Accelerated Outdoor Weathering Testing

Principles and Case Studies

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Q-Lab's Outdoor Testing Series

- This is the second of a two-part webinar series on outdoor weathering test exposures
- Last week we presented a brand-new version of natural outdoor weathering testing
- All upcoming and archived webinars can be accessed at: q-lab.com/webinars

Date	Topic
15 Feb	Natural Outdoor Weathering
22 Feb	Accelerated Outdoor Weathering

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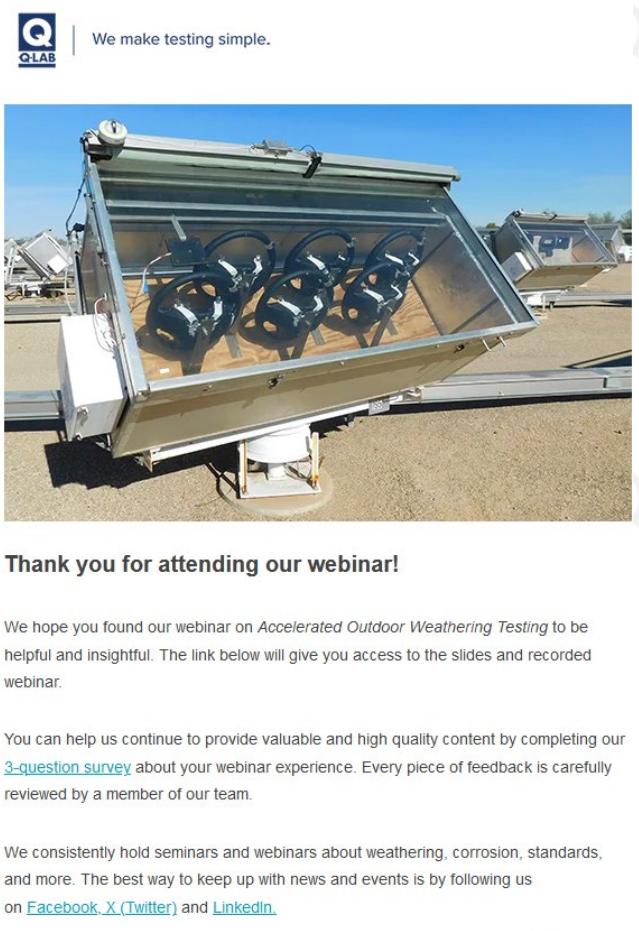
Administrative Notes

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!



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Thank you for attending our webinar!

We hope you found our webinar on *Accelerated 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.

We consistently hold seminars and webinars about weathering, corrosion, standards, and more. The best way to keep up with news and events is by following us on Facebook, X (Twitter) and LinkedIn.

Big Announcement!

- Q-Lab has acquired Arizona Desert Testing, LLC (AZTest)
- Our combined enterprise is now called **Q-Lab Arizona Desert Testing** and is located at the AZTest site in Wittman, AZ
- Contact us for Arizona natural and accelerated outdoor testing!

Q-LAB | Q-Lab Arizona Desert Testing
Formerly known as Arizona Desert Testing, LLC
AZTEST

What is *Accelerated Outdoor Weathering?*

… outdoor weathering using the sun as the source of irradiance, and where the rate of deterioration is accelerated by increasing one or more of the influencing parameters above a level obtained in the natural environment.

From ASTM G113 “Standard Terminology Relating to Natural and Artificial Weathering Tests of Nonmetallic Materials

Why Accelerated Outdoor vs. Laboratory?

Real world conditions are **more complex**

Outdoor allows for testing of **larger specimens**

Excellent balance between **speed** and **realism**

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Common forms of Acceleration in Outdoor Testing

- Increased Irradiance
  - Solar concentration and/or tracking the sun
- Modified Temperature
  - Trapping/Adding Heat or Freezing periods
- Increased Moisture
  - Supplementary water spray

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Interior Materials Testing

AIM Box

TRUE-AIM Box

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Automotive Interior Materials (AIM)Boxes

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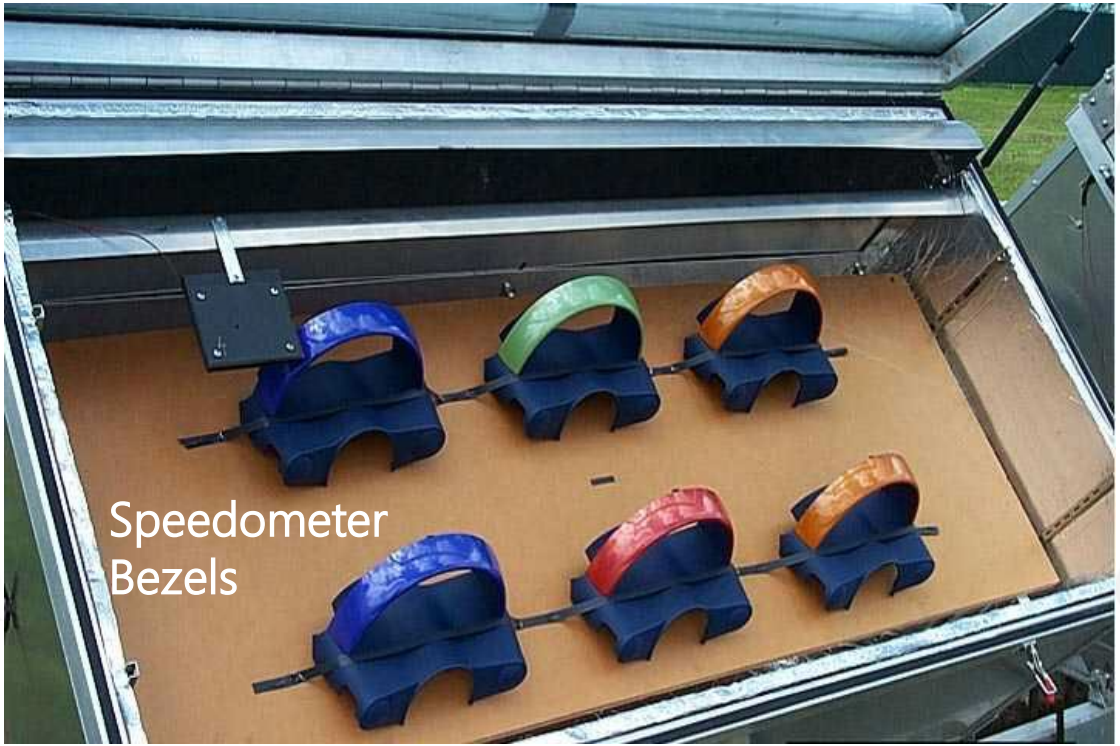
Outdoor Tests for Interior Components



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Automotive Interior Materials

AIM Box

- Reproduces extreme heat from automotive interior
- Can test entire instrument panel
- Different plastics experience different thermal expansion
- Generates differential stresses between different interior plastics

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AIM Box Configurations

- **Location**: Arizona or Florida
- **Movement**: Static 45°S or Tracking 51°S
- **Glass**: Tempered clear or laminated safety
- **Temperatures**: Range of 85 to 110 °C Black Panel

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TRUE-AIM Box

- TRUE (**T**racking **R**eflecting **U**ltra **E**xposure) AIM box increases total solar radiation exposure
- Highly reflective mirrors and dual-axis tracking (azimuth and elevation) to focus more sunlight into the box interior.
- Glass types and temperature limits are same as regular AIM Box
- Approximately doubles total sunlight received by specimens

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Natural Sunlight Concentrators

Fresnel Concentrator

Solar Concentrator

Q-TRAC

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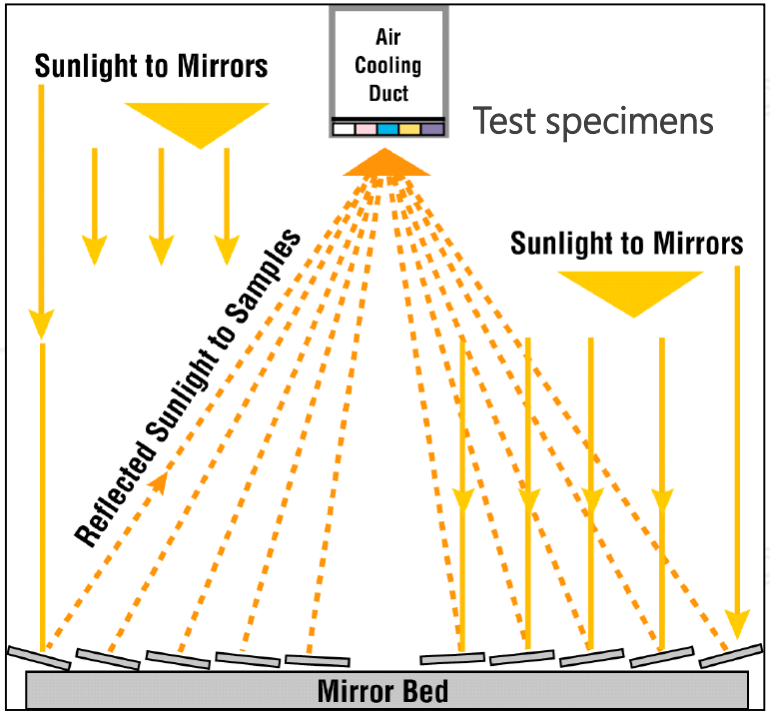
Sunlight Concentrating Mirrors



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Mirrors Reflect Sunlight onto Specimens

Mirrors on average reflect 80% of solar UV radiation

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Tracking the Sun

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Arizona Only

- Clear skies are required for tracking and concentration to work correctly
- Much lower efficiency when light is diffuse (cloud cover)
- Needs high ambient temperatures in winter
- Doesn’t work in inclement weather!

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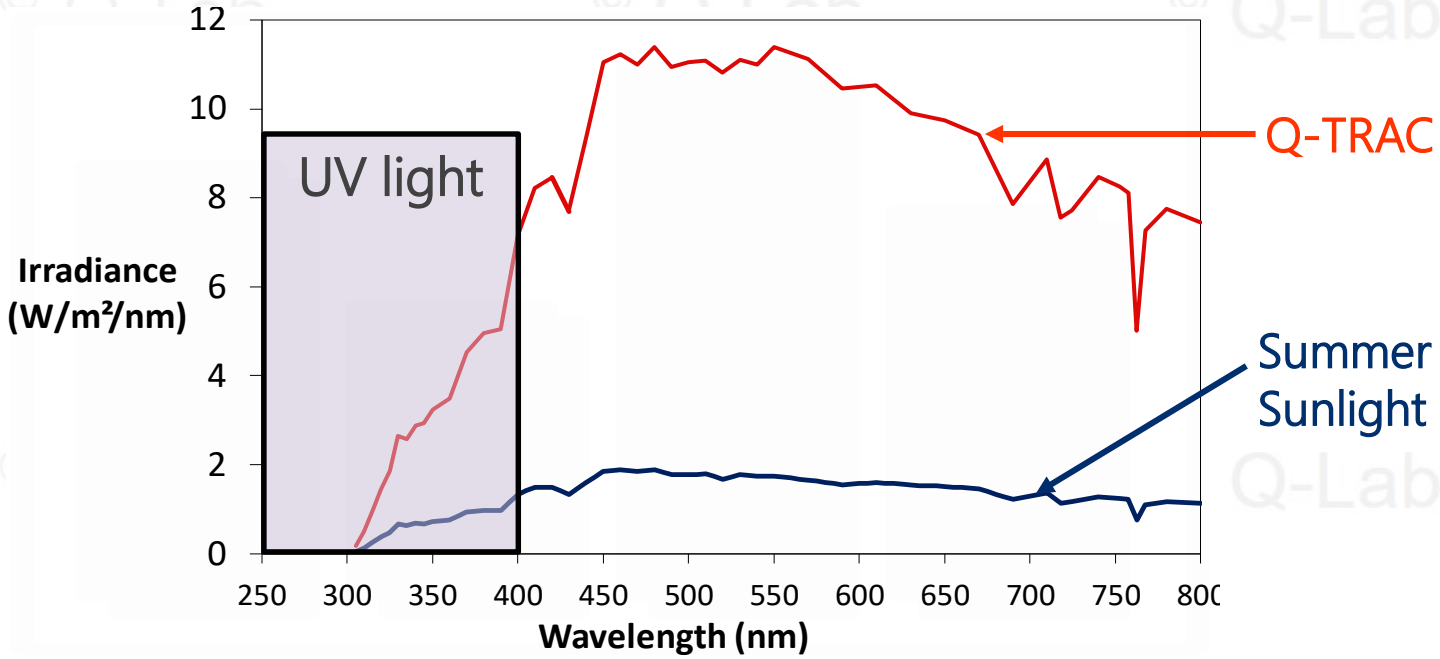
Summer Sunlight vs. Q-TRAC

~8× UV Irradiance of Natural



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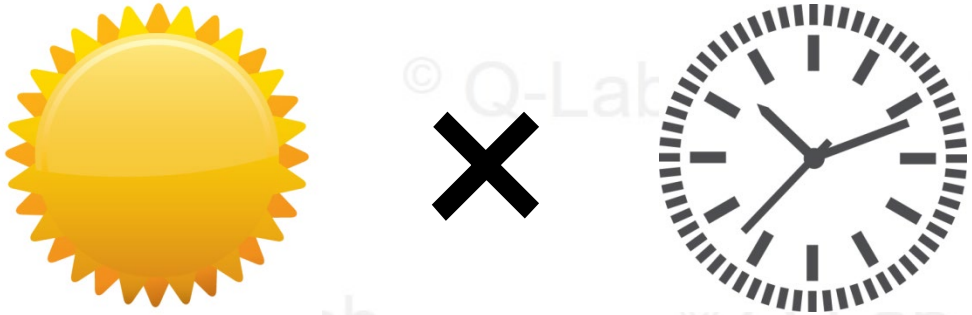
Radiant Exposure



The accumulated light energy received on a surface over a period of time, per unit area [usually MJ/m^2]

Q-TRAC tests are timed in radiant exposure, so tests finish quicker during summer months

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Q-TRAC Tests Are Usually Timed by Accumulated Radiant Dosage

Exposure Angle	1 Year Florida Energy (MJ/m^2 TUV)
0° South	322
5° South	339
25° South	345
45° South	320
90° South	170

- A Florida year is commonly defined as **280 MJ/m^2**
- Q-TRAC standards deliver **~1400** MJ/m^2 annually
- This is therefore **~5×** a typical year in Florida

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True or False?

5× the sunlight

means

5× the degradation

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Q-TRAC Acceleration

- Receives ~5 times more UV dosage
- Therefore ~5 years Florida sunlight in 1 year
- However: Light intensity is only one stressor

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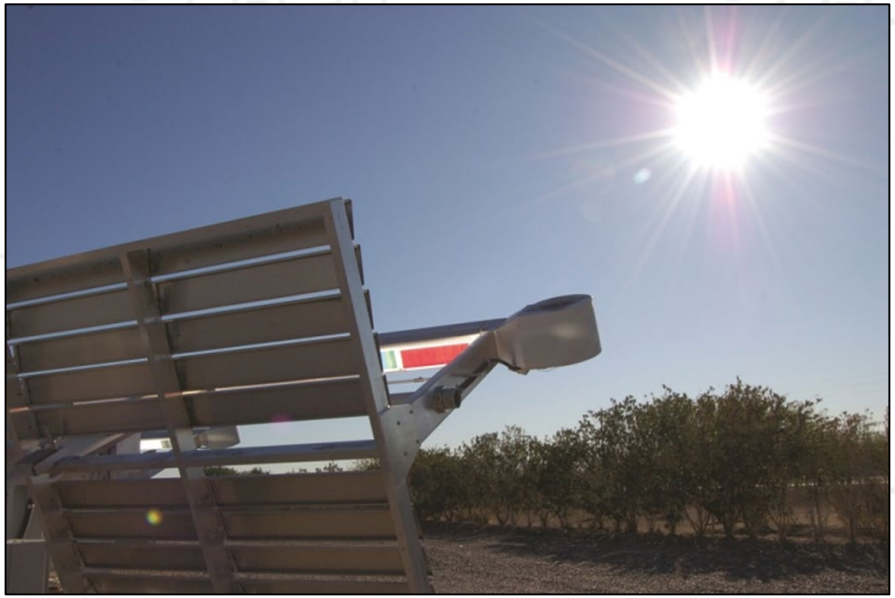
Outdoor accelerated testing

Temperature Effects



High temperatures come from both ambient desert conditions and from concentrated sunlight

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Q-TRAC Applications

Best for durable, high-temperature materials

- Coil Coatings
- Powder Coatings
- Roofing
- Building Materials
- Automotive Paints and Parts
- Some Plastics

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Q-TRAC Target Board

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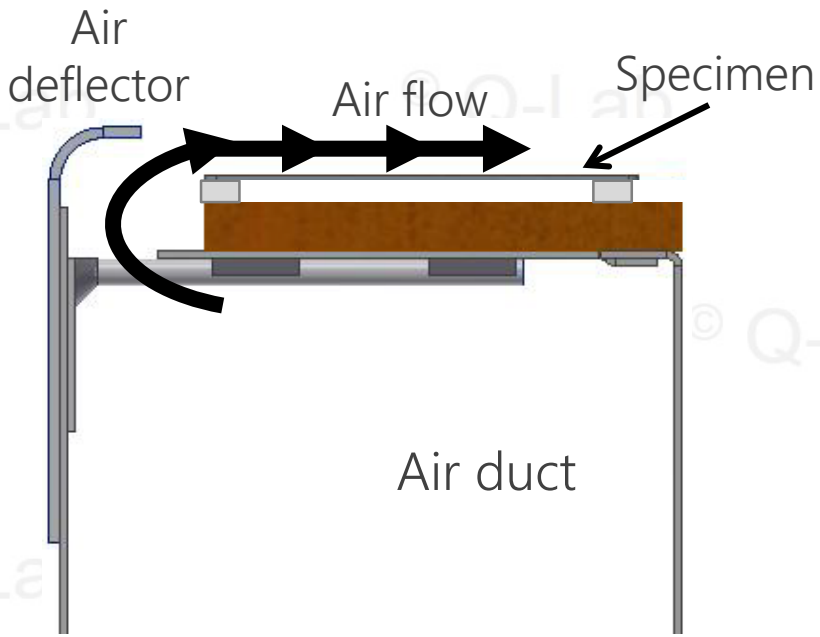
Q-TRAC Specimen Mounting

- Flat Specimens
  - Backed or unbacked
- Length < 14 cm (5.5 in)
  - Maximum to fit on target board
- Width
  - Tests are charged by length along target board
- Thickness < 2.5 cm (1 in)
  - All specimens should be similar thickness



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Temperature Effect of Mounting

	Open / Mesh	Plywood Backed	Black Box	Natural Sunlight Concentrator	
				Conventional	Temp controlled
Black Panel (˚C)	50	70	80	100	70
White Panel (˚C)	40	50	60	80	50

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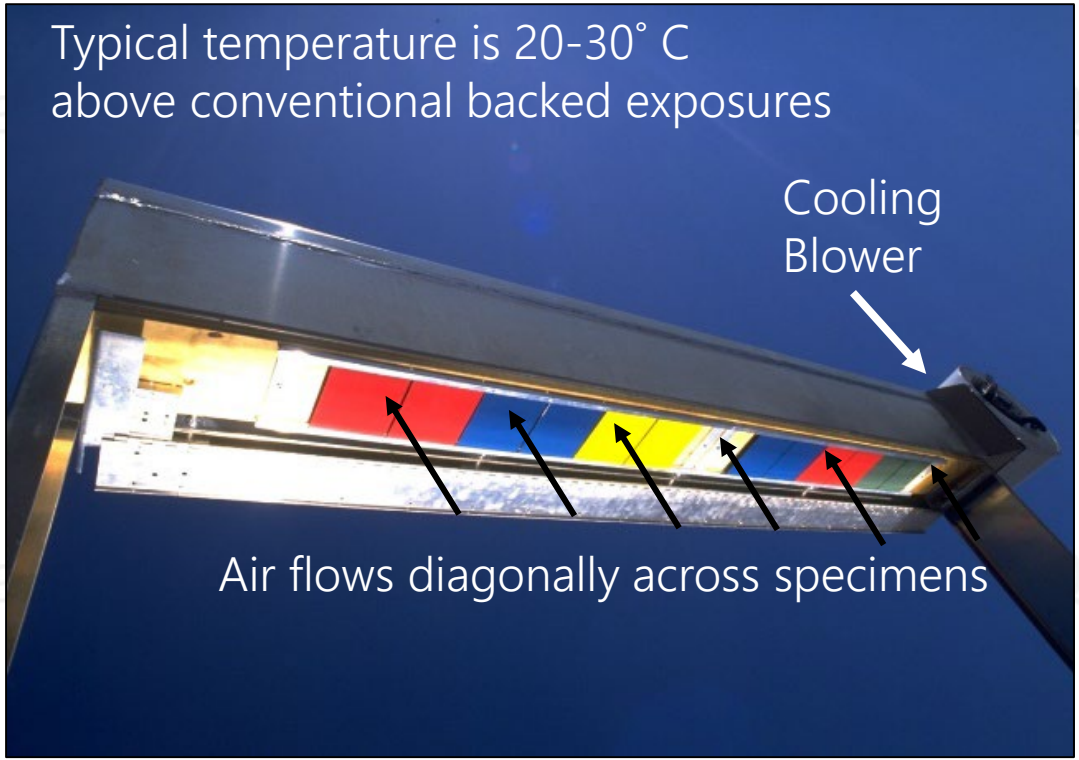
Q-TRAC Specimen Cooling



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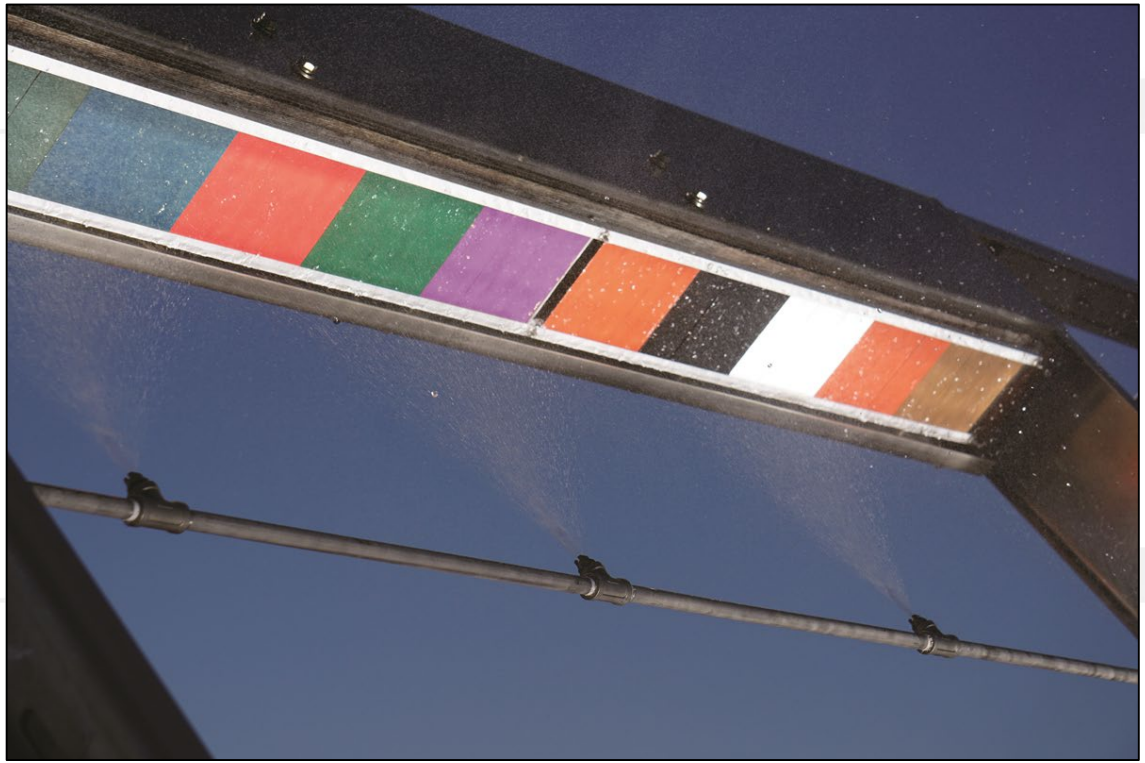
Water Spray



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Daytime water delivery

- Daytime spray dries quickly, causes thermal shock
- *Coatings do not absorb any water!*

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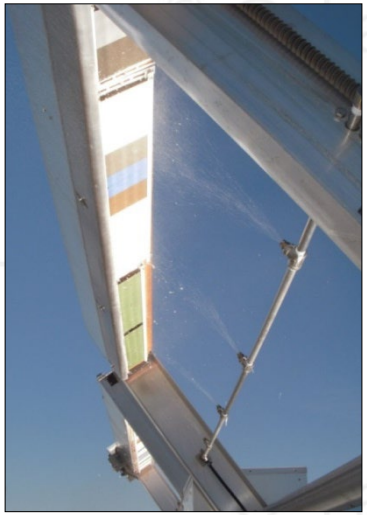
Outdoor accelerated testing

Night-time water delivery



ASTM G90 Cycle	Daytime			Nighttime		
	Spray duration	Dry duration	Cycles	Spray duration	Dry duration	Cycles
1	8 min	52 min	1 / hr	8 min		3 per night: 21:00, 00:00, 03:00
3	none			3 min	12 min	4 per hour (40 total) 19:00-05:00

- Frequent night-time spray cycles = high Time of Wetness
- Increased water presence = more realistic test

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Natural Sunlight Concentrator Cycles

Cycle	Application	Day	Night
Desert	Inks, Textiles, Building Materials	Sunlight only	Ambient
Spray (Day/Night)	Plastics, Coatings, Sealants, Building Materials, Wood Sealers	• Sunlight • Water Spray 8 min/hr	8 min Water Spray, 3 times a night
Spray (Night)	Plastics, Coatings, Sealants, Building Materials, Roofing	Sunlight only	3 min Water Spray every 15 min inverted position *(Wet like Florida)*
Soak/Freeze	Extremely Durable Factory Coated Hardboard, Roofing	• Sunlight • Water Spray 8 min/hr	Water Bath Soak 1 hour Overnight in Freezer -18 °C

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Q-TRAC Test Results

Correlation to natural outdoor product ranking & differentiation

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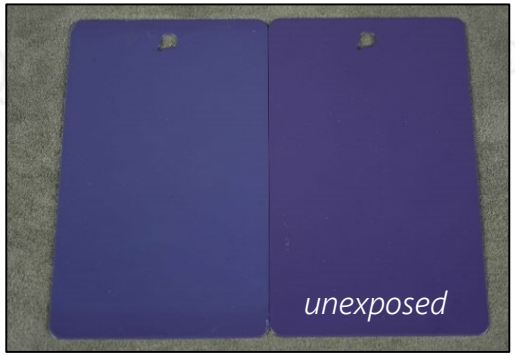
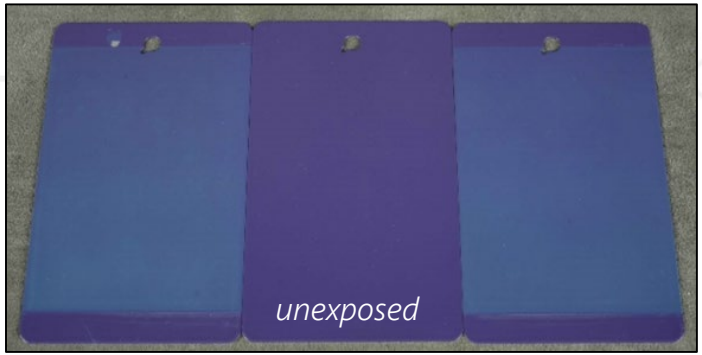
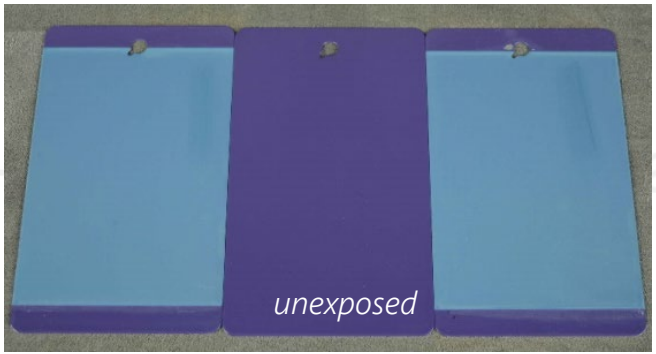
Q-TRAC / Direct Exposure Correlation

	Direct Exposure	Q-TRAC Exposure	
90 days			29 days
365 days			42 days

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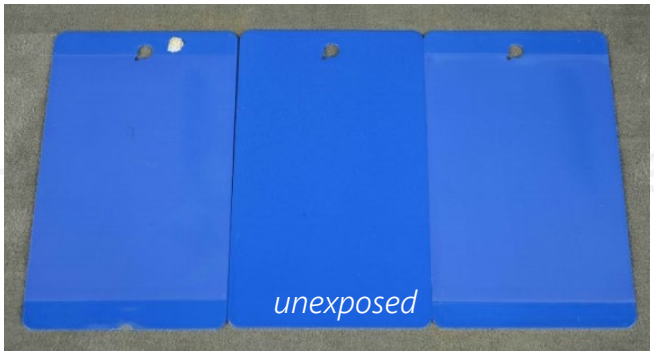
Q-TRAC / Direct Exposure Correlation

	Direct Exposure	Q-TRAC Exposure	
90 days			29 days
365 days			42 days

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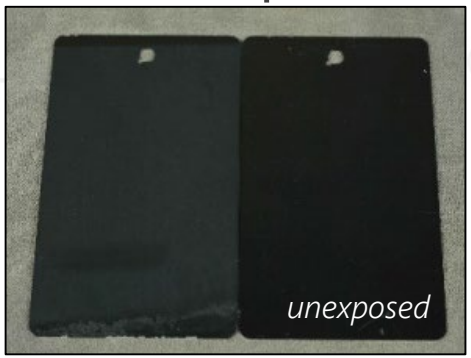
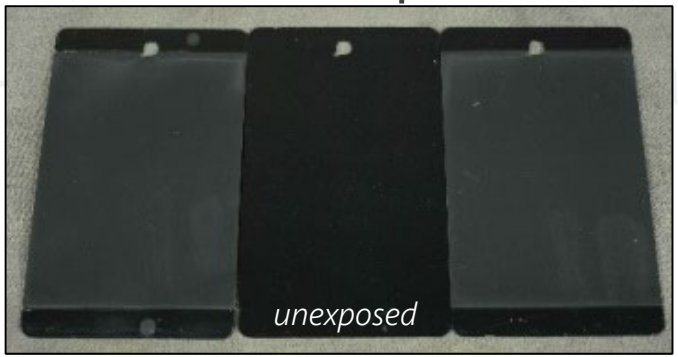
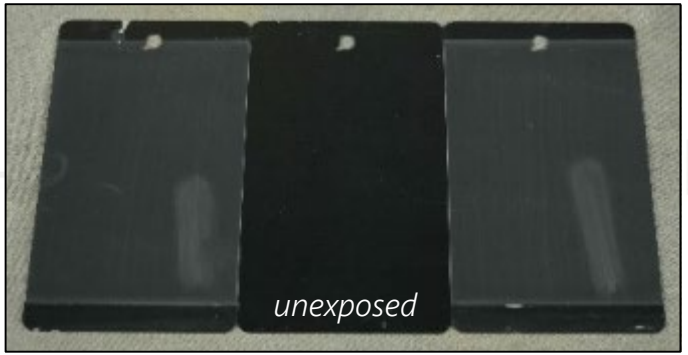
Q-TRAC / Direct Exposure Correlation

	Direct Exposure	Q-TRAC Exposure	
90 days			29 days
365 days			42 days

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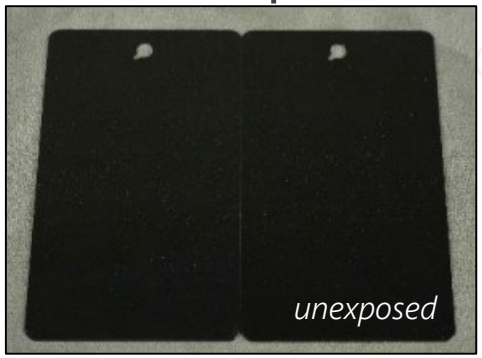
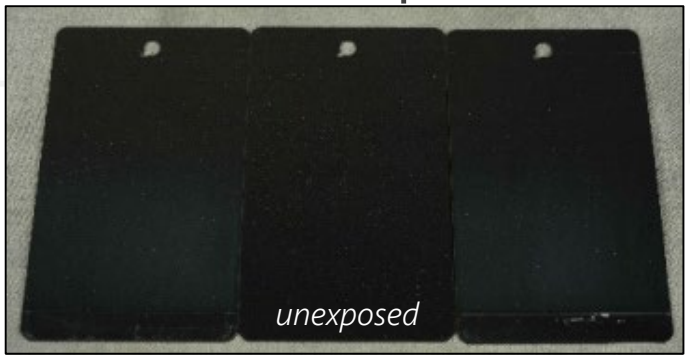
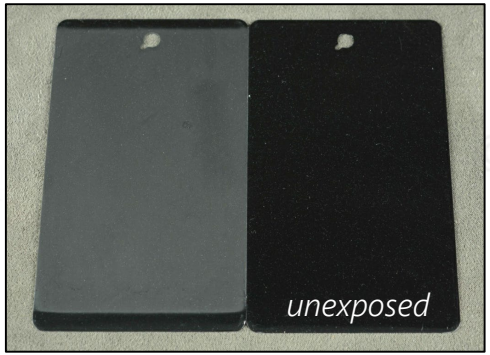
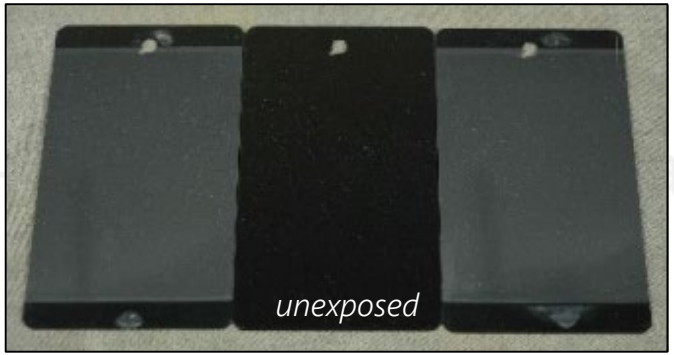
Q-TRAC / Direct Exposure Correlation

	Direct Exposure	Q-TRAC Exposure	
90 days			29 days
365 days			42 days

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Paint Performance Differentiation

Direct Exposure: 90 Days

Q-TRAC Exposure: 29 Days

Lower performance

Higher performance

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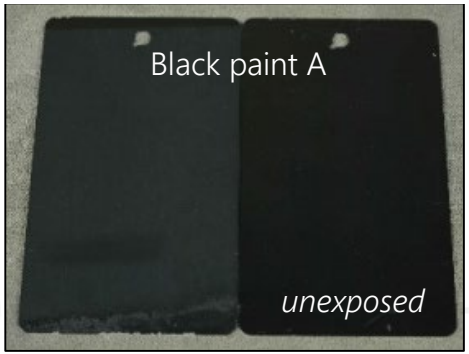
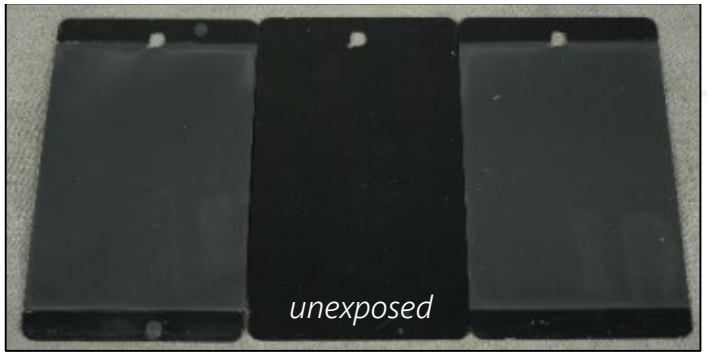
Paint Performance Differentiation

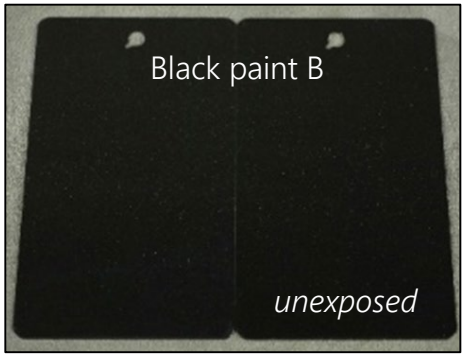
Direct Exposure: 90 Days

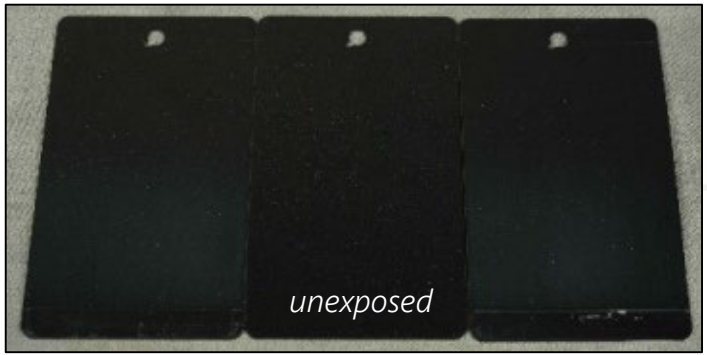
Q-TRAC Exposure: 29 Days





Lower performance





Higher performance

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Direct
365 days
Right unexposed

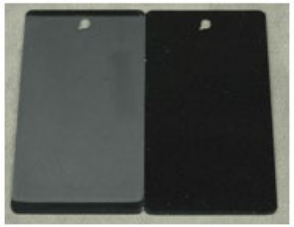
Q-TRAC
42 days
Center unexposed



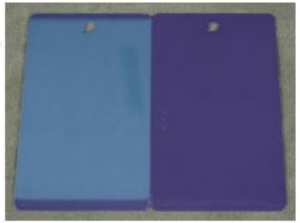










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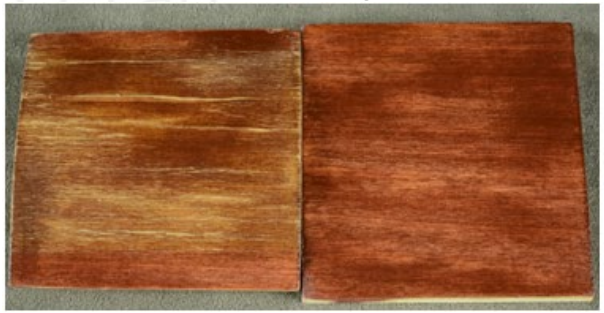
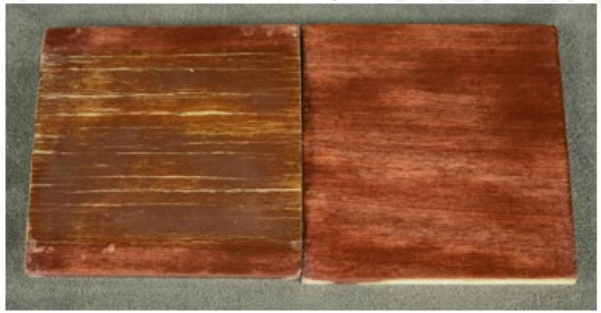
Q-TRAC Freeze/Thaw Cycle Correlation

	Direct Outdoor 365 Days	Q-TRAC Freeze/Thaw 42 Days
Wood A		
Wood B		

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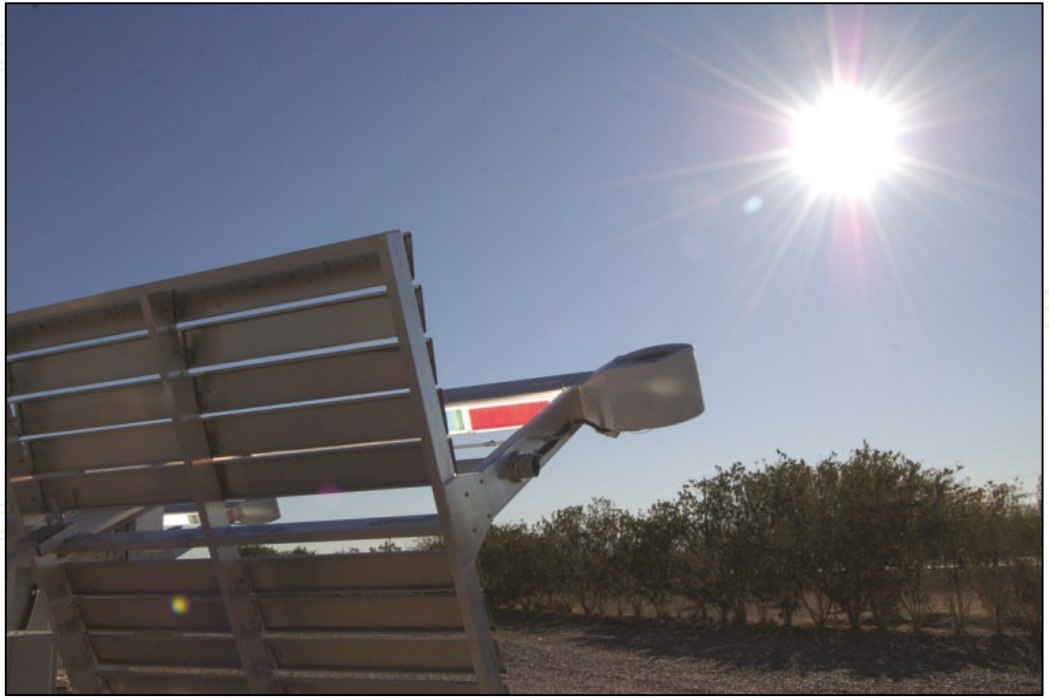
Q-TRAC Natural Sunlight Concentrator

- Fast, Accurate Results
- Full-spectrum natural sunlight
- High temperature (temp limiting available)
- Multiple water spray cycles available
- Nighttime Freezing option



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Questions?

info@q-lab.com

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