Benchmark Exposure Sites

World’s Largest Network of Natural Weathering Facilities

The climates of southern Florida and central Arizona are recognized as global benchmarks for natural weathering environments. The warm, humid, subtropical environment of our outdoor test sites in Miami and the intense sun and arid climate of our site in Phoenix are some of the harshest climates to which your products can be exposed. Often the best natural weathering test scenario requires testing in a variety of climates. For that reason, Atlas® offers the world’s largest network of outdoor weathering test facilities with more than 23 sites worldwide.

Atlas Weathering Services Group – South Florida

South Florida Test Service (SFTS) continues to pioneer natural exposure testing. Located in a rural, unpolluted environment, SFTS provides clients with more than 70 years of experience in weathering. This site is used by companies worldwide for exposure testing of paints, coatings, textiles, plastics and other various products.

Atlas Weathering Services Group – Central Arizona

Arizona, like Florida, possesses high levels of solar radiation and elevated temperatures. However, unlike Florida, Arizona has an arid climate that can have a distinct effect on material durability.

Atlas Weathering Services Group’s Arizona desert site, DSET Laboratories, is in an unpolluted environment. Since 1948, DSET has offered desert exposure testing suitable for materials used in a wide range of industries, including automotive, construction and consumer products.

Atlas Weathering Services Group – Sanary Sur Mer, France

The Bandol region of France possesses a typical Mediterranean climate. With 3,000 hours of sunlight per year, an elevation of 110 m (361 ft), average wet time of 2,700 hours, and a proximity to the Mediterranean Sea of only 4 km (2.5 miles), the site is used by many European companies to test a wide range of materials.

Atlas Weathering Services Group – Chennai, India

Located near Chennai, it is the first official outdoor exposure site in India and is characterized by a tropical climate with high levels of sunlight, humidity and temperature. This site provides valuable test data for many industries, including: automotive exterior and interior; architectural and building products; consumer durable goods; and lightfastness of textiles.
State-of-the-Art Weather Data Tracking and Reporting

Our benchmark exposure sites offer the latest technology in weather reporting instrumentation, such as total solar (UV, Visible and IR), total UV and narrow-band UV radiometers and pyrheliometers. Instruments for monitoring ambient temperature and humidity, rainfall, total wet-time and wind speed are also employed. All instruments are directly traceable to national and international standards, including the World Radiometric Reference (WRR) and the National Institute of Standards and Technology (NIST).

Reporting

Reporting of testing results and test status are customized and delivered in electronic or printed formats. Electronic delivery of reports include:

- .pdf
- .xls

Quality Accreditation

Atlas’ sites in Arizona, Florida and Sanary Sur Mer, France (ISO/IEC 17025 only) are accepted and accredited test laboratories by the following:

ISO/IEC 17025

Atlas® has always focused on being the quality leader in the weathering industry. As a result, Atlas was the first weathering organization to receive accreditation to ISO/IEC 17025, General Requirements for the Competence of Testing and Calibration Laboratories.

Atlas was also awarded the first ever A2LA ISO 17025 accreditation for technical competence in calibrating radiometers used for solar and various light source irradiance measurements.

AMECA

Atlas laboratory facilities and personnel are fully accredited by the Automotive Manufacturers Equipment Compliance Agency, Inc. (AMECA), for compliance with all AMECA laboratory requirements.

AAMA

Atlas is an approved laboratory to perform American Architectural Manufacturers Association (AAMA) indoor and outdoor test methods.

CRRC

The Cool Roof Rating Council (CRRC) has accredited Atlas Weathering Services Group as the first approved Test Farm facility for the CRRC’s Product Rating Program. To earn the coveted CRRC rating, roofing manufacturers and sellers must perform weathering tests through Atlas for three years at locations in Florida (hot/humid), Arizona (hot/dry) and the Midwest (cold/temperate).

For more detailed information about accreditation at any of our outdoor sites, contact your local Atlas representative.

Test Site Data

<table>
<thead>
<tr>
<th>Test Site</th>
<th>Florida SFTS</th>
<th>Arizona DSET</th>
<th>Sanary, France</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latitude</td>
<td>25° 52' N</td>
<td>33° 54' N</td>
<td>43° 08' N</td>
</tr>
<tr>
<td>Longitude</td>
<td>80° 27' W</td>
<td>112° 8' W</td>
<td>5° 49' E</td>
</tr>
<tr>
<td>Elevation</td>
<td>3 m</td>
<td>610 m</td>
<td>110 m</td>
</tr>
<tr>
<td>Avg. High Temperature</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer</td>
<td>34° C (93°F)</td>
<td>39° C (102°F)</td>
<td>23° C (73°F)</td>
</tr>
<tr>
<td>Winter</td>
<td>26° C (79°F)</td>
<td>20° C (68°F)</td>
<td>9° C (48°F)</td>
</tr>
<tr>
<td>Avg. Relative Humidity</td>
<td>78%</td>
<td>37%</td>
<td>76%</td>
</tr>
<tr>
<td>Total Rain</td>
<td>1685 mm</td>
<td>255 mm</td>
<td>700 mm</td>
</tr>
<tr>
<td>Total UV 295-385 nm</td>
<td>280 MJ/m²</td>
<td>333.5 MJ/m²</td>
<td>382.4 MJ/m²*</td>
</tr>
<tr>
<td>Total Radiant Energy 295-3000 nm</td>
<td>6588 MJ/m²</td>
<td>8004 MJ/m²</td>
<td>5500 MJ/m²</td>
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</table>

* Data measured from 300-400 nm

Average Monthly UV and Total Radiant Energy (MJ/m²)

<table>
<thead>
<tr>
<th>Month</th>
<th>26° South (Miami)</th>
<th>34° South (Phoenix)</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>20.0  505</td>
<td>20.1  490</td>
</tr>
<tr>
<td>February</td>
<td>22.5  545</td>
<td>19.8  546</td>
</tr>
<tr>
<td>March</td>
<td>26.5  618</td>
<td>24.7  633</td>
</tr>
<tr>
<td>April</td>
<td>28.0  612</td>
<td>33.3  755</td>
</tr>
<tr>
<td>May</td>
<td>28.0  609</td>
<td>38.6  786</td>
</tr>
<tr>
<td>June</td>
<td>25.7  543</td>
<td>36.8  770</td>
</tr>
<tr>
<td>July</td>
<td>24.7  532</td>
<td>35.1  745</td>
</tr>
<tr>
<td>August</td>
<td>24.0  543</td>
<td>32.5  756</td>
</tr>
<tr>
<td>September</td>
<td>22.3  540</td>
<td>29.3  711</td>
</tr>
<tr>
<td>October</td>
<td>21.7  555</td>
<td>25.8  705</td>
</tr>
<tr>
<td>November</td>
<td>18.0  490</td>
<td>19.2  582</td>
</tr>
<tr>
<td>December</td>
<td>18.6  496</td>
<td>18.3  525</td>
</tr>
<tr>
<td>Annually</td>
<td>280.0 6588</td>
<td>333.5 8004</td>
</tr>
</tbody>
</table>

For more detailed information about accreditation at any of our outdoor sites, contact your local Atlas representative.
Atlas® Worldwide Exposure Network

Atlas offers outdoor weathering sites worldwide to ensure factors from a variety of climates are considered. For example, the Atlas site in Sanary Sur Mer, France, is the benchmark for the European climate, our site in Hoek van Holland (North Sea Corrosion Test Center) represents the corrosive marine environment of western Europe, and the Atlas site in Jacksonville, Florida, provides representative exposures to acid rain and other environmental pollutants.

<table>
<thead>
<tr>
<th>Location</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Elevation (m)</th>
<th>Average Ambient Temp (°C)</th>
<th>Average Relative Humidity (%)</th>
<th>Average Annual Rainfall (mm)</th>
<th>Total Radiant Energy (MJ/m²)</th>
<th>Annual Climatological Data*</th>
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</thead>
<tbody>
<tr>
<td>Prescott, Arizona</td>
<td>34° 39' N</td>
<td>112° 26' W</td>
<td>1531</td>
<td>12</td>
<td>65</td>
<td>1093</td>
<td>7000</td>
<td></td>
</tr>
<tr>
<td>Phoenix, Arizona</td>
<td>33° 54' N</td>
<td>112° 08' W</td>
<td>610</td>
<td>22</td>
<td>37</td>
<td>255</td>
<td>8004</td>
<td></td>
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<tr>
<td>Chicago, Illinois</td>
<td>41° 47' N</td>
<td>87° 45' W</td>
<td>190</td>
<td>10</td>
<td>69</td>
<td>856</td>
<td>5100</td>
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<tr>
<td>Medina, Ohio</td>
<td>41° 07' N</td>
<td>81° 54' W</td>
<td>336</td>
<td>10</td>
<td>72</td>
<td>844</td>
<td>5100</td>
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<tr>
<td>Keys, Florida</td>
<td>24° 33' N</td>
<td>81° 45' W</td>
<td>1</td>
<td>25</td>
<td>73</td>
<td>989</td>
<td>N/A</td>
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<tr>
<td>Jacksonville, Florida</td>
<td>30° 29' N</td>
<td>81° 42' W</td>
<td>8</td>
<td>20</td>
<td>76</td>
<td>1303</td>
<td>5800</td>
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<td>Miami, Florida</td>
<td>25° 52' N</td>
<td>80° 27' W</td>
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<td>23</td>
<td>78</td>
<td>1685</td>
<td>6588</td>
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<tr>
<td>Alberta, Michigan</td>
<td>46° 65' N</td>
<td>88° 48' W</td>
<td>399</td>
<td>6.1</td>
<td>64</td>
<td>847</td>
<td>N/A</td>
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<tr>
<td>Ottawa, Canada</td>
<td>45° 20' N</td>
<td>75° 41' W</td>
<td>103</td>
<td>6</td>
<td>73</td>
<td>1910</td>
<td>4050</td>
<td></td>
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<tr>
<td>Hoek van Holland, The Netherlands</td>
<td>51° 57' N</td>
<td>04° 10' E</td>
<td>6</td>
<td>10</td>
<td>87</td>
<td>800</td>
<td>3800</td>
<td></td>
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<tr>
<td>Sanary, France (Bandol)</td>
<td>43° 08' N</td>
<td>05° 49' E</td>
<td>110</td>
<td>13</td>
<td>64</td>
<td>1200</td>
<td>5500</td>
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<tr>
<td>Novorossiysk, Russia</td>
<td>44° 43' N</td>
<td>37° 46' E</td>
<td>30</td>
<td>12</td>
<td>77</td>
<td>1390</td>
<td>4980</td>
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<tr>
<td>Singapore (Changi Airport)</td>
<td>01° 22' N</td>
<td>103° 59' E</td>
<td>15</td>
<td>27</td>
<td>84</td>
<td>2300</td>
<td>6030</td>
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<tr>
<td>Hainan, China</td>
<td>19° 15' N</td>
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<td>24</td>
<td>81</td>
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<tr>
<td>Guangzhou, China</td>
<td>23° 08' N</td>
<td>113° 17' E</td>
<td>6</td>
<td>22</td>
<td>79</td>
<td>1492</td>
<td>4590</td>
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<tr>
<td>Chennai, India</td>
<td>12° 35' N</td>
<td>79° 48' E</td>
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<td>28</td>
<td>72</td>
<td>1252</td>
<td>6760</td>
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<tr>
<td>Seosan, Korea</td>
<td>36° 55' N</td>
<td>126° 21' W</td>
<td>6.5</td>
<td>11.8</td>
<td>75.4</td>
<td>1235</td>
<td>4700</td>
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<tr>
<td>Miyakojima, Okinawa</td>
<td>24° 44' N</td>
<td>125° 19' E</td>
<td>50</td>
<td>23</td>
<td>76</td>
<td>1741</td>
<td>4894</td>
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<tr>
<td>Choshi, Japan</td>
<td>35° 43' N</td>
<td>140° 45' E</td>
<td>53</td>
<td>14</td>
<td>78</td>
<td>1682</td>
<td>4659</td>
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<tr>
<td>Melbourne, Australia</td>
<td>37° 49' S</td>
<td>144° 58' E</td>
<td>35</td>
<td>16</td>
<td>62</td>
<td>650</td>
<td>5385</td>
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</tr>
<tr>
<td>Townsville, Australia</td>
<td>19° 15' S</td>
<td>146° 46' E</td>
<td>15</td>
<td>25</td>
<td>70</td>
<td>937</td>
<td>7236</td>
<td></td>
</tr>
</tbody>
</table>

* Extracted from published data or measured at test site.
* Other sites in Australia are also available, please contact your local Atlas representative for more information.
Laboratory Accelerated Weathering Services

World’s Largest Network of Independent Weathering Testing Laboratories

Atlas® Weathering Services Group (AWSG) operates one of the largest networks of ISO/IEC 17025 accredited accelerated weathering testing laboratories in the world. With laboratories in the USA, Germany, France and the United Kingdom, AWSG’s indoor exposure laboratories offer artificial accelerated weathering tests and a variety of other environmental test programs, all designed to accurately simulate true end-use conditions and meet global weathering standards.

Standards

Our network of laboratory accelerated weathering testing and evaluation services is ready to test your products to a variety of global testing standards, including:

<table>
<thead>
<tr>
<th>AATCC</th>
<th>16</th>
<th>177</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM</td>
<td>B17</td>
<td>D2565</td>
</tr>
<tr>
<td></td>
<td>D5894</td>
<td>D6965</td>
</tr>
<tr>
<td>BMW</td>
<td>PrV306</td>
<td></td>
</tr>
<tr>
<td>DIN</td>
<td>75</td>
<td>220</td>
</tr>
<tr>
<td>Federal</td>
<td>Test Method 191 (Methods 5660, 5671, 5804)</td>
<td></td>
</tr>
<tr>
<td>Ford</td>
<td>BI 103-01</td>
<td>FLTM B0</td>
</tr>
<tr>
<td>GM</td>
<td>3414TM</td>
<td>4298P</td>
</tr>
<tr>
<td></td>
<td>14872</td>
<td>60292</td>
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<tr>
<td>IEC</td>
<td>68-2-5</td>
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<tr>
<td>ISO</td>
<td>105-A01</td>
<td>105-B02</td>
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<tr>
<td></td>
<td>4628</td>
<td>4892</td>
</tr>
<tr>
<td></td>
<td>9022-9</td>
<td>9227</td>
</tr>
<tr>
<td>Marks &amp; Spencer</td>
<td>C9</td>
<td>C9A</td>
</tr>
<tr>
<td>Military</td>
<td>Mil Std 810 G (Method 505.5)</td>
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<tr>
<td>Nissan</td>
<td>NES M0 135</td>
<td></td>
</tr>
<tr>
<td>RAL-GZ</td>
<td>716/1</td>
<td></td>
</tr>
<tr>
<td>Renault</td>
<td>D27 1911/C</td>
<td>D47 1122/D</td>
</tr>
<tr>
<td>SAE</td>
<td>J1885</td>
<td>J1960</td>
</tr>
<tr>
<td></td>
<td>J2412</td>
<td>J2527</td>
</tr>
<tr>
<td>VDA</td>
<td>75202</td>
<td></td>
</tr>
<tr>
<td>VW</td>
<td>PV 1211</td>
<td>PV 1303</td>
</tr>
<tr>
<td></td>
<td>PV 3929</td>
<td>PV 3930</td>
</tr>
</tbody>
</table>

To find out more details about test programs to meet these or other specific standards, contact your local Atlas representative. Standards are subject to change without notice. This might lead to the inclusion or exclusion of certain instruments.

Complete Testing Facilities

Our network of laboratories provides a comprehensive array of Atlas accelerated laboratory weathering and evaluation equipment, including:

- Ci3000+ Fade-Ometer®
- Ci3000+, Ci4000 and Ci5000 Weather-Ometers
- Ci35A and Ci65A Weather-Ometers
- CDMCA Enclosed Carbon Arc Weather-Ometer®
- CXWA Sunshine Carbon Arc Weather-Ometer
- HPUV™ Indoor Actinic Exposure System
- SolarClimatic Solar Simulation Chamber
- SUNTEST® XLS+ and CPS+
- SUNTEST XXL+
- UVTest™ UV Condensation Weathering Device
- VIEEW® Digital Image Analyzer
- Xenotest® 150 S+, Alpha+, Beta+ and 1200 LM
- SF850 and CCX2000 Corrosion Cabinets
Static Exposure Testing

Direct Weathering

Atlas® outdoor exposure laboratories offer a variety of direct weathering options to meet international and manufacturer-specific test programs and to simulate end-use conditions.

Open-Backed Exposures

- Allows for majority of specimen material to be exposed to circulation of ambient air
- Racks specifically angled to best replicate end-use conditions
- Exposures for a variety of sizes from small, coupon-sized samples, to window assemblies and automotive components, to entire vehicles

Backed Exposures

- Specimens are mounted to substrate, typically 12 mm (½") exterior-grade plywood, to simulate end-use environment by insulating back sides of specimens and increasing sample temperature
- Racks specifically angled to best replicate end-use conditions

Black Box Exposures

- Simulates air heat-sink characteristics of automobile bodies and increases sample temperature
- Black painted, metal box
- Panels on exposure cover the open top of the box and reach temperatures comparable to those of hoods, roofs and deck lids of automobiles parked in direct sunlight

Standards

<table>
<thead>
<tr>
<th></th>
<th>Fixed or Variable Angle/ Open-Backed or Backed</th>
<th>Black Box</th>
</tr>
</thead>
<tbody>
<tr>
<td>AATCC</td>
<td>111 A</td>
<td>D4141 A</td>
</tr>
<tr>
<td>ASTM</td>
<td>D1006 D1014 D1435 D3679 D4726 E1596 G7</td>
<td>G7</td>
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<tr>
<td>ECCA</td>
<td>T19</td>
<td></td>
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<tr>
<td>Ford</td>
<td>FLTM BL 160-01</td>
<td>9163P GMW14873</td>
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<tr>
<td>GM</td>
<td>3619M 9163P 9327P 9758P GMW14873</td>
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<tr>
<td>ISO</td>
<td>105-B03 877-1 877-2 2810 4665 8565</td>
<td></td>
</tr>
</tbody>
</table>

To find out more details about test programs to meet these or other specific standards, contact your local Atlas representative. Standards are subject to change without notice. This might lead to the inclusion or exclusion of certain services.
**Scab Tests**

Scab tests on coated metal automotive panels are commonly performed to evaluate the cosmetic corrosion that might occur in coated metal panels that have been damaged and exposed to highly salted environments, such as road salt or coastal areas. This test is performed in accordance with ASTM D6675—“Standard Practice for Salt-Accelerated Outdoor Cosmetic Corrosion Testing of Organic Coatings on Automotive Sheet Steel.” This practice defines the procedure for preparing, exposing and applying a 5% sodium chloride solution at specified intervals to promote corrosion.

**Indirect Weathering**

Atlas® outdoor exposure laboratories offer a variety of indirect weathering options to meet international and manufacturer-specific test programs for materials that are typically not exposed to all outdoor conditions.

**Under Glass and Black Box**

**Under Glass Exposures**

- Provides exposure to natural sunlight through glass
- Determines colorfastness/durability characteristics of materials such as: drapes, carpeting, upholstery and automotive interior materials
- Specimens are typically placed behind 3 mm thick, single-strength window glass
- Single-strength window glass absorbs radiation below 310 nm and transmits 77% of UV radiation and 85% of visible light
- Additional tempered, tinted or laminated glass available to match end-use application

**Standards**

<table>
<thead>
<tr>
<th></th>
<th>Under Glass</th>
<th>Black Box Under Glass</th>
</tr>
</thead>
<tbody>
<tr>
<td>AATCC</td>
<td>Method 16 Option 6, TM111B</td>
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<tr>
<td>ASTM</td>
<td>G24 Method A</td>
<td>G24 Method B</td>
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<td>FLTM</td>
<td>BI 160-01</td>
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<tr>
<td>GM</td>
<td>4349M</td>
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<tr>
<td>ISO</td>
<td>105-B01</td>
<td>877-2</td>
</tr>
</tbody>
</table>

To find out more details about test programs to meet these or other specific standards, contact your local Atlas representative. Standards are subject to change without notice. This might lead to the inclusion or exclusion of certain services.

**Common Applications**

**Open-Backed Exposure, Black Box Exposure, Under Glass and Black Box Under Glass**

**Paints and Coatings**

- Plastic Lenses (such as taillight assemblies and automotive coatings)
- Plastic and Metal Signs

**Other Applications:**

- Glass Free-Films
- Coil Coatings

**Backed Exposure**

**Automotive Moldings**

- Polyvinyl Chloride (PVC) Siding
- Roofing Membranes
EMMAQUA®
(Equatorial Mount with Mirrors for Acceleration, with Water [AQUA])

Weathering with Sunlight in a Fraction of the Time

EMMAQUA employs 10 highly-reflective mirrors and a sun-tracking system to concentrate sunlight onto test specimens. The result is natural weathering testing in a fraction of the time. In addition, you get the closest correlation to end-use conditions because samples are exposed to the full spectrum of natural sunlight.

Test Apparatus

DSET Laboratories pioneered the development of the EMMAQUA outdoor accelerated test methods in the early sixties. The method employs Fresnel reflecting solar concentrators that use ten flat mirrors to uniformly focus natural sunlight onto specimens mounted in the target plane. High quality, first-surface mirrors provide an intensity of approximately eight “total suns” with the spectral balance of natural sunlight in terms of ultraviolet integrity.

The target board, located at the focal line of the mirrors, lies along a wind tunnel along which a deflector directs cooling air across the specimens. A nozzle assembly sprays the specimens with deionized water in accordance with established schedules to simulate subtropical, semi-humid and temperate regions. Night time spray cycles can be used to keep samples moist during the non-tracking portion of the test to provide the total time of wetness typically encountered in subtropical regions.

Features

- Microprocessor Control
- Programmable Cycles
- Dual Axis Tracking
- Thermal Shocks
- Night Time Dew
- Patented Temperature Control
Average Annual Ultraviolet Radiant Exposure

Atlas® recommends the exposure of test specimens on an EMMAQUA® based on accumulated doses of ultraviolet radiation measured in MJ/m². The duration can be based on Arizona or Florida equivalents. The UV radiation must be measured as direct beam to avoid errors in evaluating the exposure duration.

### FLORIDA

<table>
<thead>
<tr>
<th>Location</th>
<th>5°</th>
<th>26°</th>
<th>45°</th>
<th>90°</th>
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</thead>
<tbody>
<tr>
<td>Radiant Energy</td>
<td>MJ/m² UV</td>
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<td>280</td>
<td>290</td>
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</table>

### ARIZONA

<table>
<thead>
<tr>
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<th>5°</th>
<th>34°</th>
<th>45°</th>
<th>90°</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiant Energy</td>
<td>MJ/m² UV</td>
<td>360</td>
<td>333.5</td>
<td>330</td>
</tr>
</tbody>
</table>

Sample Specifications

- **Target board size:** 13 cm x 143 cm (5” x 55”)
- **Recommended sample sizes:**
  - 5 cm x 13 cm (2” x 5”)
  - 7.5 cm x 13 cm (3” x 5”)
- **Maximum thickness:** 13 mm (0.5”)

Standards Specifying the EMMAQUA Method

EMMAQUA meets or exceeds the following industry standards:

- AAMA 624
- ASTM D4141 D4364 D5105
- SAE J576 J1961
- Ford ESB-M16J14-A WSS-M28P1-B1
- ISO 877-3
- ANSI/NSF 54
- JIS Z 2381
- MIL T-22085D

- EMMA®
- EMMA – UG (Under Glass)
- EMMAQUA / EMMAQUA+ (Cycle 1 of ASTM G90)
- EMMAQUA – NTW (Night Time Wetting, i.e., Cycle 3)
- EMMAQUA – Soak/Freeze/Thaw Cycle
- EMMAQUA – NTW (Night Time Wetting, 70° C +/- 5° C)

To find out more details about test programs to meet these or other specific standards, contact your local Atlas representative. Standards are subject to change without notice. This might lead to the inclusion or exclusion of certain services.

Common Applications

- **Adhesives**
- **Automotive Exteriors**
- **Packaging**
- **Paints and Coatings**
- **Plastics**
- **Roofing**
- **Other Applications:**
  - Agricultural Films
  - Building Materials
  - Elastomers
  - Glass (Arch. & Auto)
  - Sealants

Other Applications:

- **Agricultural Films**
- **Building Materials**
- **Elastomers**
- **Glass (Arch. & Auto)**
- **Sealants**
Temperature and Moisture Controlled

**EMMAQUA®**

Our Patented Temperature Control System Ushers in a New Era for Accelerated Outdoor Testing

Accelerated outdoor testing has often been thought of as the ultimate in solar weathering testing. Your samples are subject to actual fluctuations that products see in their end-use environment and harnessing actual sunlight, rather than a simulated light source. This gives researchers the best correlation to solar degradation. The drawback to traditional accelerated outdoor testing has been the extreme temperatures and irregular water uptake levels that are a natural side effect of solar multiplication in an EMMA® or EMMAQUA device.

Atlas® now offers a solution to control temperature in accelerated outdoor testing. Our patented temperature and moisture control systems allow customers to manage thermal buildup during an accelerated outdoor test. These patented systems can be used independently or in various combinations to create the most accurate accelerated outdoor testing results available in the industry today.

### Static Control

- Helps overcome effects of starting tests at different times of year (winter vs. summer)
- Greatly reduces temperature intermittency effects
- Manages maximum temperatures throughout the test to a user defined set-point
- Increases exposure temperature if desired
- Increases morning and afternoon exposure temperatures
**Dynamic Control**

Two temperature sensors are used, one in the exposure target area and a remotely located temperature sensor. The controller compares the two sensors and adjusts the cooling blower speed to match the remote sensor temperature.

**Night Temperature Control**

Special heater platens are mounted behind specimens on the target area to offset cooler seasonal nighttime temperatures. Specimens receive radiative, convective and conductive heating through the unexposed side.

- Approximates intermittent temperature patterns found in natural exposures on an accelerated test.
- The remote sensor may be black panels, end-use materials on exposure racks and even full-scale installations.
- Target area temperature sensors can be mounted as standard black panels or even some customer specified materials.
- The system can incorporate a variety of temperature offsets while maintaining natural environmental temperature patterns.
- Can approximate summer nighttime temperatures during winter exposures.
- Helps overcome effects of starting tests at different times of year (winter vs. summer).
- Enhances nighttime wetting degradation for some materials.
- Improves acceleration factors by speeding thermal degradation for some materials.
- Improves dark time reaction degradation for some materials.
■ Allows temperature sensitive materials to utilize EMMA exposures at different levels of acceleration
■ Allows investigation of effects from different solar and UV irradiance levels
■ Allows investigation of a material’s reciprocity characteristics
■ Maintains natural intermittent patterns of light and temperature while varying light and temperature levels
■ Can be used to design sophisticated and controlled weathering experiments
■ May allow better correlation between accelerated and end-use weathering exposures
■ Reduces material exposure temperature below other Atlas® Temperature Controlled EMMA products

■ Customization of spray cycles at varying frequency and duration to meet specific material needs
■ Ability to overcome “lensing” and thermal shock effects of wetting specimens in concentrated sunlight
■ Fine tuning of ratios of light dose to wet time to more closely simulate end-use conditions and/or accelerated degradation rates
■ Design of custom wetting cycles to accommodate different water absorption rates for different materials

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**Temperature and Moisture Controlled**

**EMMAQUA® continued**

**Variable Irradiance Control**

The number of mirrors in the EMMA® device is varied between two and ten depending on the exposure requirements of the material. A temperature control system is typically used in conjunction with this system for finer control.

<table>
<thead>
<tr>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5x Standard Irradiant Exposure</td>
<td>2.5x Standard Irradiant Exposure</td>
<td>1.67x Standard Irradiant Exposure</td>
<td>1.25x Standard Irradiant Exposure</td>
<td>1x Standard Irradiant Exposure</td>
</tr>
</tbody>
</table>

**Moisture Control**

The target area rotates out of the concentrated sunlight prior to spraying the specimens. Blown-air cools test specimens to ambient temperatures. Specimens are sprayed with ultra-pure water for the customized length of time. The programmable logic controller then rotates the test samples back into focus at the end of the water spray cycle.
Automotive Exposure Testing

Comprehensive Vehicle Testing, from Samples to Components, to Complete Vehicles

IP/DP (Instrument Panel/Door Panel) Box®

- Under glass weathering method to determine durability and/or colorfastness of materials used for automotive interiors
- Cabinet is designed to accommodate nonstandard specimen sizes such as complete automotive assemblies, as well as standard 10 x 15 cm (4" x 6") samples
- 51° angle, azimuth tracking, sealed, temperature-limiting boxes
- 45° angle, south facing, non-tracking, sealed, temperature-limiting boxes are also available
- Can be customized with client-provided windshield or side window glass to evaluate effects of different types of glass on automotive interior components
- Humidity provided via optional water tray

Standards

Exposure testing is conducted to meet or exceed the following industry standards:

| GM 2617M | 7455M | 9538P | GMW3417 |

To find out more details about test programs to meet these or other specific standards, contact your local Atlas® representative. Standards are subject to change without notice. This might lead to the inclusion or exclusion of certain services.

Atlas Weather Station

The Atlas Weather Station is ideal for customers who want to have their own test sites or who want to map various global climates. Three different options are available:

Option A
- Includes the Weather Station support mount, a UV and global radiometer, data collection capabilities and remote solar power

Option B
- Includes Option A with the addition of temperature and humidity probe

Option C
- Custom per customer requirements
- Solar Weather Station option
SAE J576 — Static Exposure

AWSG offers a packaged program for those needing the requirements of SAE J576 and Federal Motor Vehicle Safety Standard 571.108 for plastic lens material. The SAE J576 program provides a single source of both Arizona and Florida exposure tests and all optical property measurements. We recommend evaluations at one and two years for both sites to determine if problems exist with their materials prior to the end of the three year test.

- Automotive plastic lens materials undergo three years static weathering in Florida and Arizona, along with special inspection and optical property measurements.

- Evaluations include haze, luminous transmittance, chromaticity coordinates and visual inspection for cracking, crazing, delamination and color bleeding.

- For screening purposes, plastic lens material can be exposed in an EMMAQUA® with nighttime wetting to quickly determine possible failures of specimens.

- A mandatory 2-hour heat test at 79 ± 3° C will be conducted in a circulating air oven according to SAE J576c.

For more information regarding requirements for meeting and testing to SAE J576, please contact your local service representative.
Complete Vehicle Testing

In addition to providing full service testing of individual automotive interior/exterior components, Atlas® also provides facilities for evaluating complete vehicles.

- Florida and Arizona facilities evaluate material durability of complete vehicles and compatibility of vehicle components
- Provides test conditions that match exact end-use conditions and full confidence of material’s weathering performance
- Shielded exposure compounds available for test confidentiality
- Typical vehicle exposure programs include the following services:
  - Exposure of vehicle(s) in Florida and/or Arizona
  - Monthly visual inspection
  - Monthly washes and vacuuming
  - Temperature studies
  - Comprehensive reports (including photos)

Special Measurements

- Peak or continuous component temperature measurements
- UV light deposition on interior or exterior materials
- Thermal comfort analysis of new design automotive windows
- Dimensional stability of plastic body parts

Sun Tracking Carousel

- Only Atlas offers complete vehicle sun tracking carousel devices
- Carousels utilize a follow-the-sun tracking system that maintains direct exposure on specific locations of test vehicles throughout the day
- Provides data for peak component temperatures in the shortest possible time
Ultra-Accelerated Weathering System

Similar in concept to Atlas’ moderately accelerated EMMA® technology, this ultra accelerated device tracks the sun while concentrating reflected sunlight on test specimens mounted in a target area. The difference, however, is the new patented mirror system utilized in the ultra-accelerated concentrator. Having very high reflectance in the UV and near visible wavelength ranges while attenuating reflectance in the longer wavelengths visible and IR portions of the solar spectrum, this technology allows for:

- Very high concentrations of UV energy without excessive heating of test samples
- A direct normal 100/1 concentration factor able to deliver approximately 63 years of South Florida UV radiant exposure in a single year
- Customized exposure projects to meet specific material requirements
- Consistency with the sun’s UV spectrum
- Appropriate material exposure temperatures

Atlas® Outdoor Exposure Rack System

The Atlas Outdoor Exposure Rack design takes into account the best features of the historical exposure racks used at weathering sites around the world and incorporates ideas from our in-house weathering technicians and experts. We asked the question, “How can we make the exposure rack better?” and we are sure the new Atlas Exposure Rack has answered that question with improved ease of use and more!

How is the Atlas Exposure Rack an improvement over the historically available exposure rack and other exact clones in the marketplace?

1. Atlas has improved on the old flap-assembly’s traditional wingnut fasteners with an ergonomically friendly cam-lock design.
2. Atlas has also designed new “quick-release” hardware to panel and sample mounting hardware such as the flap assembly that will allow in-place removal as opposed to the slide functionality of traditional model racks.

These enhanced test racks continue to meet all applicable outdoor weathering standards, but now with better construction and ease of use.

Atlas also manufactures portable all-terrain racks, offset racks and other specialty exposure racks.
Evaluation Services

Analytical Services to Complete Any Testing Program

Atlas® offers a wide range of evaluation and measurement services for your specimens during and after the weathering process. Evaluation services are available at many Atlas global weathering facilities. To find Atlas evaluation services for your company’s needs, contact your local Atlas representative.

Photography/IR Imaging Services

Photography and Infrared Imaging are available to complement our evaluation services. Images of specimen degradation and heat loss can be taken digitally and provided via e-mail or CD-ROM.

Visual Evaluation

A variety of visual assessment services are available for rating degradation phenomena on specimens associated with the weathering process. Evaluation services are conducted to meet the global standards listed below.

Instrumental Optical Properties

The measurement of color and evaluation of other optical properties are often chosen as the principal technique for quantifying material degradation resulting from natural and accelerated exposure tests.

Evaluation Services Standards

<table>
<thead>
<tr>
<th>Service</th>
<th>Standard/Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coating Adhesion</td>
<td>ASTM D3359, GM 9071P</td>
</tr>
<tr>
<td>Blistering</td>
<td>ASTM D714, ISO 4628-2</td>
</tr>
<tr>
<td>Chalking</td>
<td>ASTM D4214, ISO 4628-6</td>
</tr>
<tr>
<td>Checking</td>
<td>ASTM D660, ISO 4628-5</td>
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<tr>
<td>Cracking</td>
<td>ASTM D661, ISO 4628-4</td>
</tr>
<tr>
<td>Erosion</td>
<td>ASTM D662</td>
</tr>
<tr>
<td>Mildew</td>
<td>ASTM D3274</td>
</tr>
<tr>
<td>Grey Scale Evaluation</td>
<td>AATCC Evaluation Procedure 1, ASTM D2816, DIN EN 20105-A02, ISO 105 A02</td>
</tr>
</tbody>
</table>

To find out more details about test programs to meet these or other specific standards, contact your local Atlas representative. Standards are subject to change without notice. This might lead to the inclusion or exclusion of certain services.

Common Applications

Evaluation services are used by a variety of industries for a variety of applications, including:

- Automotive Interior, Exterior Materials, and Components
- Building Products
- Construction Materials
- Paints and Coatings
- Plastics
- Natural & Accelerated Weathering Services

Other applications:
**Color Measurement**

Spectrophotometric color measurements are provided on three types of instrumentation. Atlas® has instrumentation for measuring both transmittance and reflectance, specular included and excluded, in a sphere geometry. Our instruments measure reflectance in a 0º/45º geometry. Atlas has portable instruments for field evaluations that measure reflectance, specular included only. Color scales include CIE L*a*b*, HunterLab, CIE XYZ, CMC and Yellowness and Whiteness indices. Illuminants include D65, C, A and F among others; 2º and 10º observer are available.

**Gloss Measurements**

Atlas uses bench-top and portable BYK Gardner glossmeters for both laboratory and field measurements at 20º, 60º, 75º and 85º.

**Distinctness-of-Reflected Image (DOI)**

DOI is the sharpness with which object outlines are reflected by a surface. This measurement is predominantly used by automotive and architectural coatings manufacturers to characterize a desired appearance for the end product. Atlas laboratories use the latest technology and equipment to make DOI measurements, including wide and narrow angle haze measurements.

**Spectrophotometry**

Absolute or relative spectral measurements as a function of incident angle are available through Atlas laboratory services. Instrumentation includes a Perkin-Elmer Lambda 950, spectrophotometer equipped with specially designed integrating spheres. Data for UV-VIS-NIR measurements include report and one normalization (e.g., solar transmittance or reflectance, color, chromaticity, etc.), in accordance with ASTM E903.

**Transmission Haze and Clarity**

Atlas uses a BYK Gardner Haze-Gard Plus to measure haze, total transmittance and clarity. The instrument measures total and diffuse transmittance to a 2º observer to illuminant C.

**Non-destructive Dry Film Thickness**

Atlas uses BYK Gardner Micro-Tri-Gloss instruments with film thickness capabilities, in accordance with ASTM D7091.
Emittance

Emittance measurements are performed using a Gier-Dunkle DB-100 IR reflectometer, emissometer which measures wavelength range of 2.5-40 microns, in accordance with ASTM E408.

Solar Reflectance Index

SRI is a value that incorporates both Solar Reflectance measurements (ASTM E903), and Emittance measurements (ASTM E408), into a single value that represents the temperature of a material in the sun. The value represents how hot a surface would get in comparison to a standard black surface (SRI=0), and a standard white surface (SRI=100). SRI is calculated in accordance with ASTM E1980 – Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low Sloped Opaque Surfaces.

Window Energy Analysis

Shading Coefficient and U-Value Analysis

Determining the Shading Coefficient (SC) for a window system provides important marketing and technical data for that system. The SC, along with the U-Value of a particular fenestration, permits the designer to perform heat gain and heat loss calculations, important in today’s competitive marketplace.

A Shading Coefficient is the ratio of solar heat gain through a glazing system to the solar heat gain through a single lite of double-strength sheet glass, when both are tested under a specific set of conditions. The U-Value is the total heat transfer coefficient in a window system.

- SC and winter and summer U-Values are calculated using methods based on the ASHRAE Handbook of Fundamentals
- Calculations can only be performed on smooth surface window systems
- Measurements required are thermal emittance, transmittance and reflectance of each window surface

Window Energy Analysis Standards

Window Energy Analysis is conducted to meet or exceed the following industry standards:

<table>
<thead>
<tr>
<th>Standard</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFRC</td>
<td>300-93 301-93</td>
</tr>
<tr>
<td>ASTM</td>
<td>E903</td>
</tr>
</tbody>
</table>

Measurement Evaluation Standards:

Instrumental Optical Properties evaluations are conducted to meet or exceed the following industry standards:

<table>
<thead>
<tr>
<th>Property</th>
<th>Standard</th>
<th>Code</th>
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</thead>
<tbody>
<tr>
<td>Color</td>
<td>ASTM</td>
<td>D2244 E308 E313 E1331 E1348 E1349</td>
</tr>
<tr>
<td></td>
<td>DIN</td>
<td>6174</td>
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<tr>
<td></td>
<td>ISO</td>
<td>7724</td>
</tr>
<tr>
<td></td>
<td>SAE</td>
<td>J1545</td>
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<tr>
<td>Gloss</td>
<td>ASTM</td>
<td>D523</td>
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<td></td>
<td>DIN</td>
<td>67530</td>
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<td></td>
<td>ISO</td>
<td>2813</td>
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<tr>
<td>DOI</td>
<td>ASTM</td>
<td>E430</td>
</tr>
<tr>
<td>Spectrophotometry</td>
<td>ASTM</td>
<td>E 308 E 903</td>
</tr>
<tr>
<td>Emittance</td>
<td>ASTM</td>
<td>E 408</td>
</tr>
<tr>
<td>Transmission Haze and Clarity</td>
<td>ASTM</td>
<td>D1003</td>
</tr>
</tbody>
</table>

To find out more details about test programs to meet these or other specific standards, contact your local Atlas representative. Standards are subject to change without notice. This might lead to the inclusion or exclusion of certain services.
Additional Services

Temperature Recording
Temperature data on all types of materials in most configurations can be provided. Temperature monitoring programs can be provided for single and multiple specimens under any type of exposure, as well as for large assemblies such as complete vehicles.

Service Types are Defined as:
- Non-recording (Manual) — measurements taken with a hand-held digital thermometer at specified points during the day
- Continuously recording (Automatic) — measurements taken with a programmed data acquisition system

Radiometer Measurement and Calibration
Atlas® offers solar radiometer outdoor calibration service directly traceable to the World Radiometric Reference (WRR) or National Institute of Standards and Technology (NIST). These radiometers include pyranometers and pyrheliometers, which measure total sunlight and total or narrow-band ultraviolet radiometers. Atlas was awarded the first A2LA ISO 17025 accreditation for technical competence in calibrating radiometers.

Calibrations Include:
- Transfer of calibration from reference to field radiometers
- Transfer of calibration from reference pyrheliometers to field pyrheliometers

Standards
Radiometer Measurement & Calibration are performed to meet or exceed the following industry standards:

<table>
<thead>
<tr>
<th>Standard</th>
<th>E816</th>
<th>E824</th>
<th>G130</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM</td>
<td>9059</td>
<td>9847</td>
<td></td>
</tr>
</tbody>
</table>

To find out more details about test programs to meet these or other specific standards, contact your local Atlas representative. Standards are subject to change without notice. This might lead to the inclusion or exclusion of certain services.
Mounting Techniques

Specimen Preparation and Mounting

The following information provides general guidelines for the types and sizes of specimen preparation and mounting required for most of our outdoor services. Customized preparation and mounting is available for some services; talk to an Atlas® representative about your specific testing needs.

Panels and Samples

A panel is defined as any flat specimen up to 305 mm (12") along one edge and must be sufficiently rigid to be self-supporting and can be mounted without special handling in a standard panel rack equipped with a mask. All AWSG panel racks are equipped with masks preset to either 152 mm (6"), 228 mm (9") or 305 mm (12"). Panel fees apply for panels up to 152 x 305 mm (6" x 12"). All specimens outside the panel definition shall be considered samples, and fees apply to samples up to 305 x 305 mm (12" x 12"). For larger specimens, multiples of the stated sizes or any portion thereof, will be used to determine fees.

**EMMA®/EMMAQUA®**

Open-Backed Exposure can also be used in static weathering

**Backed Exposure**

**Pictorial Definition of Panel**

Special Glass Mounting Technique

Open-Backed Exposure

Open-Backed Exposure Exposed Edge

SAE J576 Disc

Open-Backed and Backed Exposure Rack

Harrison Style Rack

Alternate Style Rack

Solid Plywood or Screen Mesh Backed Exposure