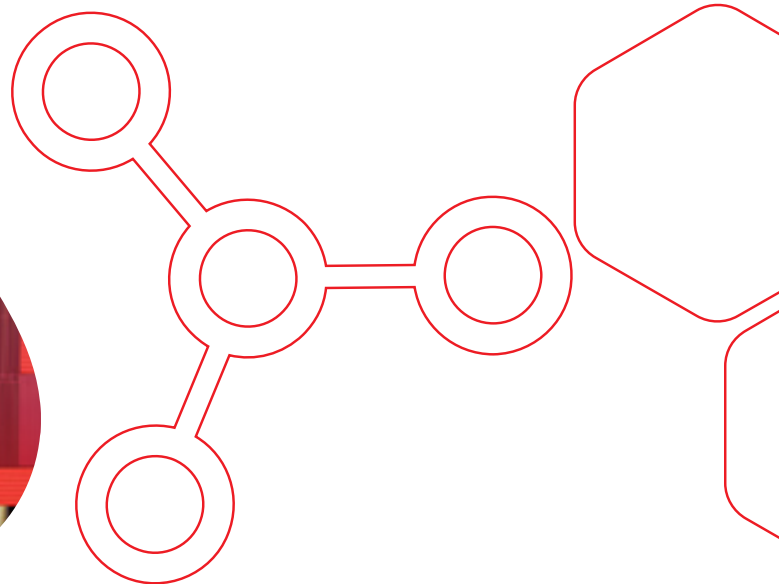
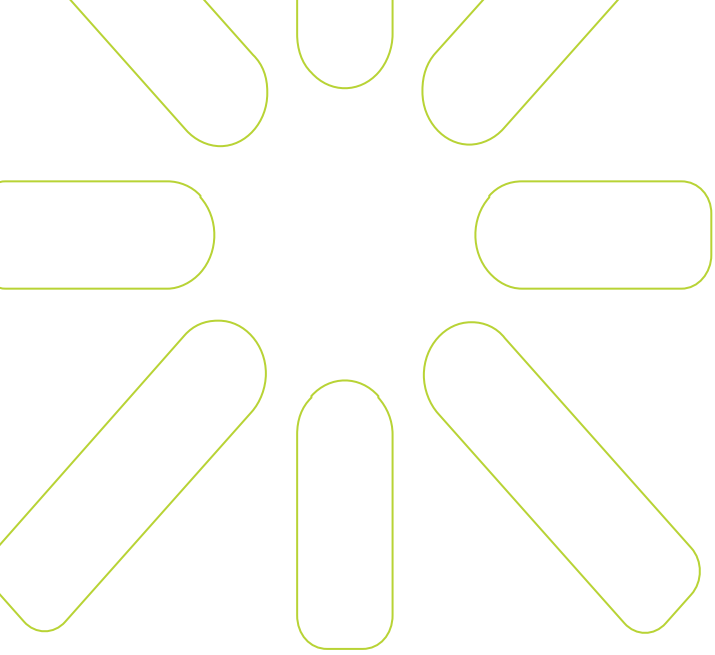


valspar



Accelerated Weathering: The QUV Decision - QUV-A or QUV-B

Technical Paper



For more than 200 years, Valspar has been an industry leader, formulating coatings rugged enough to withstand the harshest of conditions while maintaining their beauty over time. Exposure to sun (UV light), moisture and humidity, high temperatures and temperature fluctuations can have a significant impact on the performance of a coating over time.

As part of the ongoing coating development process at Valspar, scientists evaluate the performance of Valspar coatings using a variety of tests, measures and field performance feedback to ensure coatings

withstand the damaging forces of nature, providing the excellent long-term durability Valspar customers have come to expect.

The Science Behind Outdoor Weathering

Valspar has over 47 years of outdoor exposure testing history of its coil coatings. After initial exposure, coatings are typically measured for chalk and fade at three- to five-year intervals. Outdoor Florida exposure angles may include 45°, 90°, 5° and the latitude of the exposure site location, all facing south. The most common exposure angle is 45° facing south.

- **Chalking:** A powder chalk on paint is caused by degradation of the resin system and pigments. As a resin system breaks down, resin particles take on a powdery appearance. Testing of this phenomenon is performed by ASTM D 4214 test procedure and is measured by rubbing a soft fabric over the exposure. The amount of powder picked up by this fabric is calculated on a scale of 1 to 10 with 1 being poor and 10 being excellent.
- **Fading:** Loss of paint color is caused by UV degradation of the pigment and resin system. Color is calculated in Hunter units according to ASTM D 2244 noting Delta E values or noted as ΔE . One ΔE is the minimal difference visible to the naked eye.

Weathering Testing

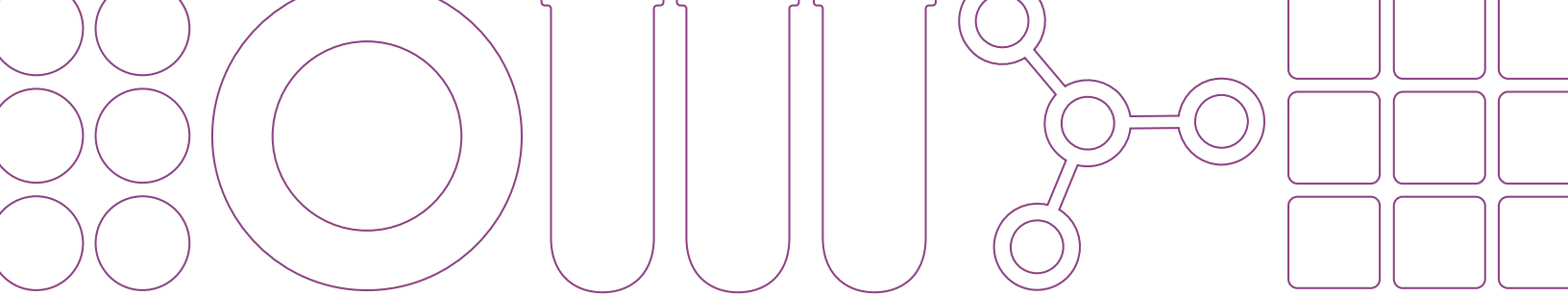
Valspar uses several methods to measure how weathering conditions impact coatings. Weather damage can include color change, gloss loss, chalking, cracking, crazing, hazing, blistering, embrittlement, strength loss and oxidation.

Three main types of weathering tests are available:

- **Natural Outdoor Weathering Testing:** Valspar owns a world-class ISO 17025 Accredited Florida Exposure Site with the same certifications as third-party testing sites.¹ This real-world test site has more than 100,000 panels on exposure—some dating back to the 1960s. Florida is considered an excellent location—high humidity, strong sun and salty air—to expose coatings to key factors that contribute to coating degradation. Valspar uses third-party test labs when required.



Valspar Natural and Accelerated Test Facility



- **Accelerated Outdoor Weather Testing:** Natural Solar Concentration Devices are the preferred accelerated method of testing coatings.² These outdoor devices concentrate natural sunlight via more reflective specially coated mirrors with the intensity of five to eight times the amount of sunlight achieved in natural conditions. By exposing coating test panels to the full spectrum of sunlight, these devices provide one of the most realistic accelerated tests available. It only takes about six weeks to get a full year of Florida weathering. Valspar uses this type of testing frequently for research, product and formulation.
- **Accelerated Indoor Weather Testing (QUV):** Valspar uses QUV Testing in its global Applied Science and Technology labs. Coated panels are placed inside a QUV Testing unit, where they are exposed to alternating cycles of UV light and moisture at controlled, elevated temperatures.



Q-Trac Natural Sunlight Concentrator Testing photo provided by Q-Lab, www.q-lab.com

QUV Lamps Weather Testing

Coated panels are placed inside a testing cabinet for QUV Testing. The two primary types of QUV Testing employ the same method for simulating dew and rain, using condensing humidity and/or water spray. However, the tests vary greatly in the spectrums of ultraviolet light used, causing markedly different results —no lamp captures the full wavelength of sunlight. Only natural sunlight and accelerated natural sunlight have that capability.

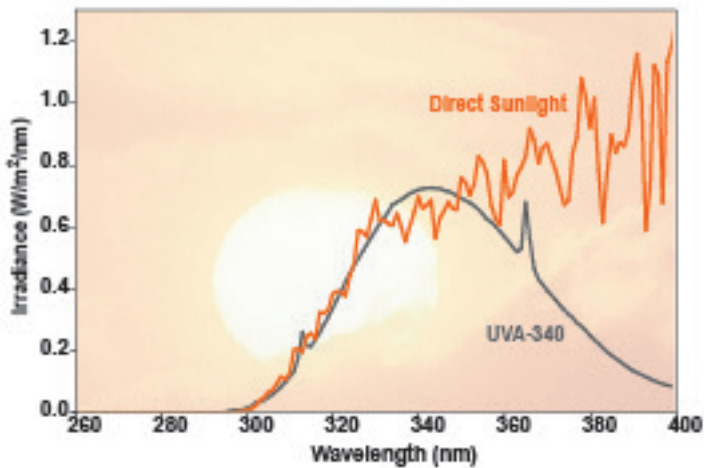


QUV® Accelerated Weathering Tester photo provided by Q-Lab, www.q-lab.com

All QUV lamps emit mainly ultraviolet rather than visible or infrared light. They are equivalent to an ordinary 40-watt fluorescent from an electrical perspective. However, each lamp type differs in the total amount of UV energy emitted and in its wavelength spectrum. Fluorescent UV lamps are typically categorized as UVA or UVB lamps based on the wavelength of the UV output.

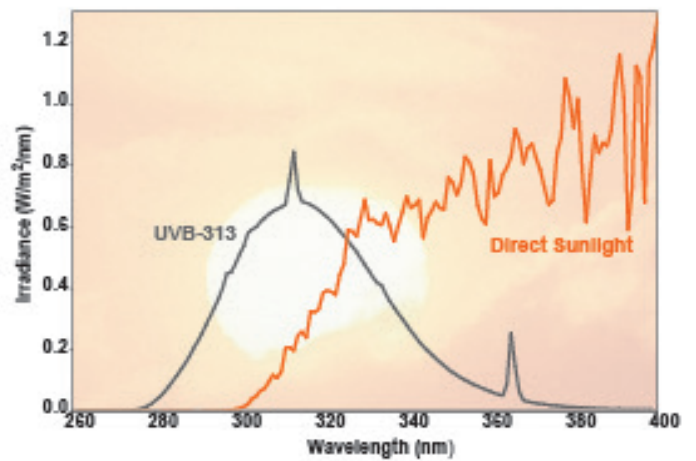
- **QUV-A 340 Testing:** Simulates the effects of real sunlight with fluorescent ultraviolet UVA-340 lamps, which provide excellent simulation of sunlight in the critical short wavelength region from 365 nm down to the solar cut-off of 295 nm. This type of UV lamp is recommended for QUV testing by the global ASTM G154 Standard. UVA-340 lamps are especially useful for comparison tests of different coating formulations.
- **QUV-B 313 Testing:** To speed up acceleration testing, UVB-313 lamps are used. They produce not only the shortest ultraviolet rays that the sun emits, they also emit unnaturally, short-wavelengths below what is found on the earth's surface, which can produce anomalous results. This type of UVB light can initiate chemical reactions to occur in the coating that would normally not be possible under natural, real-world sunlight exposures. This testing has been proven to have poor correlation to natural weathering. It can cause failures in good-quality coatings that would not occur in natural sunlight and false positives in coatings that contain low-quality pigmentation.

UVA-340 Lamps vs. Sunlight



QUV-A 340 Testing: UVA-340 lamps are the best available simulation of sunlight in the critical short-wave UV region.

UVB-313 Lamps vs. Sunlight



QUV-B 313 Testing: UVB-313 lamps produce mostly short-wave UV for maximum acceleration use UV rays not present in the earth's natural sunlight.

QUV-A 340 and QUV-B 313 charts provided by Q-Lab

QUV Testing and Pigmentation

Pigments are the key color ingredient in a coating formulation and can either enhance or degrade overall performance of the coating depending on their quality. No type of QUV testing is considered a good indicator of performance for coatings that use low-cost color pigmentation. Only natural outdoor weathering tests have been proven to detect the inferior performance that may result from the use of these pigments. Too often, detractors will use UVB measurements to make their inferior system appear to perform better. Real-world conditions are the only "truth indicator" of a system's strengths and weaknesses.

Valspar Coatings Performance in QUV Testing

Valspar's weathering research is predicated on what will occur with natural weathering conditions. In QUV-A 340 Testing, Valspar coatings perform well because they are formulated to perform well under real-world conditions. Valspar Coil and Extrusion products would not be expected to perform particularly well under QUV-B 313 Testing because the UVB lamps unnaturally breakdown the resin composition, which can provide erroneous results compared to natural sunlight. Our research is predicated on what will occur with natural-weathering not what may occur in UV wavelengths that are not present in the earth's natural sunlight.

Correlation Between Natural and Accelerated Weathering Testing

When performing accelerated testing, the results must correlate to natural weathering data to be meaningful. Although there is no exact accelerated test that completely simulates natural weathering, expert data is available to help us choose the testing that is closest to actual weathering. Valspar has thoroughly explored the correlation between natural outdoor weathering and QUV testing and has found QUV-A 340 testing superior over QUV-B 313 testing.

10-Year Independent Exposure Study

In 2005, a 10-Year Independent Exposure Study was initiated jointly by the National Coil Coaters Association and ASTM D01.53 Coil Coatings subcommittee. Independent, third party weathering tests were performed by Commercial Weathering Sites and Laboratories using:

- 23 coatings and five chemistries
- Seven exposure protocols
- Five parameters for measurement

Study Results Conclusive

The Spearman Ranking method—measuring the statistical dependence between two variables—was used to compare the data generated.

This groundbreaking study was conclusive: no accelerated technique adequately predicts long-term real-time exposure performance. One outstanding ranking difference can be seen in this example:

Coating Performance Discrepancy

In this study, Coating A exposure ranked #1 in QUV-B 313 Testing and received a #15 Ranking in natural 5-year, Florida Exposure testing. No correlation was found between QUV-B 313 and natural weathering.

Conclusion

Weather testing is a critical component of formulating new coatings or improving current formulations. At Valspar, the Research and Development team puts all new formulations through rigorous testing at various stages of the development process to formulate the right coating for the right application, ensuring long-term durability and performance once the coating is applied.

Valspar uses all three types of testing described in this paper. Outdoor natural weathering tests provide the most real-life opportunity to see how coatings perform over years and decades. Accelerated outdoor weathering tests (e.g. Solar Concentrator) are critical when formulating and testing new coatings. Indoor cabinet testing is used not only for UV light exposure but for testing coating performance with exposure to moisture, humidity, heat and changing temperatures—all natural elements that can degrade a coating over time. For Accelerated Indoor UV light testing, Valspar scientists have found, and industry sources have corroborated, that the most valuable type of UV light testing for Coil and Extrusion coatings is use of QUV-A 340 Ultraviolet Testing.

Although no accelerated test completely simulates natural weathering, there is substantial expert data to help coating manufacturers choose the right combination of comprehensive testing that is closest to actual weathering depending on the stage of the coating development process.



Industry Experts on Value of QUV Testing

UVA Most Realistic

"The QUV with the UVA-340 lamp produces the most realistic simulation of sunlight in the short wavelength portion of the spectrum. The result is a tester that provides excellent correlation with outdoor tests."

– Q-LAB Corporation, QUV Tester, www.q-lab.com

UVB Too Destructive

"UVB testing is too destructive to resin systems and masks any effects from the pigments."

– BASF, Pigment Research, Germany

No Accelerated Technique Adequately Predicts

"The 2005 Final Report on the Subject of Accelerated Weathering 10-Year update to ASTM D01.53 was supported by and presented to the NCCA. The main conclusion was that no accelerated technique adequately predicts long-term, real-time exposure. With respect to UVA and UVB, these two methods exhibit the worst correlation, with UVB-313 being the worst. UVA-340 is closer to sunlight than UVB, but both exhibit poor correlation to five years in Florida."

– Al Dunlop, Technical Director, NCCA

UVA More Appropriate

"Historically, our pigments have found the most use in PVDF/Acrylic systems, and this is how we do our weathering. We are starting to test more in polyester/melamine coatings and extruded acrylics as well as PVC. UVA is more appropriate for testing these systems"

– Mark Ryan, The Shepherd Color Company

UVB Provides Poor Correlation

"UVB is no longer widely used in Europe because it often gives poor correlation with outdoor test results. UVA is far from perfect, but in that sense significantly better than UVB. The difference is due to the fact that the spectra of the UVA bulbs is closer to the spectra of the sunlight compared to UVB. UVB lamps emit mostly shorter wavelengths than the sun, causing faster paint degradation, but the type and speed of the degradation can be unrealistic as it is caused by a type of UV-radiation that is not present in natural sunlight."

– Annina Alanen, Technical Manager, European Coil Coaters Association

QUV-A Use Recommended Over QUV-B

"While it takes longer to effect changes in highly UV durable products with QUV-A, I feel its use is warranted over QUV-B, because the UV portion of energy distribution on QUV-A bulbs is much closer to the UV spectra present in natural sunlight. The QUV-B bulbs have a portion of the energy spectrum that does not exist (other than in outer space). Functionally, that means the QUV-B bulb artificially introduces levels of energy that may activate portions of the polymer chains. This "false" activation would create free radicals in the polymer that would not exist in natural exposure, creating false negative results on systems that would be good performers in the real world. This becomes increasingly important when comparing products that have significantly different compositions (resins, pigments, additives)."

– Eric Fossen, VP Sales and Technology, Continuous Colour Coat Ltd/Metal Koting

QUV-A Can be Useful

"Fluorescent UV testers can be a useful type of artificial testing because the spectral intensities of the UVA-340 bulbs are very similar to natural sunlight in the shorter wavelength region."

– Atlas Material Testing Solutions, Weathering Test Guidebook (atlas-mts.com)

Sources:

All references in this paper to specific organizations and companies are included with express written permission and include:

- ASTM D01.53 Coil Coatings subcommittee
- Atlas Material Testing Solutions
- BASF
- Continuous Colour Coat Ltd/Metal Koting
- European Coil Coaters Association
- National Coil Coating Association (NCCA)
- Q-Lab Corporation
- Shepherd Color Company
- Valspar Coil Coatings global technical team

Footnotes:

¹Valspar's Fort Myers, Florida Test Fence is the most accredited manufacturer's test facility in the coil coatings industry. Site accreditations include:

- ISO 17025 Accredited by A2LA (American Association for Laboratory Accreditation) Accredited for Testing and accredited Exposure Site
- EPA 1st Party Laboratory - Roof Coatings, listed on Energy Stars Website
- Accredited Manufacturing Test Lab - CRRC (Cool Roof Rating Council)
- AAMA Verified Component Laboratory - American Architectural Manufacturers Association

Additional Valspar exposure testing facilities include Rochester, PA; Garland, TX; Bowling Green, KY; Marengo, IL; Queensland, Australia; Guangdong, China; and Shanghai, China. These facilities work together to test coatings in every condition possible by Valspar's technical staff that has been evaluated, tested and retested by Accreditation Bodies. During the process, factors relevant to a laboratory's ability to produce precise, accurate test and calibration is assessed, including the testing environment and handling of test items to meet industry standards.

²Q-Lab® is a registered trademark of Q-Lab Weathering Research Service.



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