

Natural Weathering Testing

A Basic Introduction on How to Perform the Best Natural Weathering Test

Q-Lab Corporation
Michael Crewdson

[View Recorded Presentation](#)

Administrative Notes

You'll receive a follow-up email from info@email.q-lab.com with links to a survey, registration for future webinars, and to download the slides

Use the Q&A feature in Zoom to ask us questions today!

Join us next week for Part 2:
Accelerated Outdoor Testing



Thank you for attending our webinar!

We hope you found our webinar on *Natural Outdoor Weathering Testing* to be helpful and insightful. The link below will give you access to the slides and recorded webinar.

You can help us continue to provide valuable and high quality content by completing our [3-question survey](#) about your webinar experience. Every piece of feedback is carefully reviewed by a member of our team.

Scope

- Products left outdoors lose performance and aesthetic properties
- Weathering tests are used to determine how well a product, or material, will resist the effect of long term outdoor exposure
- Accelerated testing is now the *most common* method for estimating service life, but ...
- Natural Weathering is the *most accurate* method for doing durability testing

Significance

- Natural outdoor weathering is the most accurate way to understand the durability
- One widely-held myth is that natural weathering is slow
 - Product development cannot afford to be slow
- Accelerated weathering is first choice
 - But accelerated weathering can give misleading results
- Outdoor weathering is never wrong
 - Benchmark testing can be reasonably quick too

Different ways to get outdoor results

- Field surveys
 - But you don't know the full history of exposure and usage
- Review a history of customer complaints
 - Generally this is too late to be of any use except for reference
 - Need to know before it becomes a complaint
- Put a sample of your product outdoors and see what happens
 - Depending where you are, this might influence the relevance
 - Might not be a good representation
- Consider sending specimens to an accredited third-party commercial test facility

Why Use a Third-Party Site

- Commercial test sites operate in recognized benchmark climates so that companies can get most relevant data
 - Commercial test sites provide unbiased results on the durability performance of their product
 - Commercial test sites have trained personnel to ensure the testing is done correctly
 - Commercial test sites provide all the specified documents and reports
- Commercial test sites have the experience to recommend the best methods
- Commercial test sites have all the proper equipment for exposures and evaluations

Choosing a test procedure

- There is no single “one-size-fits-all” standard exposure test
 - All options in a test must be reviewed and selected
 - Each option may affect the outcome of the test
 - Choose the options that best suits the end use of the product

• Options

Location (where to test)

Type of Exposure

Angle of Exposure

Backing or no backing

Duration

Services (washing?)

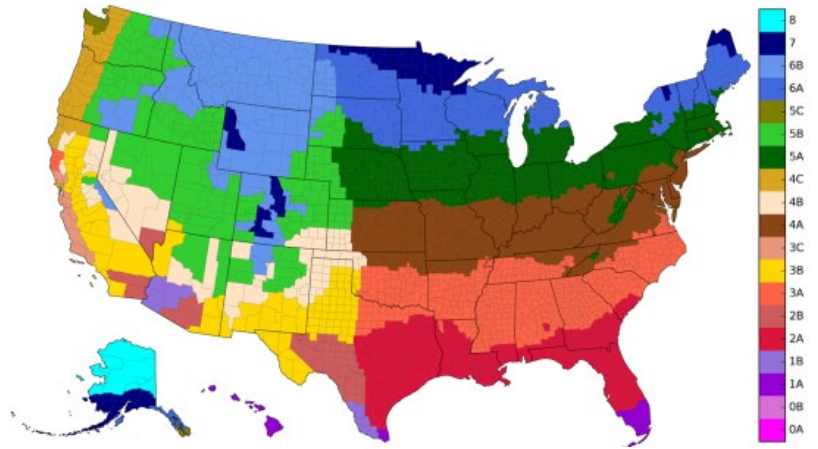
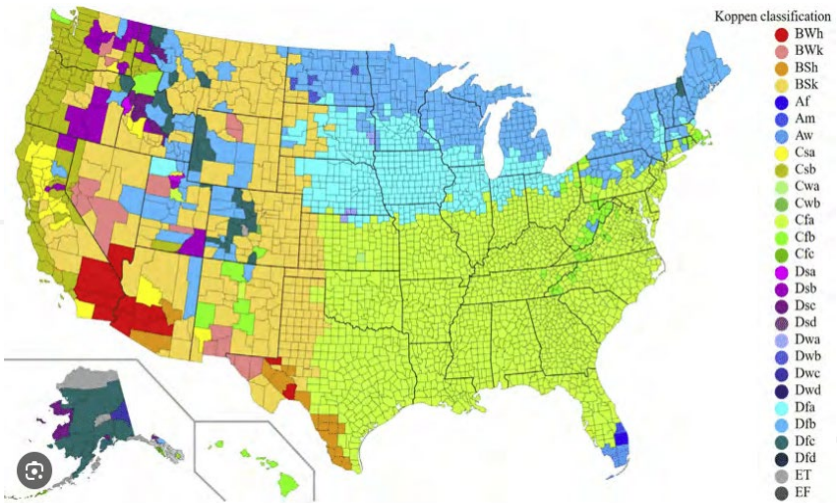
Evaluations

Type of Specimen

Climature Categories

Köppen System

ASHRAE System



Commercial Benchmark Locations

- Send your specimens to an accredited lab
- Use a benchmark climate
 - Florida, Arizona
 - Recognized, comparable
- Benchmark locations are there for a good reason
- For USA, two major geo-climatic regions



Where to Test: Florida or Arizona

Florida

- Primary Benchmark
- Hot, Humid, Sunny
- Represents most temperature locations
 - Eastern USA, Europe, East Asia, Africa, South America, China, India

Arizona

- Primary Benchmark
- Very Hot, Dry, Sunny
- Represents most dry locations
 - Western USA, Middle East, North Africa

Primary test locations



Arizona



Florida

How to Test: Type of Exposure

For Panels/Specimens

- Direct Exposure
- Black Box
- Under Glass
- Salt Spray
- Mildew
- Based on end-use position

For Whole Products

- Service Position
- Special Projects
- In Use Environment
- Recreate the actual usage

How to Test: Direct Exposure

- Most appropriate option
- Open to all weathering elements
- Specimens receive direct sunlight and rain
- Special exposure racks for mounting panels
- Choice of angles, facing direction, and orientation



How to Test: Black Box

- Specimens are exposed at 5° south of the top surface of large metal box
- Box is 12 ft wide by 5.5 ft high and 9 in deep
 - 3.65 m wide × 1.65 high × 0.23 m deep
- Black Box retains heat from the radiant solar exposures
- Designed specifically for automotive coatings and used only in Florida
- Can also be used for any direct exposure that needs higher temperatures



How to Test: Under Glass

- Specimens are exposed behind a sheet of glass
- Glass filters out some UV and protects from rain
- Specimens are 3" (75 mm) below glass cover



High-Temperature Glass Box

- Under Glass Black Box
 - Used in Arizona to test automotive interior materials
- Q-Lab AIM Box
 - Automotive Interior Material
 - Sealed
 - Automotive glass cover
 - Temperature limited
 - 79, 85, 93, 102, 110 °C



Salt Spray

- Originally designed for testing automotive parts for resistance to road salt
- Scribed panels are sprayed 2x per week with 5% salt
- Test usually runs only 10 to 20 weeks



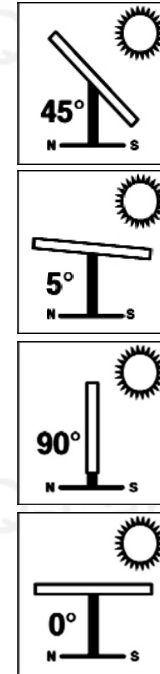
Biological Exposure

- Mildew grows in shaded, sheltered locations
- Average RH between 70 and 85%
- Regular racks at 90° North
- Enhanced mildew rack faces North in trees
- Add extra water mist to get algae



How to Test: Exposure Angle

- 45° used for majority of specimens
 - Industrial coatings, wood varnishes,
- 5° used for automotive coatings, flat roofs, decking
- 90° used for siding, architectural paints
- 0° horizontal used when water ponding is desirable
- Latitude angle (25° in So.Fla.) used for solar panels
- Variable angle (5, 25, 45°) maximizes solar radiation



How to Test: Backing Types

Open (Unbacked)



- Specimens are open to the atmosphere on all sides
- Most common type
- Rigid panels and boards
- Hard plastic specimens

Mesh



- Supports flexible specimens: rubber-like
- Mounting 3D specimens
- Does not significantly raise temperature
- Does not affect wet time

Solid



- Solid backing for textiles and fabrics
- Generally increases wet time and temperature
- End use simulation
- Insulation

How long should the test last?

- Based on Specification
 - Time is set by a material specification, thus pass or fail
- Based on an arbitrary calendar duration
 - Example 6 months, 2 years, or 5 years
- Based on arbitrary solar radiation dosage
 - Example 1 Florida Sun Year, 5 years AZ ultraviolet
- Based on Critical Failure
 - When the specimen reaches a certain pre-set failure point
- Based on Comparative Evaluations
 - When enough difference between test and reference specimens

Specimen Types

Specimens

- Panels, coupons, swatches, plaques, boards, bars
- Single material
- Easier to handle
- Basic property data
- Surface appearance properties
- Preparation adds variability
- Generally test in multiples

Objects

- Windows, wheels, doors, roofs, decks, cars, houses
- Component pieces
- Bigger, require more space
- More realistic data than specimens
- Taken from production line
- Generally tested as single item

Best Sizes for Testing

Too small?

- Big enough to handle
 - Small specimens need specialized hardware
- Will not fit into a standard frame
 - Mask area too big
- Mounting charges

Too big?

- Harder to move
- Extra costs for exposure
 - Uses more rack area
- Mounting charges
 - If special frames must be constructed

The "Goldilocks" specimen is a 4" to 6" x 12" panel

Rigid Panels

Most specimens fall into this category

- Rigid, self supporting
- Metal or wood
- Flexible materials get backing



Other Specimens

- Non-Panels
 - Fabric swatches, 3D objects, very small panels
 - Exposed on “sub-frames”
- Usually a higher charge
- More handling labor for the lab
 - Mounting and exposing
 - Storm protection



No Size Restrictions for “Objects”



Services

- Washing
 - Cleaning off the dirt and mildew
 - Allows more weathering effect on the surface
 - Physical damage possible (micro scratches on softer surfaces)
- Clipping
 - Cutting off a portion of the exposure specimen
- Masking
 - Covering a portion of the specimen to get a contrast

Evaluations

- Data on the status of the Weathering
 - Visual Evaluations
 - Color Measurements
 - Gloss Retention
 - Physical Properties
- Progress reports
 - At least every 25% of the duration
- Final Report
 - Collate all documents for complete dossier



Comparative Testing is the Best

- Compare two new products
 - Is it better, the same, worse?
 - Is it same performance but cheaper to make?
- Compare a new product to an old one
- Compare a product to a competitor
- Compare one batch to another
 - Quality control

Weather Data

- Ambient temperature and humidity
- Rainfall amount and duration
- Wet Time
- Black and White Panel Temperature
 - Direct, Black Box and Under Glass Total
- Solar Radiation
 - 0, 5, 25, 45, 90 degrees South
- Total UV Radiation
 - 0, 5, 25, 45, 90 degrees South
- Under Glass radiation
- Wind speed and direction



Uncertainty and Variability

- ASTM G141 lists variability
 - Seasonality
 - Year over year
- Specimen uniformity
- Uncertainty in Results
 - Evaluations
 - Sampling plans
 - Specimens

Benchmark Advantages

- A test in a benchmark location is fast and accurate
 - A great test is both fast and accurate
 - Same results but faster is only acceptable outcome
- Data from a benchmark site is comparable to other tests
- Benchmark weathering data is readily acceptable
 - Already written into many specifications

How much acceleration?

Generalization at its finest

- Florida (compared to most *temperate* climates)
 - 2× for other southern locations
 - 3× for mid-latitude locations
 - 4× for northern temperate locations
- Holds true for all temperate regions ~ 25 to 60 ° latitude
 - With some exceptions
- Arizona (Compared to most *dry* climates)
- Acceleration data not as well published as that for Florida

Outdoor compared to Accelerated

Outdoor

- Slower
- More accurate
- Less Variable *
- Any size specimens
- No quantity limitations
- Always correct**
- Great value

Accelerated

- Faster
- Some risk in every test
- Higher variability
- Only smaller specimens
- Quantity limitations
- Never 100% reliable

* *Short duration tests have variability issues*

** *As long as the correct test protocol has been used*

Realistic Expectations

Satisfaction increases with manageable expectations

- Outdoor weathering is slow but more repeatable
- Take advantage of the larger capacity and less expensive costs
 - More replicates, and more varieties
- Outdoor weathering is necessary to confirm accelerated results
- Interim evaluations and statistical proofing are absolutely needed
- *Comparative* testing is the most reliable method

Thank you for your time.

Questions?
info@q-lab.com

We make testing simple. |

